Drive Test Software
R&S®ROMES4
Operating Manual

1171641512
Version 66

ROHDE&SCHWARZ
Make ideas real

This manual describes the R&S ROMES4 version 23.2. It contains the following models:

- R&S® ROMES4 – Drive Test Software, Platform for Measurement and Replay (4900.5558.02)

The software contained in this product uses several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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1171.6415.12 | Version 66 | Drive Test Software

The following abbreviations are used throughout this guide: R&S®SmartONE is abbreviated as R&S SmartONE, R&S®ROMES4 is abbreviated as R&S ROMES4, R&S®TSME is abbreviated as R&S TSME, R&S®TSME6 is abbreviated as R&S TSME6, R&S®TSMx is abbreviated as R&S TSMx, RS®ROMES2GO is abbreviated as R&S ROMES2GO, R&S®ROMESCUBE is abbreviated as R&S ROMESCUBE.

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1 General description

The R&S SmartONE Mobile Network Testing Software is the unified Rohde & Schwarz solution for PC-based drive- and walk-testing. It covers all use cases around optimization, network benchmarking and engineering and scales from a single laptop to large multi-CPU installations with tens of test mobiles.

R&S SmartONE comprises the following two user interfaces (UIs), designed for the tasks at hand.

- Web-based UI based on the SmartBenchmarker application software
  This UI is available for efficient data collection and remote control support from SmartMonitor. We refer to this UI as the "Standard" mode of R&S SmartONE both in the R&S SmartONE launcher and in this document.
- Expert UI provided by the R&S ROMES4 application software
  This UI is provided for complex measurement tasks and detailed data investigation during the measurement. We refer to this UI as the "Expert" mode of R&S SmartONE both in the R&S SmartONE launcher and in this document.

To use SmartBenchmarker, the licensing system requires the WIBU software license bound to the PC. Both R&S ROMES4 and SmartBenchmarker application software use the WIBU license only. Apart from the WIBU, soft-license, available is the license stored on a WIBU license dongle.

Contact your Rohde & Schwarz representative to migrate to this licensing system at no cost. Migration is possible from May 2020 onwards.

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1.1 System requirements

R&S ROMES4 runs under the MS Windows 10 operating system (OS), 64-bit version.

Administration rights are needed to do measurements on MS Windows <version>.

The following PC performances ensure the full R&S ROMES4 functionality:

- Current generation Intel® Core™ i7 CPU

- 16 GByte RAM
- 512 Gbyte SSD
- USB 3.0 and LAN ports which must be Gigabit Ethernet capable with 9k Jumbo frame support

Since Windows 10 version 1607, Microsoft allows overriding the MAX_PATH limitation so that path names longer than 260 characters are allowed. However, Windows 10 still uses by default the mentioned limit. Therefore, R&S ROMES4 does not support path names longer than 260 characters.

R&S ROMES4 does support the English standard character set only. Do not use any special characters of other languages.

1.2 MS Windows power options

The following sections describe the modification of power setting that prevents Microsoft Windows version 10 to switch off a USB port used by a R&S ROMES4 device during measurement. Otherwise, the USB port switch off can happen under the certain circumstances causing severe problems.

To optimize the OS for measurements with the R&S ROMES4, it is highly recommended to modify the power option setting.

1. In "Start" > "Settings" > "System" select "Power & sleep" > "Additional power settings".

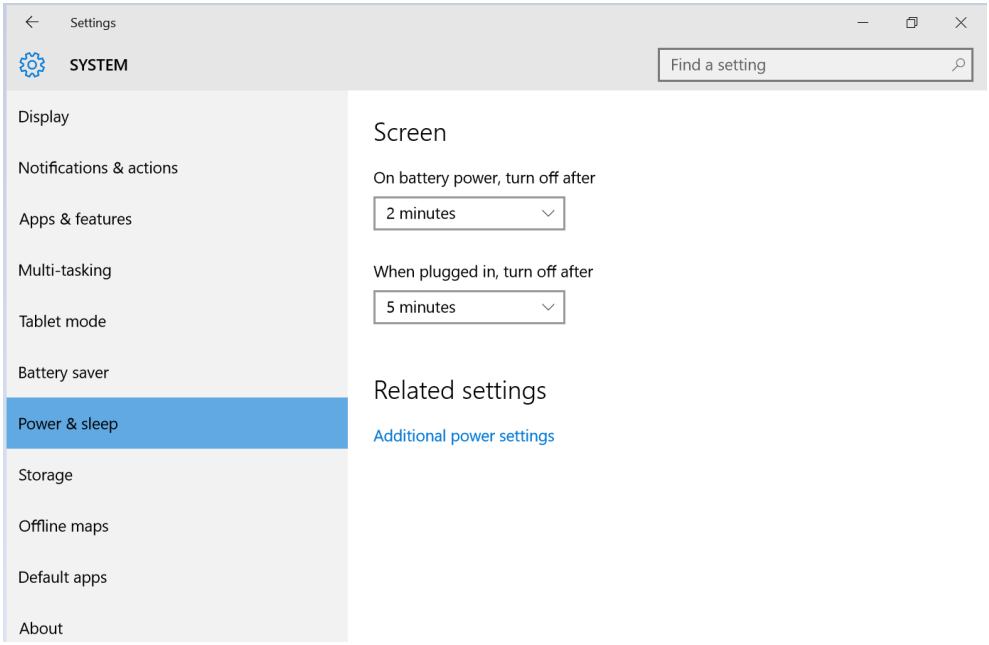


Figure 1-1: MS Windows 10 - power settings

The "Power Options" window appears.

2. Select "Power saver" instead of "Balanced (recommended)".

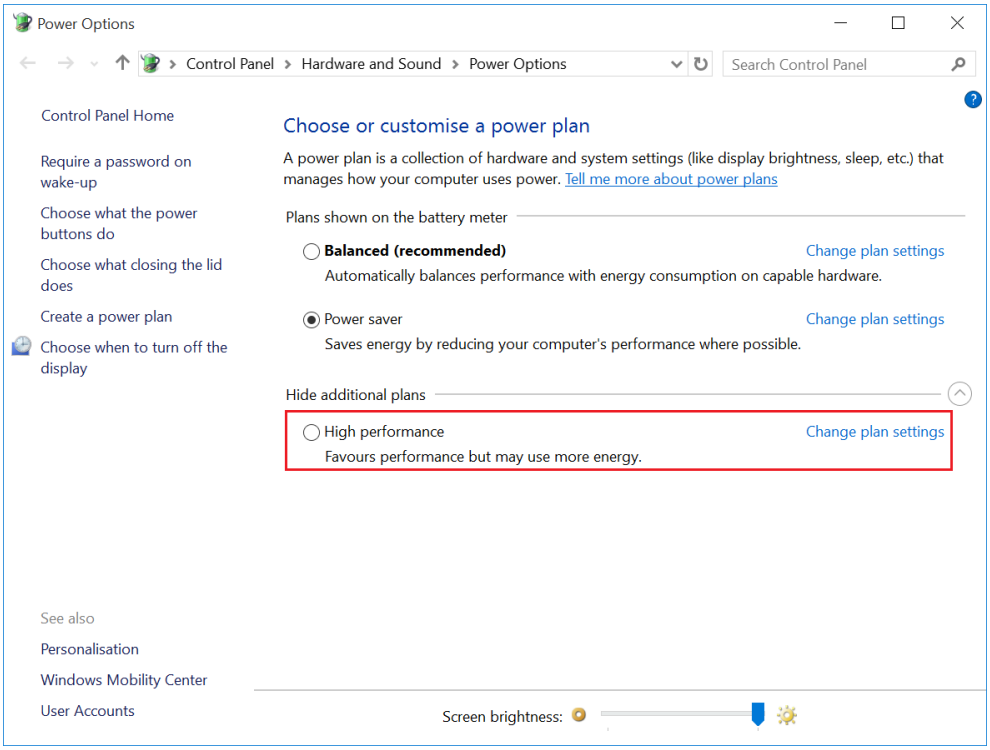


Figure 1-2: MS Windows 10 - Change plan settings

3. Click "High performance" > "Change plan settings".

   The "Edit Plan Settings" window lets you set the power plan changes.

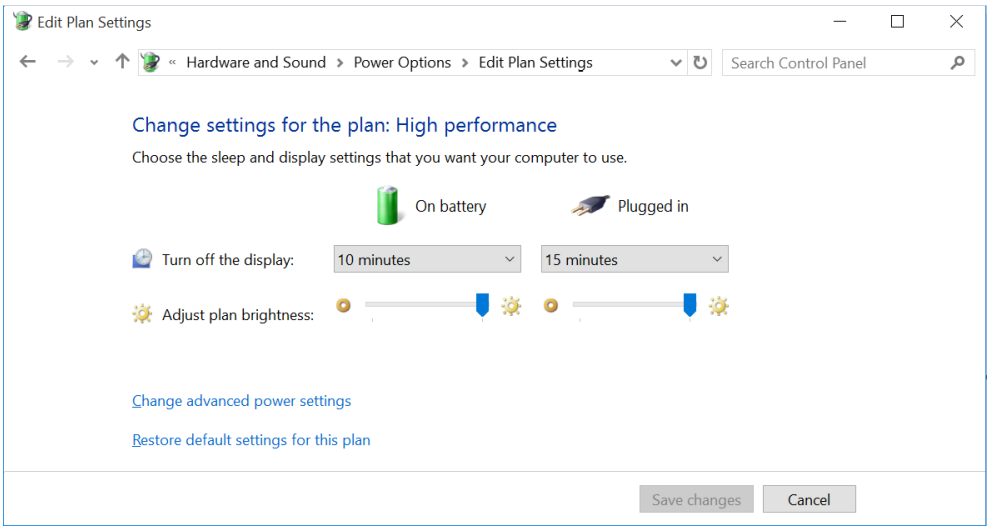


Figure 1-3: MS Windows 10 - Edit Plan Settings

4. Select "Change advanced power settings" in the "Edit Plan Settings" window.

The "Power Options" window is displayed.

5. Select "USB settings" > "USB selective suspend setting".
6. Change the setting from "Enabled" to "Disabled".
7. Press "OK".

   The modification prevents MS Windows 10 to switch off a USB port used by a R&S ROMES4 device during measurement.

1.3 MS Windows shutdown

The R&S ROMES4 correctly processes shut down events, but does not offer the option to save changed workspaces. The measurement stops and the R&S ROMES4 closes before the OS continues shutting down.

1.4 MS Windows sleep and hibernate

The OS does not allow the application to block the sleep or hibernate process. Thus, there is no possibility to cancel these processes. If the R&S ROMES4 is measuring, it tries to stop the measurement. As an application has only two seconds to respond to the operating system, it can occur that the measurement cannot be stopped completely. Due to this fact, it is highly recommended to save all data and stop the measurement before pressing the "Sleep" or "Hibernate" button of MS Windows.

Consider that not each measurement equipment supports the "Standby" mode and reacts adequate on it.

1.5 Introduction to R&S ROMES4

Due to its modular concept, the R&S ROMES4 is a perfect solution for every coverage measurement task. Rohde & Schwarz offers various options which can be combined with the R&S ROMES4. The product offers the digital mobile phone networks and digital audio broadcasting measurement options and analog signal strength measurement in almost every relevant frequency range. The latter can be used as a stand-alone solution or in combination with the R&S ROMES4.

Depending on the used devices, the complete system is either installed in a portable case or in a van.

The following picture gives an overview of the basic steps taken in a measurement tour.

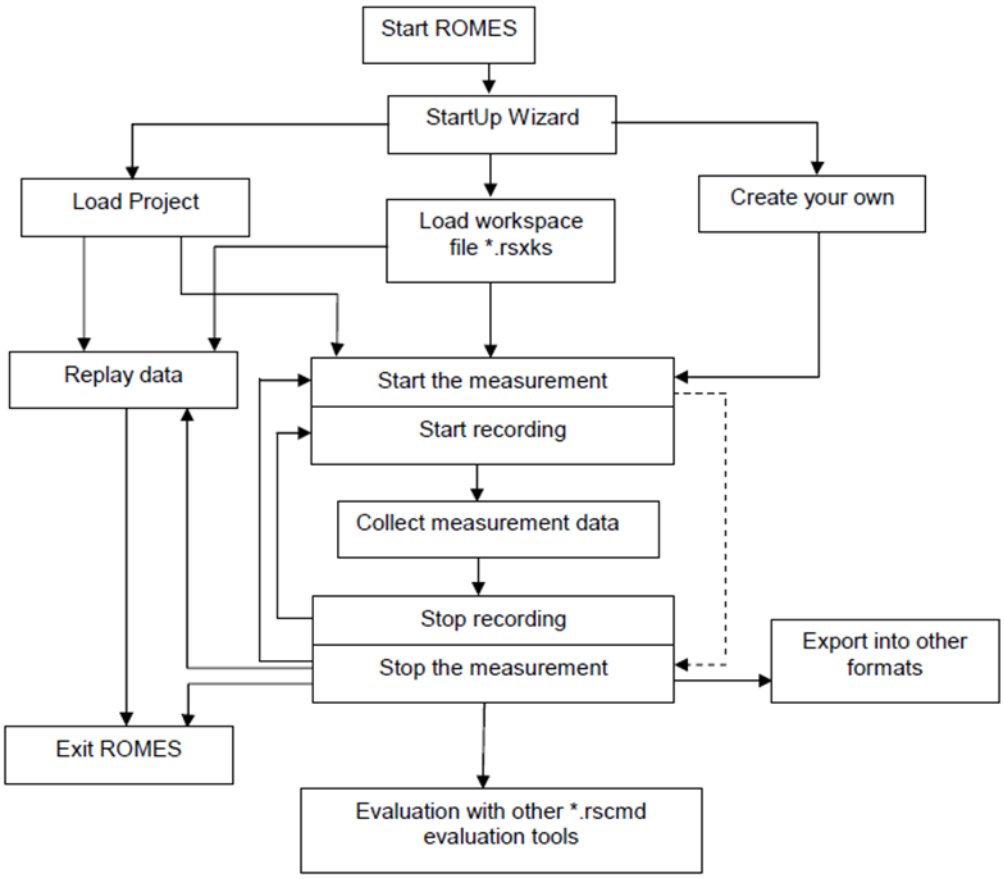


Figure 1-4: Overview of a measurement tour

The "Replay" mode is an additional feature for pre-evaluation purposes. Replay means that you can load and analyze the stored measurement data after the measurement tour, using different views that R&S ROMES4 provides for display and evaluation. You can pause the replay at points of special interest to analyze the data replayed so far, print the view contents or copy screenshots to the clipboard using the "Copy to Clipboard" item in the context menu of the view, or [ALT+PrtSc] (for capturing the active window) or [PrtSc] (for the whole screen).

1.6 Start R&S ROMES4

To perform a R&S ROMES4 measurement, you need a PC administrator rights and the WIBU license. The measurement replay needs the normal user rights and you do not need the license. When you install R&S ROMES4, the application detects or not the presence of the license. If the license is detected, the software installation continues. When the installation ends, R&S ROMES4 runs in measurement mode. This mode is indicated on your PC desktop with the icon.

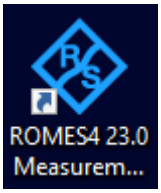


Figure 1-5: Desktop icons to start R&S ROMES4

Double-click the icon to start up R&S ROMES4.

If the license is not detected you have the possibility to work in "Replay Only" mode, see Chapter 1.10.1, "R&S ROMES4 measurement and replay mode", on page 30.

1.6.1 R&S ROMES4 measurement mode

You need the admin rights to run R&S ROMES4 in measurement mode.

For the details of the measurement mode, see Chapter 1.9, "Measurement with R&S ROMES4", on page 29.

User account control
At R&S ROMES4 start-up on a PC with the MS Windows 10, the operating software performs the steps to control user account.

The operating system asks if you want R&S ROMES4 to change the system settings. Click "Yes" to allow R&S ROMES4 makes the necessary changes, for example, changes for DQA settings.

If the current user account has no admin rights, a dialog to enter the admin password pops-up, so that R&S ROMES4 could run with admin rights.

Continue with Chapter 1.6.2, "Windows security alert", on page 23.

Suppressing R&S ROMES4 alert
It is possible to suppress the R&S ROMES4 alert pops-up for a duration of the current measurement. To suppress the alert, click the "Ignore" button. No more alert pop-ups are shown for the current measurement.

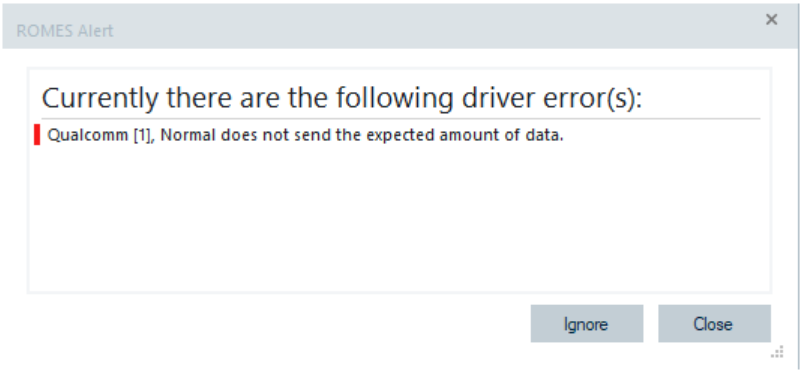


Figure 1-6: Suppressing R&S ROMES4 alert

1.6.2 Windows security alert

On the first startup of R&S ROMES4, a Windows security alert occurs to set the security level of the network access. R&S ROMES4 needs a public networks access which means that the firewall is set to the most stringent settings.

1. In the "Windows Security" dialog, select "On" in the "Public network" > "Windows Defender Firewall" option.
2. Close the dialog.

   The firewall setting for R&S ROMES4 is saved and its GUI opens, see Chapter 1.7, "Startup wizard", on page 24.

Change user account control to start R&S ROMES4 without user control alert

To avoid the alert message, change the user account control to a less secure level.

User account control change is only recommended for stand-alone machines.

Select "Control Panel" > "System and Security" > "Change User Account Control Settings". Drag the level bar to the lowest setting, as shown in the following figure.

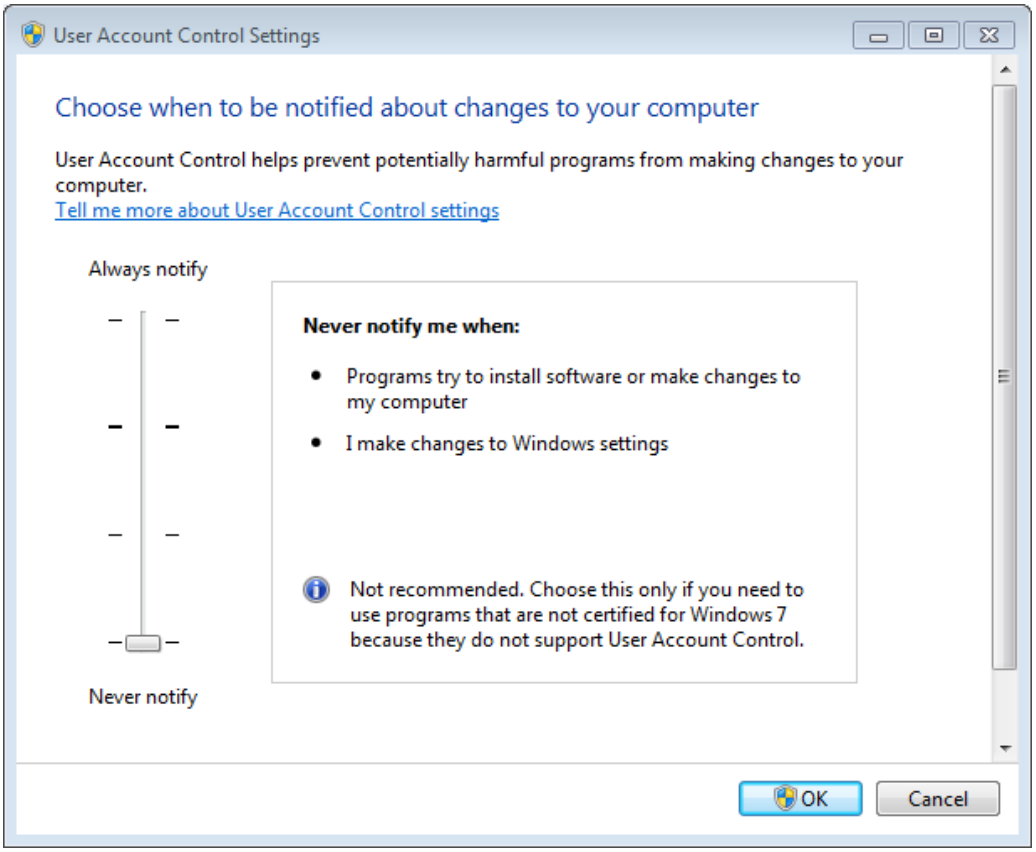


Figure 1-7: User Account Control Settings

1.7 Startup wizard

In the "StartUp Wizard" dialog you can choose how to start R&S ROMES4.

The dialog appears while running R&S ROMES4 if the option "Show Startup Wizard" is checked in "Tools" > "Preferences" > "Start Up".

You can select between the following:

- Predefined workspace
- Predefined project
- Start with an empty view area

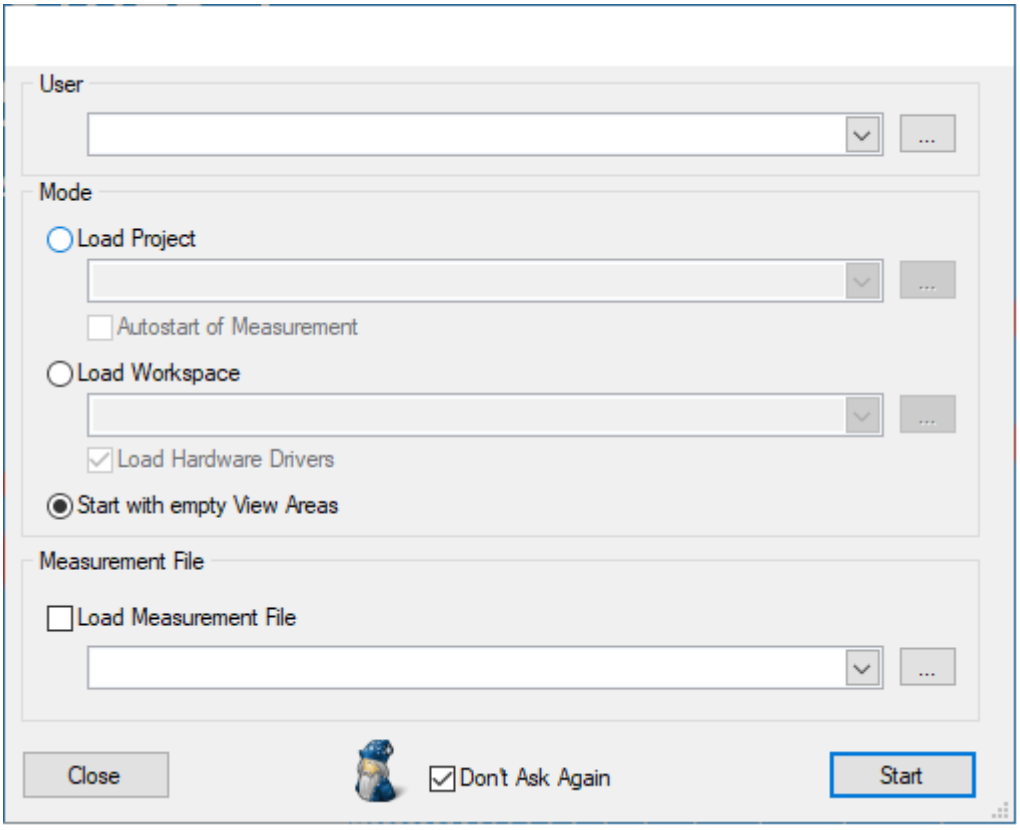


Figure 1-8: Startup & Wizard window

A measurement file can be also selected. If the measurement file is selected, it opens immediately after booting.

The dialog can be suppressed by checking "Don't Ask Again". It can be enabled again in the "Preferences" dialog.

User
To load R&S ROMES4 user, select the R&S ROMES4 user.

For each user, a copy of the R&S ROMES4 registry (only `CurrentUser` part) is created. Each R&S ROMES4 user has its own MS Windows registry entry. At the same time, the own registry entry is the only difference between the users.

At the startup of R&S ROMES4, the branch of the selected user is copied to the R&S ROMES4 branch. With different users, it is possible to personalize R&S ROMES4.

For example, personalize R&S ROMES4 with different vehicle IDs, user IDs or default directory.

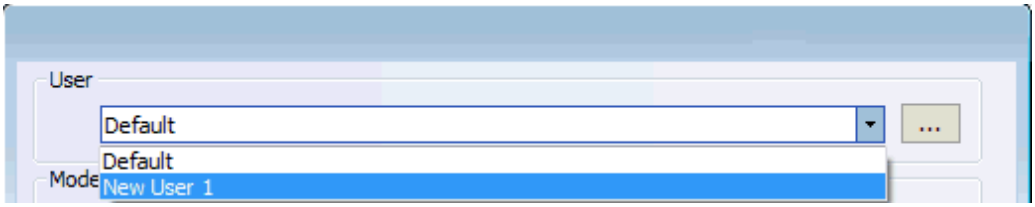


Figure 1-9: Select a user profile from the drop-down menu.

Click the button on the right of the "User" combo-box to open the "ROMES User" window. You can add a new user or remove a selected one via "Add" or "Remove", respectively.

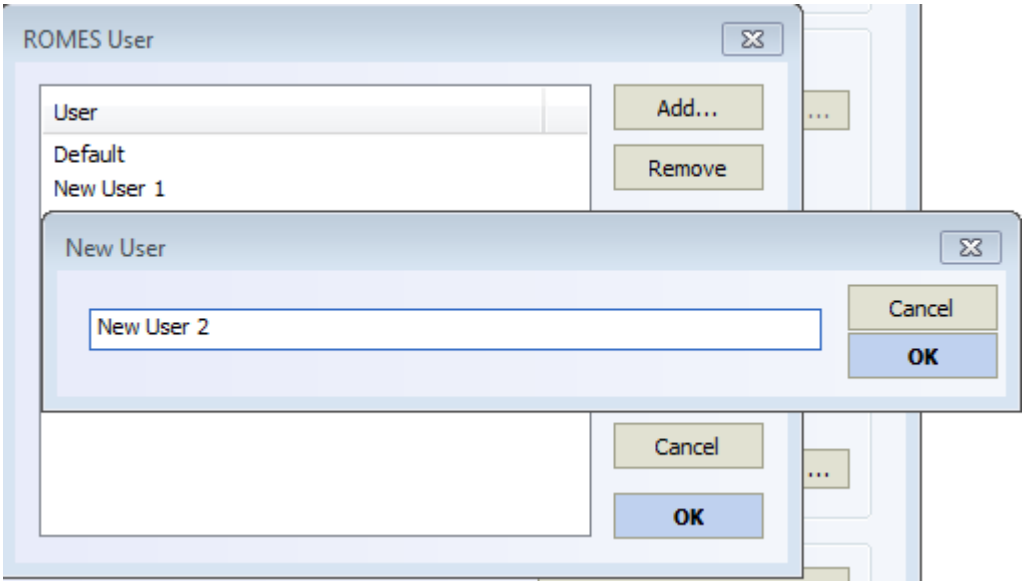


Figure 1-10: Creation of new user

Mode

- "Load Project"
  This option requires an R&S ROMES4 project file. The project file loads only the specified modules and creates only the specified views.
  The measurement can be started automatically, by checking the "Auto start of Measurement" option. In this case no "Measurement File" can be opened, and the "User Level" cannot be changed.
- "Load Workspace"
  A predefined workspace is loaded after R&S ROMES4 booting.
- "Start with empty View Areas"
  R&S ROMES4 starts without any preadjustment.

Measurement file
"Load Measurement File"

The user can select a measurement file, which will be open automatically after R&S ROMES4 booting.

Close
Click "Close" to abort the start of R&S ROMES4.

1.8 R&S ROMES4 crash report

In the unlikely event of a R&S ROMES4 crash, R&S ROMES4 offers a possibility to send the crash dump to Rohde & Schwarz.

The crash reports are dumped by MS Windows. Due to that reason, the R&S ROMES4 crash reports do not show the crash location.

To provide the crash location information, the crash dumps generated by MS Windows are added to a `*.zip` file. If sent or e-mailed to R&S, the file can help developers to catch the crashes when they appear on a customer's site.

When a crash occurs, a dialog box informs that R&S ROMES4 does not work anymore (this dialog can differ if no debugger is installed).

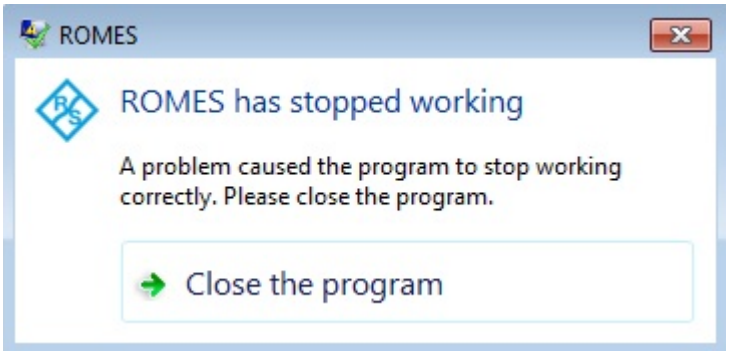


Figure 1-11: R&S ROMES4 crashed

Click "Close the program" to obtain the R&S ROMES4 crash dialog and create the crash report.

The report dialog has a form that lets you easily enter more information about the crash and provide the developers with additional information.

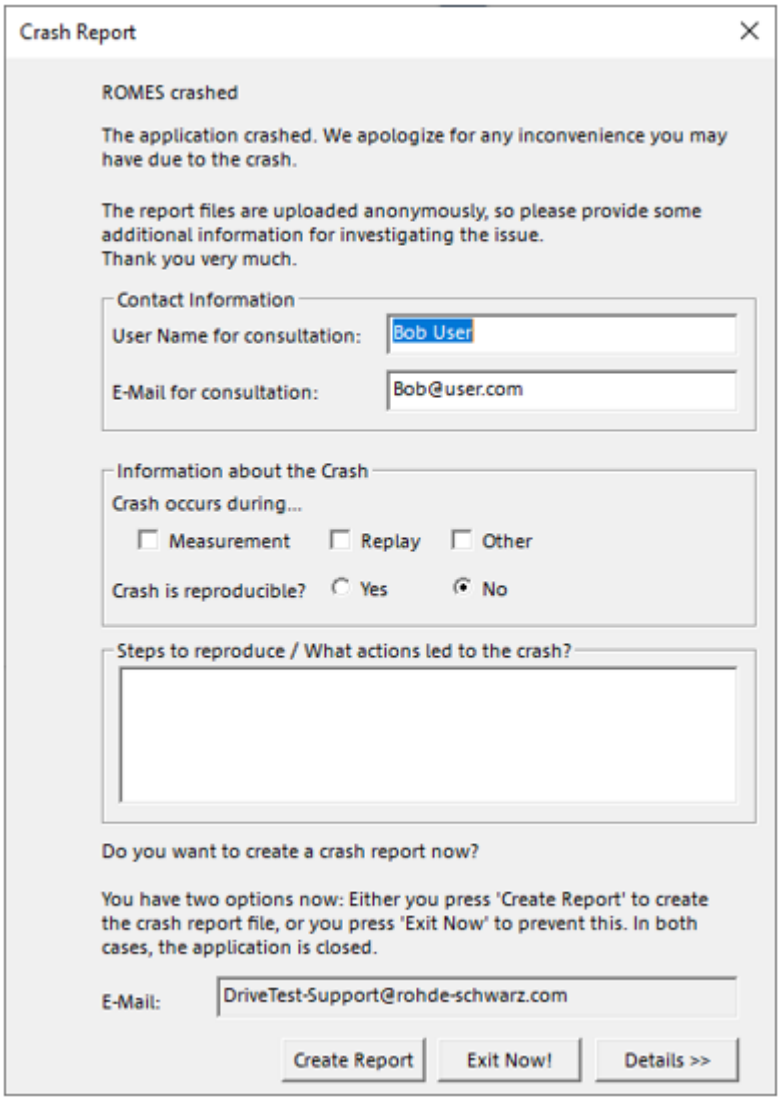


Figure 1-12: Create report when R&S ROMES4 crashes

The user name and e-mail written in the "Contact Information" are stored between subsequent dialogs and can be used for consultation. The field "Information about the Crash" offers the form to provide more information about the crash.

Press the "Create Report" button. The `*.zip` file that contains all the necessary info for Rohde & Schwarz is created.

All crash data is written into one single zipped file. When the `*.zip` file is generated, the corresponding files in the MyRomes\LogFiles folder are deleted automatically.

R&S ROMES4 supports the RusWorkerDllLoader and RusWorkerDllLoaderPhysicalLayer output files (`RuSWorkerDllLoader.exe` and `RuSWorkerDllLoader0.exe`) and the crash dumps in case the R&S ROMES4 SW or one of those files crashes.

At R&S ROMES4 start after such a crash, the dialog for existing crash report appears. It shows the same form of crash dialog, pre-filling the fields if information was provided in the dialog. You can change the information in this report.

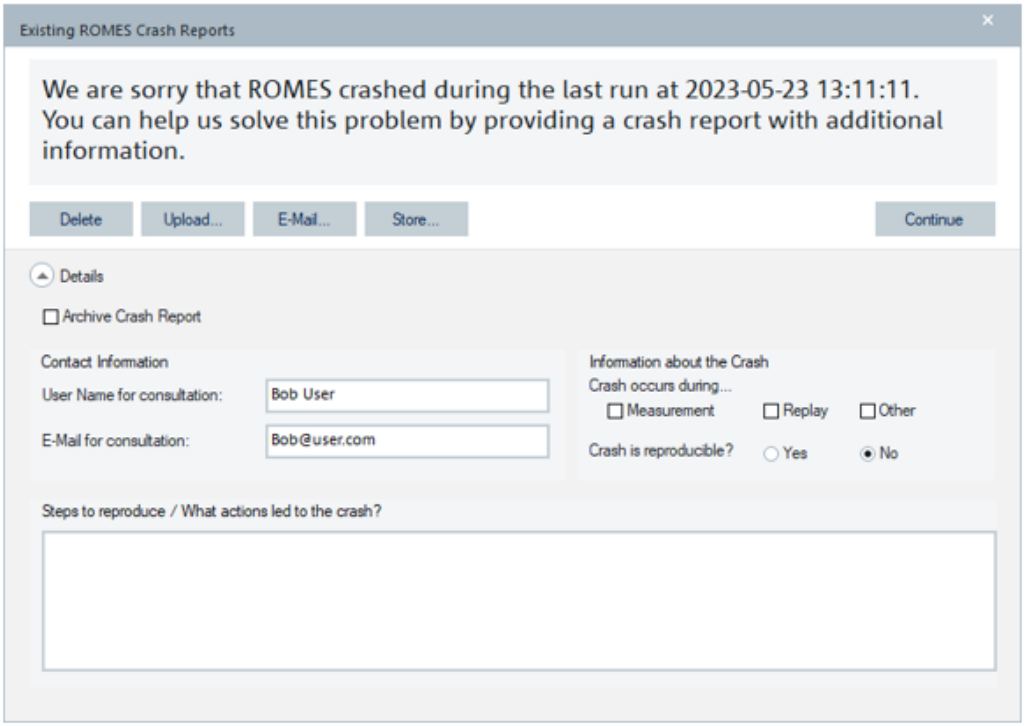


Figure 1-13: Existing R&S ROMES4 crash reports

The crash report shown in the "Existing ROMES Crash Reports" can be sent, stored, uploaded or deleted. You can send the file containing the information and description of the crash to Rohde & Schwarz via e-mail or by automatically uploading via FTP. There is also the option to skip the dialog,

- Click "Delete" to delete the file.
- Click "Upload" to upload the crash report file via FTP.
- Click "E-Mail" to send the file via e-mail.
- Click "Store" to store the ZIP file which contains one or more crash dumps on the disk. The option lets you send it later to Rohde & Schwarz, for example, if the Internet connection is not available when the crash occurs.
- Click "Continue" to skip the execution of any action. In this case, the unchanged dialog appears in the next R&S ROMES4 start.

1.8.1 Renaming the zipped crash dump file for e-mailing

Rename the zipped crash dump file to `*.txt` for sending it via e-mail in following two scenarios.

- Sending existing crash dump during startup

- Sending crash dump file just after R&S ROMES4 crashes

1.8.1.1 Sending existing crash dump during startup

During startup, if crash dump file is detected in LogFile folder, the ".txt" extension is appended to the ZIP file name.

1.8.1.2 Sending crash dump file just after R&S ROMES4 crashes

If crash occurs when R&S ROMES4 is running, the “.txt” extension is appended to the ZIP file that contains a crash dump and report.

1.8.1.3 Restrictions

- **Size restriction**
  MS Outlook can restrict the size of the attachment. The actual allowed maximum attachment size depends on the Outlook configuration.
- **Privilege restriction**
  MS Outlook can block the access if R&S ROMES4 and MS Outlook are launched with different privileges. If for example R&S ROMES4 starts as an administrator and MS Outlook starts as a regular user, an error occurs. Therefore, start both with the same privilege level to avoid the error.
  If MS Outlook is not running, R&S ROMES4 launches the sending e-mail dialog with proper privilege. If sending still fails, it is likely the size problem.
- **Possible error messages**
  - MS Outlook is in use and cannot be accessed
  - System busy with "Switch" or "Retry" options
  - Silent failure, no email dialog pops up

1.9 Measurement with R&S ROMES4

R&S ROMES4 supports that the current measurement and the evaluation of results are configured and carried out independently from each other.

- Device settings in the "Hardware" menu bar determine how the device performs measurement.
- Display configuration settings determine how the results are analyzed and viewed

Data can be viewed during the measurement without being stored (measurement mode). Data can be viewed and stored at the same time (recording mode). Data recorded in the past can be loaded from a measurement file and analyzed (replay mode).

You need administration rights to run R&S ROMES4 in measurement mode.

The contents of a result file, i.e. measurement file, depends on a kind of devices and their settings, not on a view configuration. In particular, the parameter selections and settings in "Tools" > "Configuration Active View" do not have any influence on the `*.rscmd` or `*.sqc` file. The RSCMD and SQC are the formats of measurement files which R&S ROMES4 supports.

Measurement information about user name, test vehicle and vehicle ID which is saved with the `*.rscmd` or `*.sqc` file is editable in "Tools" > "Preferences".

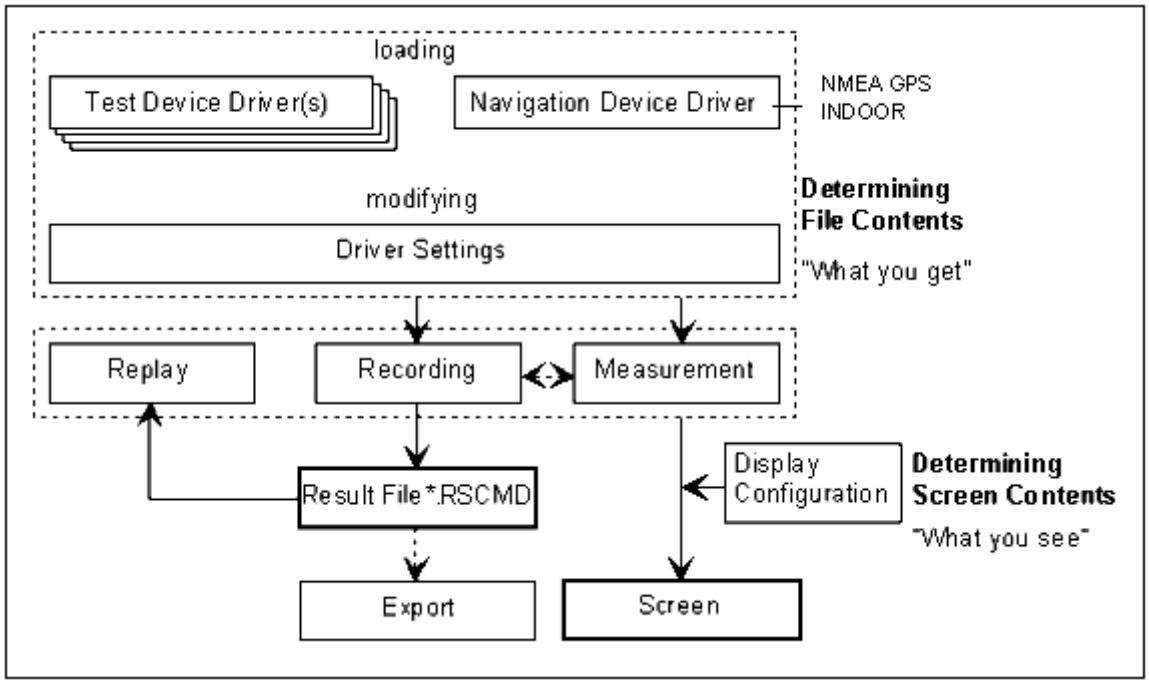


Figure 1-14: Principle of a measurement

1.10 Basic concepts of R&S ROMES4

The following section introduces the R&S ROMES4 basic operating concept, presents the measurement data and the available file formats. It also defines frequently encountered terms of the R&S ROMES4 user interface.

1.10.1 R&S ROMES4 measurement and replay mode

The R&S ROMES4 measurement mode unlocks the selected technologies so that measurements within these technologies are possible. This mode requires the WIBU license. The license can be delivered as soft-license or as stored on dongle.

Without the license, or if the license is deactivated, R&S ROMES4 can work in "Replay Only" mode. If the WIBU license is not detected, the dialog pops-up to let you decide if to start the replay mode.

Click "Yes" if you want R&S ROMES4 to start in replay mode. If you select "No", the R&S ROMES4 does not start.

In "Replay Only" mode measurements are not possible, as R&S ROMES4 does not support devices in this mode. However, all views, technologies and export functions are available.

For how to activate and deactivate WIBU soft-license, see the "R&S ROMES4 - WIBU License Management" document.

For details on current licenses, unlocked technologies on the own dongle and how to activate additional licenses, see Chapter 3.10.4, "Licenses", on page 419.

1.10.2 Workspace and measurement files

The R&S ROMES4 opening "Welcome" window shows the workspace files and the measurement files used in the previous sessions. The data in these two file types is complementary. Measurement files contain the measured data, while the workspace files (`*.rsxks`) control their visualization.

On the top-left side of the opening workspace, info about available but also missing devices is displayed.

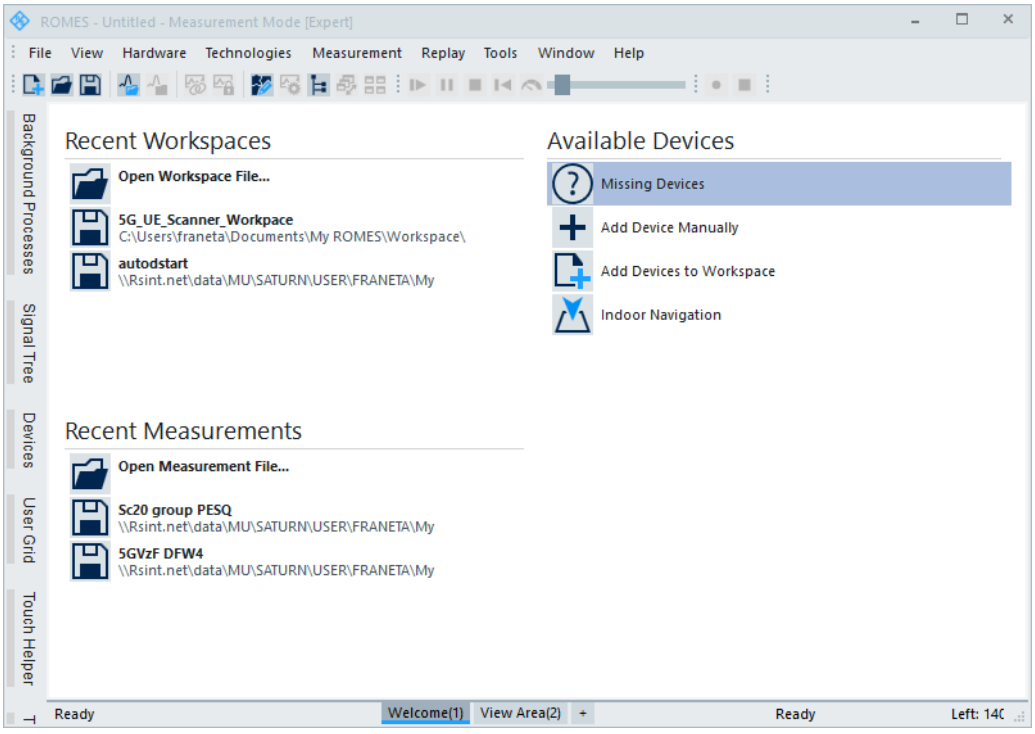


Figure 1-15: Workspace and measurement files

1.10.2.1 Workspaces

When you run your workspace file, the workspace displays the loaded device and screen settings for a R&S ROMES4 session. The display includes the type, size and position of the all open views and the parameters associated with each opened view (if applicable). If location map is defined, it is also displayed for the "ROMESMAP Route Track View" in the "Workspace".

The signal configurations defined in the "Preferences" entry, see Chapter 3.8.1.2, "Available signals configuration", on page 228, are stored in the MS Windows registry by default. They can be alternatively included in workspace.

During the session, exactly one or no workspace is active. If the R&S ROMES4 runs without any loaded workspace, the default R&S ROMES4 settings are used for the current session.

User-defined workspaces can be stored to a workspace file `<filename>.rsxks` and recalled in later sessions. So, the matching control windows can be easily set for each kind of measurement and each operator can save and reuse favorite constellations.

The default directory for saving workspaces is defined in "Tools" > "Preferences" > "General".

Workspace-related menu commands:

- Chapter 3.2.1, "New workspace", on page 104
  Create a workspace.
- Chapter 3.2.2, "Open workspace", on page 105
  Loads an existing workspace file.
- Chapter 3.2.3, "Reload workspace", on page 109
  Reloads the current workspace. All unsaved changes are lost.
- Chapter 3.2.4, "Save workspace", on page 109
  Saves the current workspace with its current name.
- Chapter 3.2.5, "Save workspace as", on page 109
  Saves the current workspace with a new name.

Default workspace

R&S ROMES4 loads a default workspace if no other workspace or measurement file is loaded. Locate the workspace in the configuration folder (supported are folders Current Users and Application Folder) and name it `~default.rsxks`.

The huge amount of information saved on the workspace is beneficial for users who transfer workspaces between PCs and use similar setups on different PCs. If you want to load an old workspace, that workspace is initially scanned for all referenced devices.

The list of devices saved on the workspace is checked against the list of available devices. The available devices are those ones that are connected to the PC (also named the host PC) R&S ROMES4 is running on. If a device saved on the workspace (or some of them) is not available on the PC, a new dialog is displayed offering the following solutions:

- Ignore the problem: R&S ROMES4 tries to load the device which still fails. These devices are marked with an orange bar.

- Remove the device from the workspace. This device is not available and therefore not loaded.

- If one or more devices are available as a replacement, they are offered as well.

- Replaced device or devices which can be loaded without problems are displayed with a green bar.

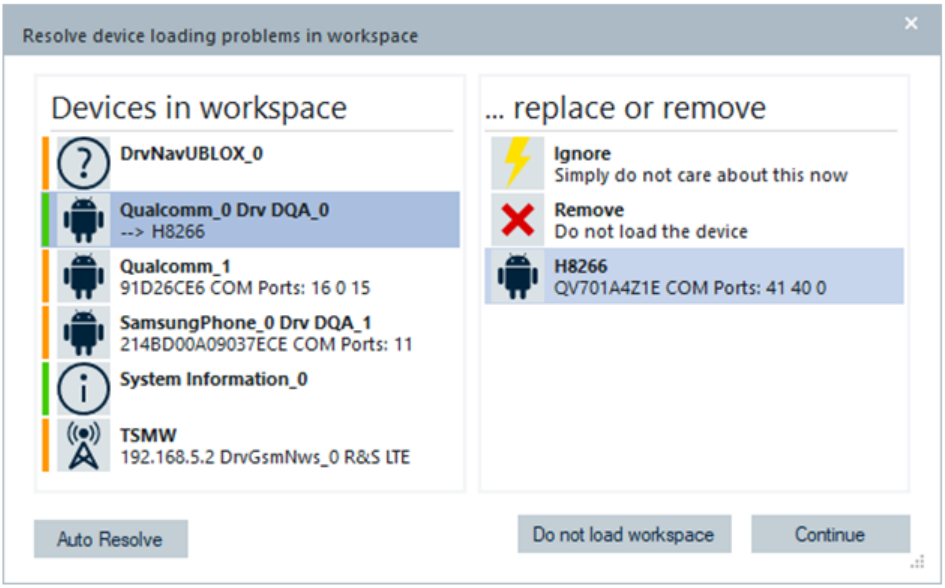


Figure 1-16: Qualcomm device replaced by H8266

Use the "Auto Resolve" button for quick replacement of the devices stored on the workspace with the currently available ones connected to the PC.

1.10.2.2 Recent measurements

R&S ROMES4 supports measurement file formats RSCMD and SQC.

A `*.rscmd` file contains the complete measurement data acquired on a tour.

A `*.sqc` file is only a container (zip) which contains several files acquired. The SQC format is suitable for data processing.

The Fully integrated devices and the On PC testing (Classic mode) devices can store data files in SQC format.

The On PC testing devices are those ones for which the `QualiPoc.apk` file cannot be installed directly on a device. Such are, for example, IoT and 5G routers/MTP or modules where QualiPoc application is not installed.

An independent Trace Decoder supports a data file conversion from RSCMD to SQC format in background if On PC testing (Classic mode) devices are used. The conversion is supported for the following devices/jobs:

- Scanners (already available since R&S ROMES4 v-19.2)

- Qualcomm chipset-based On PC testing (Classic mode) devices

- Samsung Exynos chipset-based On PC testing (Classic mode) devices

- DQA jobs executing by On PC testing (Classic mode) devices, precisely, for FTP Up- and Download, HTTP Up- and Download, Ping and NB-IoT FTP jobs.

R&S ROMES4 interpolates the GPS data even if there is no data reception for longer than 2 seconds if the SQC format is selected as a measurement file format. The Interpolated data is written into the RSCMD and MF file formats, which are then included in the SQC file format. This approach ensures that the SmartAnalytics plots the same location information for the R&S ROMES4 created scanner MF files, SmartBenchmarker or QualiPoc scanner MF files.

Select the SQC creation to have interpolated GPS information contained in RSCMD format.

On PC testing mobile devices do not support voice test files.

The `*.sqc` file created by R&S ROMES4 can contain the files listed in the following table.

Table 1-1: Measurement files contained in an SQC file

File	Mandatory	Remark
SQZ of QualiPoc	no	SQZ file of a QualiPoc measurement is copied from the phone when the R&S ROMES4 measurement has been stopped
RSCMD	yes	MF -> RSCMD converter can create the RSCMD file out of the MF/SQZ format files
SQZ of Scanner/GPS	no	SQZ file of scanner / GPS measurements*
File Handler	yes	System frames of RSCMD file
File Info	yes	To know whether the file was written by SmartBenchmarker or R&S ROMES4, R&S ROMES4 adds a `RomesFileInfo.txt` file to the container. FileID: ROMES File ID Content: Measurement File Info Text

With this approach of handling measurement files, it is not necessary to export a `*.rscmd` file for its analysis in NQDI or SmartAnalytics and additional converter is not needed.

SQZ files (i.e. measurement files MF) ready for NQDI and SmartAnalytics post-processing are produced during the R&S ROMES4 measurement using SQ Trace Decoder. The prerequisite is the activated "Write SQZ Files for Mobiles and QoS in Classic Mode" option in "Preferences" > "File Handling". The option supports the following devices/jobs:

- Scanners (already available since R&S ROMES4 v-19.2

- Qualcomm chipset based On PC testing (Classic mode) devices

- Samsung Exynos chipset based On PC testing (Classic mode) devices

- DQA jobs executing by On PC testing (Classic mode) devices, precisely, for FTP Up- and Download, HTTP Up- and Download, Ping and NB-IoT FTP jobs.

For replay in R&S ROMES4, the `*.rscmd` file within the container is extracted and opened.

During a R&S ROMES4 session, no measurement file needs to be opened because many actions (such as view configurations and export) are independent of the measurement data. A measurement file must be opened if data is recorded or replayed.

The corresponding commands consider whether a `*.rscmd` measurement file is already opened or not.

- If opened, the action is performed using the current measurement file ("Replay"), or the current measurement file is proposed as a default file for the action ("Recording").
- If not opened yet, a "File Open" dialog is opened first. In this dialog, a measurement file can be selected.

The following are measurement file-related commands:

- Chapter 3.2.8, "Open measurement file", on page 112
  Open a measurement file.
- Chapter 3.2, "File menu", on page 103
  Search for a measurement file in selected directory.
- Chapter 3.2.9, "Close measurement file", on page 115
  Close the current measurement file.
- Chapter 3.2.13, "Export measurement files", on page 130
  Export the `rscmd` file contents.
- Chapter 3.6.2, "Start recording", on page 214
  Start a measurement and write the results to a measurement file.

QualiPoc OneTraceDecoder/Converter

The `QualiPoc.apk` contains the feature OneTD to write the mobile trace data of different RATs during the QualiPoc measurement to RSCMD Phylis frames. The CGSM_MOBILEFrame, CUMTS_MOBILEFrame, CLTE_MOBILEFrame and CNR5G_MOBILEFrame are written and the frames are stored in the special MT record mtPhylisFrame in the MF database.

The `QualiPoc.apk` is installed by R&S ROMES4 via the `QPUpdateTool.exe` file.

The QualiPoc converter transports these frames to the RSCMD files.

The converter GUI allows conversion of multiple SQZ/MF measurement files and their transport to the RSCMD files.

Activate the "RSCMD Logging" option in the QualiPoc device using the "Settings" > "Advanced Analysis" > "Advanced Logging Settings" command.

If "RSCMD Logging" is not activated during a QualiPoc handheld measurement, you are warned with the following dialog.

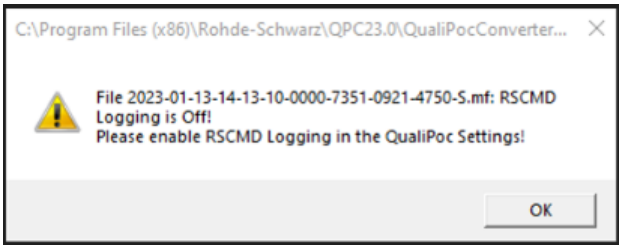


Figure 1-17: Warning to activate RSCMD logging

The converted RSCMD file shows OneTD in the measurement file info for input MF/SQZ files containing mtPhylisFrame records (instead of ROMES2GO).

01 Measurement Info	
Version	23.00 ALPHA 1]
QualiPoc Version	23.0.11
Time Zone	Offset to UTC: 1.0h
Start Of Measurement	Mittwoch, 18.01.2023, 13:39:55.200
Comment:	
Username	OneTD
Vehicle Name	QualiPocConverter
Vehicle ID:	
Num of Blocks	1
Duration	00:05:03 (HH:MM:SS)
Recorded	00:05:03 (HH:MM:SS)

Figure 1-18: Measurement info - OneTD

A log file of conversion is not deleted if the file name contains non-ASCII characters like ä, ö or ü. Therefore, do not use the special characters in the log file name.

1.10.2.3 R&S ROMES4 project

A project file (`*.rsproj`) stores all information about the necessary modules and views for a certain measurement or evaluation task. Improved are the performances of R&S ROMES4 and the clarity of its GUI. By loading a project, only necessary modules and views are used within the R&S ROMES4.

Message view is created in any case.

- To load a project, defined it while starting the R&S ROMES4. Thus, the option to load a defined project is the StartUp Wizard, see Chapter 1.7, "Startup wizard", on page 24.
- R&S ROMES4 project can be loaded also by defining the switch `'p'` at the command line:
  `Romes.exe -p C.\whereever\bestproject.rsproj`

A project is always protected by a password. However, an empty password is allowed. The project can be loaded without password, but it is required to overwrite it.

Project-related menu commands:

- Chapter 3.2.6, "Create project", on page 110
  Create a project.

1.10.3 Data selection

The data of a measurement file is presented in hierarchical tree in the view area of a selected view. The configuration menus are used to select data for viewing and exporting. The trees give a graphical presentation of the correlation between the data that originates from different devices and technologies.

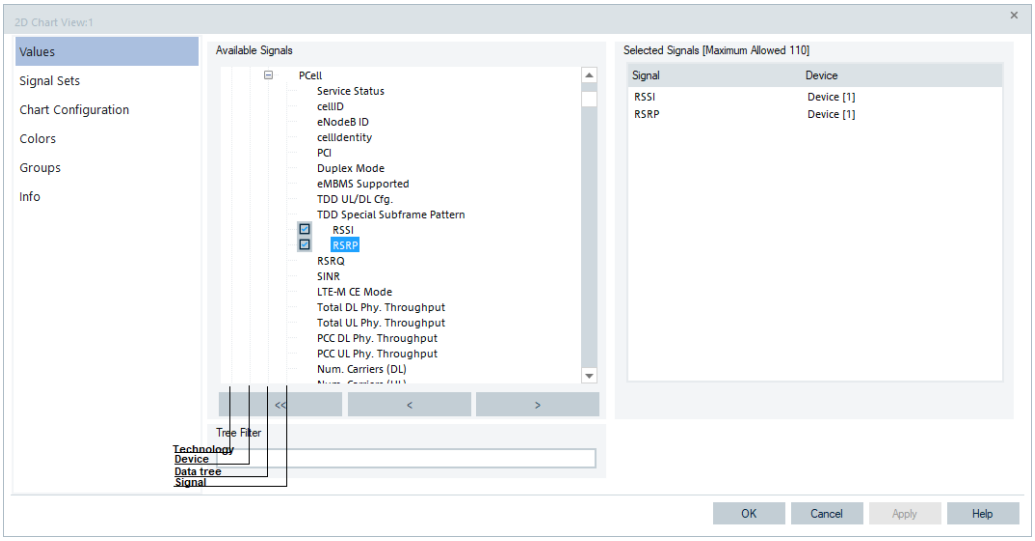


Figure 1-19: Data tree and data selection

The previous figure shows the default data tree available in the view configuration menus as long as no measurement (`<filename>.rscmd`) file is opened.

If a measurement file is opened, the data tree is adapted to the file contents. Not occupied branches because the corresponding technologies or device are not available, are truncated. The truncate ensures that any signal shown in the data tree is available in the current measurement data.

The data tree shown in "Tools" > "Preferences" does not show the device hierarchy level, because devices are selected elsewhere.

1.10.4 Signal analyzer

Signal Analyzer allows user to create and maintain composite signals. These signals are custom R&S ROMES4 signals that can compare results from existing R&S ROMES4 signals using arithmetic operations.

Composite signals can be added to views, saved with workspace, exported or imported.

Signal Analyzer is a top-level signal node in signal tree hierarchy. For signal tree, see Chapter 3.3.7, "Signal tree view", on page 158. The direct signal tree nodes are named branches. The nodes located below each branch (if present) in "Signal Analyzer" are composite signals.

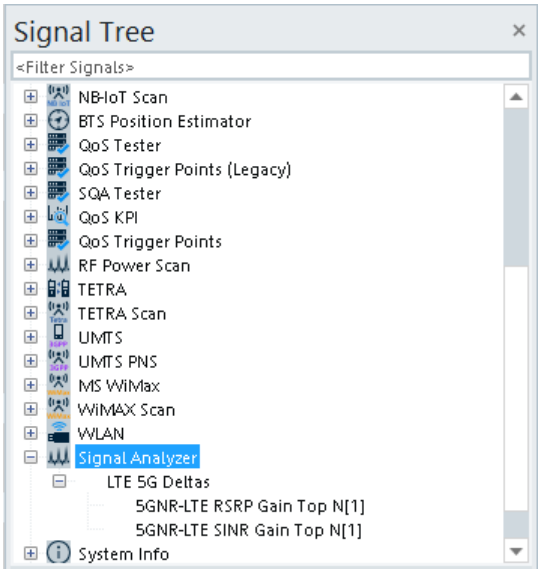


Figure 1-20: Signal tree - signal analyzer branch

1.10.4.1 Purpose of composite signals

A composite signal is an arithmetic function of one or more regular signals. The signal has the CS (S1, …, Sn) format, where CS is the composite signal function, S1 and Sn are numeric signals.

For example, following expression/function defines a composite signal function CS derived from RSRP1 and substrate signal RSRP2.

CS (RSRP1, RSRP2) = RSRP1 – RSRP2

RSRP1, RSRP2 can come from different devices.

The usage of composite signal is to compare and evaluate regular signals and make easy testing different kind of devices.

1.10.4.2 Composite signals pre-Installed with R&S ROMES4

There are two composite signals that are pre-installed with R&S ROMES4.

- "5G NR-LTE RSRP Gain Top N[1]"
  Shows the gain (in dB) between the SS-RSRP of the best member of the first 5G Top N pool and RSRP of the best member of the first LTE Top N pool.
- "5G NR-LTE SINR Gain Top N[1]"
  Shows the gain in (dB) between SS-SINR of the best member of the first 5G Top N pool and the SINR of the best member of the first LTE Top N pool.

A positive gain value indicates strong 5G signal. The negative value indicates that LTE signal is better. If Top N pools other than the first one are needed, the signal can be cloned and the signals change to use other Top N pools via the "Signal Analyzer Configuration" window. These statements are valid for both listed signals.

The signals are shown in the "Signal Tree" under "Signal Analyzer" > "LTE 5G Deltas", see the previous figure.

The expression used is "B-A", where "A" is the variable standing for LTE-Scanner Top N Pool 1/Member 1RSRP (SINR respectively), and "B" is 5G-Scanner Top N Pool 1/ Member 1 SS-RSRP.

1.10.4.3 Composite signals in basic views

The configured signal analyzer composite signals can be configured in the R&S ROMES4 "Basic Views" for use in measurement and replay.

The following basic views support configuration of the signal analyzer composite signals:

- "Alphanumeric View"
- "2D Chart View"
- "Grid View"
- "Generic Grid View"

The composite signals are configured for use in a basic view in the same way the other R&S ROMES4 signals are configured for use. Use a view configuration page to configure composite signal. Instead, drag the signal from the "Signal Tree" and drop it in the view.

Once configured in a basic view, the composite signals behave the same as standard R&S ROMES4 signals except for the "Alphanumeric View".

For composite signals configured as multi device, the result is displayed in a single "Data Analyzer" column.

The following figure shows a resulting user composite signal configured for use in "Alphanumeric View". A composite signal that subtracts an RSRP value from 5G UE and RSRP value from 5G scanner is configured as the resulting user composite signal.

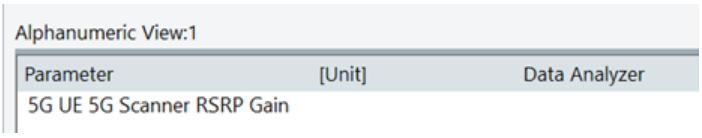


Figure 1-21: User composite signal in Alphanumeric View

For composite signals configured per device, the signal results are displayed in a column for each device that the composite signals are valid for.

In the following figure shows the use of the default 5G gain composite signals in the "Alphanumeric View". The composite signal uses a signal from both LTE scanner and 5G scanner. The value is displayed both in the LTE scanner and the 5G scanner column.

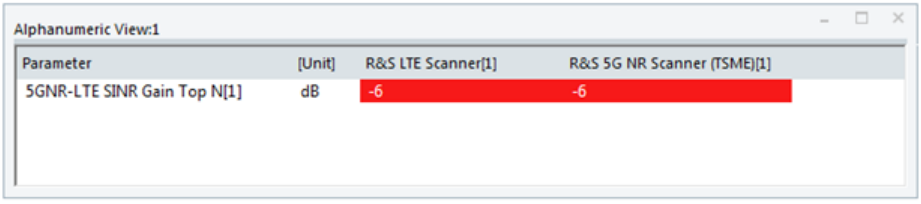


Figure 1-22: Default 5G gain composite signal

1.10.4.4 Configuration of signal analyzer

To configure the Signal Analyzer, click the "Technologies" > "TEC for Kernel" command of the R&S ROMES4 main menu.

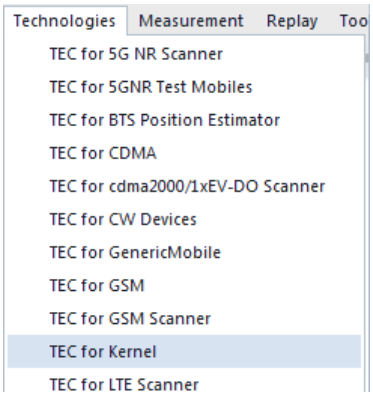


Figure 1-23: TEC for Kernel

The following window pops-up.

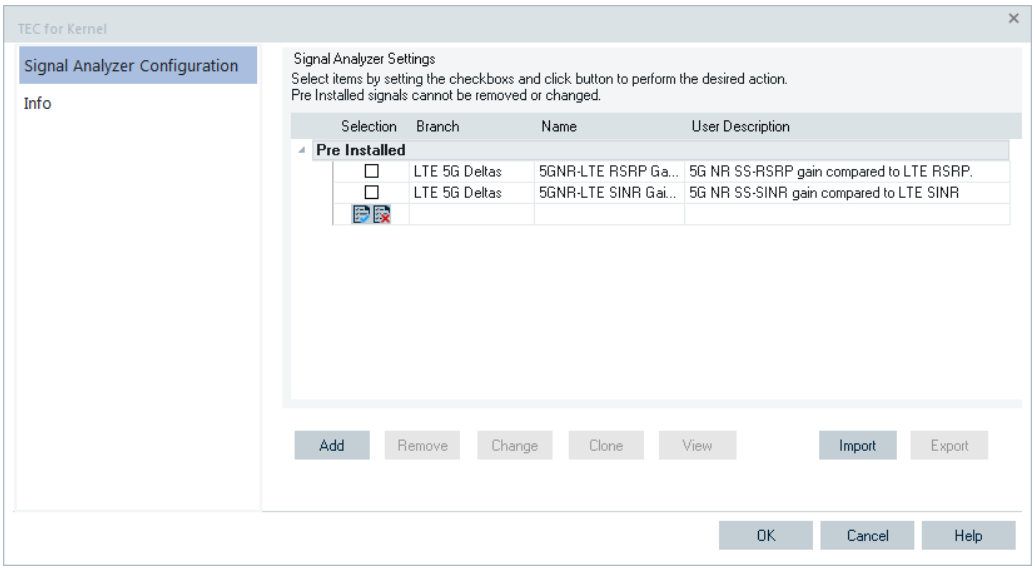


Figure 1-24: Signal analyzer configuration window

The opened window corresponds to the "Signal Analyzer Configuration" option. The signals listed under the "Pre Installed" section are installed with R&S ROMES4 and cannot be modified or deleted.

Any signals created by the user are listed under the "User Defined" section.

If there are no user-defined signals, the "User Defined" section does not appear. A grid in the middle of the page is populated with available composite signals.

The "Signal Analyzer Configuration" window can be opened also via the "Tools" > "Configuration Signal Analyzer" menu command.

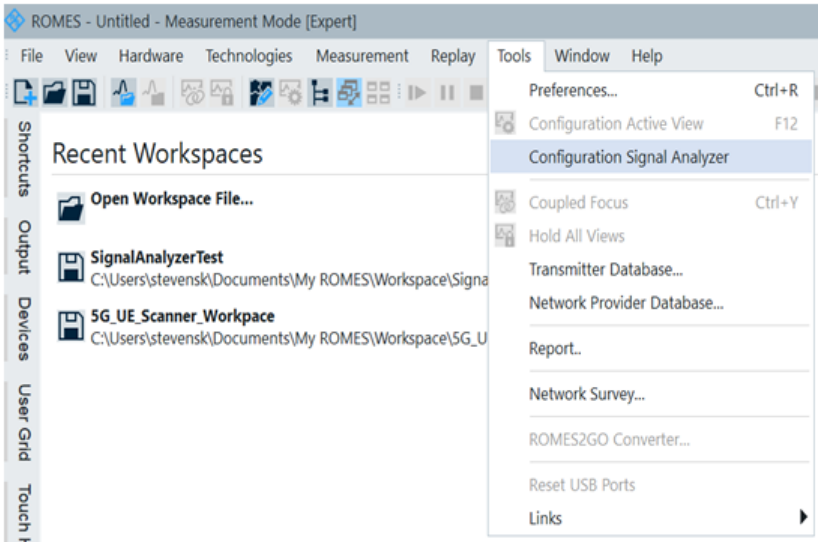


Figure 1-25: Opening the configuration window via Tools menu

Signal Analyzer - configuration of grid columns

The grid has four columns:

- "Selection"
  Selected is if checked or unselected if cleared. Click the button to apply the corresponding action to the selected composite signals.
- "Branch"
  Composite signal branch, read only. Can be changed in composite signal configuration dialog.
- "Name"
  Name of a composite signal. It is unique in the given branch, read only. The name can be changed in composite signal configuration dialog.
- "User Description"
  This field is editable. Use this field to describe the composite signal. Combination of branch and name uniquely identifies a composite signal.

Signal Analyzer - configuration of grid groups

There are two groups of composite signals:

- Pre-Installed composite signals
  Pre-installed and can be cloned and viewed, but cannot be removed, changed or exported.
- User-defined composite signals
  User defined, all button actions are allowed.

Buttons to check or clear all selections

At the bottom of each group, the selection column contains two icon buttons used to check or clear all selections.

Click the button to check all selections.

Click the button to clear all selections.

Buttons of signal analyzer configuration

There are several buttons below the "Signal Analyzer Configuration" grid:

- "Add"
  Creates a new composite signal by filling the composite signal configuration dialog.
- "Remove"
  Removes the selected composite signals.
- "Change"
  Changes the selected composite signal in the composite signal configuration dialog.
- "Clone":
  Clones the selected composite signals with new names.
- "View"
  Displays the composite signal details in the "Composite Signal Configuration" dialog.
- "Import"
  Imports composite signals from a disk file.
- "Export"
  Exports the selected composite signals to a disk file.

Preinstalled signals cannot be exported.

Two sheet level buttons at the bottom are:

- "OK"
  Saves all changes made in the "User Description" dialog or in the composite signal configuration dialog to disk.
  Note: All changes in "Analyzer Signal Configuration" or "Composite Signal Configuration" dialog are in memory and persist to disk only if the "OK" button is clicked.
- "Cancel"
  Discards all changes.

Signal analyzer - selection of the configuration buttons

The buttons are functional or grayed dependent on the composite signal selection.

- "Add" button is always active.
- "Remove" button is active only if at least one user-defined composite signal is selected. The remove action is applied only to the user-defined signals.
- "Change" button is active if only one user-defined composite signal is selected.
- "Clone" button is active if there is any composite signal is selected.
- "View" button is active if there is only one composite signal is selected.
- "Import" button is always active.
- "Export" button is active if at least one user-defined composite signal is selected.

Add a composite signal

Click the "Add" button to launch composite signal configuration dialog for user to fill the signal details.

If the signal is successfully added, the new signal is shown in the CSC grid. Refer to "Composite Signal Configuration" section for details.

Remove composite signals

Click the "Remove" button to remove all the selected user-defined composite signals.

The action does not remove pre-installed composite signals no matter they are selected or not.

Change a selected composite signal

Click the "Change" button launches the composite signal configuration dialog used to make changes.

Refer to "Composite Signal Configuration" section for details.

Clone selected composite signals

Click the "Clone" button to clone all selected composite signals with new names.

A new name gets suffix "_xxx" where the xxx is a number from 001 to 999 depending on the available next suffix number. If the number reaches the limit, the following dialog displays.

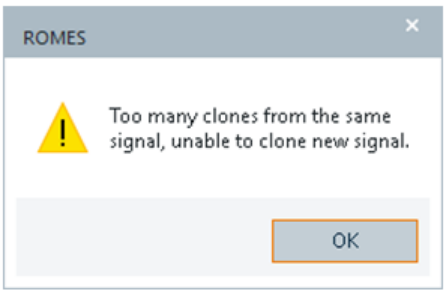


Figure 1-26: Clone warning message

View a selected composite signal

Click the "View" button to launch the composite signal configuration dialog, so that you can view the details.

All the fields in the composite signal configuration dialog are read only. However, the "Information" button is active.

Refer to "Composite Signal Configuration" section for details.

Export selected composite signals to disk

Clicking the "Export" button to launch the "Export Composite Signals" dialog. Browse a folder and select or enter a file name to export the selected composite signals.

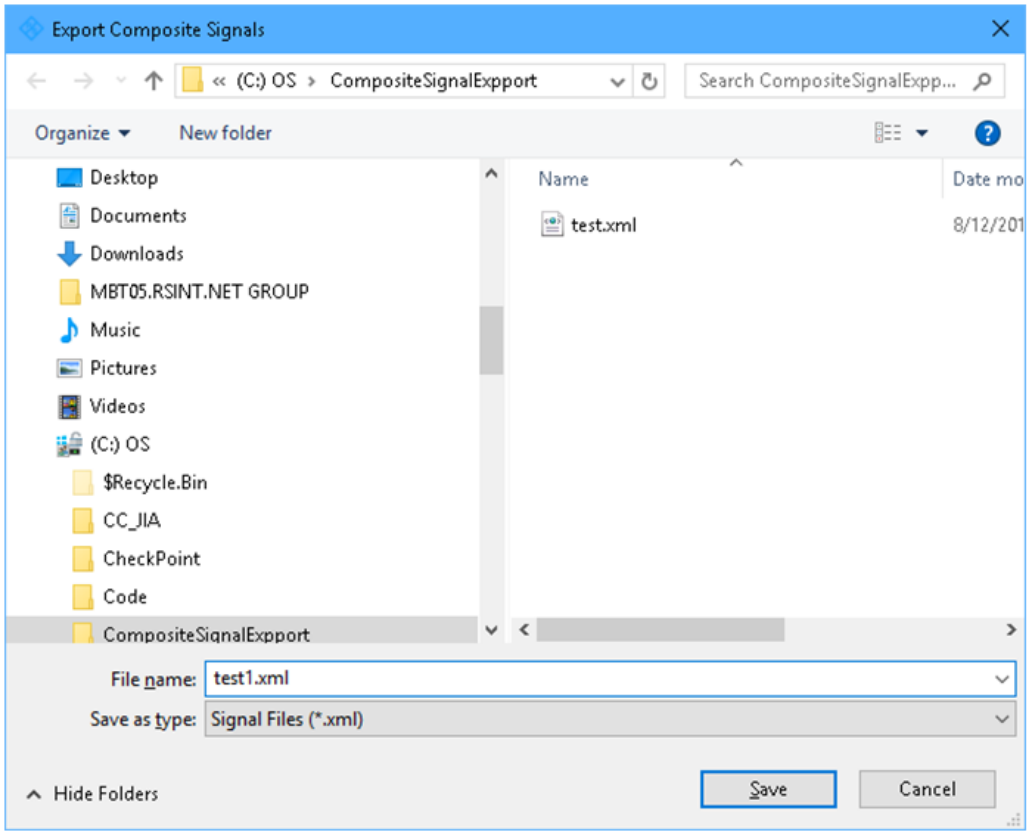
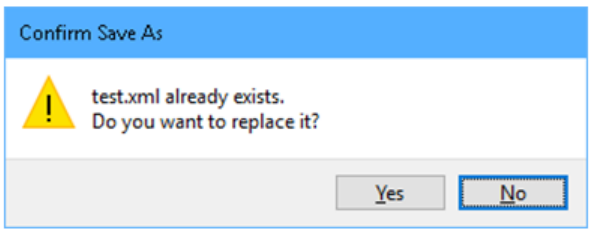


Figure 1-27: Exporting a file containing composite signals

If the name already exists, you are prompted whether replace it.



Import composite signals from disk

Clicking the "Import" button to launch the "Import Composite Signals" dialog. Browse a folder and select a composite signal file (XML file). Click "OK" to import it.

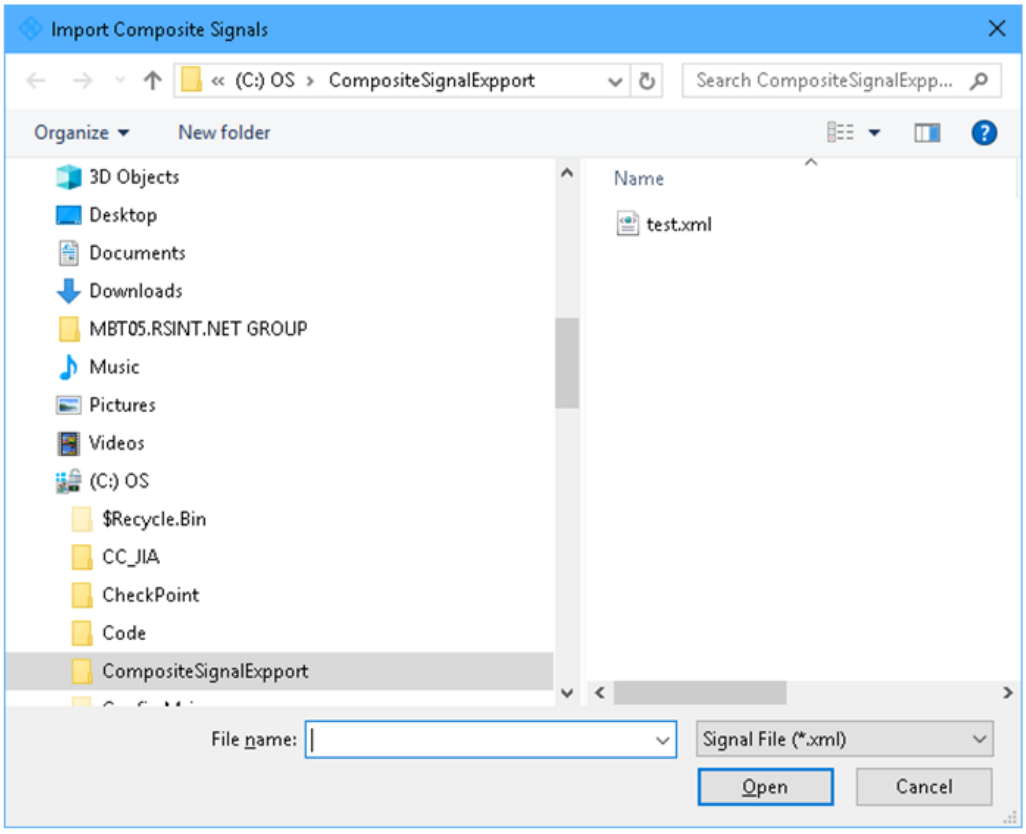


Figure 1-28: Importing a file containing composite signals

If the file is successfully imported, you receive a message indicating the number of successfully imported signals.

If any of the signals that are attempted to be imported currently exist, the import of those signals fails. You receive the error message in that case alerting you to the problem.

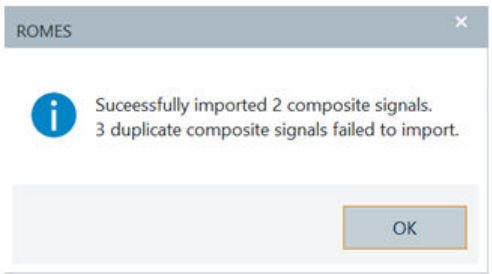


Figure 1-29: Import of some signals failed

Table 1-2: Other error messages for failed import

Error message	Cause
"No composite signals found to import"	Import file contains no signals to import or is not formatted correctly.
"Import Failed: Composite signals already exist"	All signals in the import file already exist as composite signals in R&S ROMES4.

1.10.4.5 Composite signal configuration

The "Composite Signal Configuration" dialog launches if the "Add", "Change" or "View" button in the "TEC for Kernel" > "Signal Analysis Configuration" window is clicked.

The following two screenshots of the "Composite Signal Configuration" dialog show the empty one for adding signals and the populated one for changing.

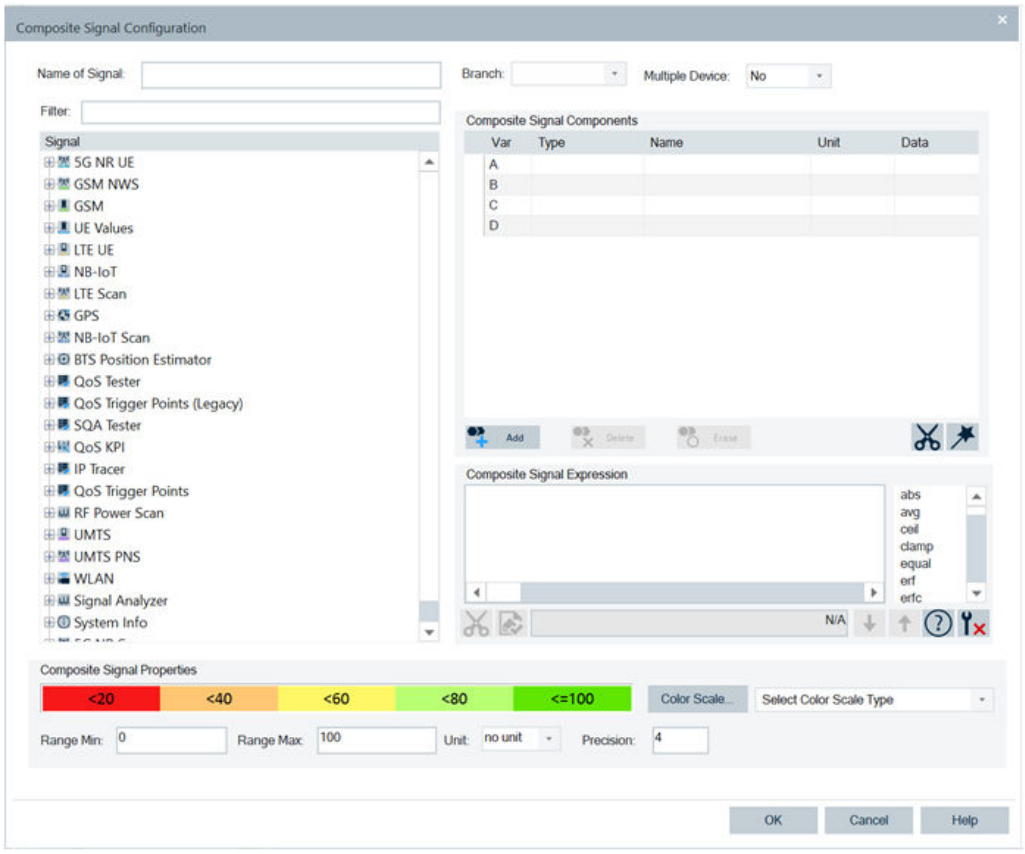


Figure 1-30: Empty Composite Signal Configuration dialog

A source signal tree is located in the "Signal" pane. A components grid is located in the "Composite Signal Components" pane.

The source signal tree contains regular signals and the leaf signals can be dragged to the "Composite Signal Components" grid.

The items in the "Composite Signal Components" grid are used as operands in composite signal expression. You can configure a signal name, branch, device type, range minimum/maximum, unit and color scale in this dialog.

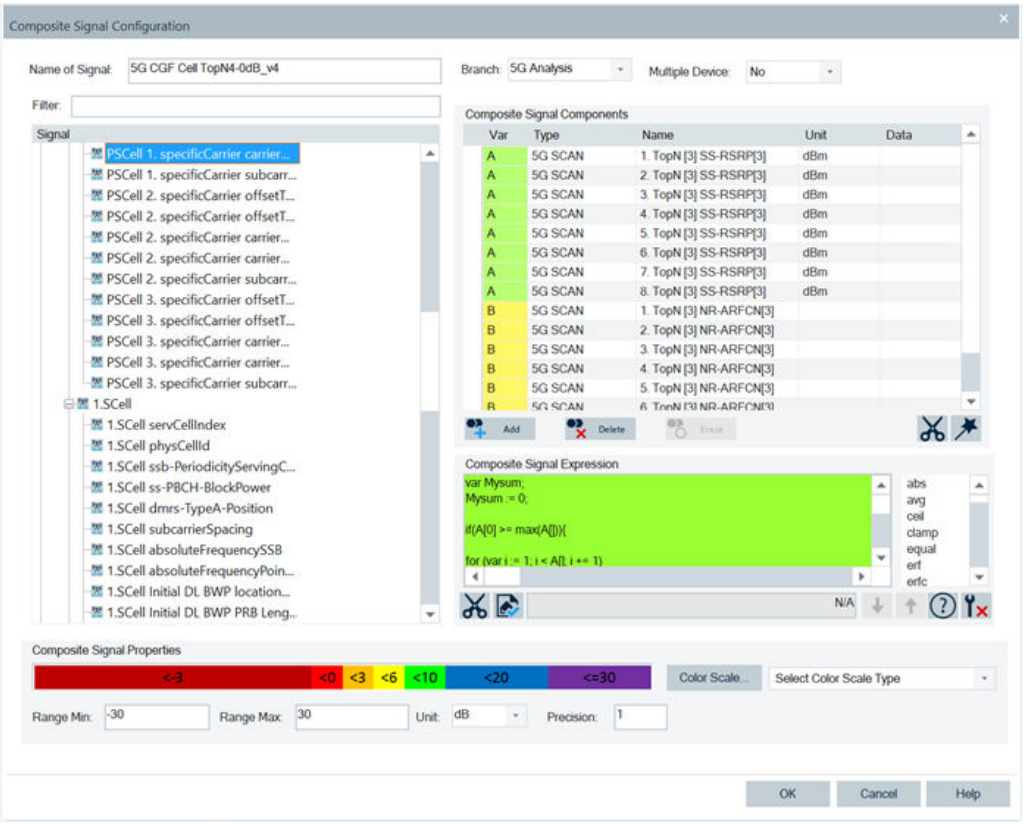


Figure 1-31: Populated Composite Signal Configuration dialog

Custom functions to calculate electromagnetic field strength

Signal Analyzer contains the several built-in functions for calculating the strength of electromagnetic field. The signal analysis is a workaround for recalculating the received power to various units, having in mind also the antenna gain.

The possible functions and their corresponding syntax are shown in the following table.

Table 1-3: Built in functions for calculating electromagnetic field strength

Function	Description	Syntax
dBmTOdBuVm	Convert value from dBm to dBuV/m	dBmTOdBuVm (X, Y, Z) X - is the value in dBm to convert Y - is the frequency Z - is the antenna gain
dBuVmTOdBWm	Convert value from dBuV/m to dBW (m2/MHz)	dBuVmTOdBWm (X, Y) X - is the value in dBuV/m to convert Y - is the bandwidth
dBmTOdBWm	Convert value from dBm to dBuV/m	dBmTOdBWm (X, Y, Z, A) X - is the value in dBm to convert Y - is the frequency Z - is the antenna gain A - is the bandwidth

The following figure emphasis the dialog's functions in the "Composite Signal Expression" pane.

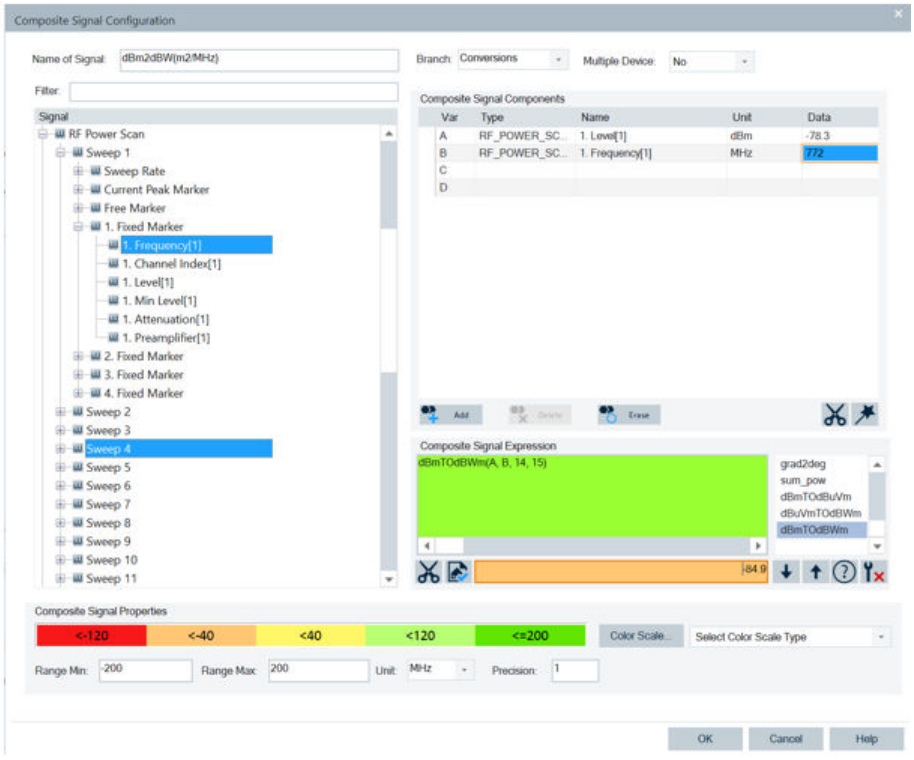


Figure 1-32: Convert dBm to dBWm function

Value map for signal analyzer

The Signal Analyzer supports the `SignalAnalyzerMaps.xml` file which defines mappings for R&S ROMES4 signals to a new value.

Locate the file in the My Documents\My ROMES\Configuration folder. With the R&S ROMES4 installation, an example file is copied to the application's configuration folder. It is copied to the user's configuration folder after the first startup if the synchronization feature is active. Otherwise, check the folder C:\ProgramData\Rohde&Schwarz\My ROMES\Configuration for the example file.

When the example file has been renamed to `SignalAnalyzerMaps.xml` and R&S ROMES4 is restarted, the two new entries "AF1" and "AF2" are offered as functions for Composite Signal Expression.

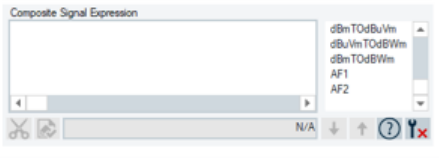


Figure 1-33: Added functions AF1 and AF2

The setup of a signal mapping is straight forward. The main tag of the file is Maps, which has to be present always. The next tag is Map, which specified one Mapping Table.

The Map has the following attributes:

- Attribute: Remark

- Name: The name of the function, which has to be used in the Signal Analyzer to get the mapping. For example, if name="MyMap", then the corresponding call is MyMap(A)

- HelpTitle: An optional help title can be specified, which is used as a tool tip header in the "Signal Analyzer" dialog for this Map.

- HelpDesc: An optional help description can be specified, which is used as a tool tip text in the "Signal Analyzer" dialog for this Map.

Each Map contains at least two-point tags. Point tags have the attribute "In" and "Out".

The values of the In attributes must be increasing. The Map maps the input value to the corresponding output value. If the input value is not equal to any Point's In attribute, the value is calculated by a linear interpolation between the neighbor Points.

Example:

```
<Maps>
    <Map Name="AF1" HelpTitle="Antenna Factor 1" HelpDesc="this is a map">
                <Point In="1" Out="10"></Point>
                <Point In="10" Out="100"></Point>
                <Point In="100" Out="1000"></Point>
    </Map>
    <Map Name="AF2" HelpTitle="Antenna Factor 2" HelpDesc="this is another map">
                <Point In="1" Out="100"></Point>
                <Point In="10" Out="1000"></Point>
                <Point In="100" Out="10000"></Point>
    </Map>
</Maps>
```

Some example calls:

AF1(1) => 10

AF1(5) => 50

AF2(30) => 3000

Ensure that the unit of the input signal has the expected value. For example, if the unit for a frequency is set to Hz, the Point in attributes has also to be in Hz. If MHz is used, a `*.xml` file has to contain MHz.

Enter composite signal name

A composite signal name is the required entry in the "Name of Signal" field.

If the entered name already exists in the selected branch, the signal is not created, the "Composite Signal Configuration" dialog stays unchanged and the following error displays.

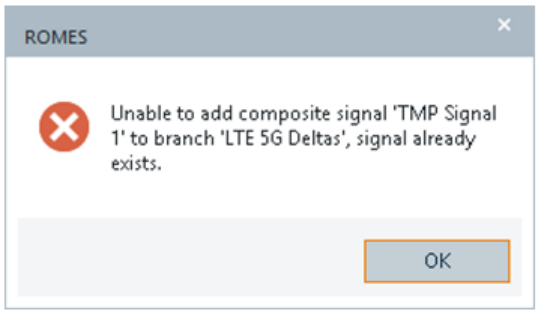


Figure 1-34: Warning message - name already exists

If the field is empty and you click "OK", the following error message displays.

Figure 1-35: Warning message - name invalid

Enter or select composite signal branch

A composite signal branch is the required entry in the "Branch" field. The filed is populated with the existing branches.

It also allows you to enter a new one. If you enter a new branch name, the signal is created under the new branch node. If it is for changing or viewing, the branch from the composite signal is automatically selected.

If you click "OK" with this field empty, the following message displays.

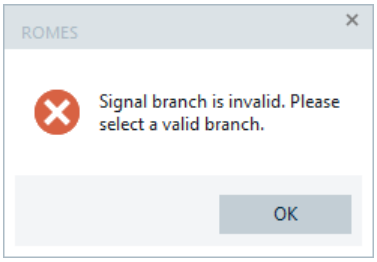


Figure 1-36: Warning message - branch invalid

Select single or multiple device type

The selection of single or multiple device type is the requested entry in the "Multiple Device" field.

The filed is populated with two choices:

- "Yes", which indicates that the signal involves multiple devices.
- "No", which indicates that the signal involves single device.

There are three signal device type categories:

- Independent Signal
  The signal is independent and has no interference with any other types, such as GPS and Error Message.
- Mobile Signal
  The signal involves mobile type of devices, such as any UE. A mobile device does not work as scan type of signal.
- Scan Signal
  The signal involves scan type of device. A scanner does not work as UE type of signal.

If you want to create a composite signal that involves both Mobile and Scan type of devices, select "Yes" in the "Multiple Device" field. Otherwise, select "No".

If "Yes" is selected, the "Device" column is present in the composite signal component grid. If "No" is selected, the column is not present.

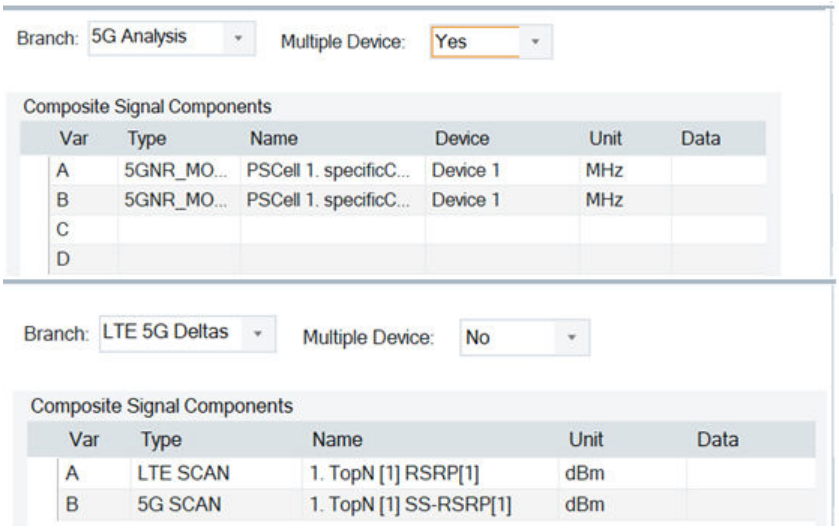


Figure 1-37: Different layout of grid dependent on selection

Source signal tree

A source signal tree is located in the "Signal" pane of the "Composite Signal Configuration" dialog.

The figure shows UE type of source signals.

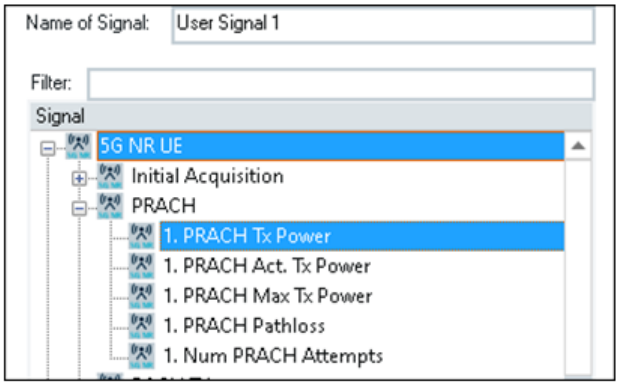


Figure 1-38: UE type of source signals

PRACH is not a leaf signal, but a branch and therefore cannot be dragged to the grid.
PRACH Tx Power is a leaf signal and can be added/dragged to the grid.

Filter source signals

The "Filter" field is located above the source signal tree. It allows you to enter string to filter the signals you want to be shown only. The figure shows the filtered result with filter string equal to "Scan".

Figure 1-39: Selected branches that correspond to filter criterion

Composite signal components grid

The figure shows an empty and one populated composite signal components (CSC grid) grid.

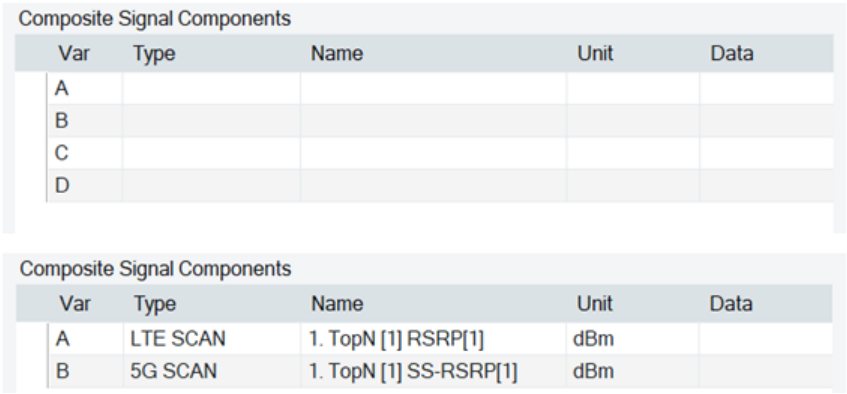


Figure 1-40: Empty and one populated CSC grid

The grid contains components for creating the signal expression.

The CSC grid has the following columns:

- "Var"
  Variable name in CSC grid that represents this row item and is used in expression, for example, A.
- "Type"
- The type of signal category, for example, LTE MOBILE or LTE SCAN.
- "Device"
  It is a drop-down column available only if the "Multiple Device" selection is "Yes". The list contains entries labeled "Device 1" to "Device n", where n is the set maximum number of devices for each technology in the "Tools" > "Preference" > "Advanced Settings" page, see Figure 3-165. You can choose a device from the list.
- "Unit"
  It is the unit that is used in the expression calculation. Before calculation, the signal value is always converted to frame unit and then to the chosen unit.
- "Data"
  Allows for the entry of test data that can be used to test the configured expression.

Preserved the top signal component rows
The grid preserves four top signal component rows. They cannot be deleted. For a new signal, "Var" field is populated with A, B, C and D. The "Delete" operation only applies to four non-top signal rows.

Add new row to CSC grid
The "Add" button is always enabled.

Click the button to a new to the grid. The "Var" field is automatically populated with the next available name, alphabetically from A to Z.

It is case insensitive. So A = a. Totally 26 variables can be used. If the number of variables exceeds 26, R&S ROMES4 generates the error message "Too many rows in grid".

A source signal can be added to and only to an empty row.

Delete row from CSC grid
The "Delete" button is enabled only if there are non-top4 rows.

If there are highlighted non-top4 rows in the grid, clicking the button deletes them. If there is no highlighted row in the grid, clicking "Delete" deletes the last non-top4 row if any.

Erase content of highlighted CSC grid row
Click the "Erase" button to erase content of the highlighted signal row, so that a source signal can be added to this row.

Note: Source signal cannot be added to a row that is occupied.

Add source signal to CSC grid

To display leaf signals, expand the source signal tree.

Drag a desired signal from the source signal tree to the empty grid row. In this way created is a composite signal component.

Device selection is necessary for multiple device type.

Clear test data

Click to clear all currently entered test data from the "Test" column.

Generate random test data

Click to generate random test data for all currently configured component signals. The data generated is a random value between the signals low expected range value and high expected range value.

Composite Signal Components

Var	Type	Name	Unit	Data
A	LTE SCAN	1. TopN [1] RSRP[1]	dBm	-18.86
B	5G SCAN	1. TopN [1] SS-RSRP[1]	dBm	-72.72

Figure 1-41: Generated random test data

Once the data is generated and if the expression is valid, the result of plugging the data into the expression is displayed in expression result field.

Figure 1-42: Expression result field

If there is a current data in "Data" field, a prompt is shown asking if to clear the currently existing data.

Click "Yes" to clear the currently existing data and replace it with the new random data.

Click "No" to leave the current data in place and only generate the new data if there is no test data entered.

Composite signal expression

Composite Signal Expression is the arithmetic expression used to produce a result for the composite signal.

The expression consists of Variables and Operators.

Variables are linked to R&S ROMES4 signals in the "Composite Signal Components" grid. There are two types of variables that can be used in the expression.

- Single variables
- Vector variables

Operators are divided to those ones valid for single variable and for vector variables. Operators are shown in Table 1-4 and Table 1-6.

Single variables

Single variables occur when a single R&S ROMES4 signal is linked a variable name.

As an example considers the case where a comparison of 5G SS_RSRP and LTE RSRP is desired. 5G SS_RSRP is assigned to the variable name of "A" and LTE RSRP is assigned to the variable name of "B". An expression of A-B would subtract the 5G SS-RSPR from the LTE-RSRP to produce the result for the signal.

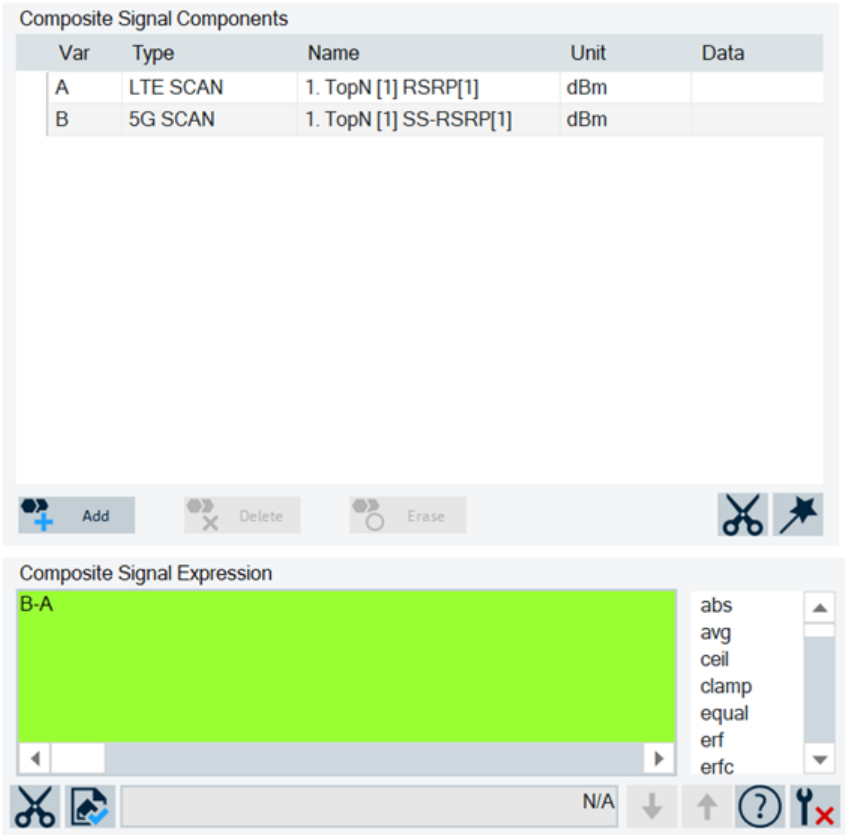


Figure 1-43: Example of single variable

Expressions containing single variables are only calculated if all signals associated with the variables in the expression are valid. In the above example if 5G SS-RSRP or LTE RSPR is invalid, then the composite signal is invalid.

Vector variables

Vector variables are assumed if a single variable is associated with multiple R&S ROMES4 signals.

Vector variables are used if arithmetic operations are to be done on a list of signals were not all signals in the list are valid at the same time.

As an example, consider the case of attempting to calculate the total bandwidth for a 5G mobile. To calculate the total bandwidth, add the primary cell and 4 secondary cell bandwidth signals to a composite signal. If each signal where to be given a different variable name and an expression of "A+B+C+D+E" used to calculate the bandwidth, then primary and all secondary cells must all be valid before a total bandwidth can be calculated.

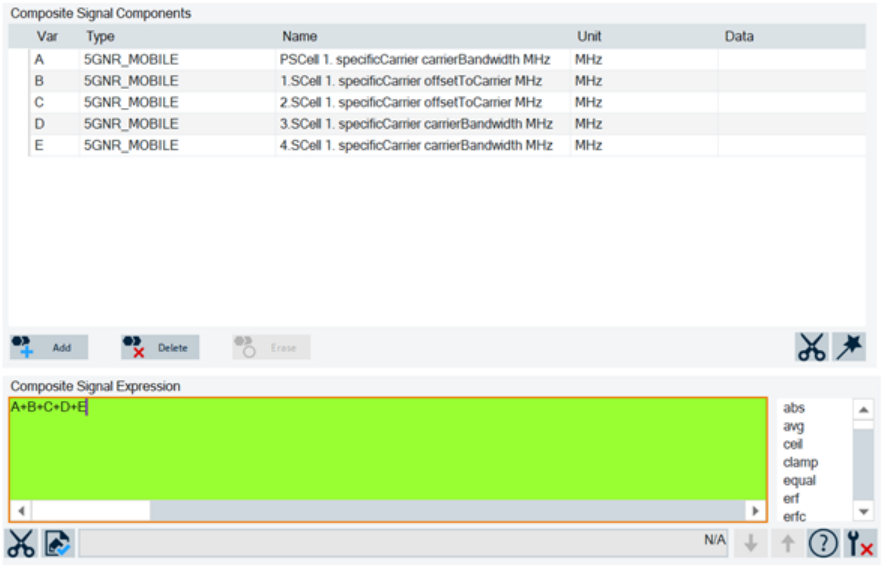


Figure 1-44: Calculation of available bandwidth with single variables

The result in the example is most likely not the desired one as the total bandwidth can/ should be calculated with just the valid cells. By using a vector variable, the calculation includes only the valid cells. The example can be changed to a vector variable by assigning the primary and secondary cells with the same variable name.

Click the variable name in the "Var" column and use the drop-down menu to select the variable name.

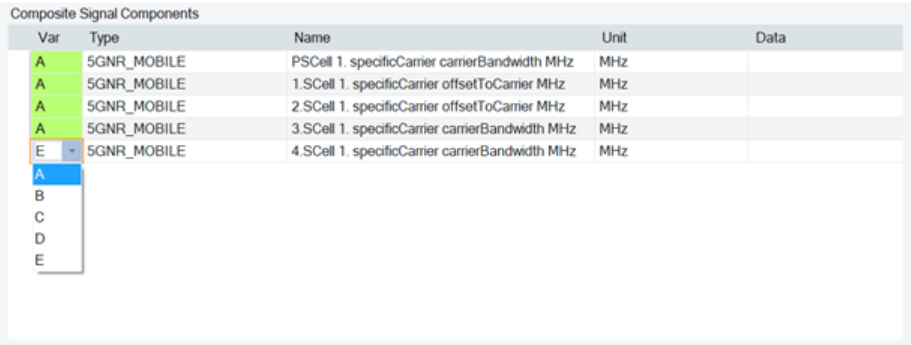


Figure 1-45: Example with vector variable

The resulting vector can then be passed to a valid arithmetic function to produce a result using only valid values. For our bandwidth example, the expression is "sum(A)".

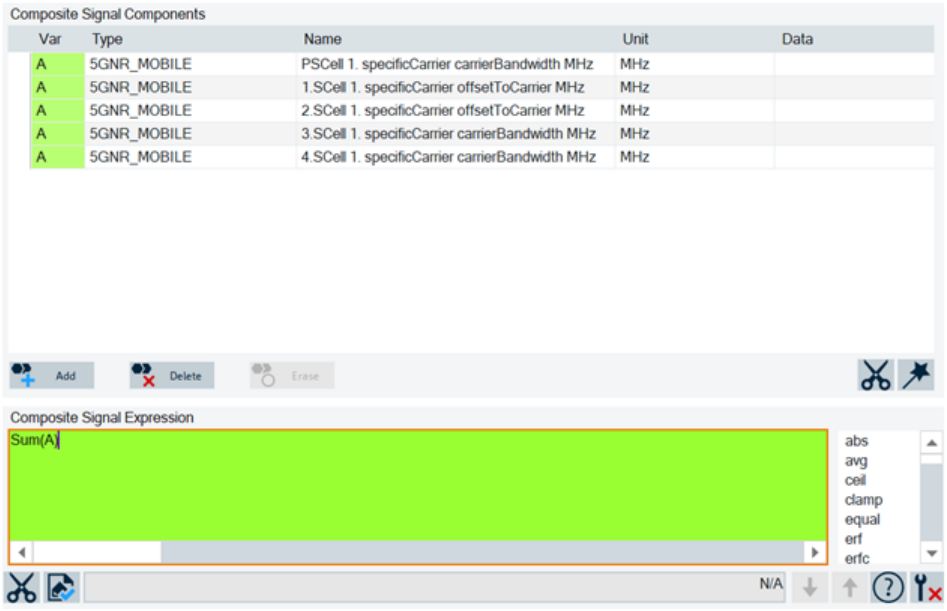


Figure 1-46: Example solution with vector variable

If only primary cell and secondary cell 1 and 2 are valid, then only those cells are used in the calculation of the bandwidth. If at any point in the measurement secondary cell 3 becomes valid, it is automatically included in the calculation. If primary and all secondary cells have invalid results, the bandwidth also has an invalid result.

Mixing single and vector variables

Vector and single variables can be used in the same expression.

For example, assume a vector variable "A" is configured and a single variable "B" is also configured. The expression of "sum(A) – B" can then be used to add up the results of all valid items defined in vector variable "A" and subtract the value of "B" from the result. For the calculation to be done, the single variable "B" must have a valid result and at least one member of the vector variable "A" must have a valid result.

If a vector variable is used with an operation that does not support vector variables, the expression still passes the validity check done by R&S ROMES4. In this case, only the first valid member of the vector is used in the calculation.

For example, if a vector variable "A" is defined and single variable "B" is defined and an expression "A+B" is used, then the first valid member of "A" would be added to the value of "B".

Operators

Table 1-4: Operators valid for single variables

Basic operators	**+, -, *, /, %, ^**
Equalities & Inequalities	=, ==, <>, !=, <, <=, >, >=
Logic operators	and, mand, mor, nand, nor, not, or, shl, shr, xnor, xor, true, false

Basic operators	**+, -, *, /, %, ^**
Functions	abs, avg, ceil, clamp, equal, erf, erfc, exp, expm1, floor, frac, log, log10, log1p, log2, logn, max, min, mul, ncdf, nequal, root, round, roundn, sgn, sqrt, sum, swap, trunc
Trigonometry	acos, acosh, asin, asinh, atan, atanh, atan2, cos, cosh, cot, csc, sec, sin, inc, sinh, tan, tanh, hypot, rad2deg, deg2grad, deg2rad, grad2deg

Example:

Table 1-5: Expressions using single variables

A+B	Added variable A and B
A-B	Subtract variable A from B
A/B	Divide variable A by B
Sum(A,B,C,D)	Sum of A, B, C and D
Avg(A,B,C,D)	Average of A, B, C and D

Table 1-6: Operators valid for vector variables

Functions	avg, max, min, mul, dot, dotk, sum, sumk, count, all_true, all_false, any_true, any_false

Example:

Table 1-7: Expressions using vector variables

Sum(A)	Sum of all members in the vector variable "A"
Avg((A)	Average of all members in the vector variable "A"
Min(A)	Minimum value of all members in the vector variable "A"

This list of valid operations can also be accessed from within "Composite Signal Configuration" window by hovering mouse over the expression edit box or clicking the ? button next to the "Clear" button.

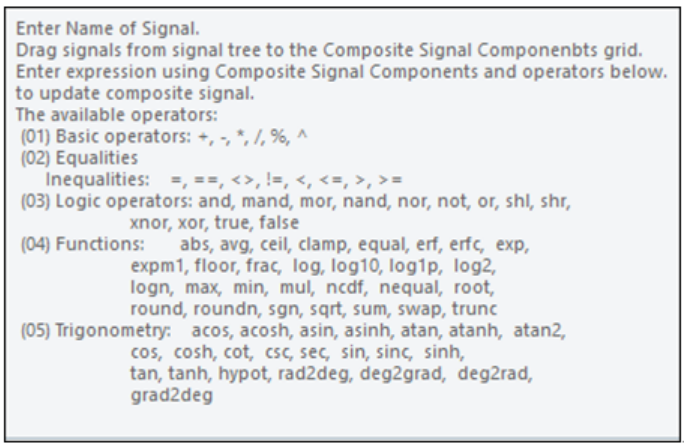


Figure 1-47: Available operators

1.10.4.6 Composite signal expression fields

The "Composite Signal Configuration" pane of the "Composite Signal Expression" dialog is shown in the following figure.

Figure 1-48: Expression entry fields

Composite signal expression validity indicator

The expression edit box shows different background color to indicate whether the expression is valid.

- If the entered expression is complete and valid, the box shows green background.
- If the entered expression is invalid, the box shows red background.
- If the expression box is empty, the box background shows no color indicator.

Function list

The expression functions field is on the right-hand side of the "Composite Signal Expression" pane, see the previous figure. The function list is a list of the available functions that can be used in the expression. Hovering the mouse over a specific entry pops-up a help entry for that function containing the definition of the function and an example of the syntax.

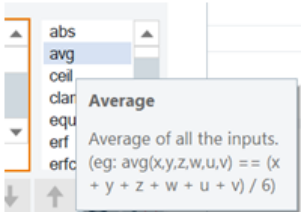


Figure 1-49: Selected function and syntax example

Double-click a function name to insert the function name in the expression edit field at the current location of the cursor.

Clear composite signal expression

Click ✂ to clear the content of the expression edit filed.

Calculate test data button

If the currently entered expression is valid, the icon appears. Click this button to update test data result if test data has been entered into the test data column.

If the current expression is invalid, the icon appears. Click the button to bring up a message with details on the error causing the expression to be invalid.

Test result field

The test result field shows the current result of the expression when using the data configured in the "Test" column. The color of the result field corresponds to where the result falls on the configured color scale for the composite signal. If test data is not configured or the expression is not valid, then "N/A" appears in the field.

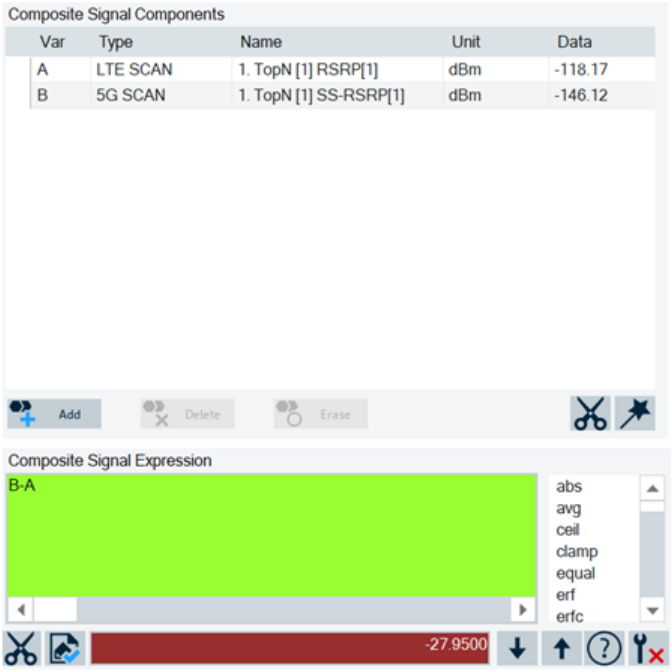


Figure 1-50: Result of composite signal expression

If the result falls outside of the currently configured minimum or maximum range, the results are nevertheless shown. The message indicates if the value is out of range high or out of range low.

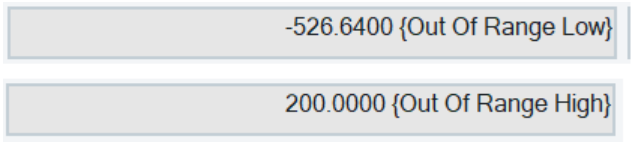


Figure 1-51: Case the result is out of range

Set low/high range buttons

The ↓/↑ set the current value of the composite signal to the minimum and maximum range value, respectively.

Expression help button

Click ⓘ to clear the content of the expression edit filed. The action pops-up the window which helps a composite signal setting.

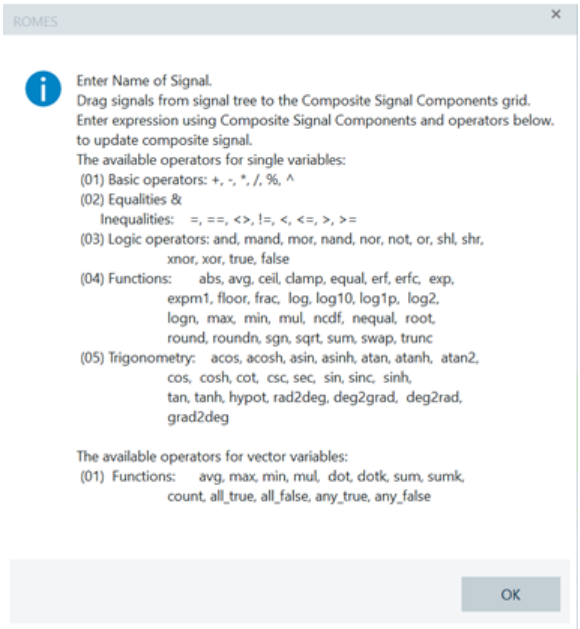


Figure 1-52: Enter signal name

Show/hide function list box

Click 🔧+/🔧× to show and hide the function list box, respectively. The action shows the "Composite Signa Expression" pane as following.

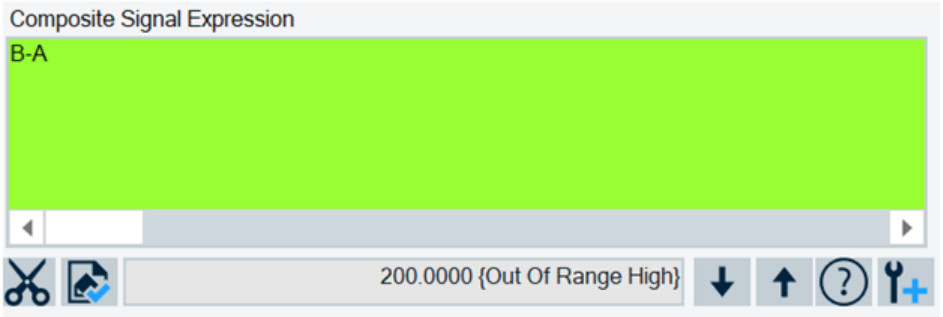


Figure 1-53: Pane layout offering opening the function list

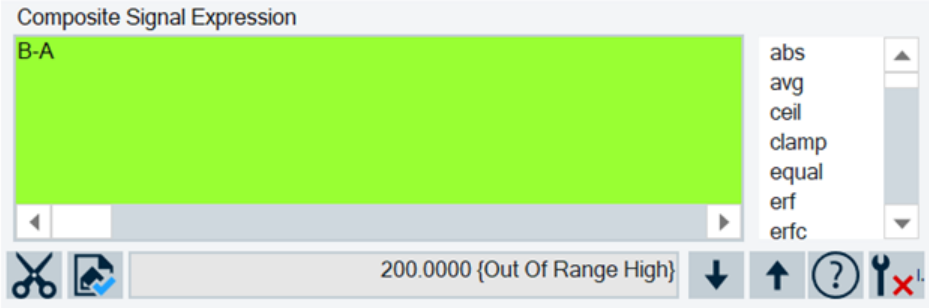


Figure 1-54: Pane layout offering hiding the function list

1.10.4.7 Composite signal properties

The "Composite Signal Properties" pane of the "Composite Signal Configuration" dialog is shown in the following figure.

Figure 1-55: Composite Signal Properties pane

Select composite signal color scale type and make change

The pane is where you choose or change the color scale type of a composite signal.

The "Color Scale" button launches a color scale dialog for customizing color scale. Click the button to get the dialog where you can change the color and the range of a signal.

The "Select Color Type" edit box is populated with default color scales.

Figure 1-56: List of default color scales

While the list is opened

- Use the up/down key to preview color scale without selecting it,
- Use mouse to select a color scale from the list. The selected one is populated in the preview bar on the left, or
- Cancel the selection process without changing it by selecting the "Select Color Scale Type" line or pressing the [ESC] key.

If the value text is too long, it shows blank. Resizing the dialog gives more space to show the hidden text.

If composite signal range min or max is changed, the color scale preview bar is refreshed.

Range minimum

Enter the composite signal range minimum in "Range Min.".

This value must be less than composite signal range maximum. If you change the value, the corresponding color scale changes accordingly.

Range maximum

Enter the composite signal range maximum in "Range Max.".

This value must be greater than composite signal range minimum. If you change the value, the corresponding color scale changes accordingly.

Composite signal unit

The "Unit" is a drop-down list populated with the predefined units and a unit from the current composite signal. Click the arrow of the list to see all default units.

If the composite signal unit does not exist, you can insert the unit to the unit list.

Select a desired unit from the list or enter a new unit. If a new unit is entered, it is added to the unit list. Select "no unit" if blank is desired.

Composite signal precision

The "Precision" entry shows the number of displayed decimal points when the result of the composite signal is displayed in a generic view.

1.10.5 Supported file formats

In the following sections listed are the file formats which R&S ROMES4 uses in addition to those measurement and workspace file formats described in Chapter 1.10.2, "Workspace and measurement files", on page 31.

The formats which are not listed are not shown in the Topic-Structure in Acrobat Reader.

1.10.5.1 Export formats

Data stored in a measurement (`*.rscmd`) file can be exported to files with special data formats and be used in other applications. Several ASCII and other export formats (`*.txt`, `*.asc`, `*.mif`, `*.pcap`, `*.csv`) are available, depending on the system configuration. Moreover, it is possible to export the layer 3 messages stored in a measurement file during replay.

A detailed description of file export and export formats can be found in Chapter 7, "Data processing", on page 2098.

1.10.5.2 View result of export format (*.csv)

Several views support the export of the displayed data to a `*.csv` (comma-separated values) file that can be opened and processed by MS Excel. The contents of the Excel lists and the delimiters (commas, semicolons etc.) are view-dependent. To adjust MS Excel to the current delimiters of the `*.csv` file, use the MS Excel "Data" > "Text to Columns" wizard.

1.10.5.3 Image files

In the "ROMESMAP Route Track View" arbitrary bitmap files (`*.jpg`, `*.bmp`, `*.pcx`, `*.png`, `*.tif`, `*.gif`) can be loaded and superimposed to a background world map. The bitmaps can be positioned onto the world map with a set of coordinates which are stored in a `*.tab` file, a short text file assigned to the bitmap. A detailed description of a bitmap positioning can be found in Chapter 4.3.3.6, "Maps menu", on page 606.

1.10.5.4 Wave files

R&S ROMES4 allows wave (`*.wav`) files to use for the following purposes:

- Announcement of an event by an acoustic signal.
  For this purpose the wave files have to be selected in the "Available Events" menu, see Chapter 3.8.1.3, "Available events configuration", on page 238.
- Announcement of an error or warning regarding the overall state of a loaded device by acoustic signals.
  The error or warning sound is played whenever the overall state of the loaded device is red or yellow, respectively. The sound is played only during measurement or recording. See "Audio alarms for device states" on page 256.
- Speech Quality measurements (SQA).
  The wave file is used as reference file and test file. Furthermore, the R&S ROMES4 allows sound files from measurement files (`*.rscmd`) in wave format `*.wav` to export.
- Fully integrated device use mode
  `LU.ini` file supports the wave format of recording settings - the file includes WAV file storing.

1.10.5.5 SC color files

In some of the scanner views, a color scale can be loaded from an SC color file (`*.scc`).

The user-defined color scales can be stored to `*.scc` files to be reused in a later session.

1.10.5.6 ASCII export configuration file

If exporting measurement data to an ASCII file, the export configurations can be stored to a `*.rma` file and reused later.

1.10.5.7 BTS list and network database files

Base station data provided by a network operator can be imported from the BTS list (`*.txt`) or ASCII table description (`*.atd`) file with definite file formats, see Chapter 7, "Data processing", on page 2098. Information on the base stations can be viewed in several views, for example, in the alphanumeric view or ROMESMAP Route Track view, see Chapter 4.2.3, "Alphanumeric view", on page 466 and Chapter 4.3.3, "ROMESMAP route track view", on page 562, respectively.

Click "Tools" > "Transmitter Database". The "Base stations" dialog opens where you can select the base station lists.

The information on base stations is imported to a network database file for internal use. It is possible to edit the data within a network database and export data to a new BTS list (`*.txt`).

Table 1-8: Supported file formats

Technology	File extension
5G NR	nrdb
LTE	ltedb
UMTS	umtsdb
GSM	gsmdb
CDMA	cndb
TETRA	tdb
WiMAX	wmdb

2 Getting started

The following chapter presents a sample session with R&S ROMES4. The aim of the chapter is to provide a quick overview of the most important functions and configurations.

The tests include:

- Chapter 2.1, "Preparations", on page 67 (i.e. startup of the system, configuration of the used hardware, loading a database containing system and network data)
- Evaluating the measurement results

The steps to perform are explained via the required menus and the screenshots of the obtained results are shown. We also point out alternative settings and related measurements which could not be reported in detail.

Chapter 2.2, "Measurement examples", on page 72 contains short operating sequences from various R&S ROMES4 applications.

2.1 Preparations

- Starting R&S ROMES4 67
- Loading devices 68

2.1.1 Starting R&S ROMES4

The R&S ROMES4 is an application that runs under the MS Windows 10.

Figure 2-1: R&S ROMES4 start icon

Double-click the icon on your desktop to start up R&S ROMES4.

The R&S ROMES4 opening page shows that the R&S ROMES4 SW is a part of the R&S SmartOne. While starting up, shown is the SW version, the date of SW issue, the percentage of loaded devices and the currently running processes.

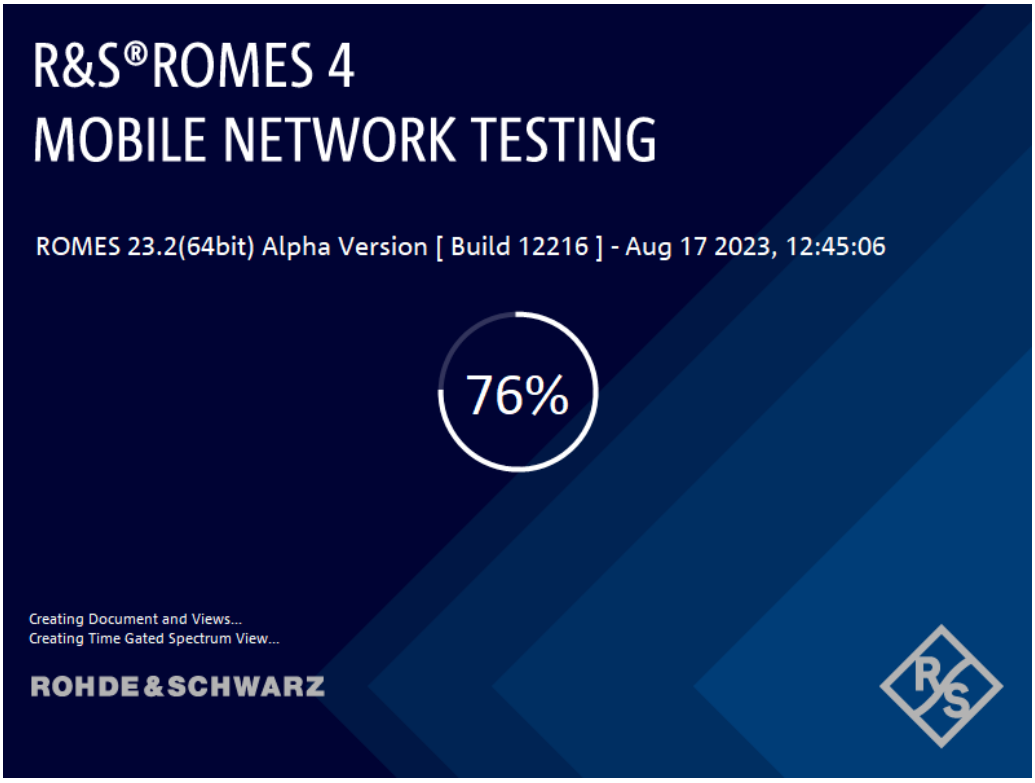


Figure 2-2: R&S ROMES4 splash screen

The background processes related to scanning the connected hardware are visualized during the startup of R&S ROMES4.

The background processes related to scanning while opening some measurement file are also visualized, see Chapter 3.2.8, "Open measurement file", on page 112.

2.1.2 Loading devices

The devices as mobile phones, positioning systems or scanners have to be recognized and supported by R&S ROMES4 before the measurement starts.

In general, the used test mobiles are connected via COM port 1 and the GPS receivers with NMEA interface connected via COM port 2 of the controller.

To load a device, perform the following steps:

1. Select the "Hardware" > "Connect/Disconnect" entry of the R&S ROMES4 toolbar menu.

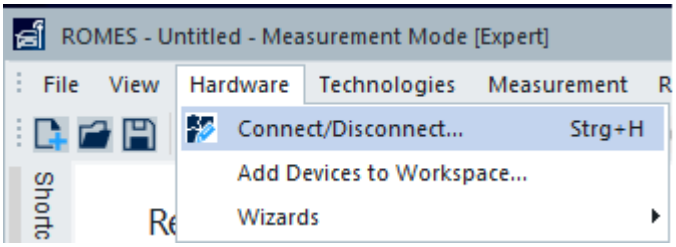


Figure 2-3: Hardware menu

The "Hardware Configuration" window opens.
The window shows a list of all devices which are supported by R&S ROMES4. The list varies according to chosen options of the coverage measurement system.

2. For a mobile device setting, select one in the "Available Devices" > "Mobile Devices" branch.

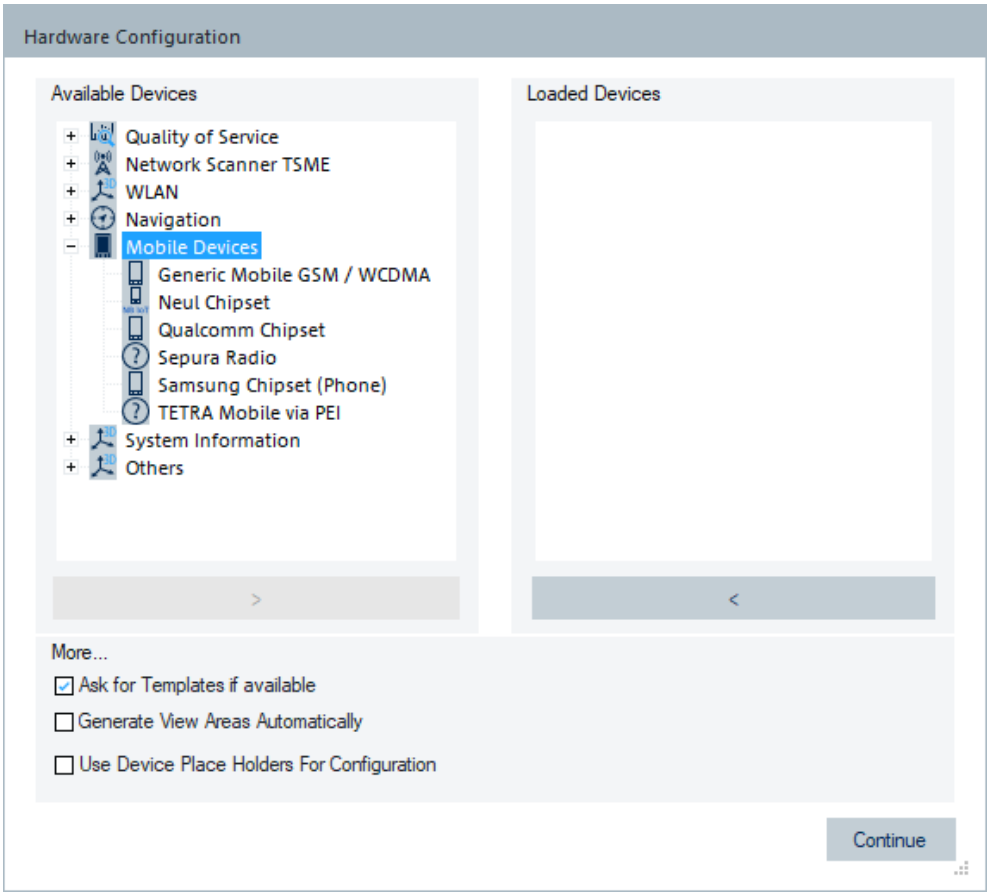


Figure 2-4: Devices supported by R&S ROMES4

3. Select the manufacturer of your mobile device.
4. Click the › button to initiate the loading.
The "Assign Serial Port" window shows the COM ports assigned to the mobile device. Set the Port 1.

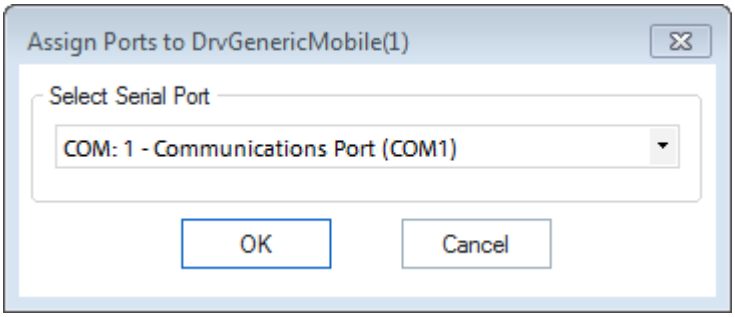


Figure 2-5: Assign the port to device

5. If the COM port 1 is not set, select it from the combobox.
6. Click "OK".
   A progress bar appears to show the initialization of the mobile device.
   After initialization, the loaded device is shown in the "Hardware Configuration" > "Loaded Devices" pane.
7. Click "Available Devices" > "Navigation" to get the list of the navigation devices that R&S ROMES4 supports.
8. Select "NMEA GPS" from the list.

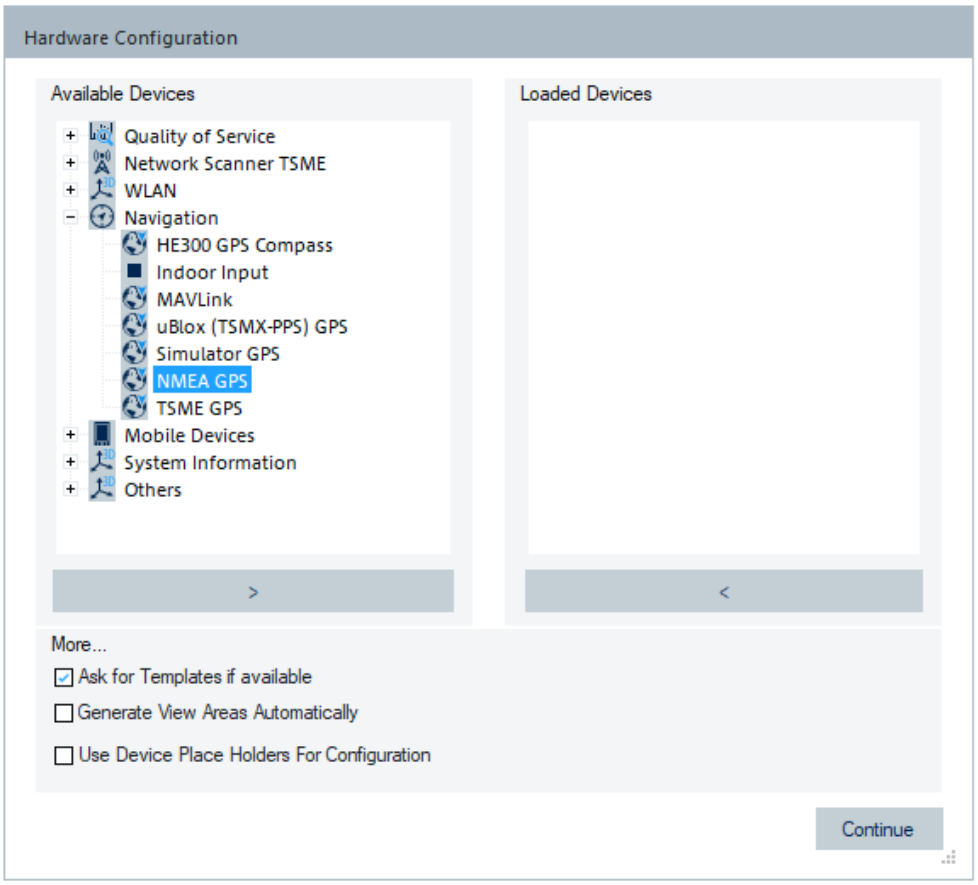


Figure 2-6: NMEA GPS device

9. Click the › button.
10. To load the device, proceed as described in step 5.
11. Assign the NMEA GPS device to COM port 2.
12. Click "OK."

    The device is loaded.
    The "Loaded Devices" pane displays the correctly loaded devices together with the other previously loaded ones.

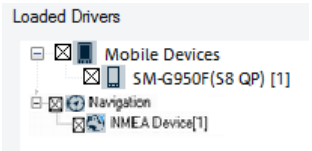


Figure 2-7: Loaded devices

13. Click "Continue" to confirm your choice. The action also closes the "Hardware Configuration" window.

2.2 Measurement examples

The following sections are intended for a quick introduction to typical measurement tasks, listing the steps necessary to set up devices, obtain, display and interpret the basic results. The examples are taken from different R&S ROMES4 options and technologies.

- Test mobiles 72
- UMTS scanner 80

2.2.1 Test mobiles

After connecting the mobile to the host PC and selecting the network providers, perform the steps like previously mentioned to load it. Qualcomm chipset-based test mobile devices are loaded in a same way. The R&S ROMES4QP, R&S ROMES4QC or ROMES4SAM option is required for Fully integrated devices (QualiPoc) and On PC testing (Classic mode) devices.

The following example shows starting measurements with the Samsung chipset-based test mobile SM-G950F. To run tests related to quality of service with the mobile device, select the analyzer in the "Quality of Service" branch.

1. Click "Hardware" > "Connect/Disconnect".

   The "Hardware Configuration"windows pops-up.

2. Select "Mobile Devices" > "Samsung Chipset (Phone)" and double-click.

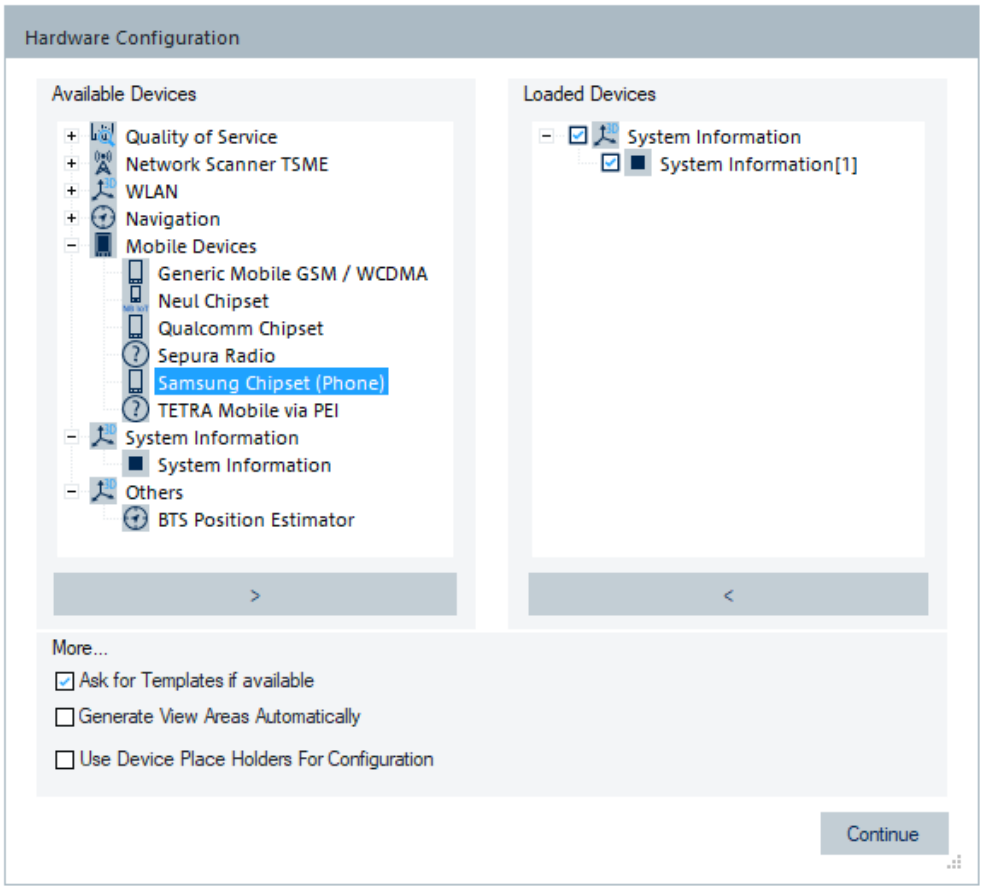
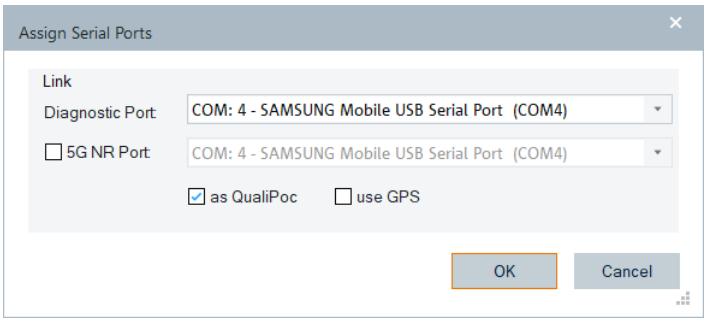


Figure 2-8: Selection of Samsung device

The "Assign Serial Port" window pops-up and displays the found COM port as it is autodetected.



3. Click "OK".

   R&S ROMES4 shows all connected test devices. In our example only one is available.

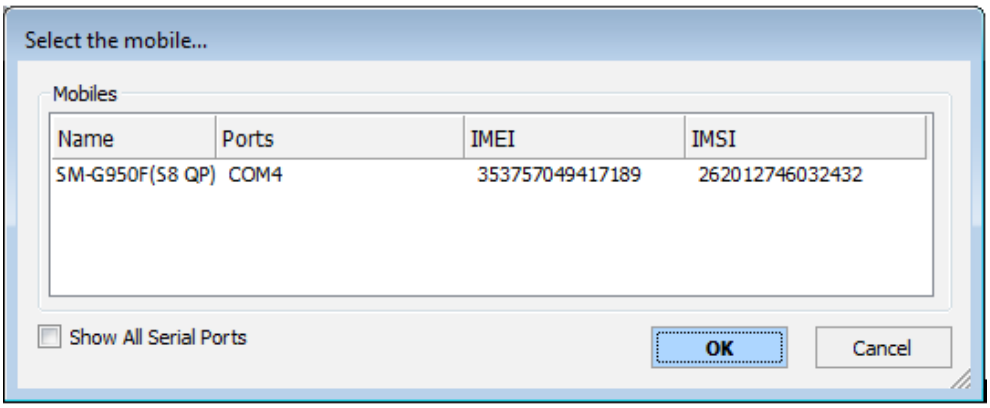


Figure 2-9: List of connected devices

4. Select the mobile device.
5. Click "OK".

   It is loaded and displayed in the "Hardware Configuration" > "Loaded Devices" pane.
6. Click "Continue" to confirm your choice and close the window.

   The Samsung device is also assigned to the "Hardware" menu as an entry.
7. Double-click the "Data Quality Analyzer" or "Speech Quality Analyzer" in the "Quality of Service" branch.

   The analyzer is loaded and shown in the "Hardware Configuration" > "Loaded Devices" pane.
8. Click "Continue" to confirm your choice and close the window.

   The analyzer is assigned to the "Hardware" menu as the QoS or SQA menu item.
9. Click the item.

   The "QoS"/SQA window pops-up where you can select a job for execution and test. See Figure 2-11.

   Now you can use the mobile device for measurements.

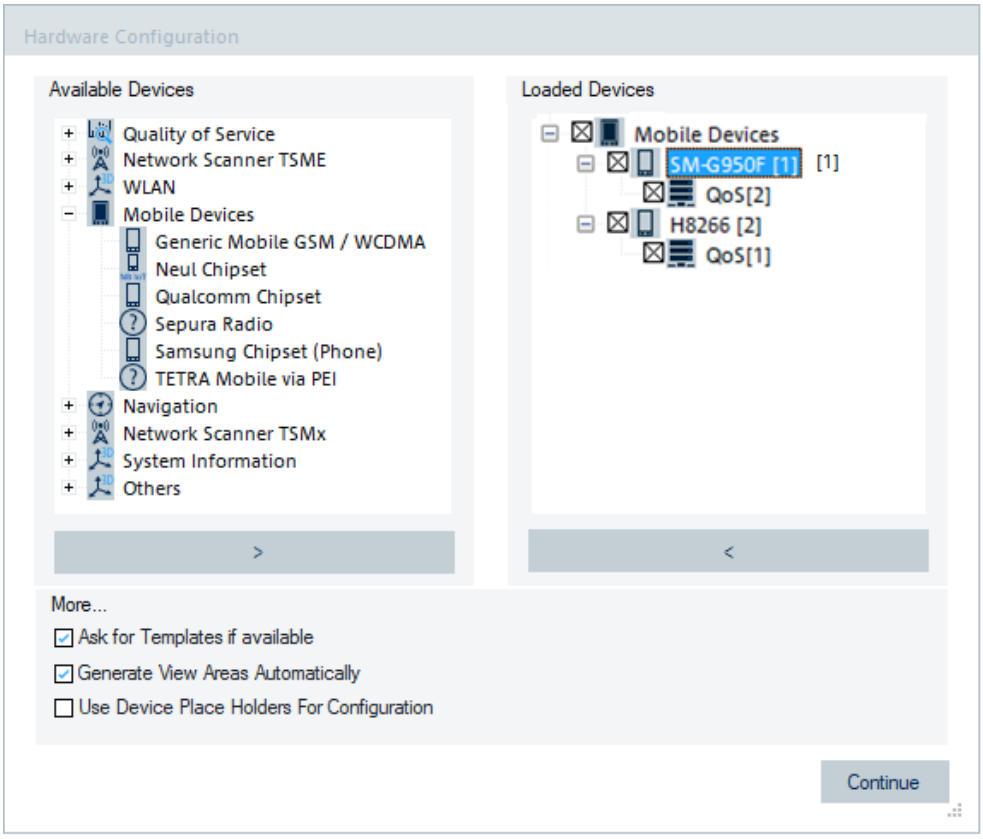


Figure 2-10: Loaded Samsung device and QoS analyzer

You can select a mobile device mode of operation as On PC testing (default), Fully integrated device (QualiPoc, also abbreviated as QP) and iPhone.

1. Default setting does not assume a voice call. Configure the voice call with a Fully integrated device (QP).

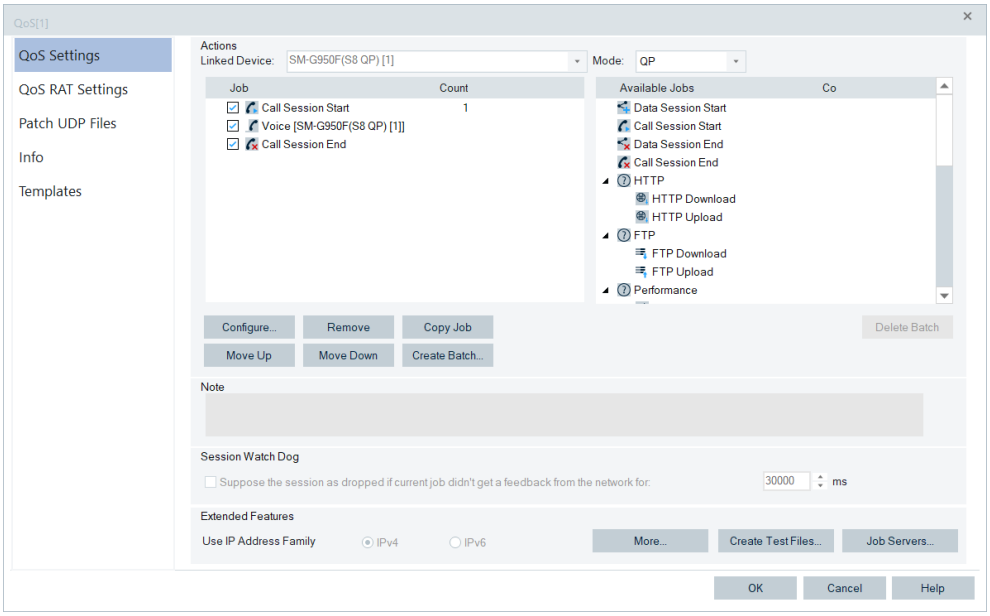


Figure 2-11: Selecting voice call

2. Select the "Auto Dialing" tab of the SM-G950F window.

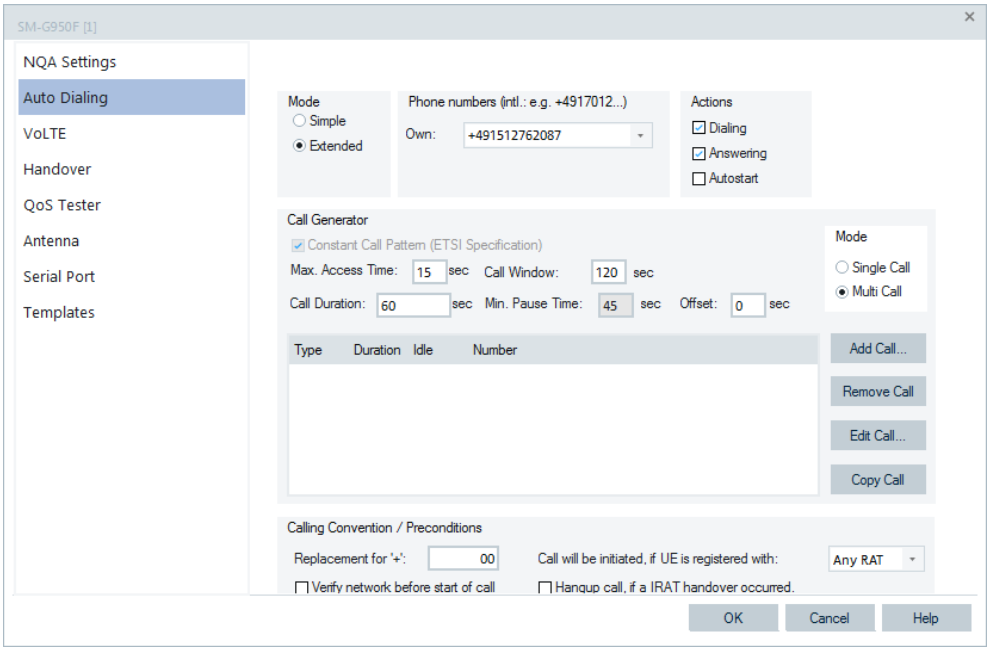


Figure 2-12: Service configuration

3. In the "Actions" pane, select "Dialing"
4. Enter a phone number to dial. It is a number where the call is accepted automatically, i.e. your mobile mailbox. It is useful to run periodical calls to get the maximum amount of measurement data, "Mode" > "Multi Cal".
5. Close the menu with "OK".

6. Now start recording.

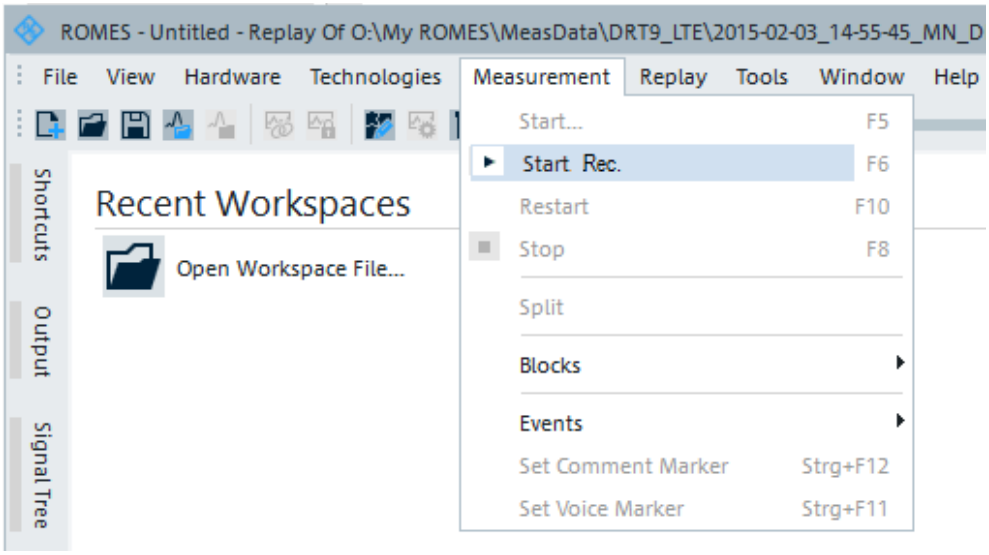


Figure 2-13: Menu to start recording

The recording starts in idle mode. You can see provider, connected cell, channel numbers and several measurement results in the "3GPP Overview View".

The call is established.

In the following figures displayed are some available mobile views.

The following two figures show the "3GPP Overview View" for the different states of a mobile device and measured parameters.

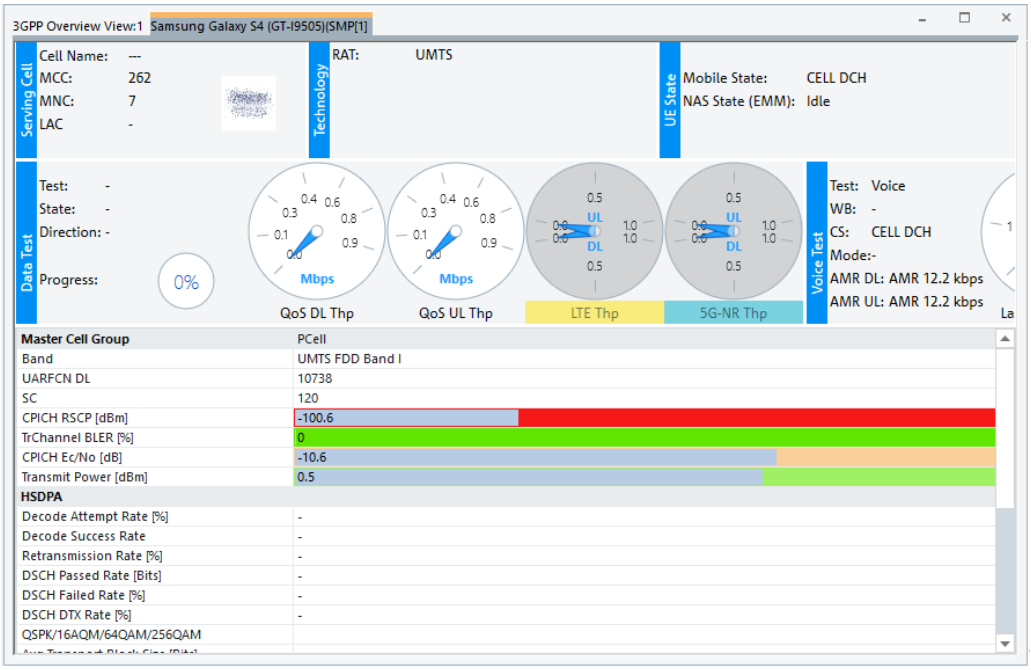


Figure 2-14: Power and quality results - UMTS

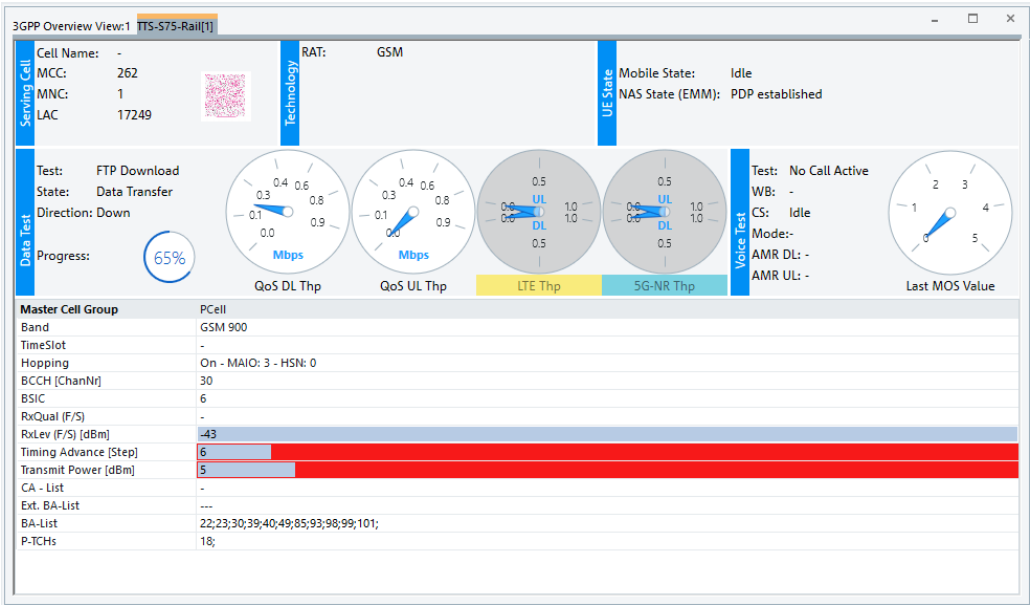


Figure 2-15: Power and quality results GSM

The "Layer 3 View" shows all Layer 3 messages and also the messages from the NQA state machine (in red color, if any).

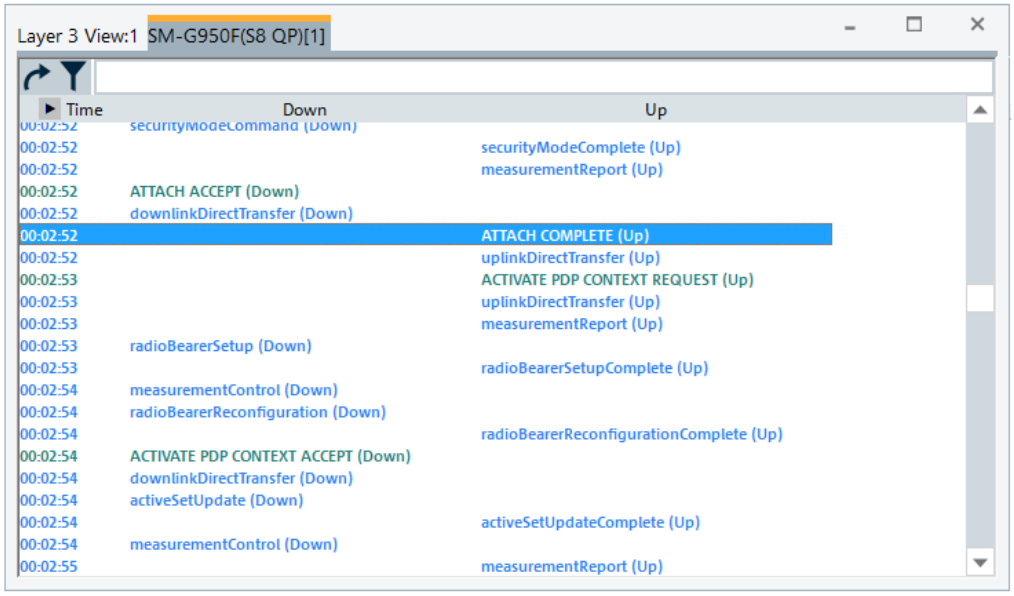


Figure 2-16: Layer 3 messages view

In the Layer 3 view you can see the whole call from start to end. If it could be established and held active until the end of the configured call duration, it is regarded as a "Good Call". Double-click a message opens the window displaying the detailed message content.

In the "Cell Set View" you can see which cells are in the neighbor set.

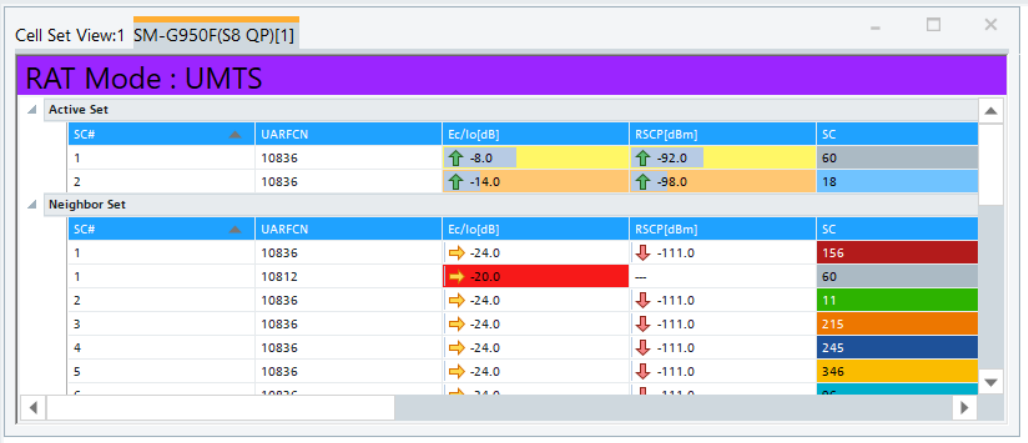


Figure 2-17: Cell set view - neighbor cells

The "ETSI QoS View" shows listed calls performed during the measurement.

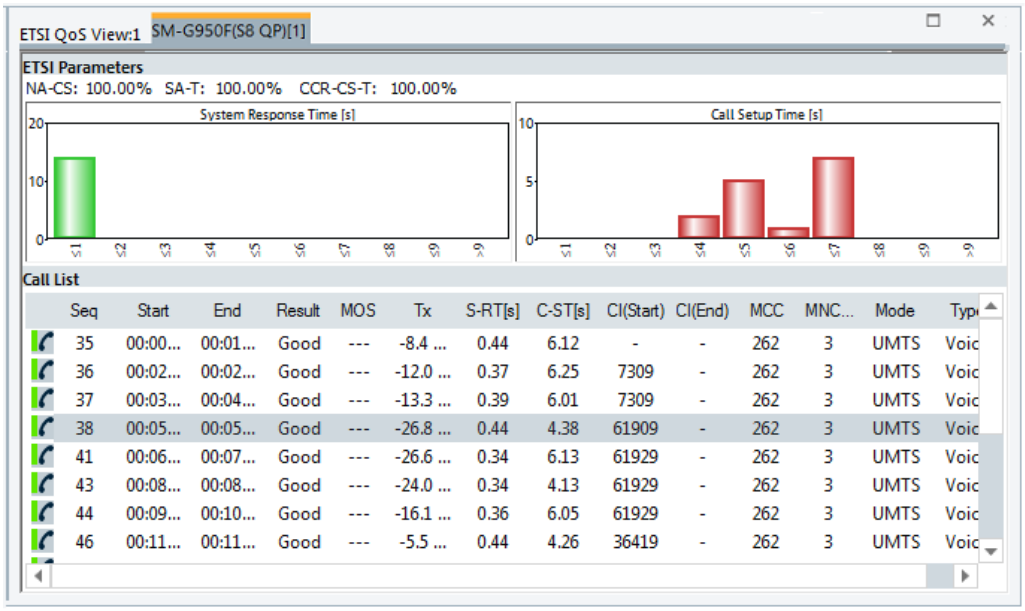


Figure 2-18: ETSI QoS view

To finish the recording, select "Measurement" > "Stop".

2.2.2 UMTS scanner

The R&S TSME WCDMA device is used for the UMTS network analysis and control.

At a UMTS scan, the test device measures and identifies all UMTS downlink (NodeB) signals in the air. The main purpose of this measurement is to test the receiving conditions of a mobile in an UMTS network and to analyze possible interferences.

Like any other R&S ROMES4 measurement, the UMTS measurements require connected scanner device and its parameters set before you can start the measurement and evaluate the results.

Connecting the R&S TSME to R&S ROMES4 as UMTS PNS

1. Click the "Hardware" > "Connect/Disconnect" in the menu bar to open the "Hardware Configuration" dialog.
2. Expand the "Network Scanner TSME" item by clicking the "+" node in the "Available Devices" list.
3. Double-click "TSME WCDMA" for the WCDMA scanner or click the › button to initiate the scanner loading.

   The selected scanner is loaded and displayed in the "Loaded Devices" pane.
4. Click "Continue" to confirm your choice. The action also closes the "Hardware Configuration" window.

   The loaded device is added to the "Hardware" menu entries.

Configuring the UMTS PNS

After having added the scanner, perform the following:

1. Go to "Hardware" > "R&S UMTS PN" to open the configuration menu. In the example, the four German operators are configured. For outside of Germany, modify the names, frequency, UARFCN and UMTS band accordingly.

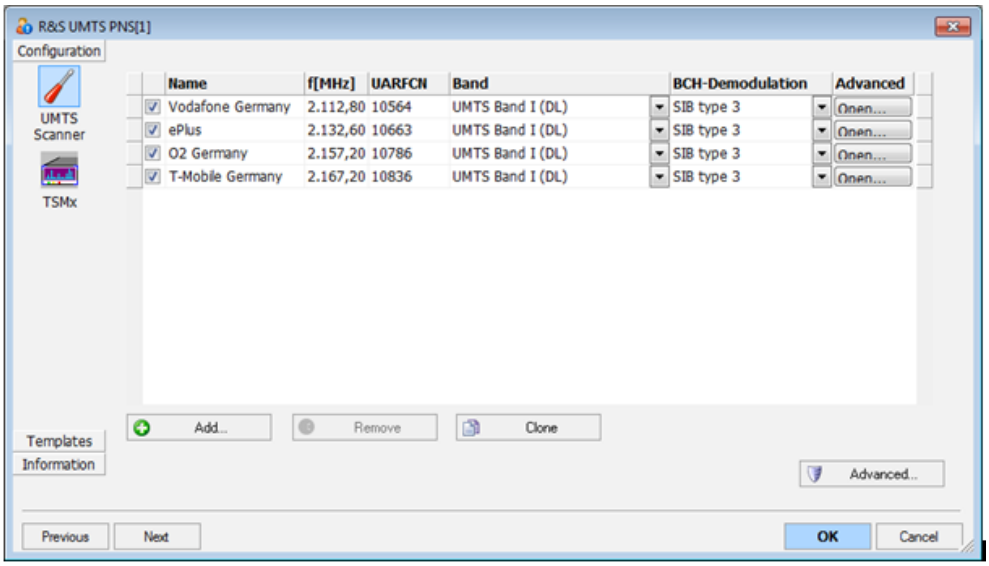


Figure 2-19: UMTS PN scanner page

2. Activate all channels with the check box in the first column.
3. By default, only SIB type 3 is configured which provides the Cell Id (CI). To get the Location Area Code (LAC), activate SIB type 1 for all channels, and SIB type 11 to get the neighbor cells list.

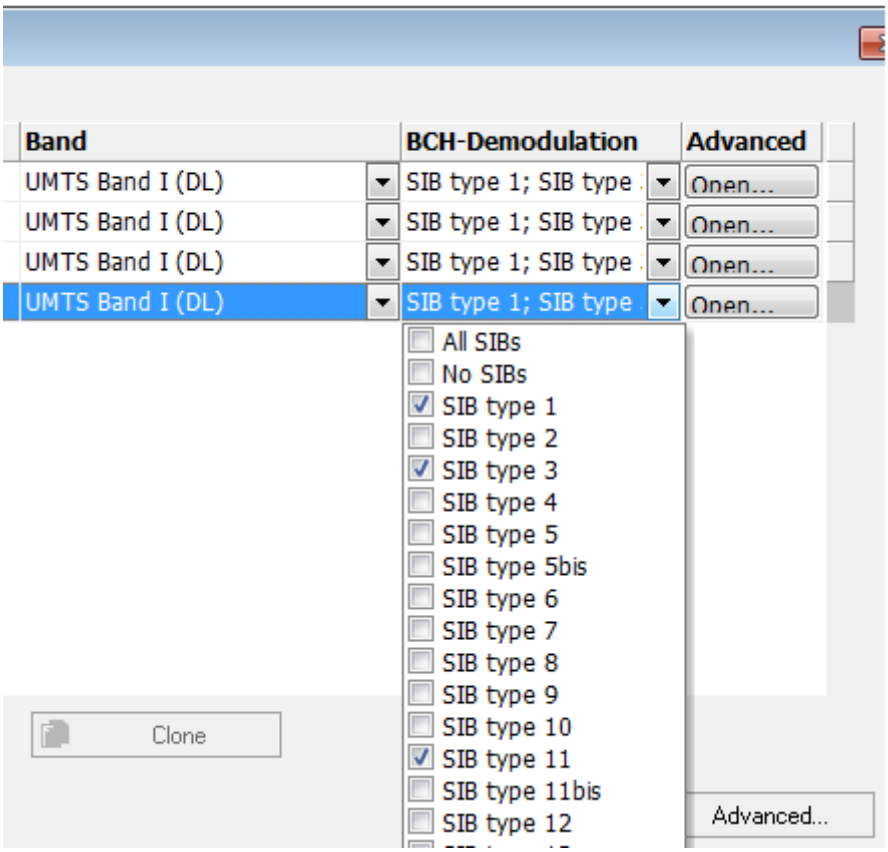


Figure 2-20: List of activated SIBs

TopN pool settings

Let us have a look at the Top N pool settings.

Select "TEC for UMTS PNS" > "Top N Settings".

By default, one pool with the eight strongest cells of all measured channels is configured.

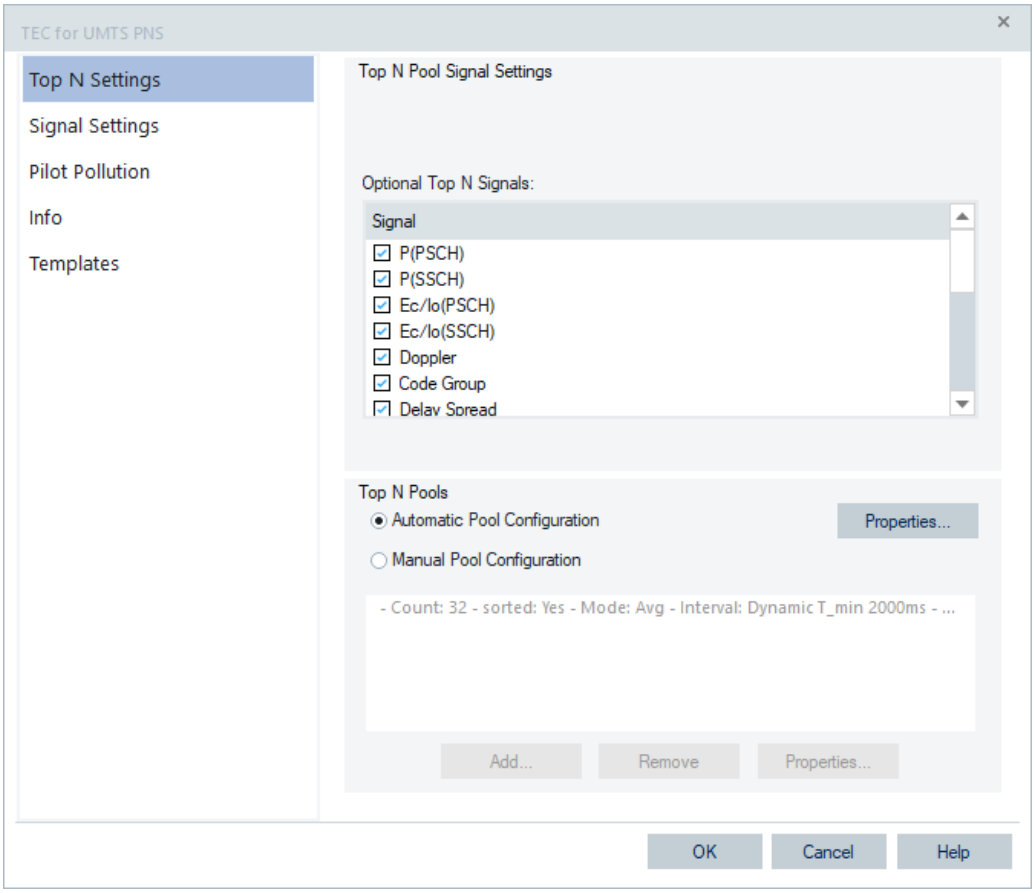


Figure 2-21: Scanner Top N Settings

It is useful to identify the strongest cells of all providers. There are settings to get the strongest cells of a single provider.

To get this information, proceed as following:

1. Select the manual pool configuration in the "Top N Settings".
2. Click "Add" to add a second pool. For the Top N pools setting, see "Top N pools" on page 326.

   The default "Top N Pool Settings" page opens where you can manually set the second pool.

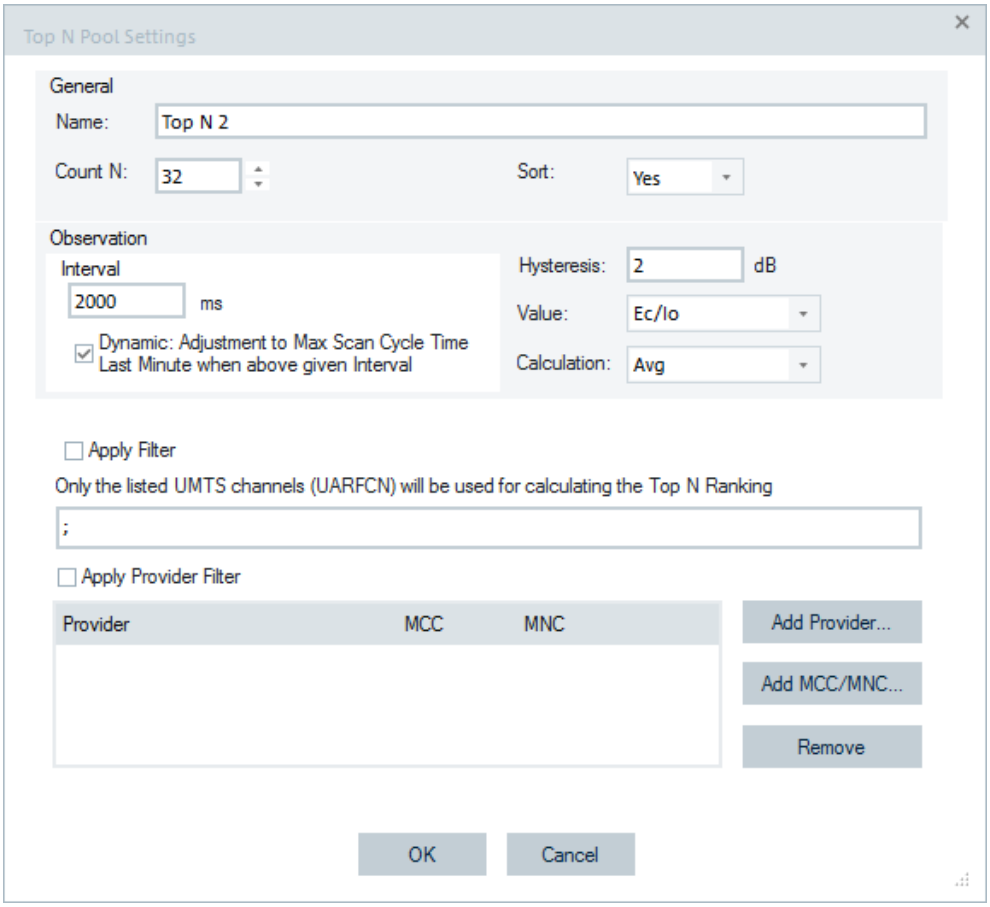


Figure 2-22: Scanner Top N Settings - Adding additional pool

3. Let us pick T-Mobile in this example up. Select the "Sort" > "Yes" option to get a sorted list.
4. Click "OK" to save the settings.

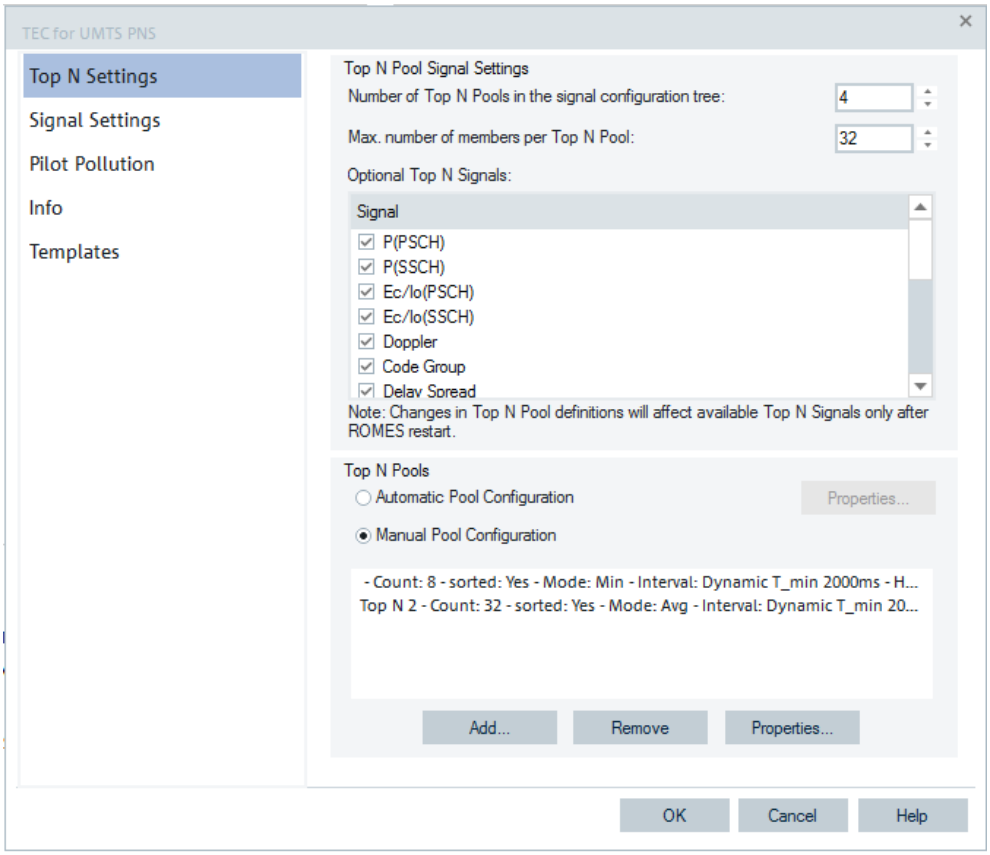


Figure 2-23: Set of two Top N pools

Now there is one pool with all providers and one with T-Mobile only.

5. Click "OK" to save the settings.

The observation interval is modified automatically if necessary. Confirm with "OK".

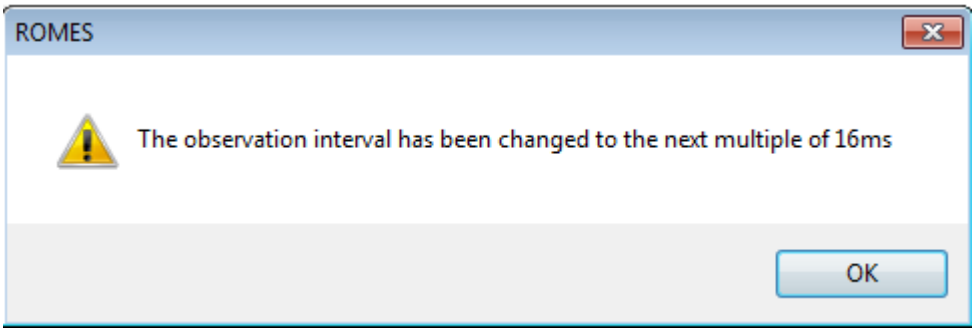


Figure 2-24: Info on changed observation interval

If the views are not configured automatically when loading the scanner, let us configure some views to display the data during measurement.

1. Select "View" > "Scanner Views" > "UMTS".

2. Select, for example, BCH view, CPICH view and Top N view of the UMTS scanner available views.

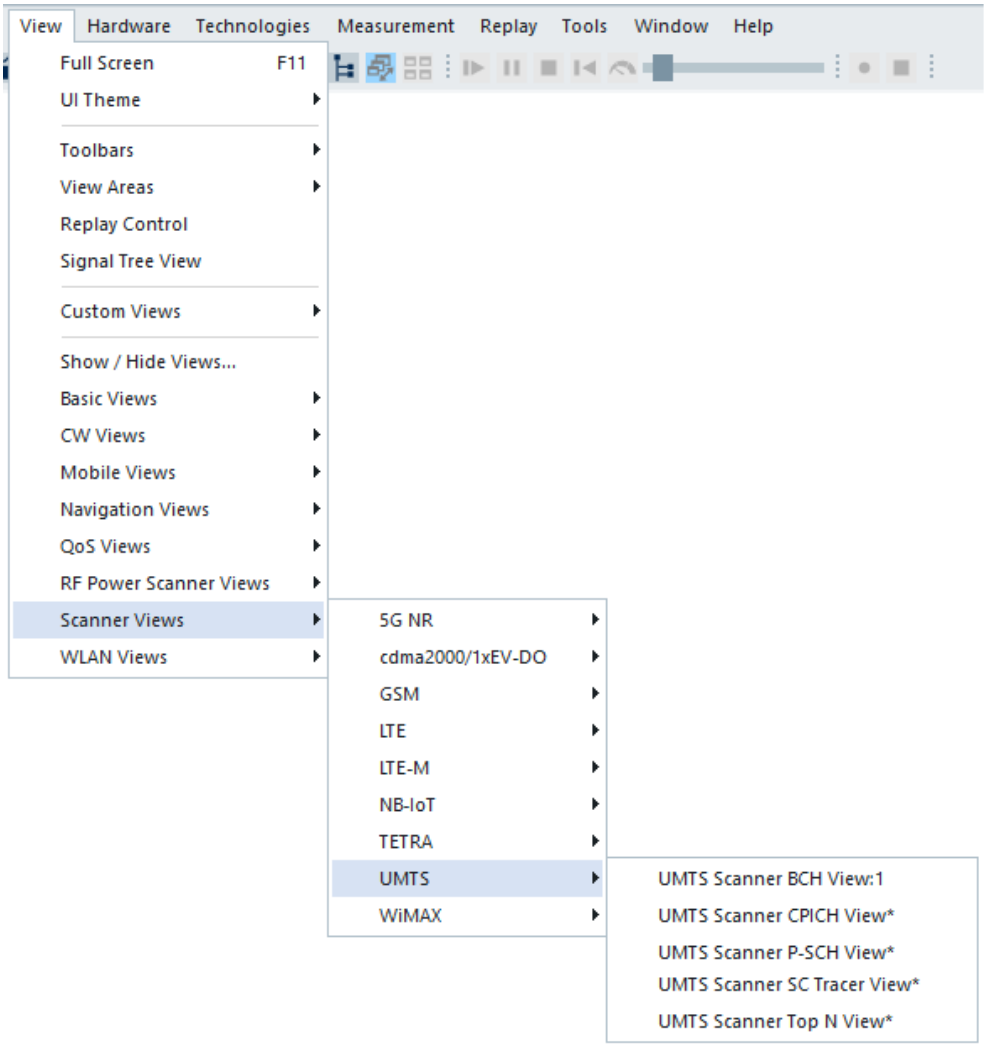


Figure 2-25: View selection

3. Use the "Tile_vertical" or the "Tile_horizontal" button to arrange the views automatically on the screen.

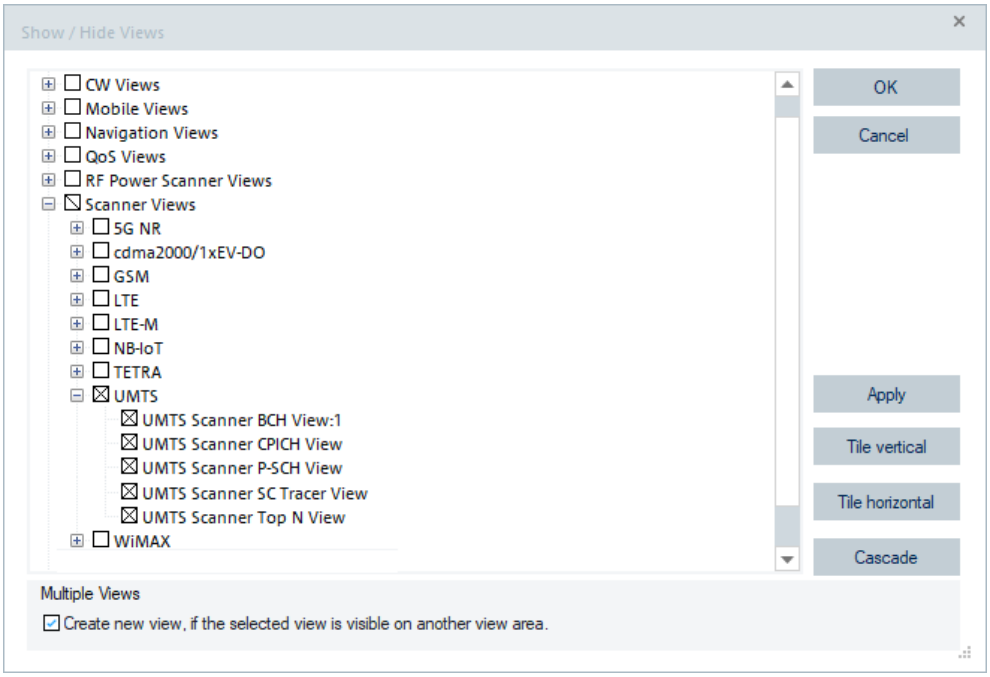


Figure 2-26: Selecting a UMTS scanner view

4. Start the recording with "Measurement" > "Start"

   The views getting filled. In the "UMTS Scanner Top N View" you can see the strongest cells. As we have configured SIB type 1 and 3, we can see also information on CI and LAC.

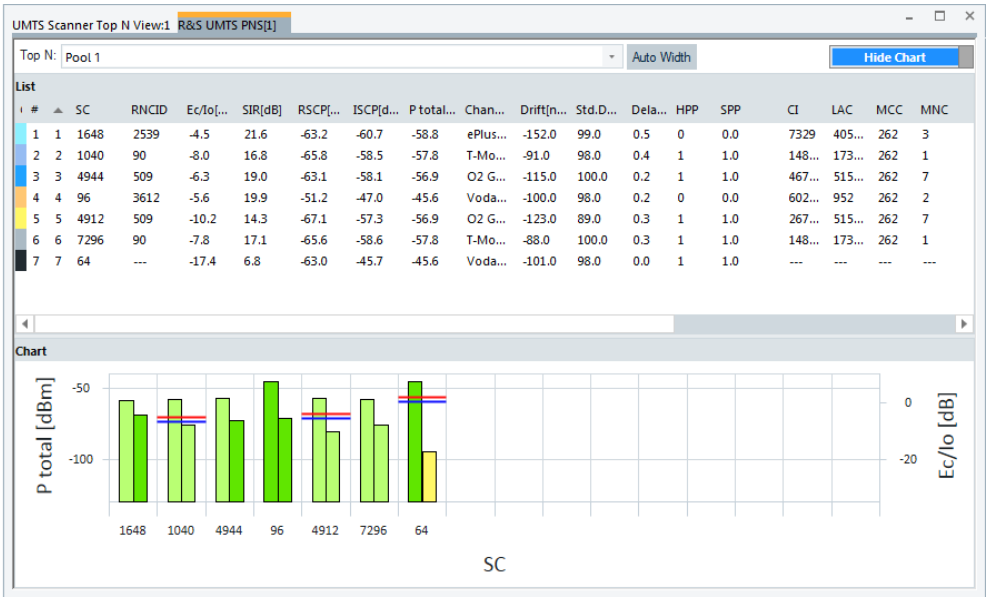


Figure 2-27: Obtained measurement results

5. Switch between the pools by selecting from the "Top N" pull-down list.

   The following figure shows the measurement results of just two configured cells, so there are just two members in the pool.

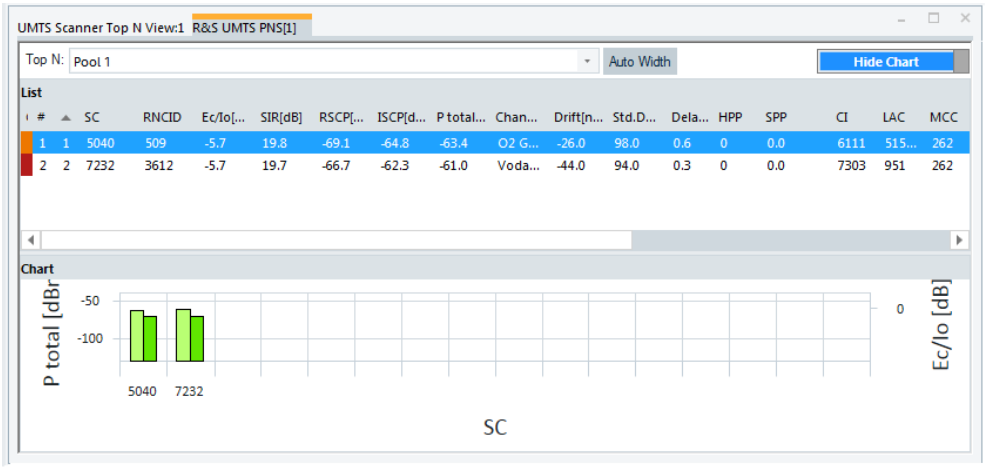
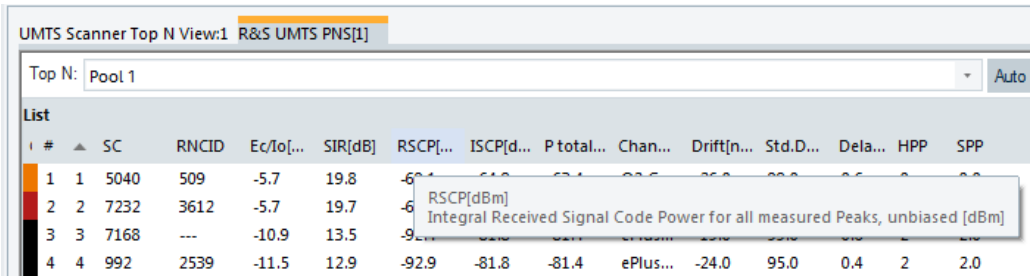


Figure 2-28: Measured cells

Hover the mouse over the column names to get explanations on the parameters in each column.



In the "CPICH View" you can see the average signal power of the received signals separately for each provider. In the left table the signals are distinguished by scrambling code (SC). Each entry is a separate NodeB. In the right table, the signals are distinguished by their slot timing which is different in case there are several signal paths because of reflections. In the example, NodeB with SC = 367 is received in three paths.

Figure 2-29: CPICH View

Successfully decoded MIB and SIBs messages are shown in the "BCH View".

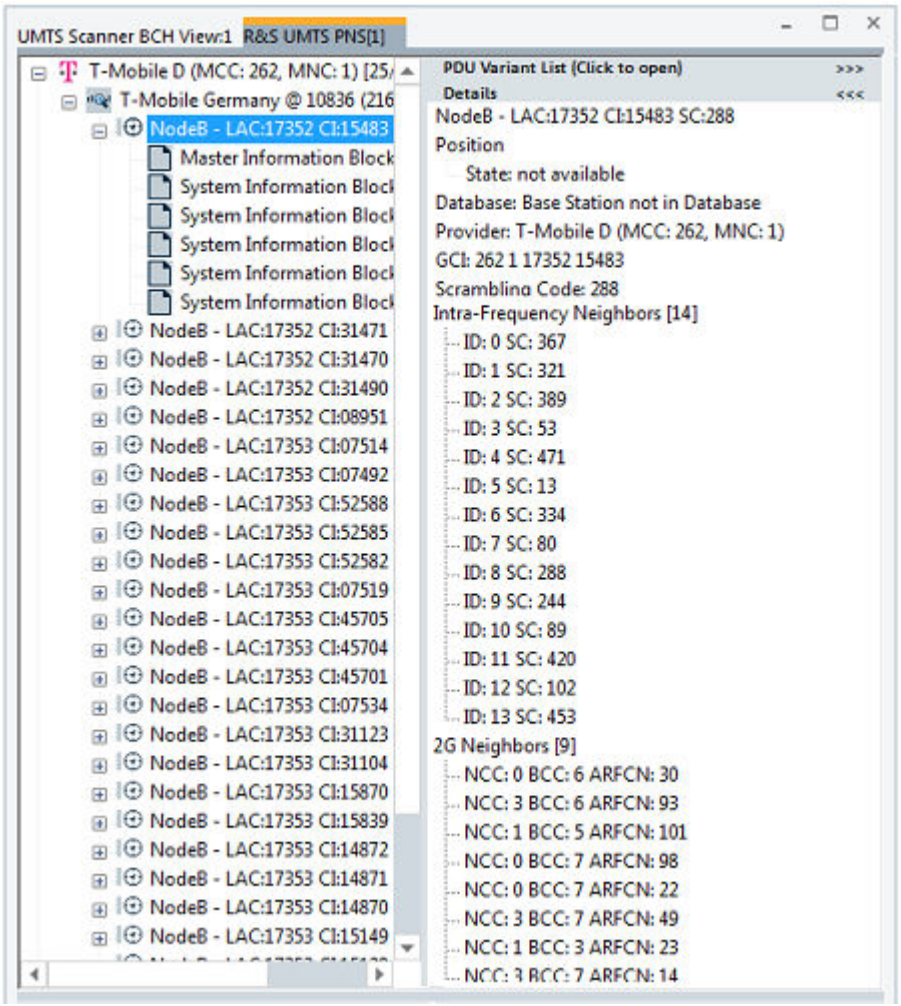


Figure 2-30: BCH View

Based on this information, it is possible to analyze if the neighbor lists are matching with the measured coverage. The matching is detected, if the scanner finds all cells included in the neighbor lists and the additional cells, not in the list but are potential neighbors.

To display data in other than UMTS scanner specific views like, for example, "2D Chart View" the parameters are also available in the general parameter tree. The parameters of the Top N pool members are available by default.

Now go to "View" > "Basic Views" > "2D Chart View" and open the configuration menu. You can select parameters from the Top N pools or for a specific scrambling code of a provider.

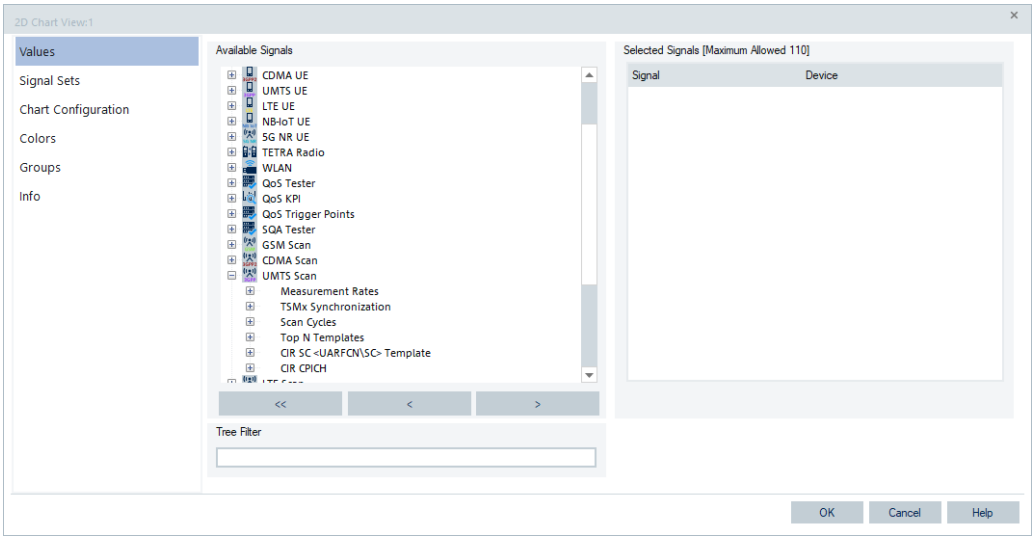


Figure 2-31: 2D chart view configuration page

Example:

Ec/Io of pool 1/rank 1 (red line) and its SC (green line), and NodeB with Scrambling Code 379 of 2132.6 MHz (blue line). At the position of the blue marker, the NodeB SC 379 is rank 1 of the pool, so the values are identical and the blue graph covers the red one. For different SC of rank 1, the Ec/Io values are different too as they come from different NodeBs. The blue and the red graph does not overlap.

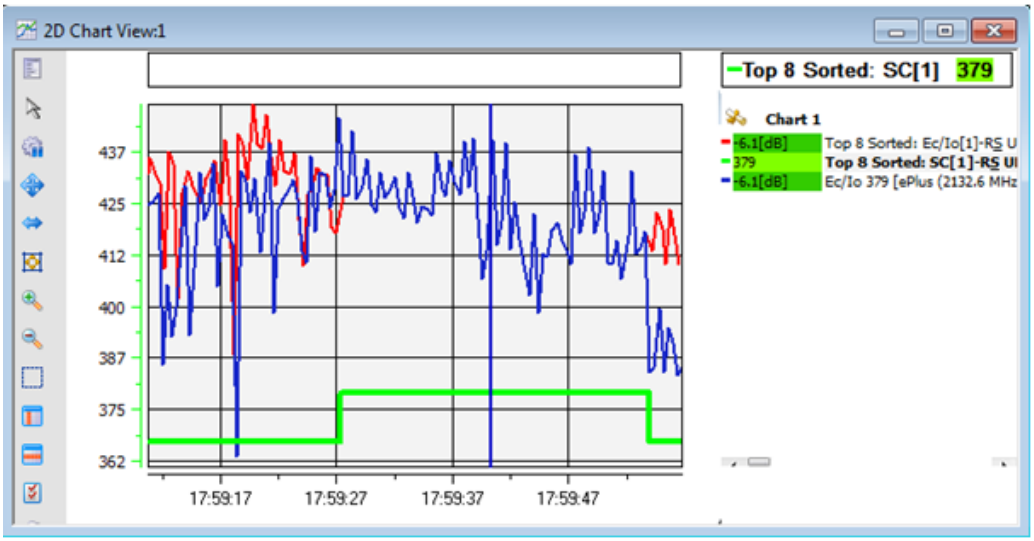


Figure 2-32: Measurement Ec/Io results

Stop the measurement with "Measurement" > "Stop".

3 User interface

This chapter describes the R&S ROMES4 interface elements and their use. Starting the application opens the main window with all its working components. Which components are active depends on the loaded workspace.

- Menus and commands....92
- File menu....103
- View menu....134
- Hardware menu....190
- Technologies menu....211
- Measurement menu....212
- Replay menu....217
- Tools menu....223
- Window menu....414
- Help menu....416

3.1 Menus and commands

The R&S ROMES4 main window consists of the elements described in this chapter. An example of the main window layout is shown in the following figure.

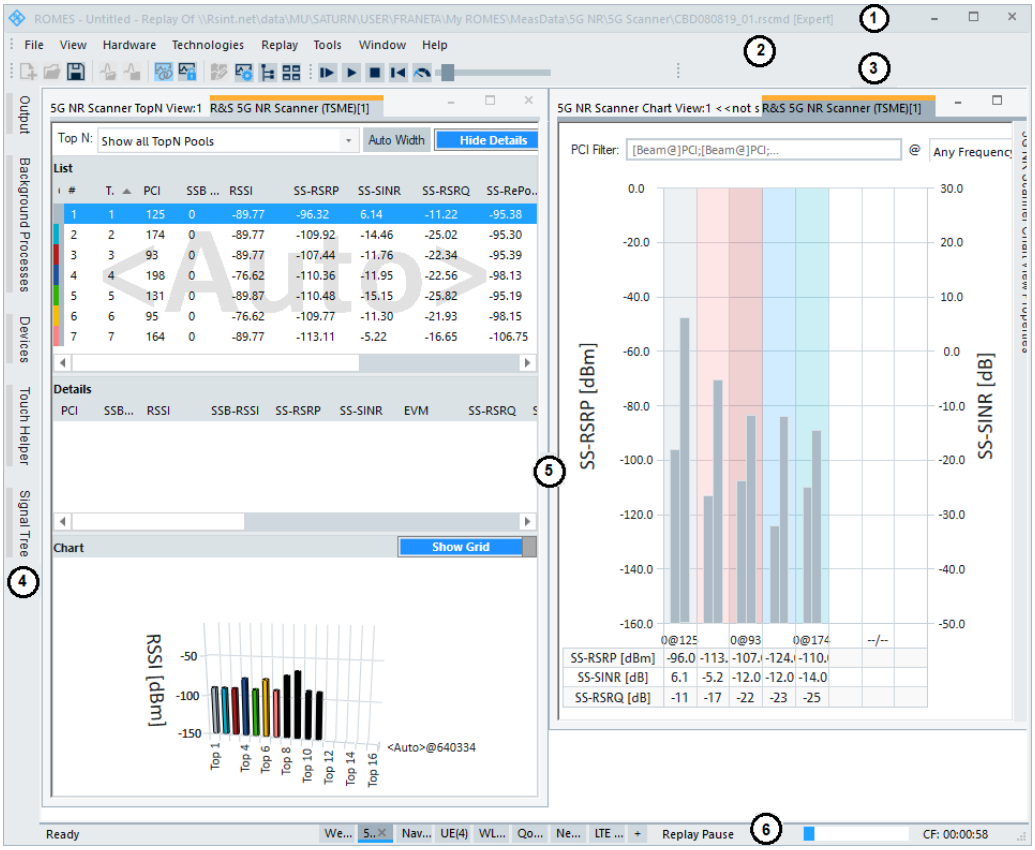


Figure 3-1: R&S ROMES4 main window - example

1 = Title bar
2 = Menu bar
3 = Toolbar and Measurement bar
4 = Docking window bar
5 = Work area with active views, subdivided into several view areas
6 = Status bar

The configuration of active elements, example given, the bars on the left-hand side of the window and the views is described in Chapter 3.3, "View menu", on page 134.

3.1.1 Menu bar

The R&S ROMES4 menu bar with various menu titles is located below the title bar along the top of the screen.

Selecting a command from one of these menus performs an action, displays a sub-menu or a dialog. The menus, including dialogs that call for an explanation, are described in this chapter.

Nine menus in the menu bar are used to access the functions and windows, which configure and control measurements and evaluation of the measurement results.

The following menus are available:

- Chapter 3.2, "File menu", on page 103

Opens and saves workspace and measurement files, exports and prints data and closes the application.

- Chapter 3.3, "View menu", on page 134
  Customizes the main application window and offers the view windows used to visualize and evaluate measured data.
- Chapter 3.4, "Hardware menu", on page 190
  Offers to load devices necessary for a wanted measurement.
- Chapter 3.5, "Technologies menu", on page 211
  Displays information on the installed technology modules. For several technologies, the menu contains particular configuration panels.
- Chapter 3.6, "Measurement menu", on page 212
  Starts and stops a measurement and displays the list of event settings.
- Chapter 3.7, "Replay menu", on page 217
  Starts and stops the replay of a measurement file and allows setting device filters.
- Chapter 3.8, "Tools menu", on page 223
  Customizes displays and defines directories for the different type of files used by the measurement system. Furthermore, it customizes the internal database for analysis of different RAT's data, e.g. Carrier to Interference (C/I).
- Chapter 3.9, "Window menu", on page 414
  Arranges and handles the different view windows.
- Chapter 3.10, "Help menu", on page 416
  Provides online help and general information on the coverage measurement system.

3.1.2 View area

There are two tabs for the work area selection in the status bar of the R&S ROMES4 GUI.

- "Welcome"
  Starting the R&S ROMES4 program with default settings shows the "Welcome" area.
- "View Area"
  Starting the R&S ROMES4 program with your views and settings stored to a file.

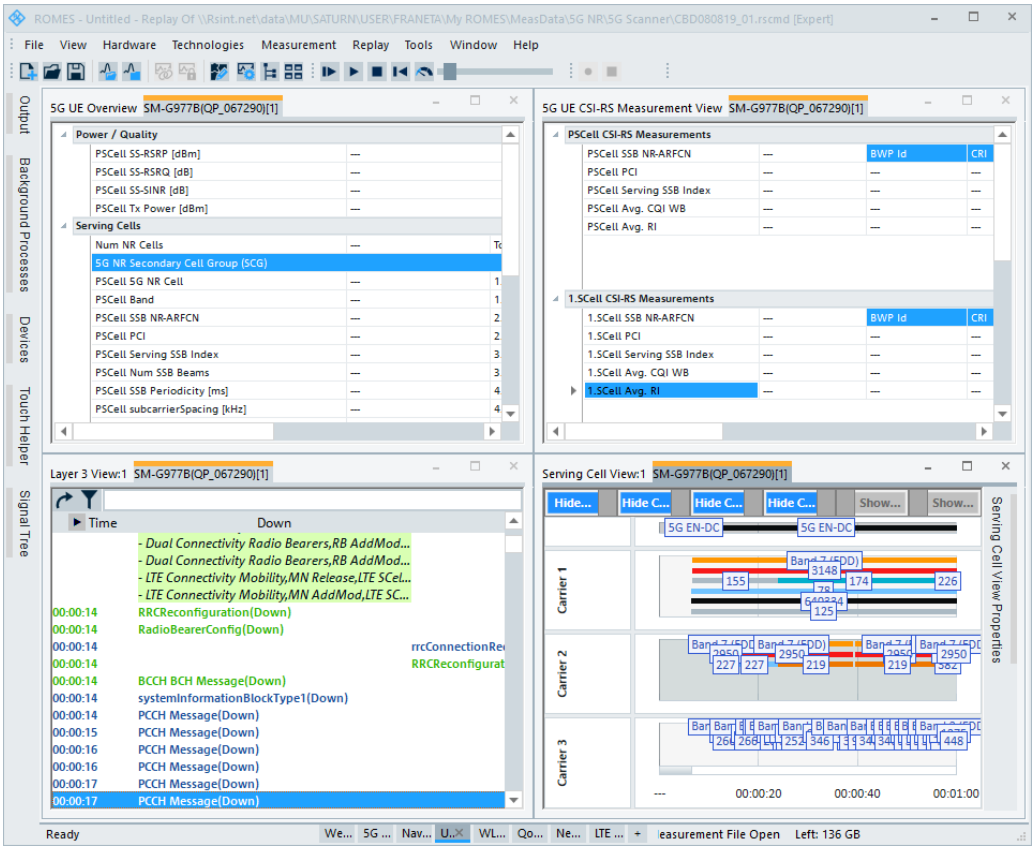


Figure 3-2: Open UE view area

Saving and loading view areas

You can save your view area with all views and their settings to a file and reuse it in a later session. You can also save one or more view areas that are loaded automatically when R&S ROMES4 starts, see Chapter 3.3.6, "View areas", on page 158.

For the R&S ROMES4 tools provided to configure different working elements of the main window and the views, see Chapter 3.9, "Window menu", on page 414.

Welcome

The "Welcome" view area allows quick access to the most important software configurations and easier measurements setup. The screen offers the lists of recently used workspaces and measurement files on the left-hand side and the currently connected (available) devices on the right-hand side.

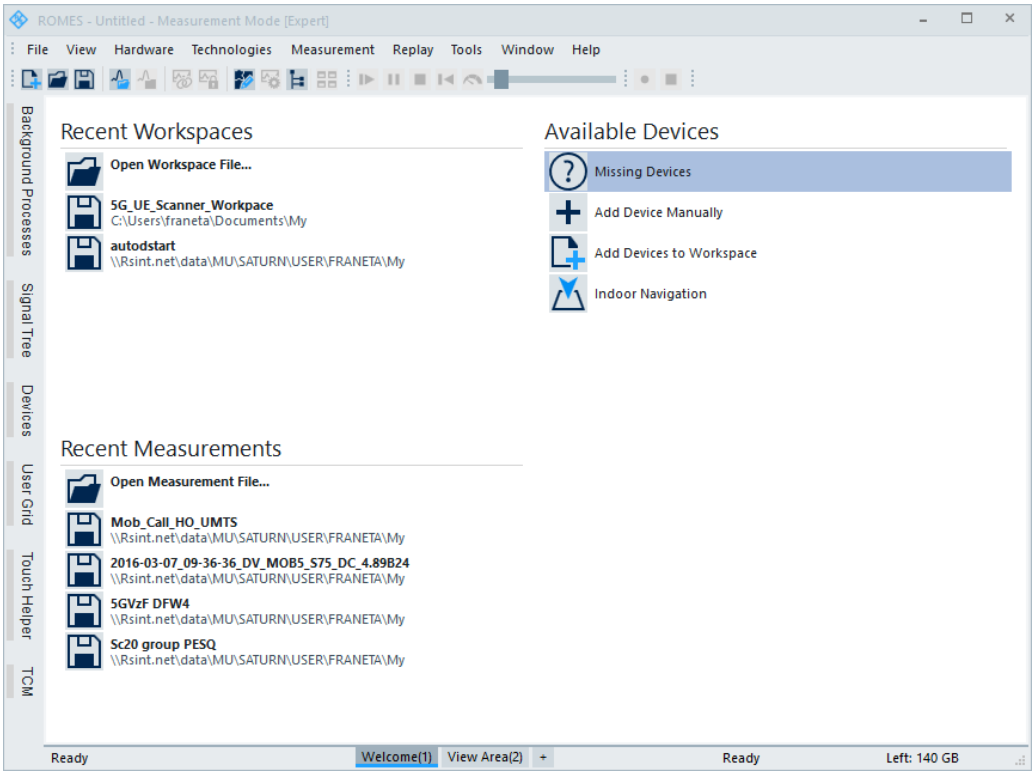


Figure 3-3: R&S ROMES4 welcome view area

All three lists have buttons of the same size. The size of buttons is not adaptable which implies that it does not change with the change of the screen size.

The "Available Devices" list starts with the "Missing Devices" button which provides information and hints about trouble shooting devices detection problems.

Double-click the button opens the "Missing Devices" troubleshooting dialog. The dialog gives the user hint about possible causes for connection problems and short links to the trouble shooting tools.

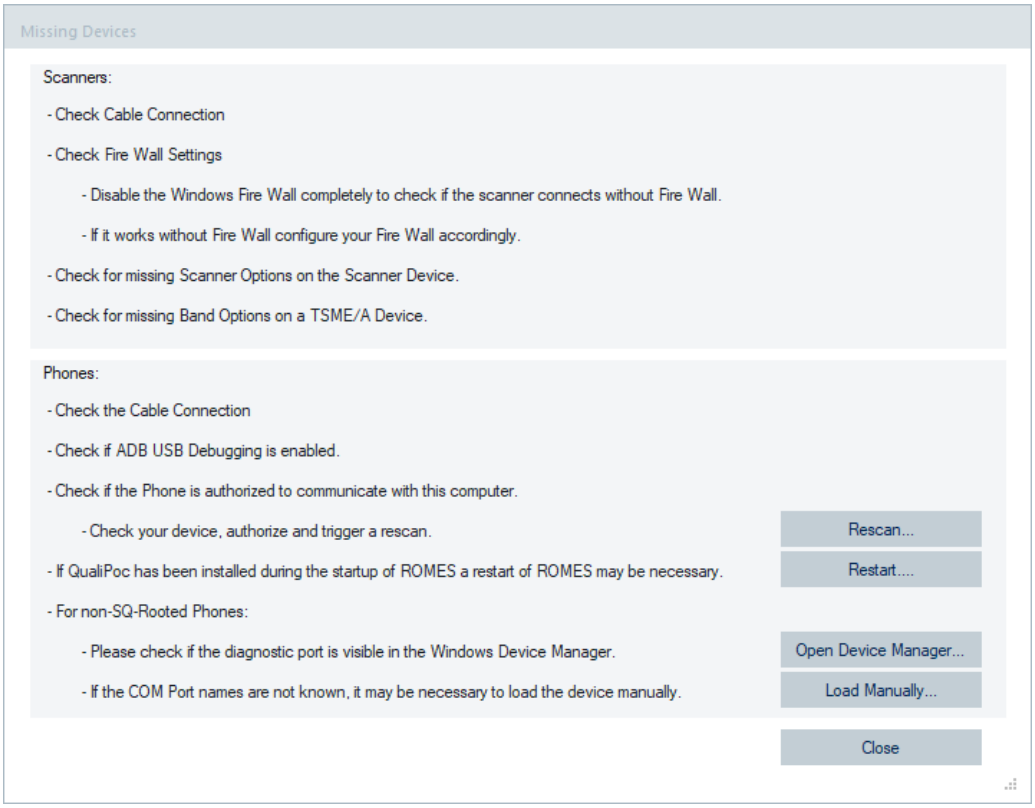


Figure 3-4: Missing devices dialog

Other icons under the "Available Devices" let you load device associated to the icon.

To select a device for measurements supported by R&S ROMES4 from the list, click the "Add Device Manually" icon. The "Hardware Configuration" dialog pops-up.

Selecting this option also activates the Place Holder feature. The feature lets you configure the R&S ROMES4 measurement workspace, scanners, mobile and GPS devices without attaching actual devices to PC on which R&S ROMES4 is running. For the feature description, see Chapter 6.1.13, "Place holder", on page 1503.

If you click the "Add Devices to Workspace" icon, displayed is the "Load multiple Devices" dialog which improves the measurement setup with several devices. For how to, see Chapter 3.4.3, "Simple hardware loading via workspace", on page 208.

Instead of loading device with its default values, you can choose to load it by starting an associated wizard or the template settings.

There are two rows in the "Choose the initial Setup for your Device" dialog related to two groups of the configuration (loading) possibilities.

- The upper row shows the available basic configurations, which are:
  – Open configuration after having loaded the measurement
  – Apply R&S ROMES4 wizard to the measurement
- The lower row shows custom pre-configured measurements, which are:
  – Templates for the measurement
  – Wizard profiles, which can be applied for the measurement

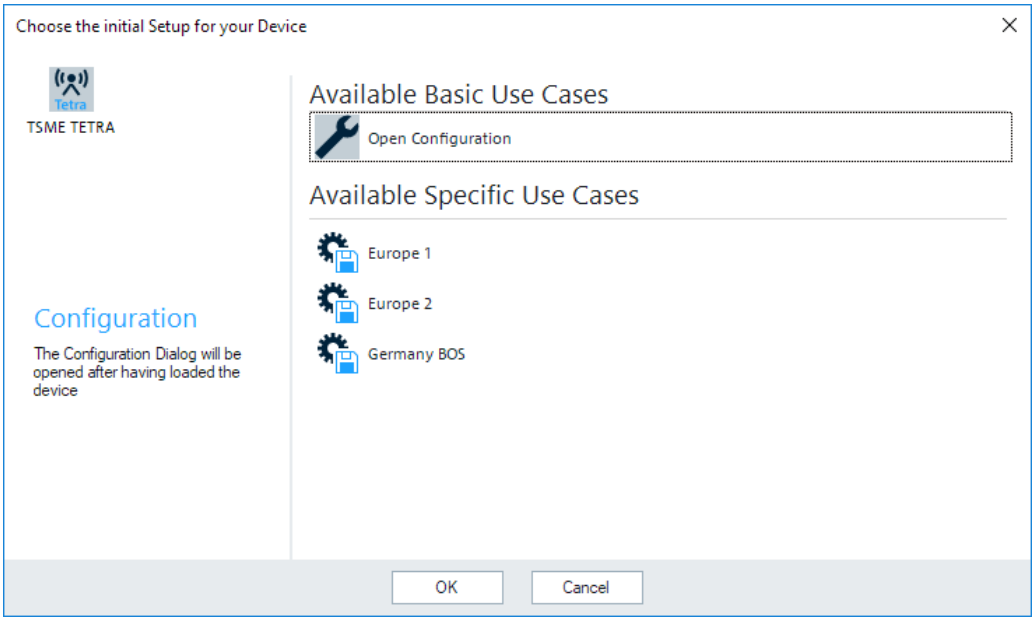


Figure 3-5: Selection of the initial setup

Note: The list of available devices and use cases is only displayed if the software is not in "Replay Only" mode.

After a measurement is loaded successfully, R&S ROMES4 offers several options to start the measurement in the "Choose your next step" page.

- Start measurement now
- Return to the "Welcome" page
- Stay on the current sheet
- Add indoor navigation
- Add GPS navigation

During the measurement execution, the "Welcome" area displays the most important items of the current measurement process, like the state of the current measurement and the state of loaded devices.

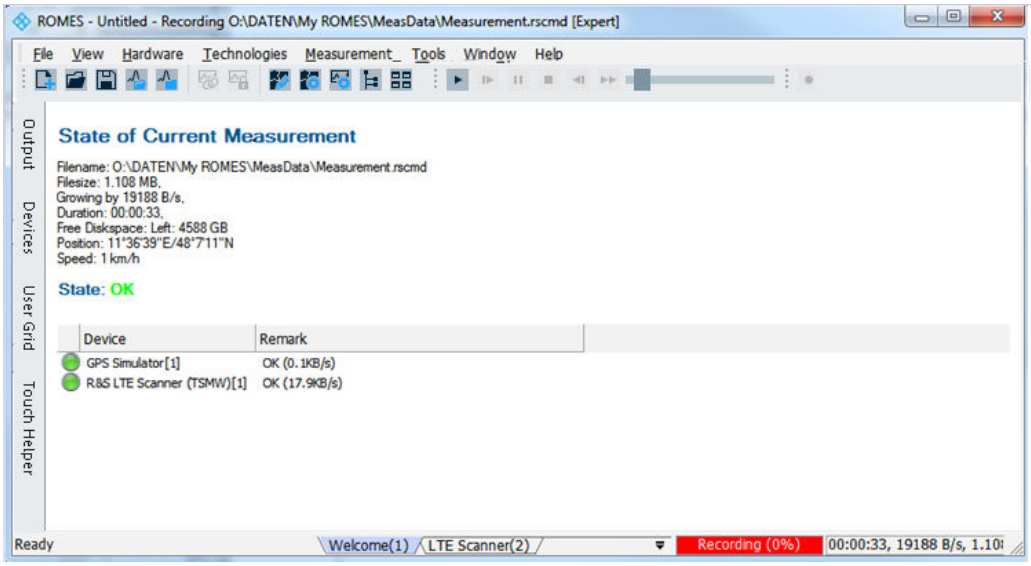
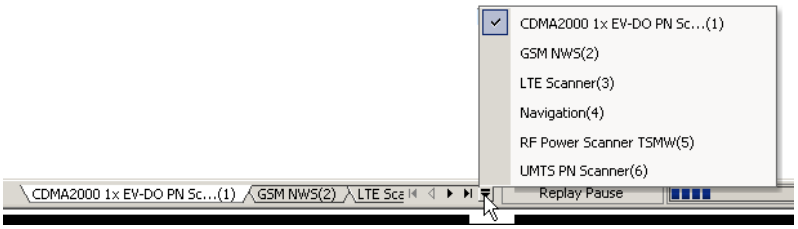


Figure 3-6: State of current measurement

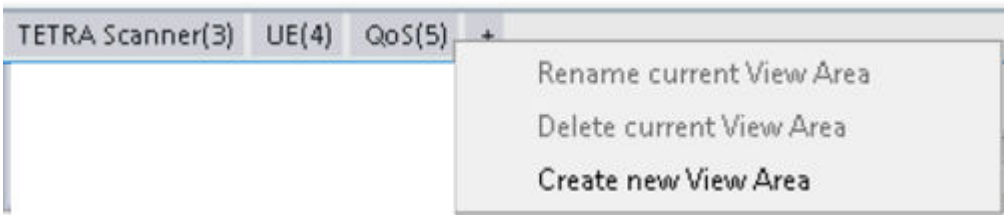
Second View Area

The second view area appears, if selected, empty (only the view area name present in the center). You can fill it with one or several views, see Chapter 3.3, "View menu", on page 134. One of the views is always active and displayed with a highlighted title bar. This approach gives the possibility to customize the view and work with it.

The view area can be divided into different superimposed view areas to gain more space and arrange the views in different groups. Each view area has a name and is accessible by clicking the associated tab in the status bar below the view area. For faster changing the view area, click the drop-down arrow to open an overview of all available open view areas. Click the target view area to change the view.



A right-click on one of the tabs opens a context menu with self-explanatory entries.



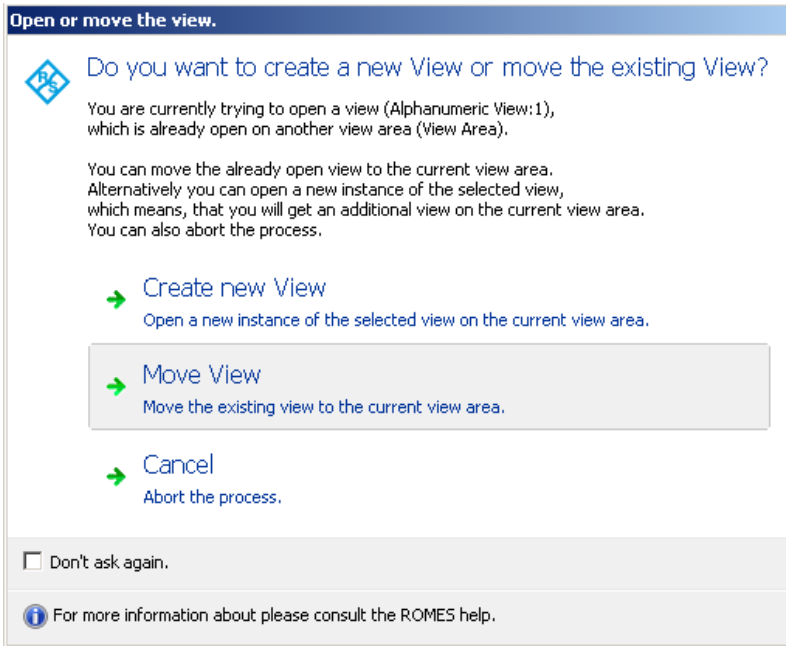
For the complete list of views, see Chapter 3.3, "View menu", on page 134.

Move a view to another view area ← Second View Area
Suppose that a view area contains a view of a view type that can be opened several times.

To move the view from the current area to a target area, use one of the following methods:

- Right-click the view and click "Move to – <Target View Area>" in the context menu
- Open the target view area and select the view type (e.g. "Alphanumeric View: 1") in the "View" menu

A dialog window opens.



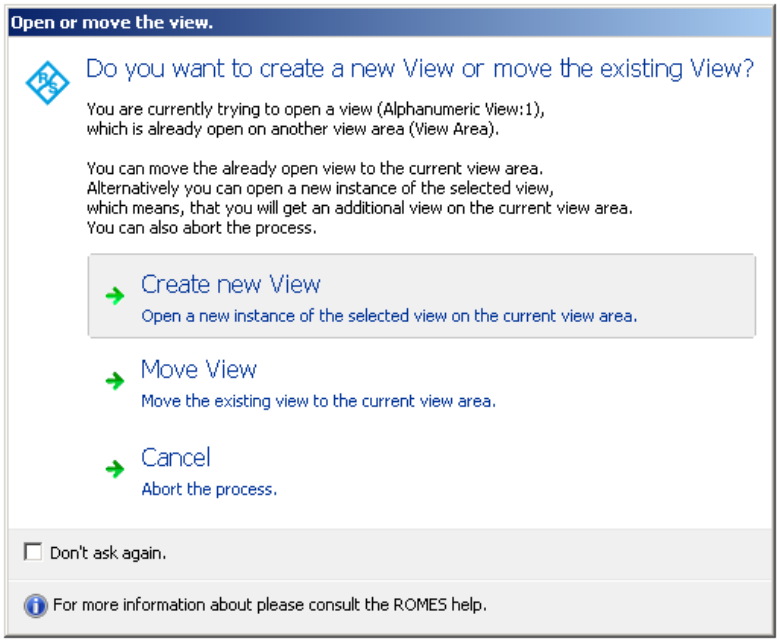
Click "Move View" to move the current version of the view to the other view area.

Create new view of the same type ← Second View Area
Suppose that a view area contains a view of the view type that can be opened several times.

To create view of the same type (for example, "Alphanumeric View:2") in another view area, use one of the offered options:

- Right-mouse button click the existing view to open the context menu, click "New View" and then move the new view to the target view area.
- Open the target view area and select the view type (e.g. "Alphanumeric View: 1") in the "View" menu

A dialog window opens.



Click "Create new View" to create view of the same type at the other view area.

3.1.3 Coupled focus

Many views provide graphical tools to highlight special areas and read a particular result. Examples are:

- Marker line and the info field in the "2D Chart View"
- Circular focus in the "ROMESMAP Route Track" view

The following figure illustrates them.

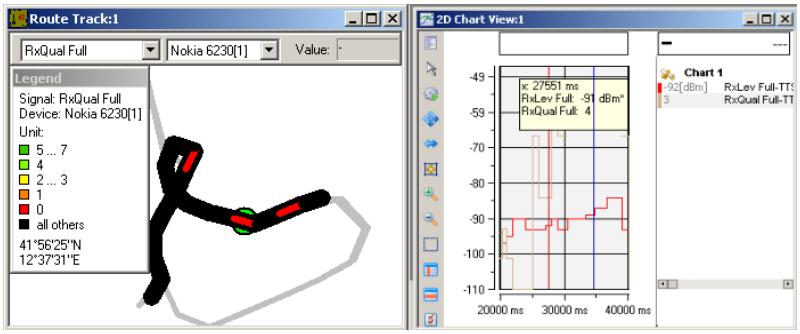


Figure 3-7: Examples for coupled focuses

The focus can be coupled in several views, which makes it easier to analyze different aspects of a coverage measurement at a particular position using a set of appropriate views. The coupled focus synchronizes the views in the current view area and synchronizes, if necessary, also the views which become later visible. All views in other areas are left unsynchronized.

The Figure 3-7 figure shows as example a local maximum of the RxLevFull reported by the test mobile in the "2D Chart View". The "ROMESMAP Route Track" view shows the corresponding geographical position.

The following tools control the coupled focus:

- The mouse cursor or the arrow keys move the focus within the view. To obtain different step widths, combine the [arrow keys] with the [<SHIFT>] and the [<CTRL>] keys.
- During the Replay Pause, the coupled focus is always enabled and cannot be disabled. The color of the coupled focus cursor changes to green. When the Replay Pause is released, the replay continues from the point in time where the last coupled focus was set to.

If no coupled focus is available for a view, the message <<not synchronized>> is displayed in the title bar.

3.1.4 Docking bars

The user can group, move and dock the R&S ROMES4 bars.

By default the bars are docked to the vertical left edge of the R&S ROMES4 main window, see Figure 3-1.

Enable or disable a R&S ROMES4 bar

1. Click the menu "View" > "Toolbars".
   A list with all available toolbars appears.

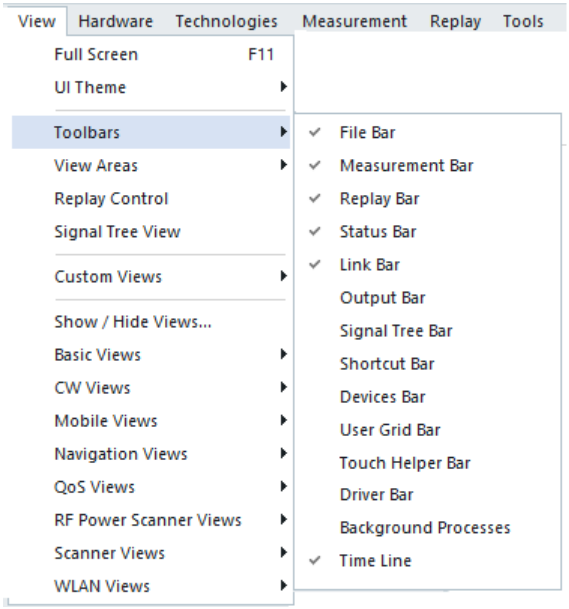


Figure 3-8: Available toolbars

2. Select the bar you want to be displayed in the R&S ROMES4.

   The related window of the selected bar is docked on the left-hand side of the R&S ROMES4 window.

Move R&S ROMES4 bar

1. To float the displayed toolbar window, click the header of the window.
2. Move the window away from the docking position.
   During dragging the window, some icons appear in the R&S ROMES4 window.
3. Drop the window at one of those icons.
   The window docks to the appropriate edge.

Make the R&S ROMES4 bar permanently visible or hide automatically.

Docked windows can be permanently visible or they can be hidden automatically.

► Use the pin in the header of window to change this property.

The following sections describe some docking windows. For all, refer to Chapter 3.3.4, "Toolbars", on page 138.

3.2 File menu

The "File" menu opens and saves workspace and measurement files, exports and prints data and closes the applications.

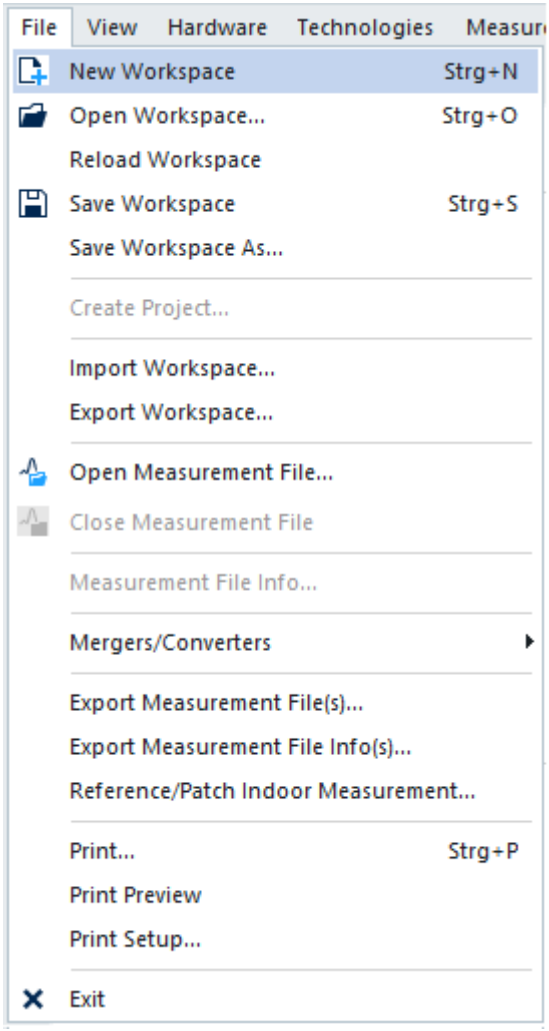


Figure 3-9: File menu

The "Mergers/Converters" menu item has own submenus, see Chapter 3.2.12, "Mergers/converters", on page 119.

3.2.1 New workspace

The "File" > "New Workspace" menu item opens the R&S ROMES4 default workspace, see Chapter 1.10.2, "Workspace and measurement files", on page 31.

The workspace opened when R&S ROMES4 starts depends on the setting in the "General" tab of the "Preferences" menu. R&S ROMES4 uses either the last workspace used in the previous session or the default workspace. When opening the last used workspace, different view windows open tiled across the main window. The main application window size of the previous session is preserved.

User-defined workspaces can be stored to a workspace file `<filename>.rsxks` and recalled in later sessions. The matching control windows can be easily set for each

kind of measurement. The operator's favorite constellations can be saved and reused later.

3.2.2 Open workspace

The function loads an existing workspace from a `*.rsxks` or a `*.rscmd` file.

The "Open Workspace" command calls up the "Open" dialog.

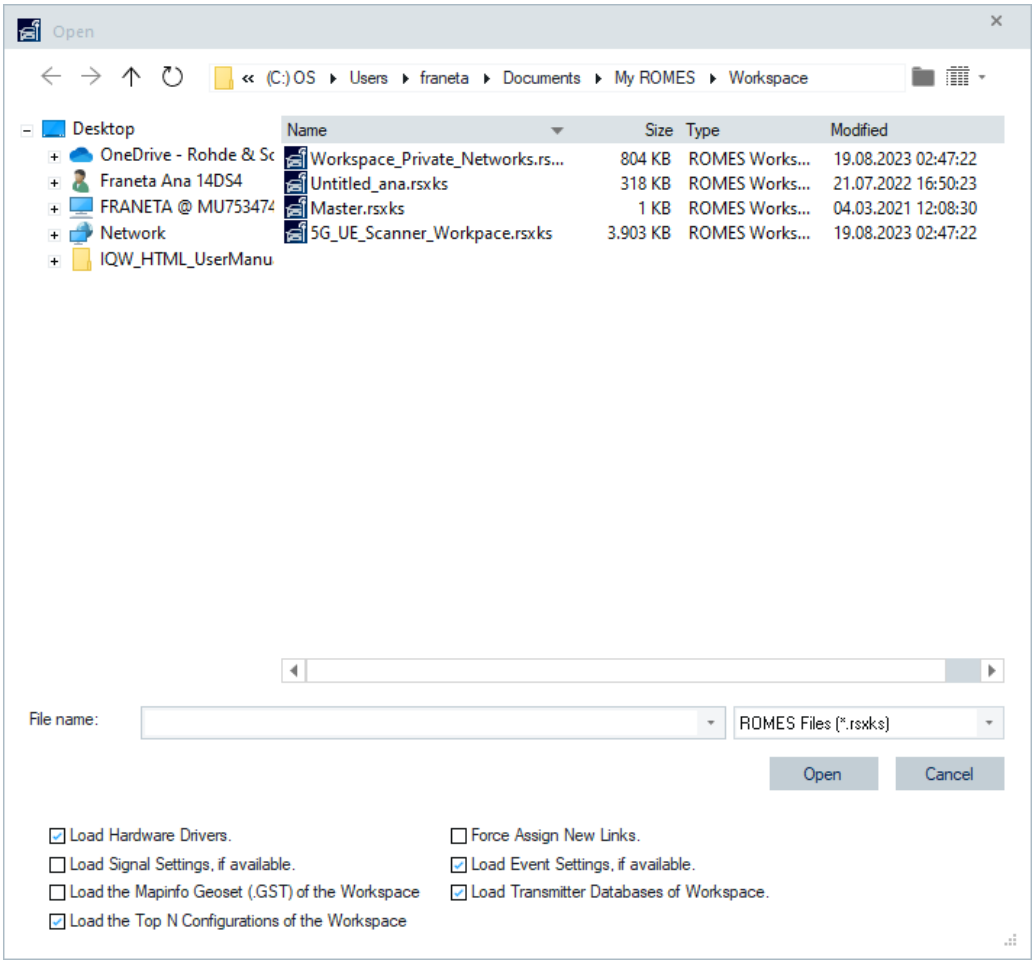


Figure 3-10: Load workspace file

Select the workspace file from the list to load the existing workspace.

Several loading options are offered after opening the workspace file, shown in the lower part of the "Open" dialog figure. Not all loading options are by default active but they can be selected if you need them.

The workspace of a measurement file can be loaded as well, see Figure 3-16.

Usage of older workspace files

The `*.rms` and `*.rsxwks` workspace files of measurement software versions 3.0 to 3NG Rev.1 SP2 cannot be used in newer R&S ROMES4 versions as their format is different. If an old workspace (`*.rms` and `*.rsxwks`) is loaded into R&S ROMES4, the system responds with an error message.

Cancel Filename Resolver

During loading a workspace, R&S ROMES4 tries to find all files which are associated with the workspace. Depending on the number of files, looking for them can take up to several minutes, especially if a file cannot be found on the computer. It is possible to cancel this process and to continue loading the workspace. The cancelation only cancels the automatic reassignment of the files. The workspace is loaded with all files, which are at the path the workspace has stored.

File list

The file list shows all files within the current directory with the extension (`*.rsxks` or `*.rscmd`) selected in the dropdown box on the lower left side.

Click one of the files in the list to enter it in the "File name" window.

File name

A file selected from the file list is entered in this field. Alternatively, enter the file name manually.

Open button

"Open" opens and loads a workspace. Alternatively, double-click a workspace file in the list of workspace files.

During the workspace loading process, R&S ROMES4 checks for the availability of the associated files. R&S ROMES4 searches for all files not found at the specified location within the R&S ROMES4 directory. The resulting dialog displays the list of those files. You can use the proposed files or browse manually for the files new search location.

Cancel button

"Cancel" discards the file selection.

Files of type

Only files of the type selected in this field are shown in the file list.

The following file types can be selected:

- **Workspace files (`*.rsxks`)**
  Standard workspace file type containing the workspace but no measurement data.
- **Measurement files (`*.rscmd`)**
  Measurement file created with an R&S ROMES4 version (e.g. 3NG) contains the workspace created at the time when the file was recorded ("Start Recording").

All workspaces and templates created with the R&S ROMES4 3NG Rev.1 SP1 or higher contain the name of the device, with which the setup was created. If a template was created with other device than the currently connected one to the R&S ROMES4 a warning pops-up. Some devices (for example, the Qualcomm chipset-based devices) also check for the device connection. If device is not connected, a warning is displayed during the loading of the workspace.

Load hardware
A workspace can be loaded with or without the hardware required for the measurement. Loading without hardware is faster and sufficient and suitable for replay sessions.

R&S TSME loading from workspace
If you try to load a workspace with the R&S TSME scanner and it cannot be found on the indicated IP address, R&S ROMES4 offers the following options:

- Continue loading the workspace without the device.
- Enter manually a new IP address of the device that you want to be used.
- Use the device automatically detected by the R&S ROMES4.

At the failure of the R&S TSME loading process, appears the usual dialog which allows you to retry or to specify new links. Specify a new IP address for the mentioned device and for each device separately.

Force Assign New Links
An additional option of the load workspace file dialog allows new physical device links of each device to be specified during the loading process. The option is helpful, if the workspace has been transferred from another computer with other physical link of a device.

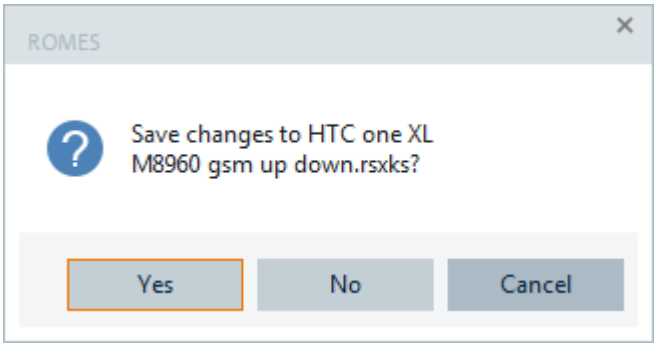
Load Signal Settings, if available
Once checked, the available signal settings for the workspace are loaded.

Load Event Settings, if available
Once checked, the available event settings for the workspace are loaded.

Load Databases of Workspace
Once checked, the databases for the workspace are loaded. Otherwise, the loading of the workspace does not affect the current configuration of the databases.

Note: Loading a most recent workspace, loads always the previously used workspace file.

As only one workspace configuration can be active at one time, the current workspace is closed before a new one is opened. Before closing the workspace, R&S ROMES4 displays the following message:



- "Yes" saves changes and closes the current configuration.
- "No" closes the current configuration without saving.
- "Cancel" returns to the current configuration.

If a workspace file cannot be located, assign a new file using the file resolver dialog. R&S ROMES4 finds an appropriate file and enters the file automatically into the dialog in this case.

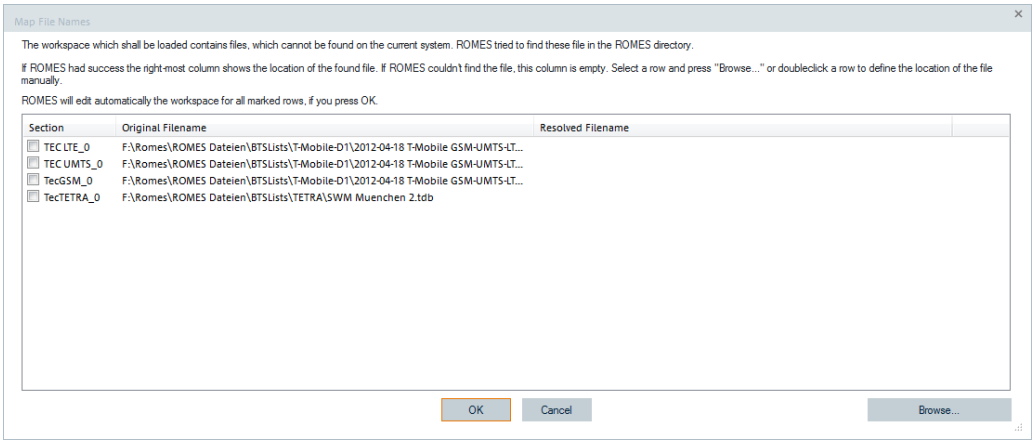


Figure 3-11: Editing workspace automatically

If a new valid workspace file is not assigned, loading of the non-existing file is not tried. R&S ROMES4 continues working by using the former loaded files. In this case an error message appears in the "Output" view:

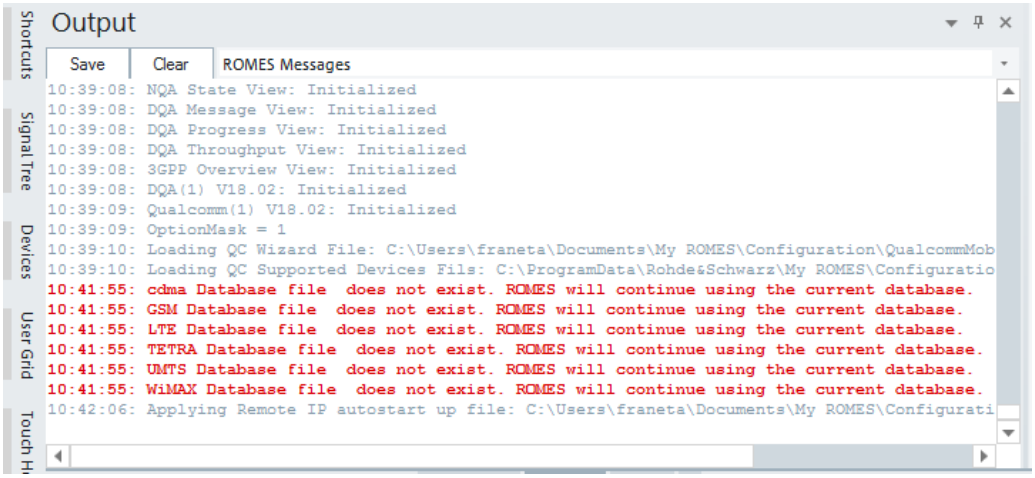


Figure 3-12: Some error messages

3.2.3 Reload workspace

Reloads a workspace file.

3.2.4 Save workspace

Saves a workspace file with its current name.

3.2.5 Save workspace as

Saves a workspace file with a new name and directory. The "Save Workspace As" command calls up the "Save As" dialog.

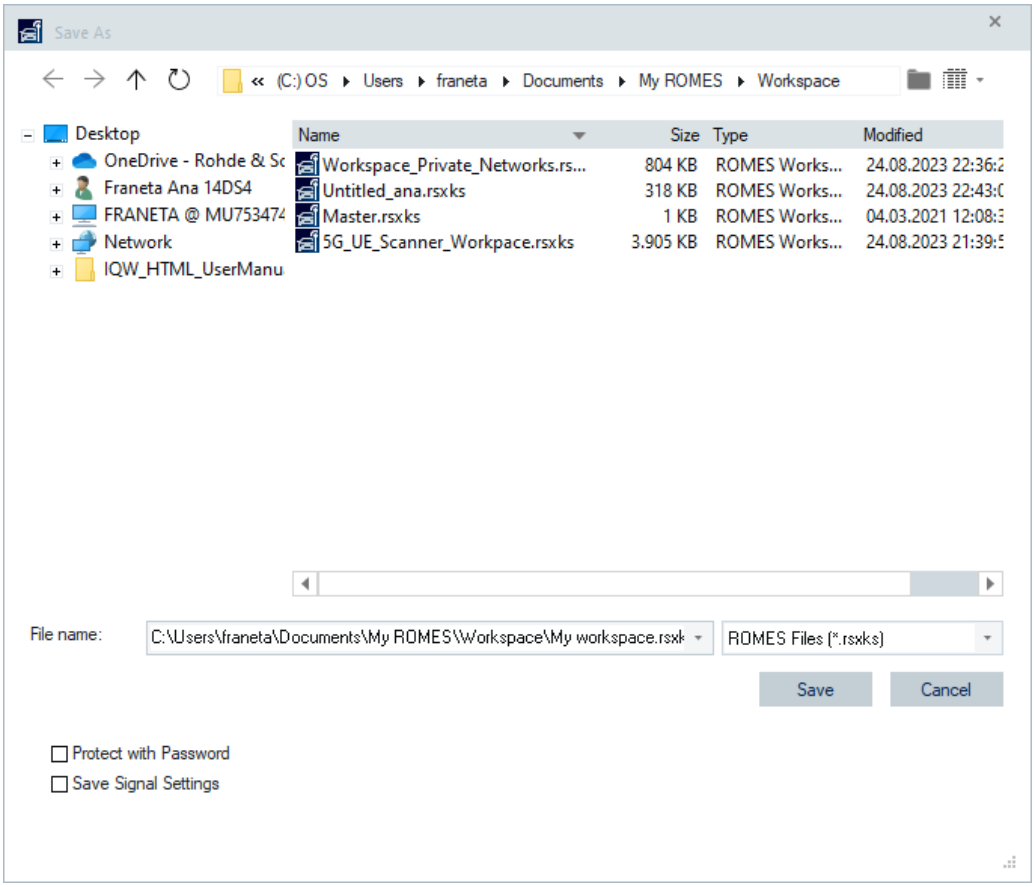


Figure 3-13: Saving workspace

This dialog is analogous to the "Open" dialog, see the previous description.

Choose a file name with the extension `*.rsxks` and a directory of your choice to save the current workspace for later use. If a file name is entered manually without extension, `*.rsxks` extension appends automatically.

3.2.6 Create project

The "Create Project" item is dimmed in the "File" menu as long as a device is not loaded. Load the device, to activate the Create project function.

To create a R&S ROMES4 project, configure the R&S ROMES4 for your task. Load devices you need and open all views, which are necessary. For such created project, choose location on your PC disk to put the project file. R&S ROMES4 automatically creates a project file (`*.rsproj`), which contains:

- All loaded devices
- All views that are opened on any "View Area"
- All technologies that are used by the loaded devices

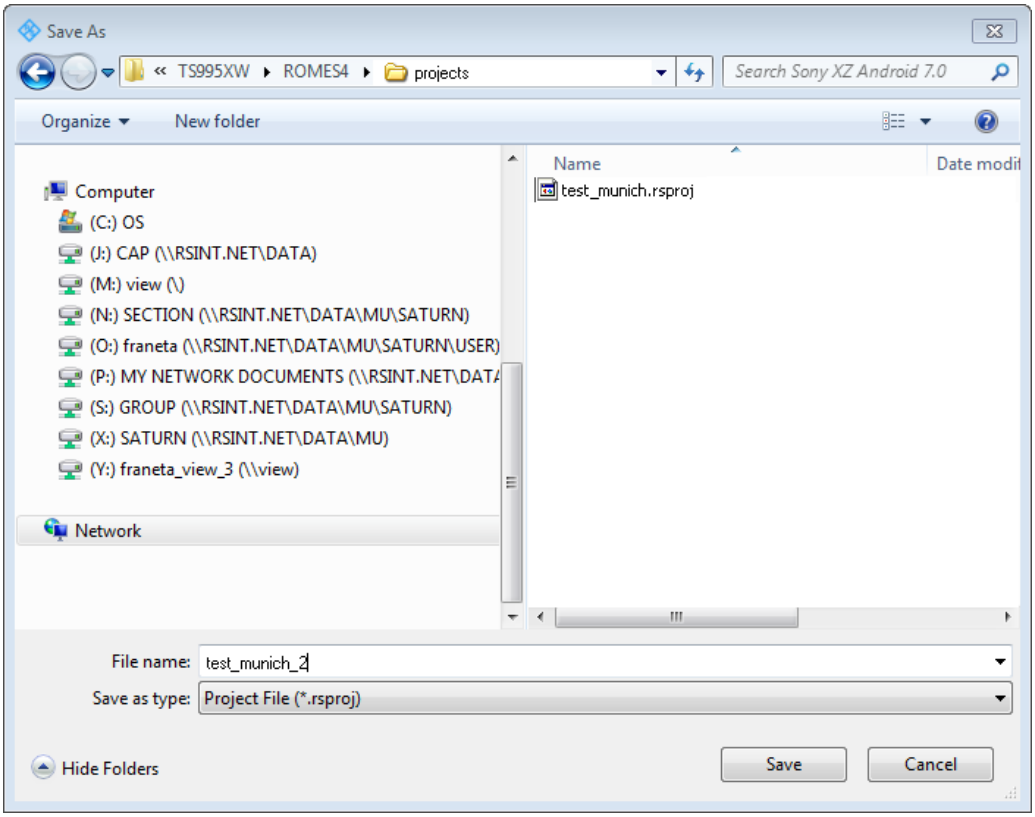


Figure 3-14: Saving the created project

If only a subset of views, technologies and devices are available in R&S ROMES4, a setup can be created via the "File" > "Create Project" command. Such a project reduces the number of modules that R&S ROMES4 loads during the startup. In that way minimized is the overall startup time and the complexity of the menus/dialogs which are filled with information concerning the modules.

3.2.7 Import / export workspace

R&S ROMES4 allows the creation of a `*.zip` file containing the Workspace and all related files except geosets and maps due to potentially large size.

The exported workspace files always contain the complete R&S ROMES4 signal description.

The import creates a directory which has the name of a ZIP file containing workspace file you want to import. The workspace file `*.rsxks` is stored In this directory. All files located in the R&S ROMES4 directory branch are stored at the same file location on the target system. All other files are copied into subdirectories in the created workspace directory.

3.2.8 Open measurement file

Click ("Open Measurement File") or [Ctrl+S] to call up the "Open" dialog. In the dialog browse for a measurement file you want to play.

The selected measurement file is replayed if the "Start Replay" command in Chapter 3.6, "Measurement menu", on page 212 is executed. It is also used as a default file for exporting.

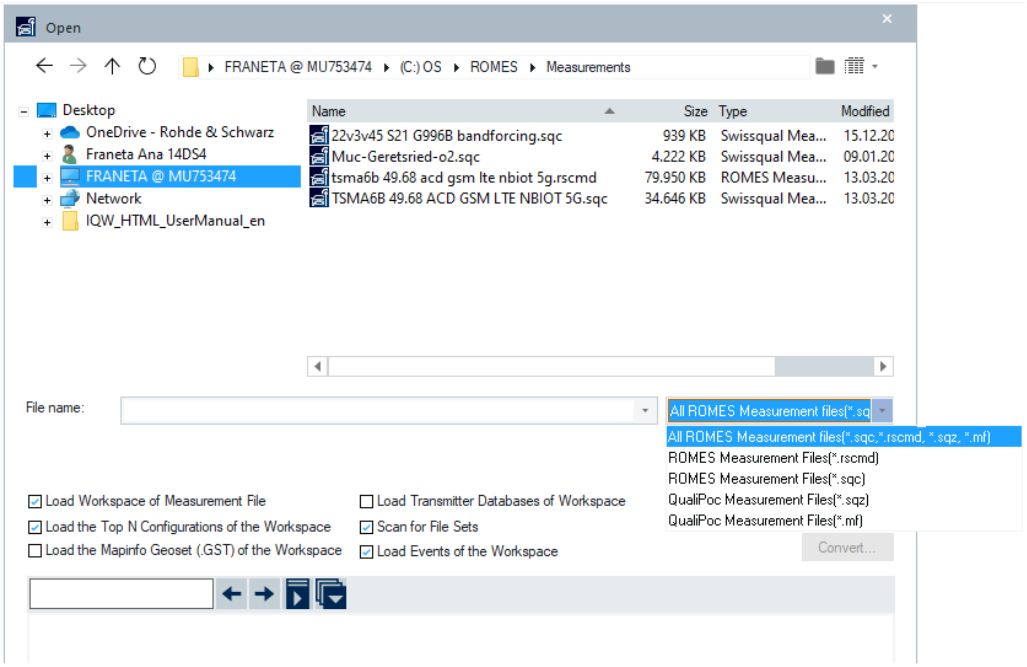


Figure 3-15: Extended Open dialog

The upper part of the dialog is analogous to the one used to open a workspace file, see Chapter 3.2.2, "Open workspace", on page 105. The left dropdown box offers to open a measurement file having one of the following file formats, as supported by R&S ROMES4:

- SQC format
- RSCMD format
- SQZ format
- MF format

If you select to open a SQC (SmartBenchmarker measurement) file or a QualiPoc SQZ file, conversion or merge is internally performed in R&S ROMES4. The result is written into a R&S ROMES4 compatible SQC file, which opens afterwards. The original file is renamed to `*.orig`.

Several loading options are offered after opening the file, shown in the lower part of the "Open" dialog figure. Not all loading options are by default active but they can be selected if you need them. The "Open Measurement File Option" dialog contains the same loading options. The dialog pops-up when the selected measurement file is opening.

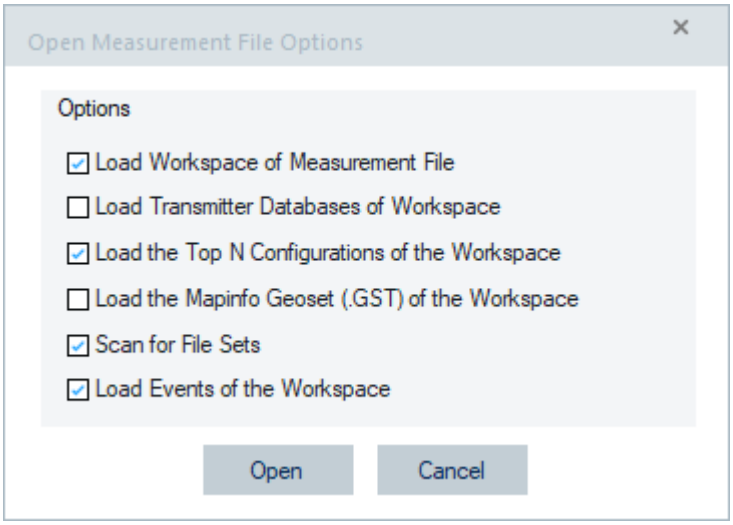


Figure 3-16: Options when opening measurement file

Loading an indoor measurement file always loads the referenced indoor floorplans, independently on the also loaded workspace.

Open as read-only
If "Open as read-only" is checked, the measurement file opened is protected so that the file contents cannot be overwritten.

Load Workspace of Measurement File
A measurement file is loaded with or without the included workspace. Loading with the included workspace allows R&S ROMES4 reconfiguration.

Before the workspace is loaded, R&S ROMES4 asks if the current settings have to be saved. Click "Cancel" to avoid saving and to load the included workspace of the measurement file immediately.

If an "Untitled" workspace is the current active workspace, the "Load Workspace of Measurement File" function is checked by default.

Note: Loading a "Most Recent Workspace" always loads the databases.

Load Transmitter Databases of Workspace
A measurement file is loaded with or without the databases specified of the included workspace.

By default the option is not checked. For further details, refer to "Load Databases of Workspace" on page 107.

Load the Top N Configurations of the Workspace
If checked, R&S ROMES4 loads the Top N configurations of the workspace.

The loading overwrites the currently used Top N configuration. In case a backup of the current configuration is required, do save it as a template from the concerning technologies menu.

Load the Mapinfo Geoset (GST) of the Workspace

Note: This functionality with MapX/MapInfo is only available if the MapX is still installed. The functionality is available if the program is running on your computer as being installed in some previous version of R&S ROMES4.

Loading of MapInfo GST from the workspace with the custom overlay maps is possible by checking the "Load the Mapinfo Geoset (GST) of the Workspace" option. This loading is recommended instead of loading it from the indoor maps. The choice is stored in the registry.

The "Load the Mapinfo LM (.lmxml) of the Workspace" check box is available on the following dialogs:

- "Files" > "Open Measurement File" > "Open"
- "Files" > "<Recent measurement file>" > "Open"
- "Files" > "Open Workspace" > "Open"
- "Files" > "<Recent workspace file>" > "Open Workspace Options"

The main usage of this option is loading GST with special overlay maps.

Scan for File Set

If checked, R&S ROMES4 searches the selected folder for additional files which are parts of a file set. All measurement files of the same set have the same file Id visible in the file info window.

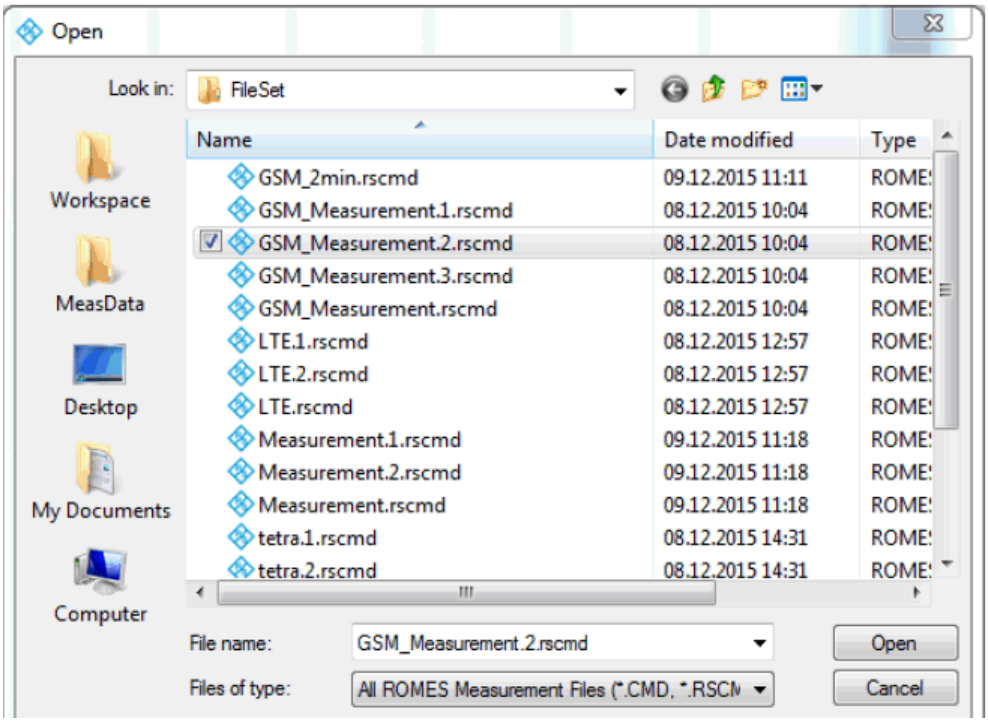


Figure 3-17: Scan for file set

Load Events of the Workspace

If checked, the events of the workspace are included in the measurement file.

File Info
Information stored with the measurement data of the selected file is displayed in the lower half of the "Open" dialog, see Chapter 3.2.10, "Measurement file info", on page 115.

File scan
R&S ROMES4 automatically scans the data, sorts the time stamps and extracts geographical information during opening a measurement file. After the scan, the entire measurement route can be displayed in Chapter 4.3.3, "ROMESMAP route track view", on page 562.

To disable the file scan, press the [Ctrl] key while opening the file or disable the measurement file scanning option in the "Preferences" > "General" window, see Chapter 3.8.1.1, "General settings", on page 224.

3.2.9 Close measurement file

Closes the current measurement file.

3.2.10 Measurement file info

Displays the file information of the current measurement file.

The file information is identical with the information displayed when a measurement file is opened, see Chapter 3.2.8, "Open measurement file", on page 112.

Included information is:

- Time zone, date and time of the started measurement. For R&S TSME, added is the information on calibration date and the self-alignment date.
- User-defined comment
- User name, vehicle type and ID, the file length in blocks, and the duration of the measurement.
- PC system Information, for example, operating system type (32 bit or 64 bit) and CPU information (available and total physical memory)
- Path alias and current values of registry keys which are defined via "Tools" > "Preferences" > "Advanced" > "Information Recorded to Measurement".
  Therefore, the state of the operating system while the measurement was made is stored.
- Used devices (for example, the R&S GSM NWS and R&S GPS devices) and the most important devices' settings made before the measurement was started, see the chapter "Hardware components".
  Device settings such as the "Meas. Mode" of a mobile device, the frequency and trigger settings are essential for the type of recorded data and the available views. Relevant information, for example, is:
- Uplink Interference information in the BCH demodulator part (necessary is to check "Uplink Interference Measurement", otherwise the line is omitted).
- Information about the band name and the used band classes for CDMA2000

- Wideband and/or MIMO measurement information.
- TETRA 2 measurements shown as "Yes" or "No".

3.2.11 Welcome page

There are two displays of the R&S ROMES4 "Welcome" page.

The R&S ROMES4 opening page after starting up the application relates to the phase which precedes measurements.

The second one is present during measurements.

3.2.11.1 Welcome page after R&S ROMES4 opening

After R&S ROMES4 startup, the "Welcome" page opens containing the following three areas.

- "Recent Workspaces"
- "Recent Measurements"
- "Available Devices"

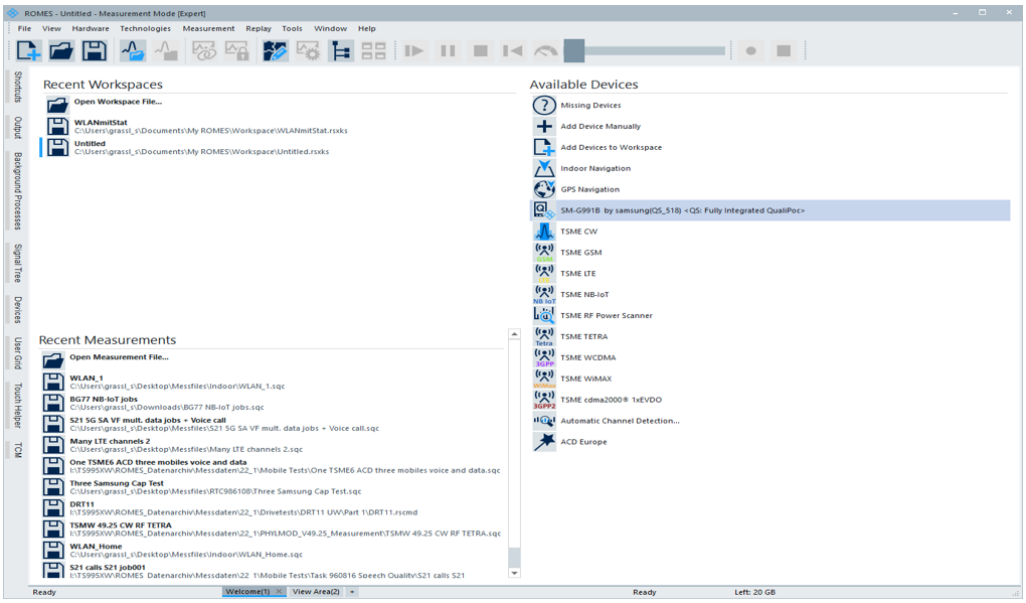


Figure 3-18: Welcome page after R&S ROMES4 opening

Recent workspaces

The "Recent Workspaces" area shows a list of recently opened workspaces.

The opened workspace files are marked with colored bars placed in front of them. The meaning of the colors is:

- Bar is missing - the workspace that does not contain a device

- Blue bar - the workspace contains device which does not support auto detection (for example, TETRA handset)
- Red bar - at least one device is missing
- Yellow bar - scanner is available, but does not have the required amount of frontends
- Green bar - all devices are available

Recent measurements

The "Recent Measurements" area shows a list of recently opened measurement files. The files are not marked with the bars.

Available devices

All available devices, i.e., the devices connected to the PC which R&S ROMES4 is running on, are shown in this area. The icon on the top of the list is related to the troubleshooting function if a device detects a problem, see Figure 3-4.

Figure 3-19: Welcome page - available devices

The fully integrated QualiPoc devices are displayed grayed out in the "Available Devices" list if their "Ready to load" state is unavailable. If the devices are in the "Ready to load" state, they are displayed as other devices.

The "Indoor Navigation" function offers the possibility to use a GPS in "GPS plus Indoor" mode.

Figure 3-20: Available GPS plus indoor and loaded QP device

The availability of the "GPS plus Indoor" mode is indicated with the presence of the "GPS Navigation" icon in the "Welcome" page. If the GPS device is not connected, and the associated icon is not present, the "Indoor Navigation" function loads the Indoor device only.

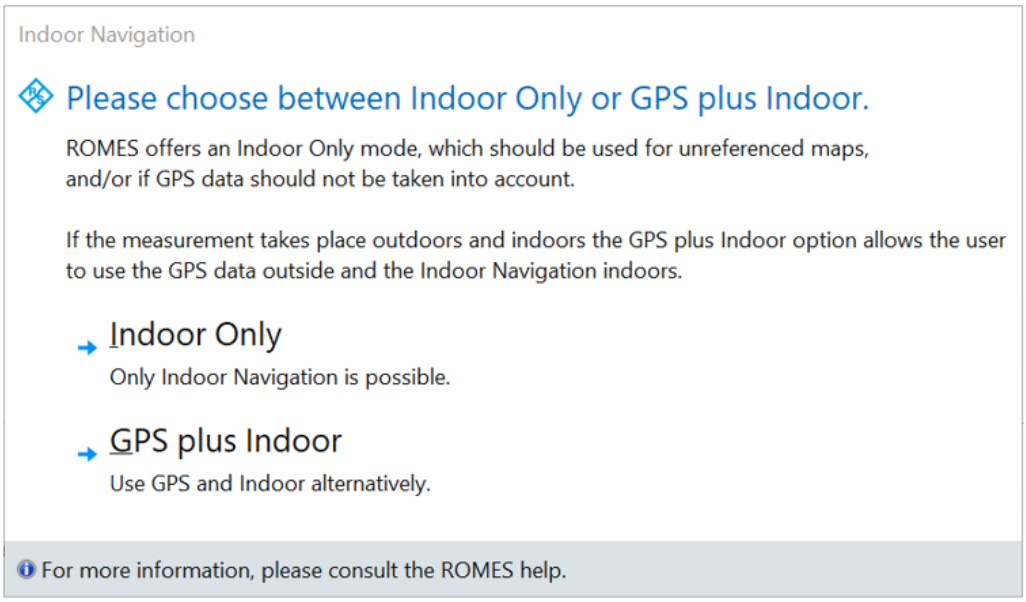


Figure 3-21: Selection of indoor navigation mode

Choose the "Indoor Only" option for the Indoor device. The indoor option is necessary if you use the unreferenced maps.

If both indoor and outdoor measurement are performed, recommended is to use the combined mode, the "GPS plus Indoor" function.

3.2.11.2 Welcome page during measurements

The "Welcome" page shows the state and the measurement values of each connected device during an active measurement.

Available devices in this case are shown in the status bar of the R&S ROMES4 main window.

The tab on the left-hand side of the title bar of a particular view in the work area shows the status of a measurement and device. One tab for each connected device is shown, see Figure 3-1.

The tabs show the name of a device/scanner and the bar color above depends on the state of the device.

The colors indicate the following device states:

- Green - state OK
- Yellow - warning
- Red - error

The bar's color of a scanner is triggered by the worst state of the involved scanner.

If necessary, the displayed data for each device can be changed by adapting the following files in the widget folders of the MyROMES directory:

- `UEWidgetView.xml` for the UE "RF Summary" tab.
- `ScannerSummaryWidgetView.xml` for the "Scanners" tab

You can create the Widget folder. Copy the files from the application folder and then adapt the files to your needs.

R&S ROMES4 always tries to load from the MyROMES directory first. The content of *...\My ROMES\Configuration*`WelcomePage.xml` is ignored.

3.2.12 Mergers/converters

R&S ROMES4 supports merging of measurement files of different formats and conversion of indoor measurement files generated by QualiPoc devices.

The "File" > "Mergers/Converters" menu command has the following items.

Figure 3-22: Supported merging function

3.2.12.1 Merge speech quality land unit files

This merging function merges the measurements of the land unit with the R&S ROMES4 measurement files. Land unit files which can be merged must be of SQZ format. The MF format is not supported.

The measurement files of the land unit must be copied into a folder which R&S ROMES4 has rights to read.

Select the "Merge Speech Quality Land Unit Files" entry of the "Mergers/Converters" menu to get the merging dialog.

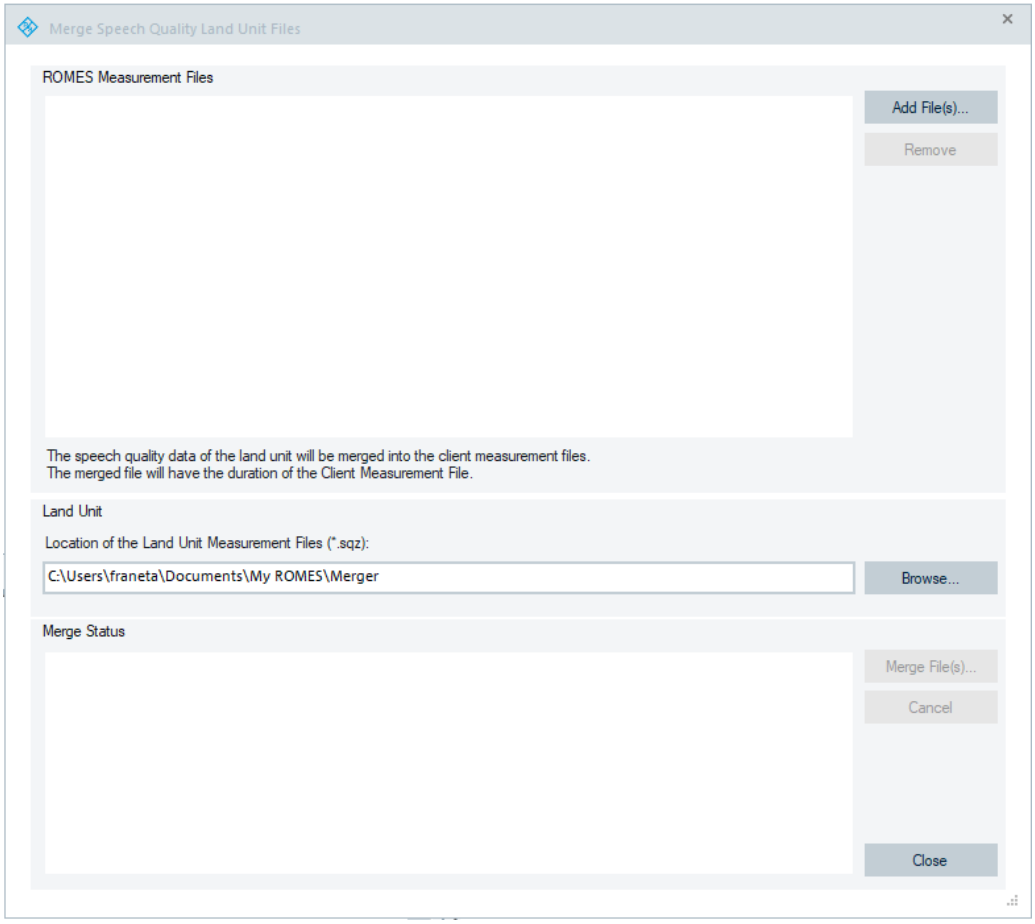


Figure 3-23: Merge Speech Quality Land Unit Files dialog

The File Merger function can also be started from the console. The executable file name is `SQPolqaFileMerger.exe`. The file is located in the same directory as the `Romes.exe` file, see the following figure.

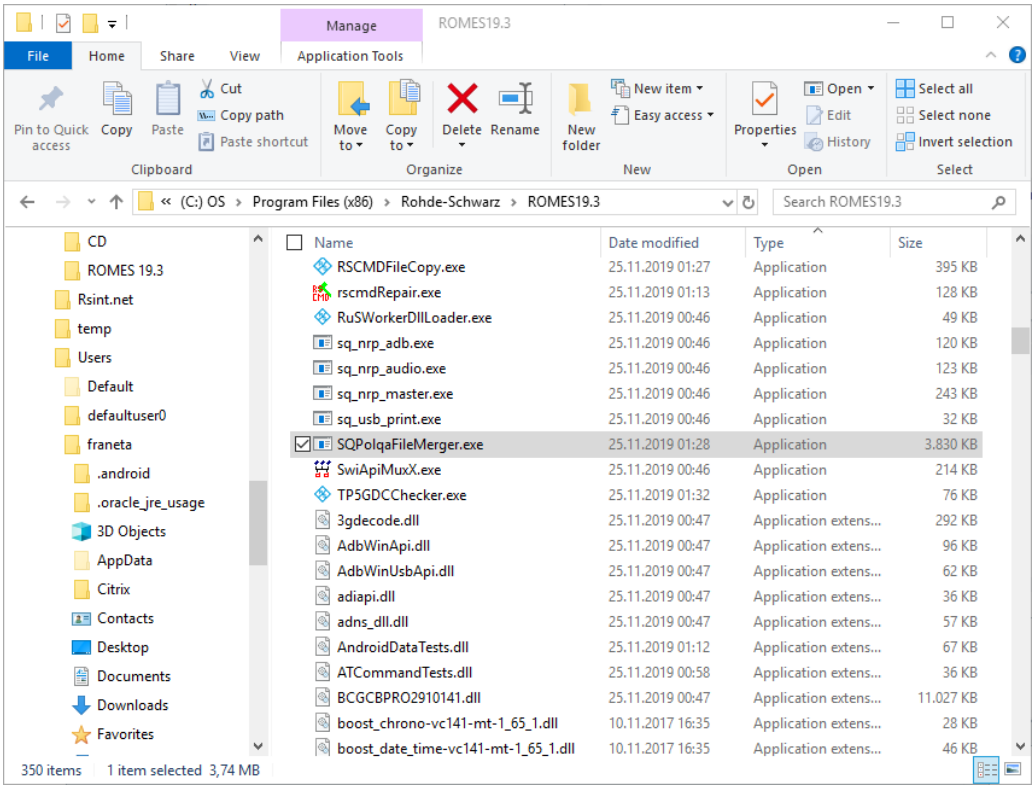


Figure 3-24: Location of the SQPolqaFileMerger file

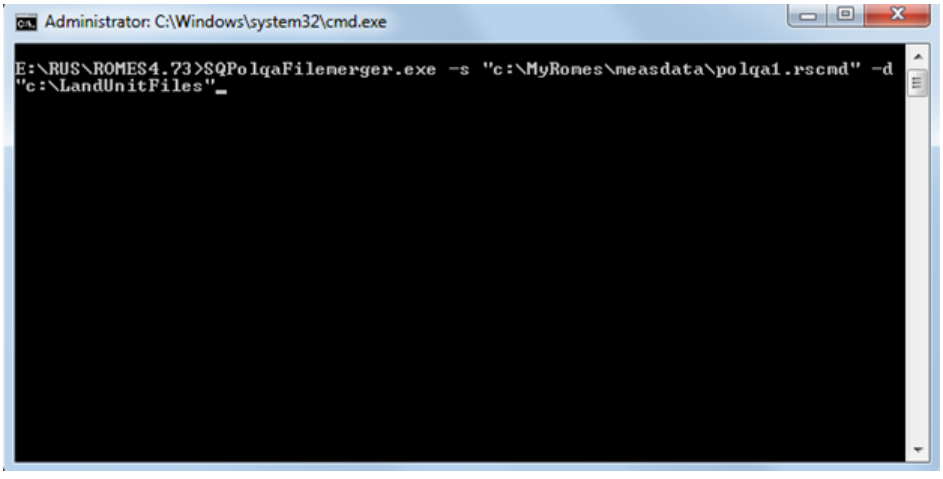
The merger must be started with the following command-line options:

```
-s "<ROMES Measurement File Name>"
```

```
-d "<Land Unit File Directory>"
```

Example:

```
SQPolqaFilemerger.exe -s "c:
\MyRomes\measdata\polqa1.rscmd" -d "c:\LandUnitFiles"
```



ROMES Measurement Files

In the "Merge Speech Quality Land Unit Files" > "ROMES Measurement Files" pane select the R&S ROMES4 measurement files that you want to merge.

Click the "Add File(s)" button to get the "Open" dialog for selection of the R&S ROMES4 measurement files to be merged.

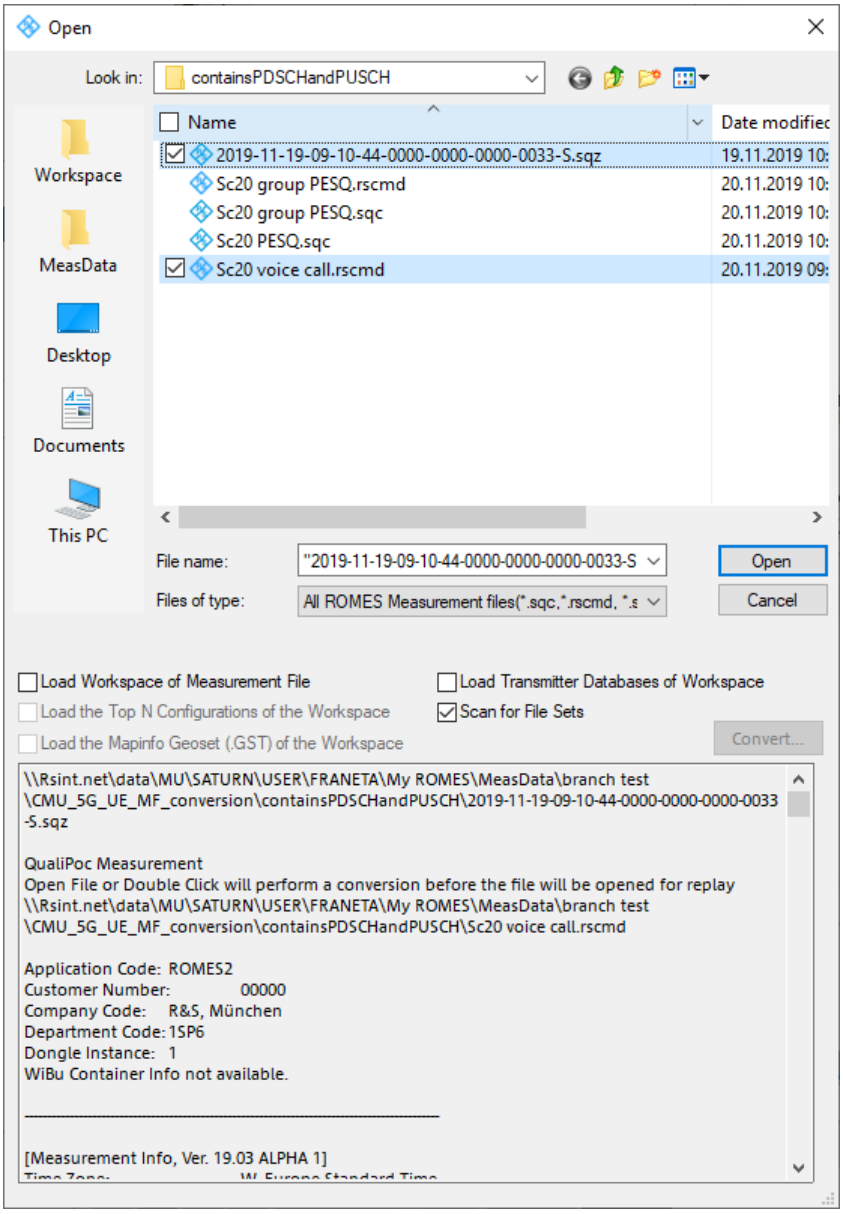


Figure 3-25: Open dialog

The selected files populate the "ROMES Measurement Files" area of the "Merge Speech Quality Land Unit Files" dialog.

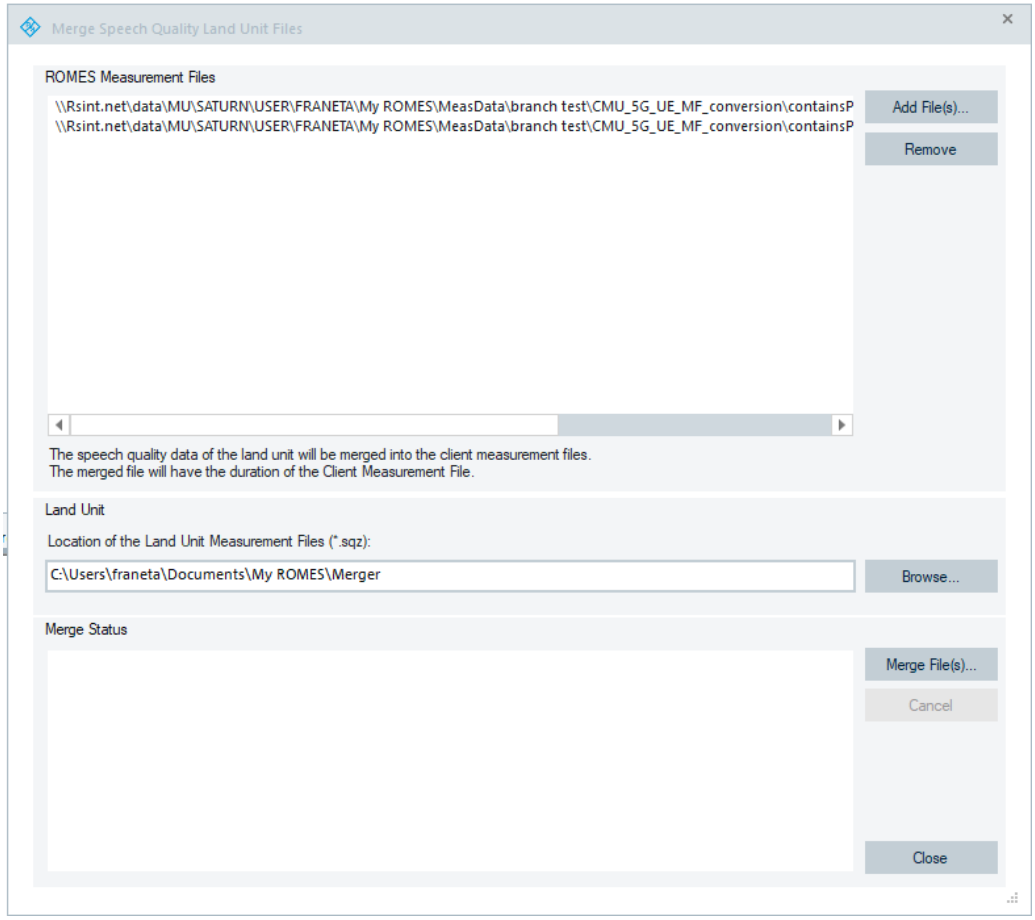


Figure 3-26: Files added for merging

Click the "Remove" button to remove a selected file from the list. Multiple selections are possible.

Land Unit
Click the "Browse" button in the "Land Unit" pane to open the "Browse to Folder" directory selection dialog. Select the directory where the land unit files are stored. R&S ROMES4 remembers the last selected directory.

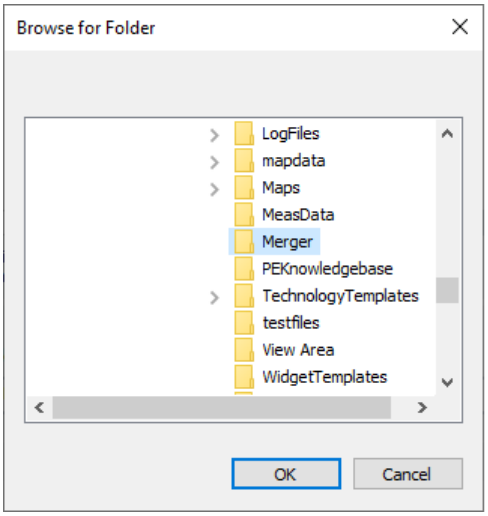


Figure 3-27: Directory selection dialog

Merge Status

Click the "Merge File(s)" button to start merging the files. Merging function recognizes the corresponding land unit measurement files with the measurement ID stored in the R&S ROMES4 measurement file header.

When all selected files have been merged, a summary is displayed in the "Merge Status" list.

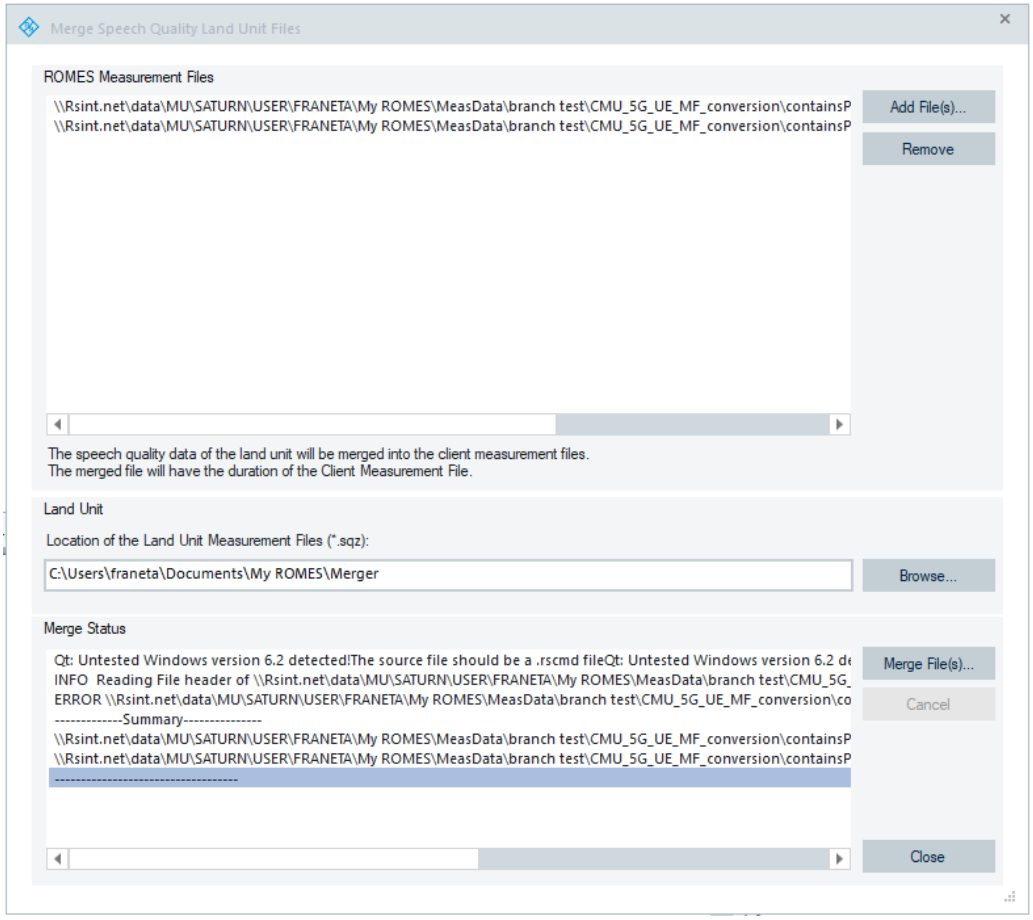


Figure 3-28: Status of the merging

The merged files have the suffix `_merged`. If the target file name with the `_merged` suffix already exists, a sequenced number is appended to the file.

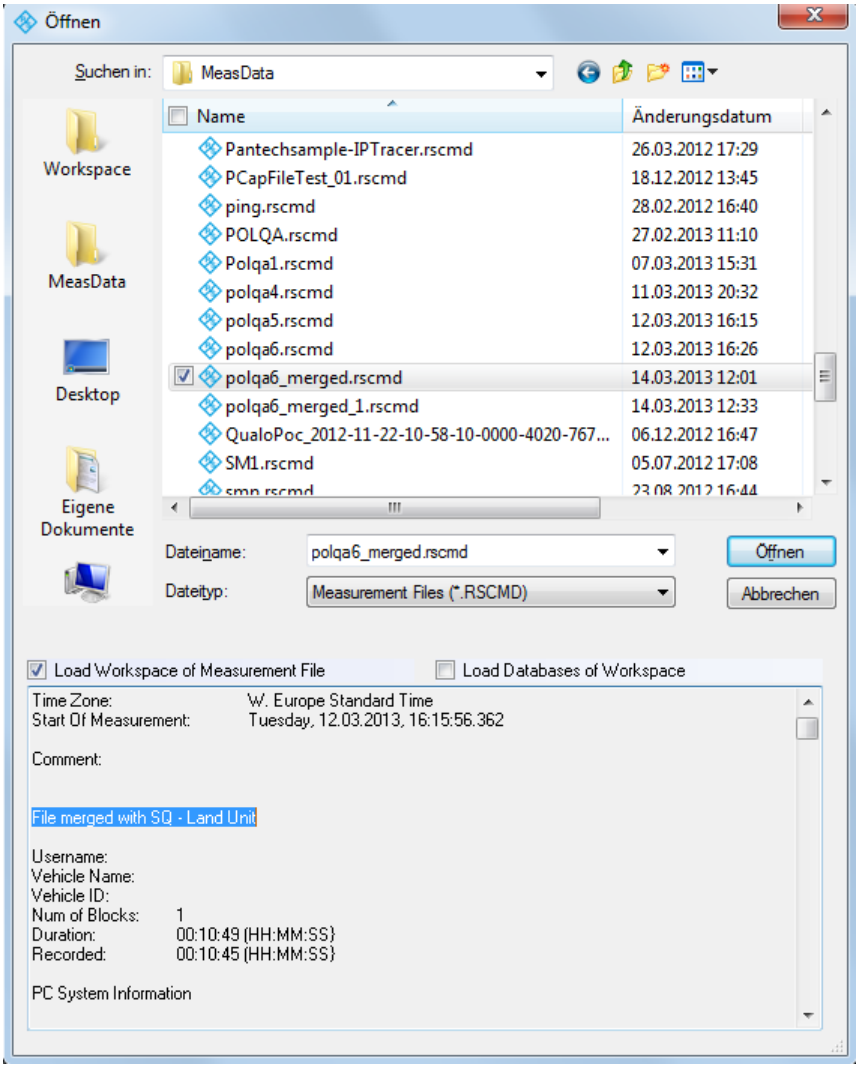


Figure 3-29: Selected merged file

Merging again an already merged file is not possible. The merged file gets an entry in the file header.

The "Cancel" button cancels the files merging.

Click the "Close" button to close the "Merge Speech Quality Land Unit Files" dialog.

3.2.12.2 Merge measurement files with QualiPoc files

R&S ROMES4 supports merging and conversion of several measurement files generated by QualiPoc devices.

An existing `*.rscmd` measurement file can be merged with `*.mf`/`*.sqz` files generated by mobile devices operating in QualiPoc mode.

It is possible to merge several measurement files generated at different time by the same device. The QualiPoc files in this case are distinguished by a different time in the filename. If at merging of several subsequent measurement files of the same QualiPoc

device a measurement file takes longer time and a max. file size or max. time is reached, the R&S ROMES4 recording switches to subsequent files. The subsequent files are named with the same filename appended by 001, 002, and so on.

R&S ROMES4 also supports conversion of QualiPoc indoor measurements. The conversion is supported, if a SmartBenchmarker file (`*.sqc`/ `*.sqz`) has indoor measurements.

► Click the "Merge Measurement Files with QualiPoc Files" entry in the "Mergers/ Converters" menu.

A window opens where the files to be merged can be selected.
It is possible to select multiple `*.mf`/`*.rscmd` files. In this case, for each `*.rscmd` file is checked whether a `*.mf`/`*.sqz` file or multiple of the `*.mf`/`*.sqz` files can be merged with the `*.rscmd` file. If N `*.rscmd` files are selected for merging with M `*.mf`/`*.sqz` files, the result of merging is N `*.rscmd` files.

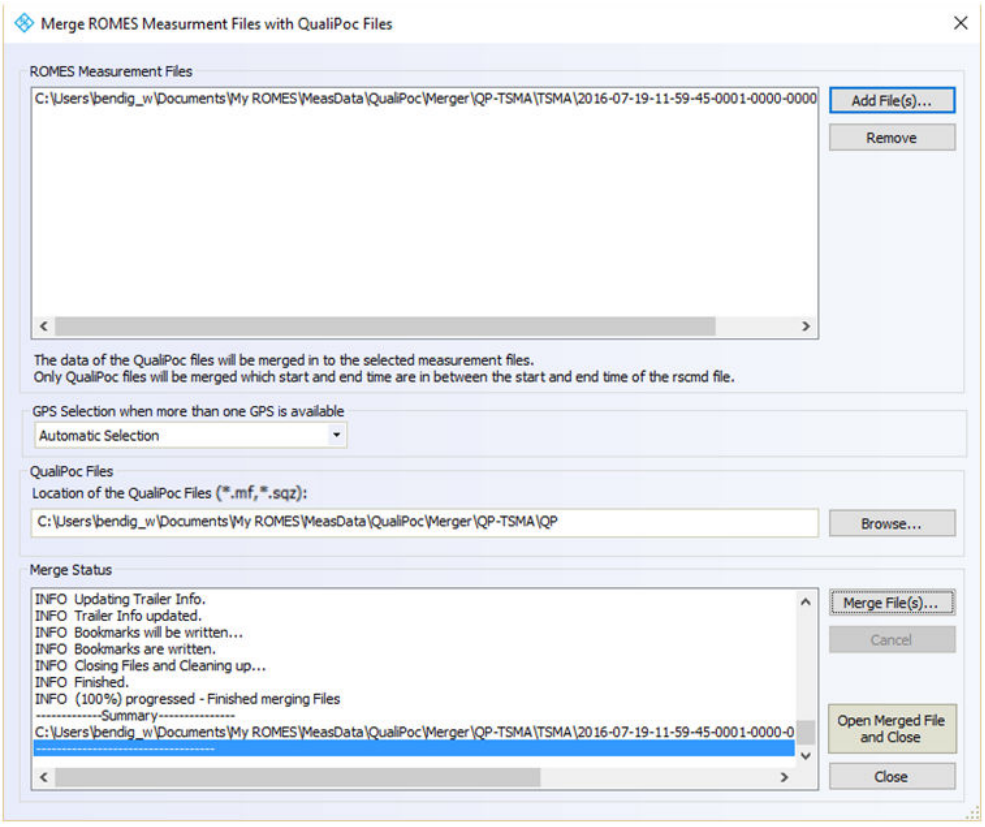


Figure 3-30: Files merging

You can open the created file directly after the successful merging using the "Open Merged File and Close" button.

Only `*.mf`/`*.sqz` files with start- and end-time in between the start- and end-time of the `*.rscmd` file can be merged.

The QualiPoc NCM function merges optionally a `*.rsmcd` file into a `*.sqz` file from the QualiPoc, which then contains the mobile data.

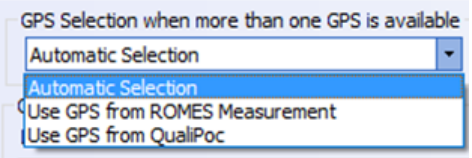
The merge procedure merges the `*.rscmd` file of the obtained `*.sqz` file with the included `*.mf` file. In this case it is not necessary to specify a source folder for the`*.mf` file in the merge dialog.

The merge procedure merges the `*.rscmd` file of the obtained `*.sqz` file.

After a successful merge, the merged `*.rscmd` file opens.

The following sections describe the parameters in the merging page.

GPS Selection when more then one GPS is available
If GPS is available in the R&S ROMES4 measurement file and in one or more QualiPoc measurement files. Select which GPS data that you want to be used in the merged file.



Default is "Automatic Selection".

The decision criteria for the default selection are:
- If Indoor is used, the GPS data with Indoor to be used
- The GPS data with the most valid position data per minute to be used.

Add File(s)
Allows selection of the RSCMD files to merge them with QialiPoc files.

Remove
Removes the selected RSCMD file from the list.

Browse
Selects the directory where the QualiPoc files are stored.

Merge File(s)
Starts the merging process. The selected RSCMD files are merged with QualiPoc measurement file, whose start- and end-time are in between the start- and end-time of the RSCMD files.

Cancel
Cancels the merging process.

Open Merged File and Close
Opens the merged file directly. The button is available only if at least one file was successfully merged. If more than one file was merged, the last successfully merged file is opened.

Merge Status
The list box shows the current progress of the merging process.

3.2.12.3 Merging/converting QualiPoc files of selected UEs

R&S ROMES4 offers you the possibility to select which UEs to be included when merging or converting QualiPoc files. For this purpose, available is the UE selection dialog.

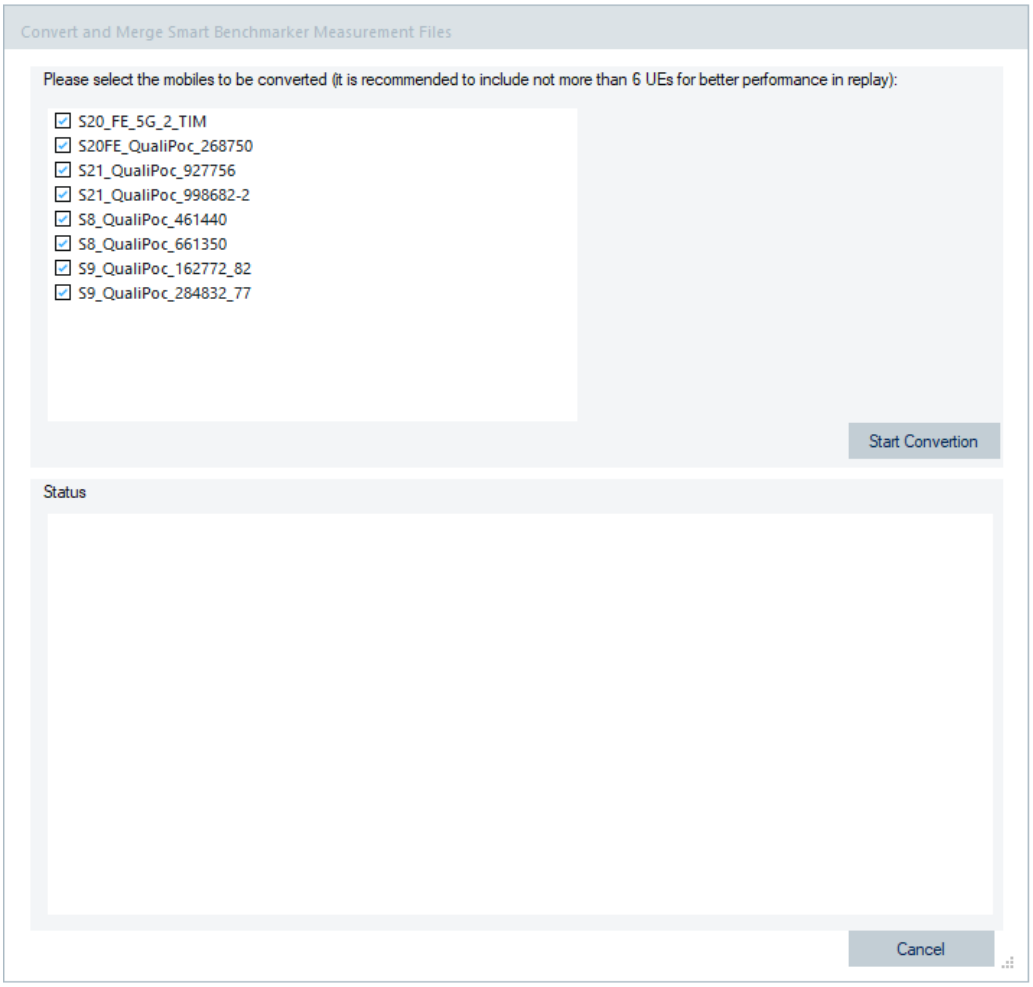


Figure 3-31: Dialog for selecting UEs for merging/conversion

1. Select UEs which measurement files that you want to convert in the shown dialog.
2. Click the "Start Conversion" button.

   The steps of the conversion are displayed in the "Status" pane.

   At the end of the conversion, the new created measurement file is automatically displayed.

An UE measurement can be split into more than one file. In such a case, the start time of each measurement file is added as a suffix in the UE selection dialog.

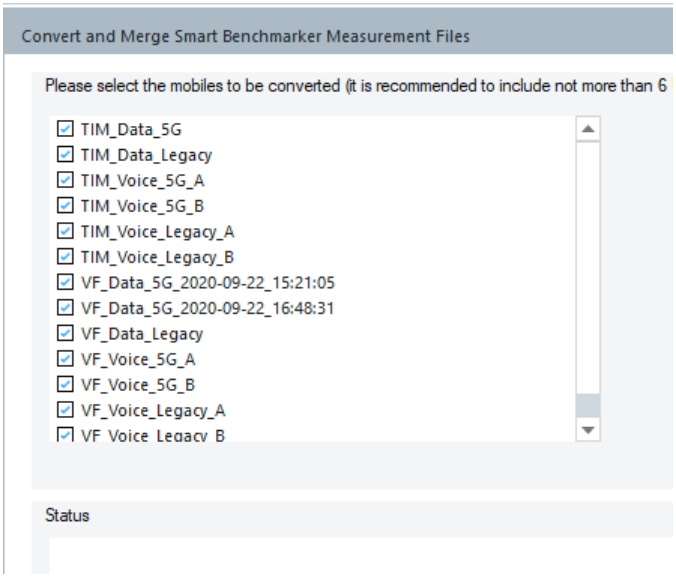


Figure 3-32: Measurement of selected UE split into two files

3.2.13 Export measurement files

Exports and saves measurement data for later evaluation, for example, with another application.

For details and an example, refer to Chapter 7.2.2, "Export procedure", on page 2100.

3.2.14 Export measurement file info

Writes the file information of several measurement files to a single text file.

The file information is identical with the information displayed when a measurement file is opened (see Chapter 3.2.10, "Measurement file info", on page 115).

It is exported in two steps.

- **Step 1:** The "Export Measurement File Info(s) command" opens a file "Open" dialog to select the measurement files.
- **Step 2:** After file selection, the "Open" button calls up a "Save As..." dialog to select a file name (`*.txt`) and a directory for the file information.

The file information on the individual files in the `*.txt` file forms the separate consecutive sections. Each section starts with the name and path of the measurement file, e.g.

`**********D:\RuS\Romes\MeasData\dvb-test4.rscmd**********`

If an R&S ROMES4 measurement file is exported, the file extension is `*.rscmd`, older measurement files keep the `*.cmd` extension.

The text file can be regarded as a catalog providing an overview of a whole archive of measurement files. If it is viewed with a suitable text editor using functionality such as the text search function.

3.2.15 Print

[Ctrl + P]

Prints the contents of the active view.

The Print option is an alternative to taking screenshots via the clipboard (see chapter 7 "Data processing"). R&S ROMES4 uses the standard "Print" menu familiar from other MS Windows applications. Printing to a file or a configurable printer with selectable page numbers is possible. For details use the context-sensitive help.

To control the appearance of the hardcopy, a preview option is provided; see Chapter 3.2.16, "Print preview", on page 131.

3.2.16 Print preview

Shows a preview of the hardcopy to be created.

The "Print Preview" command opens a window showing one page (our example shows a section of such a page).

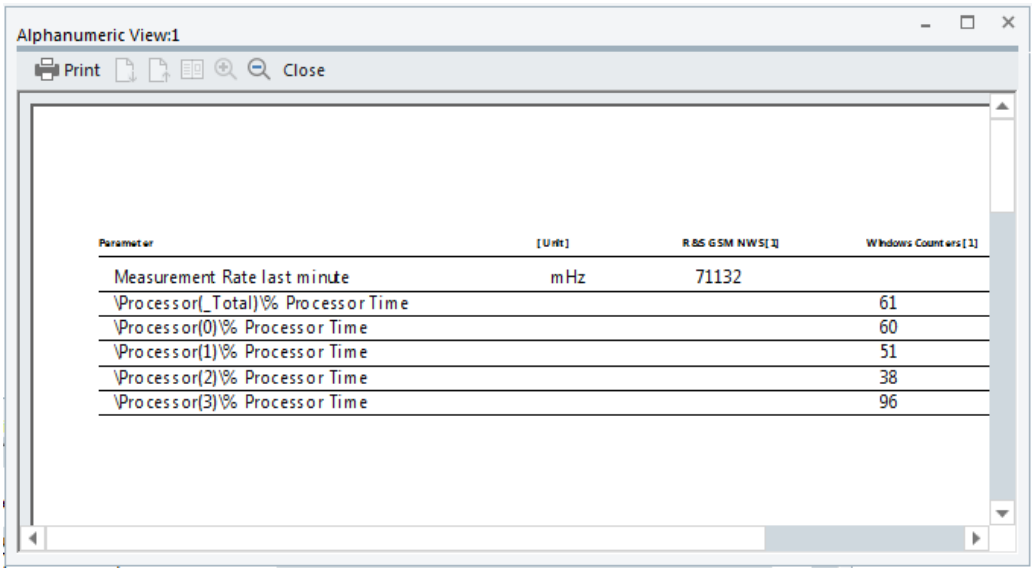


Figure 3-33: Print preview layout

The icon bar contains icons that control the preview and printout. The icons functions are listed in the following table, the order is from left to right.

Command	Description
"Print"	Print the previewed file with the current printer settings
"Next Page"	Show next page (if applicable, otherwise grayed)
"Previous Page"	Show previous page (if applicable, otherwise grayed)
"Toggle One/Two Pages display"	Show two pages (if applicable, otherwise grayed)
"Zoom In"	Magnify current page by a factor of 2 (2 steps possible)
"Zoom Out"	Reduce scale of current page by a factor of 2 (2 steps possible)
"Close"	Close the window without printing

3.2.17 Print setup

Modifies the printer settings.

R&S ROMES4 uses the standard "Print Setup" menu familiar from other MS Windows applications. For details use the context-sensitive help.

3.2.18 C:\...*.rsxks

Opens one of the workspace files saved before.

A maximum of four workspace files numbered 1 to 4 are listed in this field.

The "File" > "Open Workspace Option" dialog of the workspace files offers an additional option in comparison to the standard MS Windows file dialogs.

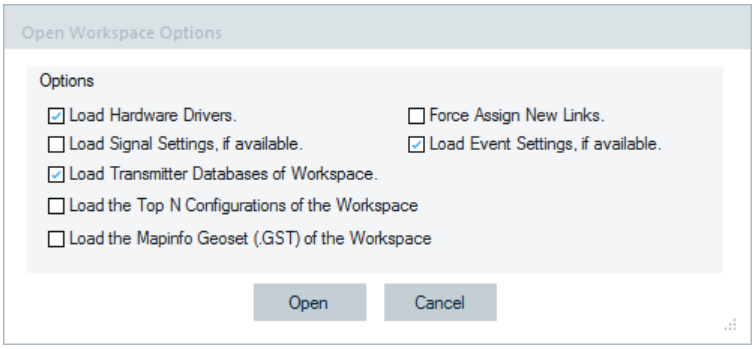


Figure 3-34: Dialog which opens a recent workspace

Load the Top N configurations of the Workspace
To avoid overwriting the current Top N configuration with the one inside the workspace, the related box needs to be unchecked before loading, see the Figure 3-34.

The Workspace file load unchecking option is always possible before loading a file, also if loading from a `*.rscmd` file.

The option is available on four different dialogs where workspaces or `*.rscmd` files are loaded. In the Figure 3-34 an example of the dialog which opens a recent workspace is shown.

The unchecking option works as expected for GSM / LTE / TETRA / UMTS, sharing the base software solution of Top N.

The CDMA and WiMAX technologies are different. If the Workspace file load option is set not to load the Top N settings from the Workspace, the default setting is used.

3.2.19 C:\...*.rscmd (or *.cmd)

Opens one of the measurement files used before.

A maximum of four measurement files numbered 5 to 8 are listed in this field.

The RSCMD file header shows the scanner types which the R&S TSME supports.

The currently open measurement file is replayed when the "Start Replay" command in the Chapter 3.6, "Measurement menu", on page 212 is executed. It is also used as a default file for exporting, see Chapter 3.2.13, "Export measurement files", on page 130.

The "Open Measurement File" dialog offers the option to the standard Windows file dialogs. A dialog allows you to configure the same options as available in the normal file open dialogs.

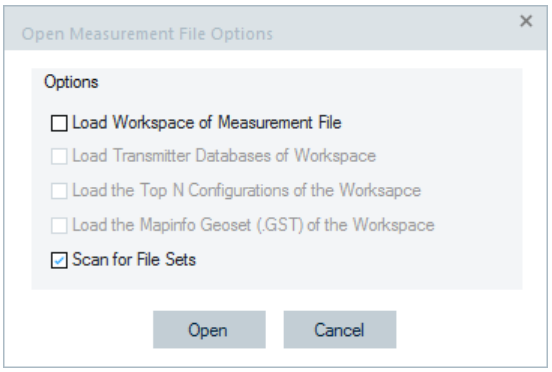


Figure 3-35: Open measurement file options

3.2.20 Exit

Closes the application.

Before closing, R&S ROMES4 issues a warning if there are unsaved changes to the currently active workspace.

3.3 View menu

The "View" menu customizes the main application window and offers the view windows used to visualize and evaluate measured data.

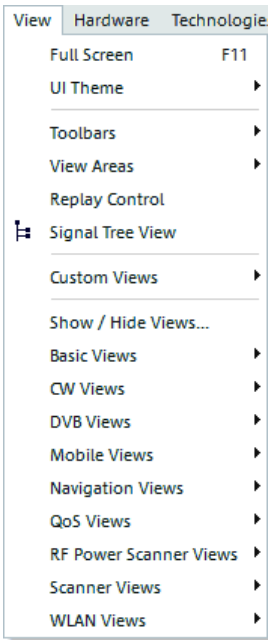


Figure 3-36: View menu

The selection of the view windows is determined during R&S ROMES4 installation. The selection depends on the system configuration and the available options.

In the "View" > "Toolbar" select the tool bars that you want to be shown. The bars are located in the horizontal line on the top or on the vertical left border of the R&S ROMES4 opening page.

3.3.1 Lazy views

To improve the startup and replay performances, only a subset of views is created during the R&S ROMES4 startup. The views that are not created are identified in the "View" menu. They have an asterisk next to their names.

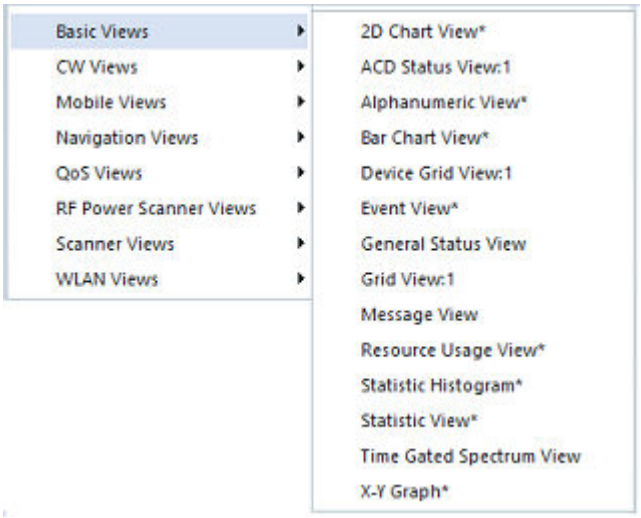


Figure 3-37: Available views in Basic Views

Views that are not created upfront, so-called the "Lazy Loaded Views", do not retrieve any measurement data until they are displayed. That means, it is a good practice to open the views required in measurement mode before starting the measurement. Some views that display more data than recently measured like chart views, cannot display all information, but start displaying measurement data once they are visible.

During replay and file scanning, the views can be created at any time. Data is delivered to those views to fill them correctly. Data filling can require a rescan of the file. If it is necessary to display more views at a time, use the "View" > "Show / Hide Views" dialog to create a set of views in one row.

By using the XML profile files, it is possible to change the lazy loading strategy for each view. For example, if you want the "3GPP Overview View" automatically created, but not displayed, change in the `RomesProfiles.xml` file the line.

```
<RomesView Name="3GPP Overview View" MinProfile="1" Tec="GSM"/>
```

to

```
<RomesView Name="3GPP Overview View" MinProfile="1" Tec="GSM"
DelayLoad="false" />
```

3.3.2 Full screen

Maximizes the main application window to full screen size.

The toolbar, the measurement bar and the status bar are hidden in full screen mode.

3.3.3 UI theme

The view customization and multiple themes are not supported. Instead, in "View" > "UI Theme" you can select light or dark mode for your dialogs.

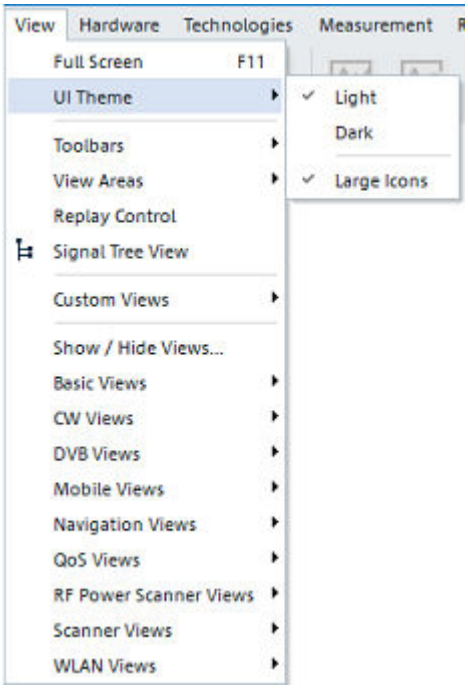


Figure 3-38: UI Theme entry

Example is given for the "ROMESMAP Route Track View".

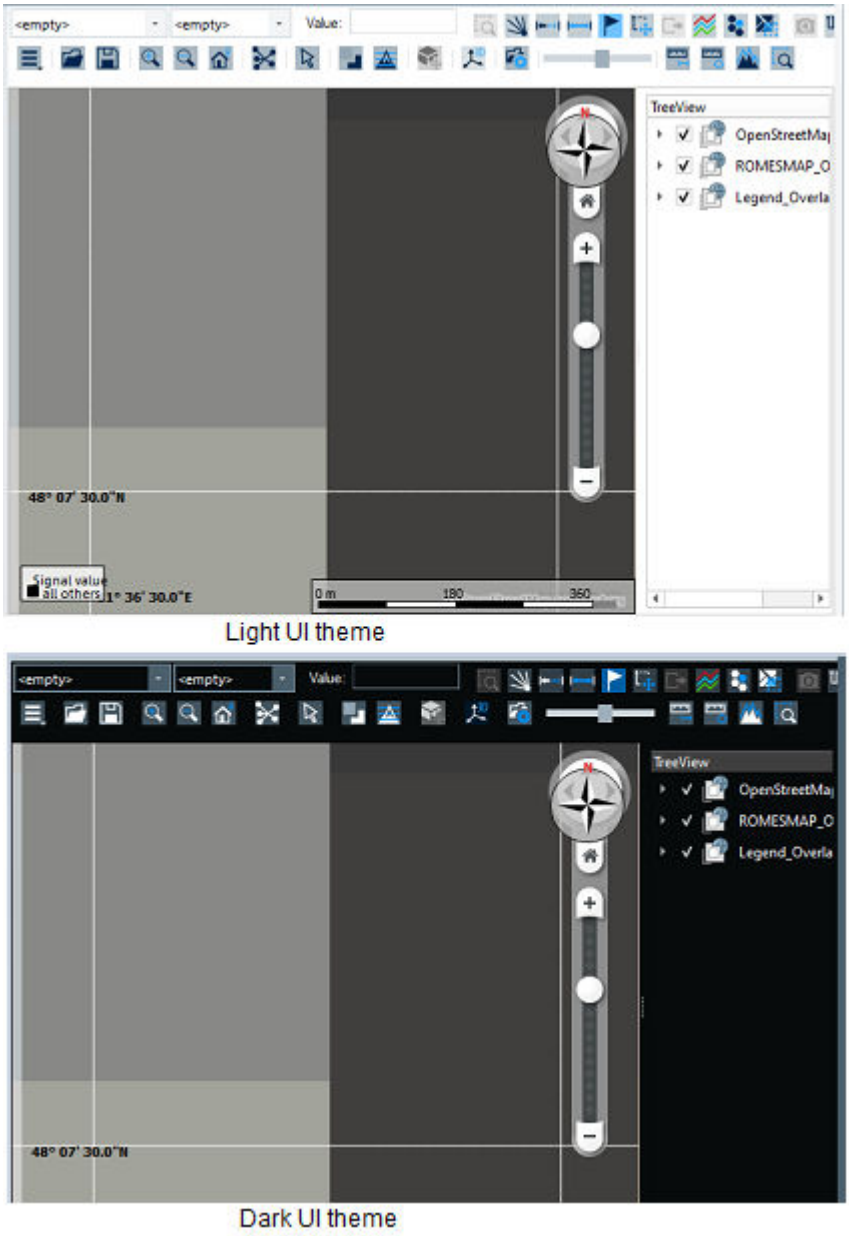


Figure 3-39: R&S UI theme for ROMESMAP

Not all dialogs currently support these two modes.

The "UI Theme" entry contains option to change the icon size. Changing the icon size applies only for the main toolbar icons and takes place immediately. All other icons are of fixed size.

3.3.4 Toolbars

Available toolbars are displayed/hidden if selected/deselected respectively in the "View" > "Toolbars" menu.

The same content is displayed if right-mouse click any point on the Menu bar.

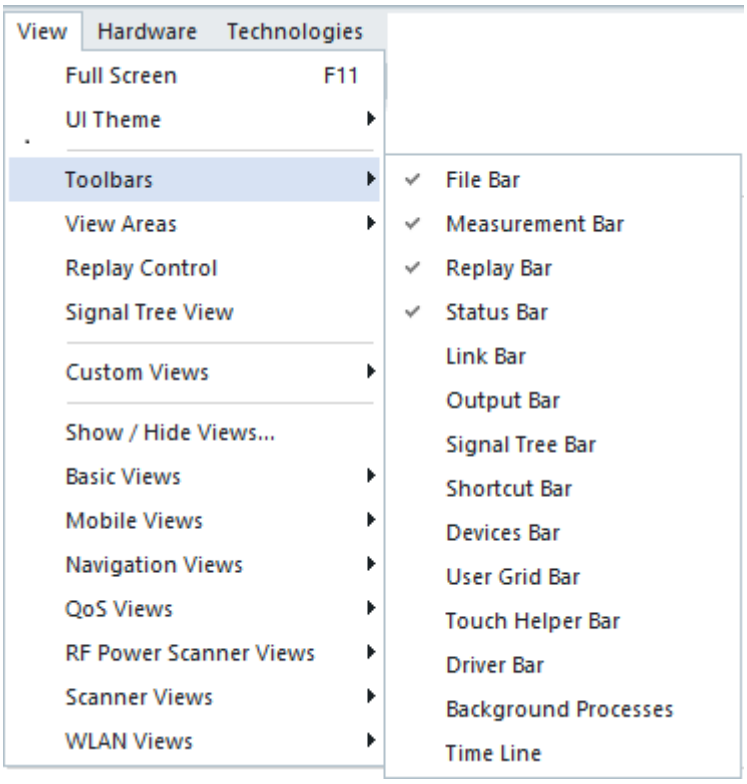


Figure 3-40: Available toolbars

File Bar
Displays and hides the toolbar of the main application window.

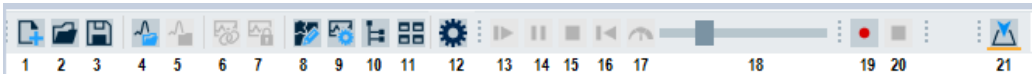


Figure 3-41: Available toolbars in View

The toolbar forms the left part of the upper margin of the main window and offers controls for the most common program tasks. Otherwise, offered are in the "File" and "Help" menu and in the context menu of the main application window.

Table 3-1: Function of the buttons in the toolbar

Control	Menu command	Shortcut
1	Create new workspace	Ctrl N
2	Open an existing workspace	Ctrl O
3	Save the active workspace	Ctrl S

Control	Menu command	Shortcut
4	Open RSCMD File for Replay	
5	Close RSCDM File	
6	Toggle Coupled Focus	Ctrl Y
7	Hold / Release all views (stops the measurement display for closer examination without stopping the measurement)	
8	Add / Remove Hardware Modules	Ctrl H
9	Configuration of active View	F12
10	Show / Hide Signal Tree	
11	Auto Arrange View	
12	Preferences (opens "Preferences" page)	
13	Step One Data Set Forward (active in "Replay" mode only)	
14	Pause Replay (active in "Replay" mode only)	Shift
15	Stop (active in "Replay" mode only)	
16	Restart Replay (active in Replay mode only)	F8
17	Toggle Replay Speed / Full Speed (active in Replay mode only)	
18	Replay Speed (active in Replay mode only)	
19	Toggle Recording	
20	Stop (Measurement mode)	F6
21	Configuration of Indoor Input	F8

*: Scrollbars are only visible if "Window" > "Manage Window" is disabled.

The following two figures show the effect of resizing the virtual desktop. The tiles are split and arranged within available desktop space.

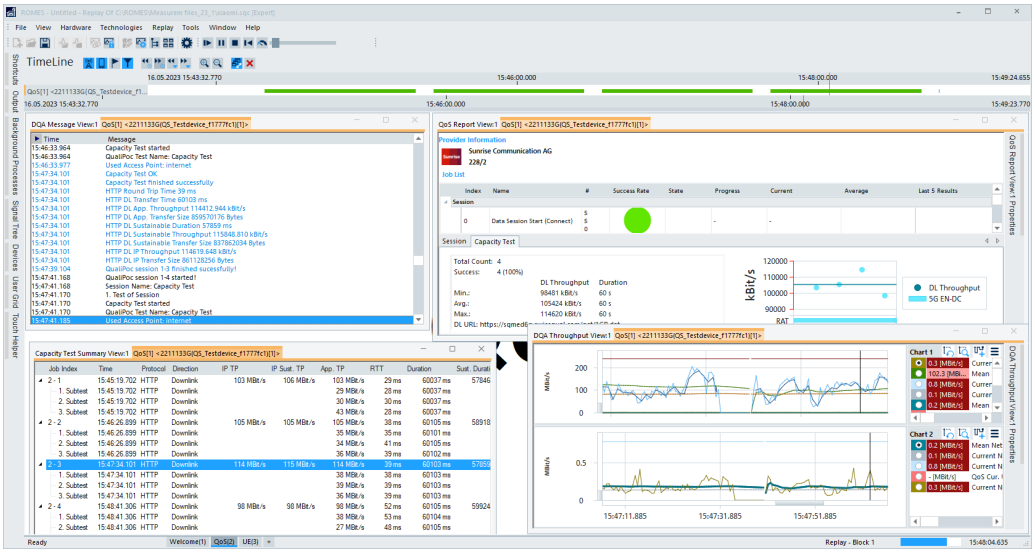


Figure 3-42: DQA views before the resize

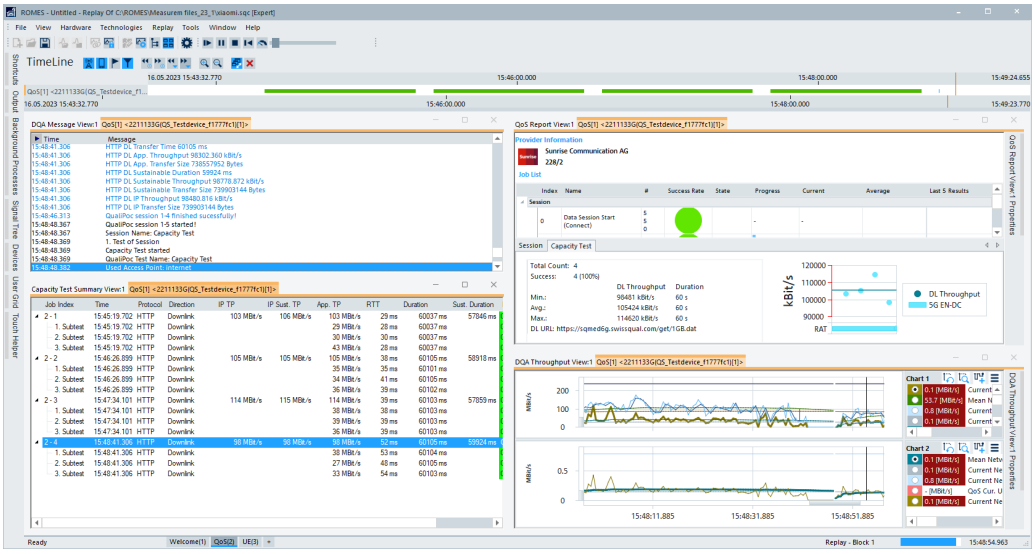


Figure 3-43: DQA views after the resize

Auto Arrange

The Auto Arrange feature is hold per worksheet. Once activated, it arranges the views without overlapping and keeps that arrangement during resize of R&S ROMES4.

To illustrate how to use the Auto Arrange feature:

1. Arrange the views roughly as you like.

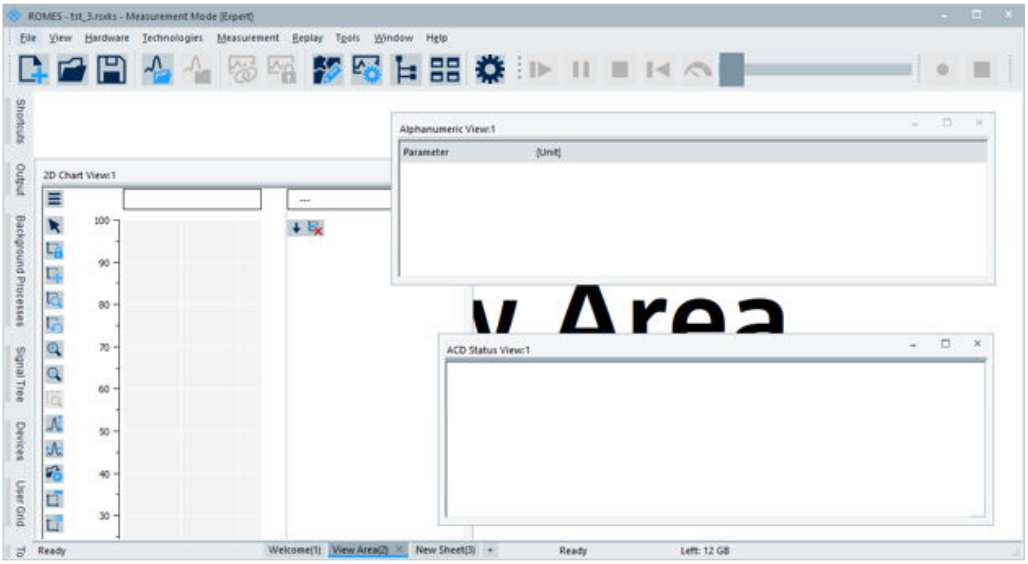


Figure 3-44: Freely arranged views - feature inactive

2. Activate the feature.

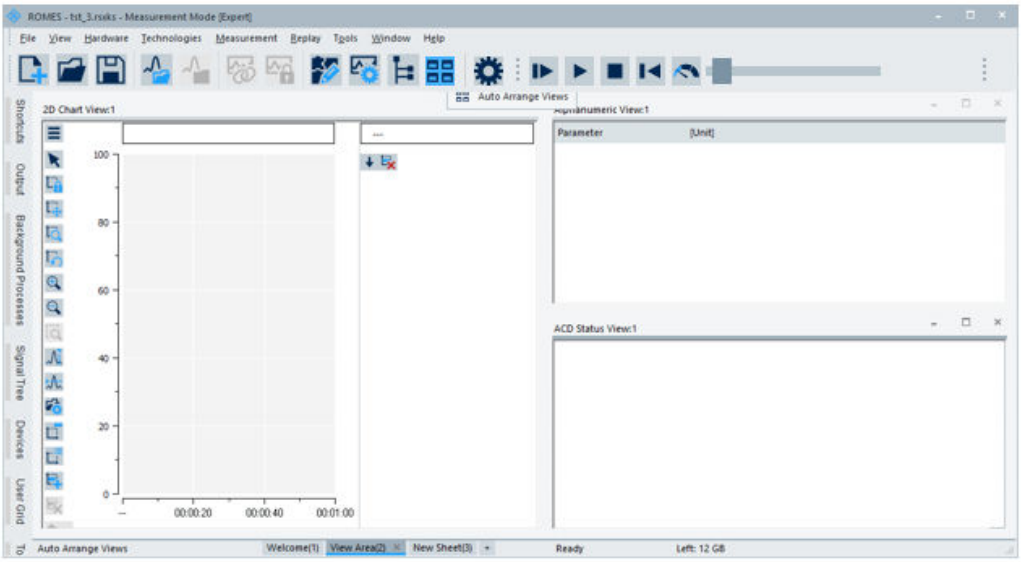


Figure 3-45: Arranged views - feature activated

While in Auto Arrange mode, sizing one side of a single view rearranges all visible views so that the complete worksheet is covered.

The Auto Arrange mode is switched off if:

- Button is triggered again.
- One view is resized on two sides, so that automatic rearrangement is not clear.
- One view is minimized or moved.
- Standard function such as "Cascade" / "Tile horizontal" / "Tile vertical" / "Arrange" is called.

- It is not clear, how the views can be arranged.

Measurement Bar
Displays and hides the measurement bar of the main application window.

The measurement bar offers controls for the most common program tasks for the measurement task. The complete list of measurement commands is available in the Chapter 3.6, "Measurement menu", on page 212.

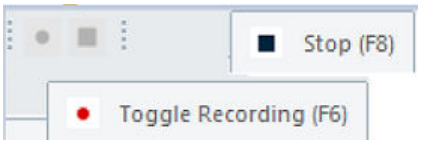


Figure 3-46: Measurement bar

Replay Bar
Displays and hides the replay bar of the main application window. The replay bar disappears during measuring tasks. If the measurement task is stopped, the replay bar is again visible.

The replay bar controls the common replay program tasks. The commands are also available in Chapter 3.3.5, "Replay control", on page 156 dialog.

Figure 3-47: Replay bar

For the functions of the controls, see Table 3-1.

Status Bar
The status bar forms the lower margin of the main window.

It shows and hides the general status of the R&S ROMES4 application on the left-hand side of the bar ("Ready" status).

This "Ready" status is replaced by other information when the mouse hovers over menu or toolbar buttons of the main window.

The status bar contains additional information ("Status of Measurement/Replay") on the right-hand side which changes dependent on whether a measurement or replaying is on.

- In the left-hand part of the status bar you see "Ready" or a short description of the function of a control element in the menu/toolbar.
  - Select the menu item description by the pointer or the cursor key or, simply click the item.
  - Toolbar button description is selected by the pointer (arrow points to the button) or click with the left mouse button.
- The middle part of the status bar contains the view area control tabs ("Welcome", "View Area", etc.).
- The next field of the status bar indicates the free disc space available for storing measurement data. During a measurement or during recording, the time elapsed since the start of the measurement is also shown. In addition, the data rate which is being written to the measurement file during recording is indicated.

- The last right-hand field of the status bar gives the status of data processing. It indicates the status of the current temporary working data set. Possible messages in this part are:

Message	Description
Ready	Ready for measuring or data processing
Replay	Data measured before and stored to a measurement file are being processed and loaded
Replay Pause	Replay process paused
Measurement file open	Status of measurement/replay. When replaying, shows amount of left data or replayed blocks.
Measuring	Measurement running (without data recording)
Recording	Measurement and data recording running

The view area control allows changing the order of the views simply by drag & drop. Click the tab of the view that you want to move. Drag the mouse to the place where you like to insert the view area while keeping the left button pressed.

Also, the names of the view areas can be edited in the tab control. Double-click the tab and enter the new name.

The fields in the right-hand part of the status bar indicate which of the following keys are latched:

Indicator	Description
CAP	The Caps Lock key is latched
NUM	The Num Lock key is latched
SCRL	The Scroll Lock key is latched

The status bar can be hidden to enlarge the main application window. A check mark on the left-hand side of the menu item indicates that the status bar is displayed.

Link Bar

Displays and hides the link bar of the main application window.

The link bar shows additional software applications available for the R&S ROMES4. Otherwise these tools are accessible via the "Tools" submenu of the R&S ROMES4 program menu.

Control	Menu command
	Start the tool R&S Device Manager

Output Bar

Displays and hides the "Output" docking window.

The "Output" window shows the status messages generated by the R&S ROMES4 application.

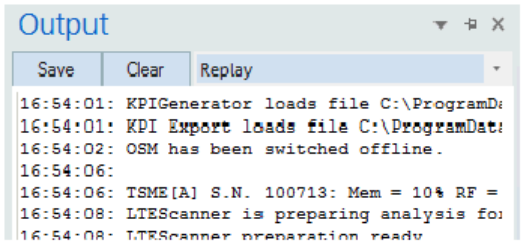


Figure 3-48: Output window - replay messages

The window contains the "Save" button to save the output file to the RTF file format. If pressed, a file dialog appears to save the content of the "Output" window.

Click "Save" to save the status messages as an RTF file. Click "Clear" to clear the current content of the window.

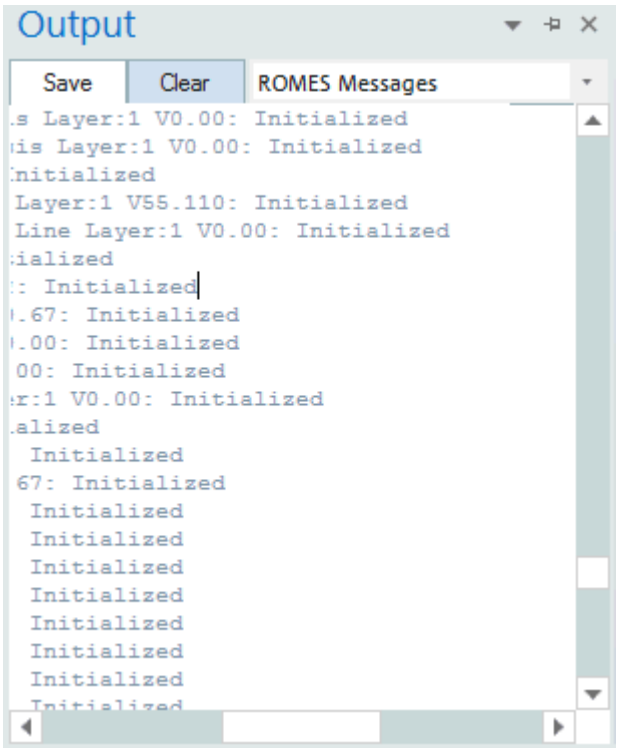


Figure 3-49: Output window - ROMES messages

In the drop-down list of the "Output" window you can select the following messages for display:

- ROMES messages
- Internal messages
- Messages of the currently opened measurement file, the section "Replay"

Signal Tree Bar

Displays and hides the docking window "Signal Tree" in R&S ROMES4.

The "Signal Tree" pane is placed in one of the docking windows.

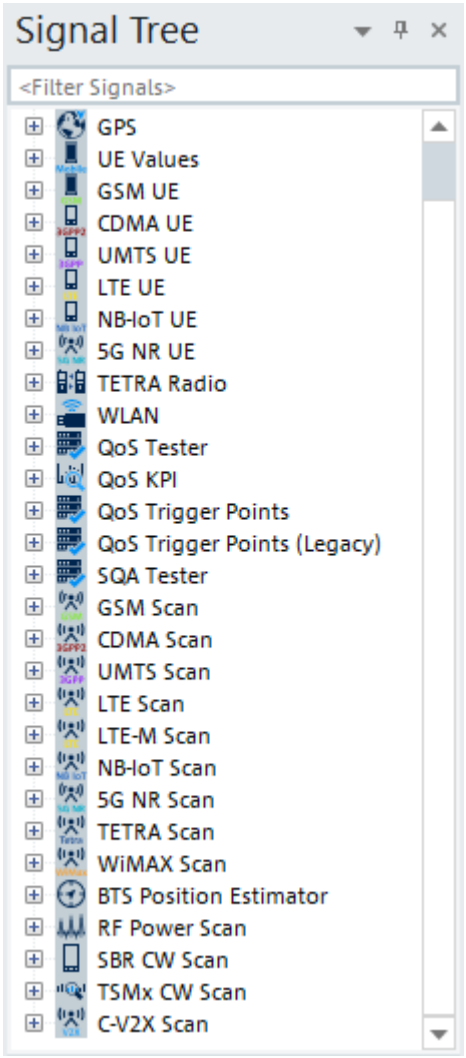


Figure 3-50: Signal Tree window

All signals within a tree's branch appear once for each technology.

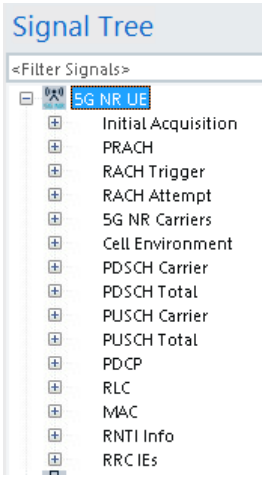


Figure 3-51: Signals under the one branch

This approach requires a device configuration dialog which allows that the device appears in a view when a signal is dragged or configured for use in the view.

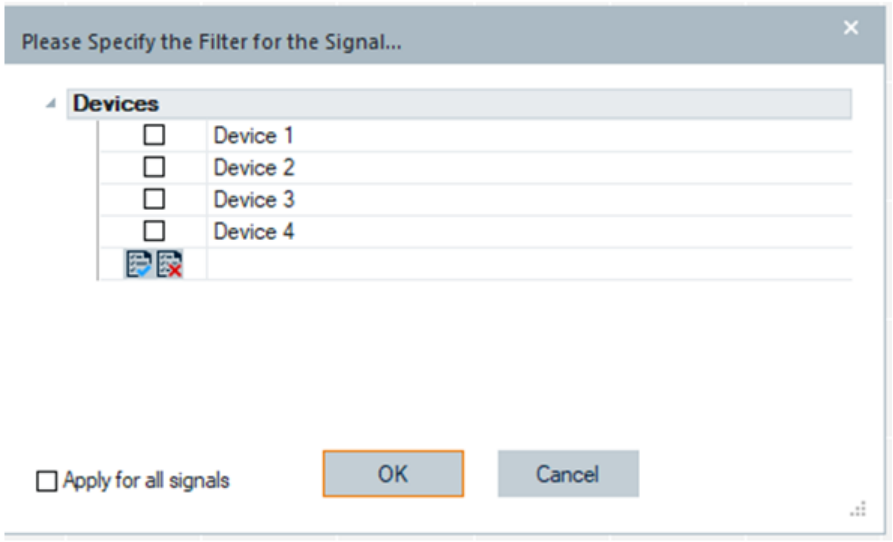


Figure 3-52: Configuration dialog for device

The list of devices shows all available devices for the selected signal of a technology. You can select one or more devices for use in the target view. The dialog allows selection of a limited number of devices. The limitation depends on the requirements of the particular view that is being configured.

If the view limits the number of devices for selection, a message appears next to the "select all" and "remove all" icons. The message indicates the maximum number of allowed device selections.

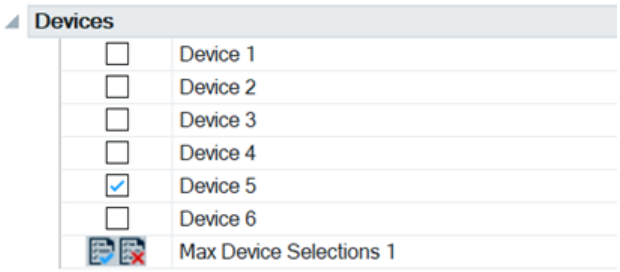


Figure 3-53: Limitation symbols - select all/remove all

If the maximum allowed device selection is one, the check box list behaves like a radio button selection. If you click a check box next to a device while another device is checked, the last one mentioned device is unchecked and the newly selected one checked.

If the maximum allowed device selection is greater than one, once the maximum number of devices is reached, a currently selected device must be deselected. In that way allowed is the selection of a new device.

To select all devices, click the "select all" icon. To deselect all selected devices, click the "remove all" icon.

Note: If the maximum number of allowed devices is less than the number of available devices, the "select all" icon is disabled.

Checking the "Apply for all signals" box, applies the device selection to all currently selected signals. If the check box is unchecked, the selected device is the default device for the next selected signal.

The following views are affected by the described approach:

- 2D Chart View
- Device Grid View
- Grid View
- Statistic View
- Statistic Histogram View
- XY View

Shortcut Bar

Displays and hides the docking window "Shortcuts" in the R&S ROMES4. The window shows several R&S ROMES4 functions that let you fast access to them.

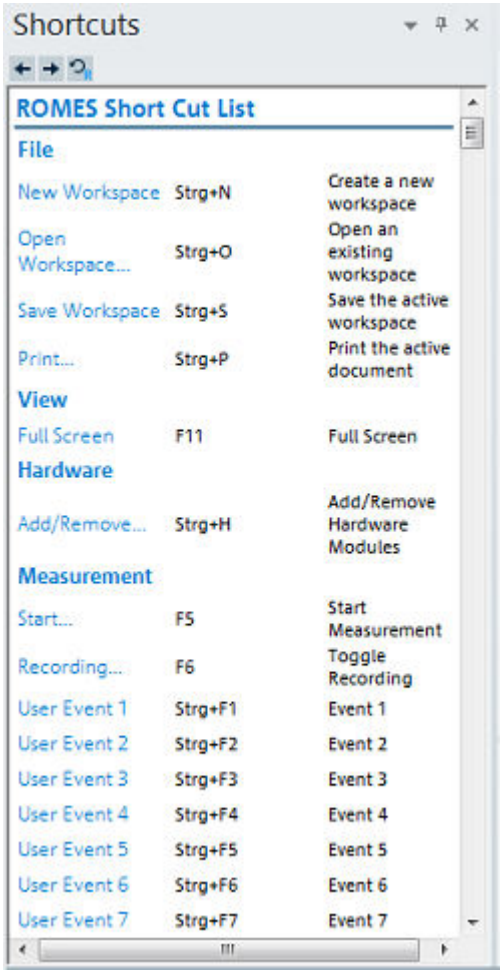


Figure 3-54: Shortcut bar docking window

Devices Bar

Displays the "Devices" window, which includes the devices connected to R&S ROMES4 and their states

The state of a connected device is indicated with a colored circuit icon on the left side of the device. Green icon indicates correct state of the loaded device. If the icon is yellow or red colored, the warning or error overall state of the device is detected, respectively. If the Audio Alarms feature for a device status is activated, detection of these states generates also an audio alert, see Chapter 3.8.1.5, "Notification center", on page 254.

The window shows all available and recognized test devices.

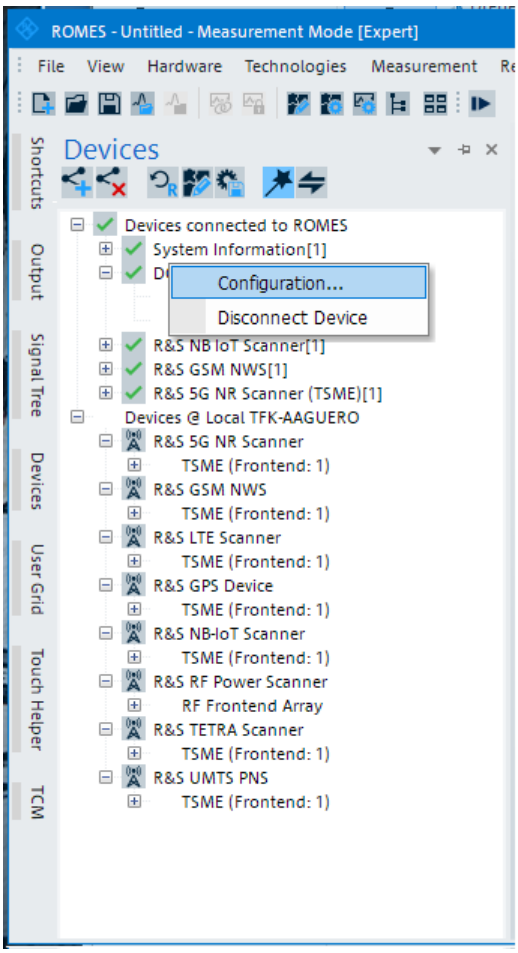


Figure 3-55: Devices window

Click with the right-mouse button the selected device to see device's details.

The functions of the buttons on top of the "Devices" window are described in the following table.

Table 3-2: Meaning of the buttons in the Devices window

Button	Description
	Configure device
	Disconnect selected devices from R&S ROMES4
	Force a rescan of the connected device.
	Opens the Add/Hide Hardware dialog
	Opens one of available Wizards

But-ton	Description
	Automatically opens Views, which are recommended for loaded devices
	Recognized devices are not connected automatically to R&S ROMES4

How to install devices, refer to Chapter 6.1.1, "Devices manager", on page 1448.

User Grid Bar

"User Grid Bar" displays and hides the user grid which can be configured by the user.

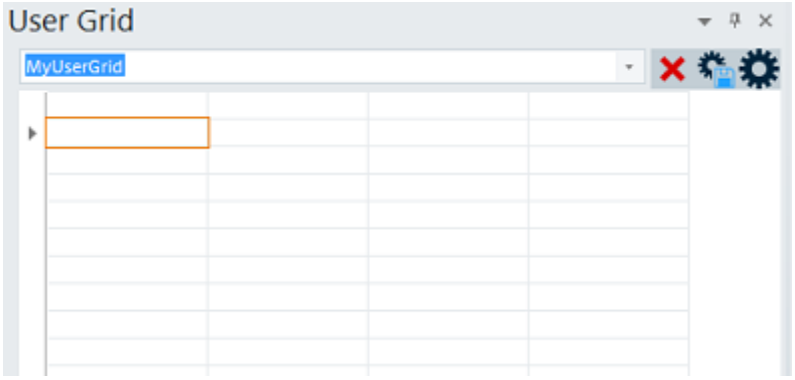


Figure 3-56: User grid docking window

The buttons available in the window are:

- - deletes the currently selected configuration
- - saves current grid configuration to as profile with the given name
- - opens the configuration dialog
  The dialog allows the number of rows and columns to be specified in the grid.

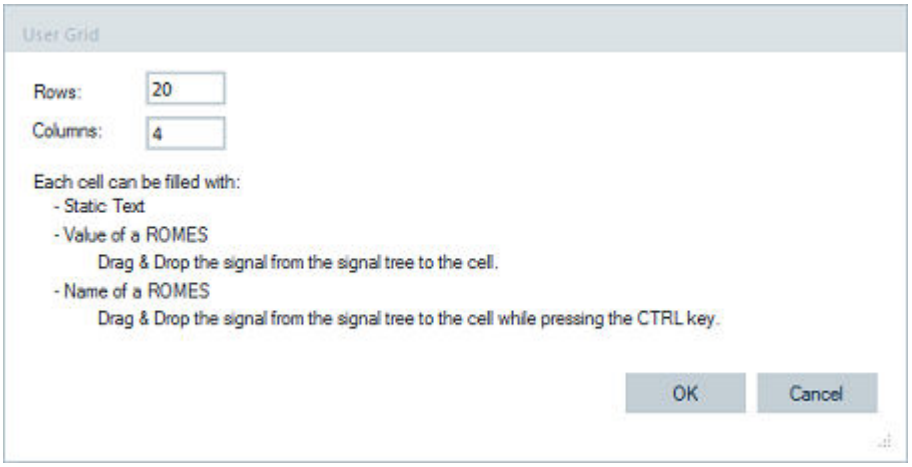


Figure 3-57: User grid settings

Each cell can contain a fixed text, that is, the name of a signal or the value of a signal. To enter a fixed text, double-click the cell and enter the text.

To show the value of a signal, drag & drop the signal from the signal tree to the cell. If you want that the name of the signal is displayed instead of the value, press the CTRL key while dropping the signal to the cell.

The configuration can be stored with the name of the combo box. Users can select a different configuration by choosing another entry of the combo box.

The grid configuration is not stored to the workspace file. The grid configuration is stored in the `MyROMES\Configuration` folder of the current user.

The "User Grid" is always on top of the normal R&S ROMES4 views.

Touch Helper Bar
Displays and hides the docking window "Touch Helper", providing a better usage of touch screens.

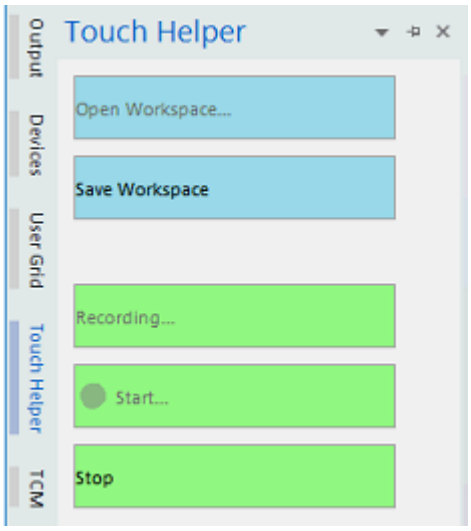


Figure 3-58: Touch helper docking window

R&S ROMES4 offers the possibility to define buttons for certain commands, see Chapter 3.8.1.11, "Touch helper", on page 277. The configured buttons are then placed in the "Touch Helper" bar, which can be pinned to the screen if necessary.

TCM handling
For TCM handling, use the extra tool which is a part of Windows Tray.

To open the detailed TCM view, use the tray icons menu of a module.

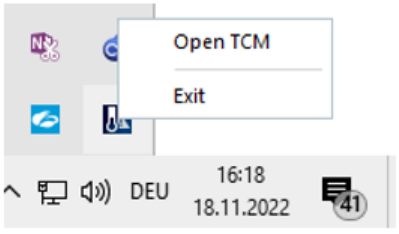


Figure 3-59: TCM tray icon menu

Select the "Open TCM" option.

The TCM dialog is shown on the left hand-side of the R&S ROMES4 "Welcome" page.

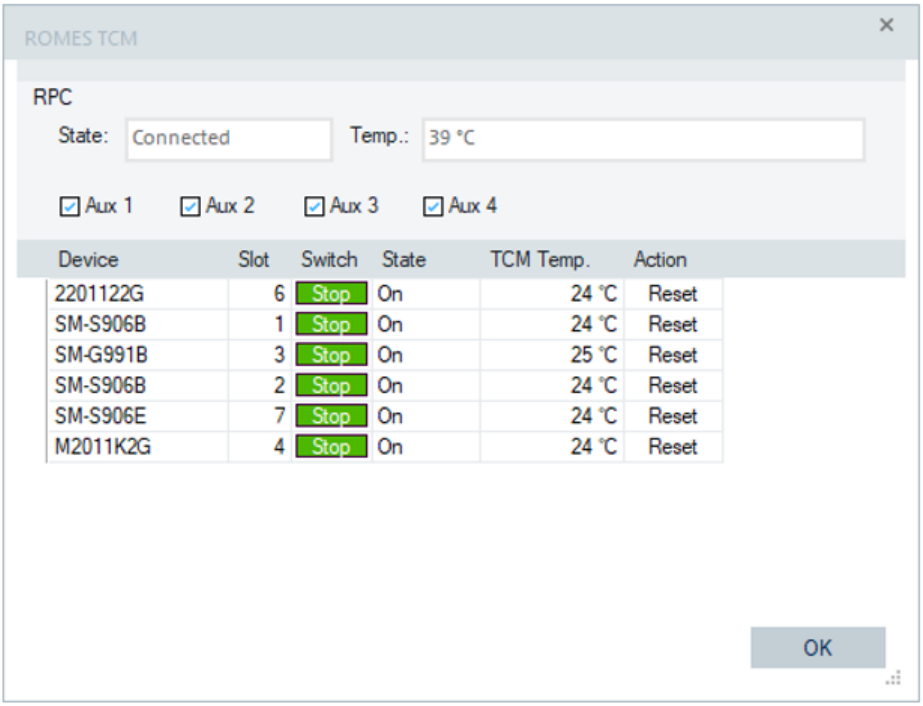


Figure 3-60: Devices names as QP unit names

The "ROMES TCM" dialog displays TCM devices' names as the QP unit names if available.

The dialog contains the section related to RPC, as it has its own sensors for temperature control. Four check boxes "Aux 1" to "Aux 4" are created for switching on/off the 12 V ports of the RPC device.

For the TCM installation, see Chapter 6.4.1.1, "Prerequisites", on page 1513.

Background Processes

If the "Background Processes" context menu is checked, the window shows running background processes, if any.

R&S ROMES4 uses concurrent processes to improve performance. These tasks and their state are visualized in the "Background Processes" window. The window opens if you click the same named bar.

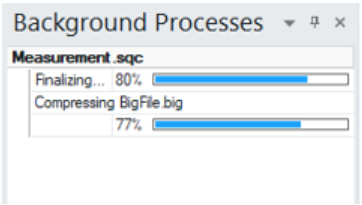


Figure 3-61: Background process window

The progress dialog is available for scanning attached hardware, opening a new measurement file or compressing the file.

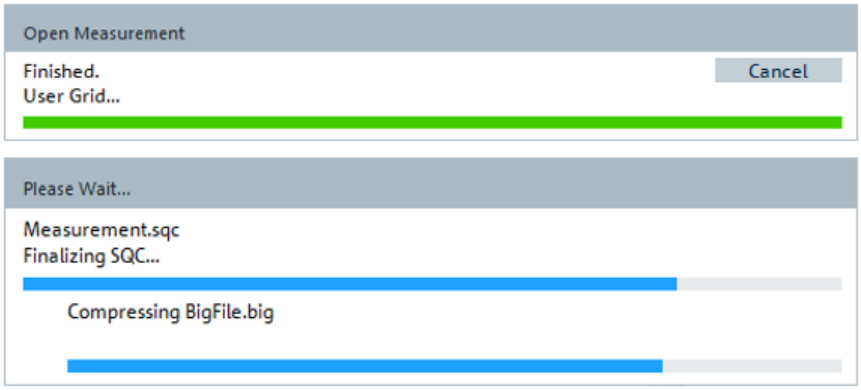


Figure 3-62: Progress dialog scans measurement file

The previous figure illustrates the progress dialog ability to display all concurrent entries.

Time Line

The timeline control gives you a fast feedback on the loaded measurement file, the data available in it and an easy possibility to navigate though the time range. It provides the tool for quick jump to a certain time in the measurement.

Click the "Time Line" command to open the "TimeLine" window.

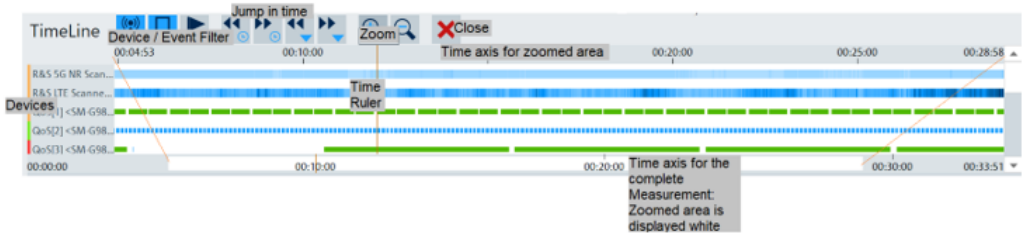


Figure 3-63: TimeLine window

The timeline control is set visible automatically when a measurement file is loaded. It displays all loaded devices (scanners and mobiles) and their respective events if not filtered away. The control allows the time position to access, set and zoom into a time range. While running a replay, the zoomed area follows the time ruler automatically.

As being implemented as a toolbar, the timeline is visible on all tabs.

The meaning of the buttons in the window is described in the following table. The buttons are grouped according to their function.

Table 3-3: Meaning of the buttons in the Time Line window

Buttons	Description
	Display data for scanners and mobiles. Events are shown for displayed devices only.
	Filter button allows devices and events without any displayed data to hide.

Buttons	Description
	Jump in time - use 5 s to jump backwards or forward. The current time is displayed as a time ruler in orange. The ruler can be moved to a different time using the mouse: press mouse button over the time ruler, move the ruler and release the ruler on the desired time.
	Jump to event - jump to the next or last displayed event.
	Zoom in or out into the displayed areas. You can use CTRL+mouse wheel to zoom in or out instead.
	Close the "Time Line" window.

Double-click the desired time in the data area to set the time.

The lower axis displays the complete time range for the entire measurement and acts simultaneous as a scrollbar. The white “button” on the axis shows the zoomed area. Using the mouse, you can drag and drop the left or right end of this button to define the zoomed area.

The zoomed area can be moved by moving the button on the lower axis or by Shift +mouse wheel. The area is updated automatically during replay, so that the current time is always visible.

Mobile display ← Time Line

The DQA jobs execution by mobiles is displayed with their respective start and stop times. These ranges are displayed in green whenever the job was successful, or in red if unsuccessful.

Figure 3-64: Successful DQA job execution with a mobile

If the job's result is undetermined, the outcome is displayed in blue.

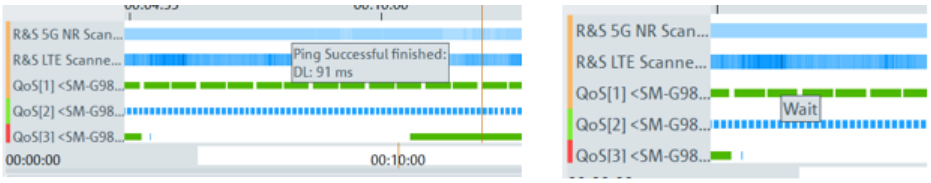


Figure 3-65: Display of undetermined job results with details

To display details, move the mouse pointer over a job.

TETRA mobile timeline display ← Mobile display ← Time Line
The Timeline control is able to visualize SQA measurement from TETRA or classic mobile phones.

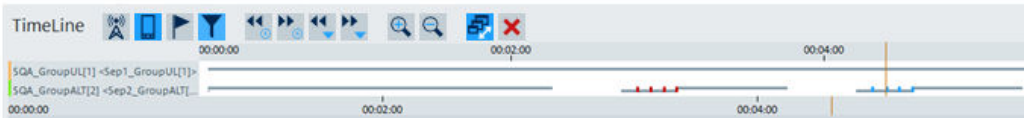


Figure 3-66: Timeline visualization of the SQA measurement from TETRA mobile

SQA messages from TETRA or classic mobiles can be structured in [Up] and [Down] messages. The [Up] message is visualized with a bar above the mid of the device line, the [Down] message is displayed below. Results are marked with a blue vertical bar. Results referencing an error are displayed red.

Scanner display ← Time Line
The count of detected transmitters in a specific time range is displayed for scanners in the "TimeLine" window.

This count is visualized in a blue scale: the darker, the more transmitters have been detected.

Figure 3-67: Displayed detected scanners

Events display ← Time Line
The "TimeLine" window shows also events if available.

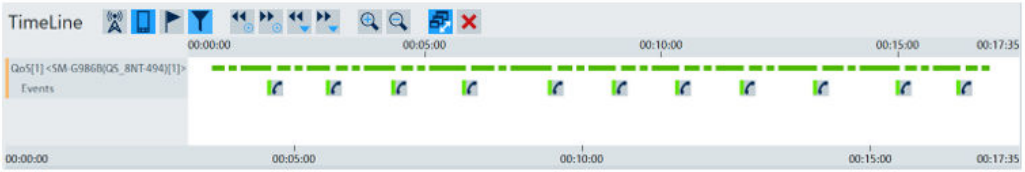


Figure 3-68: Displayed events

Every event is displayed with its icon (centered) at the respective time position. If the zoom factor is too wide, the clustered display of events is applied to avoid their overlapping display.

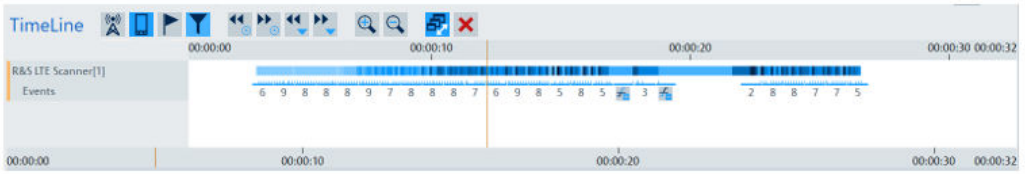


Figure 3-69: Displayed events as clustered

Each cluster has the same width in pixels. Below each cluster, the count of detected events is displayed. On top of the cluster line, the time position of the events is displayed. If only one event fits into one cluster, its icon is drawn instead of the count.

Move over a cluster to display details of the events.

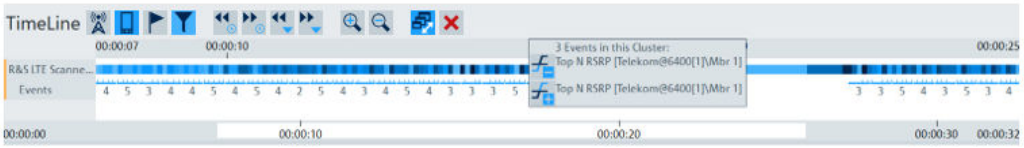


Figure 3-70: Events cluster details

Note: All types of events in this cluster are displayed without duplicates.

If you zoom in deep enough, all events are displayed without clustering.

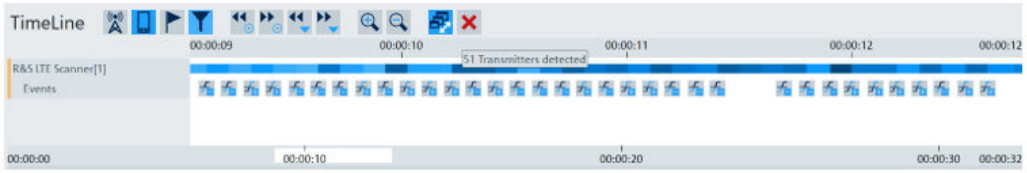


Figure 3-71: Displayed events w/o clustering

3.3.5 Replay control

Opens or closes a dialog to control the replay of a measurement file.

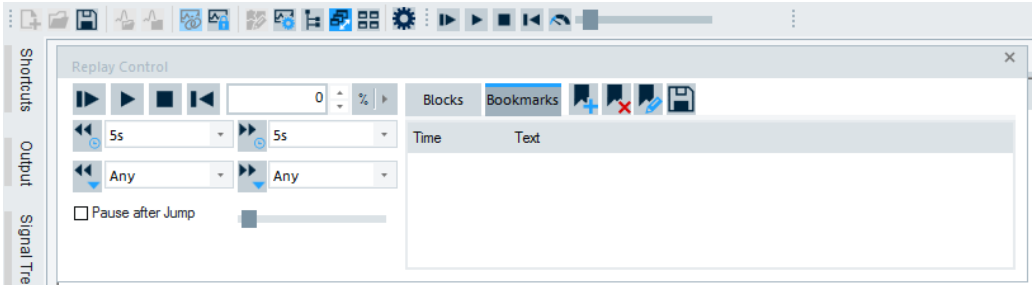


Figure 3-72: Recording buttons in tool bar and Replay control dialog

The "Replay Control" dialog opens automatically each time a measurement file is replayed, if up-front "Show Replay Control Dialog Automatically" is active in the "Preferences" dialog, see Chapter 3.8.1.1, "General settings", on page 224.

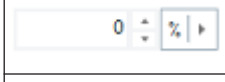
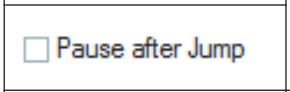
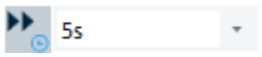
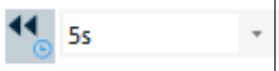
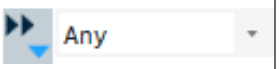
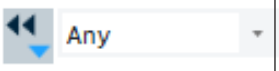
Basic functionality

The "Replay Control" dialog contains the replay control buttons of the replay bar. These buttons correspond to the following "Replay Menu" commands.

Table 3-4: Reply control buttons

Step One Data Set Forward	Stop Replay
/ Pause / Continue Replay These two buttons are unified and toggle between each other.	Restart Replay

Replay Jump

 	The control element to the right of the measurement bar icons defines by which amount R&S ROMES4 can jump forward and back within the measurement file. Together with the "Pause after Jump" checkbox, it corresponds to the Chapter 3.7.7, "Jump", on page 220.
 	The two buttons below the measurement bar icons initiate a replay jump by a selectable amount of time.
 	The two buttons below initiate a replay jump to the previous or next event. The pull-down lists select the relevant events; they give access to the list of available events in the Preferences menu. See Chapter 3.8.1.3, "Available events configuration", on page 238. **Note:** The name of the event can be too long for the panel. The too long event's name does not cause any system problems.
	Shows the speed of measurement file replay.

The unit showing the amount by which R&S ROMES4 jumps can be changed to "s" for seconds and to "m" for meter. The "m" is available only if a trigger device is attached during the measurement.

Block Mode

Blocks The "Show Block List" icon in the right half of the dialog displays the blocks in the measurement file and initiates a replay jump to the next block; if the file contains several blocks. The blocks are listed in the table above the icon; see Chapter 3.7.9, "Replay jump to block", on page 222. A double-click the block initiates a jump to the selected block.

Bookmark Mode

Bookmarks The "Bookmark" icon in the right half of the dialog displays the bookmarks in the measurement file and initiates a replay jump to the next bookmark; if the file contains several bookmarks. The bookmarks are listed in the table above the icon. A double-click the bookmark initiates a jump to the selected bookmark.

Bookmarks can be added or manipulated in the "replay pause" state. The following buttons are related to bookmarks in measurement files:

Add a bookmark	Remove the selected bookmark
Edit selected bookmark	Save bookmark list to meas. file.

3.3.6 View areas

Opens a submenu to rename, create, delete, load and save view areas.

There are entries in the context menu of the work area; see description in chapter Chapter 3.1.2, "View area", on page 94. Also, it provides commands for reusing view areas.

Save default View Area after change of screen resolution

To reuse a default View Area after a change of the screen resolution, load it ("Load View Area") and save it again under a file name containing the new resolution.

Create new View Area
Calls up the "New Sheet" as a view area. The area can be renamed and deleted. It also gives the possibility to create another "New Sheet".

Rename current View Area
Calls up the "View Area Name" window where you can rename the created area view which by default is named New Sheet.

Delete current View Area
Deletes the currently used view area.

Load View Area
Calls up an "Open" dialog box to select and load a View Area file (`*.va`) saved before. All views within the View Area are stored together with their size, position and configuration settings.

The View Area file is in XML format.

Save View Area
Calls up a "Save As" dialog to save the current view area with its views in a View Area file (`*.va`).

3.3.7 Signal tree view

The icon calls up the "Signal Tree" drag&drop tree.

Instead, you can click the "Signal Tree" bar on the left side of the screen. The list of signal groups opens. The opened list lets you select signals within a group you want to be displayed in the current measurement file.

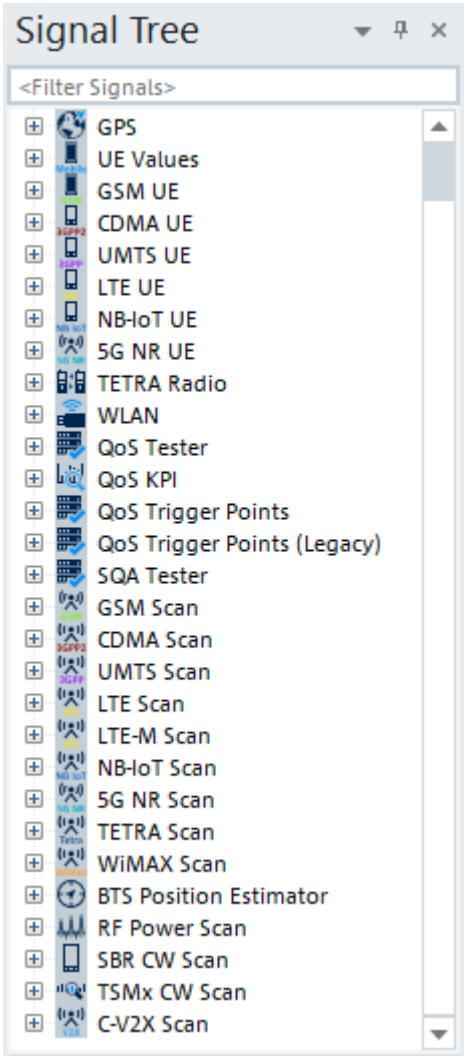


Figure 3-73: Signal tree docking window

The tree displays the branches of the data that are available in the current measurement file. The data tree structure is explained in Chapter 1.10.3, "Data selection", on page 37.

The complete data tree is displayed in a view configuration menu, for example, in the Chapter 4.3.3, "ROMESMAP route track view", on page 562, Chapter 4.2.3, "Alphanumeric view", on page 466, Chapter 4.2.1, "2D chart view", on page 448.

The signal tree view is a fast alternative for selecting a signal or a group of signals to be viewed without opening the view configuration menu.

- Click a single signal to select for displaying.
- Click several signals with pressed SHIFT or CTRL key to select a group of signals.
- Click a technology, device, or data structure node to select all signals below the node.

After drag and drop into the view area, the selected signals appear in the "Selected Parameter", "Selected Signals" lists and in the "Values" tab of the view's configuration menu. They can be removed with the context menu or the view configuration menu.

The GPS distance signal is calculated during the measurement for a GPS device and is available as a separate signal in the "Signal Tree" > "GPS" "Device" tree. The "Distance (GPS)" signal, calculated during the replay process and displayed in the "Position" branch is made obsolete.

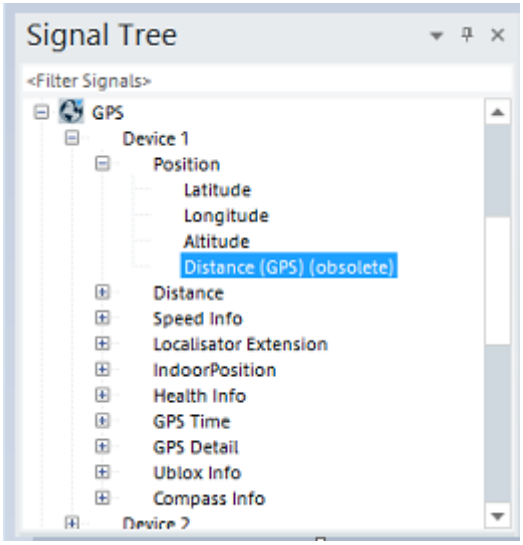


Figure 3-74: GPS Distance - obsolete parameter

3.3.7.1 Support of multi-RAT signals for UE

R&S ROMES4 supports the multi-RAT signals. The signals are included in the "Available Signals" tree under the "UE Values" entry. These signals are part of the UEs and named Generic UE KPIs. The support of multi-RAT signals helps the user to display the corresponding value of the signal for different RATs.

The signals can be used as any other signals, that is, for displaying the values in the alphanumeric view, map view and other views.

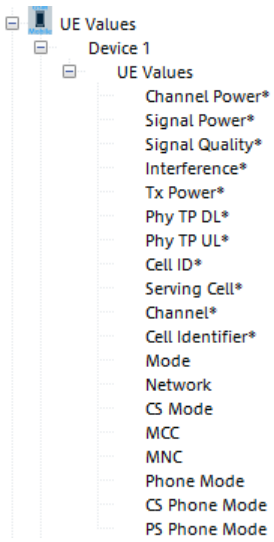


Figure 3-75: Multi-RAT signals for UE

The signals can have different valid ranges and/or units, which is RAT-dependent.

The map view displays the legends of all RAT-dependent signals. The underlays of such a signal is the color of the RAT. In this way it is easier to interpret the color of the track. Those RAT-dependent signals are marked with an "*" sign.

Currently supported multi-RAT signals are shown in the following table.

Table 3-5: Multi-RAT signals

RAT signal	GSM signal	UMTS signal	LTE signal
Channel power	RxlevFull	RSSI	RSSI
Signal power	RxlevFull	RSCP	RSRP
Signal quality	RxQual	Ec/No	RSRQ
Interference	Avg C/I	SIR estimated	SINR
Tx power	Tx power	Tx power	Tx power PUSCH
Cell ID	Cell identity	Cell identity	eNodeB ID/cellID
Serving Cell	Serving cell name from database	Serving cell name from database	Serving cell name from database
Channel	ARFCN	UARFCN	EARFCN
Cell identifier	BSIC	Scrambling code	PCI

RAT signal	GSM signal	UMTS signal	LTE signal
PhyTP DL	Qualcomm: GSM QoS Info RLC DL Rate Samsung: GSM Server Report DL Data Throughput	Qualcomm: UMTS HSDPA Decode Summary MAC Throughput Samsung: UMTS Layer 1 DL Data Throughput	Qualcomm: LTE Total PDSCH Total PDSCH Throughput Ack'd Samsung: LTE Throughput DL Data Throughput
PhyTP UL	Qualcomm: GSM QoS Info RLC UL Rate Samsung: GSM Server Report UL Data Throughput	Qualcomm: UMTS HSUPA Statistics Avg. Total TP Samsung: UMTS Layer 1 UL Samsung: LTE Throughput UL Data Throughput	Qualcomm: LTE PUSCH PDSCH Throughput Samsung: LTE Throughput UL Data Throughput

The "UE Values" branch also contains links to GSM signals, which are valid for all RATs. Selecting the value in the "GSM" or "UE Value" branch has the same effect.

For the signals description, see "R&S ROMES4 Description of Signals" manual.

3.3.7.2 Tooltips for R&S ROMES4 signals

The drag and drop tree offers a Tooltip, which shows the most important attributes of a selected signal.

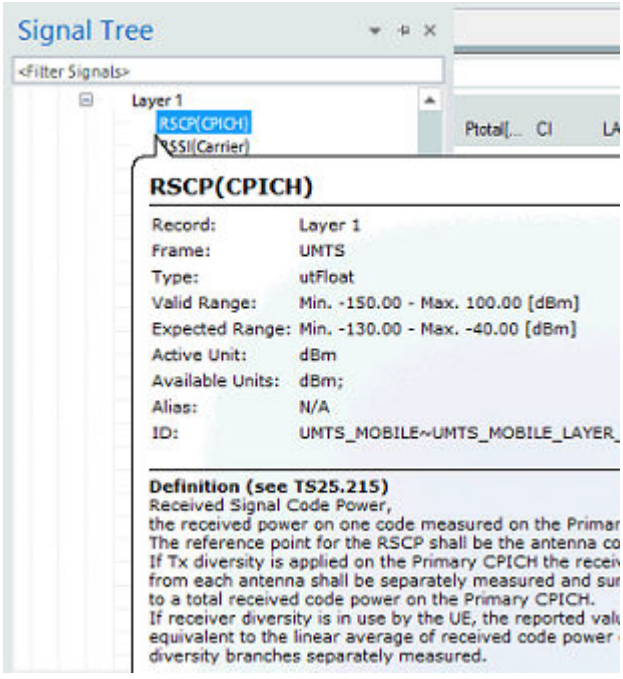


Figure 3-76: Tooltip for UMTS RSCP signal

The Tooltips offer detailed explanations of many signals in the tree, as illustrated in the previous figure.

The explanation of the described R&S ROMES4 signals can be compiled as a single document. For the document, select the "Help" > "Create Signal Description Document" command, see Chapter 3.10.3, "Create signal description document", on page 418.

The result is an HTML file, which can be displayed in the Internet Explorer and printed as a PDF document, if desired.

Open in Browser
Click the "Open in Browser" line in a Tooltip to edit the text in the default browser. While the first and second section of the information is taken directly from the technologies, the third part is taken from a description file.

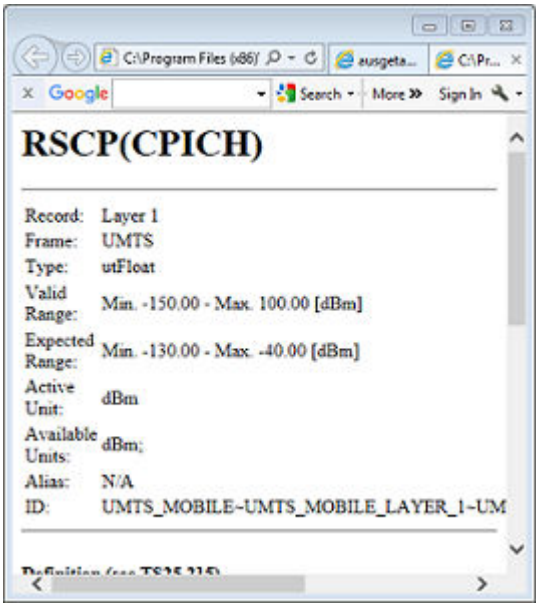


Figure 3-77: Layout of the HTML file

3.3.8 Generic views

The lower part of the "Signal Tree" shows a selection of views that are not designed for a particular technology. In general, these generic, general-purpose views can be used for arbitrary signals, irrespective of the selected measurement file.

The following templates are available in that part:

- ROMESMAP Route Track View
- Basic Views, which include the following views' templates:
  - Alphanumeric View
  - 2D Chart View
  - Statistic View
  - Grid View
  - Device Grid View

  For the views details, see Chapter 4.2, "Basic views", on page 445.

To display one or several ROMES signals from the "Signal Tree" in the R&S ROMES4 generic view:

1. Select the signal or signals from the "Signal Tree" list.
2. Drag and drop them in a selected view type icon of the lower part of "Signal Tree".

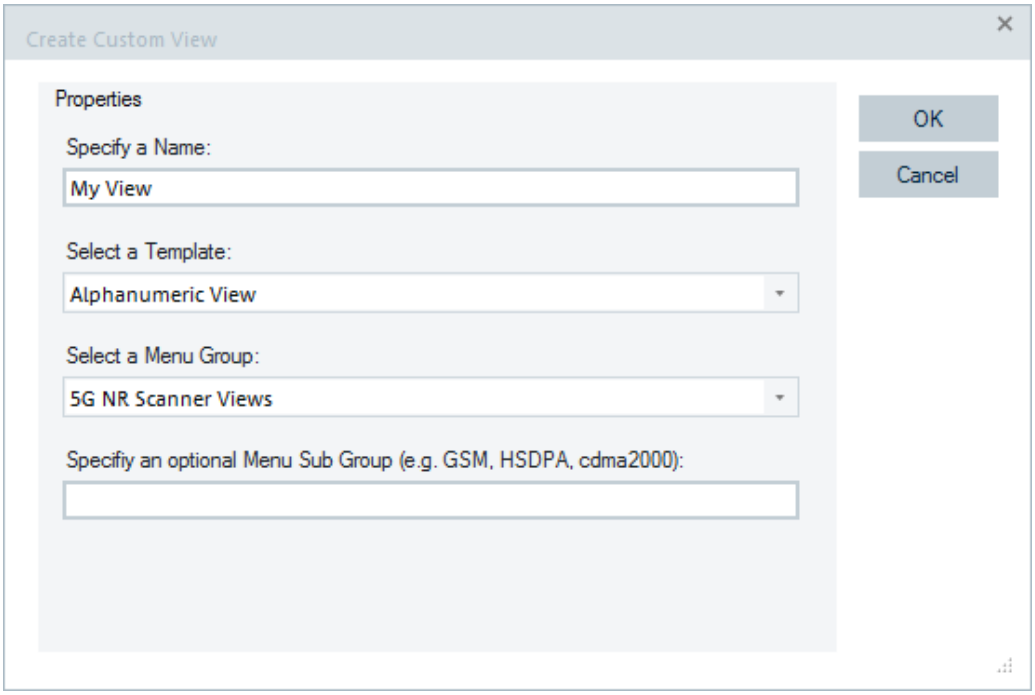
   The signals are included in the view, which opens.

3.3.9 Custom views

These views let you create your own views and administer the existing, available ones.

Figure 3-78: Custom Views

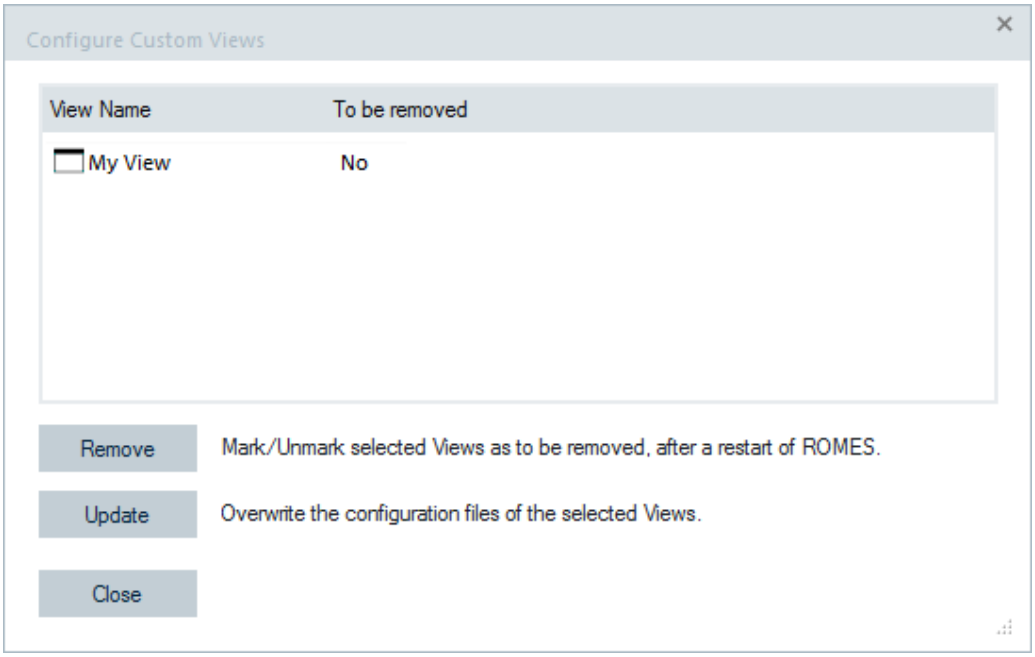
Create New
Click the "Create New" option to open the "Create Custom View" window. Select a unique name for a new view, a template and a menu group, where the new view appears In the dialog. Optionally, a subgroup can be specified.



After leaving the dialog, press "OK".

The view is created and the "My View" dialog is shown. Here you can configure the custom view. This view now appears in the menu and is created each time R&S ROMES4 starts as another view.

Administration
Lets you administer the specified custom views.



- "Remove"
  The button allows the value of the "to be removed" column to toggle. If the column shows "Yes", the view is removed during R&S ROMES4 shutting down.
- "Update"
  The button allows overwriting the configuration file of the view. Next time, the view appears according to the overwritten configuration.

Both buttons impact the appearance of the selected items in the list.

Configuration Files
The list of the custom views is stored in the `<ROMES_DIR>\Configuration\UserDefinedViews.xml` file.

The views configurations are stored is separate files per view. They have the following path:

`<ROMES_DIR>\Configuration\UDViews\<ViewName>.xml`

Note: Do not change the files manually.

3.3.10 Show / hide views

The "Show / Hide Views" shows and arranges or hides the individual R&S ROMES4 view windows.

The view command opens a dialog with the same name.

Users can select/deselect all items in the subtree by clicking a parent item.

Parent Item also indicates one of the following states:

- All views are selected

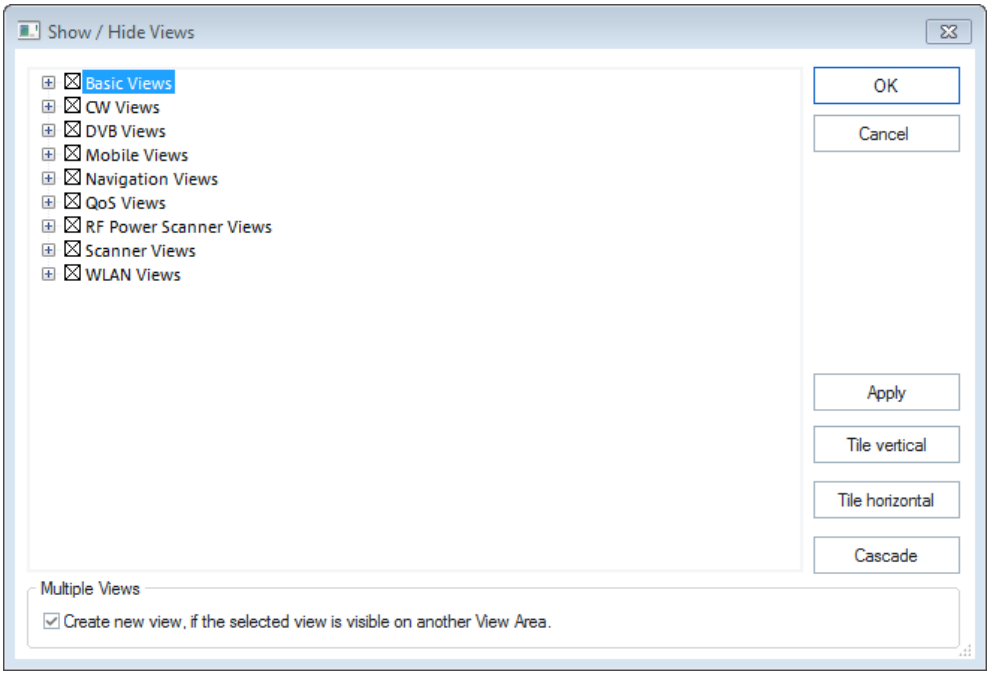


Figure 3-79: All views selected

- No any views selected

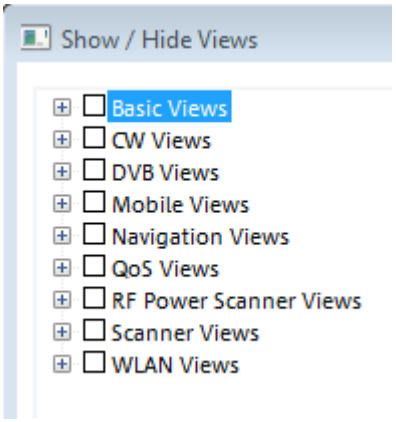


Figure 3-80: No view selected

- At least one view is selected.

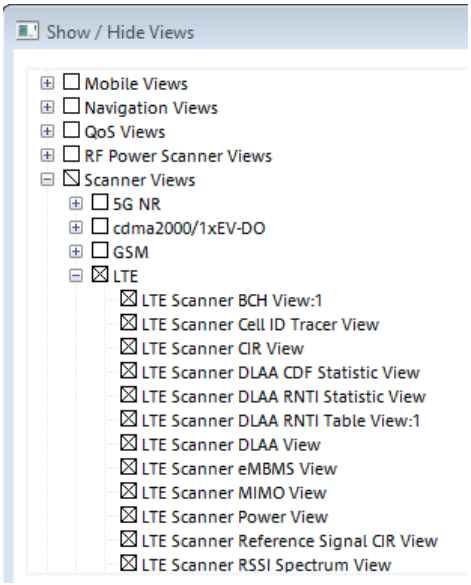


Figure 3-81: Opened views for LTE scanner

If the views are already opened, the associated items in the view are marked as “selected”. The following figure shows the case of opened "ROMESMAP Route Track View".

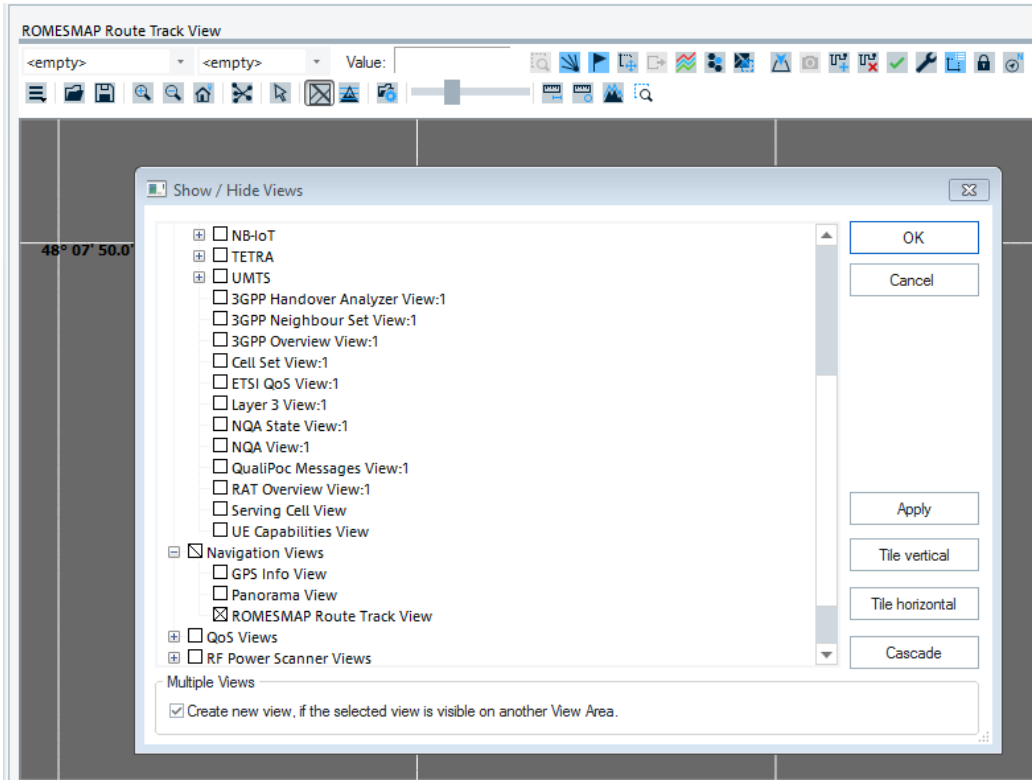


Figure 3-82: Opened ROMESMAP view and marked corresponding item

A view hidden via the "Show / Hide Views" function is temporarily removed from the main window and can be recalled anytime. The R&S ROMES4 workspace contains at least one view of every type. All views can be hidden but only multiple views of the same type (if available) can be destroyed, i.e. permanently removed.

- Main pane
  List of all provided view windows. A view is shown/opened, if selected in the corresponding check box.
- "OK"
  Apply the current settings and close the "Show / Hide Views" dialog.
- "Cancel"
  Discard the current settings and close the "Show / Hide Views" dialog.
- "Apply"
  Apply (preview) the current settings without closing the "Show / Hide Views" dialog.
- "Tile vertical / horizontal"
  The selected views are tiled, i.e. placed side by side so they do not overlap, see Chapter 3.9, "Window menu", on page 414.
- "Cascade"
  The selected views are superimposed, such that all title bars are visible.
- "Multiple Views"
  If "Create new view" is selected, the R&S ROMES4 always creates new views on the current view area and does not affect the views on the other view area sheets. Otherwise, views from other sheets are moved to the current sheet.

3.3.11 Basic views

Offers a selection of views to show information from any technology, see Figure 3-37.

A star (*) displayed behind a view type indicates that the view is not yet loaded in R&S ROMES4. The star appearance is motivated by performance reasons. When the marked view is selected and opened for the first time in R&S ROMES4, the star (*) is removed. That means the view type is now loaded and therefore faster available in R&S ROMES4. If no star is shown, then it is possible that a sign ":1" is displayed behind a view type.

A sign ":1" displayed behind a view type indicates that several views of the same type with different configurations can be opened simultaneously. How to create several views of the same type, see sections "Create new view of the same type" on page 100 and "New Window" on page 415.

Basic Views can be specified as default views for the corresponding technologies.

The following templates are available in that panel:

- 2D Char View
- ACD Status View

- Alphanumeric View
- Bar Char View
- Device Grid View
- Event View
- General Status View
- Grid View
- Message View
- Resource Usage View
- Statistic Histogram
- Statistic View
- Time Gated Spectrum View
- X-Y Graph

For detailed information, refer to Chapter 4.2, "Basic views", on page 445.

- Chapter 4.2.1, "2D chart view", on page 448
  Shows the current measurement data as a function of time. In practice, an unlimited number of 2D-charts can be defined simultaneously.
- Chapter 4.2.2, "ACD status view", on page 461
  Shows the status of use cases related to automatic channel detection for different technologies.
- Chapter 4.2.3, "Alphanumeric view", on page 466
  Shows information about the selected parameters. Several alphanumeric views corresponding to different connected mobile stations can be opened simultaneously.
- Chapter 4.2.4, "Bar chart view", on page 471
  Shows measurement data in a flexible bar chart.
- Chapter 4.2.5, "Device grid view", on page 477
  Shows any available signal during replay or measurement.
- Chapter 4.2.6, "Event view", on page 498
  Shows all events that occurred during the measurement.
- Chapter 4.2.7, "General status view", on page 501
  List of device messages of general interest.
- Chapter 4.2.8, "Grid view", on page 504
  Shows any available signal during replay or measurement.
- Chapter 4.2.9, "Message view", on page 515
  Detailed, chronological list of the system messages generated during the measurement.
- Chapter 4.2.11, "Statistic histogram", on page 525
  Collection of several diagrams to show a statistical evaluation of a signal.
- Chapter 4.2.12, "Statistic view", on page 532
  Shows the most common statistical key indicators of any R&S ROMES4 signal.
- Chapter 4.2.14, "X-Y graph view", on page 543

The X-Y graph (or scatter plot) can be used to set two signals in correlation to each other. That is, the value of one signal is used as x value, the value of another signal as y value.

3.3.12 CW views

Offers the "Alphanumeric View" to monitor a continuous wave (CW) measurements using a test receiver.

A star "*" displayed behind the view type indicates that the view is not yet loaded in R&S ROMES4. The star appearance is motivated by performance reasons. When the marked view is selected and opened for the first time in R&S ROMES4, the star is removed. That means, the view type is now loaded and therefore faster available in R&S ROMES4. If no star is shown, then it is possible that a sign ":1" is displayed behind the view type.

In general, the sign displayed behind a view type indicates that several views of the same type with different configurations can be opened simultaneously. How to create several views of the same type see sections "Create new view of the same type" on page 100 and "New Window" on page 415.

For more information, refer to Chapter 4.5, "CW views", on page 1058.

3.3.13 Mobile views

The views offer a selection of views to show, for example, GSM, UMTS, TETRA, LTE, NB-IoT, 5G NR mobile data.

The "Mobile Views" display different views depending on the selected supported technologies:

- For UMTS, see Chapter 3.3.13.6, "UMTS", on page 176
- For TETRA, see Chapter 3.3.13.9, "TETRA", on page 178 (not default, has to be enabled during the R&S ROMES4 installation)
- For LTE, see Chapter 3.3.13.7, "LTE", on page 177
- For NB-IoT, see Chapter 3.3.13.8, "NB-IoT", on page 177
- For 5G NR, see Chapter 3.3.13.1, "5G NR", on page 172
- For HSDPA/HSUPA, see Chapter 3.3.13.4, "HSDPA", on page 174/Chapter 3.3.13.5, "HSUPA", on page 175
- For GSM/GPRS, see Chapter 3.3.13.3, "GSM", on page 173/Chapter 3.3.13.2, "GPRS", on page 172

The lower part of the mobile views list contains the views that are common for several technologies (most of them for 4G and 5G NR UEs).

For detailed information about one particular view of these views, refer to Chapter 4.4, "Mobile views", on page 686.

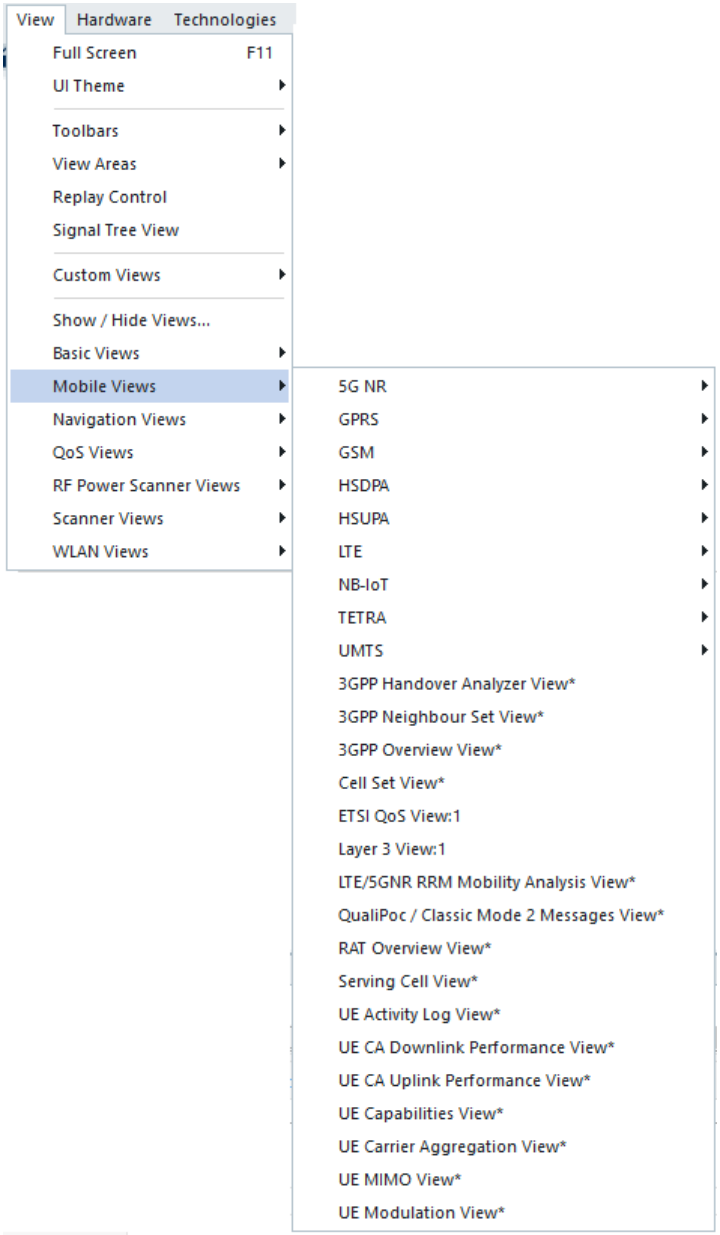


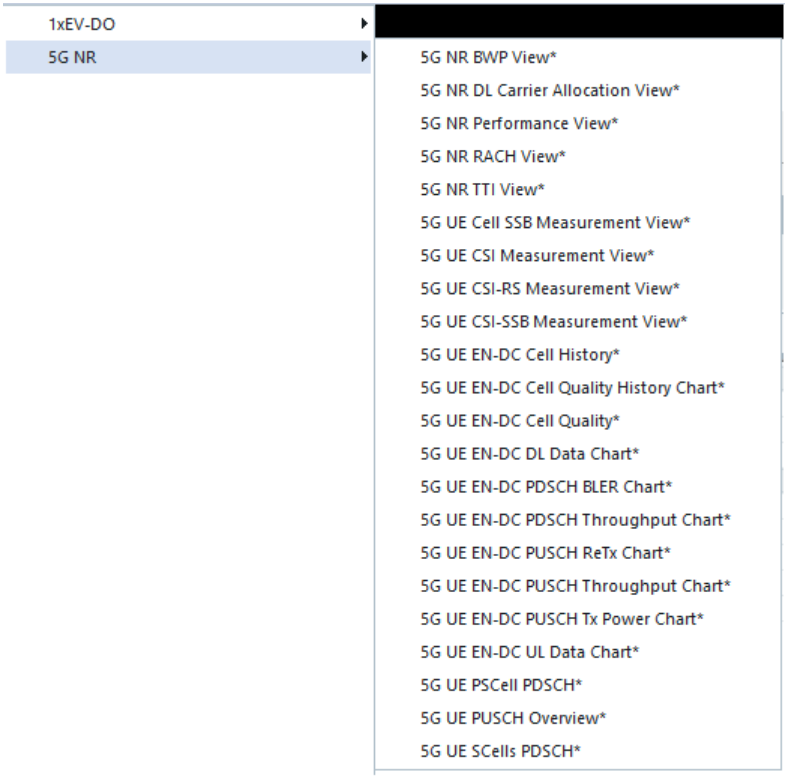
Figure 3-83: Default mobile views

A star (*) displayed behind a view type indicates that the view is not yet loaded in R&S ROMES4. The star appearance is motivated by performance reasons. When the marked view is selected and opened for the first time in R&S ROMES4, the star (*) is removed. That means the view type is now loaded and therefore faster available in R&S ROMES4. If no star is shown, then it is possible that a sign ":1" is displayed behind a view type.

A sign ":1" displayed behind a view type indicates that several views of the same type with different configurations can be opened simultaneously. How to create several views of the same type, see sections "Create new view of the same type" on page 100 and "New Window" on page 415.

3.3.13.1 5G NR

Offers a selection of views of a 5G NR mobile signals.

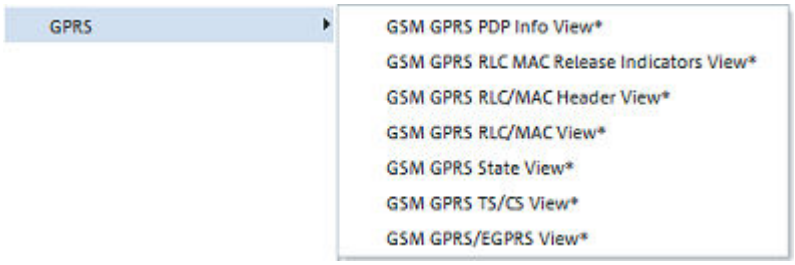


See Chapter 4.4.8, "5G NR views", on page 859.

3.3.13.2 GPRS

Offers a selection of views of a GPRS mobile signal.

GPRS views can be opened anytime, however, they are empty unless GPRS data are available.



For detailed information, refer to Chapter 4.4.4, "GPRS views", on page 770.

- Chapter 4.4.4.2, "GSM GPRS state view", on page 771
  List of parameters characterizing the operating state of mobile phones supporting GPRS.
- Chapter 4.4.4.3, "GSM GPRS PDP info view", on page 772

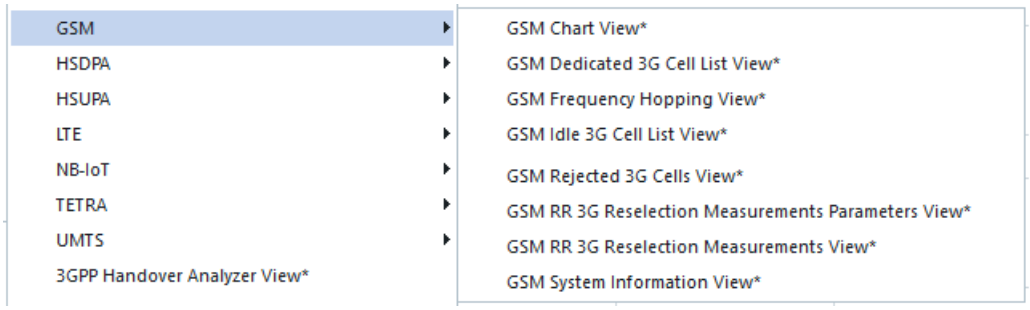
List of important Packet Data Protocol (PDP) parameters of mobile phones supporting GPRS.

- Chapter 4.4.4.4, "GSM GPRS RLC/MAC view", on page 774
  Overview of important Radio Link Protocol/Medium Access Control parameters of mobile phones supporting GPRS.
- Chapter 4.4.4.5, "GSM GPRS TS/CS view", on page 780
  Statistical evaluation of the number of timeslots (TS) that are active in the connection and the Coding Scheme (CS) that is used for the transmission of radio blocks.
- Chapter 4.4.4.6, "GSM GPRS RLC/MAC header view", on page 782
  List of the exchanged RLC/MAC block header information.
- Chapter 4.4.4.7, "GSM GPRS/EGPRS view", on page 785
  Control and physical parameters of a GPRS and EGPRS connection.
- Chapter 4.4.4.8, "GSM GPRS RLC MAC release indicators view", on page 788
  Control and physical parameters of the connection release information, such as the cause of the release, statistical parameters and the release indicator description, if supplied.

3.3.13.3 GSM

Offers a selection of views of the GSM mobile signals.

GSM views can be opened anytime, however, they are empty unless GSM data are available.



For detailed information, refer to Chapter 4.4.5, "GSM views", on page 790.

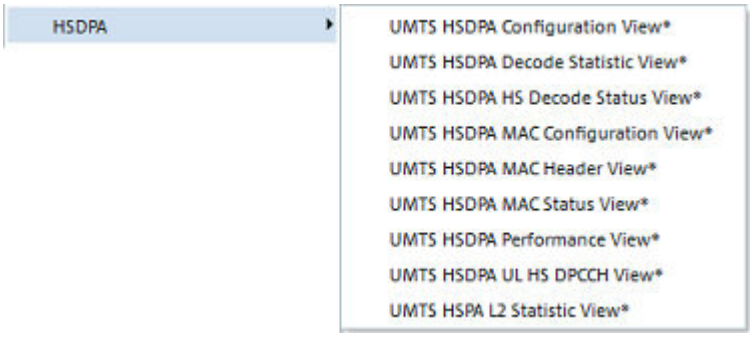
- Chapter 4.4.5.8, "GSM system information view", on page 808
  List of the GSM parameters in the Layer 3 messages System Information Type 1 to 6 sent by the BTS.
- Chapter 4.4.5.3, "GSM frequency hopping view", on page 794
  List of the frequency hopping parameters of GSM mobile phones.
- Chapter 4.4.5.2, "GSM dedicated 3G cell list view", on page 792
  Overview of the measured dedicated 3G cell parameters.
- Chapter 4.4.5.4, "GSM idle 3G cell list view", on page 796
  Overview of the measured idle 3G cell parameters.
- Chapter 4.4.5.6, "GSM RR 3G reselection measurements view", on page 803
  An overview of the Radio Resource 3G reselection measurement results.
- Chapter 4.4.5.7, "GSM rejected 3G cells view", on page 805
  Overview of the determined 3G cell parameters for rejected cells.

- Chapter 4.4.5.5, "GSM RR 3G reselection measurements parameters view", on page 799
  An overview of the Radio Resource 3G reselection measurement parameters.
- Chapter 4.4.5.1, "GSM chart view", on page 790
  Display of GSM layer 1 parameters in a 2D chart.

3.3.13.4 HSDPA

Offers a selection of views of the UMTS HSDPA mobile signals.

HSDPA views can be opened anytime, however, they are empty unless HSDPA data are available.



For detailed information, refer to Chapter 4.4.2, "UMTS HSDPA views", on page 714.

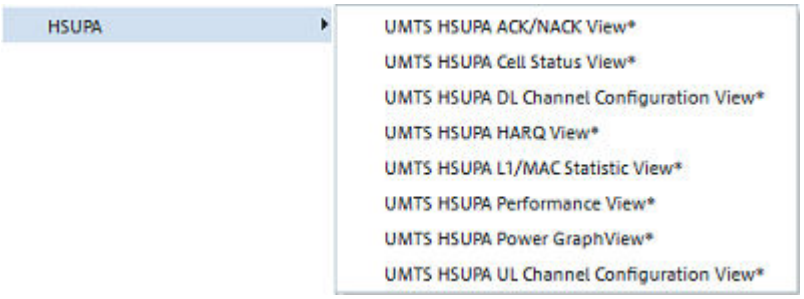
- Chapter 4.4.2.2, "UMTS HSDPA UL HS-DPCCH view", on page 718
  CQI values reported by the test mobile in the last 100 HSDPA subframes.
- Chapter 4.4.2.3, "UMTS HSDPA HS decode status view", on page 721
  Status of the HS-SCCH demodulation and the decoded HS-SCCH information.
- Chapter 4.4.2.4, "UMTS HSDPA configuration view", on page 724
  Configuration of the DL HSDPA channels received by the test mobile, the UL HS-DPCCH, and information related to the finger configuration command, the DL HS-SCCHs, and the active HARQ processes.
- Chapter 4.4.2.5, "UMTS HSDPA MAC configuration view", on page 727
  Configuration of the MAC-hs that the test mobile receives from the network.
- Chapter 4.4.2.6, "UMTS HSDPA MAC status view", on page 729
  Overview of the status of the reordering entity in the mobile receiver.
- Chapter 4.4.2.7, "UMTS HSDPA MAC header view", on page 732
  Mobile-specific subframe number and the corresponding (HS-DSCH) MAC-hs headers as defined in standard 2GPP TS 25.321.
- Chapter 4.4.2.8, "UMTS HSDPA performance view", on page 735
  Transmission performance parameters, given in terms of the requested or achieved data throughput.
- Chapter 4.4.2.9, "UMTS HSDPA decode statistic view", on page 737
  Statistical evaluation of the received DL HS-DSCH transport blocks, together with the block error rate and the number of retransmissions needs successful decoding of the blocks of each size.
- Chapter 4.4.2.10, "UMTS HSPA L2 statistic view", on page 740

Shows information about the used PDU size.

3.3.13.5 HSUPA

Offers a selection of views of the UMTS HSUPA mobile signals.

HSUPA views can be opened anytime, however, they are empty unless HSUPA data are available.



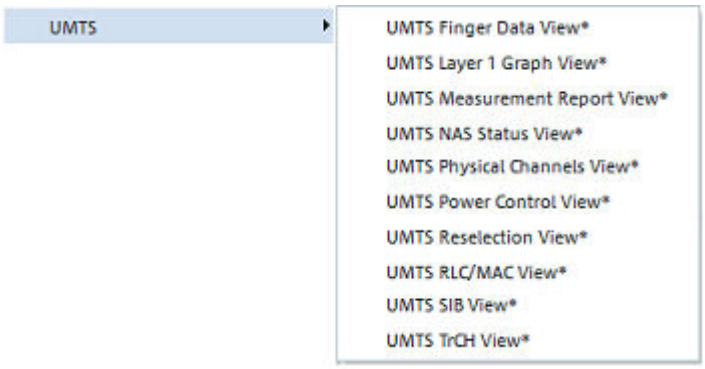
For detailed information, refer to Chapter 4.4.1, "UMTS HSUPA views", on page 688.

- Chapter 4.4.1.1, "UMTS HSUPA ACK/NACK view", on page 689
  Shows the used transport block sizes per TTI. The y-axis shows the TBS and the x-axis represents the TTIs.
- Chapter 4.4.1.2, "UMTS HSUPA cell status view", on page 690
  Shows events per TTI for HICH, RGCH, and AGCH for the mobile, serving cell and non-serving cells of the mobile.
- Chapter 4.4.1.3, "UMTS HSUPA DL channel configuration view", on page 693
  DL parameters of the active HSUPA connections, which were transmitted in the corresponding RRC messages. The power-offset table shows the basic information about the inputs of the mobiles' transmit power calculation.
- Chapter 4.4.1.4, "UMTS HSUPA HARQ view", on page 697
  Shows the characteristics of all HARQ processes of the test mobile, and a statistical evaluation of the received UL E-DCH transport blocks.
- Chapter 4.4.1.5, "UMTS HSUPA L1/MAC statistic view", on page 699
  Shows a configurable selection of the statistics parameters provided by the mobile itself.
- Chapter 4.4.1.6, "UMTS HSUPA performance view", on page 705
  Four preconfigured 2D charts showing signals related to the transmission performance in terms of the requested or achieved data throughput.
- Chapter 4.4.1.7, "UMTS HSUPA power graph view", on page 708
  Shows the most important absolute and relative power values for the HSUPA session.
- Chapter 4.4.1.8, "UMTS HSUPA UL channel configuration view", on page 710
  UL parameters of the active HSUPA connections, which were transmitted in the corresponding RRC messages. The power-offset table shows the basic information about the inputs of the mobiles' transmit power calculation.

3.3.13.6 UMTS

Offers a selection of views of the UMTS mobile signals.

UMTS views can be opened anytime; however, they are empty unless UMTS data are available.

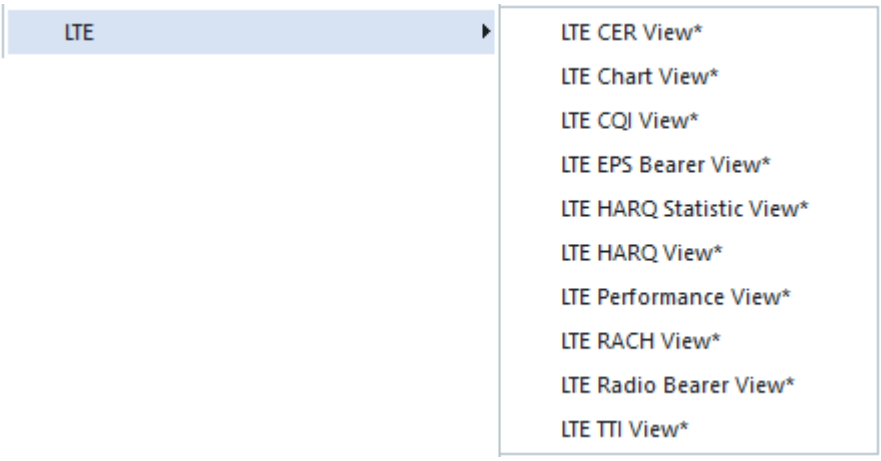


For detailed information, refer to Chapter 4.4.3, "UMTS views", on page 742.

- Chapter 4.4.3.1, "UMTS finger data view", on page 743
  Layer 1 parameters characterizing the different downlink WCDMA signals received by the mobile, captured with the different branches (fingers) of the test mobile UMTS RAKE receiver.
- Chapter 4.4.3.2, "UMTS NAS status view", on page 746
  Higher-layer (Non-Access Stratum, NAS) parameters of the serving cell and the connection.
- Chapter 4.4.3.3, "UMTS TrCH view", on page 749
  Channel coding parameters in the downlink and uplink Transport Channels (TrCHs).
- Chapter 4.4.3.4, "UMTS physical channels view", on page 753
  Physical channel parameters in the downlink and uplink WCDMA signals.
- Chapter 4.4.3.5, "UMTS SIB view", on page 758
  Tree view of the exchanged System Information Blocks.
- Chapter 4.4.3.6, "UMTS RLC/MAC view", on page 760
  Display of important Radio Link Control/Medium Access Control parameters of UMTS mobile phones.
- Chapter 4.4.3.7, "UMTS measurement report view", on page 763
  Intra-frequency measurement results that the test mobile sends to the network in a Measurement Report RRC message.
- Chapter 4.4.3.9, "UMTS reselection view", on page 766
  Display of parameters that are used for cell reselection of UMTS mobile phones.
- Chapter 4.4.3.8, "UMTS power control view", on page 765
  Transmitter output power and closed loop power control parameters of a UMTS mobile.
- Chapter 4.4.3.10, "UMTS Layer 1 graph view", on page 770
  Display of UMTS or GSM layer 1 parameters in a 2D chart.

3.3.13.7 LTE

Offers a selection of views of the LTE mobile signals.



For detailed information refer to:

- Chapter 4.4.6.1, "LTE CER view", on page 811
  Shows the reported CER values for antennas.
- Chapter 4.4.6.3, "LTE chart view", on page 814
  Shows the current measurement, for example, Tx and Rx Power or Error Rates as a function of time in a predefined 2D chart.
- Chapter 4.4.6.2, "LTE CQI view", on page 812
  Shows the reported CQI values of the downlink transmission.
- Chapter 4.4.6.5, "LTE HARQ statistic view", on page 819
  Shows statistics about the used transport block sizes and the necessary retransmission.
- Chapter 4.4.6.6, "LTE HARQ view", on page 822
  Shows detailed information about the HARQ processes in downlink and uplink direction.
- "LTE Performance View"
  Offers a quick overview of the most important parameters concerning the LTE downlink performances.
- Chapter 4.4.6.8, "LTE RACH view", on page 828
  Shows information on the test-mobile's RACH procedures during the measurement.
- Chapter 4.4.6.9, "LTE radio bearer view", on page 841
  Shows the currently active bearers.

3.3.13.8 NB-IoT

Offers a selection of views of a NB-IoT mobile signals.

- Chapter 4.4.7.1, "NB-IoT details view", on page 854
  Provides an in-depth view of the NB-IoT procedures.
- Chapter 4.4.7.2, "NB-IoT NPRACH view", on page 857
  Shows the NPRACH information.

3.3.13.9 TETRA

Offers a selection of views of the TETRA mobile signals.

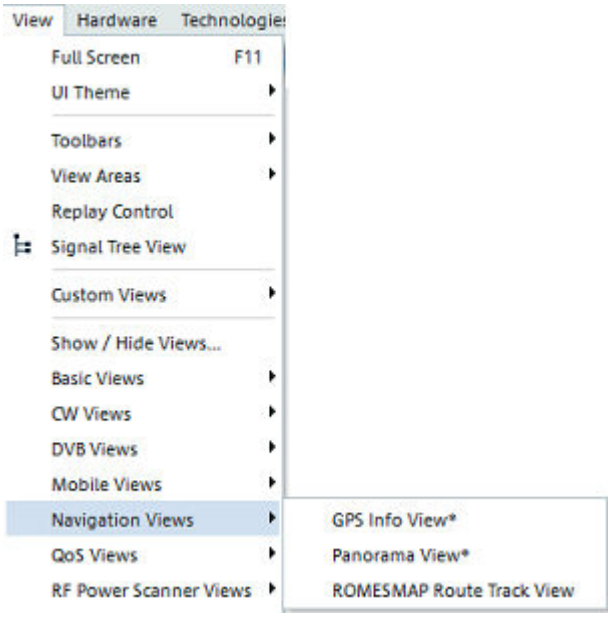
For detailed information, refer to Chapter 4.4.9, "TETRA views", on page 890.

- Chapter 4.4.9.1, "TETRA graph view", on page 891
  Shows on a 2D Chart the RSSI and the C1 of the current server and the RSSI and the C2 of the best neighbor.
- Chapter 4.4.9, "TETRA views", on page 890
  Provides the summary of the test mobile state, the received power of the radio signal and the corresponding quality of the server cell and the best neighbor. Also provides information about active cell set and system parameters. If applicable, provides the results from a connected TETRA scanner which give a quick overview of the current situation.

3.3.14 Navigation views

Offers a selection of views to display data in a map.

The Geographic Positioning System (GPS) is used to visualize data with valid geographical information (longitude/latitude parameters) in a map or to retrieve geographic information assigned to the data points.



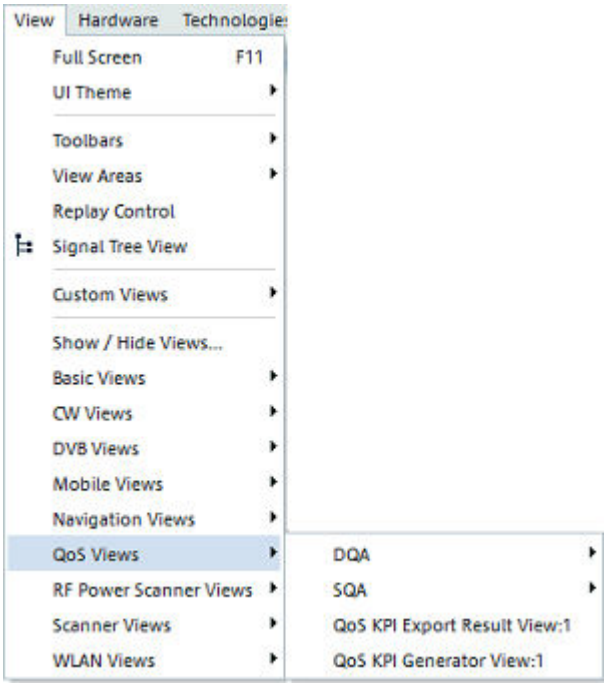
For detailed information, refer to Chapter 4.3, "Navigation views", on page 548.

- Chapter 4.3.1, "GPS info view", on page 548
  List of the geographical coordinates and other information about a particular test point.
- Chapter 4.3.3, "ROMESMAP route track view", on page 562
  Map view shows measured data, the R&S ROMES4 signals, the R&S ROMES4 events and technology-specific features, for example, displaying BTS symbols and best server symbols. Furthermore, the view shows data recorded with the Indoor navigation device.

3.3.15 QoS views

Offers a selection of views to evaluate the Quality of Service of a data connection measured with the available Quality Testers (xQA).

The QoS views are divided into several groups. One group of views is for data DQA (data quality analysis) and another for SQA (speech data quality analysis), if activated. See for example Chapter 3.3.13.6, "UMTS", on page 176.



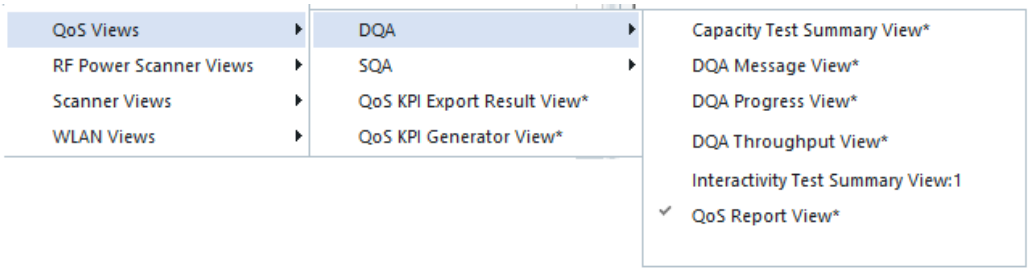
For detailed information, refer to Chapter 4.6, "QoS views", on page 1059.

- Chapter 4.6.3, "QoS KPI export result view", on page 1093
  Shows the result of the exported `*.csv` file from the KPI export definition.
- Chapter 4.6.4, "QoS KPI generator view", on page 1095
  Shows all KPIs of a session under the session tree node.

3.3.15.1 DQA

Offers a selection of views of QoS DQA data.

DQA views can be opened anytime, however, they are empty unless DQA data are available.



A star (*) displayed behind a view type indicates that the view is not yet loaded in R&S ROMES4. The star appearance is motivated by performance reasons. When the marked view is selected and opened for the first time in R&S ROMES4, the star (*) is removed. That means the view type is now loaded and therefore faster available in R&S ROMES4. If no star is shown, then it is possible that a sign ":1" is displayed behind a view type.

A sign ":1" displayed behind a view type indicates that several views of the same type with different configurations can be opened simultaneously. How to create several views of the same type, see sections "Create new view of the same type" on page 100 and "New Window" on page 415.

For detailed information, refer to Chapter 4.6.2, "QoS DQA views", on page 1071.

3.3.15.2 SQA

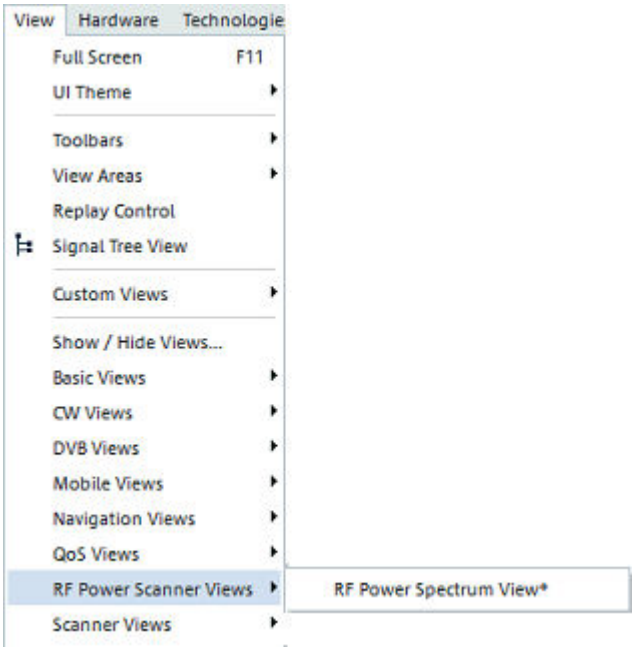
Offers a selection of views of QoS SQA data.

SQA views can be opened anytime, however, they are empty unless SQA data are available.

For detailed information related to SQA message view, refer to Chapter 4.6.1, "QoS SQA view", on page 1060. The view displays the result of the speech quality analysis which requires option R&S ROMES4SQA, Voice Quality PESQ.

3.3.16 RF power scanner views

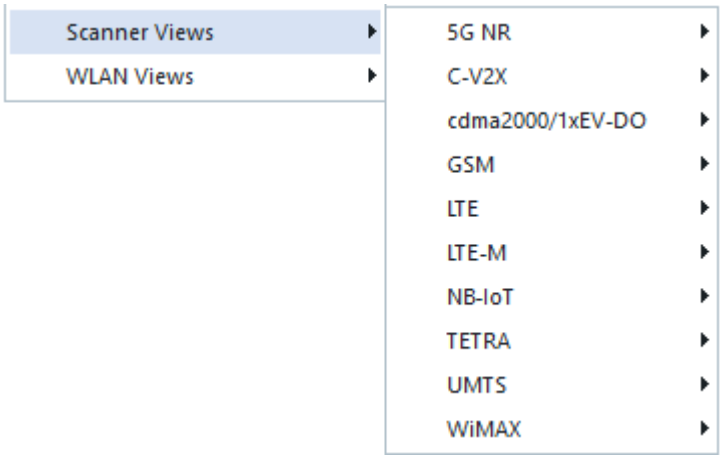
Offers a selection of views of RF Power Scan data.



The R&S TSME RF Power Scanners allow elementary spectrum measurement and analysis and show the signals for each selected sweep. For detailed information, refer to Chapter 4.8.9, "RF power scanner views", on page 1319.

3.3.17 Scanner views

Offers a selection of views to show technology scan data.



The R&S ROMES4 GUI has been aligned for the scanners. All scanner configuration pages, except GSM and TETRA which have a different underlying channel model, have been adapted.

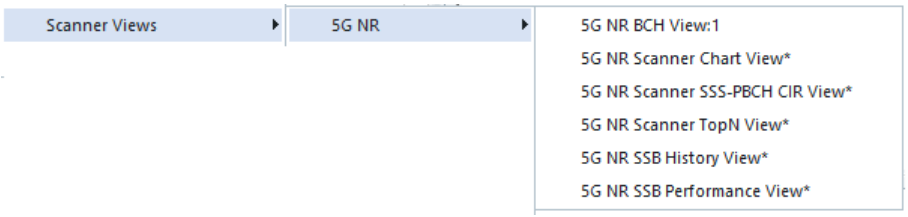
A star (*) displayed behind a view type indicates that the view is not yet loaded in R&S ROMES4. The star appearance is motivated by performance reasons. When the marked view is selected and opened for the first time in R&S ROMES4, the star (*) is removed. That means the view type is now loaded and therefore faster available in R&S ROMES4. If no star is shown, then it is possible that a sign ":1" is displayed behind a view type.

A sign ":1" displayed behind a view type indicates that several views of the same type with different configurations can be opened simultaneously. How to create several views of the same type, see sections "Create new view of the same type" on page 100 and "New Window" on page 415.

- 5G NR scanner view 182
- CDMA2000/1xEV-DO scanner views 183
- GSM scanner views 184
- LTE scanner views 184
- LTE-M scanner views 186
- NB-IoT scanner views 186
- TETRA scanner views 186
- UMTS scanner views 187
- WiMAX scanner views 188

3.3.17.1 5G NR scanner view

Offers a selection of views to show 5G New Radio scanner data.

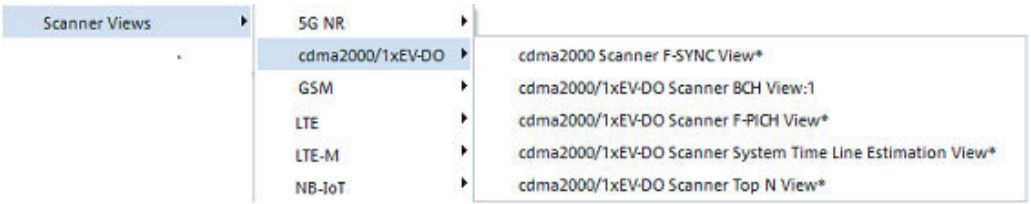


For detailed information, refer to Chapter 4.8.2, "5G NR scanner views", on page 1126.

- Chapter 4.8.2, "5G NR scanner views", on page 1126
  Shows the n best beams over all. The view can be filtered by PCI and frequency.
- Chapter 4.8.2.4, "5G NR scanner SSS-PBCH CIR view", on page 1143
  Shows the CIR of the different beams.
- Chapter 4.8.2, "5G NR scanner views", on page 1126
  Shows the standard Top N view as used by all scanner technologies.
- Chapter 4.8.2.6, "5G NR SSB history view", on page 1149
  Shows the SSB history of selected Top N pool.
- Chapter 4.8.2, "5G NR scanner views", on page 1126
  Shows the SSB performances of selected Top N pool.
- Chapter 4.8.2.7, "5G NR SSB performance view", on page 1150
  Shows the SSB performances, available only during the measurement.

3.3.17.2 CDMA2000/1xEV-DO scanner views

Offers a selection of views to show CDMA2000 or 1x EV-Do Pseudo Noise Scanner data.



For detailed information, refer to Chapter 4.8.4, "CDMA2000/1xEV-DO scanner views", on page 1160.

- Chapter 4.8.4.1, "CDMA2000/1xEV-DO scanner F-PICH view", on page 1160
  Average signal power of the received Forward Pilot Channels (F-PICHs) and analysis of the properties of all DL signals received in the CDMA2000 PN or 1x Ev-DO scan.
- Chapter 4.8.4.3, "CDMA2000/1xEV-DO scanner F-SYNC view", on page 1172
  Information that the R&S TSMU decoded from the Forward Synchronization Channel (F-SYNC).
- "CDMA2000/1xEV-DO scanner system time line estimation view"
  Shows the parameters used for the GPS signal-based CDMA system time line.
- Chapter 4.8.4.5, "CDMA2000/1xEV-DO scanner Top N view", on page 1175
  List of the properties of the signals from the base transceiver stations that are elements of the Top N Pools.

- Chapter 4.8.4.2, "CDMA2000/1xEV-DO scanner BCH view", on page 1168
  CDMA/1xEV-DO System Information (SI) messages decoded from the BCH demodulator (Layer 3 messages).

3.3.17.3 GSM scanner views

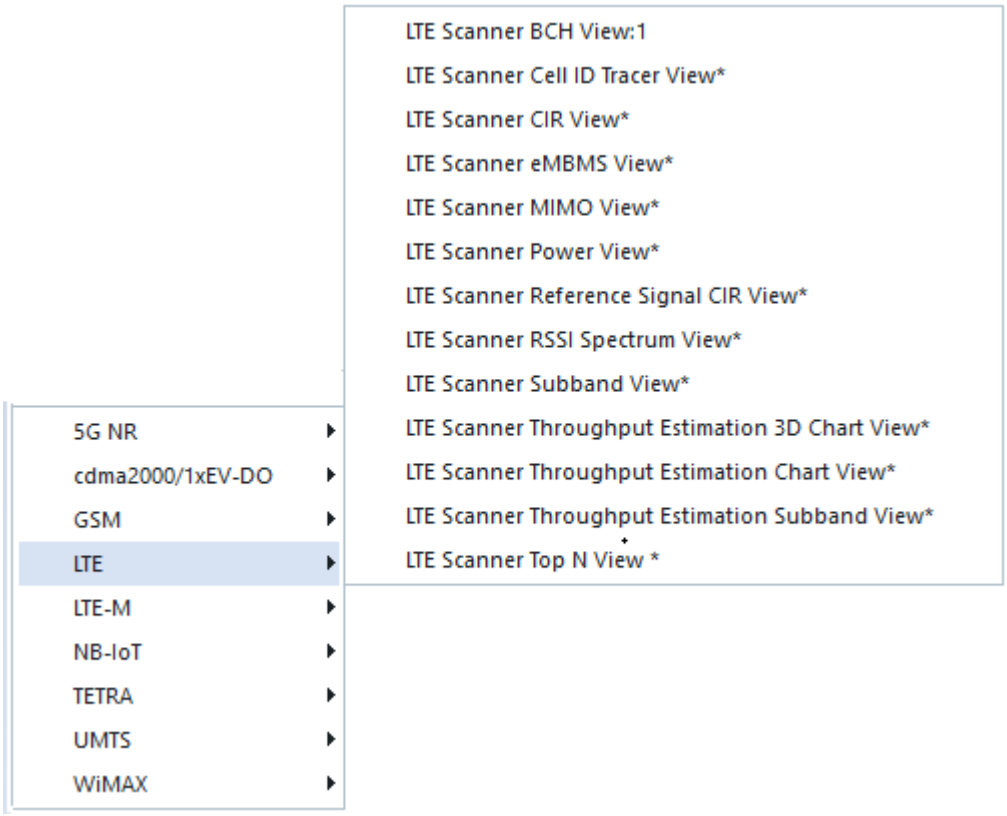
Offers a view to visualize GSM network scan data.

For detailed information, refer to Chapter 4.8.5, "GSM scanner views", on page 1179.

- Chapter 4.8.5.2, "GSM scanner BCH view", on page 1181
  System Information (SI) decoded from the GSM BCH with their full contents.
- Chapter 4.8.5.3, "GSM scanner Top N view", on page 1187
  Shows the properties of the signals from the base transceiver stations that are elements of the Top N Pools.
- Chapter 4.8.5.4, "GSM scanner transmitter view", on page 1196
  Shows the GSM data measured and demodulated by R&S radio network analyzers during the GSM network scan.

3.3.17.4 LTE scanner views

Offers a selection of views to show LTE Scanner data.

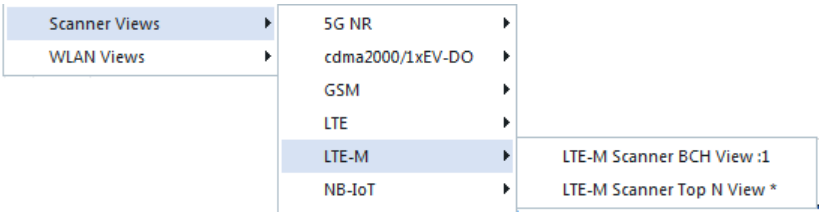


For detailed information, refer to Chapter 4.8.6, "LTE scanner views", on page 1204 and among other views to the following ones.

- Chapter 4.8.6.2, "LTE scanner BCH view", on page 1212
  Shows the System Information Blocks (SIBs) and Master Information Block (MIB) decoded from the LTE BCH channel.
- Chapter 4.8.6.4, "LTE scanner CIR view", on page 1227
  Shows the channel impulse response of the LTE signals.
- Chapter 4.8.6.3, "LTE scanner cell ID tracer view", on page 1222
  Shows the evolution in time of the time delay and power of all received LTE peaks with a particular Cell ID or a particular rank in a top N pool.
- Shows the downlink allocation analysis results
- Chapter 4.8.6.6, "LTE scanner MIMO view", on page 1234
  The view shows the measured condition numbers of one cell.
- Chapter 4.8.6.7, "LTE scanner power view", on page 1238
  Shows the channels quality by viewing the general Signal-to-Interference-plus-Noise Ratio (SINR) and specific SINR of S-SCH and SINR of P-SCH.
- Chapter 4.8.6.10, "LTE scanner subband view", on page 1244
  The view shows the measured subband SINR values of one cell.
- Chapter 4.8.6.14, "LTE scanner Top N view", on page 1258
  Shows the properties of the signals from the base transceiver stations that are elements of the Top N Pools defined in the technology configuration.

3.3.17.5 LTE-M scanner views

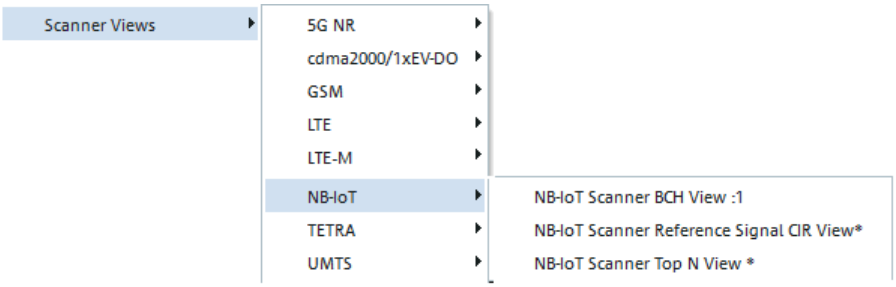
Offers a selection of views to show LTE-M scanner data.



- Chapter 4.8.7.2, "LTE-M scanner BCH view", on page 1281
  Shows the System Information Blocks (SIBs) and Master Information Block (MIB) decoded from the LTE BCH channel.
- Chapter 4.8.7.3, "LTE-M scanner Top N view", on page 1288
  Shows the properties of the signals from the base transceiver stations that are elements of the Top N Pools defined in the technology configuration.

3.3.17.6 NB-IoT scanner views

Offers a selection of views to show NB-IoT scanner data.

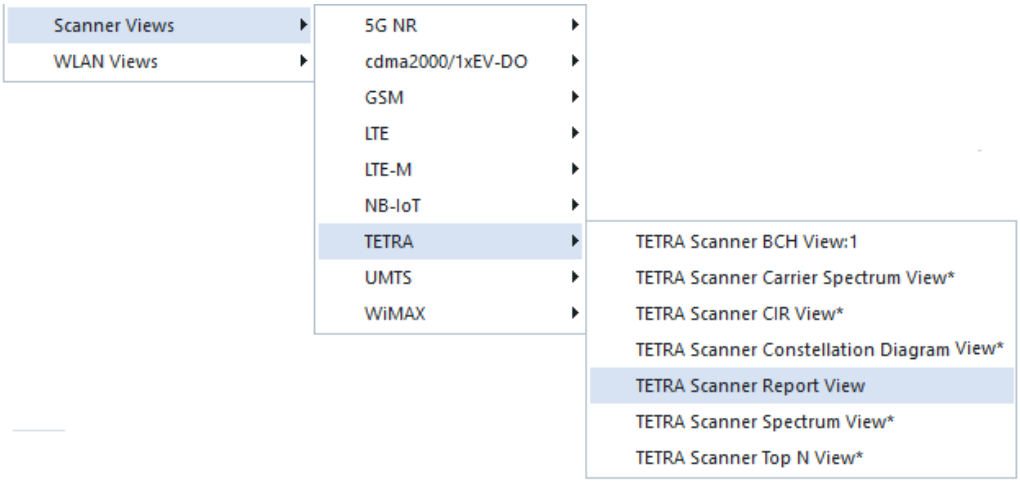


For detailed information, refer to Chapter 4.8.8, "NB-IoT scanner views", on page 1297.

- Chapter 4.8.8, "NB-IoT scanner views", on page 1297
  Shows a list of detected BTSs and their MIB and SIBs decoded from the NB-IoT BCH.
- Chapter 4.8.8, "NB-IoT scanner views", on page 1297
  Shows the CIR and CIR peaks of the reference signal measurements.
- Chapter 4.8.8, "NB-IoT scanner views", on page 1297
  Shows the properties of the NB-IoT scanner signals received from the eNodeB.

3.3.17.7 TETRA scanner views

Offers a selection of views to show TETRA Scanner data.

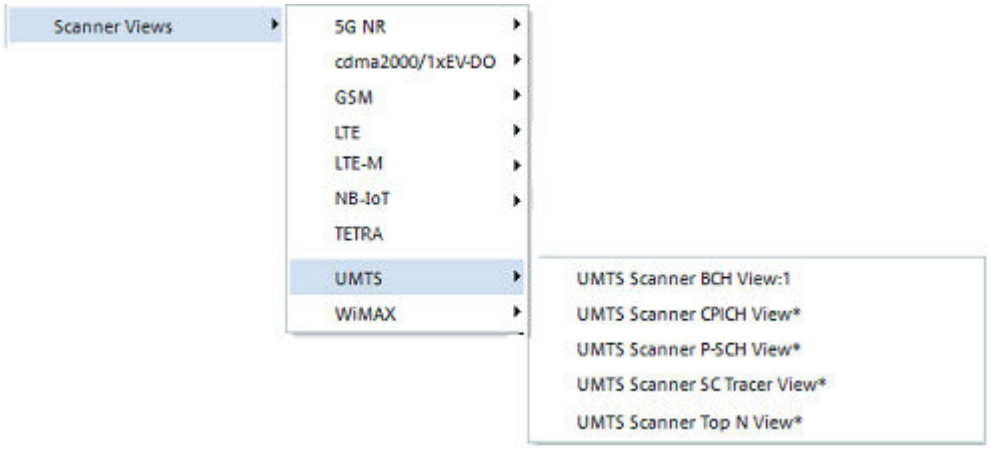


For detailed information views, refer to Chapter 4.8.10, "TETRA scanner views", on page 1339.

- Chapter 4.8.10.3, "TETRA scanner CIR view", on page 1346
  Shows the channel impulse response of the TETRA signals.
- Chapter 4.8.10.1, "TETRA scanner BCH view", on page 1340
  Shows information received by the broadcast channels of the TETRA signal. It is summary of all found TETRA transmitters.
- Chapter 4.8.10.2, "TETRA scanner carrier spectrum view", on page 1342
  Shows the scanned spectrum of a single carrier.
- Chapter 4.8.10.4, "TETRA scanner constellation diagram view", on page 1348
  Shows the current state of the constellation diagram of either a fixed carrier or a specified member of a Top N Pool.
- Chapter 4.8.10.6, "TETRA scanner spectrum view", on page 1356
  Shows the total inband power of each carrier index.
- Chapter 4.8.10.7, "TETRA scanner Top N view", on page 1363
  Shows the properties of the signals from the base transceiver stations that are elements of the Top N Pools defined in the technology configuration.

3.3.17.8 UMTS scanner views

Offers a selection of views to show UMTS Pseudo Noise Scanner data.

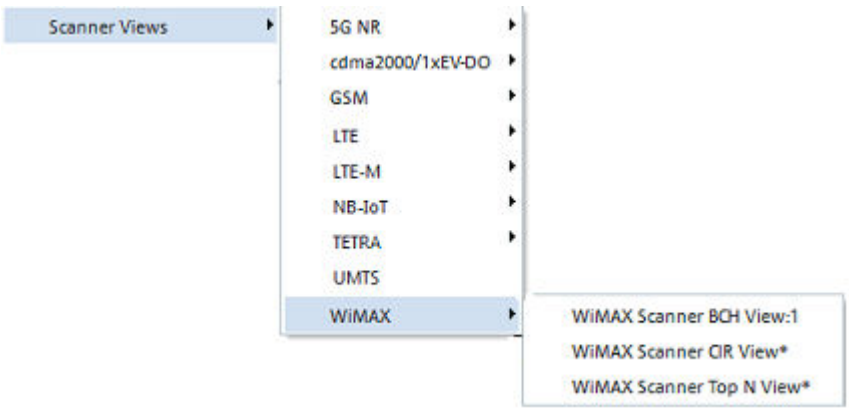


For detailed information views, refer to Chapter 4.8.11, "UMTS scanner views", on page 1370.

- Chapter 4.8.11.2, "UMTS scanner BCH view", on page 1377
  Shows System Information Blocks (SIBs) and Master Information Block (MIB) decoded from the UMTS BCH with their full contents.
- Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383
  Shows the average signal power of the received P-CPICHs and a comprehensive analysis of the properties of all DL signals received in the UMTS PN scan.
- Chapter 4.8.11.4, "UMTS scanner P-SCH view", on page 1391
  Shows the properties of the Primary Synchronization Channel in the DL UMTS signal.
- Chapter 4.8.11.6, "UMTS scanner SC tracer view", on page 1397
  Shows the evolution of the delay time of a single CPICH relative to the frame boundary. Several PNS SC Tracer Views with different configurations can be opened simultaneously.
- Chapter 4.8.11.7, "UMTS scanner Top N view", on page 1404
  Shows the properties of the signals from the NodeB that are elements of the Top N pools. The pools are defined in the device configuration menu.

3.3.17.9 WiMAX scanner views

Offers a selection of views to show WiMAX Scanner data.

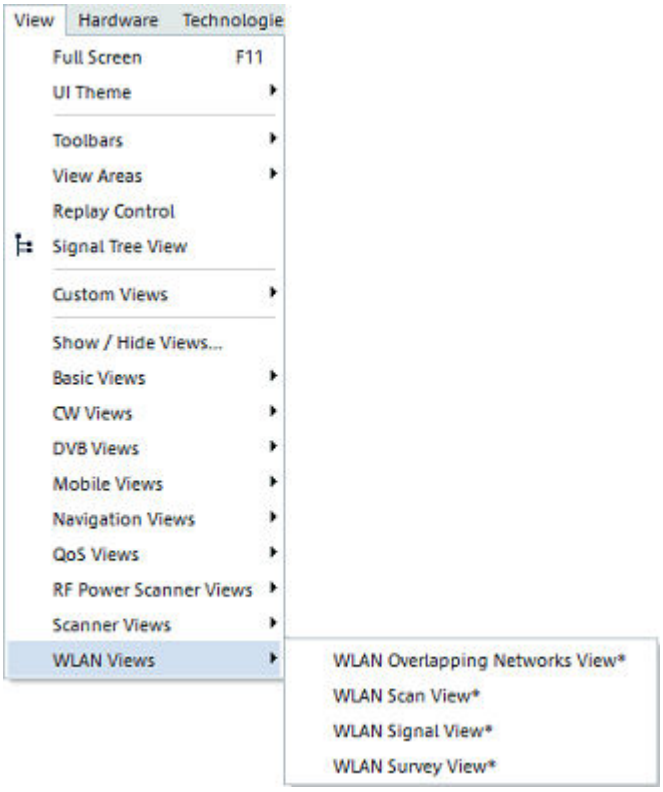


For detailed information views, refer to Chapter 4.8.12, "WiMAX scanner views", on page 1412.

- Chapter 4.8.12.1, "WiMAX scanner BCH view", on page 1413
  Shows the demodulated and decoded content of received channels of the WiMAX signal.
- Chapter 4.8.12.3, "WiMAX scanner Top N view", on page 1420
  Shows the properties of the signals from the base transceiver stations that are elements of the Top N Pools defined in the technology configuration.
- Chapter 4.8.12.2, "WiMAX scanner CIR view", on page 1416
  Shows the channel impulse response of the WiMAX signals.

3.3.18 WLAN views

Offers different views to analyze the WLAN information obtained in the network scans performed by a WLAN adapter in regular intervals.



For detailed information, refer to Chapter 4.7, "WLAN views", on page 1103.

- Chapter 4.7, "WLAN views", on page 1103
  Shows the information on co-existing channels and overlapping channels.
- Chapter 4.7.2, "WLAN scan view", on page 1108
  Shows the basic information acquired in a WLAN network scan (WLAN BSSID list information).
- Chapter 4.7.3, "WLAN signal view", on page 1112
  Shows RSSI of all received signals in a 3-dimensional bar graph.
- Chapter 4.7.4, "WLAN survey view", on page 1114
  Shows the statistical evaluation of the results in the other WLAN views.

3.4 Hardware menu

The "Hardware" main menu is used to load hardware devices necessary for a measurement.

3.4.1 Loading hardware

For automatic detection of hardware device, use the Chapter 6.1.1, "Devices manager", on page 1448 function. Otherwise, use the "Hardware" > "Connect/Disconnect" command. Both ways load the hardware devices necessary for a measurement.

Load the hardware devices (i.e., network scanners and different types of mobile phones) before a measurement is started.

They can be provided in two different ways:

- Implicitly, by loading a workspace file
- Explicitly, via the "Hardware" command

The installation process is menu-guided. For further information, refer to Chapter 6, "Hardware Components", on page 1447.

The installation process is menu-guided. For further information, refer to chapter "Hardware Components".

It is not necessary to load device for evaluating data in the replay mode.

The "Hardware" menu commands are disabled as long as a measurement file is opened.

3.4.2 Wizards

Wizards simplify the setup of a measurement task. Available wizards are listed in the "Hardware" > "Wizards" menu.

Select a wizard from the menu and follow the instructions on the screen.

The settings of wizards can be stored as profiles. These profiles are used for loading devices via the R&S ROMES4 "Device Manager".

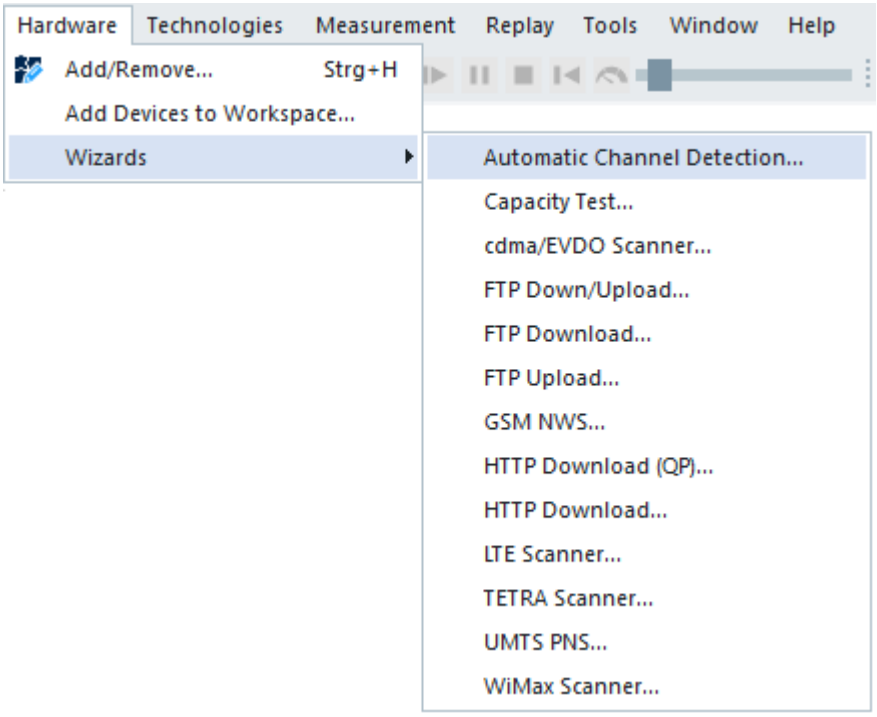


Figure 3-84: Hardware menu – Wizards

3.4.2.1 Automatic channel detection wizard

The Automatic Channel Detection (ACD in further text) function is aimed to make the channel detection faster. Scanners have to be available for technologies that support ACD function to do channels detection. The screenshot Figure 3-86 shows the radio access technologies (also here named TECs) which ACD wizard supports.

The algorithm takes care about the reliability of the fast channel detection, especially of fast cdma/EVDO channels detection. For the GSM, UMTS and cdma2000/1xEVDO scanners, the measurement rates are set automatically. Each individual channel of mentioned technologies gets approximately the same number of measurements per second in settings of the measurement rate.

For scanner measurement rate signals, see Chapter 3.8.1.2, "Available signals configuration", on page 228.

The LTE, NB-IoT and 5G NR finders of ACD provide fast and efficient channel detection. The finders and their scanners support frontend distribution for the automatic channel detection. The function distributes the selected band onto the all available frontends automatically. If you want to specify a specific frequency range for a frontend, this frequency range can be defined in the transducer table as XML file. Note that each R&S TSME must be connected to its own network card when detecting channels automatically.

If the channel list of a scanner which does ACD function contains the specific channels to scan, the ACD considers this information. The ACD treats these channels as already detected.

The ACD performance depends mainly on the number of different technologies and the size of the observed frequency range. It is highly recommended to shrink both parameters as much as possible to achieve the maximum benefit of this feature.

The function needs a license. If the license is not found when running the wizard, an error message is displayed.

ACD wizard start procedure

The ACD wizard sets up a measurement, which detects and locates all available channels in a specified frequency band for 5G NR, LTE, NB-IoT, UMTS, GSM, and cdma2000/1xEVDO. In GSM, if necessary to search for channels in the several bands (for example, GSM900/1800 and GSM450), several instances of the GSM network scanner have to be configured.

The wizard supports configured scanners demodulation messages. Selection of demodulation messages per TEC to be available in ACD wizard is covered in the following procedure, see the step 9. The selection for each TEC is stored to disk and is available next time the technology scanner is loaded. The all previously mentioned technologies support demodulation messages.

TETRA also supports demodulation messages, but automatic channel detection is not supported by ACD wizard. The ACD function is only configurable in the TETRA configuration page.

1. Start the ACD wizard selecting the "Automatic Channel Detection" command in "Hardware" > "Wizards".

   The wizard starts with the existing configuration. It checks if there are devices which can interfere with the setup.

2. If such devices are found, the ACD wizard pops-up a dialog to inform you about the necessity to unload those devices. The dialog offers you to abort the ACD wizard. Otherwise, click "Yes" to continue with the wizard.

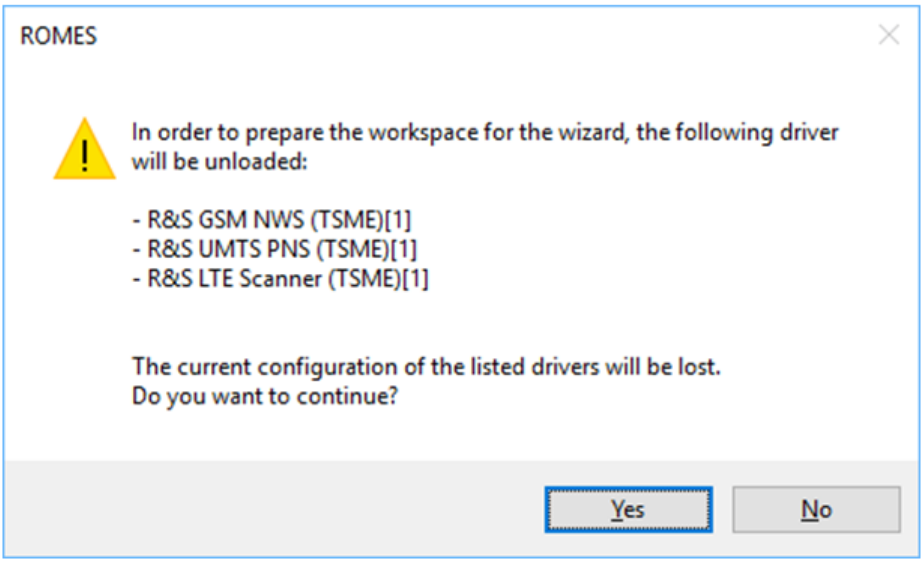


Figure 3-85: ACD wizard warning during setup

   The ACD opening "Welcome to the Automatic Channel Detection Wizard!" page is displayed.

3. Specify the RATs for ACD among the available ones. The available technologies for ACD scanning are those ones for which a license is available in a configured device.

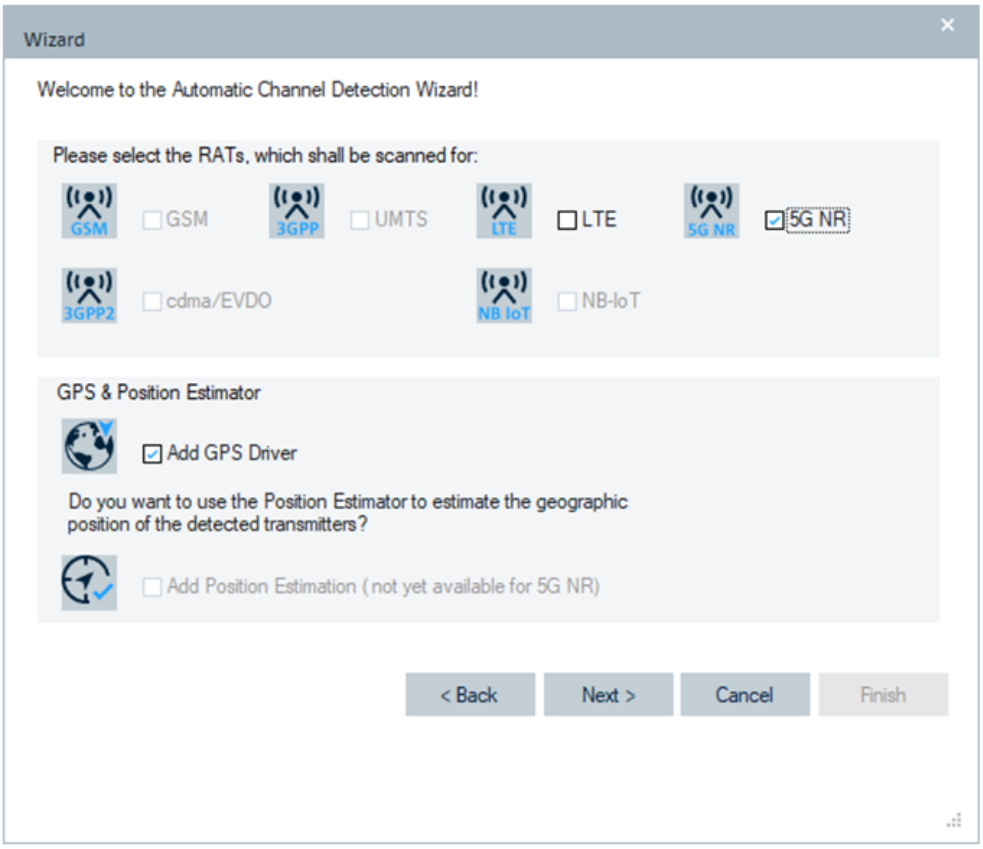
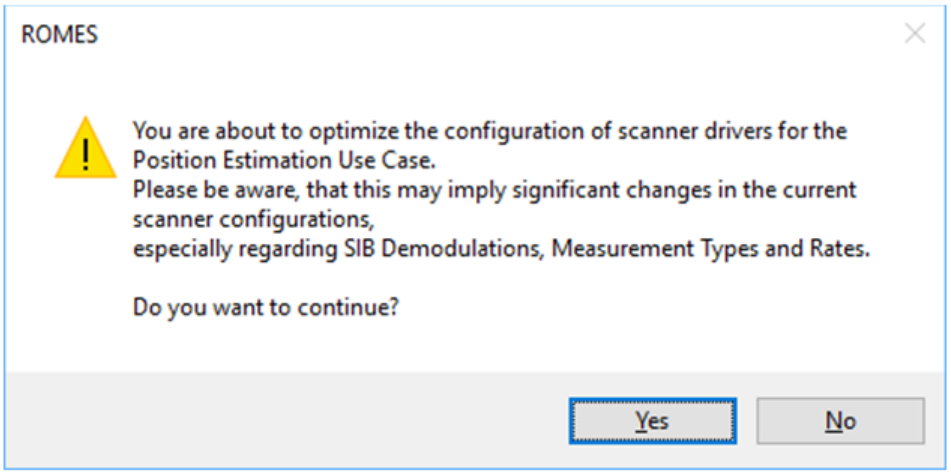


Figure 3-86: Opening ACD wizard page

4. Select the positioning type to be added to ACD in the lower part of the wizard's opening page.
   You can select between a GPS devices and Position Estimator. The latest one requires a license. If the license is unavailable, the position estimation is dimmed in the page. The Position Estimator estimates the geographic position of the detected transmitters letting the wizard to set sensitivity and ACD to "Fair". These properties favor the scanning speed of the found channels and improve the results of the position estimation.
5. Click the "Next" button.

   Continue with the step 6 or 7 dependent on which positioning type you selected.
6. If you selected the position estimation as a positioning type, the warning dialog pops-up.
   The dialog informs you that the optimization of a scanner configuration for this use case can imply significant changes. You can abort the optimization process, if desired.



Otherwise, click "Yes" to continue the process.

The next wizard's page opens.

7. Select how do you want to specify the target frequency range for ACD in that page. Select the first option if you know the 3GPP or 3GPP2 bands that you want to use. The wizard selects the 3GPP and 3GPP2 target bands accordingly. Click "Next" and go to step 10.

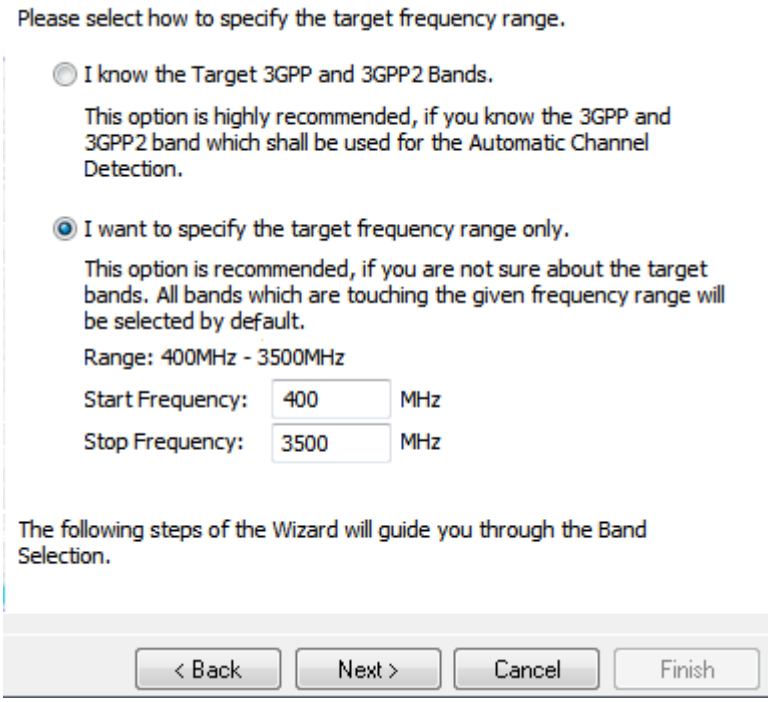


Figure 3-87: Second ACD wizard page

8. If you select the second offered option for the target frequency range, you have to specify bands. To do that, click "Next".

The additional ACD wizard's page opens where you can select bands per technology.

9. Select the bands for scanning within the given range per technology. Select also the configured scanner demodulation messages to be available in the ACD wizard. The "MIB/SIB Preselection" offers two choices for MIB/SIB demodulation messages. "Minimum Set of MIB/SIBs" is the default choice. The "All MIB/SIBs" choice enables all the demodulation messages.

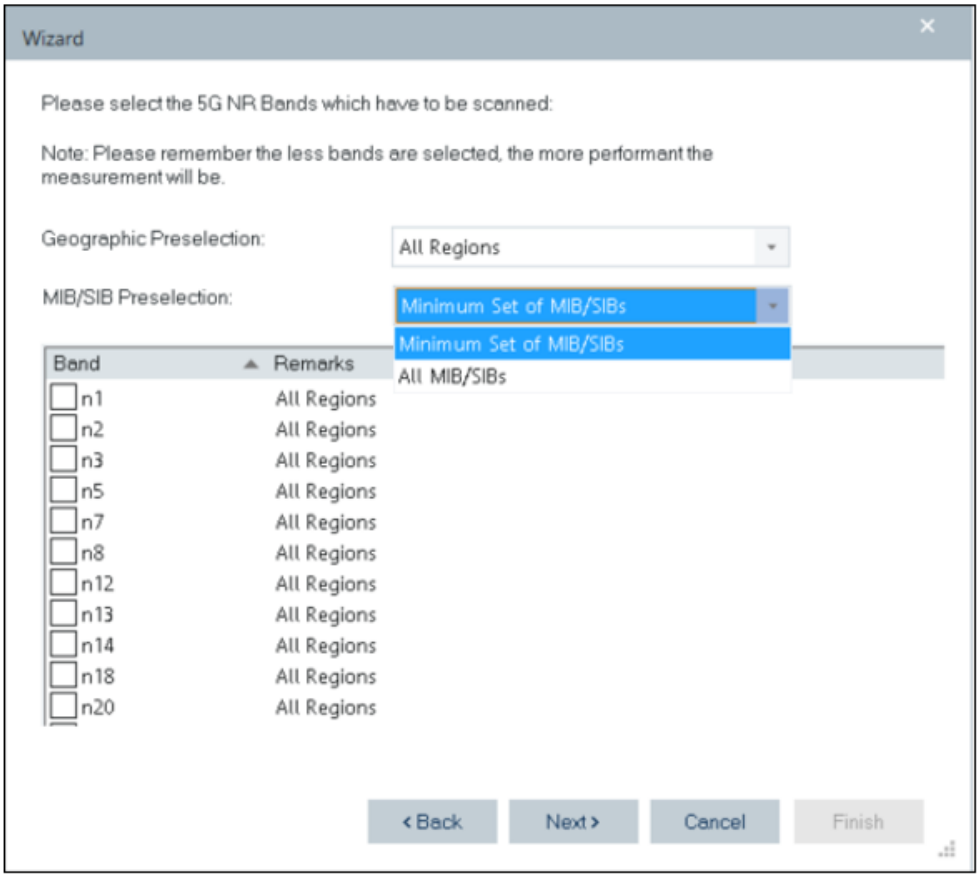


Figure 3-88: Select band and MIB/SIB for scanning

The ACD wizard supports scanning of up to 20 bands of any supported technology in one measurement. The geographic preselection usage shrinks the number of bands for the user's position.
Click "Next".

10. The final ACD wizard page pops-up.
11. Verify in this page if the selected RATs and bands are the right ones.

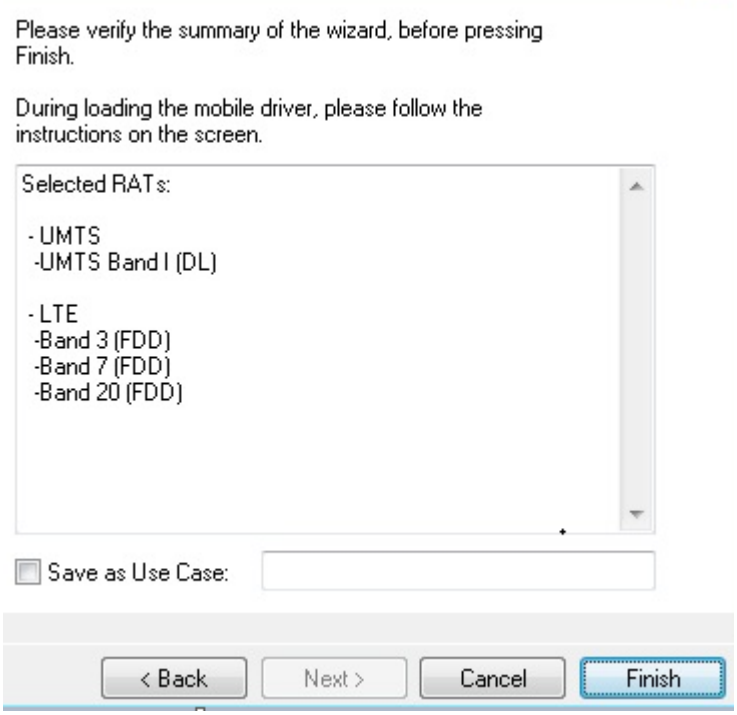


Figure 3-89: ACD wizard final page

12. If you check the "Save as Use Case" box, the wizard saves the settings under a given use case name
13. Click "Finish".

    The ACD wizard loads the necessary devices and creates the default worksheets for the selected technologies. An additional ACD worksheet is created, which includes the ACD view and an alphanumeric view with the most important signals for GPS and Position Estimator.

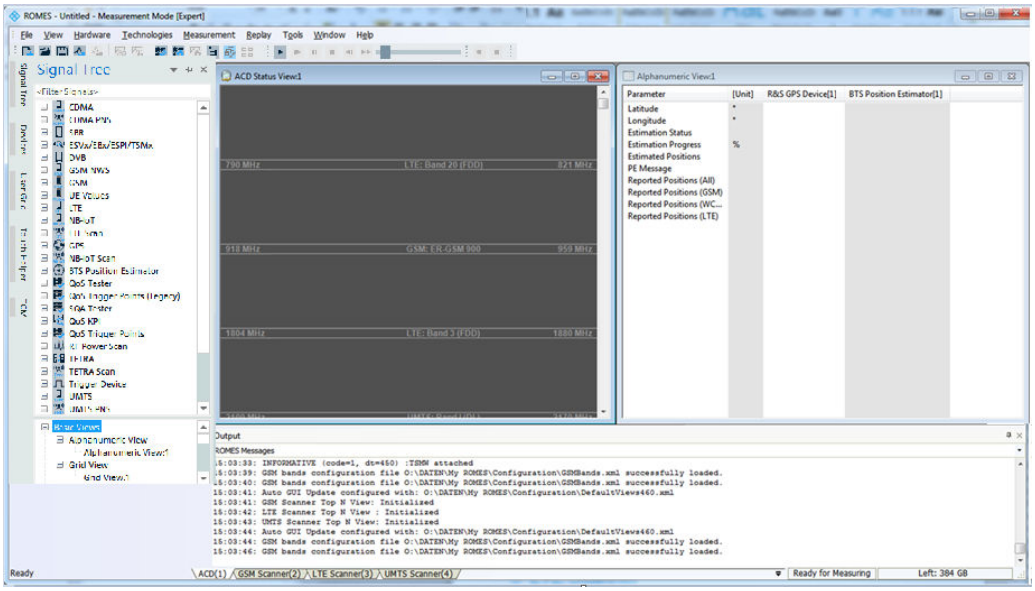


Figure 3-90: Automatic channel detection worksheet

ACD wizard uses layer 3 messages

The Use Layer 3 Messages feature is active within the ACD wizard by default.

If the ACD is configured to use Layer 3 messages, the 5G NR scanner activates SIB4 demodulation.

The ACD wizard supports the usage of Layer 3 message of LTE. Previously you have to activate manually it in LTE scanner configuration page. Check the "Use Layer 3 Messages" box in the "Scanner Configuration" > "Automatic Channel Detection" dialog to activate the ACD and SIBs demodulation. See Figure 6-288.

If configured, the SIB5 demodulation starts automatically. SIB5 uses the content of 5G NR SIB4 to get quick access to other 5G NR channels. SIB5 is used as additional source for LTE channels detection.

ACD uses band slicing

It is possible to define specific frequency ranges for 5G NR ACD bands. These bands slices can be selected afterwards in the ACD wizard or the manual ACD configuration of the 5G NR scanner configuration.

To do so, create an XML file `ACDBandSlices.xml` in the folder My Romes\Configuration folder.

The content of the file has to be the following:

```
<BandSlices>
    <BandSlice RAT="5GNR" Band="78" MinInHz="3300000000" MaxInHz="3400000000"/>
    <BandSlice RAT="5GNR" Band="78" MinInHz="3700000000" MaxInHz="3800000000"/>
    <BandSlice RAT="5GNR" Band="257" MinInHz="26500000000" MaxInHz="28000000000"/>
</BandSlices>
```

The entries in the file have the following meanings:

- RAT: always 5G NR,
- Band: 5G NR Band Number
- Min/MaxInHz: Minimum and maximum of the frequency range

The range has to be within the specified band. Ranges which do not fulfill this condition are ignored.

The R&S ROMES4 measurement file info shows the applied ranges during the measurement.

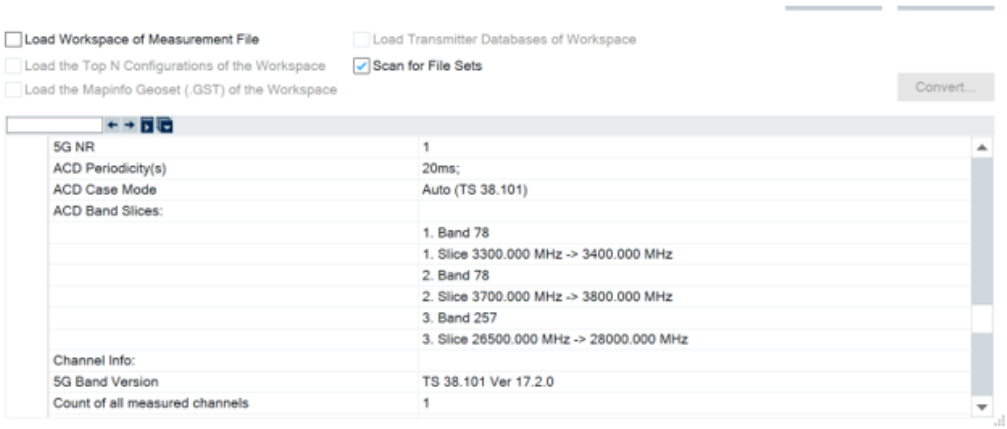


Figure 3-91: Applied ranges in measurement file info

The ACD Band Slicing feature helps to reduce the scanner load-doing ACD, especially for wide frequency bands.

3.4.2.2 Capacity test wizard

The R&S ROMES4 DQA Capacity Test job wizard is available for smartphones with Android OS (QualiPoc devices).

1. Click "Hardware" > "Wizard" > "Capacity Test".

   The wizard page opens for the selection of the mobile device if you want to load a new device.

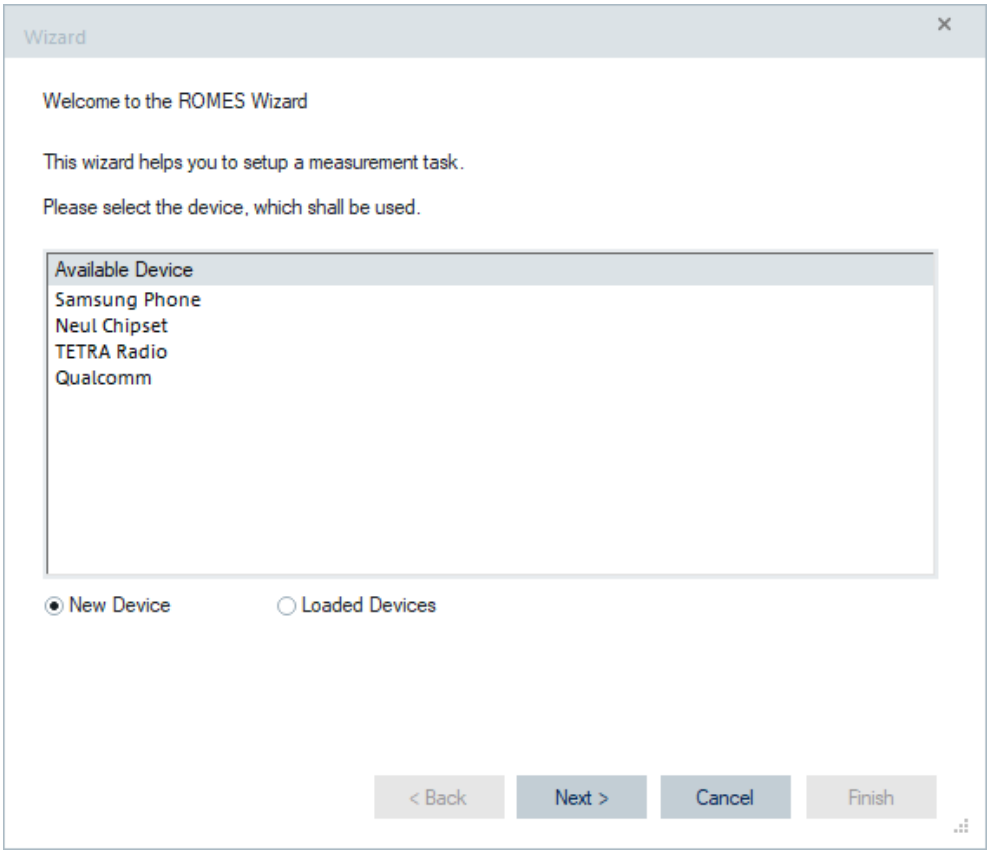


Figure 3-92: Wizard opening page applicable for DQA jobs

Note: Instead, you can select the option "Loaded Devices" and in that case the "Available Devices" list is empty.

2. Select mobile device from the "Available Devices" list.
3. Click "Next".

   The page pops-up where you have to define the "URL", i.e. file to load, "Transfer Time" which is the duration of the test and the number of parallel downloads of the specified file, "Run Count".

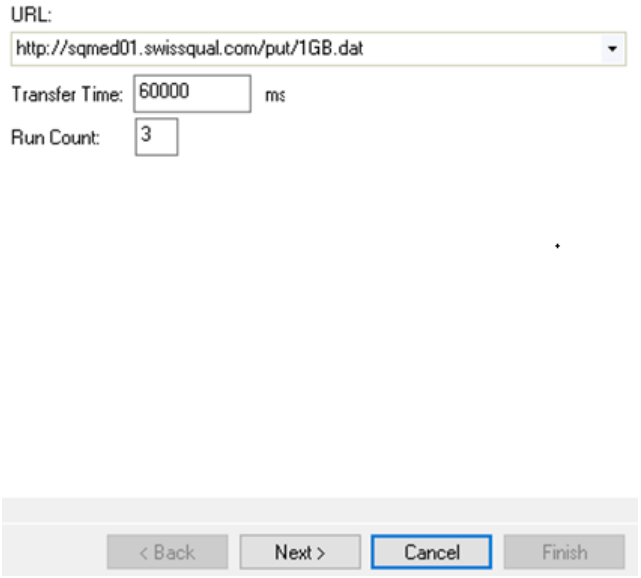


Figure 3-93: Running wizard for selected device

If you select the second option, you are requested to select device. Select the device from the "Hardware" > "<Device name>" menu.

4. Click "Next".

   The capacity test for the selected smartphone is configured.

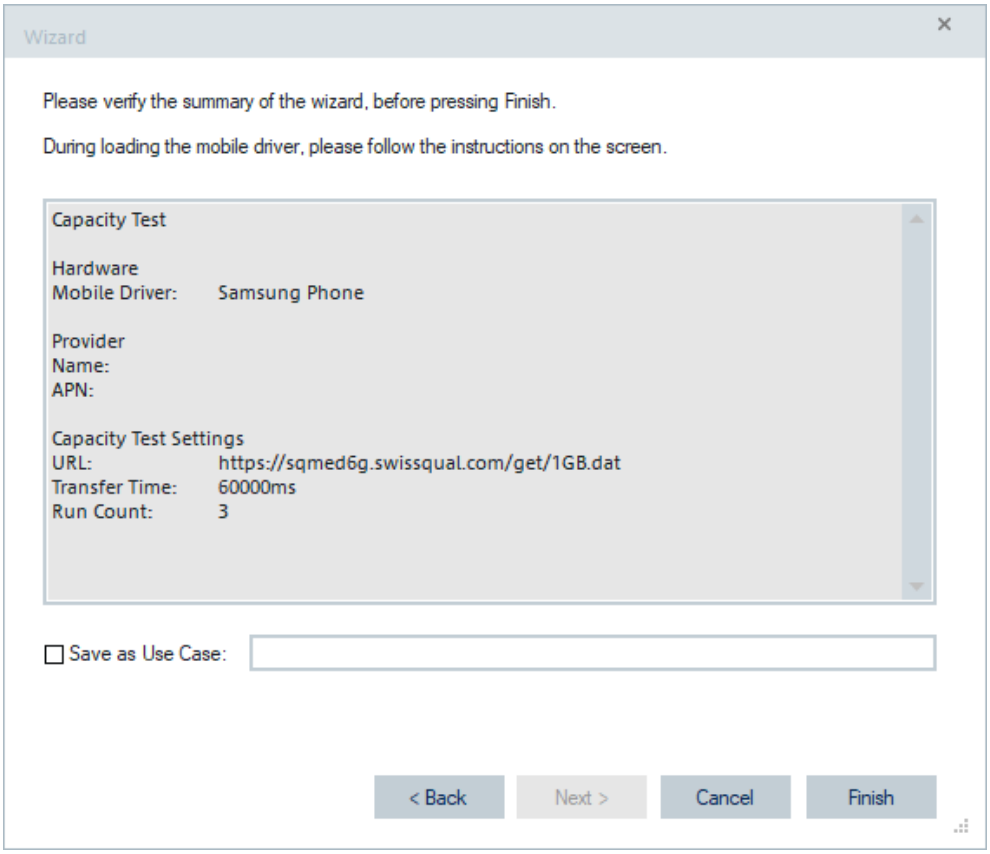


Figure 3-94: Configured job

5. Click "Finish".

   The wizard page closes.

The mixture of the upload and download capacity test is supported in the DQA job configuration page, see Chapter 6.5.2, "DQA jobs with Android OS-based smartphones", on page 1961.

3.4.2.3 cdma/EVDO scanner wizard

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new one ("New Device").

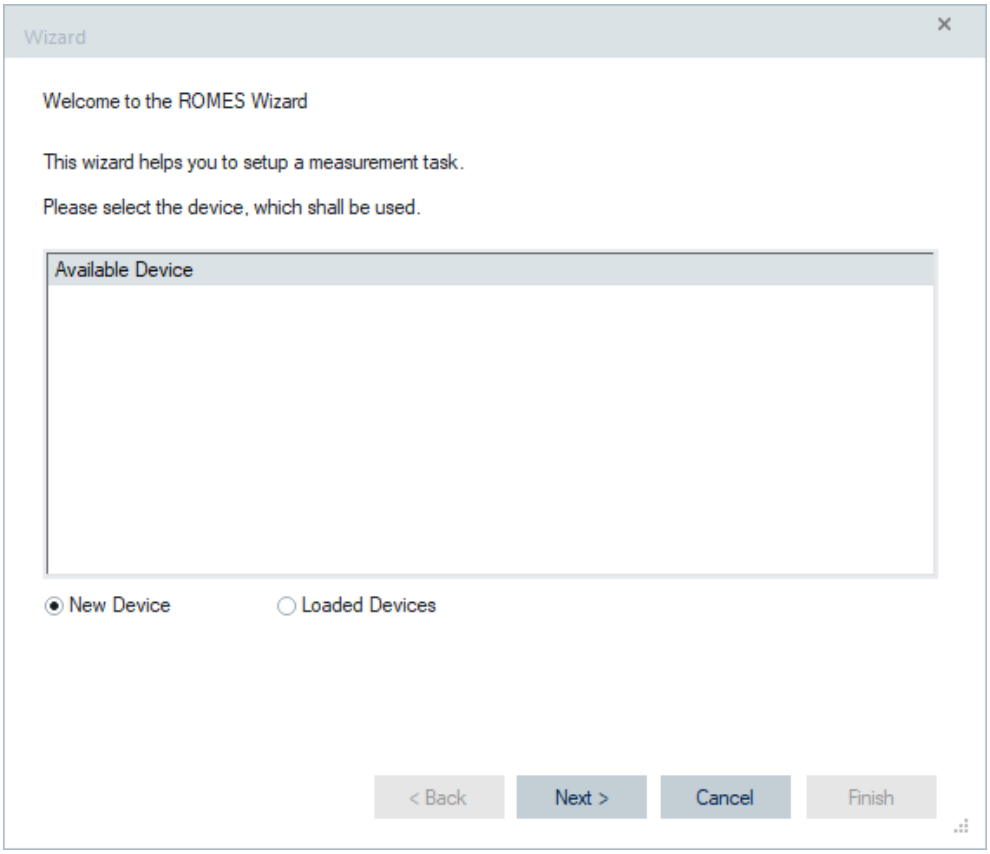


Figure 3-95: ROMES Wizard page for cdma/EVDO

3. For a previously not loaded device, select "New Device".
4. Select the channels for scanning. The wizard supports selection of up to 12 channels.

   For each selected channel, define the following parameters:
   - Channel Name
   - Channel Number
   - Bandwidth [MHz]
   - BCH Demodulation
     In the "Demodulation" column you can select System Information Blocks for demodulation.
   - Usage
5. Verify the data that you entered.
6. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.2.4 FTP down- and up-load wizards

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Device").
   For a previously not loaded device, select "New Device".
3. For a previously not loaded device, select "New Device".
4. Specify the ftp server by IP address or name.
5. For "FTP download/upload" wizard only:
   - Specify the file to download.
   - Enter password and name if necessary.
     If you press the "Anonymous" button, the wizard generates password and name automatically.
   - Specify the directory on the server and the local file to upload.
6. For "FTP Download" wizard only:
   - Specify the file to download.
   - Enter password and name if necessary.
     If you press the "Anonymous" button, the wizard generates password and name automatically.
7. For "FTP Upload" wizard only:
   - Specify the file to upload.
   - Enter password and name if necessary.
     If you press the "Anonymous" button, the wizard generates password and name automatically.
   - Specify the directory on the server and the local file to upload.
8. Verify the data that you entered.
9. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.2.5 GSM NWS wizard

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Devices").
3. For a previously not loaded device, select "New Device".
4. Select the channels for scanning.
   For loaded BTS database, you can configure the scanner automatically depending on the content of the database.

5. For manual scan, specify a band.
6. For manual scan, put the channels in after specifying the band.
7. Select additional measurements, which the scanner can do. For example, specify System Information Block messages for demodulation and whether to save spectrum into the measurement file.
8. Verify the data that you entered.
9. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.2.6 HTTP download / HTTP download (QP) wizard

For both HTTP Download wizards, the following steps are valid steps:

1. Select device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Device").
3. For the previously not loaded device, select "New Device".
4. Choose the country, provider and the network for the data connection.
5. Specify the URL of the HTTP transfer file.
6. Set the user name and password for the HTTP download and press "Next".

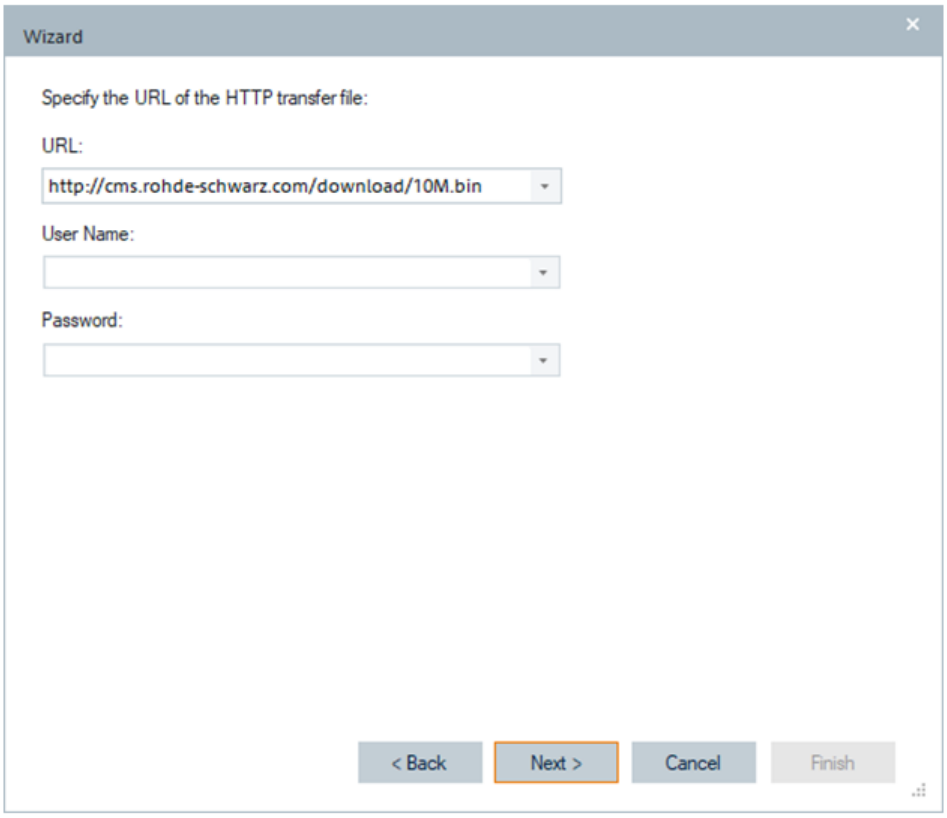


Figure 3-96: HTTP download wizard

7. Verify the data that you entered in the opened window.
8. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

The same procedure applies to set up the HTTP Download (QP) measurements via the associated wizard.

3.4.2.7 LTE scanner wizard

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Device").
3. For a previously not loaded device, select "New Device".
4. Select the channels for scanning. The LTE scanner wizard supports scanning of up to 63 channels.

   For each selected channel, define the following parameters:
   - Channel Name

- Band
- EARFCN
- BCH Demodulation
- LTE Measurement

Note: A band specification and EARFCN are basis for the frequency calculation. All other LTE parameters set up according to default values.

5. Verify the data that you entered.
6. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.2.8 TETRA scanner wizard

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Device").
3. For a previously not loaded device, select "New Device".
4. Select Base Frequency Index.
5. Select Frequency Offset [kHz].
6. Select First Carrier Index.
7. Select Last Carrier Index.
8. Verify the data that you entered.
9. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.2.9 UMTS PNS wizard

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Device").
   For a previously not loaded device, select always "New Device".
3. Select the channels for scanning. The UMTS PNS wizard supports scanning of up to 32 channels.

   For each selected channel, define the following parameters:
   - Channel Name
   - UMTS band/UARFCN or frequency

Note: If you want to measure on a frequency which is not the standard 3GPP UARFCN, select "No UMTS Band".
A band specification and UARFCN are the basis for the frequency calculation. All other UMTS parameters set up according to default values.

4. In the "Demodulator" column you can select System Information Blocks for demodulation.
5. Verify the data that you entered.
6. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.2.10 WiMAX scanner wizard

1. Select the device that you want to use.
2. Decide if to apply the settings to an already loaded device ("Loaded Devices") or to a new device ("New Device").
3. For a previously not loaded device, select always "New Device".
4. Select the channels for scanning. The WiMAX scanner wizard supports scanning of up to 12 channels.

   For each selected channel, define the following parameters:
   - Channel Name
   - Frequency [MHz]
   - Bandwidth [MHz]
   - BCH Demodulation
     In the "Demodulation" column you can select System Information Blocks for demodulation.
5. Verify the data that you entered.
6. Press "Finish".

   The wizard loads and configures the all necessary devices automatically. Now start the measurement.

3.4.3 Simple hardware loading via workspace

A measurement setup with several devices, loading and configuring them separately could be time consuming. To improve this activity, the "Load multiple Devices" dialog can be used. The dialog lists all available devices and lets you load wanted devices simultaneously. For each device and ACD a template, wizard or configuration can be selected.

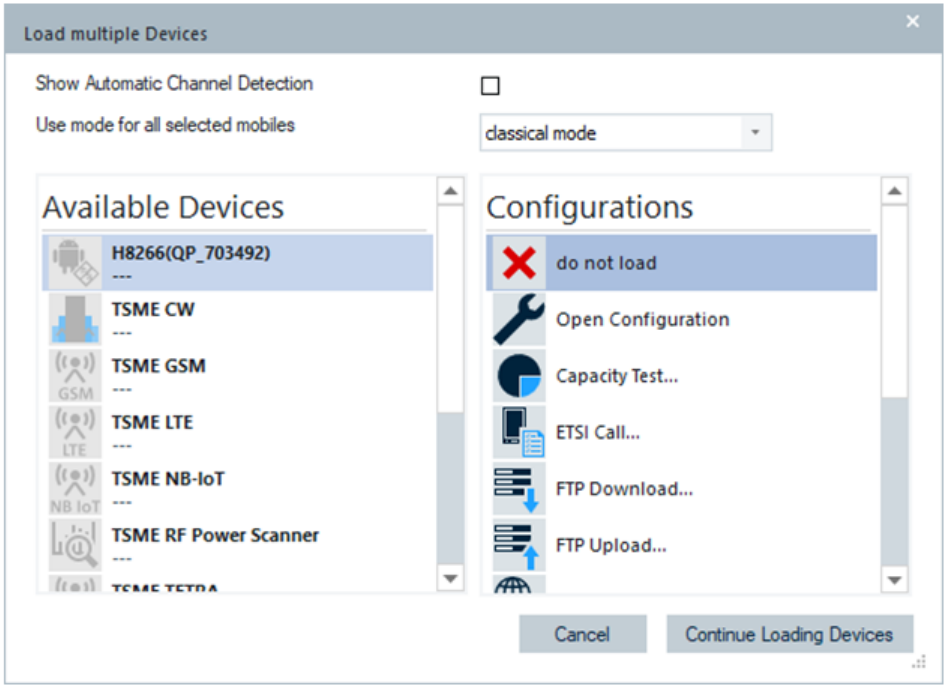


Figure 3-97: Simplified HW loading test device in on PC testing (classic) mode

To speed up the loading process, choose between loading all devices in a specific use mode or loading each device in a separate mode. For example, load some devices in On PC testing (Classic mode) and the other ones in Fully integrated device mode. This loading improves the devices setup time.

If a device is not loaded, its icon is displayed grayed out in the "Available Devices" pane of the dialog.

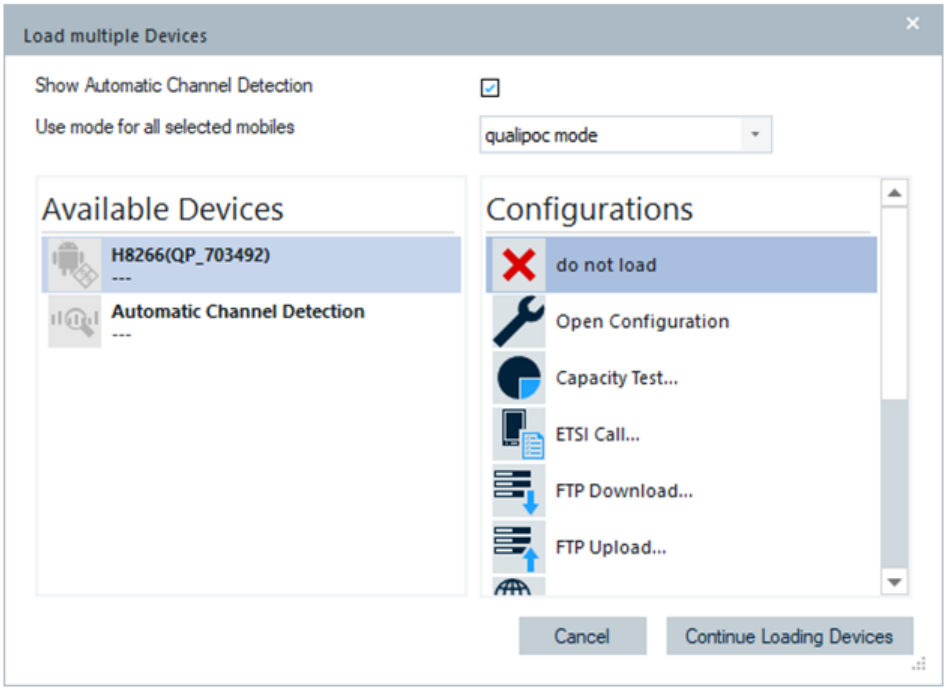


Figure 3-98: Simplified HW loading test device in fully integrated device mode

Select as many devices for loading as you want to. Press "Continue Loading Devices" to load them as fast as possible. After the all specified devices have been loaded, possible wizards or configurations are displayed.

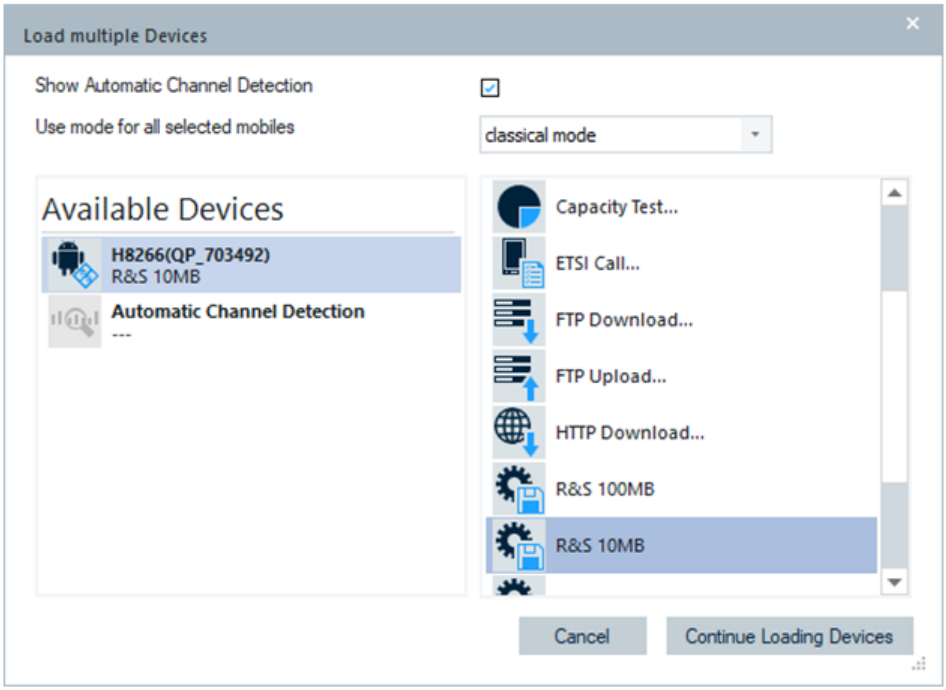


Figure 3-99: All loaded devices

3.5 Technologies menu

The "Technologies" menu displays all mobile technologies for which R&S ROMES4 supports the specific settings on the installed technology modules. The menu contains particular configuration pages for several technologies.

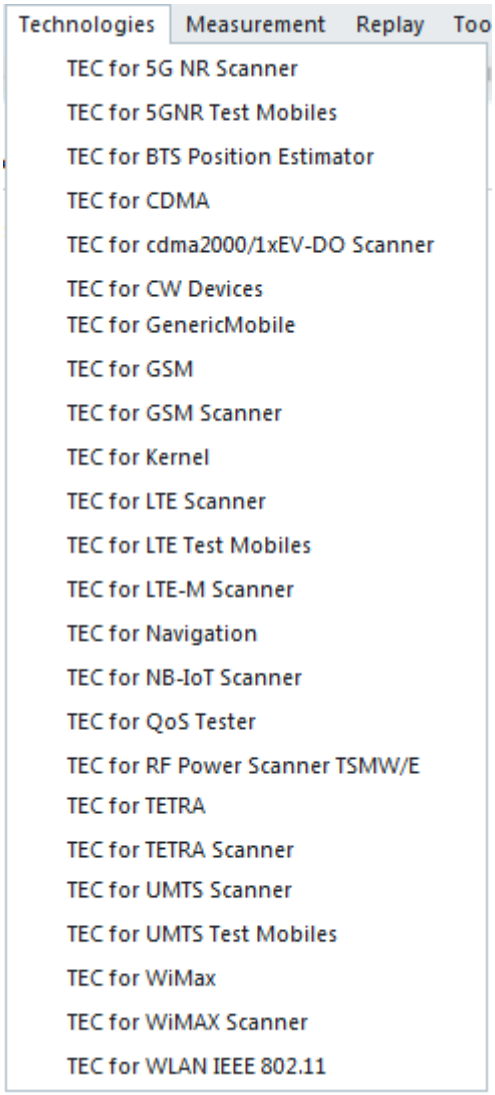


Figure 3-100: Technologies menu

The "Technologies" menu contains the following entries, which allow preferred settings:

- "TEC for 5G NR Scanner"
  Opens the 5G NR scanner settings page, see chapter Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279
- "TEC for BTS Position Estimator"
  Opens the "Position Estimator" settings page, see chapter Chapter 3.8.2.5, "TEC for BTS positon estimator", on page 294
- "TEC for CDMA2000/ 1x EV-DO Scanner"

Opens the CDMA PNS settings page, see chapter Chapter 3.8.2.7, "TEC for CDMA2000 1x Ev-DO PNS", on page 300

- "TEC for GSM Scanner"
  Opens the GSM NWS settings page, see chapter Chapter 3.8.2.8, "TEC for GSM NWS", on page 305
- "TEC for LTE Scanner"
  Opens the LTE scanner settings page, see chapter Chapter 3.8.2.12, "TEC for LTE scanner", on page 341
- "TEC for LTM-M Scanner"
  Opens the LTE-M scanner settings page, see chapter Chapter 3.8.2.14, "TEC for LTE-M scanner", on page 362
- "TEC for NB-IoT Scanner"
  Opens the NB-IoT scanner settings page, see chapter Chapter 3.8.2.13, "TEC for NB-IoT scanner", on page 356
- "TEC for QoS Tester"
  Opens the "QoS Settings" page, see chapter Chapter 3.8.2.15, "TEC for QoS tester", on page 367
- "TEC for RF Power Scanner TSME"
  Opens the "RF Power Scanner Signals TSME" settings page, see chapter Chapter 3.8.2.16, "TEC for RF power scanner TSME", on page 369
- "TEC for TETRA"
  Opens the "TETRA Parameters" settings page, see chapter Chapter 3.8.2.17, "TEC for TETRA", on page 373
- "TEC for TETRA Scanner"
  Opens the TETRA scanner settings page, see chapter Chapter 3.8.2.18, "TEC for TETRA scanner", on page 374
- "TEC for UMTS Scanner"
  Opens the UMTS PNS settings page, see chapter Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279
- "TEC for WiMAX Scanner"
  Opens the "WiMAX Scanner TopN" settings page, see chapter Chapter 3.8.2.11, "TEC for WiMAX scanner", on page 337

Other entries in the menu show only the information on installed module and related file.

3.6 Measurement menu

The "Measurement" lets users start and stop a measurement and display the list of event settings.

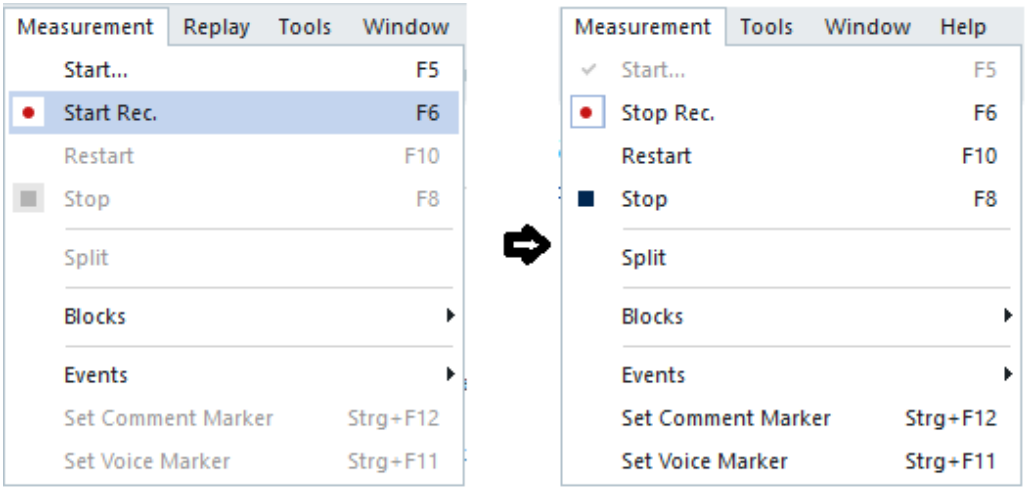


Figure 3-101: Measurement menu

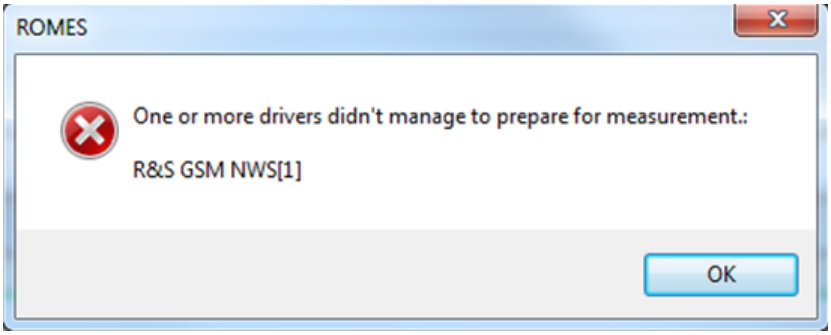
3.6.1 Start

Starts the measurement without writing the data to a file.

A measurement can also be started with the "Start measurement" button on the measurement bar.

The "Start Measurement" command is disabled unless at least one device has been loaded using the "Hardware" > "Connect/Disconnect" command.

If there are errors with device, the summary error message shows the list of devices which have problems at the start of measurement.



Before the measurement starts, a temporary measurement file (`*.rscmd` or `*.sqc`) must be defined. To this end, the "Open" window pops-up and offers a list of already existing measurement files.

1. Select one of the existing files to overwrite previous measurement data.
2. Define a new measurement file if you do not want to overwrite any existing data.

3. Click the "Open" button to open the selected/defined file for writing and return to the measurement, which starts immediately.

With a temporary measurement file, it is possible to switch over to recording without delay while a measurement is running. Otherwise, nothing is recorded and the temporary file is deleted after the end of the measurement.

3.6.2 Start recording

Click the button in the toolbar to start the measurement (if not yet running) and write the data to a measurement file. The replay of the results is later possible based on written data in the file.

If the measurement recording is running, the button gets the function to toggle recording.

Data recording can also be started by clicking the "Measurement" > "Start Rec." command of the menu bar. A measurement file (not temporary this time) must be defined as explained in the previous section.

The "Start Rec." command is disabled unless at least one device is loaded using the "Hardware > Connect/Disconnect" command.

"Start Recording" creates a block in the measurement file. See Chapter 3.7.9, "Replay jump to block", on page 222.

Data recording rate

The data recording rate depends on the number and kind of used devices and on the measurement settings.

Example:

- Low rate case - 2 GSM test mobiles doing autodial and network quality analysis with GPS generate data recording rate of about 3 MB per hour.
- Medium rate case - UMTS PN scanner with SIB decoding with GPS generates data recording rate of about 50 MB per hour
- High rate case - UMTS PN scanner with SIB decoding with GPS and CW test receiver with raw data generates data recording rate of about 50 MB per hour. The CW test receiver generates data recording rate of about 25 MB per hour.

Measurement file

The "Start Recording" command overwrites the current measurement file which has been selected and opened by the "File > Open Measurement File" command, see chapter Chapter 3.2, "File menu", on page 103). If no measurement file has been selected yet, the "Open Measurement File" command is executed first which calls the "Open" window up.

3.6.3 Stop recording

If the measurement recording is running, you can stop the data recording without stopping the measurement using the same button.

Data recording can also be stopped with the "Stop Rec." command of the "Measurement" menu.

Stop recording terminates the current block in the measurement file, see Chapter 3.7.9, "Replay jump to block", on page 222.

3.6.4 Stop

Click

Click the button to stop the measurement and the measurement data recording. The same button is used to stop the measurement file replay.

An ongoing measurement or replay can also be stopped with the "Stop" command in the "Measurement" or "Reply" menu bar, respectively.

If "Ask for Comment after the Measurement" is enabled in the "Preferences" dialog, see chapter Chapter 3.8.1.1, "General settings", on page 224, a user-defined comment can be stored within the header of measurement file.

3.6.5 Blocks

Opens a submenu to define blocks within a measurement file.

The "Blocks" entry is enabled only while a measurement is running. The menu commands "Start Block" and "Close Block" define the start and end of a block, respectively. "Discard Current Block" is enabled after "Start Block".

Blocks represent a useful navigation tool within the replayed measurement file; see Chapter 3.7.9, "Replay jump to block", on page 222.

3.6.6 Events

Click the "Measurement" > "Events" command to open a submenu with a list of up to 10 user-defined events.

A user-defined event can only be triggered if a recording is started. The events are stored within the measurement file currently recorded. The default names "Event_1" to "Event_10" can be changed via the "Tools" > "Preferences" command, see Chapter 3.8.1.3, "Available events configuration", on page 238.

To handle event easier, use shortcuts which trigger the individual user events. The default shortcuts for user-defined events from 1 to 10 are the [Ctrl+F1] to [Ctrl+F10] keys.

3.6.7 Set comment marker

Click the "Set Comment Marker" command to trigger including a comment marker event in the measurement file.

The purpose of the comment marker event is to include a written comment into the measurement file that is related to the particular time or position when the "Set Comment Marker" was triggered. After "Set Comment Marker" is activated, a comment entry dialog is shown.

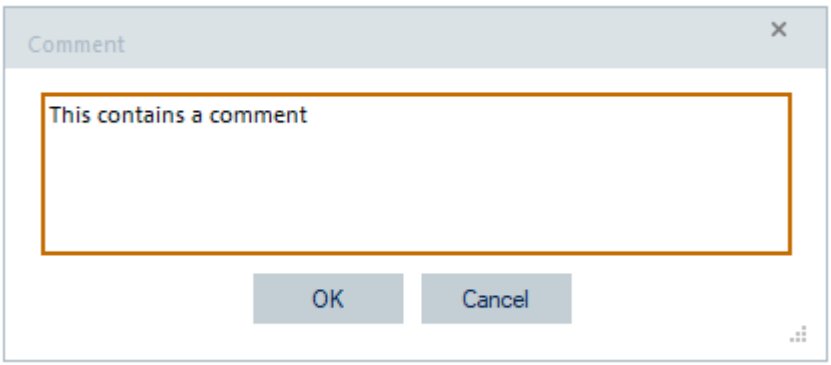


Figure 3-102: Dialog to enter a comment

At the end of the comment, click "OK" to continue the measurement. The "Set Comment Marker" is enabled after "Start Recording". For configuration information, refer to "Comment event" on page 243.

Note that the measurement recording cannot be stopped unless the comment marker is closed or disabled.

To trigger a comment marker easier, a shortcut can be used (default is [Ctrl+F12]).

3.6.8 Set voice marker

Click the "Set Voice Marker" command to trigger or stop a voice marker event to be included in the measurement file.

The purpose of the voice marker event is to include a spoken comment into the measurement file that is related to a particular time or position. After "Set Voice Marker" is activated, the "Recording (0%)" message in the status bar indicates that R&S ROMES4 is ready for recording the comment spoken into a connected microphone.

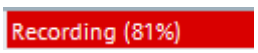


Figure 3-103: Recording status

At the end of the comment, click "Set Voice Marker" again to continue the measurement. "Set Voice Marker" is enabled after "Start Recording". For configuration, refer to "Voice marker event" on page 244.

Note that the measurement recording cannot be stopped unless the Voice Marker is closed or disabled.

To trigger a voice marker easier, a shortcut can be used (default [Ctrl+F11]).

3.7 Replay menu

The "Replay" menu starts and stops the replay of a measurement file.

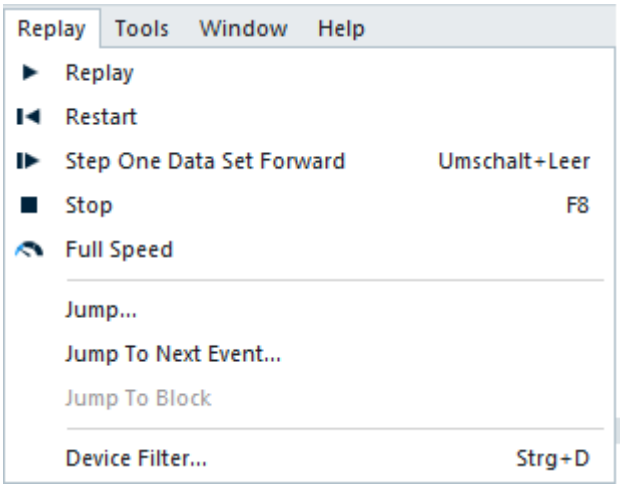


Figure 3-104: Replay menu

3.7.1 Start

To load a measurement file, click the icon besides "File" > "Open Measurement File".

During the replay, the Welcome sheet shows an overview of the currently available sheets and the views that are opened on them. Click the text to be brought to the corresponding item.

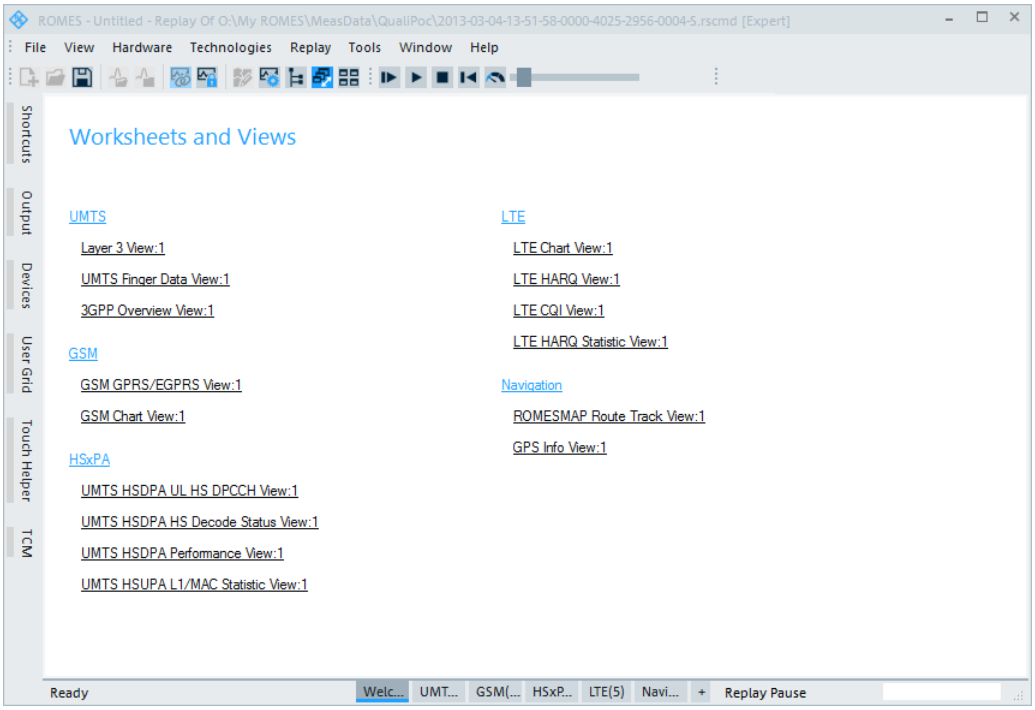


Figure 3-105: Welcome page during a file replay

Hardware devices

To replay a file, it is not necessary to load a device. You only have to configure the desired views.

Measurement file

The "Replay" command replays the current measurement (`*.rscmd` or `*.cmd`) file, that is, the file opened via "File" > "Open Measurement File", see chapter Chapter 3.2, "File menu", on page 103. If no measurement file is selected yet, the "Open Measurement File" command is executed first. It means, the "Open" entry is called up.

Note: A replayed measurement file must not have the "Read Only" file attribute. To replay files from a CD-ROM or DVD-ROM, copy the files to a hard disk or another appropriate medium. Change also the file attributes.

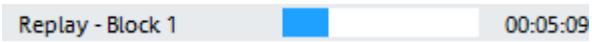
Monitoring the replay process

Two different tools are indicated while the measurement file is replayed:

- In the measurement bar, next to the icons controlling the replay mode, the "Replay Speed" is indicated on a marker bar with an meter symbol, see Figure 3-106.

By default the measurement file is loaded at "Min" speed. The replay speed can be enhanced by dragging and dropping the arrow symbol on the marker bar to the right. Minimum and maximum speed depends on your system resources.

- On the right-hand side of the status bar, a bar graph indicates the progress of the replay, i.e. the percentage of data already loaded. It shows the current state of the replay (block no. or paused) and the elapsed time.



3.7.2 Pause / continue replay

/ Pauses (interrupts) and continues the replay process, respectively.

The "Pause Replay" button is unified with the "Continue Replay" button. While a measurement is replayed, the button changes to pause. While pausing, the button offers to continue replaying.

No replay active
All icons are grayed except the "Continue Replay" icon. "No replay active" is the status after starting the measurement system or after a replay was completed or stopped.

Replay running or paused
A measurement file is being replayed. You can now pause, jump to another position in the file, pause, or stop the replay. A paused replay can be continued by clicking the "Pause" icon again or stopped.

3.7.3 Step one data set forward

A pause after the next data frame (i.e. the next time when data were recorded) can be initiated this button on the measurement bar. The function is available while a measurement file is being replayed. If applied repeatedly, it can be used to step through the measurement file and monitor the individual data frames recorded.

3.7.4 Restart replay

Stops and restarts the current replay process.

A restart can also be initiated with this button on the measurement bar. This function is available while a measurement file is being replayed.

3.7.5 Status of the replay process / full speed

Shows the speed changes of the current replay.

Click the button to toggle replay speed from manually set speed to maximum. If the current speed is just at the maximum, another click changes it back to the value before the maximal replay speed was selected. The current replay speed is always shown at the speed bar.

Figure 3-106: Adjusting the reply speed

3.7.6 Device filter

Opens the "Replay Device Filter" dialog for the test devices in the replayed file.

The "Replay Device Filter" shows the test devices of the currently replayed measurement file. If no measurement file is opened, it shows the devices included in the last replayed file. Measurement data from unchecked devices is excluded from the replay. The dialog is updated each time a new measurement file is loaded.

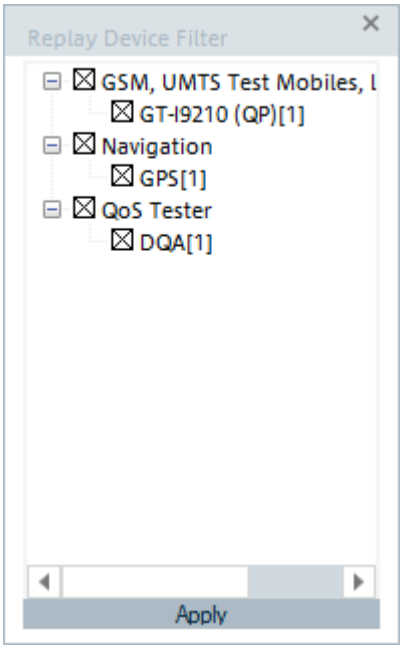


Figure 3-107: Devices filtering for replay

3.7.7 Jump

Jumps forward and backward in the measurement file.

Click the "Jump" command. The "Replay Jump" window opens.

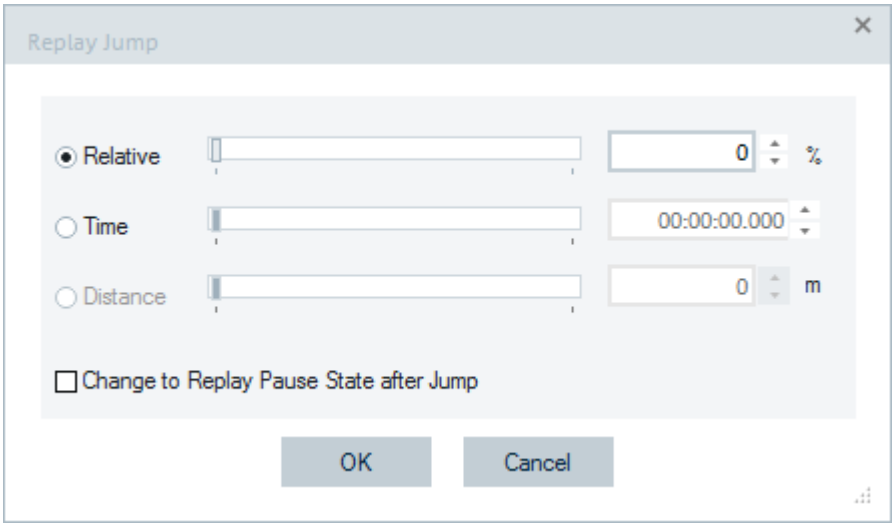


Figure 3-108: Replay jump

The current position within the measurement file, the current measurement time, and the current driven distance is indicated in the three fields to the right of the "Relative/Time/Distance" radio buttons. The position of the arrows on the marker bar corresponds to the relative time needed to replay the file up to that position in time, relative to the total measurement time. The current distance is relative to the total distance.

After selecting one of the three parameters "Relative/Time/Distance", the current position in the measurement file can be changed by overwriting the value in the field, by incrementing/decrementing the indicated value with the up/down buttons on the right side, or by dragging the arrow across the marker bar.

Distance is only available if a trigger device is attached during the measurement.

Measurement files are recorded such that a later measurement time corresponds to a later file position of the measurement data. The "Replay Jump" function can therefore be used to select a particular stage of the measurement tour.

If "Change to Replay Pause State after Jump" is checked, the replay is paused after the jump. Otherwise, it is continued.

In many views it is possible to initiate a replay jump to a particular timestamp in the measurement file; see Replay jump to timestamp in Chapter 4.1, "Common properties of R&S ROMES4 views", on page 428.

3.7.8 Replay jump to next event

Jumps forward to the next event in the measurement file.

Click the "Jumping... Event found" command to open the "End of Files" window.

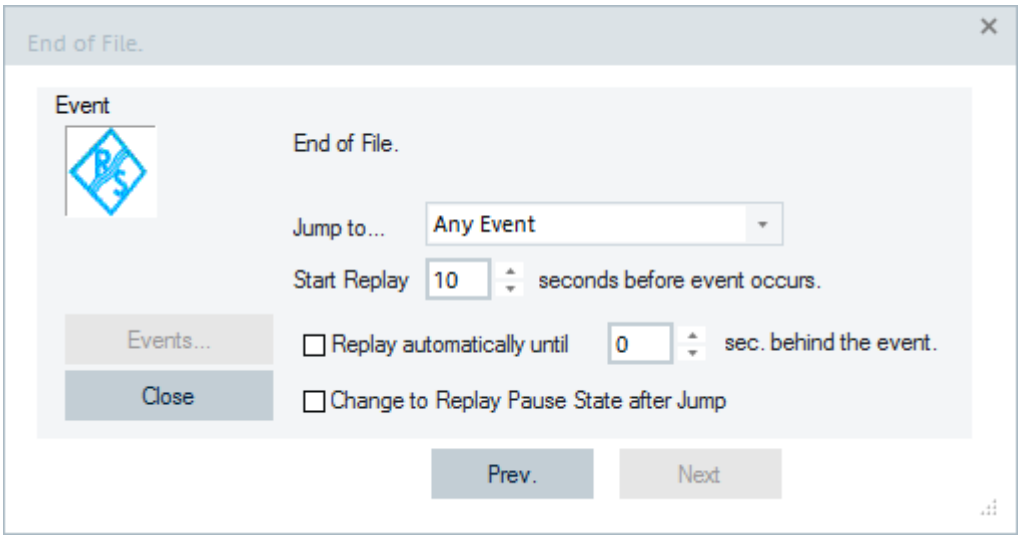


Figure 3-109: End of file

The events to be searched for must be defined in the "Preferences" > "Available Events" tab. See chapter Chapter 3.8.1.3, "Available events configuration", on page 238 before the replay is started.

The event found is indicated in the "Event" panel, together with its time stamp in the measurement file and the name of the measuring device.

- "Jump to"
  List of events, according to the current Chapter 3.8.1.3, "Available events configuration", on page 238
- "Start Replay"
  Defines the start time of the replay to be initiated after a particular event is found.
- "Replay"
  Closes the "Event" found window and resumes the replay session, refreshing the contents of all views. The replay is paused or restarted at the "Start Replay" time, depending on whether "Change to Replay Pause" is activated or not. At the end of the file, the "Replay" button is replaced by "Close", the title bar of the window indicates "End of File".
- "Prev. / Next"
  Jumps to the previous or to the next event in the measurement file. This button is disabled if no event is found.
- "Events"
  Opens the "Available Events" tab in the "Preferences" menu to change the current event selection. This button is disabled if no event is found.

3.7.9 Replay jump to block

Jumps to a block in the measurement file.

Recording is interrupted and the "Jump to Block" dialog is opened.

Replay "Jump to Block" is only enabled if a measurement file recorded with R&S ROMES4 V3.22 or higher containing several blocks is replayed. The blocks must be defined during the measurement using the Blocks submenu; see below. A new block is defined each time that recording is started (Start Recording). Stop Recording closes the current block. A name can be assigned to each block if this feature is enabled in the Preferences dialog; see Chapter 3.8.1.1, "General settings", on page 224.

The blocks in a measurement file can be exported separately; see Chapter 7.2, "Exporting data", on page 2099.

The "Jump to Blocks" dialog displays a complete list of the blocks in the replayed measurement file. Each block is characterized by the timestamp for the start (SOB) and end of the block (EOB).

- "Jump"
  Jumps to the selected block and closes the dialog. The replay is resumed or pauses at the start of the selected block, depending on whether the "Change to Replay Pause State after Jump" box is checked. Jump is disabled if no block is selected in the list.

- "Cancel"
  Closes the dialog without any further action.

3.8 Tools menu

The "Tools" menu configures the display and defines directories for the different types of files used by the measurement system.

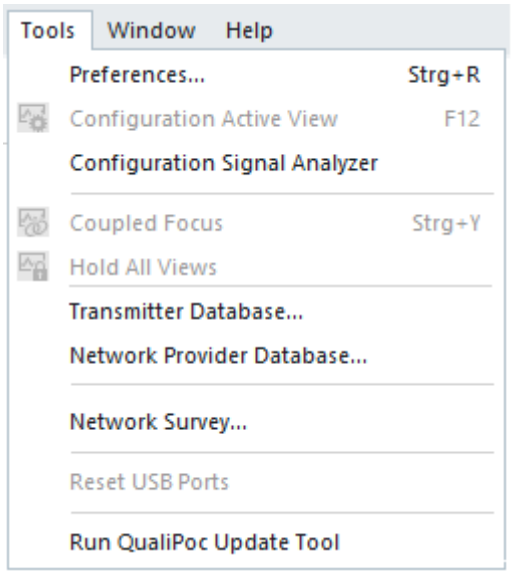


Figure 3-110: Tools menu entries

3.8.1 System configuration (preferences)

For the system configuration, select "Tools" > "Preferences" of the R&S ROMES4 main application page.

The "Preference" page contains several entries to configure different system parameters.

- Configuration of the general system and measurement parameters, see Chapter 3.8.1.1, "General settings", on page 224
- Selection of signals to measure out of available signals, see Chapter 3.8.1.2, "Available signals configuration", on page 228
- Selection and definition of events to monitor, see Chapter 3.8.1.3, "Available events configuration", on page 238
- Configuration of the measurements, like update rate of the list views, see Chapter 3.8.1.4, "Performance", on page 253
- Configuration of notification center. The center notifies a remote system whenever the R&S ROMES4 event occurs, see Chapter 3.8.1.5, "Notification center", on page 254

- Configuration of formats for date, position, distance and for the scrambling code, see Chapter 3.8.1.6, "Formats settings", on page 256
- Configuration of Autostart/Restart, see Chapter 3.8.1.7, "Auto-/Restart settings", on page 260
- Configuration of a measurement file format for upload and export, see Chapter 3.8.1.8, "File handling", on page 265
- The Automatic Channel Detection (UMTS, LTE, NB-IoT, 5GNR) stores all detected channels in a 1x1 km raster after the measurement, see Chapter 3.8.1.9, "Automatic channel detection", on page 270.
- Configuration the maximum number of supported devices per technology, see Chapter 3.8.1.10, "Advanced settings", on page 271
- Configuration of the commands to be displayed as bars in "Touch Helper", see Chapter 3.8.1.11, "Touch helper", on page 277
- Configuration of the custom colors to the color scheme in "User colors", see Chapter 3.8.1.12, "User colors", on page 278

Click "OK" to store the configurations to the current workspace.

Some of the "Preference" functions are not available during a measurement or replay.

3.8.1.1 General settings

Selecting "Tool" > "Preferences" opens the page for general system configuration. The figure shows default configuration.

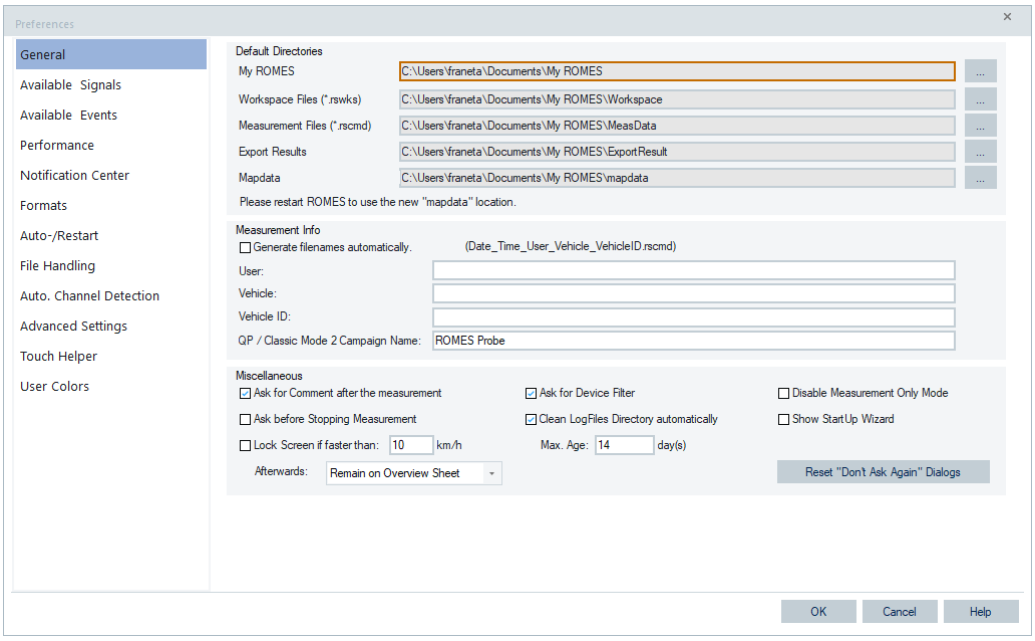


Figure 3-111: Preferences – General

After performing configuration, click "OK" to load only the selected devices. Otherwise, click "Cancel" to return to the default properties and load all devices.

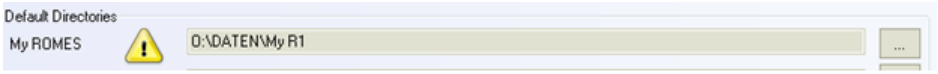
At installing a new version, the directory is synchronized again until the user switches off the process. The related registry key is not taken from the former R&S ROMES4 version.

Default Directories

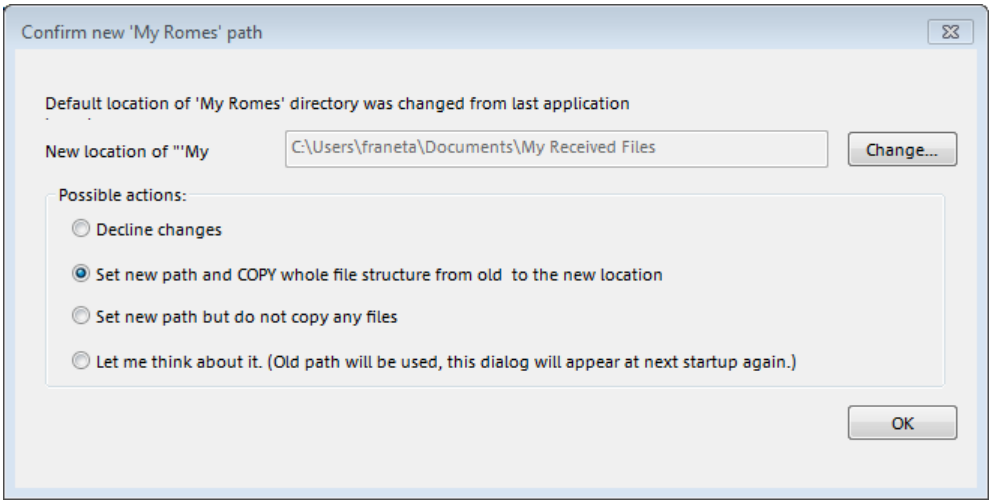
"Default Directories" displays the current default directories for measurement files (`*.rscmd` or `*.cmd`), workspace files (`*.rsxks`), and exported data files, see Chapter 7.2, "Exporting data", on page 2099. The directories can be changed in the "Browse for Folder" dialog. To open the dialog, click the "..." buttons.

Adjust the path to the My ROMES directory. Using a new directory request, restart R&S ROMES4.

After the path has changed, an exclamation mark indicates that the application of the new path is still pending.



At the next startup of the R&S ROMES4, the following dialog appears.



Choose one of the possible actions:

- "Decline changes"
  Do not use the new path - R&S ROMES4 continues using the original path.
- "Set new path and COPY..."
  Use the new path - R&S ROMES4 tries to copy all files from the original directory to new one. Those files are logged to a log file. It can occur that not all files can be copied due to restricted access rights. Some files can be locked by R&S ROMES4 or another application. Copy those files manually.
- "Set new path but do not copy any files"
  Use the new path, but do not move or copy the files.
- "Let me think about it. (Old path will be used, ...)"
  The new path remains pending - the dialog appears again at the next startup.

Measurement info
"Measurement Info" lets you specify the user name, vehicle used for the measurement tour and the vehicle's ID. The entries are stored in the measurement file and displayed by opening the measurement file, see the "Open Measurement File" command in Chapter 3.2, "File menu", on page 103.

- "Generate filenames automatically"
  If checked, R&S ROMES4 automatically assigns a file name (`User_Vehicle_VehicleID_Date_Time.rscmd`) to any measurement file created by executing the "Start Measurement" or "Start Recording" commands. Otherwise, these commands first open a dialog for selecting the directory and defining the name of the measurement file.
- "QP / Classic Mode 2 Campaign Name"
  The measurement campaign name ROMES Probe can be defined in the "Preferences" > "General" configuration page, apart from being always displayed in SmartAnalytics and NQDI.

Miscellaneous
The "Miscellaneous" pane contains several entries to control the recording of measurement files.

The function to update directory structure at startup is by default ON. Also, the automatically generated view areas function and the option to generate the overview views only is by default ON. Other miscellaneous functions are configurable.

Ask for Comment after the measurement ← Miscellaneous
If checked, a user-defined comment can be entered before the measurement file is closed on executing the "Stop Measurement" command.

Ask before Stopping Measurement ← Miscellaneous
If checked, the system asks if to stop the measurement.

Lock Screen if faster than ... ← Miscellaneous
If a speed of moving vehicle exceeds the specified value during the measurement, R&S ROMES4 switches to "Welcome" view area at the active "Lock Screen if faster than" option.

The software shows only a minimum set of parameters required for different reasons in this case.

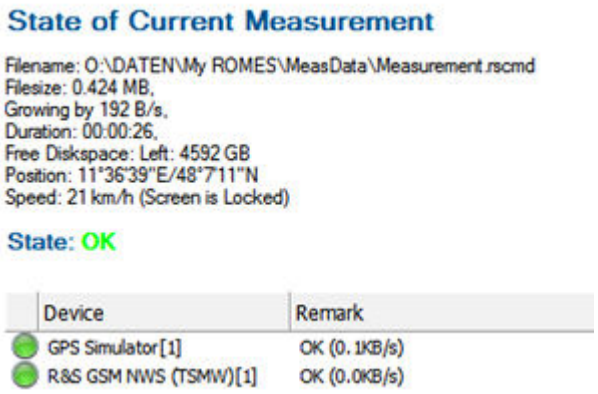


Figure 3-112: Locked screen due to exceeded speed

Note: If the Telecom version of the RCS shell-box is detected by R&S ROMES4, the speed lock is set to 5 km/h automatically, see Support of RCS Telekom.

Clean LogFiles Directory automatically ← Miscellaneous
By default the directory is cleaned at each startup of the R&S ROMES4. All files older than 14 days are deleted.

Max. Age ← Miscellaneous
The maximum age of a log file is adjustable. Set for how many days your log file is kept.

Ask for Device Filter ← Miscellaneous
If checked, R&S ROMES4 opens the "Device Filter" selection dialog while opening the measurement file.

The Chapter 3.7.6, "Device filter", on page 219 shows the test devices of the currently active measurement file. If no measurement file is opened, it shows the devices of the last replayed file.

Measurement data from unchecked devices is excluded from the replay. The dialog is updated every time a new measurement file is loaded.

The first file scan has to be a complete scan. In that case, the user-defined device filter setting only becomes active after the first complete measurement file scan has been performed.

After that, the device filter is displayed according to the settings shown in "Device Settings".

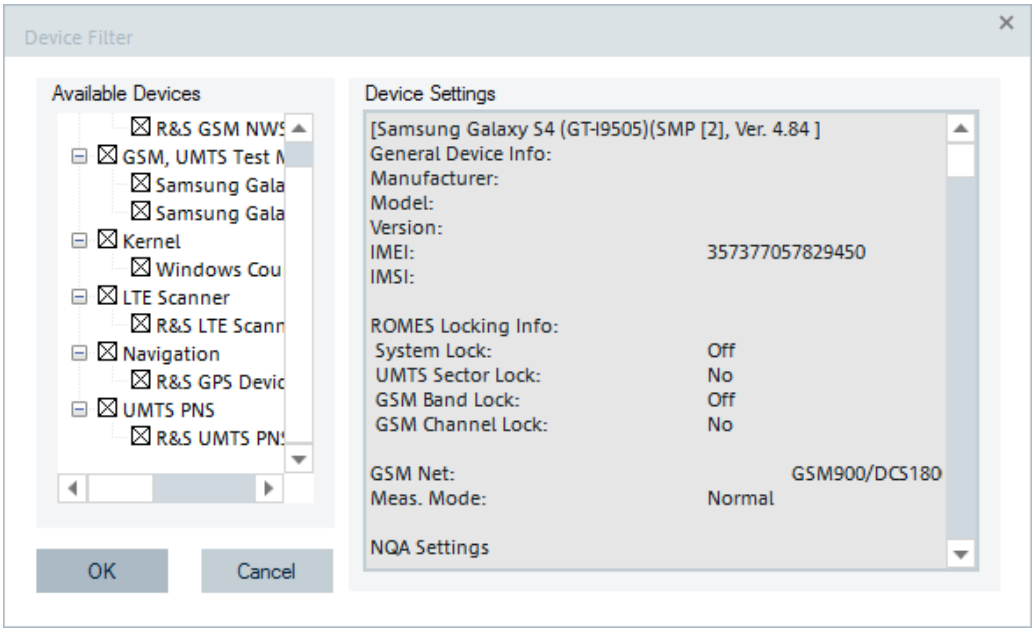


Figure 3-113: Preferences – Device Filter

Note: If a measurement file is scanned for the first time, "Device Filter" is not shown.

Disable Measurement Only Mode ← Miscellaneous
If checked, the Measurement Only mode is disabled. As this mode does not record any data, it can be helpful to disable it, to avoid it is switched on accidentally.

Show StartUp Wizard ← Miscellaneous
The wizard allows choosing the way of the R&S ROMES4 start. You can select to start the application with the predefined workspace or project file or to start an empty R&S ROMES4. In addition, a measurement file can be selected. In this case, it is opened immediately after R&S ROMES4 booting.

R&S ROMES4 loads automatically only those modules that are supported by the available licenses and resolved dependencies during startup.

Afterwards ← Miscellaneous
The option lets you choose if R&S ROMES4 switches back to the last viewed "View Area" or remains on the "Welcome" view area after the speed lock has been released. For details, see "Miscellaneous" on page 226.

Reset "Dont Ask Again" Dialog ← Miscellaneous
The “Don’t ask again” dialog for R&S ROMES4 reset using this button, refer to "Miscellaneous" on page 226.

3.8.1.2 Available signals configuration

The "Preferences" > "Available Signals" dialog displays all the signals available for viewing and lets configure the range and the color scale for them.

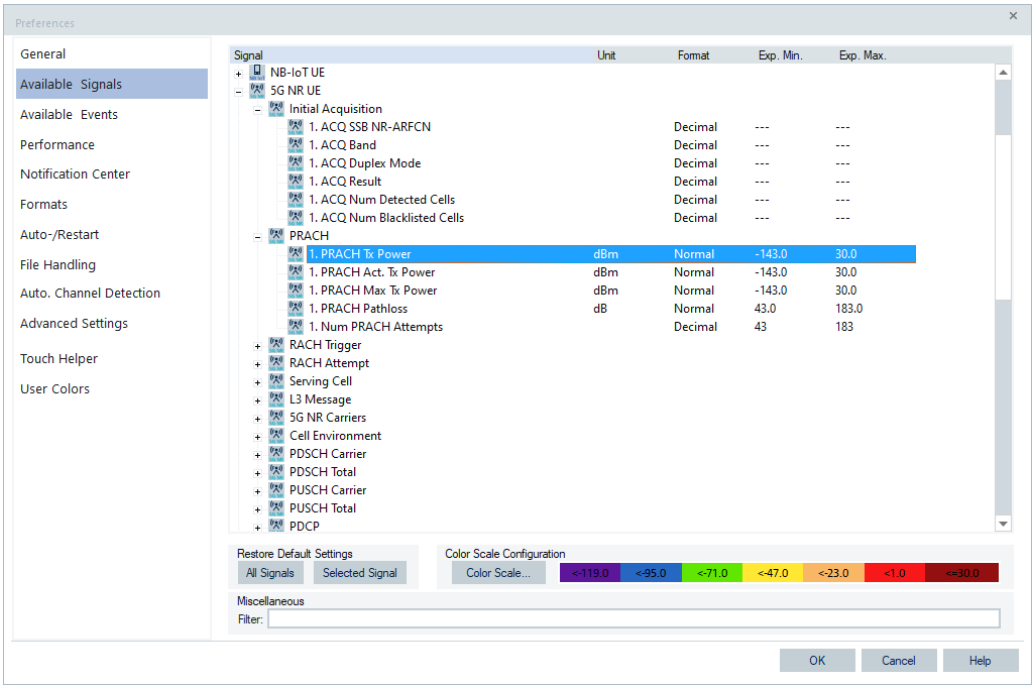


Figure 3-114: Available signals configuration - 5G NR PRACH Tx power

Signal Tree

The available signals are structured as a tree.

To modify the view, double-click an entry in the columns, for example, the unit, format or the range of a signal that you want to visualize.

Exp. Min and Exp. Max define, for example, the total y-axis scale of several views (e.g. the "2D Chart View"). Manual scaling of the y-axis is particularly useful if the actual value range of a signal (or its range of interest) is considerably smaller than its "natural" scale. For example, if only small GSM signal levels are measured so that the entire RxLev scale between 0 and 63 is not needed.

Each signal definition contains a full set of parameters, for example:

- Name, ID and html detail description
- Color scale
- Unit description
- Formatting description
- Ranges
- Physical access description

The configured R&S ROMES4 signals, which are multiplied in a large extent, can occupy a significant portion of available 2GB memory space, although these multiple instances of a signal slightly differ. To avoid the high memory usage of the signals, the signals internal composition is based on pointers to the main common variables of their multiple instances.

As a result of the pointers-based signal internal composition, all instances of a multiplied signal share the setup of:

- Color scale
- Unit description

- Ranges

The achievements are:

- Signal with full variables content
- Lightweight signal instance, which uses only pointers to the variables of the previously mentioned signal

Restore Default Settings

The two buttons in the "Restore Default Settings" panel reset the unit, format, and the expected minimum and maximum to default.

- "All Signals"
  Default settings for all signals
- "Selected Signal"
  Default settings for selected signal only

Color Scale Configuration

For the selected signal, you can choose a way of the signal visualization in the Route Tracking or Indoor view, with the support of the "Color Scale for <variable>" dialog. The dialog opens for the selected signal if you click the "Color Scale Configuration" > "Color Scale" button.

If no meaningful scale is assigned to the selected signal, the button is disabled (grayed, and "Not Available" is indicated instead of a color scale.

Since all changes of signal settings made in "Preferences" are unique for each signal, the changes you make in the "Color Scale for <variable>" dialog are saved at the dialog closing with "OK".

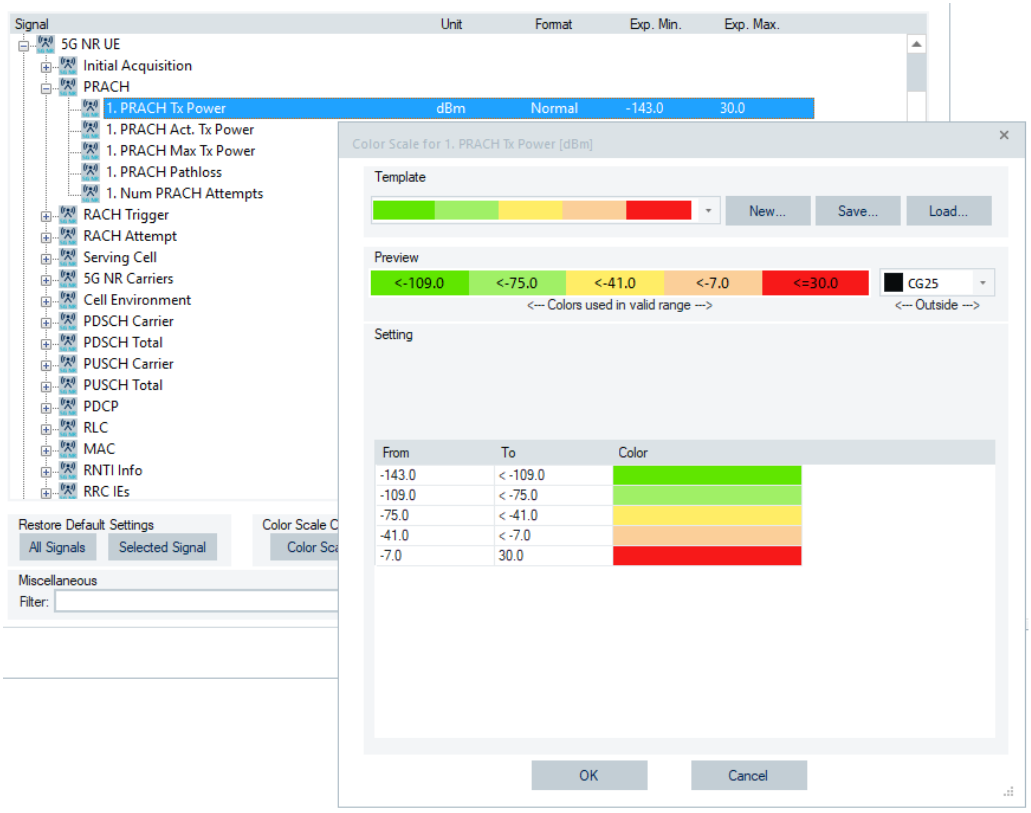


Figure 3-115: Color scale configuration for selected signal

The "Color Scale for <variable>" dialog displays by default-assigned colors to five sub-ranges of the selected signal range in the "Signals Tree".

The dialog is made of the following sections.

Template ← Color Scale Configuration
Contains a combo-box which offers you all current known color templates. Select other color set. The selected signal is adapted automatically.

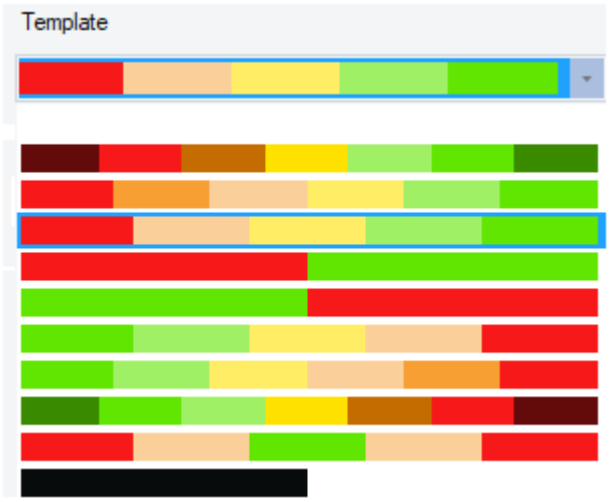


Figure 3-116: Colorset selection within Template

Once you have selected a color set, it is mapped equidistant to your selection of signal's range. You can now move the borders in the "Preview" by moving them with your mouse. The color set is also configurable in "Settings".

- "New"
  If you need a template different to the ones already in the combo box, click "New". For the options available in this button, see "Color Scale Template Editor" on page 233.
- "Save"
  Saves the current color scale as a `*.csl` template file. At the next R&S ROMES4 startup, this defined color setting is loaded and used.
- "Load"
  Opens the "Open" dialog letting you to load a color configuration from a color scale file defined previously as a template (the "Open" > "File Name" offers the CSL format).
  The color scale files are ASCII text files. They contain the defined colors and the corresponding ranges.

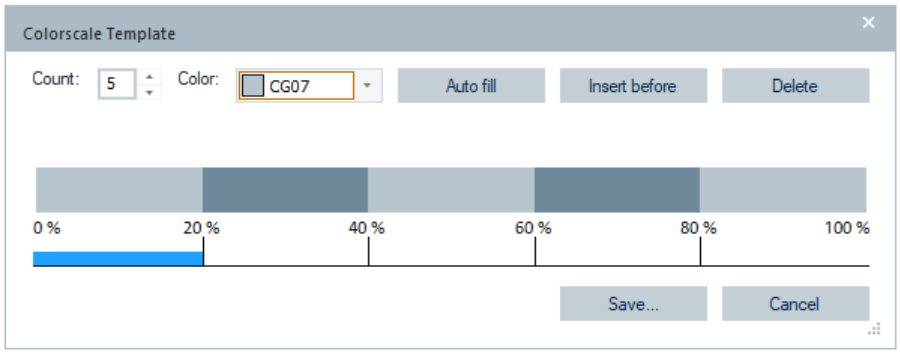
```
[Col]
NumberOfEntries=3
RangeMin=0.000000
RangeMax=33.000000
Type=0
Color_0=255
Value_0=0.000000
Color_1=33023
Value_1=12.000000
Color_2=65535
Value_2=25.000000
```

Figure 3-117: Three colors in the color scale file

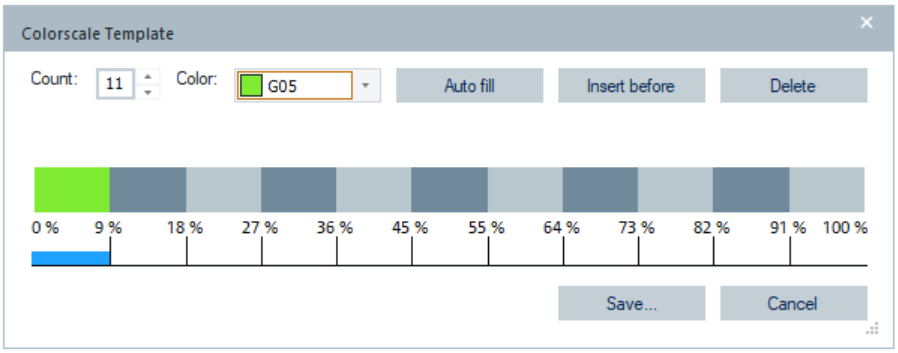
Color Scale Template Editor ← Template ← Color Scale Configuration

As mentioned in the previous text, if you need a template different from the ones available in the "Template" combo box, click "New". The buttons in "Template" section can be used for color setting in the following way:

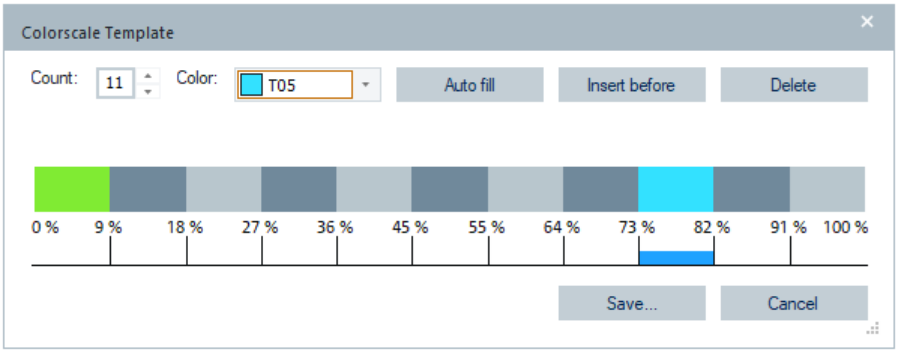
1. The first section is already selected. Click the axis or preview to select a different section.



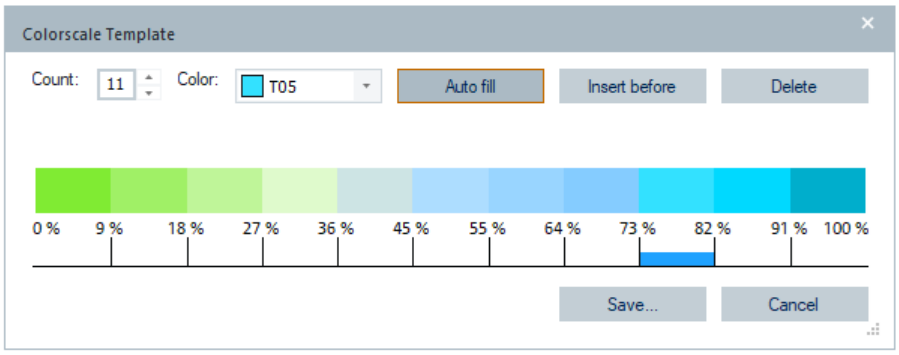
2. Change the color of the selected section by changing the color in the "Color" combobox.



3. Continue by selecting another section and color.



4. Now, select another section and set its color or try the "Auto fill" button. The button sets the remaining (empty) sections automatically.



Using this function, you can create smooth color sets with a variable count of pre-set nodes (Green G5 and Teal T5 in the example).

Changing the count using the spin-box of the "Count" deletes sections from the end or adds new sections at the end. Up to 16 colors are allowed.

Use "Insert before" or "Delete" buttons to add a section in a specific location or delete the selected section, respectively. Save the new template to the Configuration/Color-scales folder.

All templates stored there are offered in the Template's combo-box of the "Color Scale for <variable>" dialog.

Preview ← Color Scale Configuration
Shows the current color configuration.

The combo-box on the right in this section shows a list of colors to change the formerly fixed color settings for the “other” values of the signals. This color is used if the value of the signal is not within the range of the color scale.

Setting ← Color Scale Configuration
The section offers two ways to set up and display signals coloring.

- Signal coloring of to up to five subranges ("From", "To", each) and the subranges associated with these colors. The lower limits ("From") in the table can be changed (double-click a table field under the "From" column and overwrite the entry) but must remain in ascending order.
- Signal auto-coloring option possible if the "Auto Color: Generated color sequence with repetition" is checked. The color scale contains 16 colors as default.
  In this option, the color of a selected signal is not based on the value, but on the occurrence of the value. The first occurred value gets the first color, the second occurred value gets the second color of scale and so on.

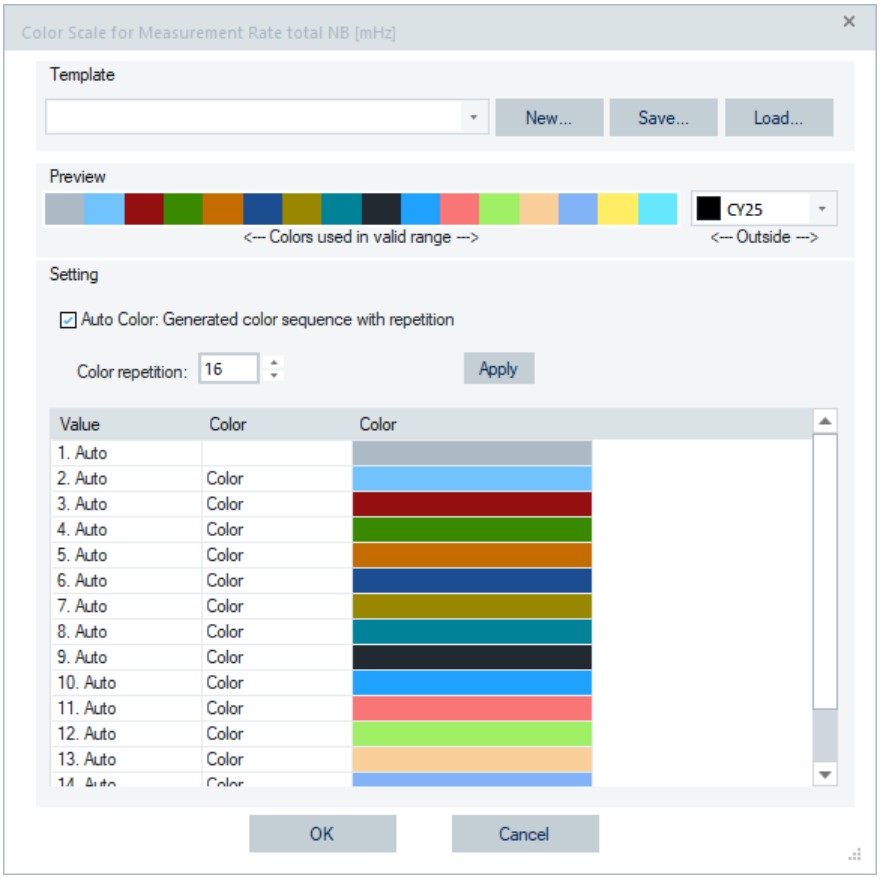


Figure 3-118: Auto-coloring dialog

All the colors generated in this way are unique and the colors of adjacent values are more different than others. You can edit the colors. Then the color scale is applied to the whole range of a signal as a repetitive pattern. Almost any change in a value is shown with a different color.
This function automates the definition of a signal color scale with many colors. A typical application is, for example, for the TETRA LA signal. It has a large range and has a different color for each value in a measurement, so that a change in LA is immediately visible.
The following signals are set to default auto-color if the "Auto Color:..." check-box is checked:
- 5G NR RAT: NR-ARFCN, PCI
- LTE RAT: EARFCN, PCI
- UMTS RAT: UARFCN, SC
- GSM RAT: BCCH

The "Apply" button generates the new scale after changing the color repetition.

- You can change a color field in the "Settings" > "Color" column within the "ROMES Color Picker" dialog. The dialog pops-up when right-mouse click the field. This changing possibility applies to both color setting ways.
  A color field in the "Settings" >"Color" column in both setting ways you can change in the pop-up "ROMES Color Picker" dialog which appears when right-mouse click the field.

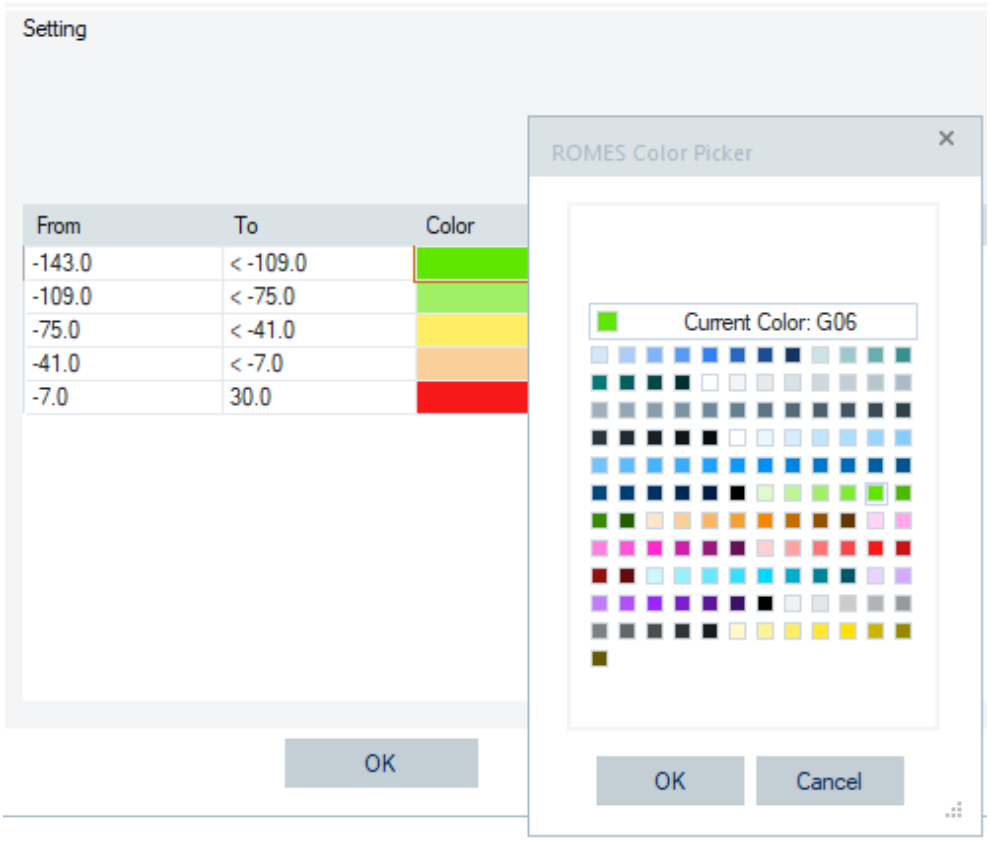


Figure 3-119: Current color in the color picker

Color Scale for Scanner Measurement Rate Signals ← Color Scale Configuration
For the GSM, UMTS, LTE and cdma/EVDO scanner measurement rate signals an additional color scale configuration is available.

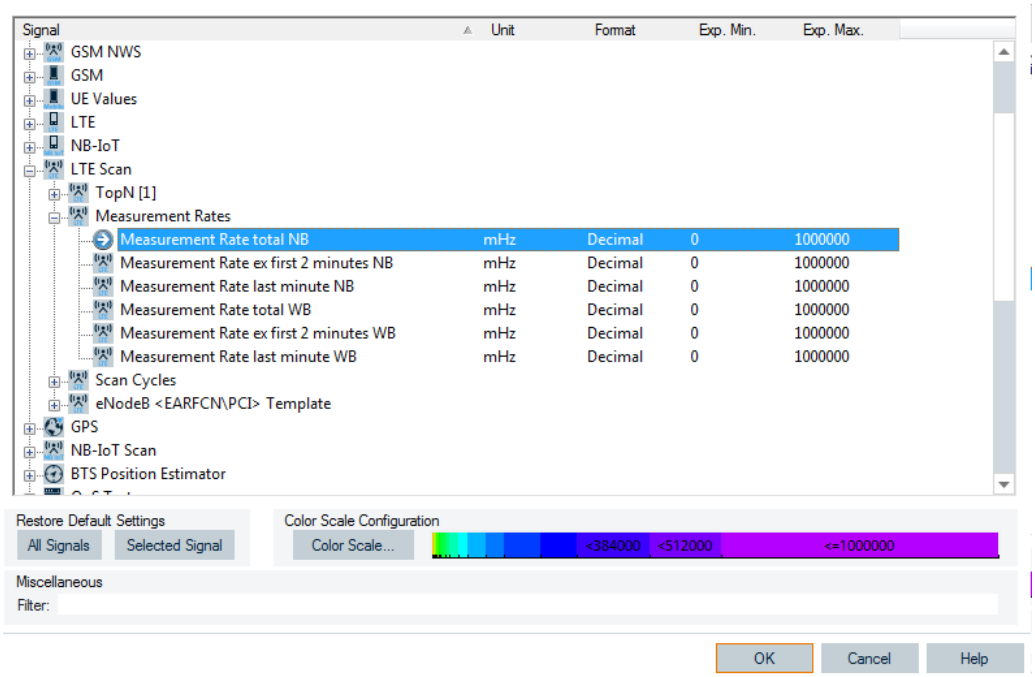


Figure 3-120: LTE scanner measurement rate signals

For the scanner measurement rate signals, the standard 5-color scale with 200 Hz intervals is tailored into 20 colors scale and non-linear intervals. Such a tailoring favors the lower numbers, as illustrated in the following figure.

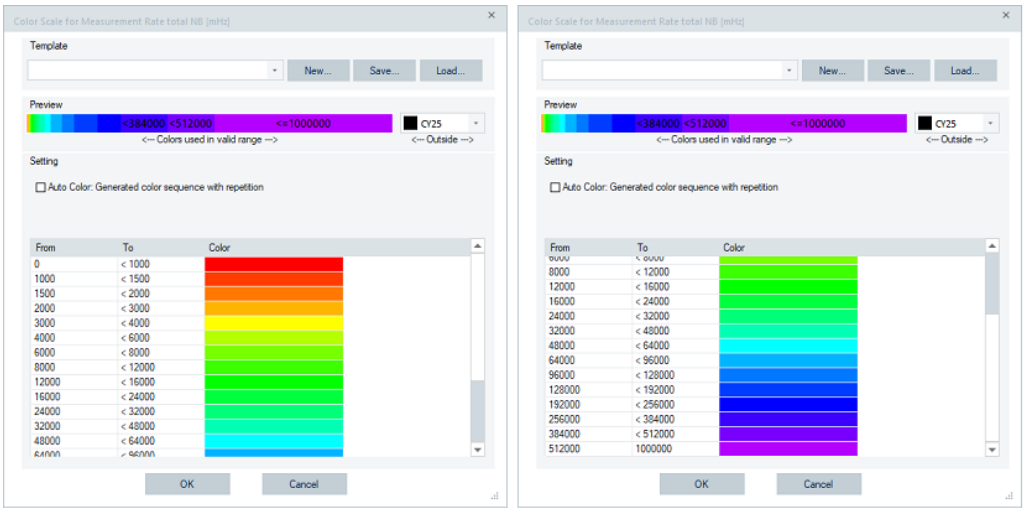


Figure 3-121: Color scale for scanner measurement rate signals

Miscellaneous

In this panel you can filter the list of available signals.

Note: By default, the simultaneous configuration of all the signals related to a signal selected for editing is active. For example, selecting the GSM RxLev signal of a serving cell, enables measuring and editing up to 6 neighbor cells' RxLev.

- **Filter**
  A text filter lets you filter the signals by a given text string.
  Only signals that include written text are shown. If the parent tree items state was expanded and the filter does not match any signals, the tree item is collapsed. Otherwise, the tree item remains in the former state.
  In the following figure is an example of filtering FTP signal. Only the signals that include the FTP text are shown.

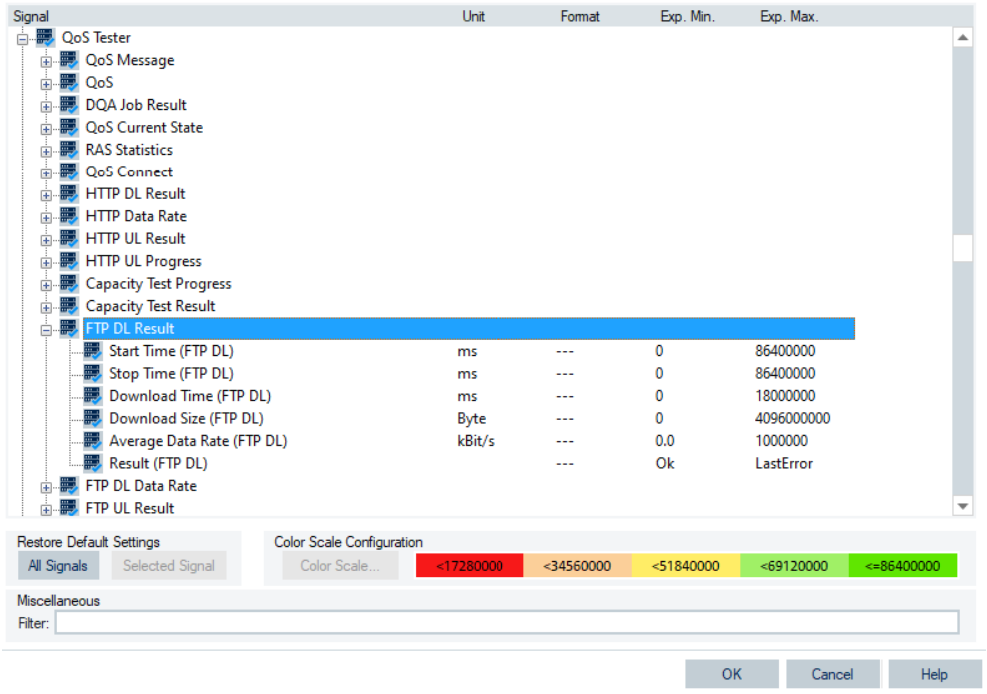


Figure 3-122: Filtering QoS Testing - FTP signals

3.8.1.3 Available events configuration

The "Available Events" dialog in the "Preferences" > "Basic" is used to select the signal events for recording during the measurement.

The test system automatically generates the signal events according to the properties of a measured signal and the settings made in the "Available Events" dialog. The examples of the signal events are sudden changes of a numeric signal value or recorded actions. For example, a drop of the measured signal power or a channel change triggers the numeric signal value change. The start of a call or a handover triggers the recorded action change.

Each signal event definition contains a full set of parameters, for example:

- Name, ID
- Threshold properties definitions multiplied by max device

As the result of the pointers-based signal internal composition, all instances of an event signal share the threshold settings per device.

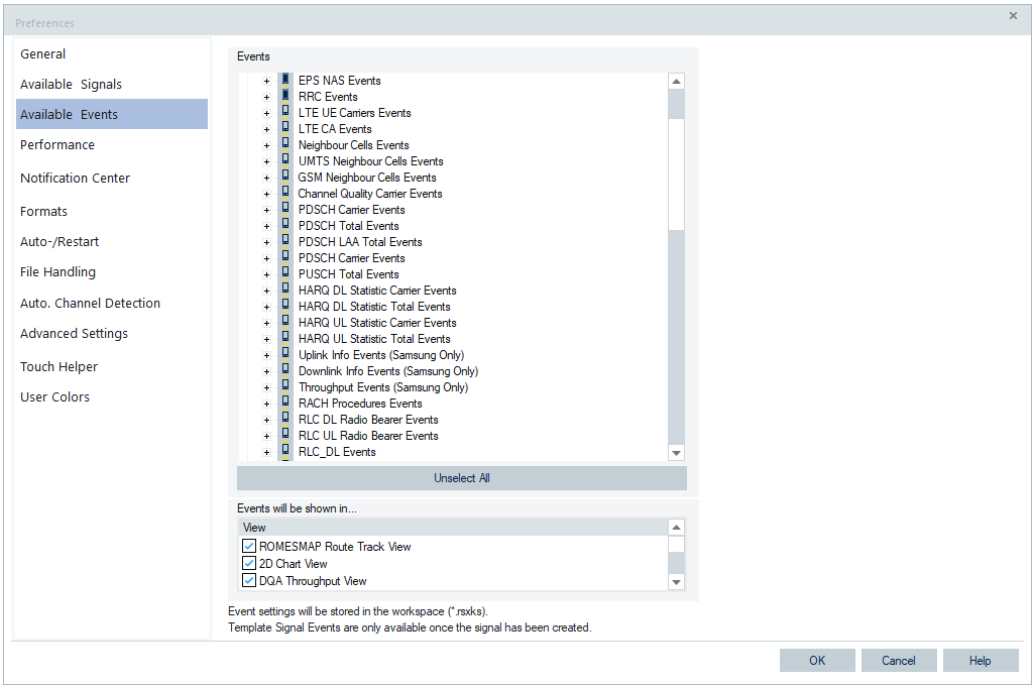


Figure 3-123: Preferences – Available Events

It is possible to configure the R&S ROMES4 events apart from the technologies events, see "ROMES events" on page 242.

If an event is activated, the event symbol is displayed in general purpose and other view types, for example, in the "2D Chart View" or in the "ROMESMAP Route Track View".

An event view displays a chronological record of the all events that occurred during the measurement.

Under certain circumstances, it can happen that some events are present during recording but not during replay. The presence of the events during recording but not replaying can happen if timings in recording and replay slightly differ. The typical case is when event states exist only for a short time, like below 1 second.

Events

The "Events" tree shows all events available by the R&S ROMES4. The available events are structured per technology and per device which recorded them, UE or scanner or the R&S ROMES4 counters. The events are associated with symbols. Selecting an event opens a specific configuration section in the right half of the dialog.

It is necessary to select events you are interested in. Double-click the selected event to activate it for recording. An activated event is marked by a checkmark and indented.

The "Events" pane contains the "Unselect All" button. To unselect all previously selected events, press the button. The button is useful if many events must be unselected or to assure that nothing is chosen.

The selected event in the following figure supports the option to be pointed in time when device's RAT mode or network changes.

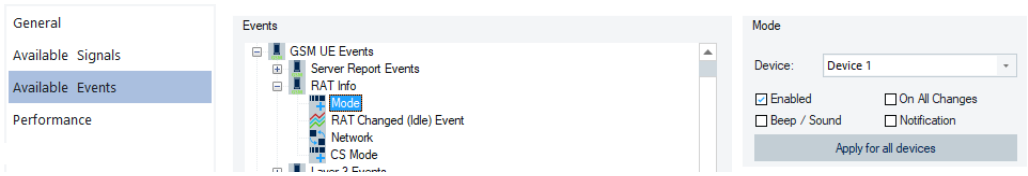


Figure 3-124: Point event in time

The events are directly connected to the corresponding signals in the "Signal Tree". To get all changes of RAT's mode (UMTS, LTE, 5G, and so on) or networks, check the "On All Changes" option.

Events of template signals

There are no Top N events available for GSM, UMTS, LTE, NB-IoT and 5G NR scanners. A Top N event is available in the "Events" list if a responding signal is used in the 2D View or the ROMESMAP Route Track View.

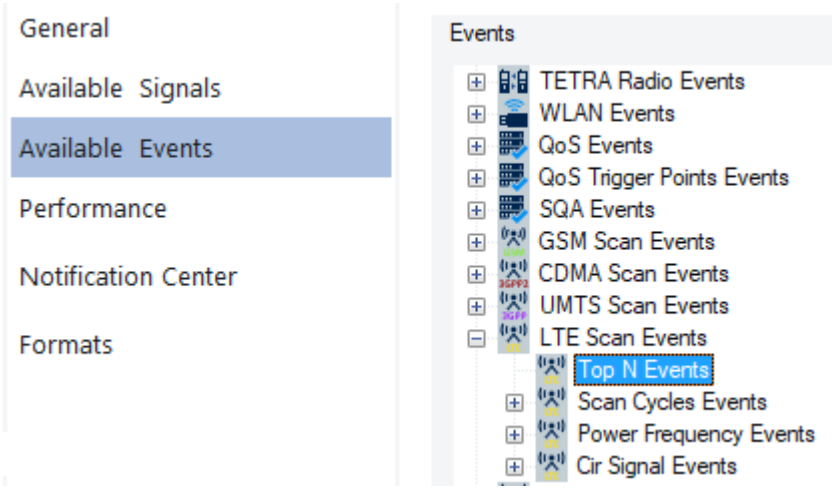


Figure 3-125: Top N events are not configurable

The previous note is not true if a scanner Top N event stands for a Top N signal configured as the template signal.

A template signal is not an actual signal, which belongs to one specific value, but a generic template which can be specific by specifying the templates parameters.

Scanner Top N signals are the most common templates for example. The Top N RSRP value node in the "Signal Tree" stands for the RSRP value of any TopN pool and pool member. When the template is added to one of the views, the user is prompted to enter parameters Top N pool and Top N member to create the specific signal.

These specific signals and their events for the specified Top N pool and Top N member are available and can be found on the "Available Events" page.

<Event>
Depending on the selected event, various settings are offered on the right side of the "Available Events" dialog.

- "Device"
  Select events to be generated for only one or for all used devices
- "Enabled"
  Event recording is enabled for the selected device, if the event recording is enabled in the event tree. Double-click the event to label its symbol by a check-mark.
- "Beep/Sound"
  If checked, a configurable sound announces that an event was triggered
- "On All Changes"
  If checked, an event is selected whenever the value of the selected parameter changes
  This function is useful to indicate the change of channels or modes, for example. It is not used for measurement parameters that continuously vary in time, like RxLev.
- "Apply for all devices"
  If the button is clicked (and the label appears in a dashed frame), the event settings are valid for all devices used, not just for the device indicated in the "Device" field.

Finally, the user events "Event_1" to "Event_10" can be renamed for later identification in the "Event" panel.

Positive Slope/Negative Slope
An event can be triggered when a signal parameter passes a given threshold in upward or downward direction ("Positive Slope"/"Negative Slope"). This feature is provided for numeric parameters that cover a range of (continuous or discrete) values, e.g. RxLev, FER etc.

- "Activate"
  If the box is checked, the positive or negative slope event is triggered, respectively.
- "Threshold"
  Entry of the positive/negative threshold. The units of the signal are selected automatically.
- "Sound"
  A sound to announce that the event is activated by loading a `*.wav` file which can be selected via the browse (…) button. The selected `*.wav` file is indicated in the "Sound" window. At the same time, the gray square icon on the right side changes to an icon showing a megaphone. R&S ROMES4 provides a selection of `*.wav` files in the "Sounds" subdirectory of its program directory.

Slope Toggle Mode
A toggle mode for crossing threshold events is supported.

If checked, the "Slope Togle Mode (Hysteresis)" prevents getting two consecutives “positive” or “negative” events. After having triggered a positive event, first a negative event has to be triggered, before the next positive events can be triggered (hysteresis).

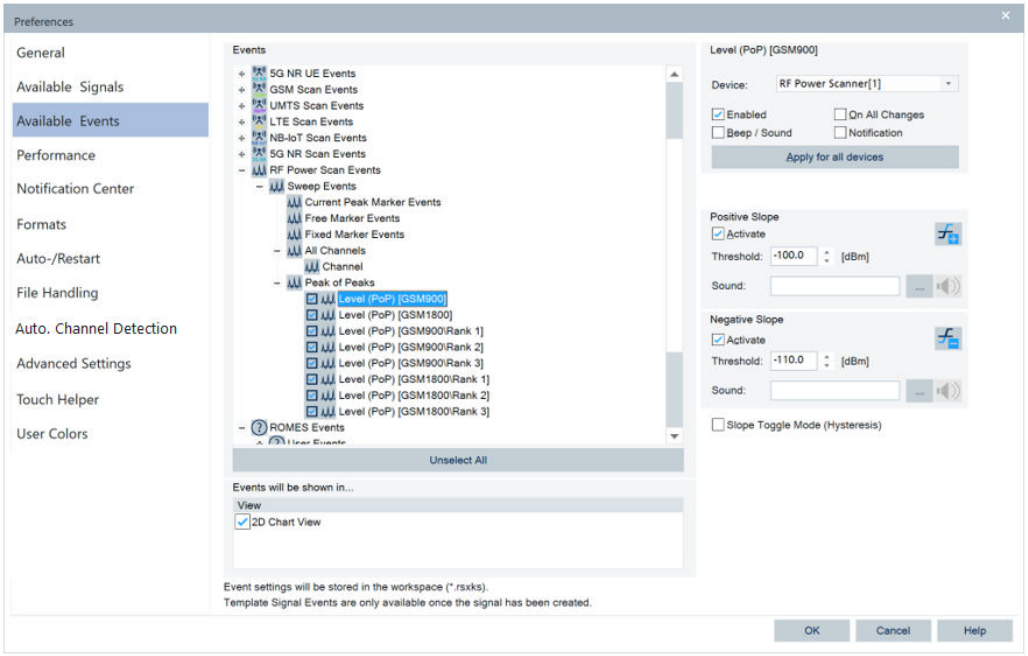


Figure 3-126: Toggle mode for selected PoP event

Missing the toggle mode activation, the event is triggered whenever the given threshold is passed in the right direction.

Events will be shown in…
The list of all opened views capable of displaying events. The events appear in all selected views.

ROMES events
At the bottom of the events tree in the "Events" pane, there is the "ROMES Events" branch.

The "ROMES Events" include:

- "User Events"
- "Marker Events"
  The "Marker Events" include the following options:
  – "Comment"
  – "Voice Marker"
- "Network Survey"
  The "Network Survey" includes the options:
  – "Threshold Passed Up"
  – "Threshold Passed Down"
  – "Unknown Transmitter"
  – "Too less Satellites"
  – "Enough Satellites again"

  For more, see Chapter 3.8.7, "Network survey", on page 410.

The user and comment events must be triggered manually during a measurement. They are intended to include information into the measurement file that is not automatically recorded. Information such as "traffic jam" or "tunnel in/out" can help during the assessment of the measurement data.

User Events ← ROMES events
User events are located within the "Romes Events" > "User Events" branch of the event tree. The events' names can be changed for later identification. Use names such as "Enter_tunnel", "Leave_tunnel" instead of the default event names "Event_1" to "Event_10".

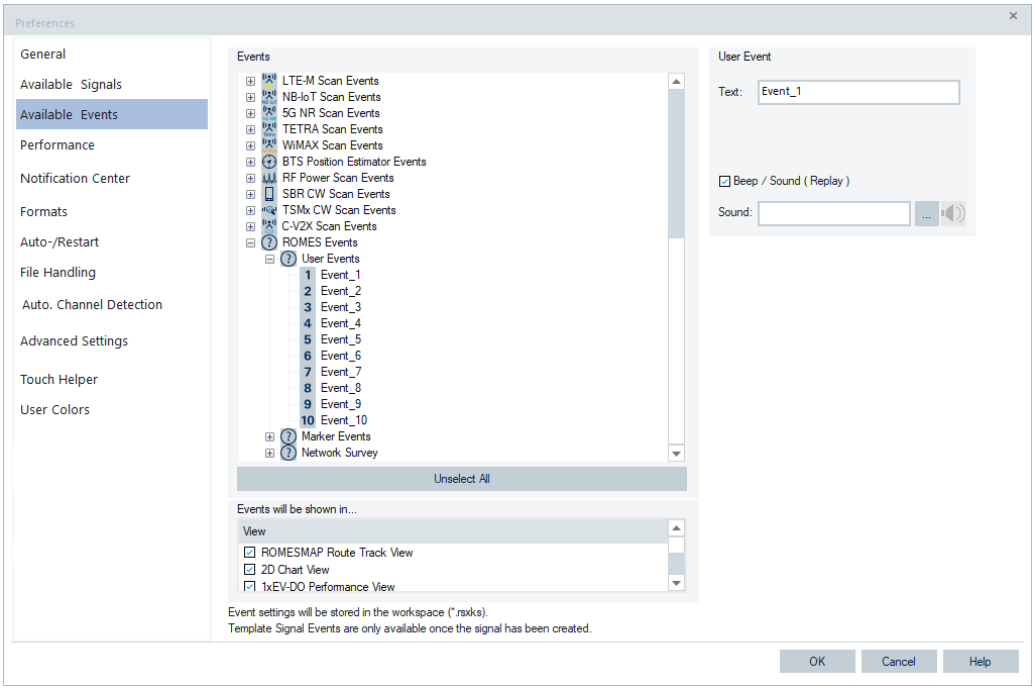


Figure 3-127: User events

The event names are shown in the "User Events" list opened by the "Events" command in the "Measurement" menu.

Marker events ← ROMES events
The marker events comprise the comment events and the voice marker events.

Comment event ← Marker events ← ROMES events
To configure a comment event, go to the "ROMES Events" > "Marker Events" branch of the event tree.

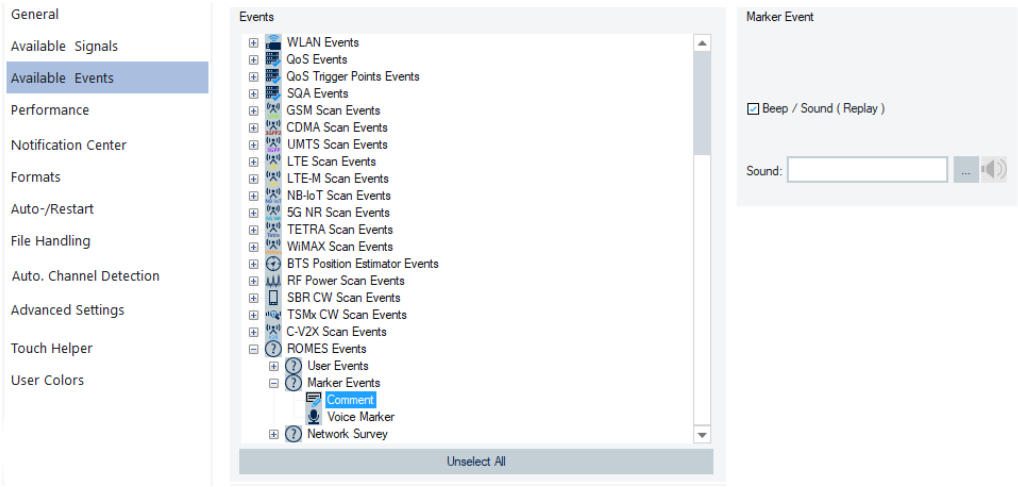


Figure 3-128: Comment event

The purpose of the comment event is to include a written information into the measurement file related to a particular time or position. When recording measurement data ("Measurement" > "Start Recording"), you can trigger events using the Chapter 3.6.7, "Set comment marker", on page 216 command in the "Measurement" menu.

The comment event can be used during recording independently from the activation in the event configuration menu. However, for displaying a comment event during replay the activation is mandatory.

Voice marker event ← Marker events ← ROMES events

The voice marker event is also configured in the "ROMES Events" > "Marker Events" branch of the event tree.

The purpose of the voice marker event is to include a spoken comment into the measurement file that is related to a particular time or position. If recording measurement data ("Measurement" > "Start Recording"), you can trigger voice marker events using the Chapter 3.6.8, "Set voice marker", on page 216 command in the "Measurement" menu.

Network survey ← ROMES events

The R&S ROMES4 notification function offers several possibilities to notify a remote system whenever some R&S ROMES4 event occurs.

The network survey events are active by default if the "Tools" > "Network Survey" > "Activate Network Survey" option is checked, see Figure 3-288.

It is possible to activate/deactivate the events manually. For manual actions, check the "Notification (Measurement only)" check box in the "Network Survey Event" pane.

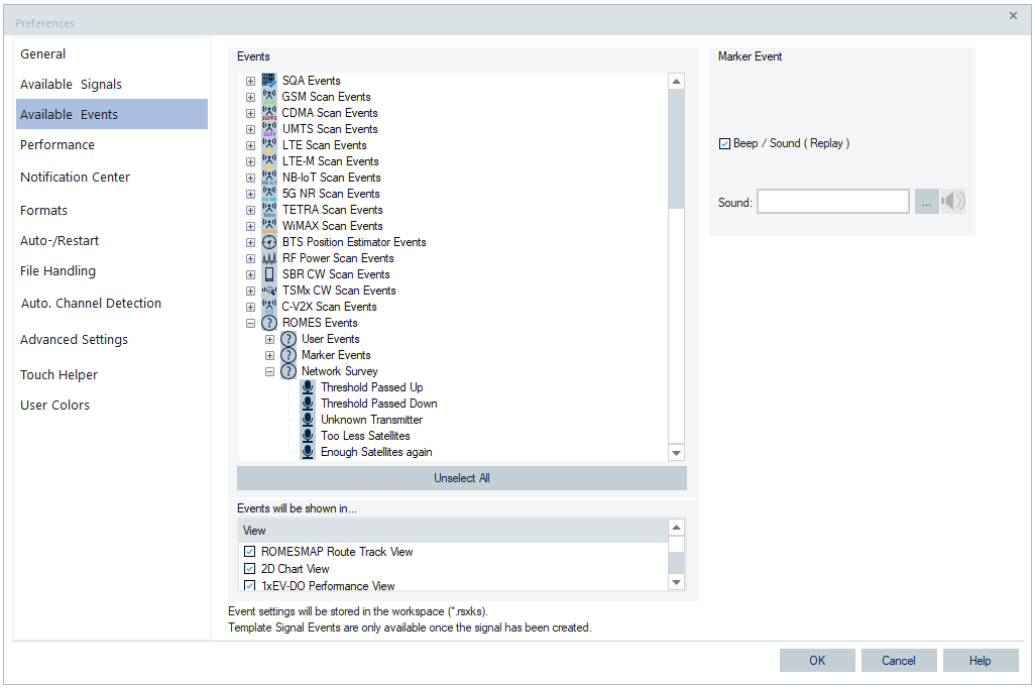


Figure 3-129: Dialog to activate network survey events

The events are displayed in the "Basic Views" > "Event View". If necessary, the events can be published via the Notification Center function.

You can choose a way of notification and set the corresponding parameters in the "Notification Center" dialog, see Chapter 3.8.1.5, "Notification center", on page 254.

LTE UE and 5G NR UE events

In the following sections some R&S ROMES4 supported events are pointed out. We are here focusing on EN-DC events and the 5G NR events.

LTE UE events

The events are configured in the Preferences > "Available Events" > "LTE UE Events" tree.

Some LTE mobile events are described in the following sections.

Redirection and carrier aggregation events ← LTE UE events

These events are configured in the common "RRC Events" branch of the "LTE UE Events" tree.

Redirection event

The redirection event generates a report whenever an LTE RCC message with a “redirectedCarrierInfo” was received. The target network is displayed in the event info. Also the event info of the already existing “mobilityControlInfo” event shows the "targetPhysCellId".

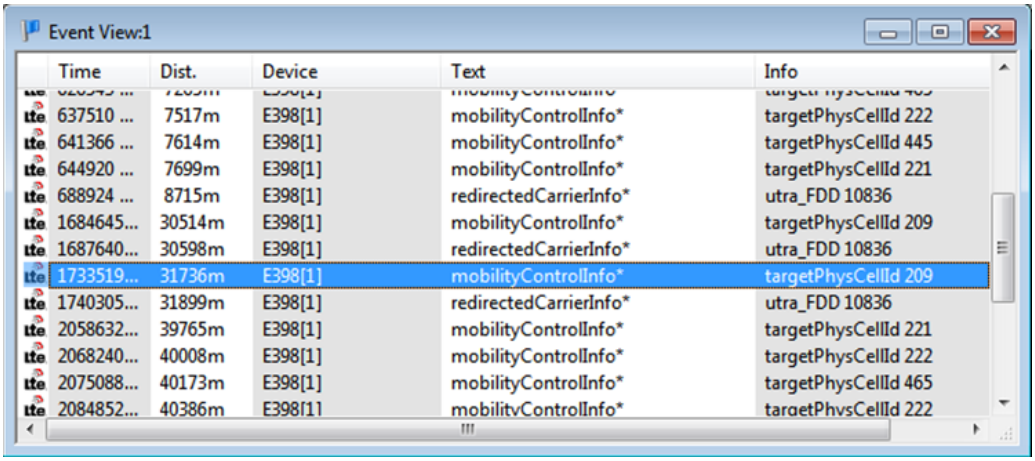


Figure 3-130: Redirection event

LTE-Advanced carrier aggregation events

There are events to inform the user about the point in time when a secondary component carrier (SCC) has been added or released.

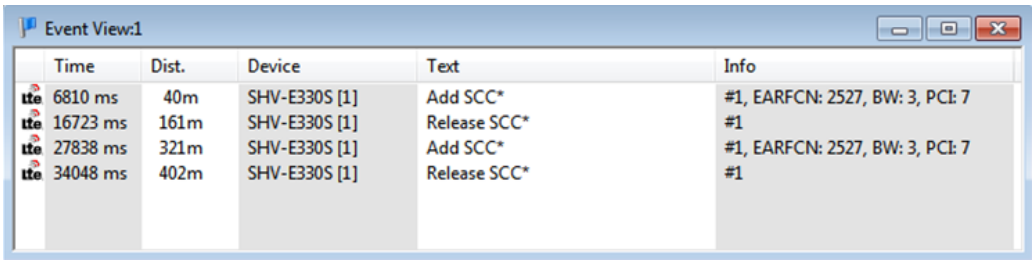


Figure 3-131: LTE-Advanced carrier aggregation events

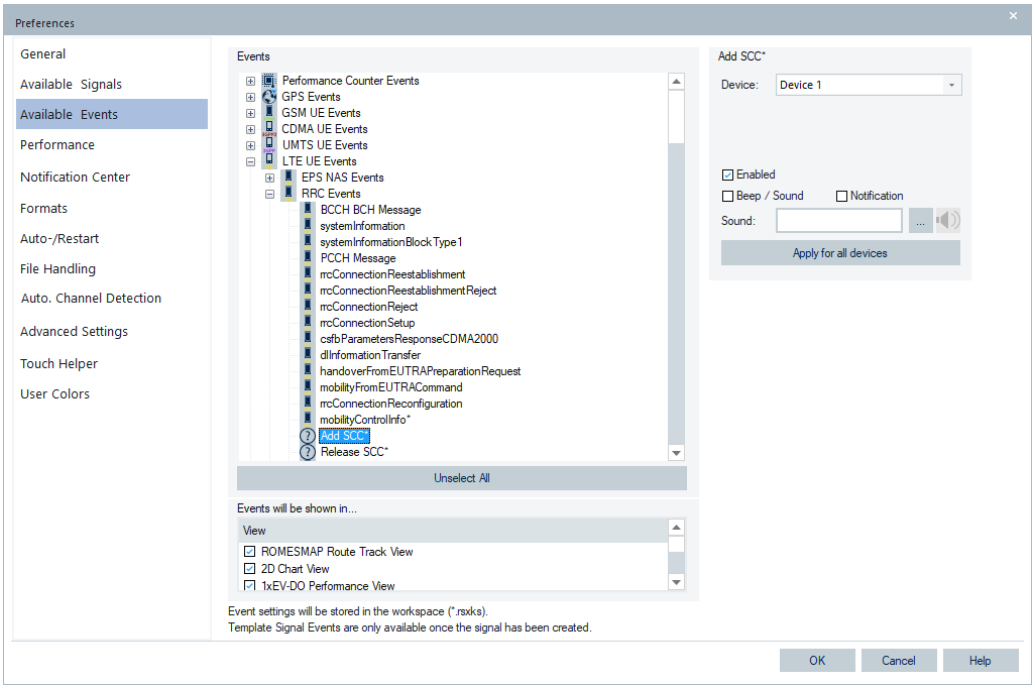


Figure 3-132: Adding carrier aggregation events

RLC radio bearer events ← LTE UE events

LTE RLC radio bearer events generate report wherever a radio bearer is established, modified or removed.

The events are logged in the "Event View". The "Info" column displays the corresponding unique radio bearer configuration IDs. Also, the events can be visualized in the "2D Chart View" and "Map View" regarding the point in time, respectively the location, they occurred.

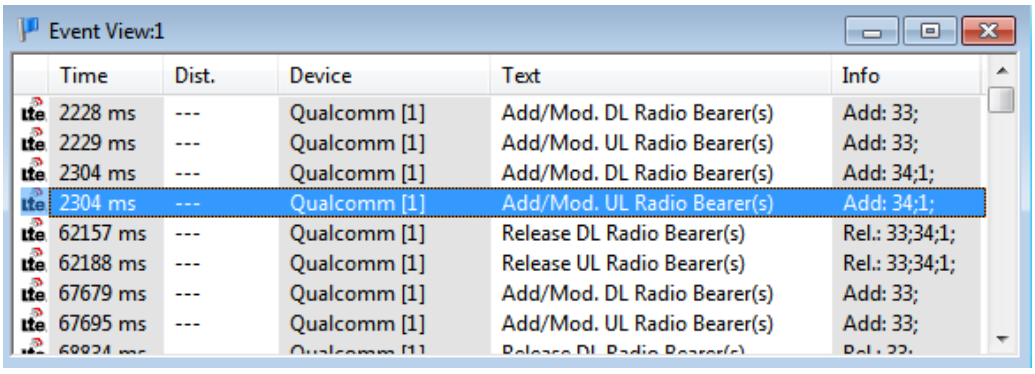


Figure 3-133: LTE RLC radio bearer events

Note: Replaying old measurement files provides wrong information, which can result in too many events. Use the event obtained only with the measurement files recorded with the current R&S ROMES4 version.

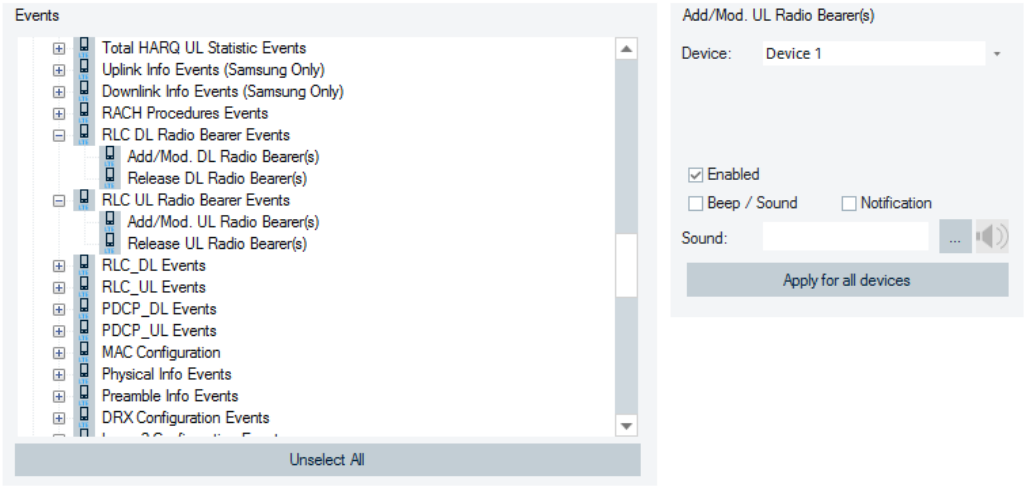


Figure 3-134: LTE RLC radio bearer events configuration

LTE NQA events ← LTE UE events

The NQA events for LTE generate reports concerning a call status and its quality.

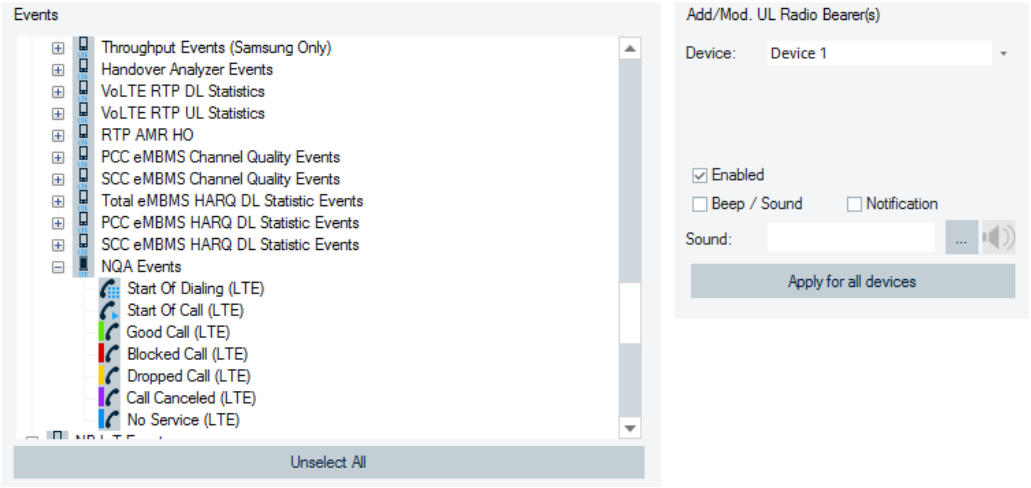


Figure 3-135: NQA events for LTE UE call

4G/5G RRC events ← LTE UE events

The events are available in the "LTE UE Events" tree.

The 5G EN-DC RRC events available in R&S ROMES4 since version 19.3 are further extended.

R&S ROMES4 enhances and extends the RRC event feature with reworked and refined definitions and structure of the events. There are events for 5G NR IRAT Mobility and 5G NR CA/DC cell configurations.

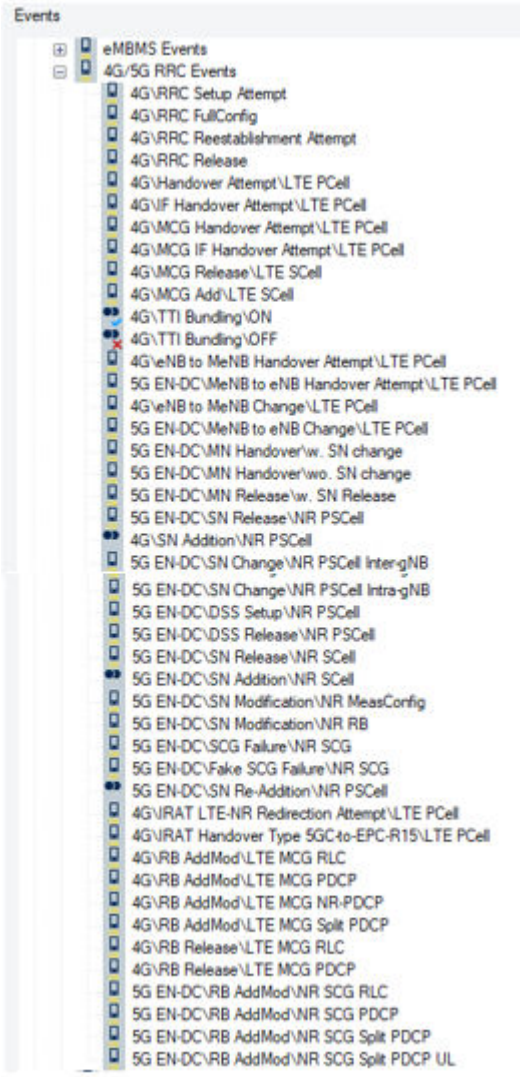


Figure 3-136: LTE UE 4G/5G events

For the description of all 4G/5G RRC events, see Table 12-12.

LTE/5G NR UE RRC measurement events

The "RRC Measurement Events" of both LTE and 5G NR UE can detect the SON-related event A3. Additional R&S ROMES4 events for SON are available.

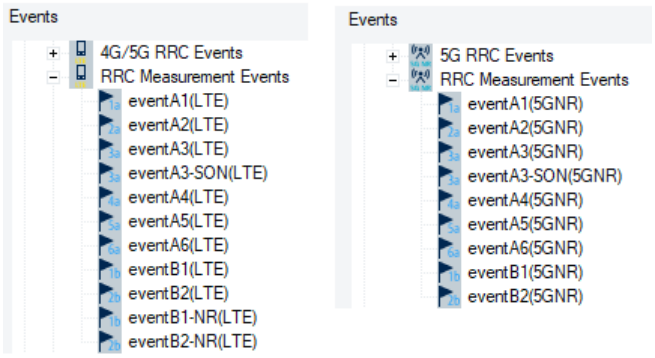


Figure 3-137: RRC measurement events of LTE and 5G NR UE

The SON events are accounted for the calculation of Mobility KPIs, but can be observed in the "Layer 3 View".

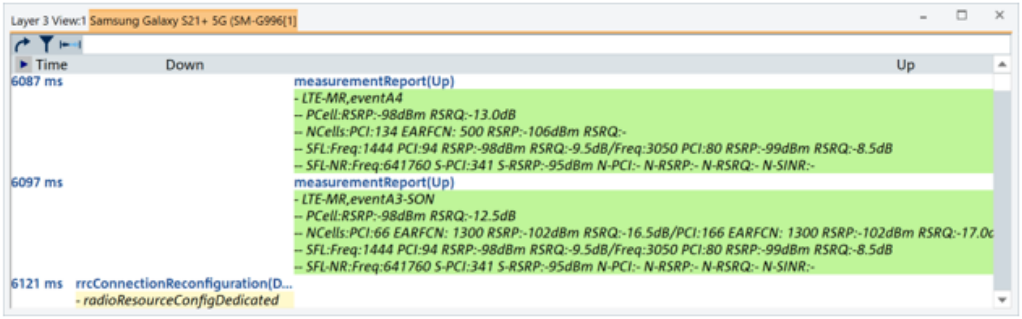


Figure 3-138: SON events in Layer 3 View

5G NR UE Events

The following figure shows the event groups which are supported.

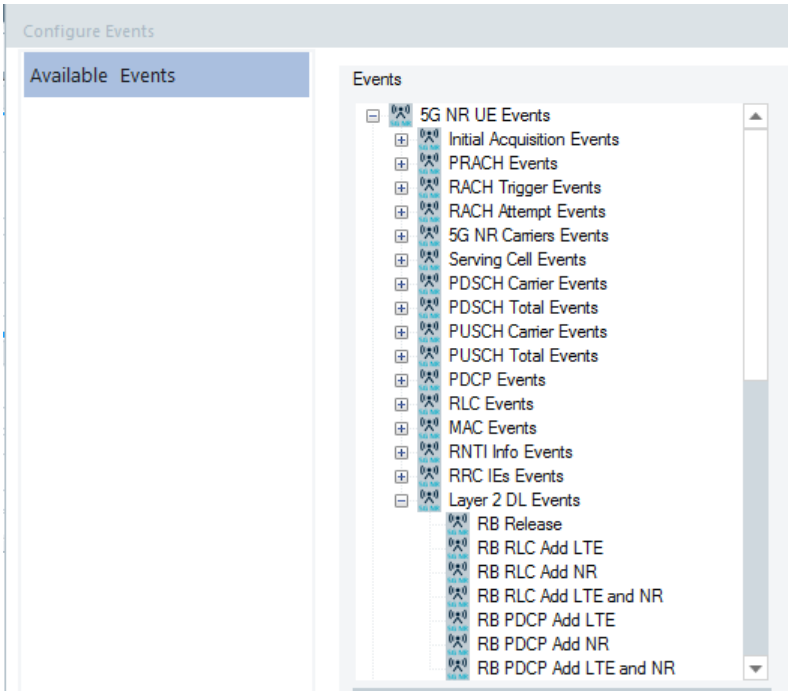


Figure 3-139: 5G NR UE supported events

The RRC events make it easy to follow the 5G and LTE message flow based on RRC messages.

The RRC messages are transferred via the LTE network in the Non-Standalone (NSA) operation of 5G NR. Therefore, most of the events are found under the LTE events branch. Only two 5G events for RACH procedure are under the 5G NR UE events.

The Layer 2 DL events provide information on a 5G radio bearer establishment procedure, that is, the bearer addition and release.

The events can be displayed in the "Basic Views" and "Events" if they are enabled. The "Layer 3 View" display of the events depends on the events activation.

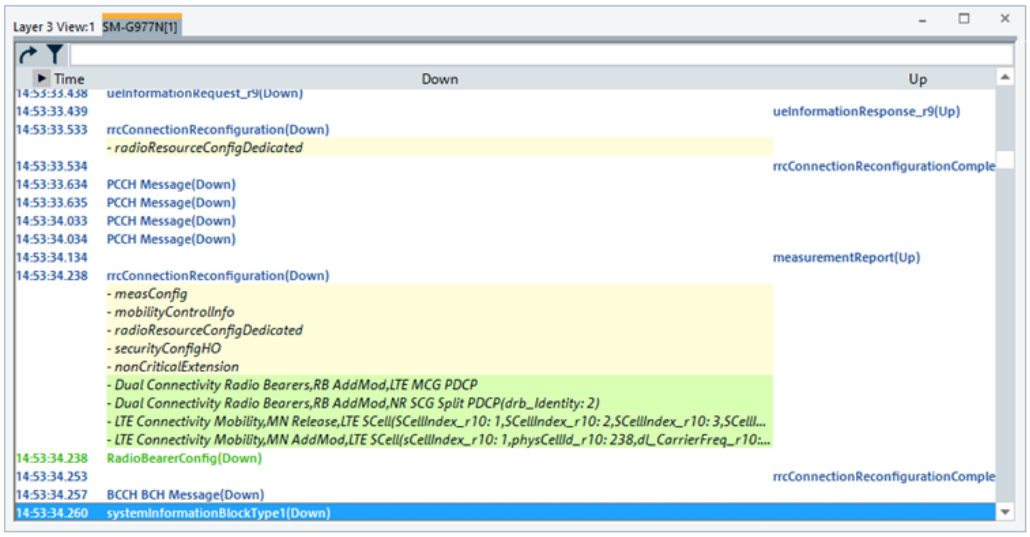


Figure 3-140: Layer 3 view - emphasis on DC RB messages

5G RRC Events

This group of events supports the overview of events in 5G SA networks.

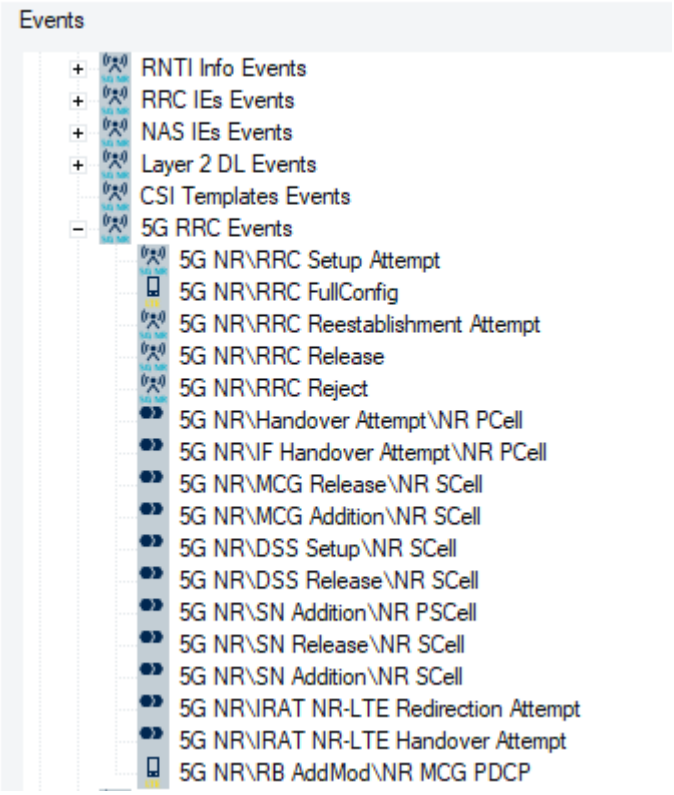


Figure 3-141: List of the 5G RRC events

For the description of the all 5G RRC events, see Table 12-13.

Loading of an 5G event defined as a `*.xml` file is done in the following way:

1. R&S ROMES4 tries to load the file `5GEventConfig.user.xml` from the current users MyROMES\Configuration folder.

2. If this file does not exist, the standard file `5GEventConfig.xml` is loaded from \ProgramData\Rohde&Schwarz\My ROMES\Configuration.

3.8.1.4 Performance

To improve the performance of R&S ROMES4, the update rate of the list views (for example, the "Top N Views", the "TETRA Scanner Spectrum View", the "RF Power Scanner Views") is adjustable. The default configurations are shown in the following figure.

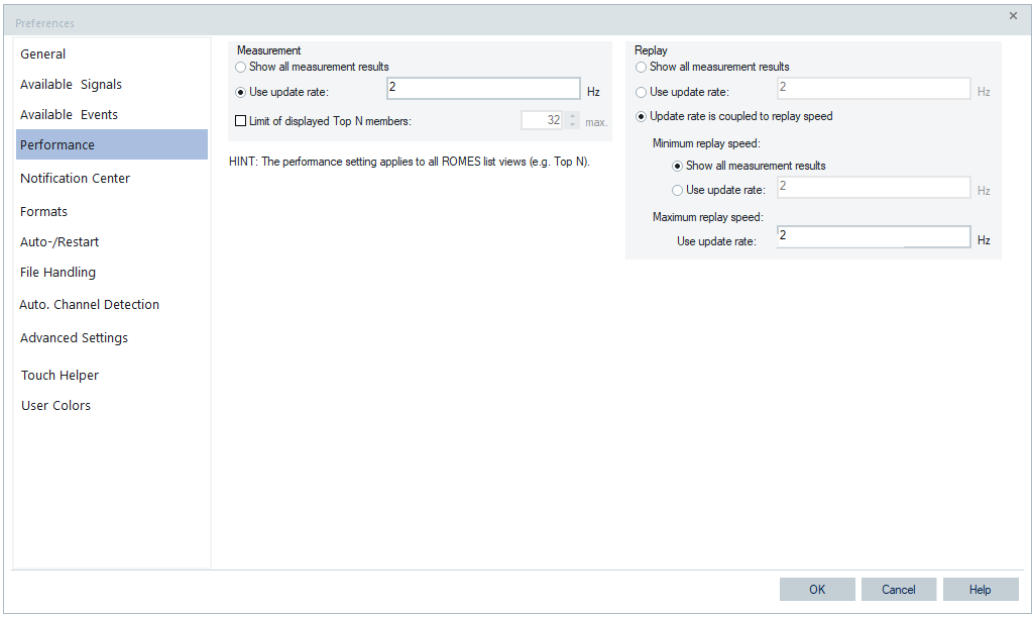


Figure 3-142: Preferences – Performance

Measurement
Data tree shows all the signals available for viewing. Double-click the entries in the corresponding columns, for example, display format or a value range (expected minimum and maximum) to modify the value in a view.

- "Show all measurement results"
  The list of views updates for each changed measurement result.
- "Use update rate"
  Lists are only updated if measurement results have been changed and the values are older than the update rate. Set as default 2 updates/sec.
- "Limit of displayed Top N members:"
  If selected, limits the count of displayed Top N members in the GSM, UMTS, LTE and TETRA Top N view. In this way the user can optimize the CPU load during measurements and recording.
  The red line at the bottom of the "Top N List" in the "Top N Overview View" indicates that the Top N pool has more members than displayed, see Figure 4-921.

Replay
Two buttons in "Restore Default Settings" reset the unit, format, and the expected minimum and maximum to default.

- "Show all measurement results"
  The list of views updates each time measurement results change.
- "Use update rate"
  Lists are only updated if measurement results have been changed and the values are older than the update rate.
- "Update rate is coupled to replay speed"
  For maximum replay speed, the update rate can be set.
  For minimum replay speed, there are two possibilities:
  – "Show all measurement results" (default)
    The list of views updates each time the measurement results change, if the replay speed ranges from 0 % up to 10 %. For replay speed above 10 %, a dynamic update rate is used.
    *UPDATE_RATE = MAX_UPDATE_RATE * 100 / REPLAY_SPEED_IN_PERCENTS*
  – "Use update rate"
    A dynamic update rate is used for all replay speeds.
    *UPDATE_RATE = MIN_UPDATE_RATE + (MAX_UPDATE_RATE – MIN_UPDATE_RATE) / 100 * REPLAY_SPEED_IN_PERCENTS*

3.8.1.5 Notification center

A channel for notification of a configured network survey event, out of offered ones, can be selected in the "Notification Center" dialog. The events are by default activated in the "Tools" >"Network Survey" dialog.

The events can be manually activated/deactivated in the "Preferences" >"Available Events" > "Network Survey" dialog by checking/unchecking the "Notification (Measurement only)" check-box.

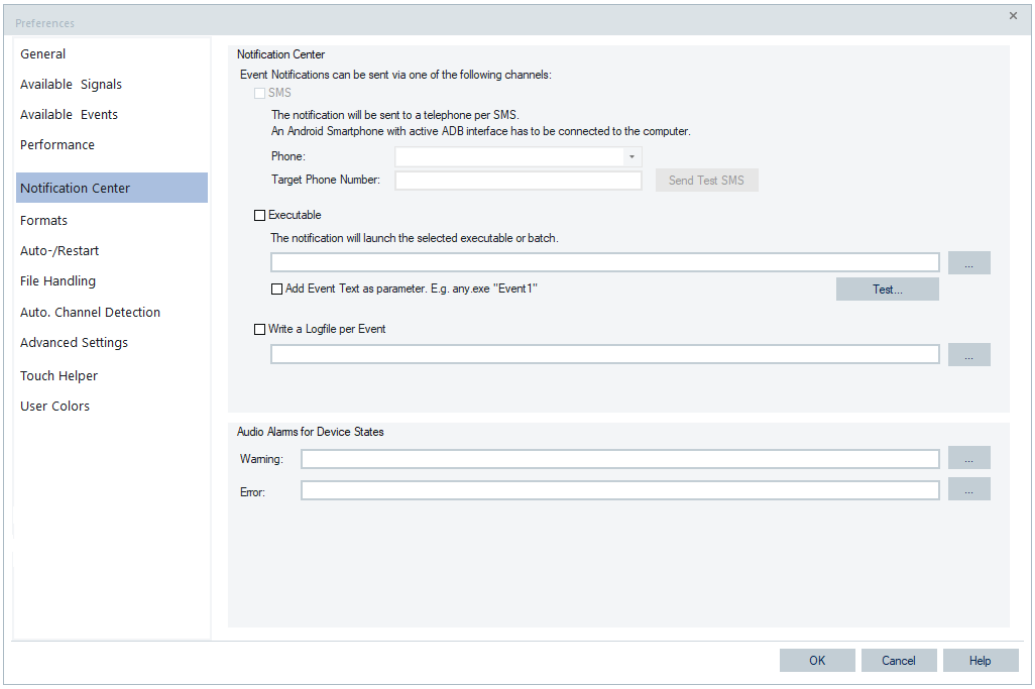


Figure 3-143: Preferences - Notification Center

The available channels for notification are:

- "SMS"
- "Executable"
- "Write a Logfile per Event"

SMS

R&S ROMES4 can send an SMS by a R&S ROMES4 event occurring. The SMS is sent using the "ADB" interface of the selected Android smartphone. Ensure that the ADB is enabled on the phone and connected properly to the computer.

Note: Deactivate the "Screenlock" of the phone.

Successfully tested UE - Samsung Galaxy S5.

Executable

An event also can trigger the execution of an executable or batch file.

Optionally, the event text can be passed to the executable as a parameter, for example `any.exe "Event1"`.

This option is useful if you have special needs for the event notification.

For example, use the SNMP Trap Generator (the TrapGen tool) for sending the SNMP Trap Messages to the SNMP Manager.

The following command entered under "Executable" gives an example how to trigger the TrapGen tool to send the SNMP Trap Messages:

```
e:\trapgen293\trapgen.exe -d 192.168.2.1 -v 0.0.0.0.0.0.0000.0.0.0.0 STRING
```

The command consists of the following parts:

- `e:\trapgen293\trapgen.exe` which is a path to executable

- `-d 192.168.2.1` which is destination IP address
- `-v 0.0.0.0.0.0.0000.0.0.0.0 STRING` which is variable parameter, that is, object ID and a type of variable
  The complete variable parameter is necessary to forward the event text as a parameter if the corresponding check box is checked in "Notification Center" > "Executable".

Write a logfile per event
An event can be written in a log file. For log file per event, browse the output path.

The log files of the events have the following JSON format:

```
{"Event":"<EventName>",

"Info":{

"Time":"",

"Type":"",

"Power":"",

"Technology":"",

"Name":"",

"MCC":"",

"MNC":"",

"LAC-TAC":"48020",

"CI":"85943/1",

"Frequency":"806.000000",

<RAT dependent element>

}

}
```

Audio alarms for device states
The option allows an error/warning sound to play if the error/warning overall state of a loaded device is detected. Select the wave file that you want to be played in the mentioned situations by browsing in the "Warning" and "Error" fields.

The error or warning sound is played whenever the overall state of the loaded device is red or yellow, respectively.

The sound is played only during measurement or recording.

3.8.1.6 Formats settings

In "Formats" you can set specific formats for exporting.

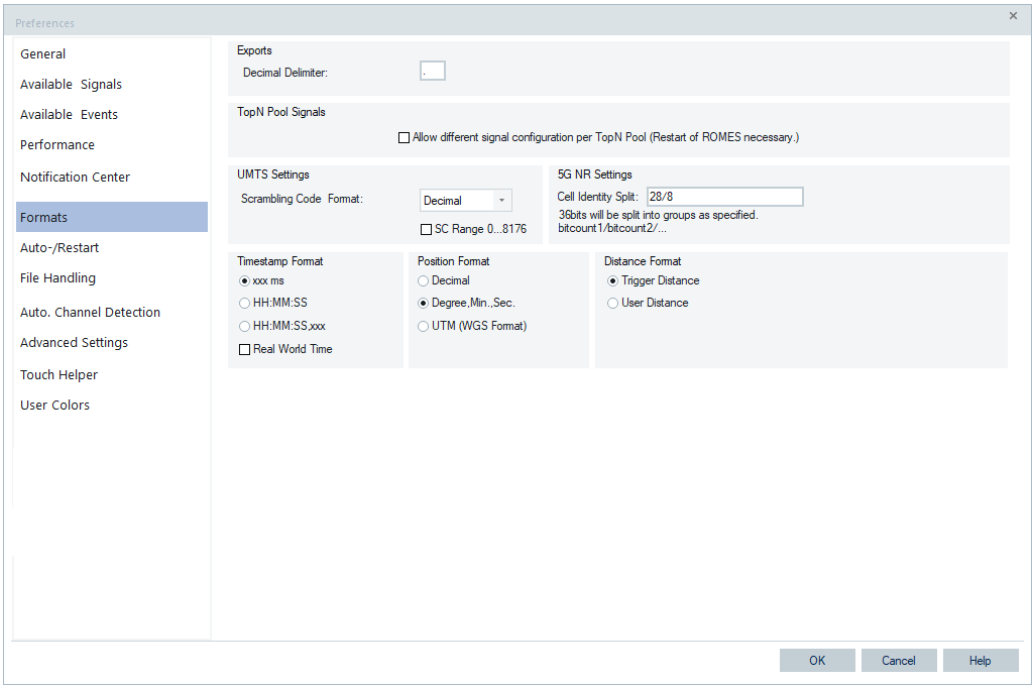


Figure 3-144: Preferences – Formats

Exports

- "Decimal delimiter"
  This character separates the values of two signals in the export file.

TopN pool signals

Different R&S ROMES4 signal configurations (for example, color scale, limits) can apply to different Top N pools or providers. However, the signals within the same pool have the same settings.

UMTS settings

- "Scrambling code format"
  "SC Format" opens a drop-down list to select whether the Primary Scrambling Code in the signals and in the views (e. g. the PNS CPICH) is displayed in decimal, octal, Hex small or Hex large format.
- "SC Range 0...8176"
  According to standard 3GPP TS 35.213, the primary scrambling codes are numbered n = 16*i (i = 0 to 512). 15*512 and numbers n = 16*i + k (i = 0 to 512, k = 1 to 15) are reserved for the optional secondary scrambling codes. This convention is used if SC Range 0 … 8176 is checked. In the alternative convention, the Primary Scrambling Codes numbers are divided by 16 and cover the range 0 to 511.

5G NR settings

"Cell Identity Split" lets you specify the usage of 36 bits available for 5G NR cell identity.

R&S ROMES4 offers the possibility to format the CI value - the format is a string which specifies how many bits out of 36 CI bits are taken for each group. Groups are separated by "/". The default splitting is 28/8, but can be anything else, for example, 21/15 or 20/16.

The format is used in "5G NR BCH View" and for the following signals:

- "5G NR UE" > "Serving Cell" > "Cell Identity"

- "5G NR Scan" > "Top N Templates" > "Top N NCI User"

- "5G NR Scan" > "gNodeB Templates"> "NCI User"

The L3 details of 5G scanner/5G UE and 4G scanner/4G UE give additional cell identity split interpretation. For detailed interpretation, see "5G NR RRC messages" on page 977/"LTE RRC messages" on page 979 respectively.

Timestamp format

The "Timestamp Format" panel defines the format of the timestamp signal to be included in the measurement file. A timestamp of 36.123 s is displayed as follows:

xxx ms	36123
HH:MM:SS	00:00:36
HH:MM:SS, xxx	00:00:36,123

Note: If "File Scanning" is activated and a measurement file is already opened, all changes on the timestamp format are active not earlier than the file is reloaded. Change the timestamp active by closing and reopening the file.

Position format

"Position Format" defines whether the position coordinates used in the views are displayed in decimal, degree/minute/second or in UTM format.

The UTM format is shown in the views or info where the position coordinates are displayed, like:

- "ROMESMAP Route Track View", see Figure 4-186.
- BTS position in the "BTS Info" and in the "BTS Short Info", see "Show BTS Info" on page 578.
- "GPS Info View"

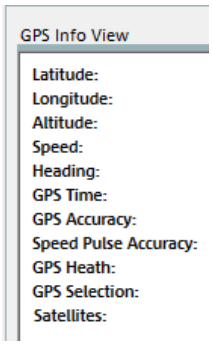


Figure 3-145: GPS Info view - UTM position format

UTM format supported views and dialogs ← Position format

The position of a device can be edited in the UTM format in the following views or dialogs:

- "Alphanumeric View"

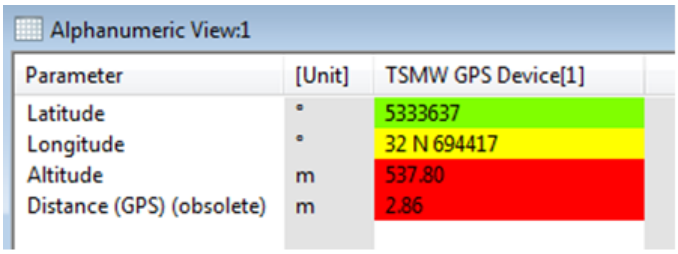


Figure 3-146: Device[1] alphanumeric view - UTM format

- "BCH view"

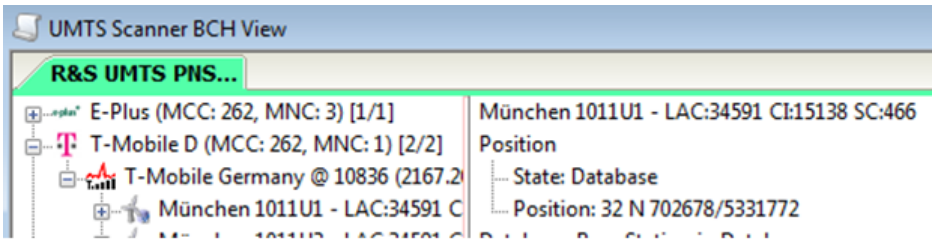


Figure 3-147: BCH view, case UMTS scanner - UTM format

- "Base station"

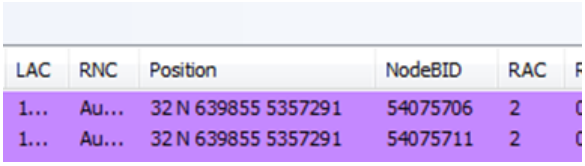


Figure 3-148: Base stations info - UTM format

The dialog is shown when selecting the "Tools" > "Transmitter Database" command.

- "Modify Transmitter"

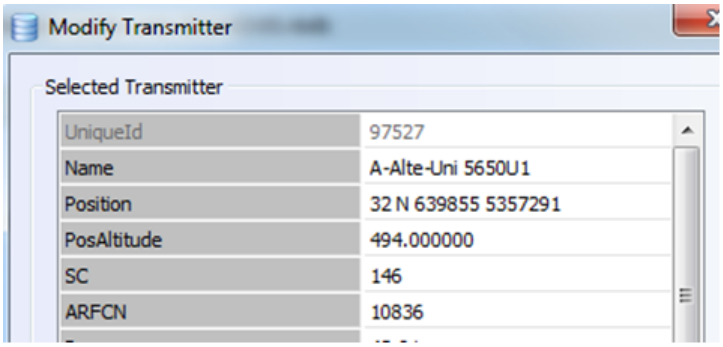


Figure 3-149: Modify transmitter data - UTM format

- "Measurement file info: Driven area"

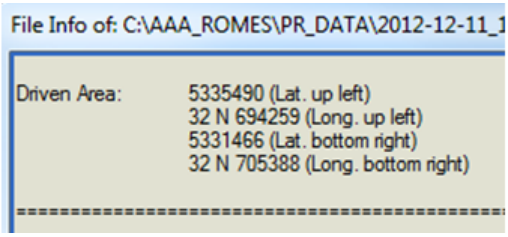


Figure 3-150: Measurement file info - UTM format

When exporting, a driven area info is shown as:
ASCII Export
[DATA]
13:49:55;?;1;191;-82.35;?;6.15;?;?;?;-103.12; -11.09;5335009;32 N 695587;515.97;0.01
13:49:55;?;1;191;-82.35;?;6.15;?;?;?;-103.12; -11.09;5335009;32 N 695590;515.97;0.02
How to export, see Chapter 7.2, "Exporting data", on page 2099.

Unit "°" is shown for UTM in "Basic Views" and exports.

Distance Format
The "Distance Format" panel defines whether the R&S ROMES4 views use the R&S ROMES4 trigger distance scale or a user-defined distance scale.

3.8.1.7 Auto-/Restart settings

The tab specifies the autostart and restart settings of R&S ROMES4.

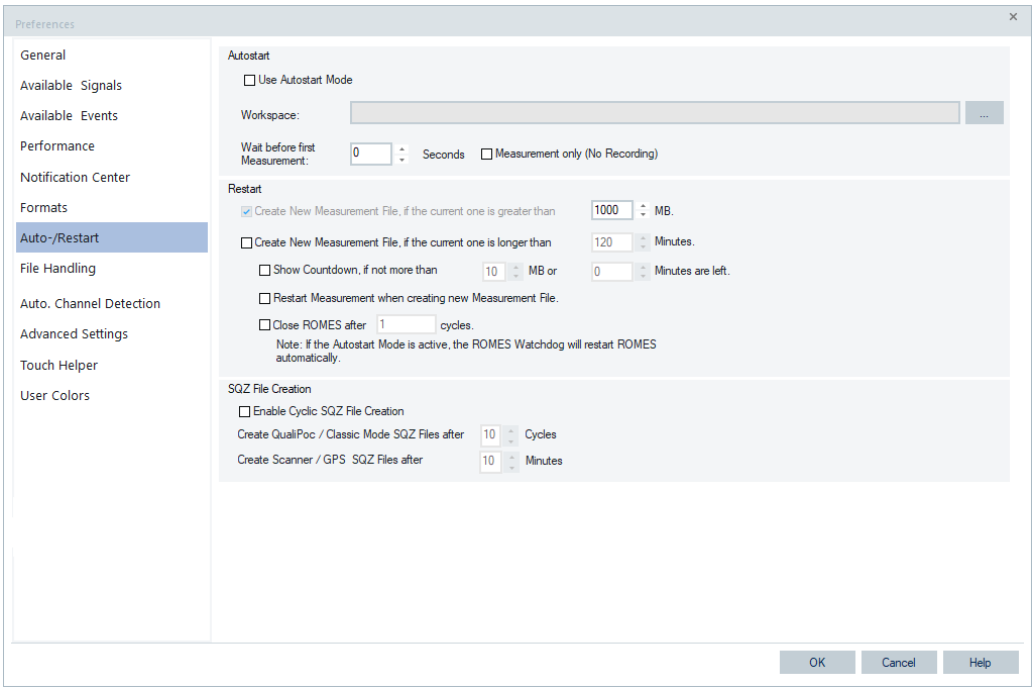


Figure 3-151: Preferences – Auto-/Restart

Autostart
The function "Use Autostart Mode" activates/deactivates measurements automatically. If a workspace file is specified, it is used for the measurement.

By elapsing of a measurement cycle, the measurement stops and restarts automatically.

R&S ROMES4 can wait n seconds before starting the first measurement.

If the user stops the measurement initiated by the Autostart feature, the R&S ROMES4 Watchdog stops automatically. There is no pop-up dialog.

At the R&S ROMES4 restart, the autostart function gets active again.

24/7 system stability ← Autostart
A Watchdog timer can observe the R&S ROMES4 operation to ensure the system stability 24 hours, 7 days. The Watchdog starts automatically if R&S ROMES4 starts up in autostart mode.

The Watchdog observes the startup process and whether the measurement has been started automatically.

If any failure occurs, the Watchdog shuts down R&S ROMES4 and restarts it. After three restarts within a measurement time less than five minutes, the Watchdog stops the observation and sends a notification to a Notification Center.

R&S ROMES4 itself checks its system health every 60 seconds. It checks if the sufficient memory is available and if all devices are in good shape. If a problem is detected, R&S ROMES4 shuts down. The Watchdog detects the missing R&S ROMES4 process and restarts the application.

Restart
The restart function can be used only if the autostart mode is inactive. The function forces creation of a new measurement file and the measurement restart if the specified condition is fulfilled.

Optionally, a countdown dialog can be displayed before the restart of the measurement takes place. Activate the "Show Countdown" option.

Note: R&S ROMES4 does not support measurement files greater than 1.8 GB.

It is possible to create a set of measurement files without restarting the measurement. Each single file of such a file set is a fully valid and can be replayed, exported or evaluated with R&S ROMES4NPA.

R&S ROMES4 allows opening the complete file set or a part of it for replaying. To generate a new file during the measurement, select the "Measurement" > "Split" menu item.

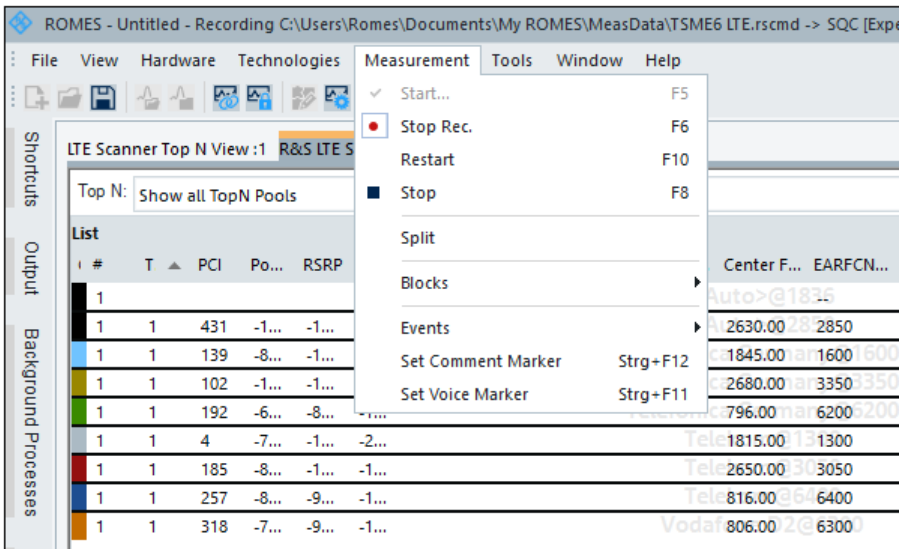


Figure 3-152: Splitting measurement file

By default, R&S ROMES4 generates a file set when the configured maximal file size or measurement time has been exceeded. The measurement restart, when creating a measurement file due to file size or time limits, can be selected via "Restart Measurement when creating new Measurement File".

The format of the file name of the subsequent files of a file set is:

`<Filename>.<part>.rscmd`

If the user enters, for example, the file `myROMESMeasurement.rscmd`, the following files are created:

- `myROMESMeasurement.rscmd`
- `myROMESMeasurement.1.rscmd`
- `myROMESMeasurement.2.rscmd`
- `myROMESMeasurement.3.rscmd` and so on.

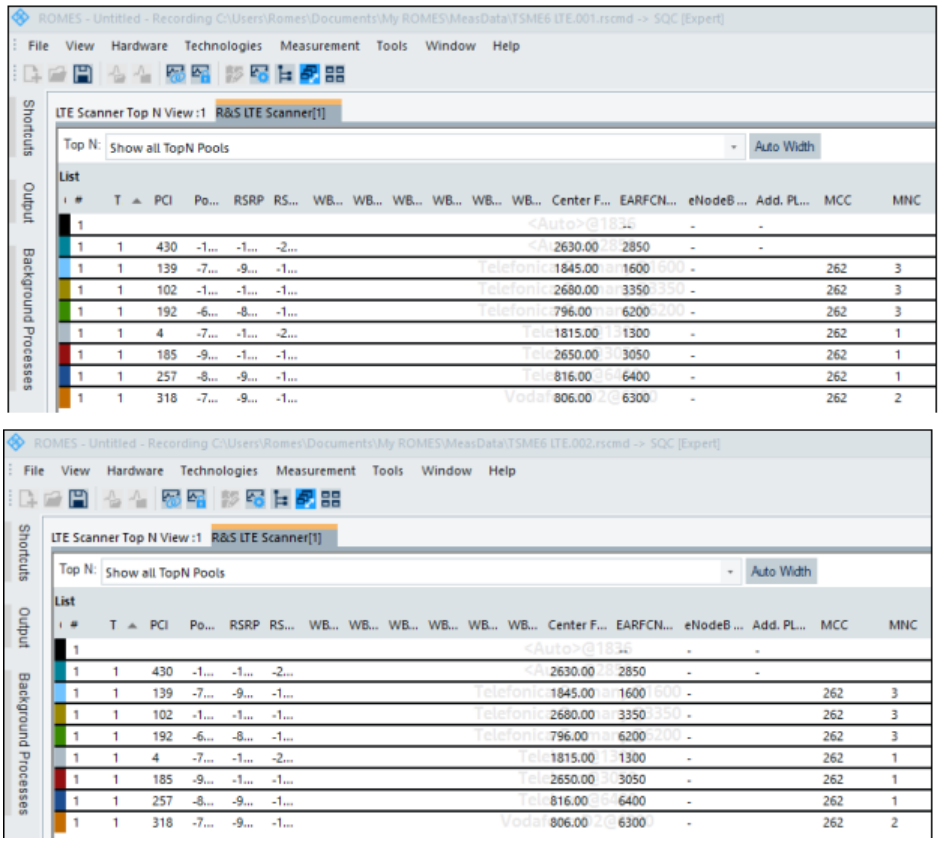


Figure 3-153: Result of splitting

The "Open" dialog for R&S ROMES4 "Replay" operation mode offers an option to scan for files sets, see "Scan for File Set" on page 114.

If you want, you can select to open the complete set of files or just parts after identifying a file set. By default, the complete file set is selected.

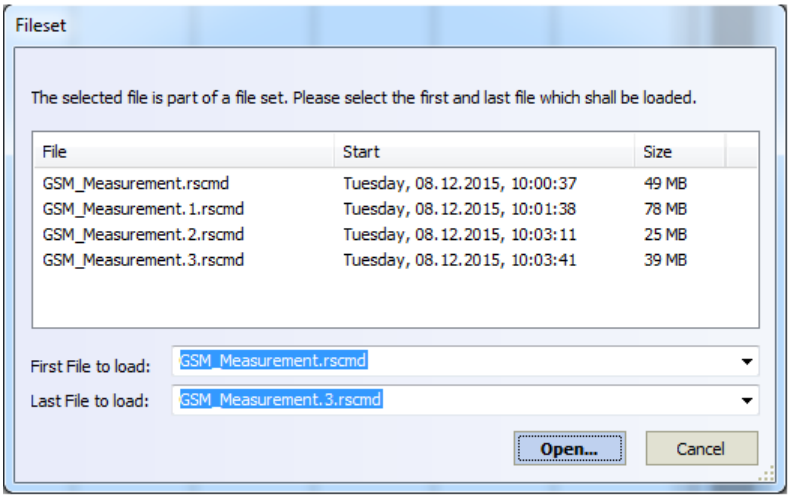


Figure 3-154: Select file to load

If checked, "Close ROMES after <n> cycles" closes R&S ROMES4 automatically after n cycles of measurement. One cycle is one measurement of <x> MB or <y> minutes as specified in the "Restart" pane.

If "Use Autostart Mode" is checked, the R&S ROMES4 Watchdog restarts R&S ROMES4 automatically after it has been closed.

For long-term measurements as monitoring use cases, we recommend restarting every eight hours. To do so, use the option "Restart measurement when creating new Measurement File", "Create New Measurement File, if the current one is longer than", for example, "120 minutes" and "Close ROMES after", for example, "4 cycles",

The choice between choosing a longer or shorter restart period depends on use case.

Note: Keep in mind that R&S ROMES4 could run into memory problems, if the amount of data is too high.

SQZ File Creation
At R&S ROMES4 crash, the measurement fragments of the last measurements left on the hard disc.

The "SQZ File Creation" function, if activated, creates an SQZ file from these measurement fragments at next start of R&S ROMES4. To create the file, a periodic writing of SQZ files for QualiPoc, Classic Mode of operation, scanner and GPS measurements is introduced.

To activate the feature, check the "Enable Cyclic SQZ File Creation" box.

If the feature is activated, the QualiPoc and Classic Mode SQZ files are created and copied to the measurement folder after 10 cycles of the session loop. The scanner and GPS SQZ files are created and copied to the measurement folder after 10 minutes.

If R&S ROMES4 crashes, R&S ROMES4 asks you if you want to create an SQC from the last measurement during after the next restart.

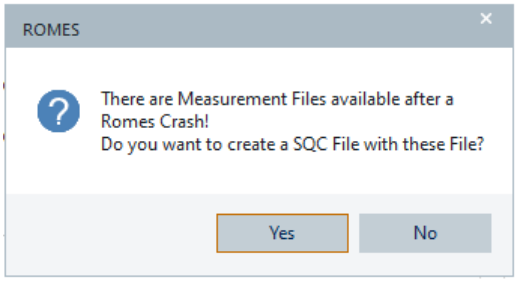


Figure 3-155: Option to create SQC file from crash

If you select "Yes", the action is followed by the information on created file.

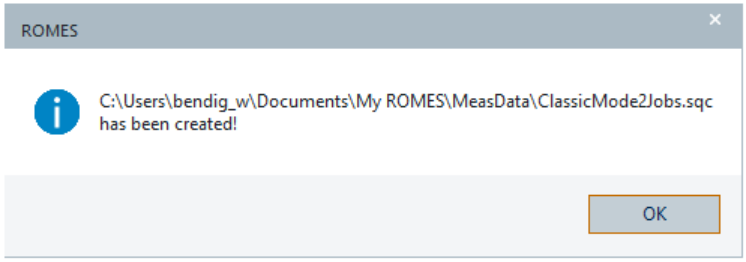


*Figure 3-156: Information on created *.sqc file*

Note: This feature is only available if the SQC file format is activated.

3.8.1.8 File handling

The "File Handling" dialog lets you select the output format of exported measurement data files and a way to export them.

The dialog supports upload of measurement files to an FTP server. You can select out of three supported protocols for uploading to the server. R&S ROMES4 supports the server public key authentication if the SFTP protocol is selected.

The function to write SQZ files for mobiles and the QoS in classic mode is enabled by default. The SQZ files (MF-measurement files) ready for post-processing in NQDI and SmartAnalytics are produced during the R&S ROMES4 measurement using the SQ Trace Decoder.

Output format
R&S ROMES4 supports the RSCMD and SQC measurement file formats.

The SQC format is a default output format. This option compresses the measurement RSCMD file and the all related QualiPoc SQZ files to a SQC file (ZIP format). The created file has a name of the RSCMD file and the extension "sqc".

For more details, see Table 1-1.

FTP upload
R&S ROMES4 supports the following FTP uploads:
- Upload of the R&S ROMES4 measurement files
- Upload of results of the automatically exported files

The "FTP Upload" options upload the measurement files and/or the results of the automatically exported files. The upload is accomplished if "Upload ROMES Measurement File" and/or "Upload result of automatically exported file" is checked, respectively.

If both options are checked, both uploads are executed. If both options are deselected, the entire FTP upload section is deactivated.

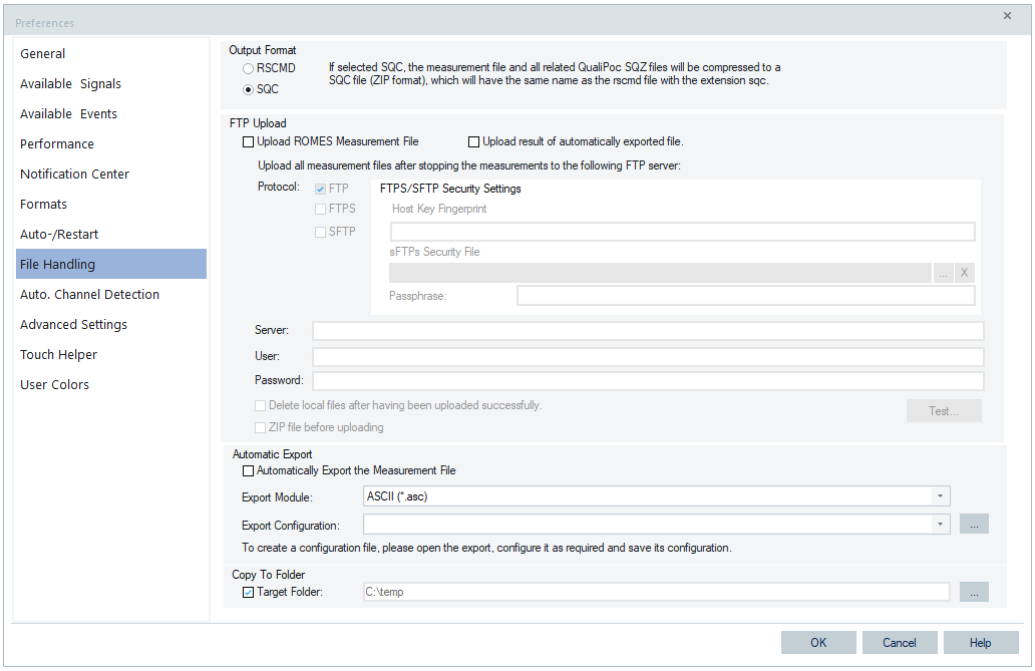


Figure 3-157: Preferences – File Handling

The "FTP Upload" > "Protocol" entry allows for file upload selection among the FTP, FTPS and SFTP protocols.

At any given time, only one of the three protocols can be enabled. Use the "Test" button to set the common configuration entries, "Server", "User" and "Password" for files upload.

R&S ROMES4 supports uploading to subfolders of all FTP protocols.

Enter subfolders in the "FTP Upload" > "Server" edit box. The previous screenshot is using SFTP as an example.

- Multiple levels of subfolders can be entered.

- Subfolders are auto-created if they do not exist in FTP server.

- Same logic applies to all FTP protocols.

The "FTPS/SFTP Security Settings" pane is dimmed if the FTP or FTPS protocol is selected as the upload protocol. The pane is active if you select the SFTP protocol. The entries in the pane are used to make the SFTP server public key authentication. For the details, see the SFTP protocol section.

FTP upload starts at the point in time R&S ROMES4 switches to a new measurement file.

Switching to a new file happens if the maximum file size is reached, the maximum duration of the file is exceeded or the user splits the measurement manually.

If there is seamless file change, the measurement file is not closed by R&S ROMES4. The features which rely on the accessibility of all measurement files of the current set file prevent the file to close. Due to the measurement file directory inaccessibility to FTP loader and the file zipping, R&S ROMES4 creates a copy of the measurement file (`_<filename>.rscmd`) and uploads that one.

Note: If there is seamless file change, it is not possible to delete the measurement file after upload.

To see the messages of the FTP loader, check the R&S ROMES4 "Output".

If the FTP upload fails, the FTP loader retries the upload every five minutes, unless it succeeds.

If closing R&S ROMES4 while an upload is still pending, a warning message is issued.

To avoid shortage of disk space, delete the file locally if the system is meant to run 24/7.

- "Password"
  The field hides the entered password. The ciphered password is saved in registry.

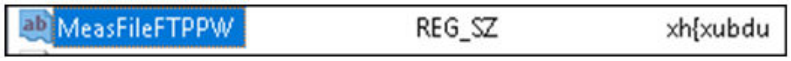


Figure 3-158: Stored ciphered password

FTP protocol ← FTP upload
If "FTP" is checked for files upload, the "FTPS" and "SFTP" selection components are inactive.

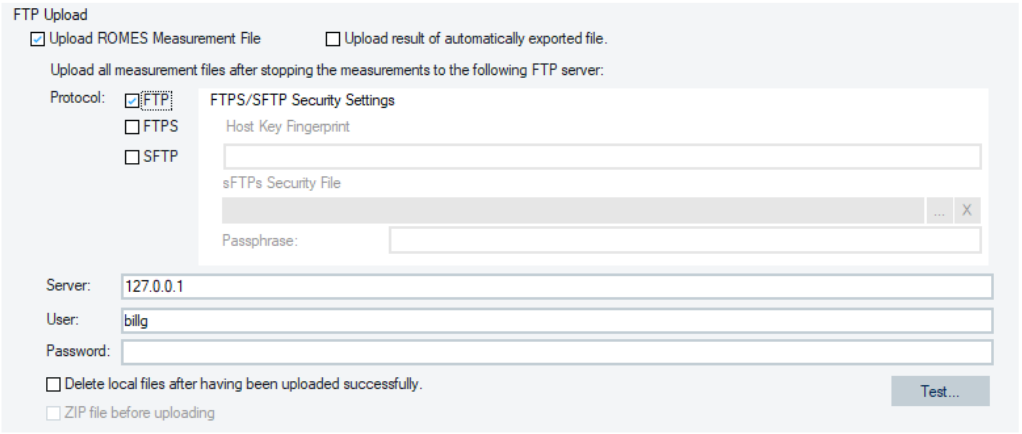


Figure 3-159: Selection of FTP protocol

Enter the server, user name and password and click "Test" to test the setting and upload the file to FTP server.

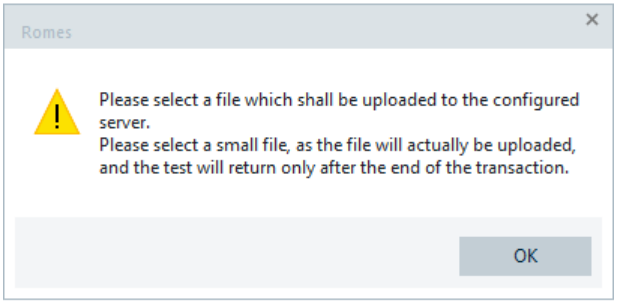


Figure 3-160: Warning to select FTP file

After the file selection and loading, the messages pops-up indicating the successful FTP upload.

FTPS protocol ← FTP upload
If "FTPs" is checked for files upload, the "SFTP" selection component is inactive.

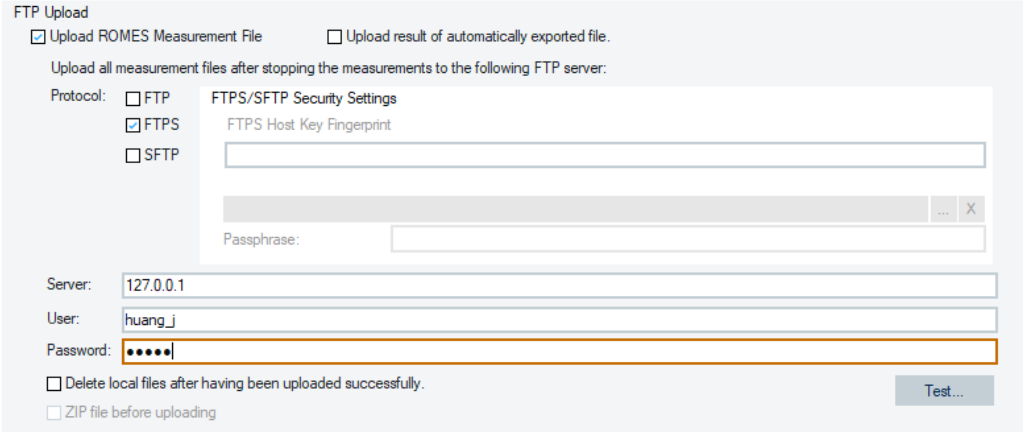


Figure 3-161: Selection of FTPS protocol

Click "Test" to test the FTPS settings and enforce file upload.

SFTP protocol ← FTP upload
R&S ROMES4 supports SFTP server public key authentication. For the authentication, you can use SFTP private key file. A host key fingerprint and user password can be used. Their usage is optional if the private key file is specified and accepted.

If "SFTP" is checked, the SFTP protocol is available and the FTP and FTPS protocols are inactive.

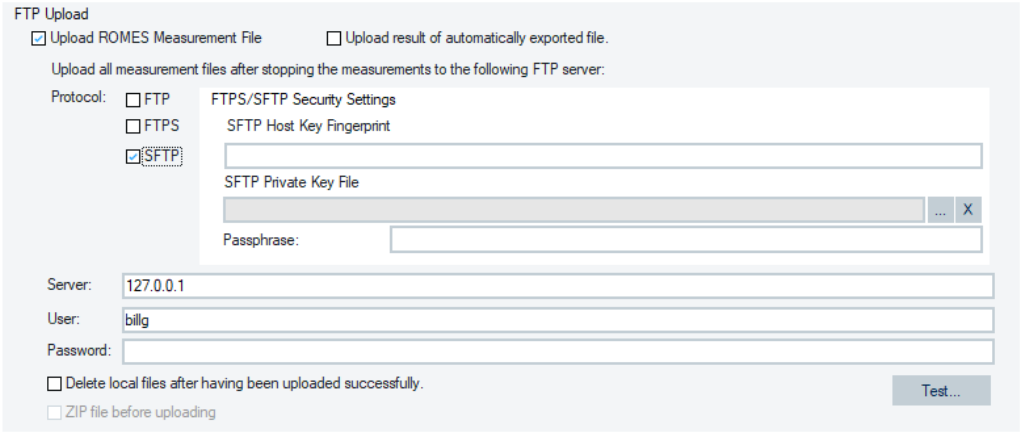


Figure 3-162: Selection of SFTP protocol

The SFTP host key fingerprint is displayed in the "SFTP Host Key Fingerprint" when the SFTP private key file is selected. The SFTP host key fingerprint authenticates the server.

The "SFTP Host Key Fingerprint" box can contain a string that is saved in previous successful upload. Use the ☒ button to clear the content of the box.

The SFTP private key file authentication is added to the SFTP server authentication option while SFTP upload.

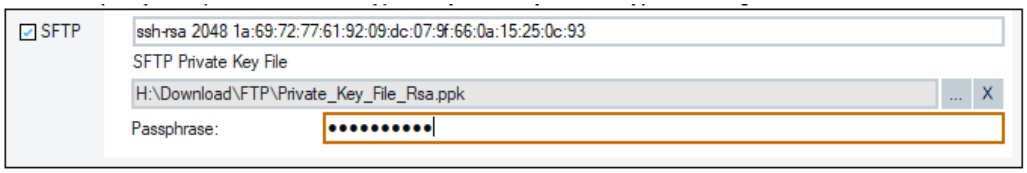


Figure 3-163: SFTP protocol settings

To use private key file for authentication, user's public key file has to be added to SFTP server public key container.

The ▢ button lets you browse and select a private key file from the Windows' "Open" page. The selected file is displayed in the "SFTP Private Key File" box.

The private key file authenticates user.

The ☒ button lets you clear the content in the "SFTP Host Key Fingerprint" and "SFTP Private Key File" box.

The "Passphrase" box is used to enter a passphrase.

Click "Test" to test the SFTP settings and enforce the selected private key file upload.

User must provide either password or private key file for authentication.

If a private key file is specified and accepted, the server's host key fingerprint is automatically accepted and displayed in the "SFTP Host Key Fingerprint" box. User provided host key fingerprint and user password are ignored.

If a private key file requires passphrase, enter passphrase accordingly.

If private key file is not specified, or specified private key file is not accepted, password is used to authenticate the user.

Automatic export

It is possible to export a measurement file automatically. The option needs activation.

The automatic export is triggered after the measurement is stopped or split.

To export the measurement file automatically:

1. Select "Automatically export the Measurement File".

The option is activated.

2. Select the file's export format in "Export Module", for example, ASCII.

3. Browse the configuration file that you want to apply in "Export Configuration" and confirm the selection with "OK". For creation of such a file, see Chapter 7.2.2, "Export procedure", on page 2100.

A copy of the measurement `auto_export_<measurementfile>.rscmd` is created and the R&S ROMES4 command-line export feature is called to do actual export.

The result of the export is stored in the "Export Result" default folder.

Note: Ensure that the disk has enough space available for the copy of the measurement file and the export result.

Copy to Folder
Check the "Target Folder" box to activate the option to copy the measurement file automatically to a different folder. This folder can be any folder of the MS Windows operating system. For example, you can upload the file automatically to the cloud, so that the measurement file is coped to the cloud folder.

3.8.1.9 Automatic channel detection

The Automatic Channel Detection (ACD) function stores all detected channels (UMTS, LTE, NB-IoT, 5GNR) in a 1x1 km raster after the measurement. This information can be used to speed up the channel setup for the next measurements.

To enable, disable or configure this feature (enabled by default) open the "Preferences" > "Auto Channel Detection" page. The page offers settings, which apply to all technologies of the ACD.

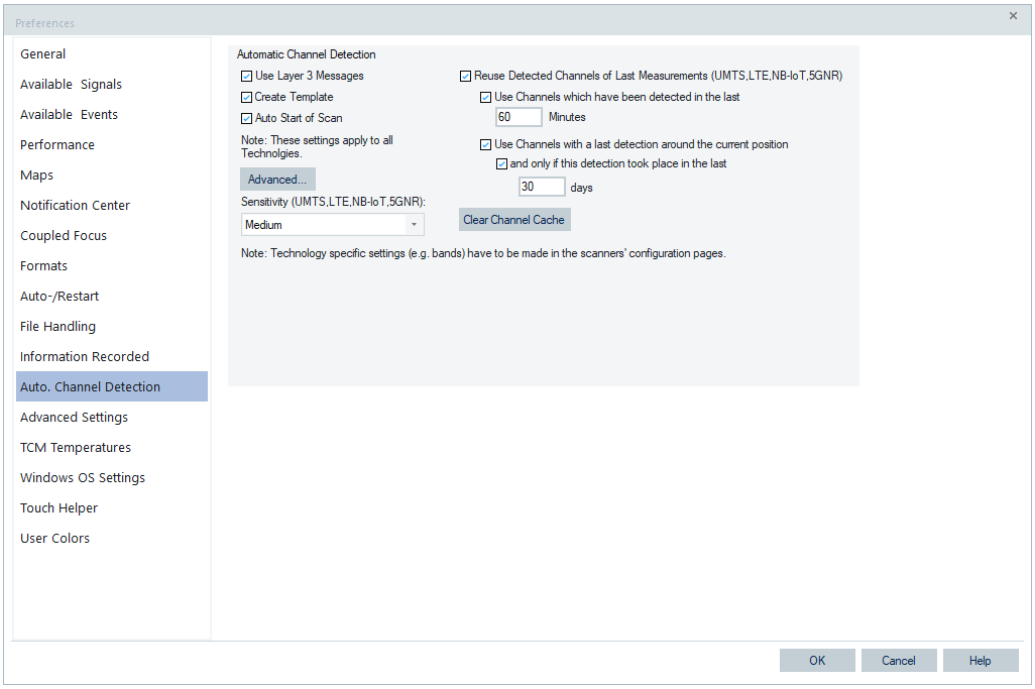


Figure 3-164: Preferences – Automatic Channel Detection

The left part of the page offers the settings, which can be found at the scanners ACD settings page also. The right side of the page offers settings for the Reuse feature.

Reuse Detected Channels...
The feature can be switched on and off with the "Reuse Detected Channels of Last measurements..." check box. The filters can be set based on two criteria.

The option "Use Channels which have been detected in last" > "n Minutes" helps to speed up the measurement, especially in bad GPS coverage or indoor environment. If this check box is checked, the new measurements automatically add all channels to the scanners, which have been detected by the ACD within the last n minutes. The location is not considered.

To use the location, enable the "Use Channels with a last detection around the current position" option. During the drive test, R&S ROMES4 builds up a 1x1 km raster. If any channel has been measured in such a raster before, it is added automatically to the technology scanner. It is possible to filter out the raster results by using the additional time filter. If this filtering option is selected, only channels, which have been actively measured within the last m days are considered.

It is also possible to clear the channel cache if "Clear Channel Cache" is clicked. The raster information is built up again with the next measurement. The cache contains the data for 90 days. Spectra which have not been measured for 90 days are removed.

3.8.1.10 Advanced settings

The "Advanced Settings" option gives the possibility for advanced configuration of devices and export of all the system settings.

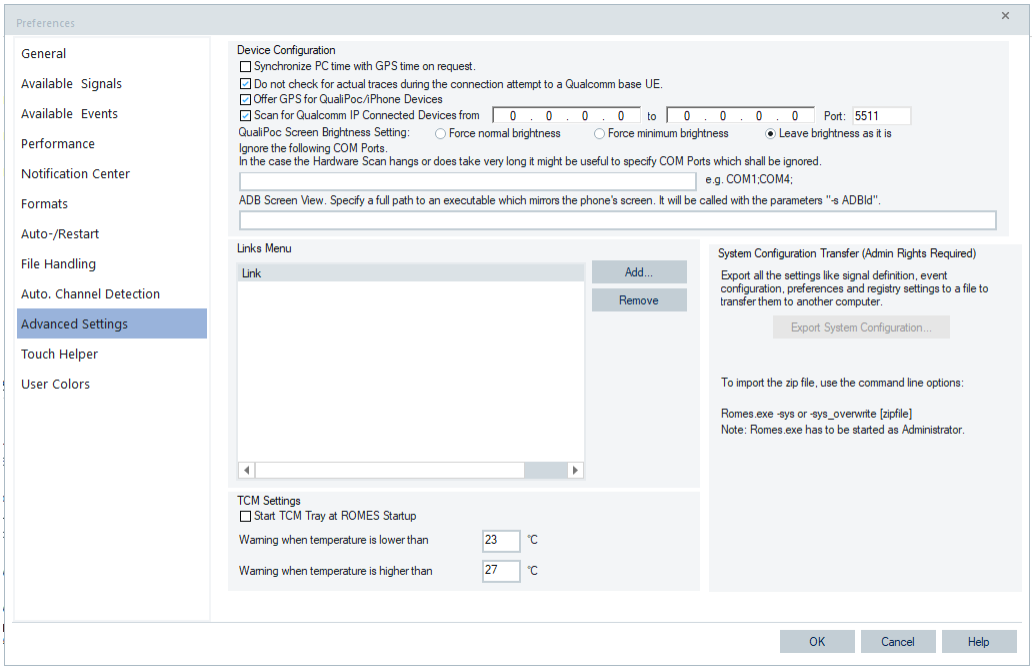


Figure 3-165: Preferences - Advanced Settings

Device Configuration
The following functions related to devices configuration are included in this pane.

Note: The QualiPoc closes when R&S ROMES4 is shutting down by default. However, QualiPoc does not close if the "Auto Power Off" option in the "QualiPoc Settings" > "Identify Moblie" is checked. For QualiPoc settings, see Figure 6-29.

Synchronize PC time with GPS time on request ← Device Configuration
If checked, the PC time is aligned to an existing time information from a GNSS system, for example, from GPS. The function checks if a GNSS device is available and the time information is reliable.

As it is important that no change of the clock and no timestamps jumps happen within a measurement, this time setting is implemented only before or after a measurement. An automatically generated file name consisting date and time is aligned to the time data in the file.

After loading a GNSS (GPS) device, the time information is monitored.

If the time information from the GNSS device is not available, the system shows its unavailability in the status bar as No GPS Time.

If a reliable time information from a GNSS device is available and the difference to GNSS time is below 5 sec, the system shows PC Time synced in the status bar. If the difference is more than 5 sec, the system shows PC Time not synced.

The mentioned synchronization status indications apply to devices in R&S TSME/ TSME6 which have a build in GNSS chip. It applies also to devices using uBlox protocol and NMEA protocol like TSMX-PPS2 and other GPS devices.

Note: The indication of synchronization status does not apply to MAVLink and R&S HE300.

At the beginning of a measurement or when it stops, the option gives the possibility to adjust the PC time. If the sync state is PC Time not synced, R&S ROMES4 informs about the time difference and asks for a PC time adjustment. The displayed dialog gives the possibility to set the PC time.

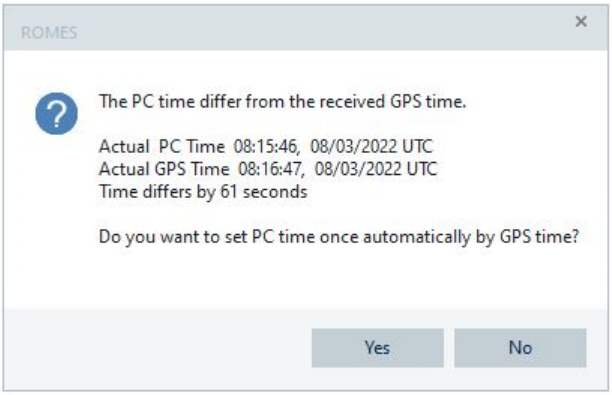


Figure 3-166: Dialog to set PC time by GPS

Note: R&S ROMES4 needs ADMIN rights for a set time. Without ADMIN rights, set time does not work.

The GNSS system needs minutes to get reliable time information from a GNSS device if it is powered on or has bad receiving conditions. Thus, it is necessary to set the GNSS antenna to good receiving conditions.

If only GPS is used, it needs up to 12 minutes to achieve the leap seconds which adjust the UTC time by several seconds. Only if the leap seconds info is received, the time can be considered as reliable. Without reliable time information, the PC time set is not attempted.

Note: The reported time is in UTC. This UTC time differs to the real-world time by time zones and daylight savings.
Set the Windows time zone (for example, UTC+01:00 Amsterdam, Berlin, ...) correct.

Offer GPS for QualiPoc/iPhone Devices ← Device Configuration
QualiPoc with GPS or GPS of iPhone is available if this option is activated.

Do not check for actual traces during... ← Device Configuration
R&S ROMES4 tests by default if the given COM port delivers actual trace data during connecting to a Qualcomm UE. Check this option to suppress this test.

"Do not check for actual traces during the connection attempt to a Qualcomm UE" unchecked is useful for use cases in which UE does not deliver any trace in connecting state.

Scan for Qualcomm IP Connected Devices ← Device Configuration
The function "Scan for Qualcomm IP Connected Devices from <IP address> to <IP address>" improves the handling of the diagnostic port per IP connection.

If necessary, R&S ROMES4 can scan for IP diagnostic ports by activating this function. Set the start and end IP address for scanning and specify the diagnostic port in the "Port" field.

Note: Only the last byte of the addresses can differ.

R&S ROMES4 scans specified IP addresses and report Qualcomm devices connected to these addresses.

Note: A device has to support Ping and the Qualcomm diagnostic interface on the specified port.

QualiPoc Screen Brightness Setting ← Device Configuration
To reduce the device power consumption, the screen of QualiPoc device is dark since QualiPoc version 23.0. The "QualiPoc Screen Brightness Setting" let you switch between the following screen brightness:

- "Force normal brightness"
- "Force minimum brightness"
- "Leave brightness as it is" (default)

Ignore the following COM Ports ← Device Configuration
Lets you specify COM ports to be ignored during the hardware scan. Specify the ports by the full name and separate them using a semi-column, e.g. COM1;COM2;COM3;.

The option is useful if the scanning hangs or device scan takes long. Especially Bluetooth COM port can lead to long device scanning duration, for example.

ADB Screen View ← Device Configuration
The "ADB Screen View" option offers to enter a path of an executable file, for example `scrcpy.exe` which mirrors the Android device's screen.

R&S ROMES4 supports applications which can mirror the Android device's screen, for example the AndroidScreenCopy application. The application is called with the standard ADB parameter `-s adbID`.

Independently on used application, the application has to accept this parameter to identify the mobile device (for example, "-s AddroidID"). The application can be called from "Devices" tab.

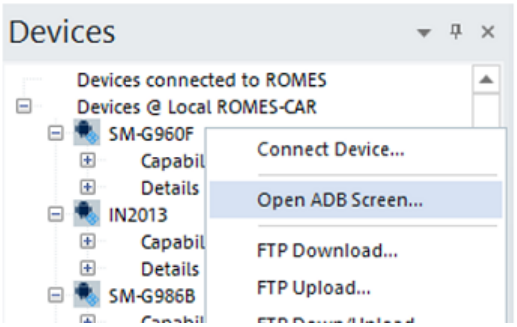


Figure 3-167: Calling the mirroring application

Note: R&S ROMES4 calls the application as specified and is not responsible for the correct behavior of it.

Links
The "Links" entry in the "Tools" menu shows a list of links to access software programs. The list is modified via the "Add" and "Remove" buttons.

- "Add"
  Opens a file browser window. Here you can select a new software program to be added to the "Links" list.
- "Remove"
  Deletes the selected link from the "Links" list.

System configuration transfer
The R&S ROMES4 system configurations can be exported as the `SystemStatusV473.xml` file from one computer and import to another R&S ROMES4 installation on a different computer. The system configuration transfer requires administration rights.

All files located in the MyROMES directory are identified by the tag, for example, MyROMES_FileKey.

If a new R&S ROMES4 version is installing, the prerequisite is to open and close the file before the configuration settings are exported.

The "Export System Configuration" option requests to give an archive file name first. Then, it saves the current R&S ROMES4 configuration in a zipped archive.

Import a ZIP file by using command-line switches. Two different switches are available:

`Romes.exe -sys [file]`

Or

`Romes.exe -sys_overwrite [file]`, where

`-sys` asks before overwriting any file on the target computer.

`-sys_overwrite` overwrites all files on the target computer without asking.

`[file]` the name of the ZIP file (optional). If it is not defined, a file selection dialog appears.

The SystemStatus.XML file can contain two different XML tags, which both have the attribute Name:

- **RegKey:**
  The only attribute is "Name", which specifies the subbranch of the R&S ROMES4 (HKEY_LOCAL_MACHINE\SOFTWARE\Rohde & Schwarz\%ROMES_DIR%) branch in the registry.
  RegKey Example 1:
  <RegKey Name="General\UMTS_PNS_SETTINGS*"/>
  The command copies all keys of the branch HKEY_LOCAL_MACHINE\SOFTWARE\Rohde & Schwarz\%ROMES_DIR%\General\UMTS_PNS_SETTINGS and its subbranches. (“*” is the wildcard for all below the specified branch)
  RegKey Example 2:
  <RegKey Name="General\ReplayOnlyVersion"/>
  Copies only one key HKEY_LOCAL_MACHINE\SOFTWARE\Rohde & Schwarz\%ROMES_DIR%\General\ReplayOnlyVersion
- **FileKey**:
  Analogous to the RegKey tag, the FileKey tag specifies files to be transferred.
  FileKey Example 1:
  <FileKey Name="DriverTemplates*"/>
  Copies all files in the %ROMES_DIR%\DriverTemplates and its subdirectories
  FileKey Example 2:
  <FileKey Name="Driver\QualcommMobiles.xml"/>
  Copies only the file %ROMES_DIR%\Driver\QualcommMobiles.xml

TCM Settings

R&S ROMES4 supports TCM temperature range setting via an own application, TCMTray.exe. The application is installed automatically with the R&S ROMES4 setup.

The TCM Tray application, at the ROMES Directory/Tools/TCM, can be started automatically or manually by R&S ROMES4.

If started automatically, TCM Tray exists with R&S ROMES4. Its lifetime is bound to R&S ROMES4.

To allow R&S ROMES4 to start TCM Tray automatically, select the option "Start TCM Tray at ROMES Startup". After setting this option, TCM Tray is started immediately and with every start of R&S ROMES4.

For manual TCM Tray start, use the following command-line parameters:

-r: correlated registry path to R&S ROMES4

-c: color scheme (light or dark)

Example:

TCMTray.exe -r "SOFTWARE\Rohde & Schwarz\Romes22.3" -c light

If you do not enter the right parameters, the following error is displayed.

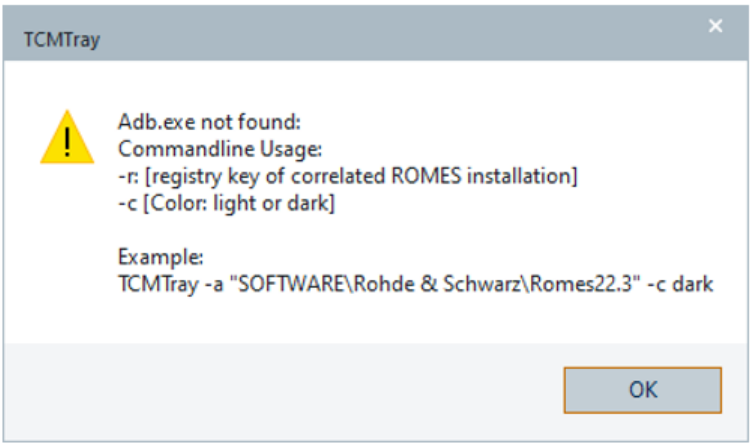


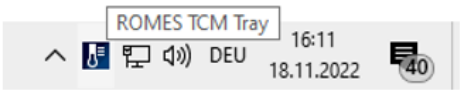
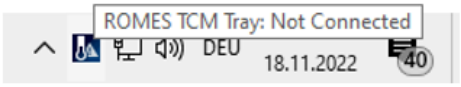
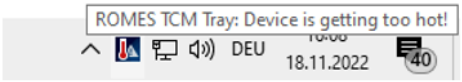
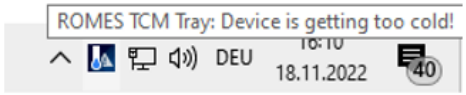
Figure 3-168: Response to a wrong parameter

Set the temperature values for issuing a warning message. Allowed range for the lower temperature value is 23 °C to 25 °C and for the higher 25 °C to 27 °C.

R&S ROMES4 uses the configured temperature values to decide if warnings need to be issued in the "ROMES TCM" dialog when the TCM temperature is not in the given range.

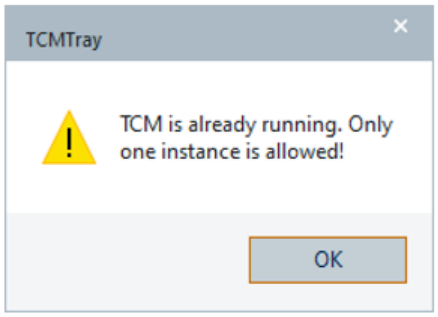
Once TCM Tray is running, its icon and status is displayed in the tray box in the following way.

Table 3-6: Running TCM tray status

Icon of the TCM tray status	Meaning
	TCM started and connected. All found devices are in a normal state (not too hot or cold).
	TCM started but not connected. Check your RPC/TCM device.
	TCM connected - one device has a problem as getting too hot.
	TCM connected - one device has a problem as getting too cold.

Note: If TCM Tray is started manually, its lifetime is not bound to R&S ROMES4 which lets you monitor your mobiles without R&S ROMES4.

Note: TCM Tray can be started only once. It does not start, if another TCM Tray instance is already running. The "TCMTray" information window pops-up the information about an already running instance.



Open the detailed TCM view/dialog using the tray icons menu, see "TCM handling" on page 151.

3.8.1.11 Touch helper

The "Touch Helper" tab lets you select from the list-box the commands you want to be displayed as buttons of the "Touch Helper" bar in the "Welcome View" area. You can also select the color of a button corresponding to the selected command.

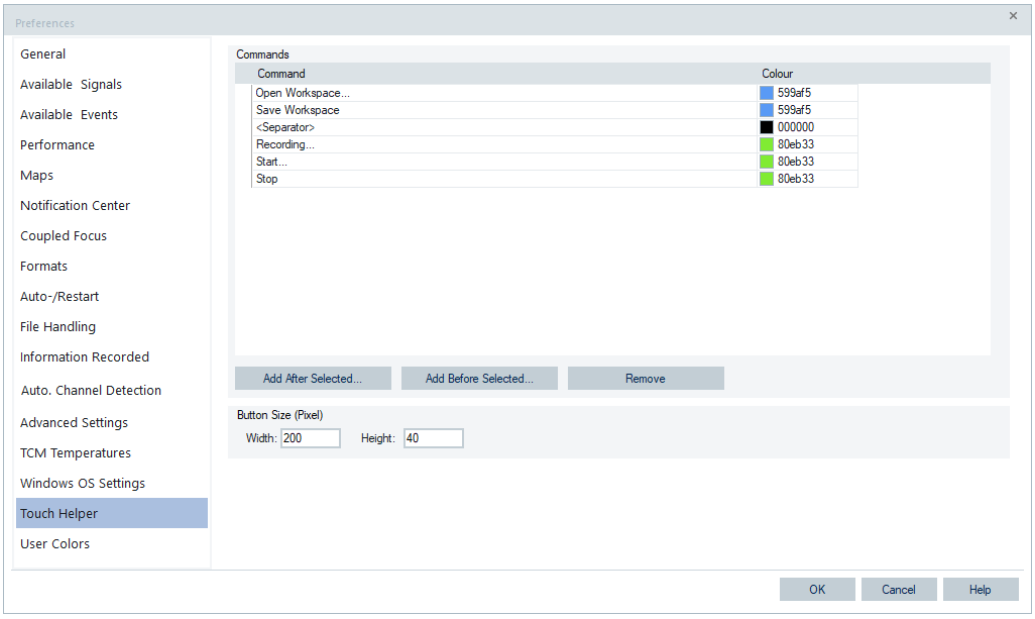


Figure 3-169: Touch Helper dialog

"Add" and "Remove" add and remove a button to the bar, respectively. A separator adds additional space between two buttons and allows buttons to be grouped. The color of the separator is not used.

Also, the width and height of the buttons can be adapted to the needs of the user.

Press "OK" to confirm the selection.

The settings of the Touch Helper bar are stored in the `..\My ROMES\Configuration\` folder of the current user.

3.8.1.12 User colors

The "Preferences" > "User Colors" dialog lets customers define and use their preferred colors.

New colors can be defined in the "Define Color" pane on the left side of the dialog.

The right side pane shows all currently available colors. The "System Defined Colors (read only)" shows colors predefined in the Rohde & Schwarz and the "User Defined Colors" already defined additional user colors.

Up to 100 colors can be defined, removed or changed.

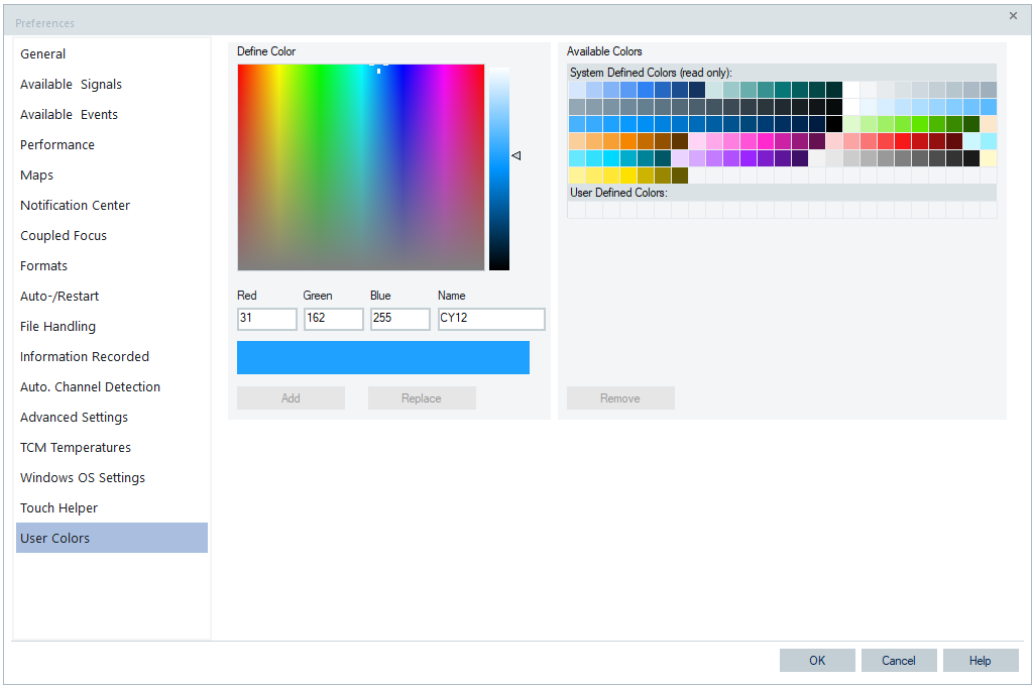


Figure 3-170: User colors dialog

The user colors are stored in .../MyRomes/Configuration/UserColors.xml and therefore can be shared with other users.

Once defined, user colors can be used just as the predefined colors and selected in the various color pickers available in R&S ROMES4.

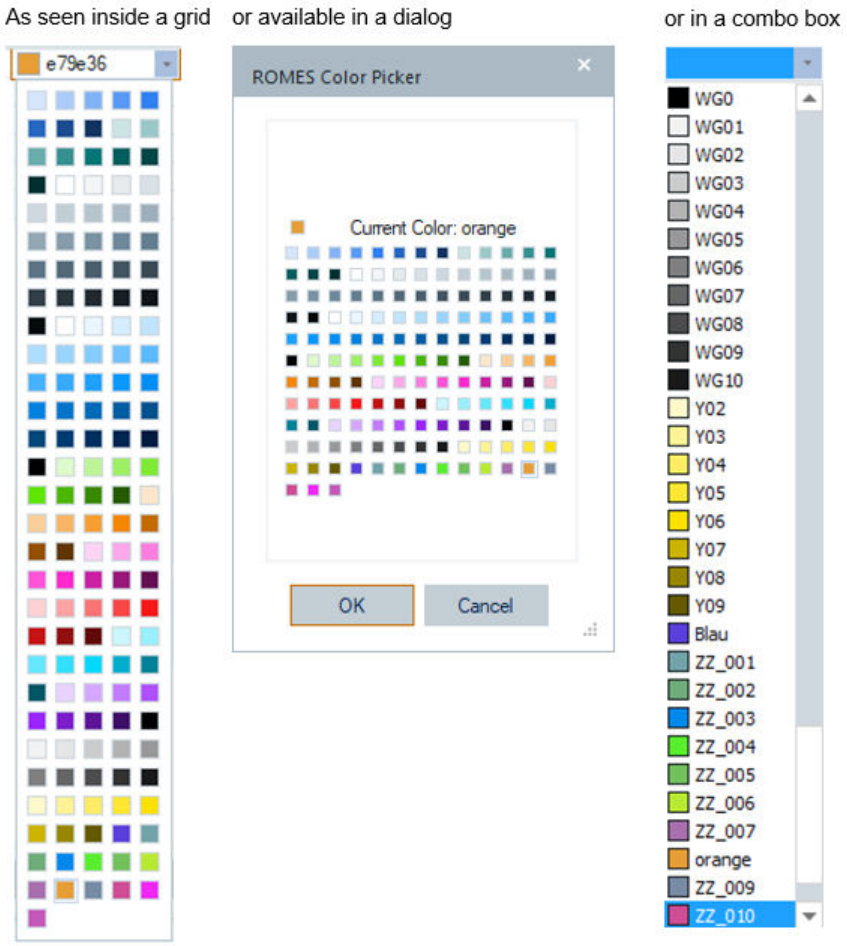


Figure 3-171: User color pickers

Once a color is picked for a special usage in R&S ROMES4, it is stored with its RGB value. If you change the color or you delete it, the color is still available for the special usage.

3.8.2 Overview of settings (configuration of software modules)

- Technologies 280
- Technology scanner settings, info, templates 285
- Configuration of workspace scanner Top N setting 288
- TEC for 5G NR scanner 290
- TEC for BTS positon estimator 294
- TEC for C-V2X scanner 295
- TEC for CDMA2000 1x Ev-DO PNS 300
- TEC for GSM NWS 305
- TEC for UMTS scanner 321
- TEC for CW devices 336
- TEC for WiMAX scanner 337
- TEC for LTE scanner 341

- TEC for NB-IoT scanner....356
- TEC for LTE-M scanner....362
- TEC for QoS tester....367
- TEC for RF power scanner TSME....369
- TEC for TETRA....373
- TEC for TETRA scanner....374

3.8.2.1 Technologies

The "Technologies" tab in the R&S ROMES4 GUI is used to set the SW modules. Click the tab to get the list of available modules.

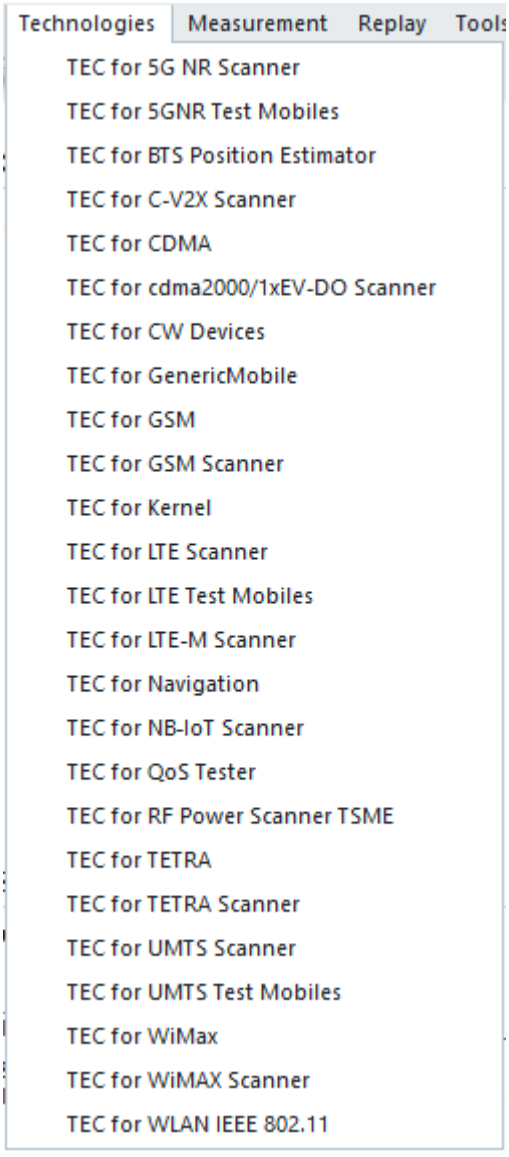


Figure 3-172: List of available SW modules

The R&S ROMES4 technology scanning capability is characterized with the generic implementation of some processing, handling and displaying the features that can be set via "TEC for <variable>" pages.

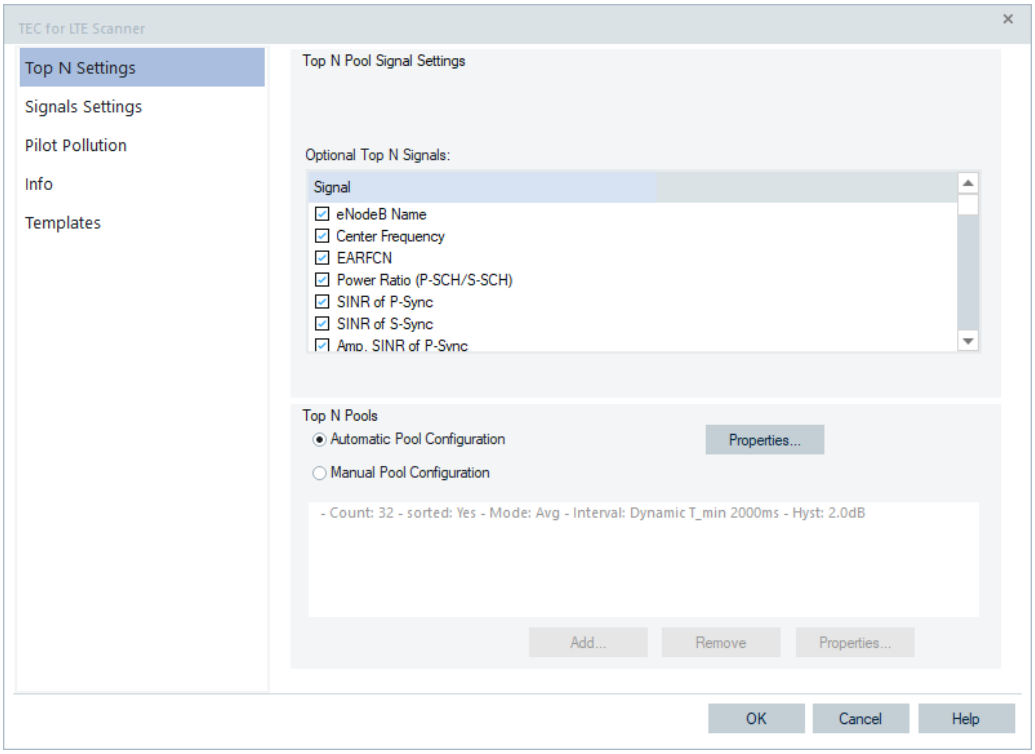


Figure 3-173: TEC for LTE Scanner page as an example

Most of the R&S ROMES4 "TEC for <variable> Scanner" pages have the common "Information" and "Templates" page layout.

The TEC configuration pages can be resized (enlarged). The panes within them follow the size.

Generic implementation of the Top N processing and display features
GSM, UMTS, LTE, NB-IoT, LTE-M, 5G NR and TETRA scanner technologies share the generic implementation of the Top N processing and the Top N display functions. The benefit for the user is a common Top N user interface and improved performances.

Note: There are no Top N events available for GSM, UMTS, LTE, NB-IoT and 5G NR scanners, see Figure 3-125. A Top N event is available in the "Events" list if a responding signal is used in 2D or ROMESMAP Route Track view.

Top N pool configuration
The Top N pools filtering provides the filtered scanners' result of channels and/or providers.

There are two ways of filtering GSM, UMTS, LTE, NB-IoT, and 5G NR channels and/or providers used for Top N pool ranking.

- Automatic pool configuration (not supported by TETRA scanner)
- Manual pool configuration

If a use case requires an evaluation of the scans sorted out by channel and/or provider, the user needs the appropriate-filtered pools. Manual filtering is applicable for many use cases because usually a user scans always the same channels/providers and therefore the configuration is done only once.

However, the R&S ROMES4 feature Automatic Channel Detection (ACD) gives the possibility to find and scan unknown networks and automatically create Top N pools.

To open the automatic pool configuration page of a technology, see, for example, "Automatic Pool Configuration" on page 347. If this option is selected for a technology, the Top N selector control gets the additional entry "Show all TopN Pools" which shows all Top N pools present in the Top N list of the "<Technology> Top N Scanner View". The decision values responsible for calculation and ranking the Top N pools are available as signals in "Preferences" > "Available Signals".

Note: If a measurement file is opened or a measurement is active, the Top N pool configuration is disabled.

Automatic channel detection monitoring

ACD monitoring as a R&S ROMES4 supported use case lets you fine-tune the setup for a long-term monitoring.

The aim of the ACD monitoring use case is interested to detect high power transmitters which transmit that power.

To optimize the performance of the system, we recommend the following settings:

1. Open a blind scan page of any involved scanner. The figure shows the LTE scanner ACD page.

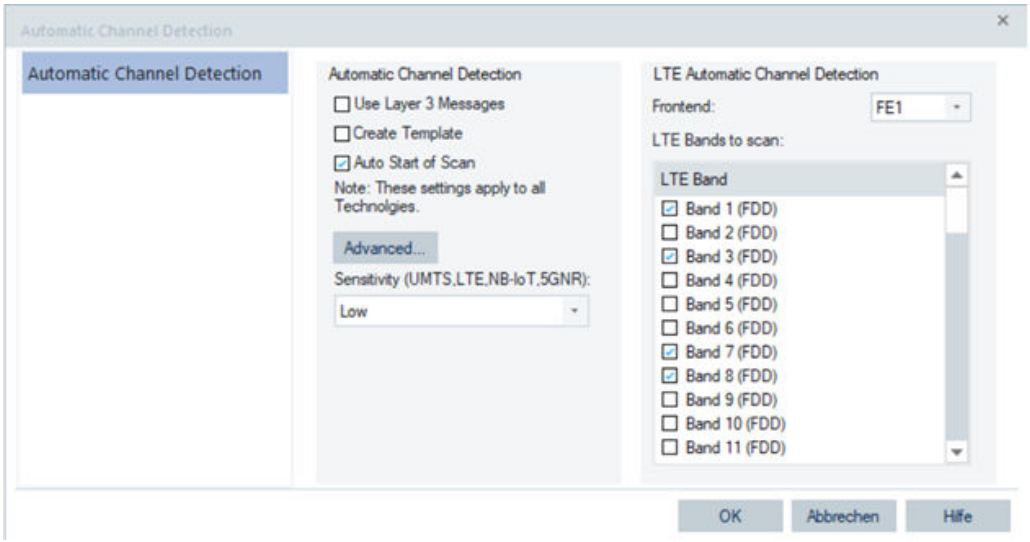


Figure 3-174: ACD page of LTE scanner

2. Unselect the "Use Layer 3 Messages" check-box. Otherwise R&S ROMES4 reads out all neighbor lists of detected transmitters and adds the detected neighbor cells' channels automatically to the system.

This automatic approach has a sense during a drive test but is not what is needed during a monitoring use case. The monitoring use case aims to measure only actual “on air” transmitters.

3. Unselect "Create Template". The template can be used to set up a new measurement with the found channels which is not requested for the monitoring use case.

4. Select the appropriate "Sensitivity" dependent on the requirements of the monitoring use case. This option is available for UMTS, LTE, NB-IoT and 5G NR scanners.

The following table shows the default settings for the sensitivities per supported technologies. The values in the table show how strong a transmitter has to be at least in terms of power and quality to be added to the R&S ROMES4 technology scanner.

Table 3-7: ACD default sensitivities per supported technologies

Technology	Measured parameter	Low	Medium	High
UMTS	Power (dBm)	-100	-160	-160
	Quality (dB)	3	0	-5
LTE	Power (dBm)	-100	-160	-160
	Quality (dB)	3	0	-5
NB-IoT	Power (dBm)	-120	-160	-160
	Quality (dB)	0	-5	-15
5G NR	Power (dBm)	-120	-160	-160
	Quality (dB)	3	0	-5

Note: -160 (dBm) stands for “power value ignored”, only the quality value is of interest.

If these values do not suit use case, they can be changed in the registry.

1. Open "Start" > "Windows System" > "Run" > "regedit".

2. Navigate to the branch ACD. The path is shown in the line below the menu bar (in the screenshot shown is the 5G NR case).

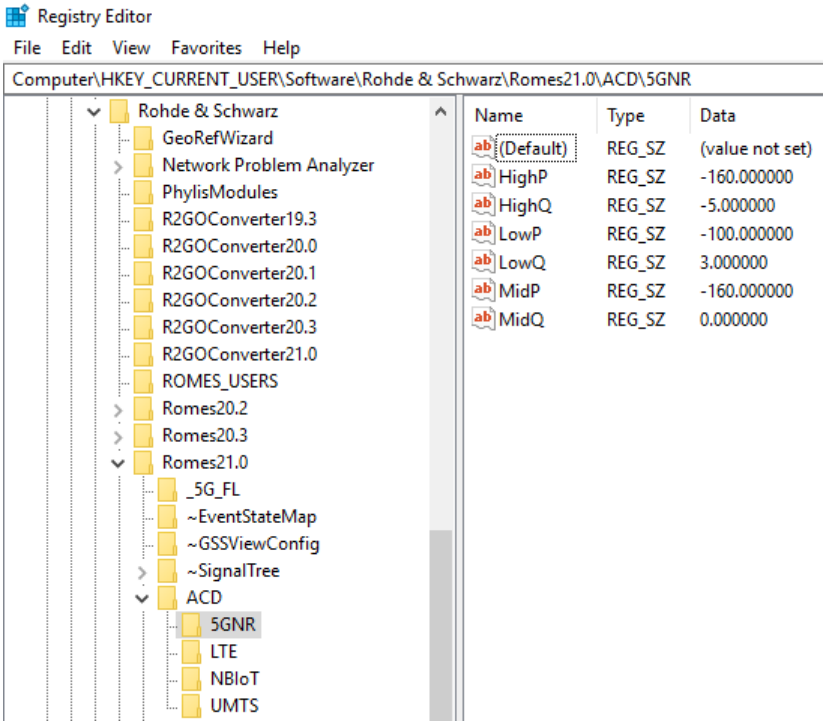


Figure 3-175: ACD branch in regedit

3. Below the ACD branch one branch per technology allows you to adapt the values (<x>P for Power, <y>Q for Quality).

The actual-used values are written into the measurement file's info which is the lower part of the Window's "Open" page of a measurement file you want to open.

Implementation of the dynamic PDU handling

Many broadcast messages are not static but their content varies in time. Demodulation and display of the broadcast messages dynamic changes is supported by the R&S ROMES4 implementation of the PDUs dynamic handling applicable to all RATs.

The implementation is generic and is based on configuration of PDUs. For example, implemented is to the measurements with a repetition interval of SIBs and SIs to record their changes over a time.

In case a dynamically configured SIB is static and does not change its content during the measurement, only the last transmission timestamp is shown in the "TimeStamp" column.

For the dynamic PDU configuration, see for example Dynamic PDU Settings.

The "Measurement Info" of the measurement files shows the repetition interval for dynamic PDUs. It is displayed directly after the PDU name, as shown in the following figure.

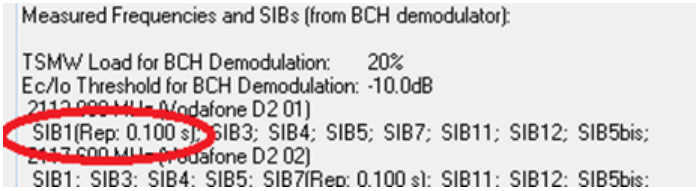


Figure 3-176: Dynamic PDU repetition interval as a measurement info

3.8.2.2 Technology scanner settings, info, templates

Each the "TEC for <variable> Scanner" configuration page is a proprietary sheet that contains multiple buttons on the left side of the page.

Three types of buttons are common for each technology scanner setting.

- Settings
- "Info"
- "Templates"

The figure Figure 3-173 shows them for LTE TEC.

Settings

The Settings function stands for different settings related to Top N pool and Top N signals settings. The pages vary dependent on technology.

Workspace scanner Top N settings

Scanner Top N settings in workspace are maintained on switching between manual and automatic Top N setting modes or loading, stopping, closing measurement files.

The main purpose of this feature is to keep the Top N settings in workspace when loading a measurement file and then stop and close it.

The Top N settings in workspace are not supported by TEC for CDMS2000 / 1xEV-DO Scanner and TEC for WIMAX Scanner, as these technologies do not have automatic and manual mode. For the configuration of the scanner Top N settings workspace, see Chapter 3.8.2.3, "Configuration of workspace scanner Top N setting", on page 288.

Info

The following figure shows the "Info" page of the "TEC for LTE Scanner".

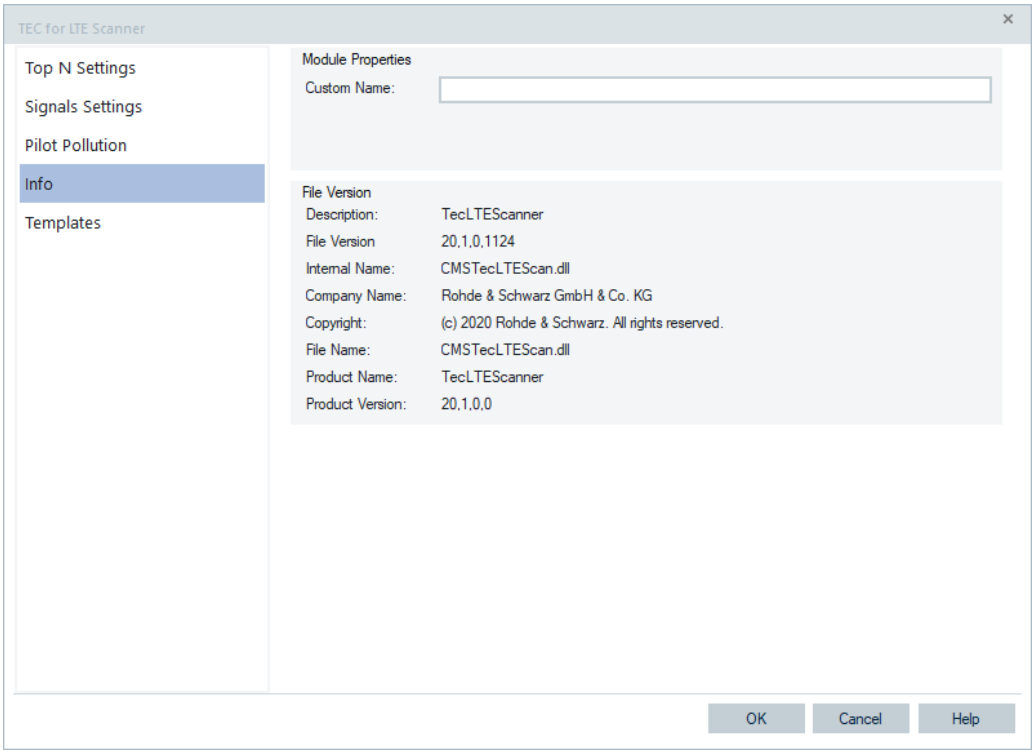


Figure 3-177: Info page

The page contains the scanner information and the "Custom Name" box.

If the custom name is entered, it is shown as the page title. The custom name is saved to template file if you save current settings to a template. It takes effect immediately.

Templates

You can save the current settings of the all settings pages of a "TEC for <variable> Scanner" to a template file or reload an existing template file into system.

To save the current setting to a new template file, click the "Save" button in "Templates" > "Save Current Settings as Template".

The figure shows the "Template" page of the "TEC for LTE Scanner".

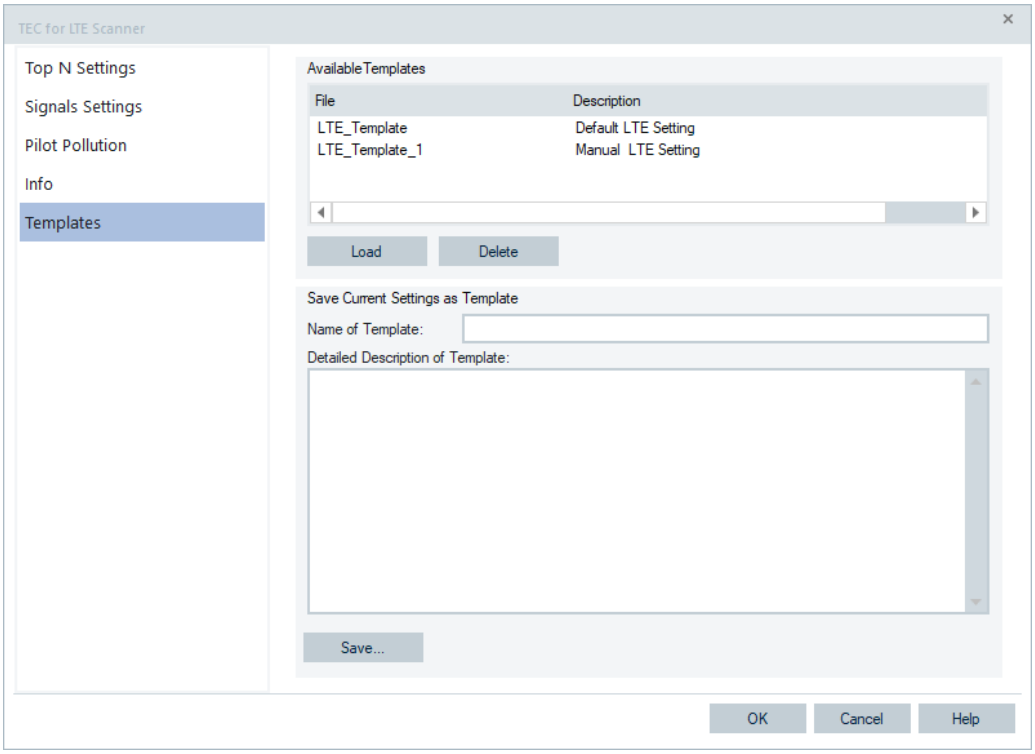
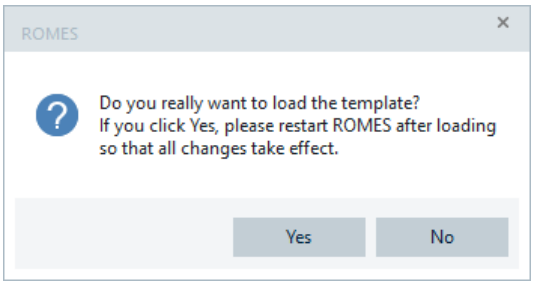


Figure 3-178: Templates page - example

1. Click the "Save" button to save the current settings to a new template file with a file name given in "Name of Template" or
2. Highlight an existing template file in "Available Templates" list.
3. Click "Save" to save the current settings to that file.
4. Load the saved template file into system by highlighting it in "Available Templates".
5. Click the "Load" button. Instead, double click it.
6. Before loading a template, the following dialog asks you to confirm the action.



7. Click "Yes" to continue loading, otherwise, nothing happens.

All by the R&S ROMES4 supported "TEC for <variable> Scanner" configurations support this save/restore template procedure.

Many configuration changes require restarting R&S ROMES4.

Restart R&S ROMES4 after loading a new template. In that way the changes take effect.

3.8.2.3 Configuration of workspace scanner Top N setting

Workspace scanner Top N setting states

The workspace scanner Top N settings have the following states:

- Default Top N - the Top N settings when R&S ROMES4 starts
- Workspace Top N - the Top N settings with a named workspace
- Updated Top N- the Top N settings with updates on top of Default or Workspace Top N
- Measurement Top N - the Top N settings embedded in a measurement file.
  In this state the Top N setting modification is disabled until the measurement file is stopped and closed.

Top N setting state transition

The Top N state before opening a measurement file is the base Top N. This base Top N can be any one of the defaults Top N, workspace Top N, updated Top N or measurement Top N.

The Top N state can change on following actions:

1. Load a measurement file.
2. Load new or a named workspace that closes current workspace
3. Change Top N settings.
4. Close the measurement file.

The following table shows Top N settings state transitions.

Table 3-8: Top N state transition

Source of Top N state	Action	Destination Top N state
Any Top N state	Load measurement	Measurement Top N
Any Top N state	Load a new workspace	Default Top N
Any Top N state	Open a named workspace	Workspace Top N
Default Top N	Change Top N settings	Default Top N
Workspace Top N Updated Top N	Change Top N settings	Updated Top N
Measurement Top N on top of Default Top N	Close measurement file	Default Top N

Source of Top N state	Action	Destination Top N state
Measurement Top N on top of Updated Top N	Close measurement file	Updated Top N
Measurement Top N on top of Workspace Top N	Close measurement file	Workspace Top N

Typical workflow scenarios

Update Top N settings on default Top N state

If current state is default Top N, after applying any changes, current state is still default Top N.

A template load also changes the default Top N.

The preferred Top N settings can be saved as templates.

Update Top N settings on workspace Top N state

Current Top N state changes to Updated Top N.

Updated Top N state stays for more Top N setting changes.

The updated Top N is discarded when opening a new or a named workspace.

Load measurement file on default Top N state

The measurement embedded Top N can be loaded depending on user's choice.

On closing, the default Top N is restored no matter whether the measurement Top N is loaded or not.

Load named workspace Top N

If a named workspace is loaded, its Top N settings are saved as workspace Top N.

Update Top N settings on workspace Top N state

The updated Top N is saved on top of workspace Top N.

The updated Top N is used to restore the Top N settings on closing measurement file.

The updated Top N is discarded when opening a new or a named workspace.

Load measurement file on updated Top N

The measurement file can be opened on updated Top N.

The measurement embedded Top N can be loaded depending on user's choice.

On measurement closing, the updated Top N is restored.

The updated Top N is discarded when opening a new or a named workspace.

Load measurement file on workspace Top N

The measurement file can be opened on workspace Top N.

The measurement embedded Top N can be loaded depending on user's choice.

On closing, the workspace Top N is restored.

Load template

Loading a template changes default Top N, but not workspace Top N.

The Top N setting changes are discarded when opening a new or a named workspace.

Save workspace

"Save workspace" updates the workspace file including the workspace Top N. The new Top N setting becomes the new workspace Top N.

Any updates before saving workspace file become the new workspace Top N.

Save workspace as

"Save workspace as" creates a workspace file.

The new workspace Top N is saved; the original file update is discarded.

Any updates before saving workspace file become the new workspace Top N.

3.8.2.4 TEC for 5G NR scanner

R&S ROMES4 supports the configuration of the 5G NR scanner. In 5G NR a transmitter is identified by PCI like in 4G RAN and, in addition, by Beam Index.

Select the "Technologies" > "TEC for 5G NR Scanner" entry to open the "TEC for 5G NR Scanner" page.

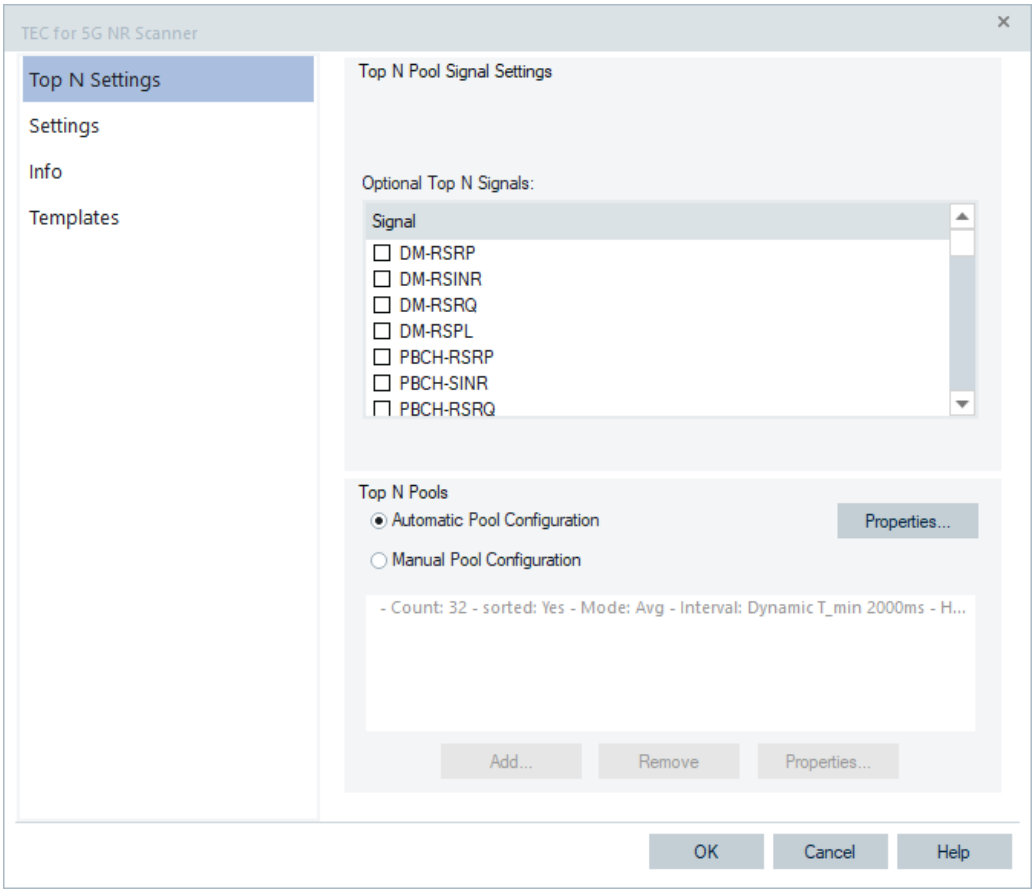


Figure 3-179: 5G NR Top N pool settings

The page contains the following tabs:

- "Top N Settings", the opening page
- "Settings"
- "Info"
- "Templates"

The 5G NR technology provides signals for the Top N pools and template signals which are used to get the measurement parameters of a specific gNodeB. For the signal description, see the "Description of the R&S ROMES4 Signals" document.

5G NR scanner Top N settings

The upper pane of the page lets you select the optional Top N signals for display in the "Tree View" if they are also selected in the "5G NR Scanner Top N View".

The lower pane lets you specify if to configure the Top N pools automatically or manually.

A number of parameters per each beam and per cell are considered when setting the scanner. The next section is dedicated to these parameters.

The following Top N values per cell (PCI) and per beam are configurable:

- RSRP
- RSRQ
- SINR

The values per cell include all beams of the cell which fulfill the specified thresholds. Click the "Settings" tab to open the page where you can specify the thresholds. The linear average value over all beams is fed into the Top N algorithm.

Measurements of optional Top N signals

The 5G NR scanner can measure the Reference Signal power, quality and SINR of synchronization signals (primary PS and secondary SS), demodulation signal (DM), PBCH, SSB and SS-PBCH signals. The scanner can measure and report the signal path loss (SLP) of these signals and the received power (x-RePower, where x stands for any of the mentioned signals).

The power (x-RSRP) is defined as the linear average over the power contributions of the resource that carry respectively PS, SS, DM-RS, PBCH, SSB, SS-PBCH signals.

The signal to noise and interference (x-SINR) is defined as the linear average over the power contributions of all present signals divided by the linear average of interference and noise over the same signals. The signals which can be detected are PS, SS, DM-RS, PBCH, SSB and SS-PBCH.

The quality (x-RSRQ) is defined as the received quality of all resource elements of the one of the mentioned signal types.

The optional signals are also those signals that are broadcast in MIB, k-SSB, the gNodeB name, distance to the device and so on. k-SSB is the frequency domain offset between SSB and the overall RB grid.

For the all optional signals and their description, see the "Description of R&S ROMES4 Signals" document.

To have the signals available for measurement, activate them in the "Optional Top N Signals" > "Signals" pane, see Figure 3-179.

The signals are visible in the Top N view if you configure them in the "5G NR Scanner TopN View" configuration page, see "5G NR scanner TopN view configuration" on page 1148. They can be exported and visualized in a map view.

RSRQ is not specified for PS, DM-RS and PBCH. Therefore, the signals remain empty. RSRQ is defined for SS only.

Note: The scanner history, performance and chart views cannot visualize the previously listed signals.

5G NR settings

The "Settings" page lets you specify the following:

- "SS-PBCH-RE Power [dBm]"
  The configured value of the SS-PBCH RE power is used for calculating the path loss.
- "Thresholds for Cell Ranking"
  A configured threshold value to be used for the cell Top N pool ranking. The available thresholds for cell ranking are:

  - "thresholdRSRP [dBm]"
  - "thresholdRSRQ [dBm"]
  - "thresholdSINR [dBm]"
- "Store High Speed Data for Smart Analytics"
  Select the option to store the 5G High-Speed Scanner data into the `*.sqc` file, if necessary. By default the option is off.

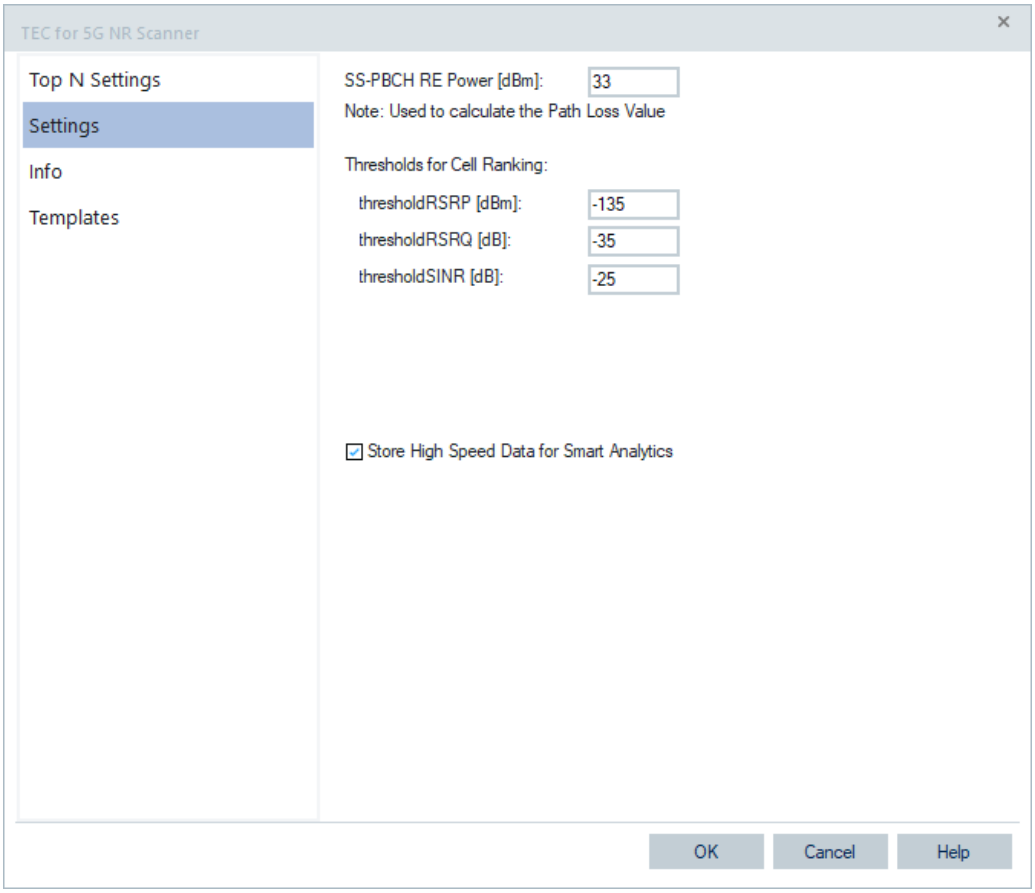


Figure 3-180: 5G NR settings page

R&S ROMES4 supports all 3GPP TS 38.101 specified band versions, that is, the Ver. 15.20.0, 15.30.0, 15.40.0 (default) and 15.50.0.

The 3GPP TS 38.101 version 15.10.0 was introduced temporary and as being obsolete is removed from R&S ROMES4.

Replay old measurement files
The old measurement files replay is still supported.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.5 TEC for BTS positon estimator

Selecting the "Technologies" > "TEC for BTS Positon Estimator" entry opens the configuration page of the BTS position estimator technology.

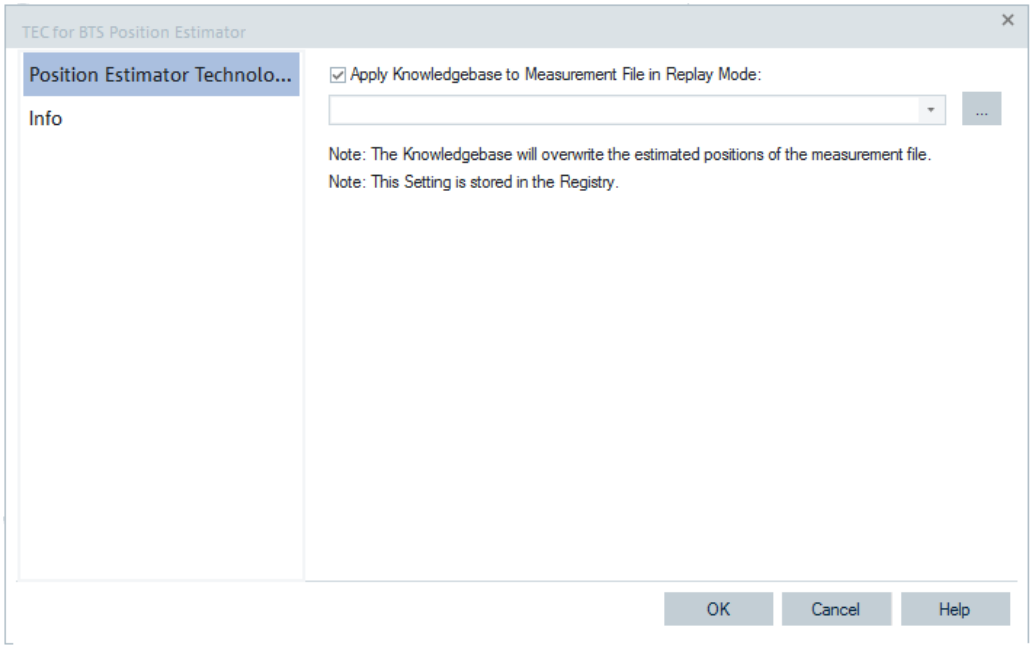


Figure 3-181: Position Estimator configuration

By applying a knowledge base file the estimator adds, respectively overwrites, the estimated positions to all transmitters which have been decoded in the measurement file.

For more, refer to Position Estimation Knowledge Base File.

3.8.2.6 TEC for C-V2X scanner

R&S ROMES4 supports the configuration of the Cellular V2X, that is the LTE version of V2X, scanner.

Select the "Technologies" > "TEC for C-V2X Scanner" entry to open the "TEC for C-V2X Scanner" page.

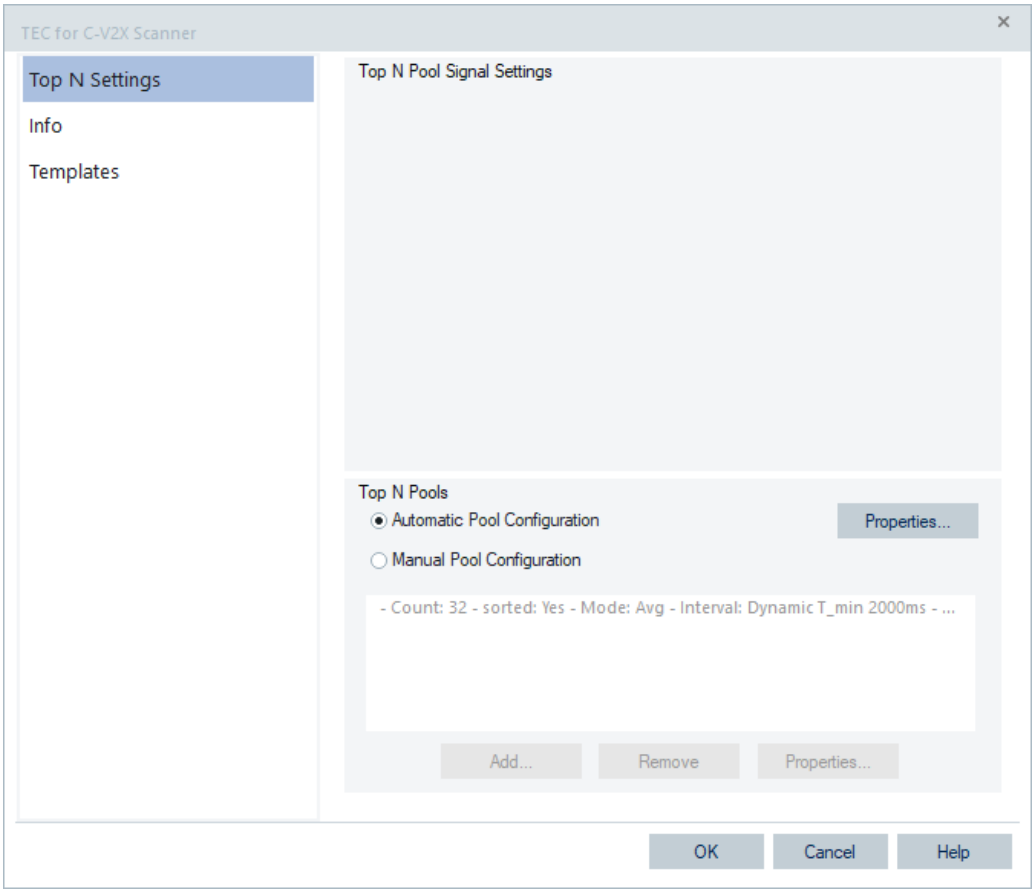


Figure 3-182: C-V2X Top N pool settings

The page contains the following tabs:

- "Top N Settings", the opening page
- "Info"
- "Templates"

The C-V2X technology provides signals for the Top N pools and template signals which are used to get the measurement parameters of a specific gNodeB. For the signal description, see the "Description of the R&S ROMES4 Signals" document.

Top N settings

This configuration page is the standard page for the Top N pool signal settings made of two panes.

- "Top N Pool Signal Settings" without function
- "Top N Pool"

Top N pool signal settings

The upper pane of the page has no function as there is a single Top N node under the "Top N Templates" node.

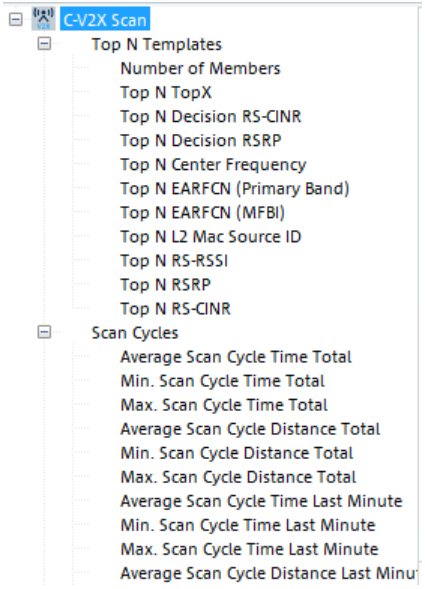


Figure 3-183: C-V2X Top N signals

Top N pools

This lower pane lets you specify whether to configure the Top N pools automatically or manually.

Automatic Pool Configuration
Automatic is the default Top N pool configuration option. It orders the scanner to use automatic Top N pool property configuration.

Click the "Properties" button next to the "Automatic Pool Configuration" button to launch the "Top N Pool Settings" page.

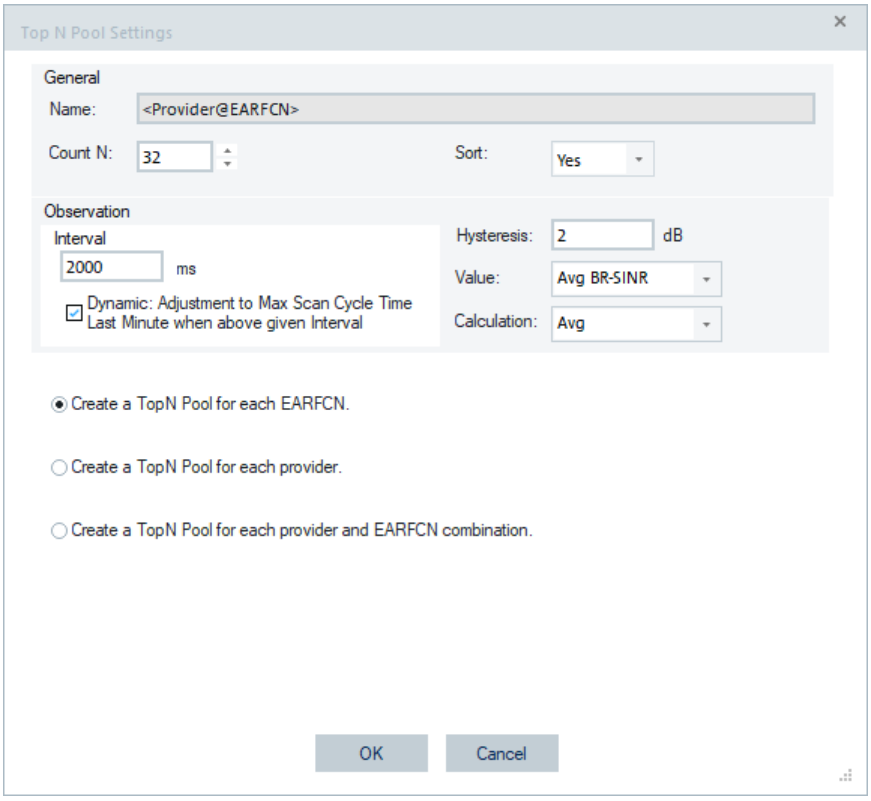


Figure 3-184: C-V2X scanner automatic pool configuration

Specify the following entries in the "General" pane:

- "Name"
  Defines the name of Top N Pools.
  The specified name is displayed in "C-V2X Scanner Top N View" background and Top N drop-down "List".

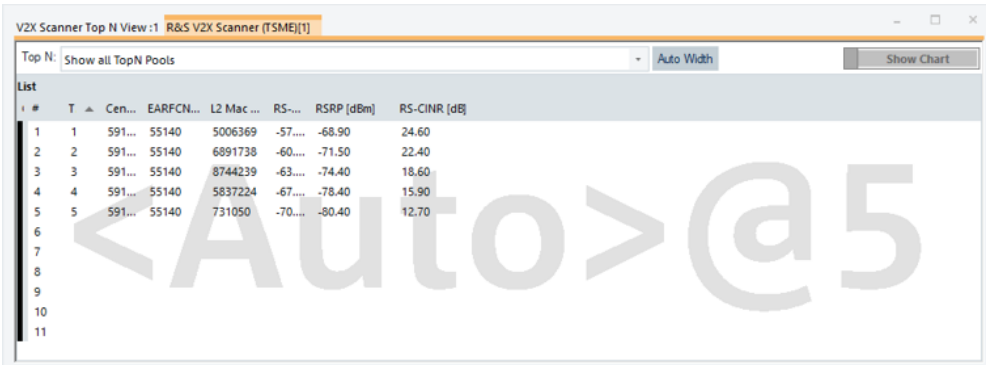


Figure 3-185: Top N pool names in background

- "Count N"
  Specifies the number of top ranked items to display.
- "Sort"
  Specifies whether to sort the items in the Top N list or not.
- "Observation"
  – "Interval"

Specifies the interval to refresh the values.
  - "Dynamic: Adjust to ..."
    The Top N calculation adjusts dynamically the Top N calculation interval to the max. scan cycle time last minute when the above given interval is shorter.
- "Value"
  Drop-down list to specify the decision value for Top N ranking. The possible values for ranking are:
  - Avg BR-SINR
  - Avg BR-RSRP
- "Calculation"
  Specifies how to calculate the selected decision value for Top N ranking. The possible options for calculation are:
  - Min
  - Max
  - Avg
  - Last

The lower part of this pane specifies the criterion for the automatic pool configuration.

Select the criterion among the following options:
- "Create a TopN Pool for each EARFCN"
- "Create a TopN Pool for each provider"
- "Create a TopN Pool for each provider and EARFCN combination"

Manual Pool Configuration
Click the "Manual Pool Configuration" radio button in the "Top N Settings" pane of the page, to activate the bottom section of the page.

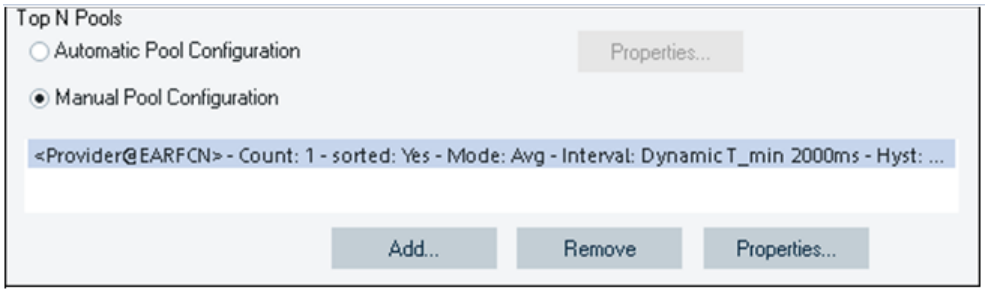


Figure 3-186: Bottom buttons active in manual pool configuration

The active buttons let you do the following:
- "Add"
  Adds a new entry to the list.
- "Remove"
  Removes the selected item from the list.
- "Properties"
  Launches the "Top N Pool Settings" page to specify the highlighted items.

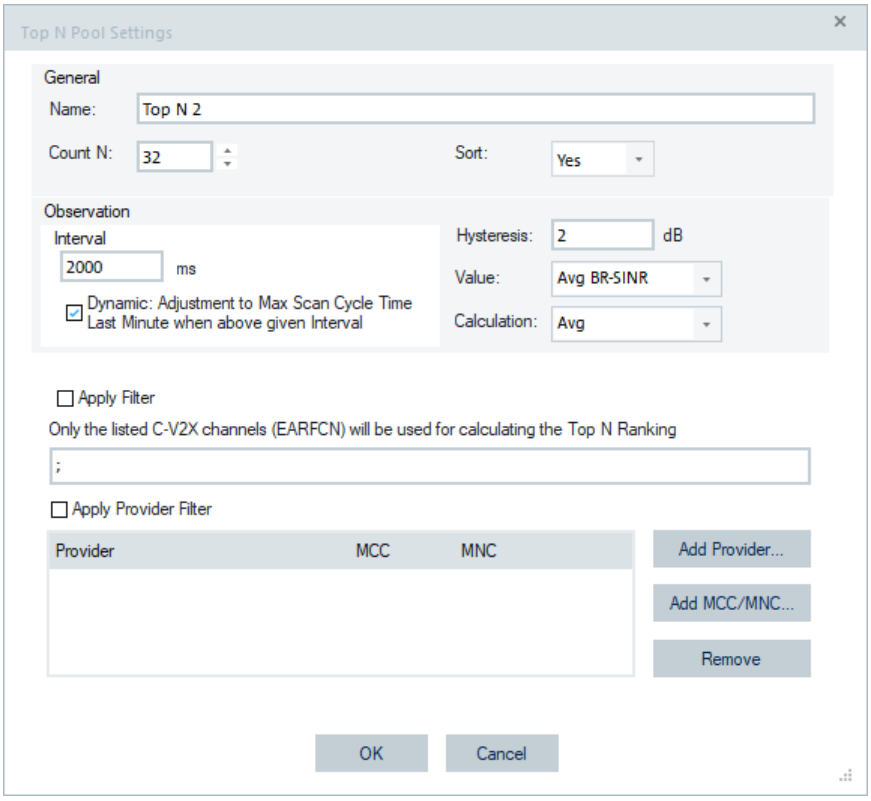


Figure 3-187: Top N pool settings for manual configuration

The "General" pane is the same as the one for automatic pool configuration. For the entries in this pane, see "Top N pools" on page 363.

The lower part of the "Properties" > "Top N Pool Settings" page has the following entries:

- "Apply Filter"
  If checked, the filter string specified in the edit box below is applied. Otherwise, no filter is applied.
- Filter String Box
  The filter string contains a semi-colon delimited EARFCNs. If "Apply Filter" is checked, only the EARFCNs of the string are shown in Top N list.
  Example: 5514;8448;5110;
- "Apply Filter Provider"
  Specifies the list of providers to be shown.
- Provider grid
  Specifies the list of providers to be shown.
- "Add Provider"
  The button is used to add provider.
- "Add MCC/MNC"
  The button is used to add provider by MCC/MNC.
- "Remove"
  Removes the selected provider.
- "OK"
  The button is used to accept the changes.
- "Cancel"

The button is used to discard the changes.

3.8.2.7 TEC for CDMA2000 1x Ev-DO PNS

Selecting "Technologies" > "TEC for CDMA2000 1x Ev-DO PNS" opens the configuration page with the following tabs:

- "Top N Settings"
- "Top N Settings in Registry"
- "Signal Settings"
- "Info"
- "Templates"

The "Info" and "Templates" tabs are RAT technology independent.

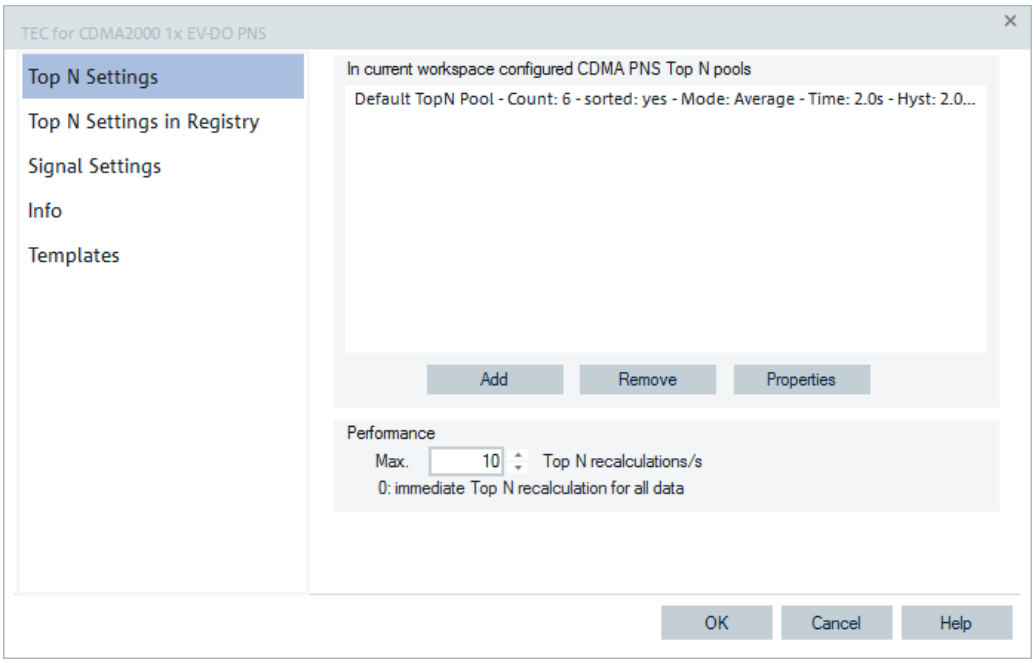


Figure 3-188: TEC for CDMA2000 1x EV-DO PNS

CDMA PNS Top N settings

The page is opened by selecting "TEC for CDMA2000 1x Ev-DO PNS", see the previous figure.

The upper pane "In current workspace configured CDMA PNS Top N pools" is used to administrate the Top N pools of the current workspace.

The lower pane "Performance" is used to set the number of Top N recalculations per second.

In current workspace configured CDMA PNS Top N pools
The pane shows the Top N pools list configured in the current workspace.

The Top N pool list can be amended using the "Add" button.

The entries in the list can be deleted using the "Remove" button and the properties of a list entry can be viewed or modified using the "Properties" button.

Add ← In current workspace configured CDMA PNS Top N pools
Adds user-defined Top N pools in the list of available signals, see Chapter 3.8.1.2, "Available signals configuration", on page 228.

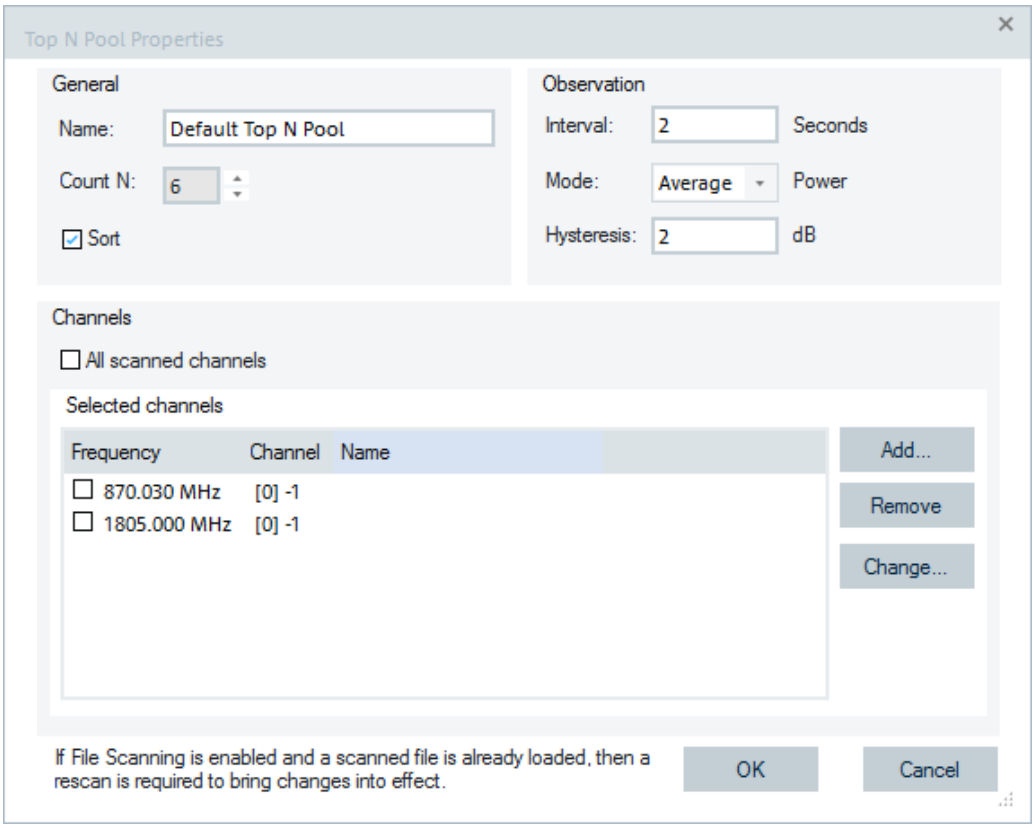


Figure 3-189: CDMA2000 1xEV-DO PNS - Add page

The "Add" dialog contains the following panes:

"General"

- "Name"
  Name of the CDMA PNS Top N pool.
- "Count N"
  Number of pool elements (range 1 to 16). The display of pool elements in the list of available signals is limited to the "Max. Number of members per Top N pool".
- "Sort"
  If checked, the initial Top N View list is sorted by the averaged measured signal power during the observation in the Top N pool.

"Observation"

- "Interval"
  Measurement interval in seconds (range 0 to 300).
  The observation interval is limited, see Interval.
- "Mode"

The parameter is used for ranking the Top N pools. The ranking of the pools within one observation period can be set according to average/max ./min power values.

- "Hysteresis"
  The parameter (in dB) is used for FDD cells if the quality measure for cell selection and reselection is set to CPICH Ec/No.

"Channels/Selected Channels": A list of RF channels to be displayed in the Top N list can be entered manually. In the channel list the absolute RF channel numbers are placed in increasing order of ARFCN.

- "All scanned channels"
  All scanned BCCH channels are displayed in the Top N Poll list.
- "Selected channels"
  Fixed channel list allows the manual entry of the RF channel numbers to be displayed in the Top N list. The channels or channel ranges for the scan signals are set separated by commas (e.g. 1-10,13,90-102).
  Dynamic channel list defined by selected mobile: The displayed channels are defined by the configured test mobile.

Remove ← In current workspace configured CDMA PNS Top N pools
Removes the selected CDMA PNS Top N pool from the "Top N Pool" list, see also "Remove" on page 311.

Properties ← In current workspace configured CDMA PNS Top N pools
Allows the modification of the properties for the selected Top N pool.

The "Properties" page contains the same panels as the "Add" page.

CDMA PNS Top N settings in registry

The tab opens a page which contains two panes for administrating the scan signal settings of the current workspace.

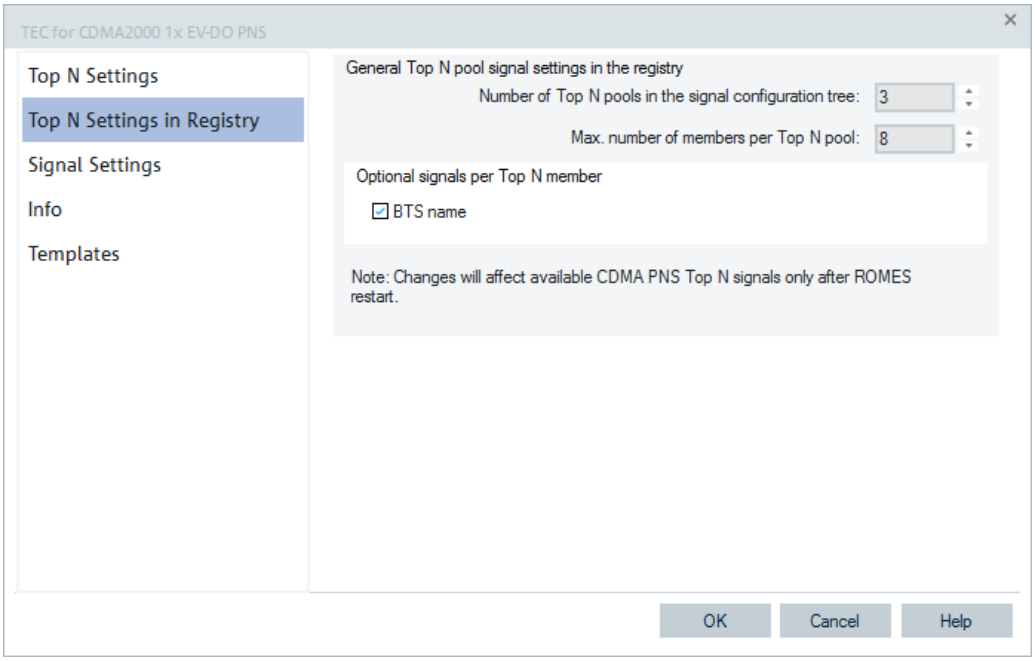


Figure 3-190: CDMA PNS Top N settings in registry

General Top N pool signal settings in the registry
The changes in Top N pool definitions made on this panel will affect available Top N signals only after R&S ROMES4 is restarted.

- "Number of Top N pools in the signal configuration tree"
  Defines the maximum number of Top N pools in the list of "Available Signals", see Chapter 3.8.1.2, "Available signals configuration", on page 228.
- "Max. Number of members per Top N pool"
  Defines the maximum members per pool in the list of "Available Signals", see Chapter 3.8.1.2, "Available signals configuration", on page 228.
- "Optional signals per Top N member"
  If checked, the BTS name taken from the CDMA BTS database (if available) is included in the settings.
  Note: Optional signal settings are the R&S ROMES4-specific settings.
  The selected optional signals are stored with the current R&S ROMES4 installation and not at the current workspace. Therefore, if you open the current workspace with another R&S ROMES4 on another computer, the selected optional signals are not selected anymore.
  Select the optional signals again for that other R&S ROMES4 installation.

CDMA PNS signal settings

The tab opens the page where you can create the signals for each possible PN offset.

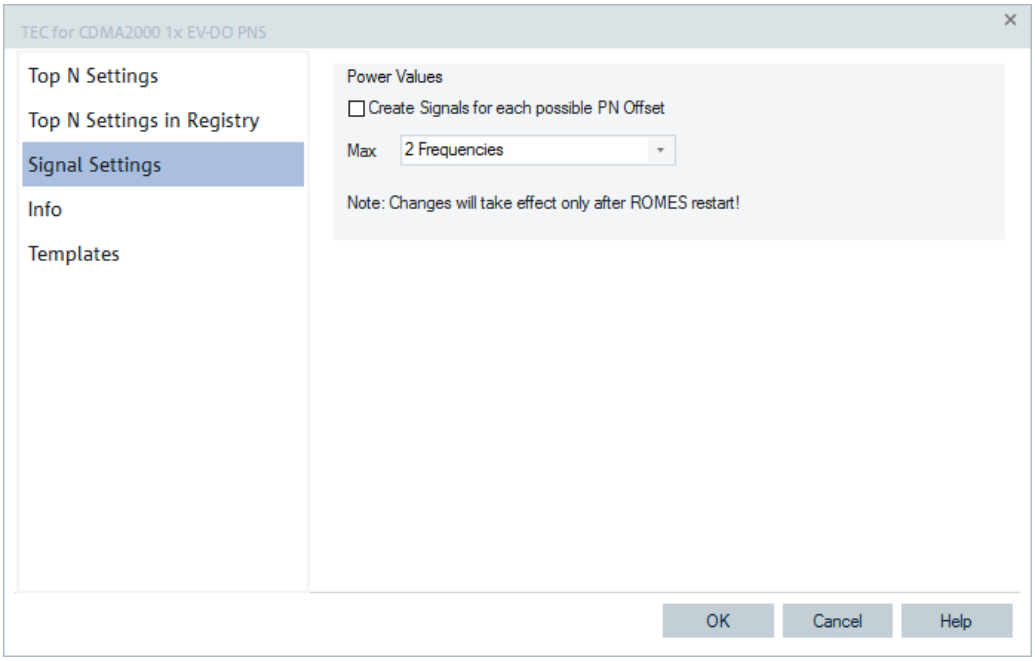


Figure 3-191: CDMA PNS signal settings

Power values
The changes made on this panel will affect available Top N signals only after R&S ROMES4 is restarted.

- "Create Signals for each possible PN Offset"
  Let you specify the maximum number of frequencies (max.12) for which the signals of each possible PN offset can be created.

Note: When a measurement file is loaded, the frequency is displayed as an additional information on the parameters in the basic views and in the signal tree.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.8 TEC for GSM NWS

Selecting the "Technologies" > "TEC for GSM Scanner" entry opens the "TEC for GSM NWS" configuration page with the following tabs:

- "Top N Settings"
- "Signal Settings"
- "UE Interference Trigger"
- "Top N Interference Trigger"
- "C/I Analysis Parameters"
- "C/I Analysis Export"
- "Matching ETS"
- "Info"
- "Templates"

The "Info" and "Templates" tabs are RAT technology independent.

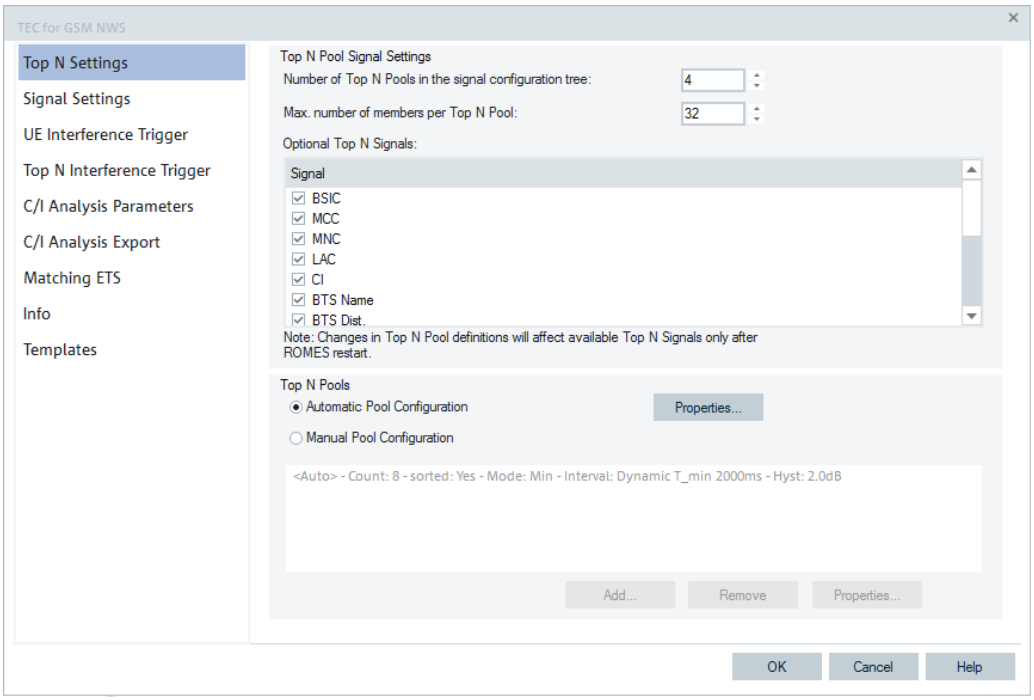


Figure 3-192: GSM Scanner Top N Settings

GSM NWS Top N settings

The "Top N Settings" page is divided into two panes:

- "Top N Pool Signal Settings" to set preferences for the Top N pool signals and activate some optional signals.
- "Top N Pools" to administrate the Top N pools of the current workspace and to filter them for ranking.

Top N pool signal settings

The Top N pool definitions' changes made in this pane affect the available NWS Top N signals only after R&S ROMES4 is restarted.

If the Top N values are used for basic views or exports (for example, for ASCII, KML), signals have to be defined for the required number of Top N pools. The following parameters are configurable:

- **Number of Top N Pools in the signal configuration tree**
  Defines the number of signals for different Top N pools respective channels and/or providers. This number is the maximum number of channels and/or providers that are expected during the measurement campaign.
  For GSM, UMTS, LTE, NB-IoT and TETRA technology, a maximum Top N pool configurations is limited to 64. If a workspace is loaded from a measurement, there is a mismatch between the count of Top N pools in the workspace and ones configured in R&S ROMES4. In this case, a message is shown, which explains the problem and gives a hint for a solution.

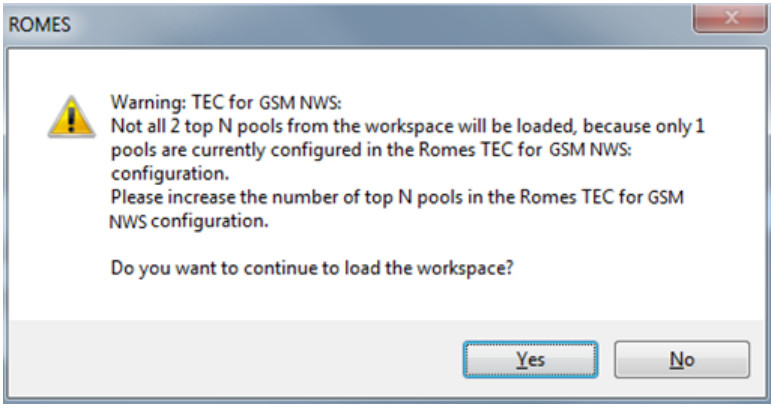


Figure 3-193: Warning message for the mismatch

  The check is done before actually loading the workspace. You can cancel loading the workspace, which saves waiting time.
  Note: As the GSM, UMTS, LTE, NB-IoT and TETRA technologies share common base software, this warning message is issued for each of them when the mismatch occurs.

- **Max. number of members per Top N pool**
  Defines how many members to be post-process and displayed per Top N pool. Set this value to n if you are interested in the n-th strongest cells per Top N pool respective channel and/or provider. These values are valid only for post processing and displaying, and have no effect to the actual measurement. The number of members is limited to 64.

- **Optional Top N signals**
  Optional signal settings are R&S ROMES4 specific-settings.
  The selected optional signals are stored with the current R&S ROMES4 installation and not at the current workspace. Therefore, if the current workspace opens with another R&S ROMES4 on another computer the optional selected signals are not selected anymore and have to be selected for this other R&S ROMES4 installation again.
  - "BSIC"
    Base transceiver station (BTS) identity code. In this view, the BSIC is always octal (so that BSIC = ab where a is the NCC and b is the BCC), irrespective of the format selected in "Preference" > "Available Signals", that is, octal/decimal/hex.
  - "MCC"
    Mobile Country Code
  - "MNC"
    Mobile Network Code
  - "LAC"
    Location Area Code
  - "CI"
    Cell identity in binary format, 16 bits long string
  - "BTS Name"
    Name of the BTS, taken from the GSM BTS database (if available).
  - "BTS Dist."
    Distance to the BTS in km
  - "NCC"
    Network Colour Code
  - "BCC"
    Basestation Colour Code
  - "C1"
    C1 cell selection criterion
  - "C2"
    C2 cell reselection criterion
  - "NR"
    Neighbor relation to another members of the Top N pool. It is a percentage of members which are listed in the BA list. It is available if at least the SI2 is demodulated.
  - "Provider"
    Name of the network provider.

Top N pools

The pane lets you choose between the automatic and manual filtering of channels and/or providers for obtaining Top N pools.

The buttons displayed in this pane depend on selected filtering type. The "Properties" button is displayed in both cases as needed for configuration of the basic Top N pool parameters.

Automatic Pool Configuration
This option creates the pools automatically. Automatic pool creation depends on what is measured, respectively what was measured when replaying or exporting a file.

Click "Properties" to configure the template for the auto Top N pools.

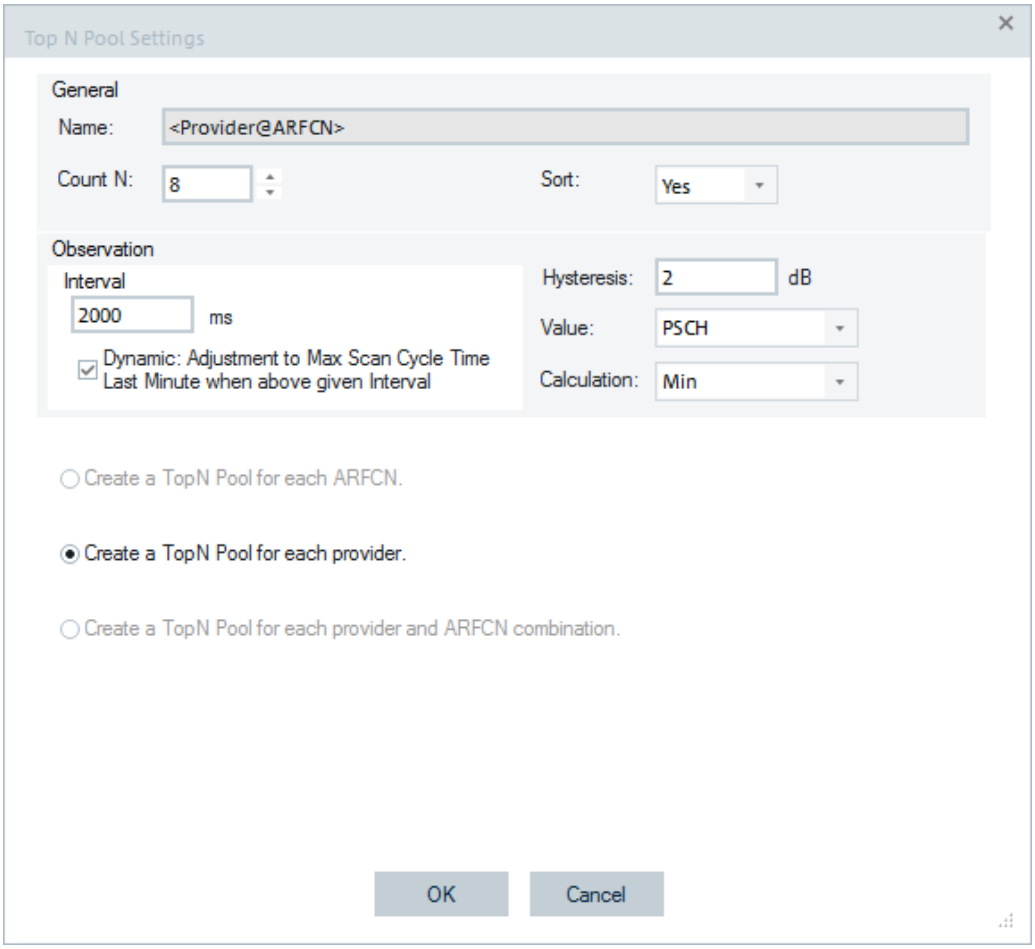


Figure 3-194: Properties page of automatic Top N pool

The properties in the "General" pane are basically the same as ones of a manually configured Top N pool, see "Properties" on page 312. The only difference is that the pool name cannot be set, it is set automatically.

There is only one possibility for Top N pool selection. The "Create a Top N Pool for each provider" is by default only available.

Note: Automatic pool configuration removes the manually configured pools. To keep them, save the configuration as a template.

Manual pool configuration
This option shows a list of the GSM NWS Top N pools configured in the current workspace. The option lets you add more Top N pools or modify the parameters values of the configured ones.

If this type of Top N pool configuration is selected, the following buttons are displayed:
- "Add"

- "Remove"
- "Properties"

Add ← Manual pool configuration
Amends additional pools with default settings to the Top N pools list. To customize the Top N pool, modify it directly in the "Add" dialog or open the Top N pool later on via the "Properties" button.

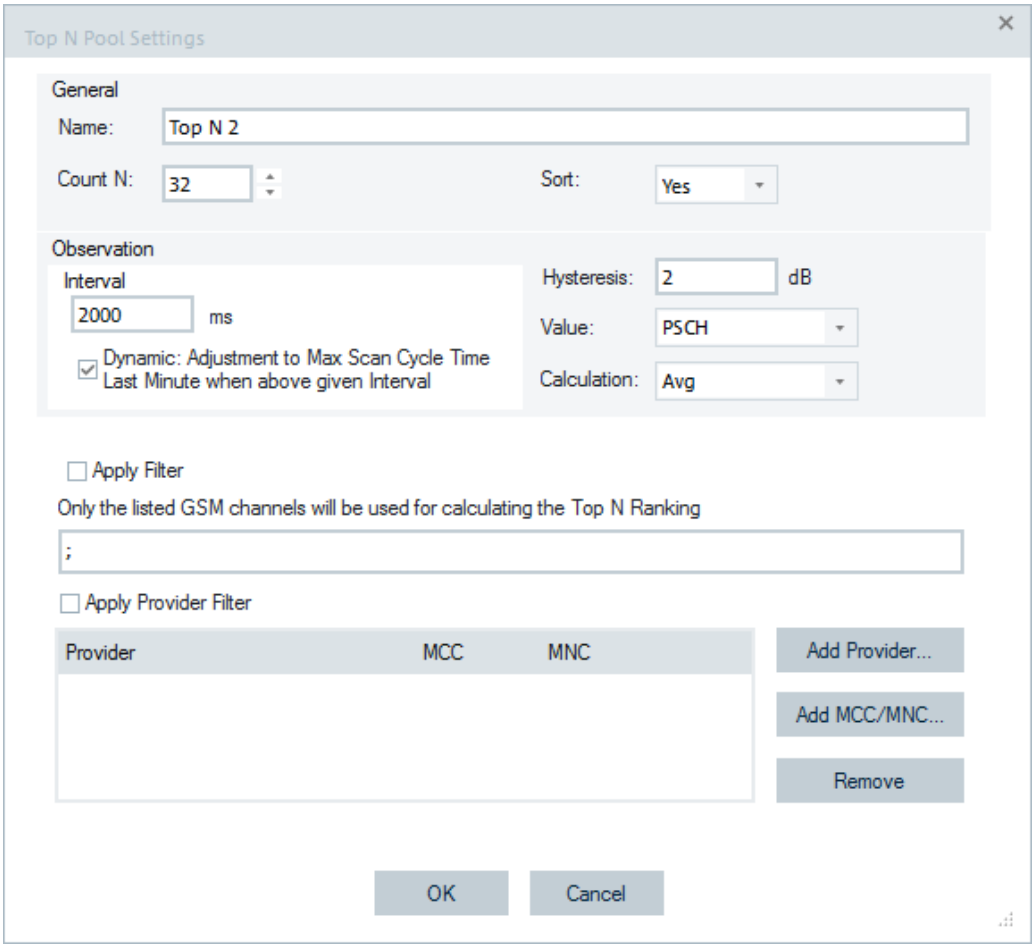


Figure 3-195: Manual GSM Top N pool - Add/Properties

The page contains the following panes:

- "General"
- "Observation"
- "Apply Filter"/"Apply Provider Filter"

General

- "Name"
  Name of the GSM NWS Top N pool. The name identifies the pool in the views and in the data tree, so it is worth to select meaningful names.
- "Count N"
  Number of pool members, ranging from 1 to 64. The number is limited to avoid a crash which can occur when entering too high number of Top N members. The dis-

play of Top N pool members in the list of "Available Signals" is limited with the settings in the "Max. Number of members per Top N pool" as well.

- "Sort"
  In an unsorted pool ("Sort: No"), the members remain at fixed positions unless they are replaced by a new member having a stronger selected signal ("Value") which is observed. Unsorted pools are suitable for monitoring a BTS or a fixed set of BTSs for an extended period of time. They are particularly easy to monitor in graphical diagrams where fixed positions always correspond to the same BTSs.
  In a sorted pool ("Sort: Yes"), the members are sorted according to a stronger signal which is observed. The positions are redistributed after each update, according to the observed signals' strengths. Sorted pools are suitable for monitoring or comparing signals with definite strength, e.g. the strongest and second-strongest signal along a measurement tour, irrespective of the transmitting BTSs.

Observation

- "Interval"
  Measurement interval given in seconds (range 0 to 300). The interval applies for selected calculation mode, that is, average/max/min/last (minute). The observation interval is automatically adapted by the system as long as the measurement period is longer than the configured one. That value is shown in "Replay" of the Top N List.
  The observation interval is limited to the integer values from 100 ms to 60000 ms. The warning message appears if the user inserts a value out of the range, see the following figure.

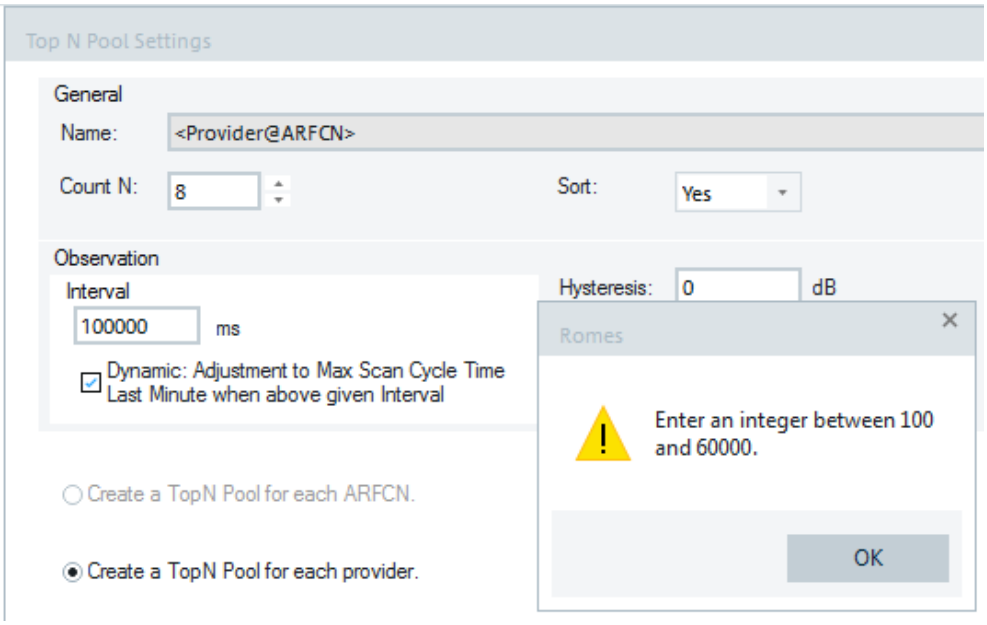


Figure 3-196: Observation interval limits

The same limitation is valid for CDMA, UMTS, WiMAX, LTE, NB-IoT and TETRA technologies.

- "Dynamic: Adjustment to Max Scan Cycle Time Last Minute when above given Interval"
  The Top N calculation can dynamically adjust the Top N calculation interval to the max. scan cycle time last minute when above given interval is shorter.

The option is switched on by default. The interval is automatically increased to the max. scan cycle time of the last minute, if this interval is larger than the interval given in milliseconds. If the interval is shorter, then the members of the Top N are a randomly changing set, which is not useful.
Before applying any Top N calculation, the first scan-full cycle has to be completed.
NOTE: A valid Top N needs at least one measurement of each frequency.
The "Dynamic: Adjustment to Max Scan Cycle Time" replaces the previous adjustment to the maximum scan cycle time of the total file.
The old GSM Top N settings can lead to a different Top N behavior if comparing the files of R&S ROMES versions 4.77 and higher with the previous ones. Update Top N to the “dynamic” option.

- "Hysteresis"
  The hysteresis value (in dB) determines the hysteresis for the ranking of the pool members. To switch it off, enter 0 dB and set the sort mode to "Last".
- "Value"
  The parameter is used to select signal type which is used for ranking the Top N pools. The parameter can be selected between the PSCH (synchronization channel burst power), C/I and the UE emulation Cue.
- "Calculation"
  The parameter determines if the average/max/min/last value of the previously selected parameter within one observation period is used for ranking.

Filters let you manually select criterion for Top N pool ranking.

- "Apply Filter"
  Used for Top N pool filtering based on configured RF channels.
  If checked, only the listed RF channels entered by users are considered when ranking the Top N pool.
- "Channel list"
  In the channel list the absolute RF channel numbers are placed in increasing order. For performance reason (mostly memory usage), it is desirable to configure only a few of frequencies (channels) for the channel-specific signals. As default, the first n channels of each scanner are assigned to the channel signals.
  Fixed channel list allows the manual entry of the RF channel numbers to be displayed in the Top N list. The channels or channel ranges for the scan signals are set separated by commas (e.g. 1-10,90-102). Single RF channels are defined by using the separator “;” (e.g. 13; 14).
- "Apply Provider Filter"
  Used for Top N pool filtering based on configured provider.
  If selected, filters for Top N pool ranking only the selected providers.
- "Provider/MCC/MNC"
  Via the "Add Provider" or "Add MCC/MNC" users can add a provider from the "Network Provider Database" to the list of providers or enter directly a combination of MCC and MNC.

Remove ← Manual pool configuration
Deletes the selected entry from the "Top N Pools" list, after confirmation in the following dialog.

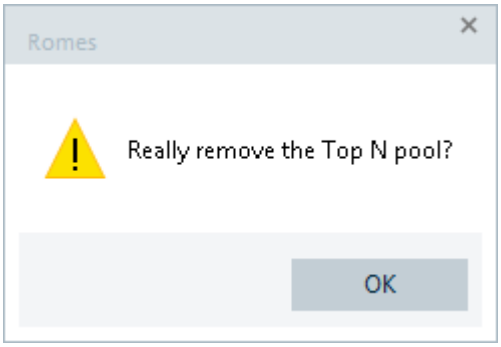


Figure 3-197: Remove Top N pool dialog

The last Top N pool configuration cannot be removed. This approach is applicable for all ROMES technologies.

The following dialog is displayed in this case.

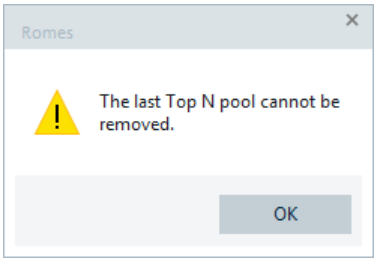


Figure 3-198: Top N pool cannot be removed

Properties ← Manual pool configuration
Shows the properties of an entry from the list and lets users modify the configured parameters values.

The button opens the page which is common for GSM, WCDMA, LTE and TETRA Top N pool properties setting, see Generic implementation of the Top N processing and display features.

The "Properties" dialog contains the same panes as the "Add" dialog, see "Add" on page 309.

Scan cycles signals of GSM NWS events

The implemented scan cycle signals in GSM NWS are:

- Scan Cycle Time Total (Average/Min./Max.)
- Scan Cycle Distance Total (Average/Min./Max.)
- Scan Cycle Distance Last Minute (Average/Min./Max.)

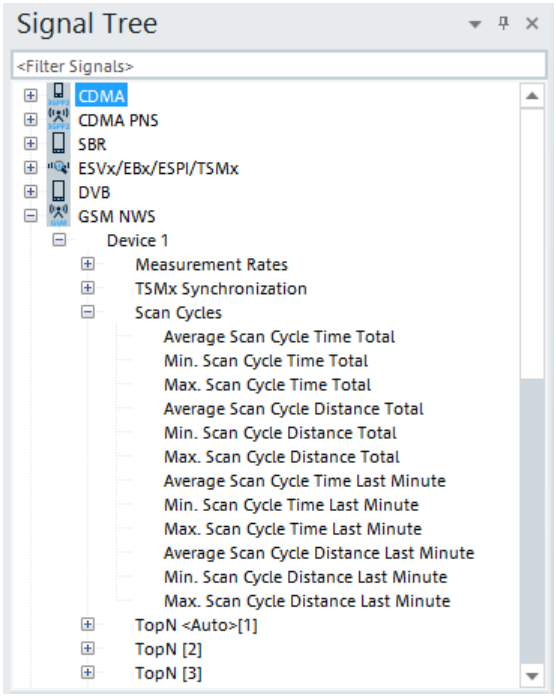


Figure 3-199: GSM NWS scan cycle signals

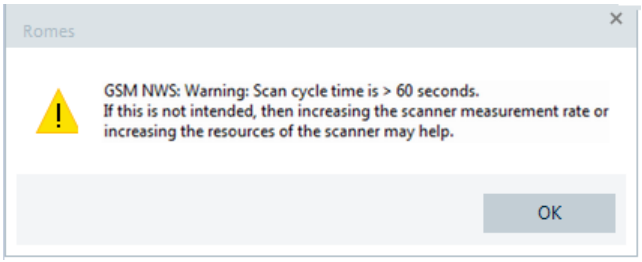
One "scan cycle" is defined as the all configured frequencies measured at least once. One "scan cycle" is also valid if multiple scanners are combined.

The state of the cycle analysis is sampled every 5 seconds and stored in the scanner data models for coupled focus analysis.

The “total” values are calculated from the complete measurement.

The “last minute” values are calculated with a sliding window of one-minute duration.

A warning has been implemented for long scanner cycle times (> 60 sec). It can be shown in the file scan phase in replay mode.



Confirm this warning message by clicking the "OK" button during the NPA processing. The NPA processing waits for this confirmation to proceed.

GSM, UMTS and LTE default scan-averaging time is 2000 ms. A problem with the Top N updates can already occur earlier than when exceeding a 60 sec scan cycle. Nevertheless, the 60 sec scan cycle time is considered as a major measurement problem.

Signal settings

This tab opens a page allowing you to administrate the scan signal settings of the current workspace.

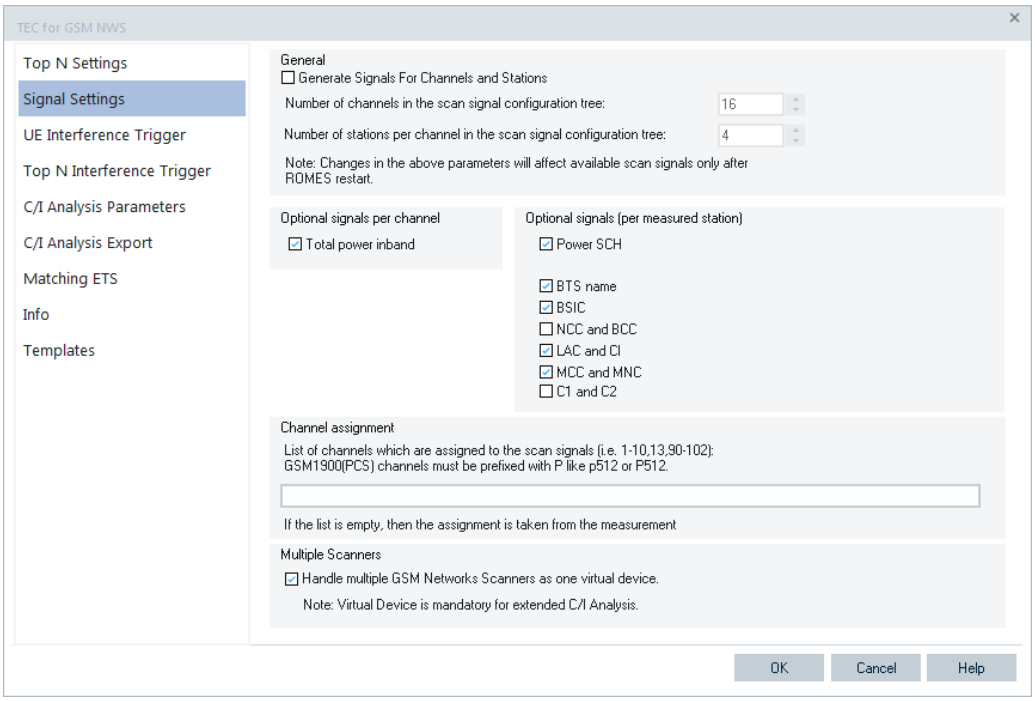


Figure 3-200: GSM NWS signal settings

General

- "Generate Signals for Channels and Stations"
  If the "Generate Signals For Channels and Stations" box is checked, R&S ROMES4 generates signals for the configured number of channels and stations, set in other two parameters of the "General" pane.
  If unchecked, what is a default setting for the parameter, R&S ROMES4 generates signals for just one channel selected from the "Scanned Channel<ARFCN\BSCI> Template" branch in the "Available Signals" tree, see GSM Scanner Templates.
- "Number of channels in the scan signal configuration tree"
  Defines the maximum number of channels in the "Signal Tree", see Chapter 3.8.1.2, "Available signals configuration", on page 228.
- "Number of stations per channel in the scan signal configuration tree"
  Defines the maximum number of stations per channel. For example, scanned are several stations on a given channel. 4 stations and 15 channels are shown by default and the previous parameter.

Default setting for "Generated Signals For Channels and Stations" reduces the number of scanner measured signals, which otherwise can be huge due to combination of configured number of stations and channels. The deactivated parameter offers easy accessibility to the measurement data of a specific scanned channel without need of the former signals.

Optional signals per channel

- "Total power inband"
  Total in-band power (if available)

Optional signals (per measured station)

- "Power SCH"
  Code power of the SCH (Synchronization Channel)
- "BTS Name"
  Name of the BTS, taken from the GSM BTS database (if available)
- "BSIC"
  Base transceiver station (BTS) identity code. In this view, the BSIC is always octal (so that BSIC = ab where a is the NCC and b is the BCC), irrespective of the format selected in "Preferences" > "Available Signals" (octal/decimal/hex)
- "NCC and BCC"
  Network Color Code and BTS Color Code
- "LAC and CI"
  Location Area Code and Cell Identity
- "MCC and MNC"
  Mobile Country Code and Mobile Network Code
- "C1 and C2"
  Cell selection/re-selection criterion, respectively

Channel assignment

The function assigns a created list of channels to the scan signals. All GSM channels can be assigned. Even the measurements with GSM1800 and GSM1900 can be evaluated in parallel with scan signals.

The “p” prefix in front of the channel number stands for the option to scan GSM1900 (PCS) channels and distinguish them from the channel numbers of GSM 1800.

The “p” is so far only necessary in the channel list of the scan signal assignment. In other places there is always a specific network indication given, like “GSM 850 + GSM 1900”.

After assignment, 16 signal parameters are available for each channel in the tree view. If the channel assignment field is left blank, the parameters are assigned to the first found channels at run-time. For example, assigned are 1, 2, 3 for GSM900, or 512, 513, 514 for GSM1800 or p512, p513 for GSM1900. The channel assignment fields or channel ranges for the scan signals are separated by commas (for example, 1-10,13,90-95). If the channel assignment field is filled, the available signal parameters are assigned to the entered channels. The signal parameters can be displayed, in the "Alphanumeric View", for example.

Multiple scanners

Allows you to choose how to handle the measurement results of the GSM scanners.

To get the maximum output of the extended GSM C/I Analyzer, the measurement results of multiple scanner devices are merged in R&S ROMES4 as provided from one single virtual device. The merging of these measurement results is necessary for the algorithms used by the GSM C/I Analyzer modules. For normal coverage measurements, this mode offers the most out of the data provided by the scanners.

The multiple GSM network scanners handling as one virtual device is the default settings.

However, in some situations it is necessary to evaluate the results of different scanners separately. The typical case is a necessity to compare the performances of antennas. The comparison is possible by measuring the two antennas under the test with two scanners.

If you need the GSM NWS measurement results handled separately, uncheck the "Handle multiple Scanner GSM..." option. Changing the option requires R&S ROMES4 restart.

After the restart, all the C/I related configuration pages are not available anymore in "TEC for GSM NWS".

The following views are also not available in this mode:
- "GSM Scanner Transmitter View"
- "GSM Scanner Interference Analyzer View"
- "GSM Scanner interference Event View"

Once you again activate multiple scanner options and restart R&S ROMES4, the "TEC for GSM NWS" and the views behave as all the other scanner technologies. That is, the multiple tabs for different devices at the TopN and BCH view are shown.

Note: Auto TopN pools are not supported with multiple scanners for any technology.

UE interference trigger

The configuration applies to the selected analysis which is displayed in the top row of the "UE interference Trigger" page. The analysis type can be selected in the "Selected analysis" text box.

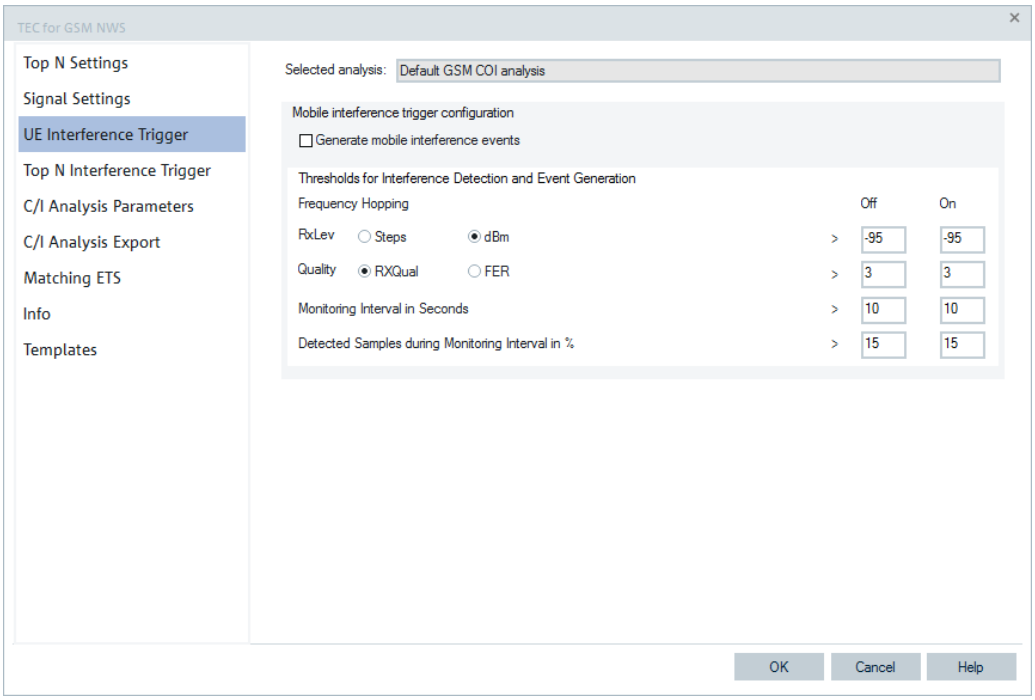


Figure 3-201: Mobile Interference Trigger

Mobile interference trigger configuration

- "Generate mobile interference events"
  The triggering and detection events must be enabled. Adjacent channels are **not** measured by default. Triggering and calculation of the COI event is also by default **OFF**, see "Channel Selection" on page 1785.
- "Thresholds for Interference Detection and Event Generation"
  Sets the conditions for interference event detection. The conditions can be set independently for serving cells that operate at constant frequency (Frequency Hopping Off column) or in frequency-hopping mode (Frequency Hopping On column). An interference event is detected if both the measured RxLev and RxQual values exceed a threshold for a sufficient number of samples within a certain period of time.
  - "RxLev"
    Minimum received signal level required for an interference situation. The value can be entered either as a RxLev value in steps from 0 to 63 (steps) or as an absolute level in dBm.
  - "RxQual"
    Minimum received signal quality required for an interference situation. The value can be entered either as RxQual value (range 0 to 7) or as a minimum Frame Error Rate (FER) detected by the test mobile, expressed in %.
    In case RxQualS < RxQualF (that is, when DTX in downlink is used), the sub values are used.
  - "Monitoring Interval in Seconds"
    Period of time for the evaluation of the trigger conditions for RxLev and RXQual. The monitoring interval is a moving time interval ranging up to the current measurement time.
  - "Detected Samples during Monitoring Interval in %"
    Minimum percentage of measurement points within the monitoring interval fulfilling the trigger conditions for both RxLev and RxQual. A minimum percentage of 3% or larger is required.

Top N interference trigger

The "Top N Interference Trigger" tab opens a page which allows you to configure the trigger conditions for interferer reporting, that is, the threshold values for interference detection and event generation for the selected Top N members as a trigger sources.

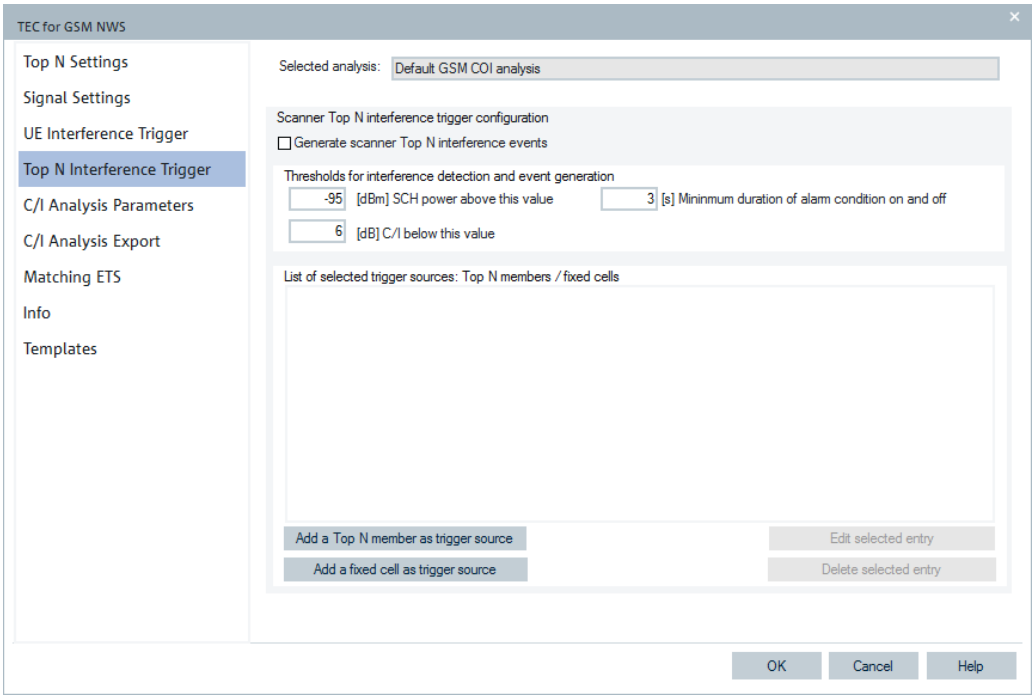


Figure 3-202: Top N interference trigger configuration

C/I analysis parameters

The "C/I Analysis Parameters" tab opens a page which allows you to configure the interferer reporting of the selected analysis.

It contains a check box for switching the calculation and reporting of potential interferers on or off.

A C/I threshold level [dB] limits the reporting to interferers which have a worse (lower) C/I.

A choice can be made to use the min. C/I or the average C/I for reporting and threshold decision.

A leading and a trailing time span [s] can be configured before and after the event duration to include more measurements into the analyzed time span.

Furthermore, the check box allows switching the use of SYSTYPE1 information on Tx channels on or off. If the SYSTYPE1 information is not reliable, it is useful to switch it off.

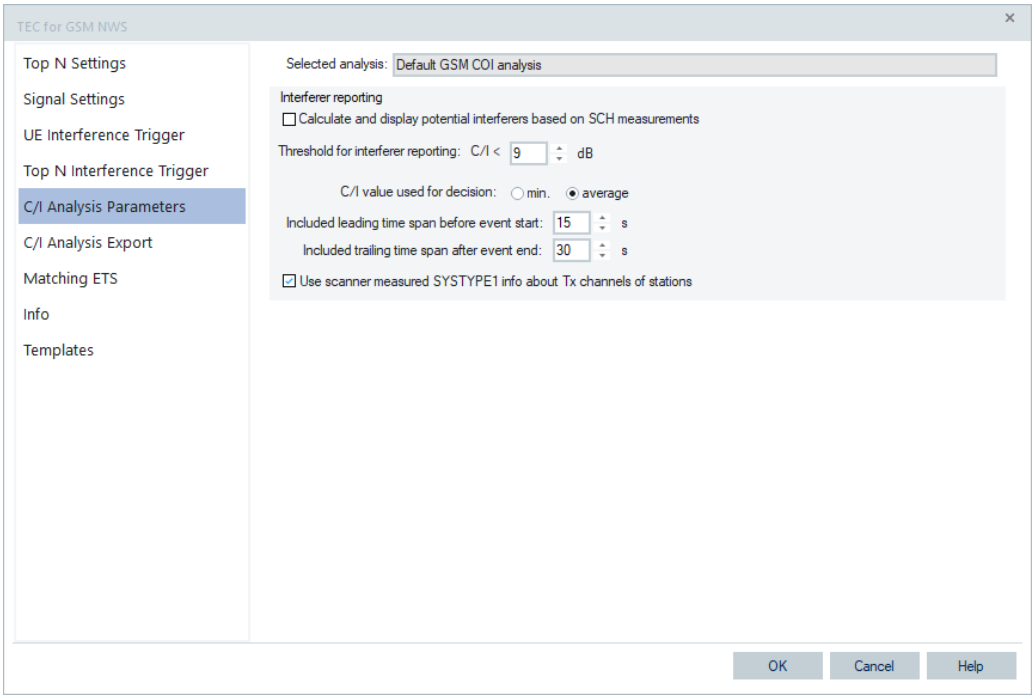


Figure 3-203: C/I analysis parameters configuration

C/I analysis export

For the COI interferer export, it is possible to select which states of interferers can be included. Default is "Confirmed" interferers.

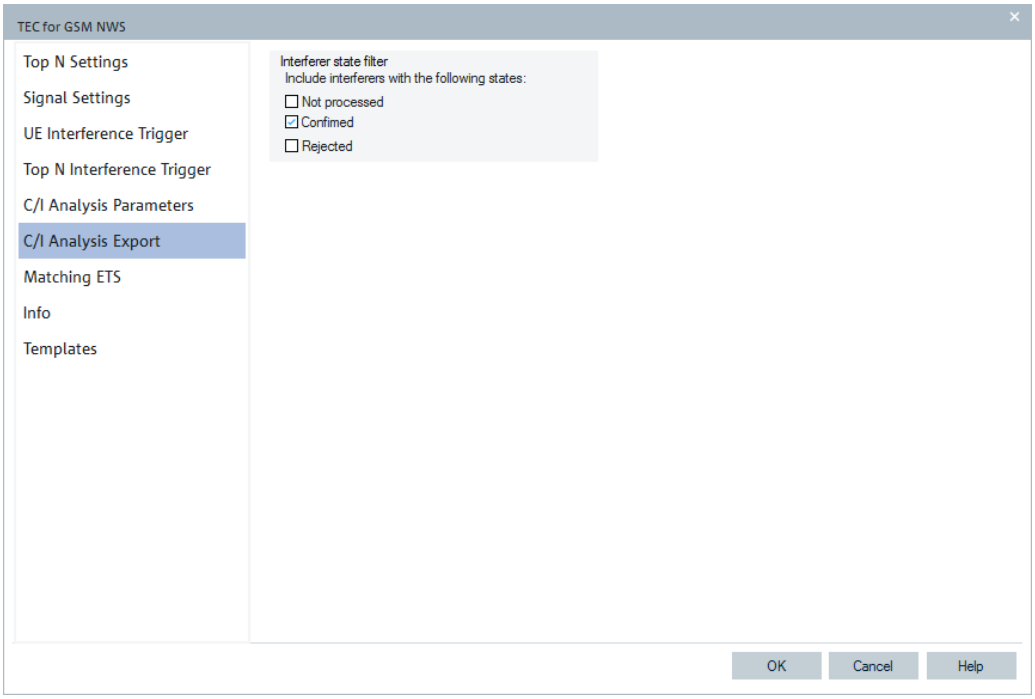


Figure 3-204: C/I analysis export configuration

Matching ETS

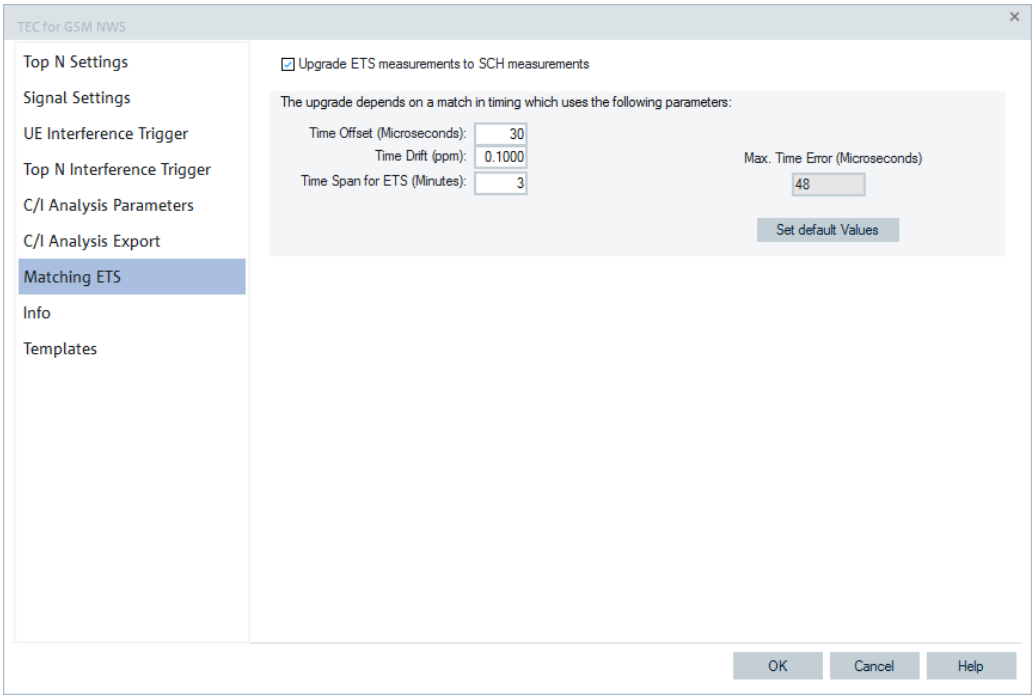


Figure 3-205: Matching ETS

- "Upgrade ETS measurements to SCH measurements"

If this option is enabled, an Extended Training Sequence (ETS) is upgraded to an SCH measurement if an SCH could not be measured.

The upgrade depends on a match in timing that uses the following parameters:

- "Time Offset (Microseconds)"
  Defines the time offset in microseconds.
- "Time Drift (ppm)"
  Defines the time drift in ppm.
- "Time Span for ETS (Minutes)"
  Defines the time span for ETS in minutes.
- "Max. Time Error (Microseconds)"
  Defines the maximum time errors in microseconds.
- "Set default Values"
  The button resets the configured parameters to the default values. Before the resetting, you are asked if you really want to reset to default value.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.9 TEC for UMTS scanner

Click the "Technologies" > "TEC for UMTS Scanner" entry to open the UMTS PNS configuration page.

The following tabs are available:

- "Top N Settings", the opening page

- "Signal Settings"
- "Pilot Pollution"
- "Info"
- "Templates"

The "Info" and "Templates" tabs are RAT technology independent.

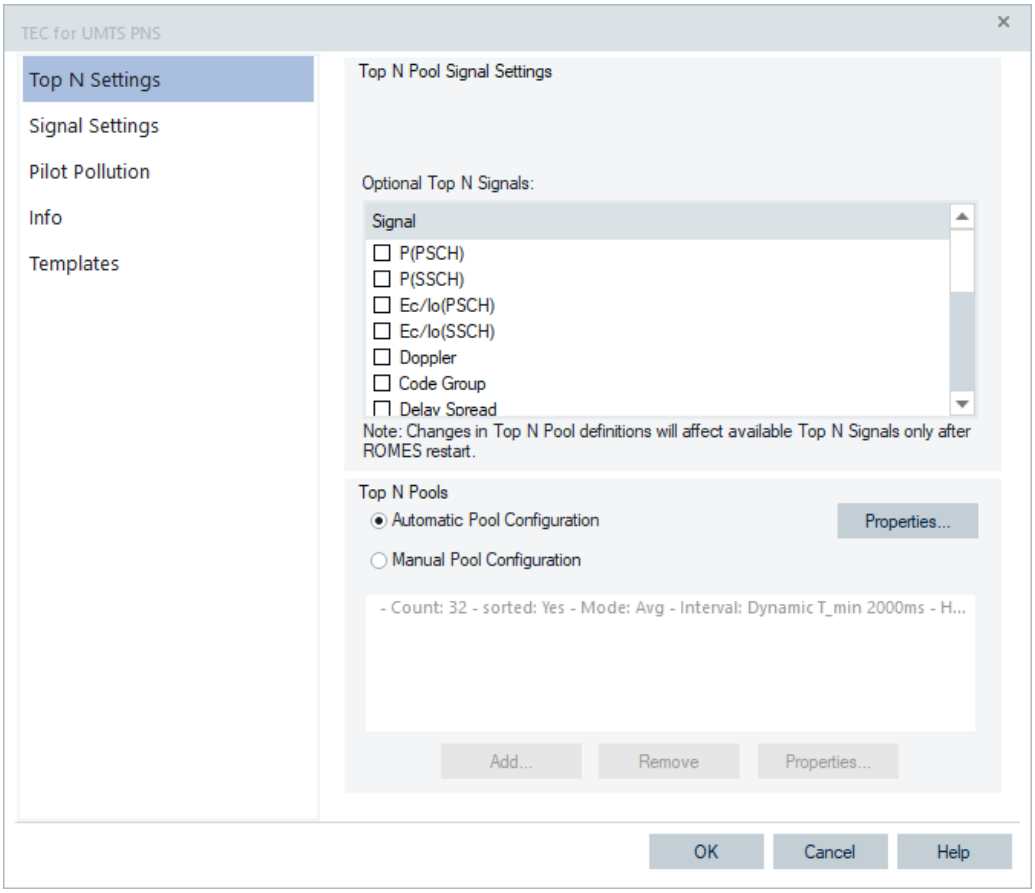


Figure 3-206: TEC for UMTS PNS

UMTS PNS Top N processing done as postprocessing

The Top N configuration and calculation is a task of UMTS scanner postprocessing and follows the processing scheme of the other technologies. Therefore, the measurement files do not include Top N records.

One major benefit of doing the Top N and Pilot Pollution calculation in the postprocessing is the possibility to change the calculation parameters according to needs.

Multiple UMTS PNS configurations

Multiple of R&S TSME can be configured for UMTS PNS measurements. The configuration is done in the "Hardware Configuration" page, as the following figure displays.

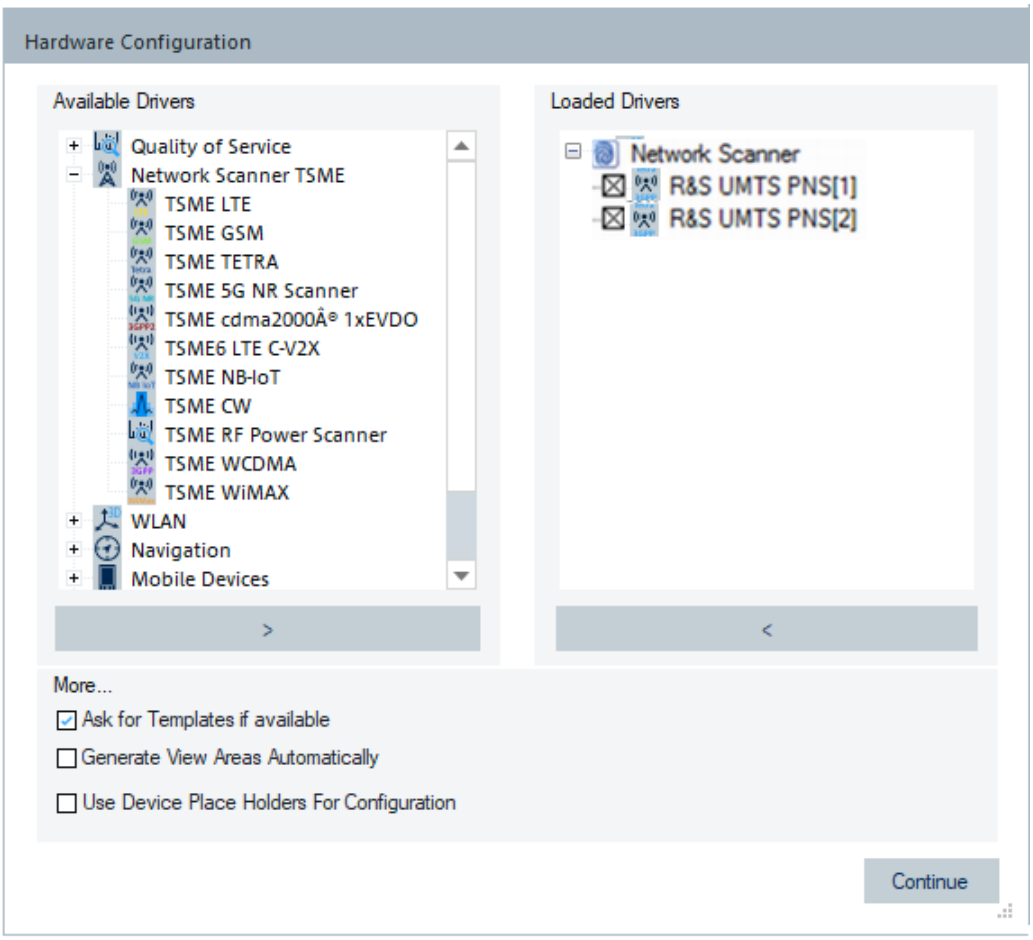


Figure 3-207: Multiple UMTS PNS configurations via hardware configuration page

This feature opens many possibilities for measurements configurations, for example, higher measurement rates by using more scanners or dedicated scanning tasks apart from general scanning tasks.

The following is applicable for the configured multiple devices, if not mentioned otherwise:

- During an UMTS PN scan, the test devices measure and identify all UMTS downlink (NodeB) signals in the air.
- The spectrum analysis consists of a frequency sweep over a specified range to detect arbitrary UMTS downlink and uplink signals.

Do not configure the same frequency/UARFCN for two UMTS PN scanners.

UMTS PNS Top N settings

The configuration page, see the Figure 3-206, is divided into two panes:

- "Top N Pool Signal Settings" lets you select some optional signals

- "Top N Pools" lets you administrate the Top N pools of the current workspace and to filter them for ranking
  The configuration is used to evaluate the Top N pools and to display them in the "UMTS Scanner Top N View".

As the Top N pools also appear in the signal tree, they can be analyzed in general R&S ROMES4 views, for example, in the "Alphanumeric View"or "ROMESMAP Route Track View".

The UMTS scanner Top N configuration page is derived from a generic scanner Top N configuration page.

The UMTS PNS Top N configuration is valid for all used UMTS PN scanners. All scanners have the same Top N pools configuration.

Top N pool signal settings

The maximum number of Top N pools can be limited in the "Measurement" on page 253.

In the "UMTS Scanner Top N View" the optional signals can be displayed apart from the default ones if selected in "Top N Pool Signal Settings".

There is a single Top N node under the "Top N Templates" branch in the "Signal Tree" showing all default and selected optional signals.

Optional Top N signals

Note: Optional signal settings are the R&S ROMES4-specific settings.

The selected optional signals are stored with the current R&S ROMES4 installation and not at the current workspace. Therefore, if the current workspace opens with another R&S ROMES4 on another computer, the optional selected signals are not selected anymore and have to be selected for this other R&S ROMES4 installation again.

The following optional signals can be selected:

- "P(PSCH)"
  The signal power of the Primary Synchronization Channel of all recorded DL UMTS signals.
- "P(SSCH)"
  The signal power of the Secondary Synchronization Channel of all recorded DL UMTS signals.
- "Ec/Io (PSCH)"
  Ratio of the received energy per PN chip for Primary Synchronization Channel to the total transmit power spectral density.
- "Ec/Io (SSCH)"
  Ratio of the received energy per PN chip for Secondary Synchronization Channel to the total transmit power spectral density.
- "Doppler"
  Doppler frequency due to a relative movement of the test vehicle to the Node, that is, a cell pilot signal deviation due to movement.
- "Code Group"

Scrambling code group

- "Delay Spread"
  RMS (Root Mean Square) delay spread in chip periods - standard deviation of the time delay DeltaT at all CPICH measurement points weighted with the measured power Ec (CPICH). A small delay spread indicates that the individual CPICH peaks of the NodeB signal are relatively close or that the power of peaks with different time delay is low.
- "Drift [ns/s]"
  Mean time drift of P-CPICH concerning the internal clock which can be synchronized with the PPS of GPS.
- "Std.Dev.Drift"
  90% confidence interval width of the average time drift. A small value indicates that the drift measurement is estimated to be relatively accurate.
- "Cue-Qual"
  Cell reselection criterion value based on UE emulation by quality information in system information blocks.
- "Cue-Lev"
  Cell reselection criterion value based on UE emulation by level information in system information blocks.
- "NR"
  The Neighbor Relation is the percentage of cells in the current Top N pool, which are the members of the specific intra-frequency neighbor cells list. The signal is available only if at least SIB11 and SIB12 are demodulated.
- "Add. PLMNs"
  Additional PLMNs shared on this NodeB.
  R&S ROMES4 supports the 3GPP specified RAN Sharing feature. The feature supports that a physical base station serves several network operators, i.e. PLMNs.
  Check "Add. PLMNs" to visualize the base stations for all PLMNs in the list. The info about primary PLMN is a part of the standard MIB message, while the list of additional PLMNs is contained in the "v690NonCriticalExtension" element.

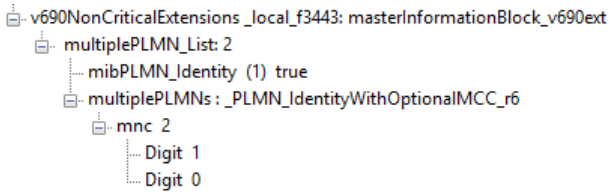


Figure 3-208: RAN sharing info in v690ext MIB

Note: The shown MCC and MNC signals of the NodeB in the TopN List view are always related to the primary PLMN. However, for TopN pools, filtering of NodeB signals applies to all PLMNs that are in the list and the mentioned signals are shown in the "Add. PLMNs" column.
If the TopN pool is created automatically for the PLMNs, a pool for each PLMN in the list is also created automatically.

- "Frame Time of arrival offset to PPS"

Time difference between PPS and the start of a UMTS frame received by the scanner (only available if the Position Estimation option was available during the measurement).

- "Frame Number of arrival offset to PPS"
  Virtual frame number between PPS and the start of a UMTS frame received by the scanner. It is virtual frame number of the RF frame in which the CIR has been measured.

To activate the signal configuration changes, R&S ROMES4 must be closed and restarted.

Top N pools

The pane lets you choose between the automatic and manual filtering of channels and/or providers for obtaining the Top N pools.

The buttons displayed in this pane depend on selected filtering type. The "Properties" button is displayed in both cases as needed for configuration of the basic Top N pool parameters.

Automatic pool configuration
This option creates the Top N pools automatically for the user. Depending on what is measured, respective what was measured when replaying or exporting a file, the pools are created automatically.

Click "Properties" to configure the template for the auto Top N pools.

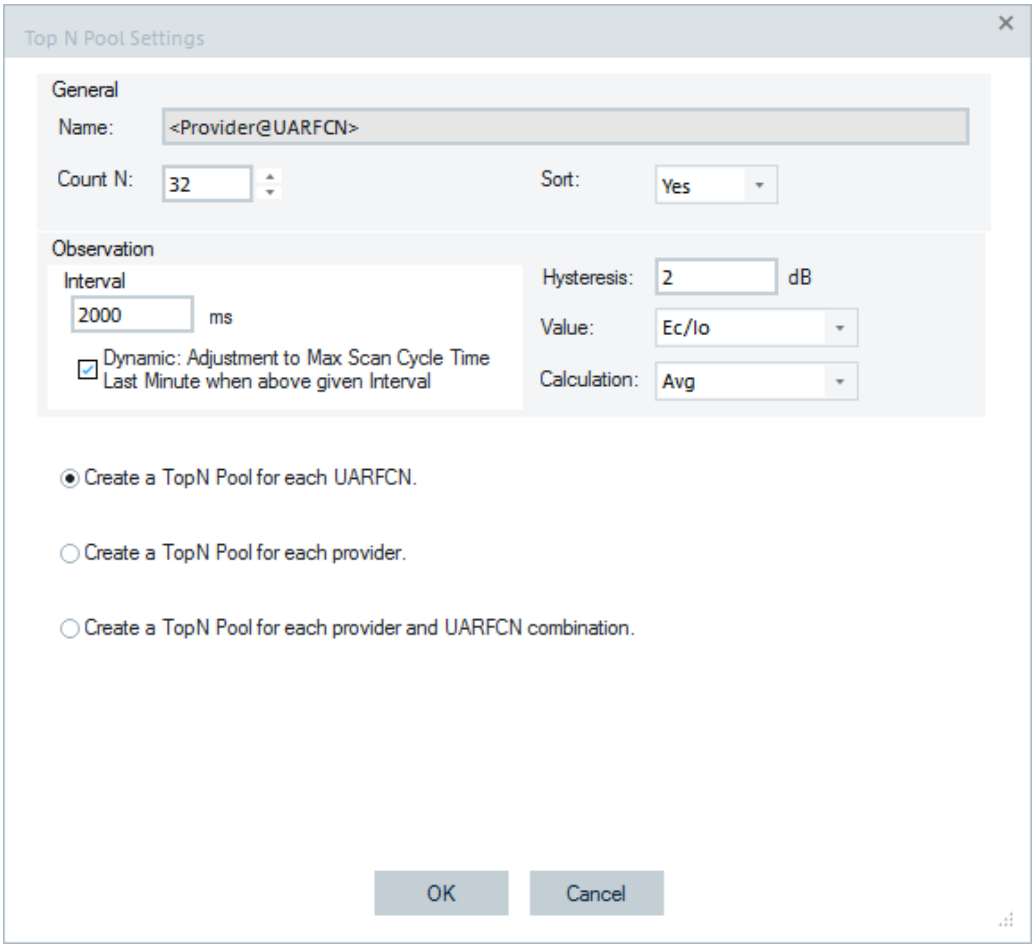


Figure 3-209: Automatic UMTS Top N pool filtering

The properties in "General" are basically the same as the properties of a manually configured Top N pool, see "Manual pool configuration" on page 328. The only difference is that the pool name cannot be set, it is set automatically.

The main difference in this case is that you have to select the criterion for the automatic Top N pool configuration among the following:

- Channel-based selection
  If selected, evaluates Top N pool for each frequency (UARFCN) which is scanned.
- Provider-based selection
  If selected, evaluates Top N pool for each provider in the provider list. If provider has several channels, the Top N pool is evaluated for all those channels.
  Note: Transmitters are only added to the Top N pools evaluation from the point in time when their PLMN code has been decoded.
- Provider and UARFCN combination-based selection.
  If selected, evaluates Top N pool for all combinations of provider and channels. The option helps to separate providers from each other if they share the channels, for example, at a country borders. The previous note applies to this selection as well.

Note: Automatic pool configuration removes the manually configured pools. To keep them, you can save the configuration as a template.

Manual pool configuration
The option shows a list of the UMTS Top N pools configured in the current workspace. It lets you add more pools or modify the parameters values of the configured ones.

If this type of Top N pool configuration for filtering and ranking is selected, the following buttons are displayed:

- "Add"
- "Remove"
- "Properties"

Add ← Manual pool configuration
Amends additional pools to the default settings to the Top N pools list. To customize the Top N pool, modify it directly in the "Add" dialog or open the Top N pool later on via the "Properties" button.

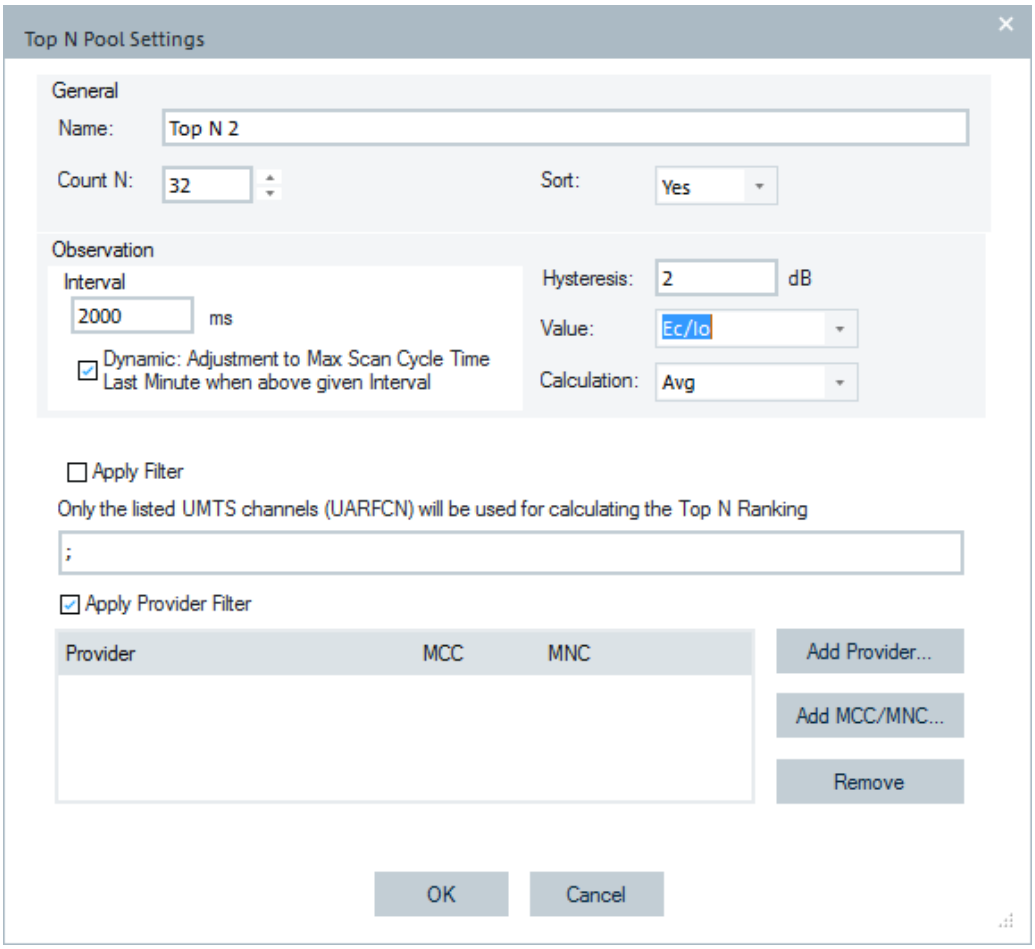


Figure 3-210: UMTS PNS Top N pool - Add/Properties

The page contains the following panes:

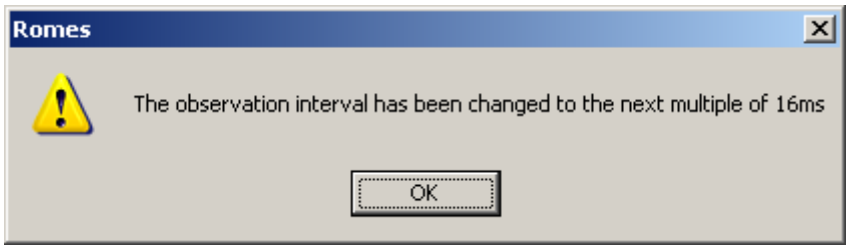
- "General"
- "Observation"
  Defines the update interval and the criteria for Top N pools evaluation and ranking
- "Apply Filter/Apply Provider Filter"
- Defines the criteria for the Top N pools filtering

The "General" pane contains the following entries:

- "Name"
  Name of the UMTS Top N pool. The name identifies the pool in the views and in the signal tree. Therefore select the meaningful names.
- "Count N"
  Number of Top N members in a Top N pool. The number is limited to 64 to avoid a crash which can occur when entering too high max count of top N members. The actual number of elements can fall below N and vary if the system is not able to detect and analyze enough signals.
- "Sort"
  In an unsorted pool ("Sort: No"), the members remain at fixed positions unless they are replaced by a new member having a stronger selected signal ("Value") which is observed. Unsorted pools are suitable for monitoring a NodeB or a fixed set of NodeB for an extended period. They are particularly easy to monitor in graphical diagrams where fixed positions always correspond to the same NodeB.
  In a sorted pool ("Sort: Yes"), the members are sorted according to a stronger signal which is observed. The positions are redistributed after each update, according to the observed signals strengths. Sorted pools are suitable for monitoring or comparing signals with definite strength, e.g. the strongest and second-strongest signal along a measurement tour, irrespective of the transmitting NodeBs.

The "Observation" pane contains the following entries:

- "Interval"
  Lets you calculate the evaluation period as minimum/maximum/average/last or the measurement value (Ec/Io, RSCP of CPICH or Cue) for all signals. The selected calculation value is recalculated and the pool is updated every time the system receives a new UMTS PN scan data. The Ec/Io, RSCP or Cue values received within the evaluation interval before the current time is entered into the calculation. Large evaluation intervals tend to stabilize the pool by delaying the exchange of pool elements.
  The observation interval is limited, see Interval.
  The observation interval obeys the following rules:
  – The interval is always a multiple of 0.016 s regardless of the measured rate if only one frequency exists in the Top N pool.
    If the current value differs, the following warning appears.

    The correction is performed automatically.
  – If there are multiple frequencies in the Top N pool, the minimum interval depends on the number of frequencies in the measurement and the sampling rate according to the formula:
    2 * (number of frequencies in the measurement) / sampling rate + 0.5 s.
    e.g.: 2 * (4 Freq.) / 0.1 + 0.5 = 80.5 s
    Sampling rate = number of measurements per second

- "Dynamic: Adjustment to Max Scan Cycle Time Last Minute when above given Interval"
  The Top N calculation adjusts dynamically the Top N calculation interval to the max. scan cycle time last minute if the previously given interval is shorter.
  The option is on by default. The interval is automatically increased to the max. scan cycle time of the last minute, if it is larger than the interval given in milliseconds. If the interval is shorter, then the members of the Top N are a randomly changing set which is not useful.
  Before applying any Top N calculation, the first scan-full cycle has to be completed.
  Note: A valid Top N needs at least one measurement of each frequency.
- "Hysteresis"
  Minimum level difference between the signal value of a pool candidate and the lowest signal value in the pool. A pool candidate becomes a pool element and replaces a previous element if
  Ec/Io or RSCP (candidate) ≥ Ec/Io or RSCP (previous) + Hysteresis
  A large hysteresis stabilizes the pool, preventing elements from being replaced because of small fluctuations in the measurement results.
- "Value"
  Indicates selected signal for ranking the Top N pools. For that purpose the Ec/Io, RSCP or UE emulation criterion (Cue) signal can be observed. The first two signals make ranking according to quality and power, respectively. If you wish to rank the detected cells based on the UE emulation criterion, choose the third option.
  Often, only one network is under the investigation, so probably you would like to set a provider filter to the Top N configuration. The configuration of the Top N pool has to be done before a measurement file is going to be opened, respectively a measurement is started.
- "Calculation"
  Determines if the "Min/MaxAverage//Last" value of the previously selected parameter is used for ranking within one observation period.
  Ec/Io (CPICH) is the ratio of the received energy per PN chip for the P-CPICH to the total transmit power spectral density, see Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

The filtering part of this page contains the following entries:

- "Apply Filter"
  Used for Top N pool filtering based on configured UMTS channels.
  If checked, only the listed UMTS channels (UARFCN) are considered when ranking the Top N pool.
- "Channel List"
  In the channel list the absolute UMTS channel numbers are placed in increasing order. For performance reason (mostly memory usage), it is desirable to configure only a small number of frequencies (channels) for the channel-specific signals.
  Single UMTS channels are defined by using the separator “;”. The range of UMTS channels is defined by using the “-“ separator.
- "Apply Provider Filter"
  Used for Top N pool filtering based on configured provider.
  If selected, filters for Top N pool ranking only the selected providers.
- "Provider/MCC/MNC"
  Use "Add Provider" to selected and add a provider to the list from the "Network Provider Database" page. Instead, you can use "Add MCC/MNC" to enter directly a combination of MCC and MNC.

"Top N Signals" and "Top N Pools" are dynamic concepts. The signal level from a specific NodeB varies in time and according to the measurement position. The elements of a Top N pool are exchanged accordingly and even their number can change if the system detects less than N signals.

Remove ← Manual pool configuration
Deletes the selected entry from the "Top N Pools" list; see "Remove" on page 311.

Properties ← Manual pool configuration
Shows the properties of an entry from the list and lets you modify the configured parameters values; see "Properties" on page 312.

Scan cycles signals of UMTS scan

The following figure shows the implemented scan cycle signals in UMTS scan.

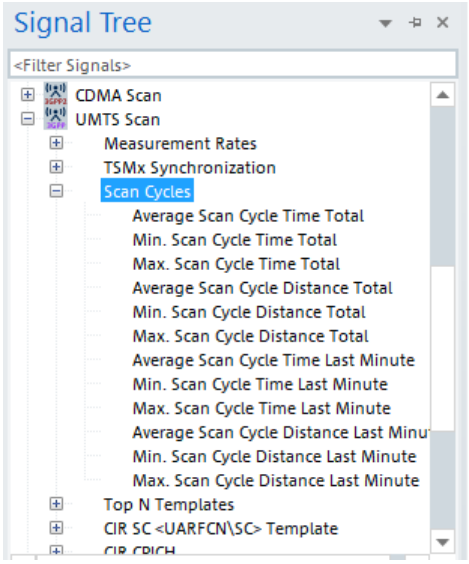


Figure 3-211: UMTS scan cycle signals

For details, see "Scan cycles signals of GSM NWS events" on page 312.

UMTS PNS signal settings

Click "Signal Settings" to get the page letting you to do the following:

- Selection of a data format of the scrambling code and configure channel frequencies.
- Configuration of the CIR signals for each scrambling code and predefined number of frequencies.
- Selection of UARFCN channels for assignment to the scan list.

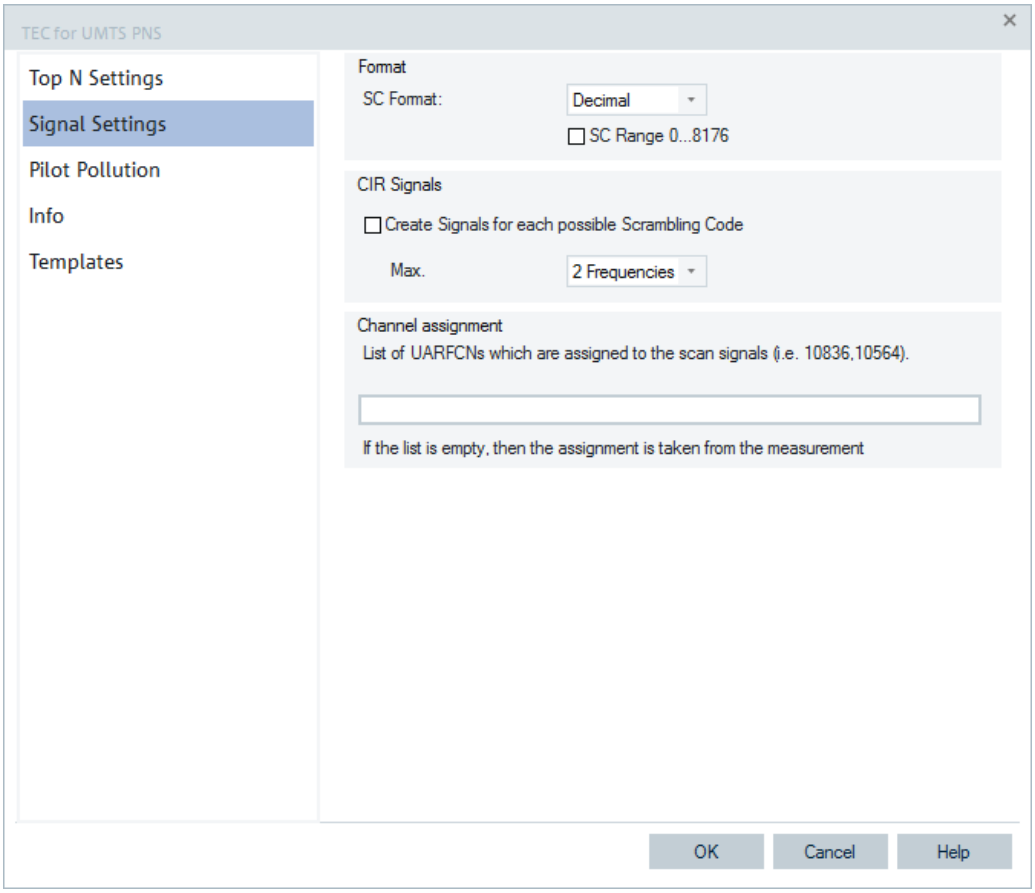


Figure 3-212: TEC for UMTS PNS - UMTS technology window

The number of signals configured for scanner receiver and the enabled options stay unchanged. Therefore, the signal settings function does not affect the measurement.

Format

- "SC Format"
  "SC Format" opens a drop-down list to select whether the Primary Scrambling Code in the signals and in the views (for example, in the chapter Chapter 4.8.11.4, "UMTS scanner P-SCH view", on page 1391) is displayed in decimal, octal, hex small or hex large format.
- "SC Range"
  According to standard 3GPP TS 35.213, the primary scrambling codes are numbered as n = 16*i (i = 0 to 512). The 15*512 numbers n = 16*i + k (i = 0 to 512, k = 1 to 15) are reserved for the optional secondary scrambling codes. This convention is used if "SC Range 0 … 8176" is checked.
  In the alternative convention, the Primary Scrambling Codes numbers are divided by 16 and cover the range 0 to 511.

CIR signals
The default setting for "Generated Signals for each possible Scrambling Code" is unchecked. The unchecked option reduces the number of scanner measured signals, which otherwise can be huge due to combination of configured number of SCs and channels. The inactive option offers easy access to the measurement data of a specific scanned channel.

If "Create Signals for each possible Scrambling Code" is checked, the R&S ROMES4 creates CIR signals for each of the 512 Primary Scrambling Codes allowed for the downlink UMTS signal and for the number of frequencies selected in the "Max" drop-down list. The number of created signals is 512*n, where n denotes the selected number of frequencies.

The CIR signals are filled with data when a measurement or replay session is started.

The CIR signals can be configured in "Preferences" > "Available Signals", see Chapter 3.8.1.2, "Available signals configuration", on page 228 and analyzed in many generic views, for example, in the "2D Chart View".

Signal	Unit	Format	Exp. Min.	Exp. Ma
TopN [1]				
TopN [2]				
TopN [3]				
TopN [4]				
CIR SC <UARFCN\SC> Template				
Ec/Io	dB	---	-35.0	0.0
SIR	dB	---	0.0	20.0
RSCP	dBm	---	-130.0	-30.0
ISCP	dBm	---	-130.0	-30.0
P	dBm	---	-130.0	-30.0
UL Interference	dBm	---	-130	-80
Cue-Qual		---	-10.0	20.0
Cue-Lev		---	-20.0	70.0
CIR CPICH				

Figure 3-213: Configured CIR signals

In the replay session, however, a few displayed signals have several advantages:
- Signal tree is easier to handle as unwanted signals are omitted.
- Performance is improved as less system resources are needed.

It is possible to avoid the previously described setting for CIR signals as a combination of each CS and selected number of frequencies. As the number of combinations in that case can be huge, the number of measured signals becomes also huge. The obtained huge number of signals makes it difficult to find and select the required measurement data.

The "CIR SC<UARFCN\SCI > Template" branch of "Available Signals" enables easy access to the measurement data of interest. For details, see UMTS Scanner Templates.

Omitting the CIR signals does not affect the functionality of the Chapter 4.8.11, "UMTS scanner views", on page 1370.

Channel assignment
For performance reason (mostly memory usage), it is desirable to configure only a few frequencies (channels) for the channel-specific signals.

The channel assignment option offers to configure a list of channels (UARFCN) to be used as CIR signals. The feature applies to multiple scanners of the UMTS technology. With this option, it is possible to export the signals of the n-th measured channel with only one set of channel signals. Simply, enter the UARFCN in the channel list of the TEC configuration. The signal names show the assigned channel numbers in the alphanumeric view, see Figure 4-45.

Pilot pollution

"Pilot Pollution" lets you define the thresholds for the calculation of the Hard Pilot Pollution (HPP) and Soft Pilot Pollution (SPP). HPP and SPP are weighted sums of the Received Signal Code Power (RSCP) of all measured CPICHs relative to a reference CPICH signal. Thus, it is a measure of the potential interference/pollution of the reference CPICH.

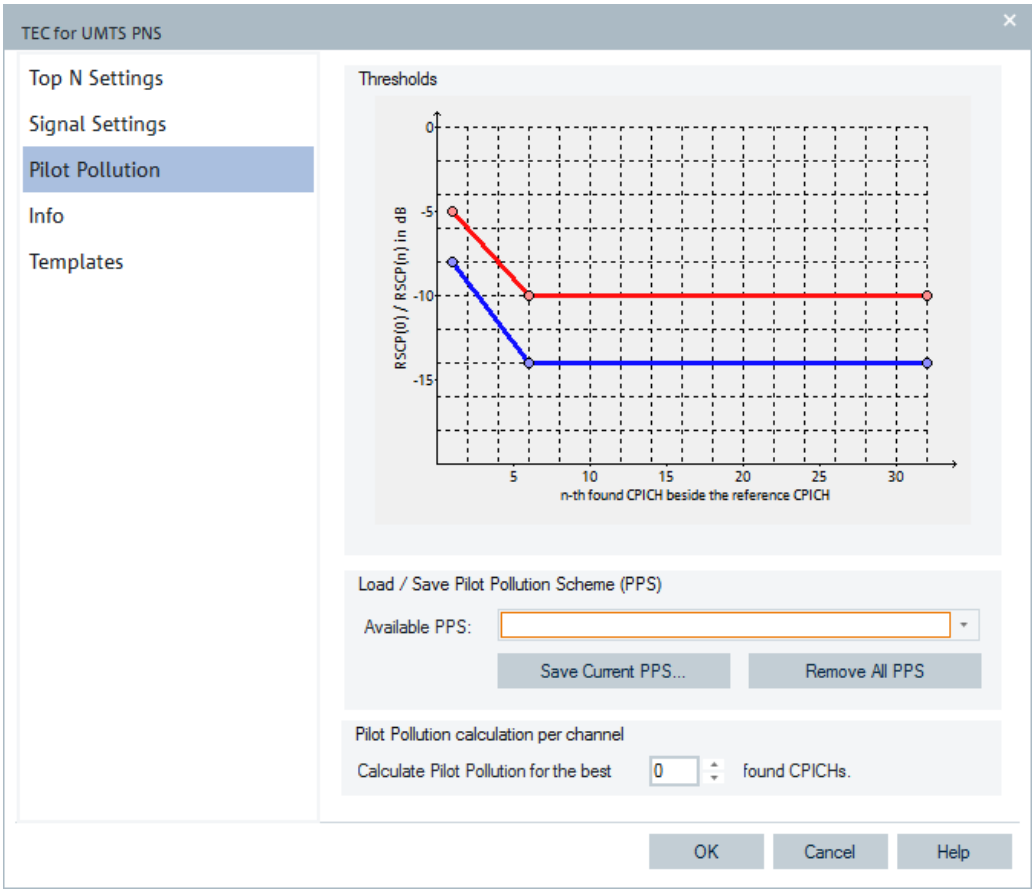


Figure 3-214: TEC for UMTS PNS - Pilot Pollution window

The HPP and SPP are indicated in the "UMTS Scanner Top N View", see Chapter 3.3.17.8, "UMTS scanner views", on page 187. The same thresholds apply to all reference pilot signals selected in the "Top N Property" dialog.

Pilot pollution signals also appear in the signal tree. Therefore, they can be analyzed in general R&S ROMES4 views, for example, in the "Alphanumeric View" or "ROMES-MAP Route Track View".

Thresholds
They are graphical representation of the upper T_{high} and the lower T_{low} threshold for the calculation of the pilot pollution. To calculate the pilot pollution for a given reference signal CPICH(0), all other detected CPICHs are sorted according to their signal strength and comparison with T_{high} and T_{low}.

HPP(0) is equal to the total number of received channels CPICH(n) (n=1,2,3, and so on) exceeding the upper threshold $T_{high}(n)$.

SPP(0) is equal to HPP(0) plus the sum of all received channels CPICH(n) between the lower threshold T_{low} (n) and the upper threshold $T_{high}(n)$, each weighted by the ratio.

$(RSCP(n) – T_{low}(n)) / (T_{high}(n) – T_{low}(n))$.

Signals below T_{low} (n) do not contribute to HPP and SPP. This definition shows that HPP(0) ≤SPP(0), irrespective of the reference CPICH and that both quantities, are minimized for the strongest CPICH in the Top N pool (if CPICH(j) > CPICH(k) , then HPP(j) ≤ HPP(k) and SPP(j) ≤ SPP(k)).

Pilot pollution threshold settings
The thresholds $T_{high}(n)$ and T_{low} (n) are both defined by two polygonal curves in the range 1 ≤ n ≤ 32. The cursor shows an Ⓐ symbol when pausing over one of the circles separating the straight sectors of the curves. It can then be used to drag the circle in vertical direction. Double-clicking a point on a curve inserts a new point or removes the current point. $T_{high}(n)$ and T_{low} (n) can be modified with the following restrictions:

$T_{high}(n)$ must be larger than T_{low} (n) for all n.

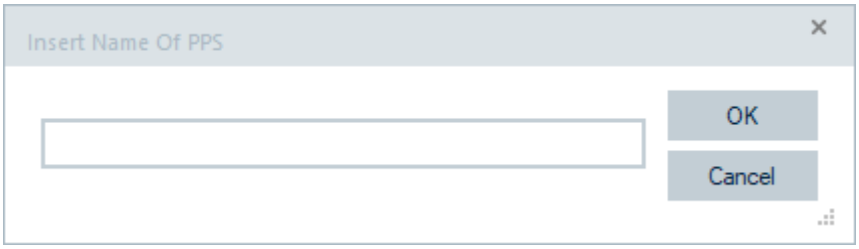
Both functions must be monotonically descending, i.e. for n > m applies:

$T_{high}(n) ≤ T_{high}(m)$ and

$T_{low}(n) ≤ T_{low}(m)$

Load / Save pilot pollution scheme (PPS)
Once defined in the "Thresholds" diagram, a pilot pollution scheme can be named and stored for later reuse.

- "Available PPS"
  List of all defined pilot pollution schemes. A selected PPS appears in the "Thresholds" diagram. "OK" applies the selected PPS.
- "Save Current PPS"
  Opens an input box for the name of the current PPS. The saved PPS is added to the list of available PPS.



- "Remove All PPS"
  Clears the list of available PPS.

Pilot pollution calculation per channel
The "Pilot Pollution calculation per channel" lets you select the number of reference CPICHs for which a pilot pollution analysis is performed. The pilot pollution is always calculated for the k signals with the strongest P-CPICH level in the Top N pool, where 0 ≤ k ≤ N. A selected number k > N is replaced by N upon pressing "OK".

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.10 TEC for CW devices

Selecting the "TEC for CW Devices" > "CW Technology" menu opens the page containing the "CW Technology" tab.

The "Number of Signals" pane lets you set the number of CW test receiver signals for display in the data trees (for example, in the "Values" page of the 2D chart configuration menu). It is possible to configure maximum 512 CW signals in the tree. The configured number of the CW signals brings the setting into effect after R&S ROMES4 restart.

This number leaves the receiver configuration and the enabled options unchanged and does not affect the measurement.

However, a smaller number of displayed signals has the following advantages in replay mode:

- Data tree is easier to handle as unwanted signals are omitted.
- Performance is improved as less system resources are needed.

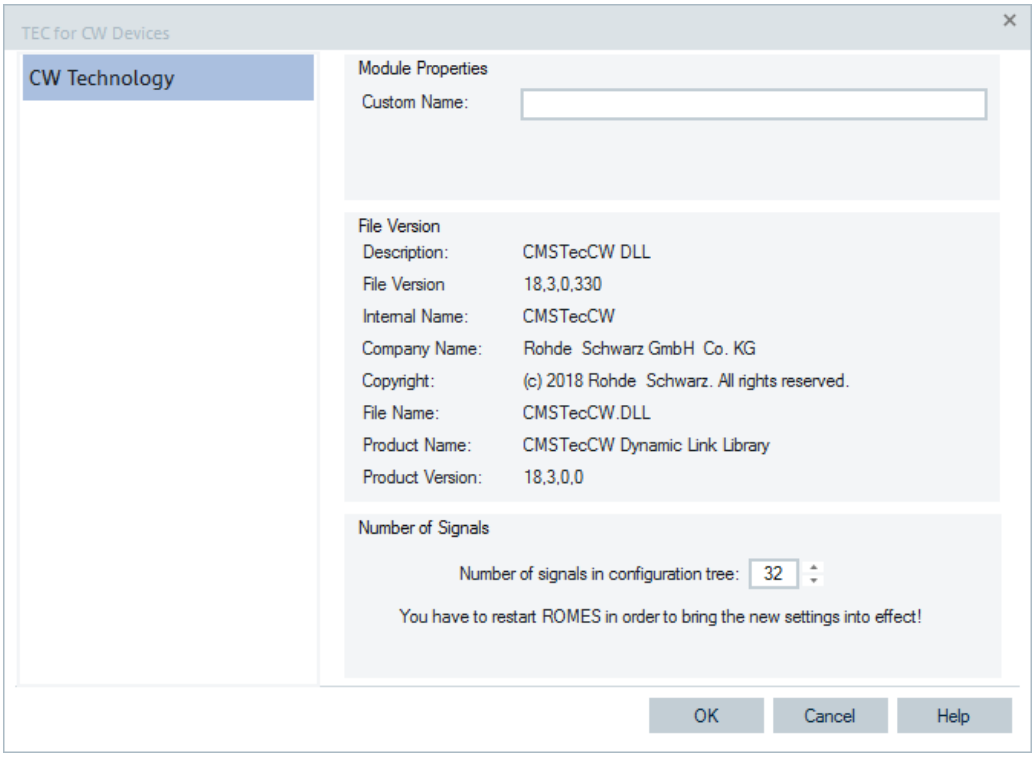


Figure 3-215: Configuration of Software Modules – TEC for CW Devices

3.8.2.11 TEC for WiMAX scanner

Click the "Technologies" > "TEC for WiMAX Scanner" entry for the WiMAX scanner configuration pages.

The following tabs are available:

- "Top N Settings", the opening page
- "Info"
- "Templates"

The last two tabs are technology independent.

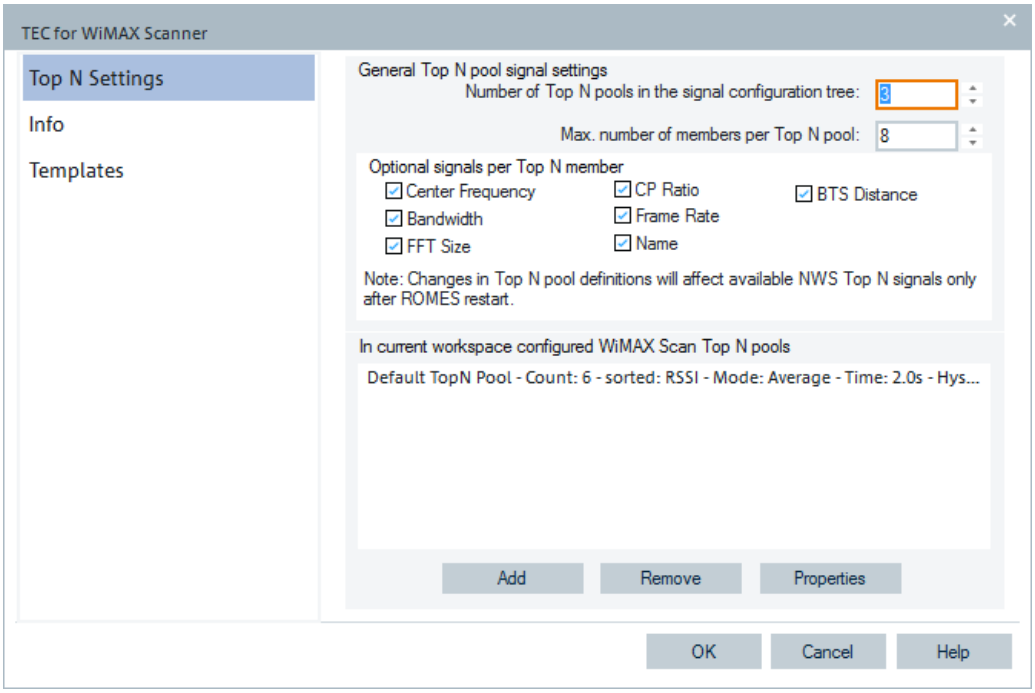


Figure 3-216: TEC for WiMAX Scanner – WiMAX TopN Settings

WiMAX Top N settings

"TEC for WIMAX Scanner" lets you configure WiMAX scanner Top N pools.

The "Top N Settings" page is divided into two panes.

- "General Top N pool signal settings" lets you set preferences for the general Top N pool signals.
- "In current workspace configured WiMAX Scan Top N pools" lets you administrate the Top N pools of the current workspace.

General Top N pool signal settings

The changes in Top N pool definitions made in this panel will affect available Top N signals only after the R&S ROMES4 is restarted.

- "Number of Top N pools in the signal configuration tree"
  Defines the maximum number of Top N pools in the list of available signals, see Chapter 3.8.1.2, "Available signals configuration", on page 228.
- "Max. Number of members per Top N pool"
  Defines the maximum members per pool in the list of available signals.
- "Optional signals per Top N member"
  Note: Optional signal settings are R&S ROMES4 specific settings
  The selected optional signals are stored with the current R&S ROMES4 installation and not at the current workspace.
  Therefore, if the current workspace opens with another R&S ROMES4 on another computer, the optional selected signals are not selected anymore and have to be selected for another R&S ROMES4 installation again.
  – "Center Frequency"
    Center frequency of the used channel according to standard IEEE 802.16

– "Bandwidth"
  For WiMAX, different bandwidths are possible according to standard IEEE 802.16
– "FFT Size"
  Fast Fourier Transformation Ratio
– "CP Ratio"
  Cyclic Prefix Ratio
– "Frame"
  Frame Rate
– "Name (of BTS)"
  WiMAX base station name
– "Distance (to BTS in km)"
  Distance to BTS

In current workspace configured WiMAX Scan Top N pools
This panel shows a list of the Top N pools configured in the current workspace.

The Top N pool list can be amended using the "Add" button.

An entry in the list can be deleted using the "Remove" button.

The properties on an entry can be viewed or modified using the "Properties" button.

Add ← In current workspace configured WiMAX Scan Top N pools
Adds the Top N pools you defined in the list of "Available Signals", see Chapter 3.8.1.2, "Available signals configuration", on page 228.

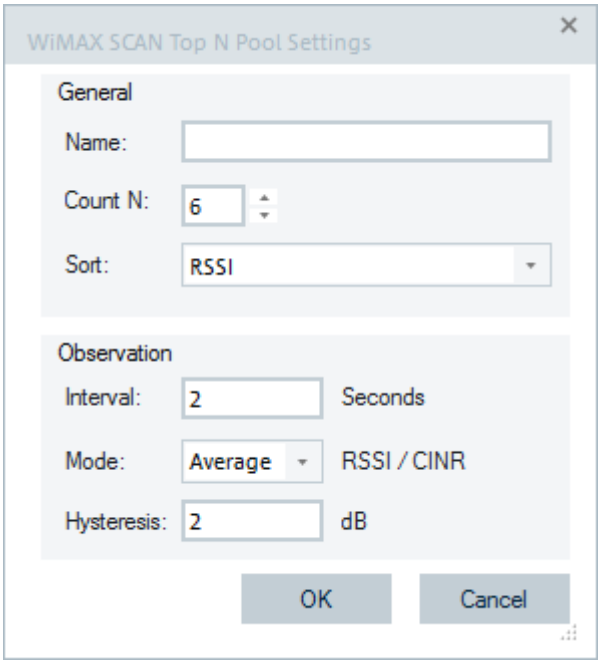


Figure 3-217: Add - opening page

The "Add" page contains the following panes:

"General"
- "Name"

Name of the WiMAX Scan Top N pool.

- "Count N"
  Number of pool elements (range 1 to 16). The amount of the pool elements in the list of available signals is limited to the "Max. Number of members per Top N pool".
- "Sort"
  The Top N View list can be sorted by RSSI and CINR or not sorted.

"Observation"

- "Interval"
  Interval in which the selected value (RSSI or CINR) is observed, given in seconds (range 0 to 300).
  The observation interval is limited, see Interval.
- "Mode"
  The measured RSSI and CINR power value defines the sort order for the Top N View. The sort mode can be set to average/max/min/last power values.
- "Hysteresis"
  Measurement interval in seconds (range 0 to 300).

Remove ← In current workspace configured WiMAX Scan Top N pools
Removes the selected WiMAX Scan Top N pool from the "Top N Pools" list, see "Remove" on page 311.

Properties ← In current workspace configured WiMAX Scan Top N pools
Allows the modification of the properties for the selected Top N pool.

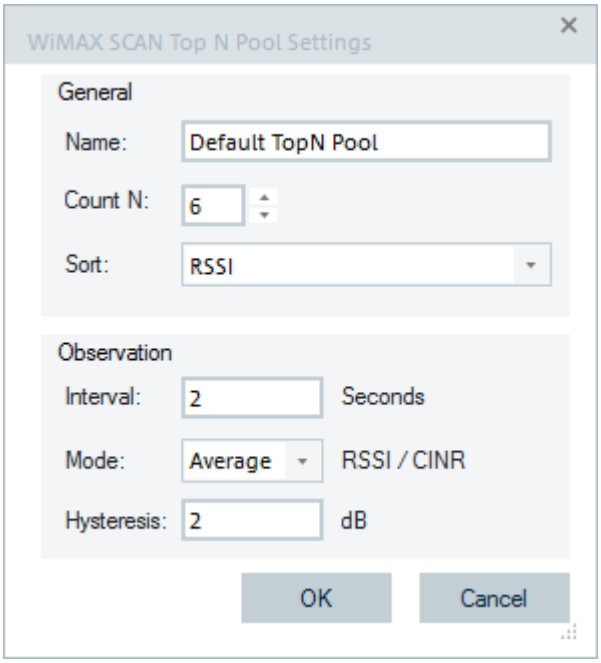


Figure 3-218: Properties - opening page

The "Properties" dialog contains the same panes as the "Add" dialog.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.12 TEC for LTE scanner

Select the "Technologies" > "TEC for LTE Scanner" menu to open the configuration pages. The following tabs are available:

- "Top N Settings", opening page
- "Scanner Signals"
- "Pilot Pollution"
- "Info"
- "Templates"

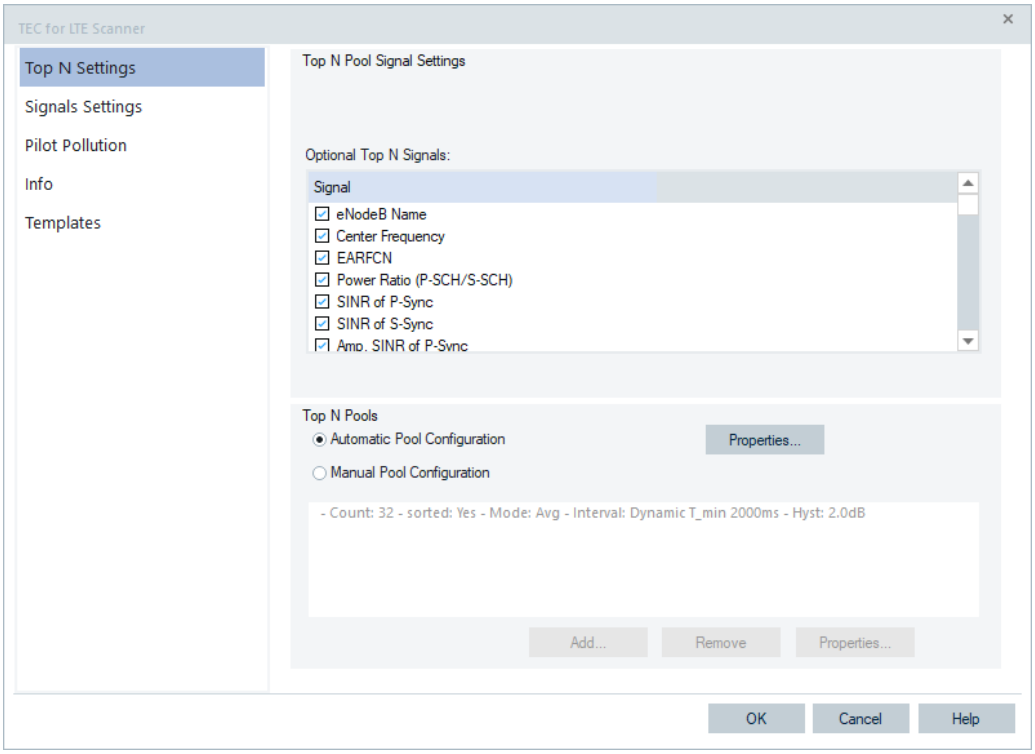


Figure 3-219: Scanner Top N Settings page

The "Info" and "Templates" tabs are technology independent.

Top N settings

The LTE Top N pool settings are done in the "TEC for LTE Scanner" page. The Top N pool configuration is stored in the registry. The last workspace settings are the default for the Top N pool configuration of new workspaces.

The "Scanner Top N Settings" page is divided into two panes:

- "Top N Pool Signal Settings" lets you activate some optional signals.
- "Top N Pools" lets you administrate the Top N pools of the current workspace and filter them for ranking.

Top N pool signal settings

The pane contains the list of optional signals in "Optional Top N Signals". If you want an optional signal to be displayed in the "Signal Tree" and "LTE Scanner Top N View", select it in the list.

If selected, the optional signal gets a column in the "List" pane of the "LTE Scanner Top N View". Otherwise, only the default signals are displayed in the view.

The selected optional signals are stored with the current R&S ROMES4 installation and not at the current workspace. If you open the current workspace with another R&S ROMES4 on another computer, the selected optional signals are not selected. Select the optional signals for that R&S ROMES4 installation again.

Optional Top N signals

- "eNodeB Name"
  Given name of an LTE BTS
- "Carrier Frequency"
  Selected carrier frequency
- "EARFCN"
  E-UTRA Absolute Radio Frequency Channel Number
  The signal stands for the primary EARFCN value of the given Top N pool (Primary Band). It has to be differentiated from the Top N EARFCN (MFBI) signal which is by default visible in the "LTE Scanner Top N View" and "Signal Tree".
  Top N Signal EARFCN(MFBI) shows the frequency current value of the cell as received in SIB 1 “multiBandInfoList” or “multiBandInfoList_v9e0” fields.
- "Power Ratio (P-Sync/S-Sync)"
  Average/maximum/minimum/last power, depending on the Top N pool settings measured on Primary Synchronization Signal/Secondary Synchronization Signal.
- "SINR of P-Sync"
  Signal-to-Interference-plus-Noise Ratio of Primary Synchronization Signal
- "SINR of S-Sync"
  Signal-to-Interference-plus-Noise Ratio of Secondary Synchronization Signal
- "Amp. SINR of P-Sync"
  Amplitude-based Signal-to-Interference-plus-Noise Ratio of Primary Synchronization Signal
- "Amp.SINR of S-Sync"
  Amplitude-based Signal-to-Interference-plus-Noise Ratio of Secondary Synchronization Signal
- "Frame Struct. Type"
  FDD (Frame Structure Type 1) or TDD (Frame Structure Type 2)
- "RS SINR"
  SINR of Reference Signal
- "CIR out of CP"
  Percentage of CIR values outside of the cyclic prefix
- "ECI(28) and ECI(20/8)"
  EUTRAN Cell Identifier columns, showing the 28 bits long string, are added to the "Top N List". The information is the same as the one in the ECGI column, but the formatting of these parameters in the list is different.
- "MCC"
  Mobile Country Code
- "MNC"
  Mobile Network Code
- "TAC"
  Tracking Area Code
- "Cyclic Prefix"
  Type of Cyclic Prefix used - normal or extended.
- "Cyclic Prefix Length"
  Length (in µs) of the Cyclic Prefix.

- "Physical-Layer Cell Identity Group"
  Cell Identity Group of the Physical Cell ID, range 0 to 167
- "Physical-Layer Cell Identity"
  Cell Identity referring to the physical layer, range 0 to 2
- "HPP"
  Hard Pilot Pollution of the eNodeB signal as defined via the "Pilot Pollution" configuration page, see "Pilot pollution" on page 353.
- "SPP"
  Soft Pilot Pollution of the eNodeB signal as defined via the "Pilot Pollution" configuration page, see Chapter 3.8.2.12, "TEC for LTE scanner", on page 341.
- "Internal CellID"
  Unique cell identity.
- "eNodeB Distance"
  Distance to eNodeB
- "4G Drift"
  Time drift against the receiver time in ns.
- "Cue-Qual"
  Cell reselection criterion value based on UE emulation by quality information in system information blocks.
- "Cue-Lev"
  Cell reselection criterion value based on UE emulation by level information in system information blocks.
- "NR"
  The Neighbor Relation is the percentage of cells in the current Top N pool, which are the members of the specific intra-frequency neighbor cell list. NR is available only if SIB4 is demodulated.
- "Frame Time of Arrival Offset To PPS"
  Time difference between PPS and the start of a LTE frame received by the scanner expressed in ms.
- "Subband RSRP / RSRQ"
  RSRP and RSRQ values measured within the subbands. Activating these optional signals creates the set of WB subband RSRP/RSRQ min/max signals with and without noise capping (NC) in the available signals tree, as highlighted in the following figure. The signals are included in the basic views.
  For the signals description, refer to "R&S ROMES4 Description of Signals" document.

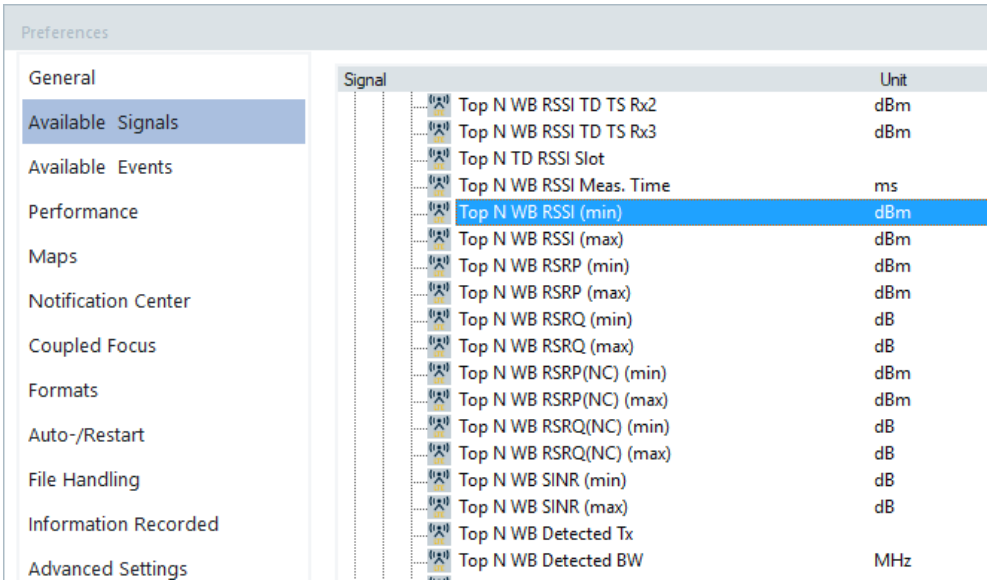


Figure 3-220: WB subband RSRP/RSRQ available signals

R&S ROMES4 Alphanumeric view shows the WB subband RSRP/RSRQ min/max signals.

- "CIR Delay Spread"
  CIR delay spread is the time between the first and the last peak in the "CIR sync." measurement.
  The value is displayed in the available signals tree, the same branch as previously mentioned. The signal is also shown in the basic views. Note that the signal is present in the last column of the "LTE Scanner Top N View" or in the next-to-last column if the "Create Signal for each NPCI" is activated, see "LTE signals settings" on page 352.
- "Add. PLMNs"
  Additional PLMNs shared with this eNodeB.
  R&S ROMES4 supports the 3GPP specified "RAN Sharing" feature. The feature requests that a physical base station serves several network operators, i.e. PLMNs.
  "Add. PLMNs" active fulfills the goal to visualize the eNodeBs for all PLMNs in the list. The list of the PLMNs is a part of the SIB1. The first entry in the list is the primary PLMN for R&S ROMES4. Every entry of the list is taken as a valid PLMN, while the "cellReserverdForOperatorUse" flag is considered.

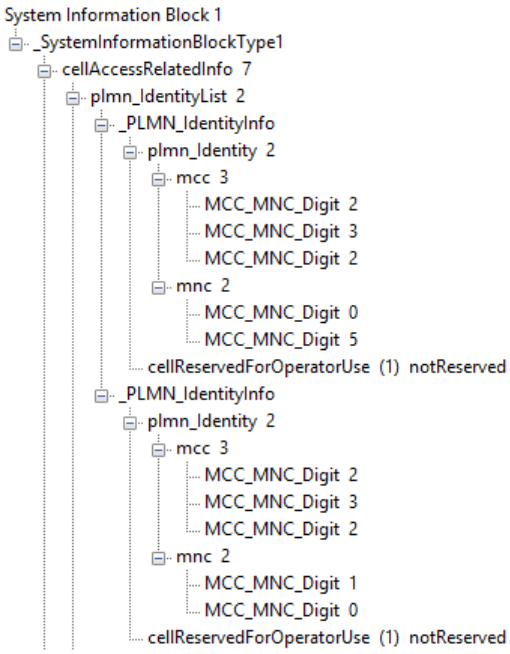


Figure 3-221: RAN sharing info in SIB1

Note: The shown MCC and MNC signals of the eNodeB in the "TopN List" are always related to the primary PLMN. However, for Top N pools, filtering of the eNodeB signals considers all PLMNs that are in the list and the mentioned signals are shown in the "Add. PLMNs" column.
If the Top N pool is created automatically for the PLMNs, a pool for each PLMN in the list is also created automatically.

- "Frame Number of Arrival Offset To PPS"
  Virtual Frame Number between PPS and the start of a LTE frame received by the scanner.
  It is internal virtual frame number for the RF frame, in which the CIR has been measured.
- "Provider"
  Name of the network provider.
- "MIB DL Bandwidth"
  LTE downlink bandwidth decoded from MIB, expressed in MHz.
- "MIMO2x2 / MIMO4x4 / MIMO4x4"
  MIMO characteristics of an eNodeB, contains average Rank and Condition Number, expressed in dB.
- "SIB2 eMBMS / DSS"
  SIB2 broadcasts eMBMS subframe pattern (MBSFN) to be configured by UEs. For details, see "Description of R&S ROMES4 Signals".
- "eNodeB Tx Ports"
  Number of eNodeB Tx antenna ports decoded from MIB.
- "LTE-M"
  Indicates that the cell supports LTE-M.
- "5G NR"

Indicates that the cell supports interworking with 5G RAT.

- "Sch SIBs"
  Indicates scheduled SIBs.

To activate a changed signal configuration, R&S ROMES4 must be closed and restarted.

Top N pools

The pane lets you choose between the automatic and manual filtering of channels and/or providers for obtaining the Top N pools. The buttons displayed in this pane depend on selected filtering type. The "Properties" button is displayed in both cases as needed for configuration of the basic Top N pool parameters.

It administrates the Top N pools of the current workspace.

This pane shows a list box with the Top N pools configured in the current workspace. The selected list entry properties can be viewed or modified using the "Properties" button. The selected list entry can be deleted from the list of configured Top N pools using the "Remove" button.

Automatic Pool Configuration
This option creates the Top N pools automatically for the user. Depending on what is measured, respective what was measured when replaying or exporting a file, the pools are created automatically.

Click "Properties" to configure the template for the auto Top N pools.

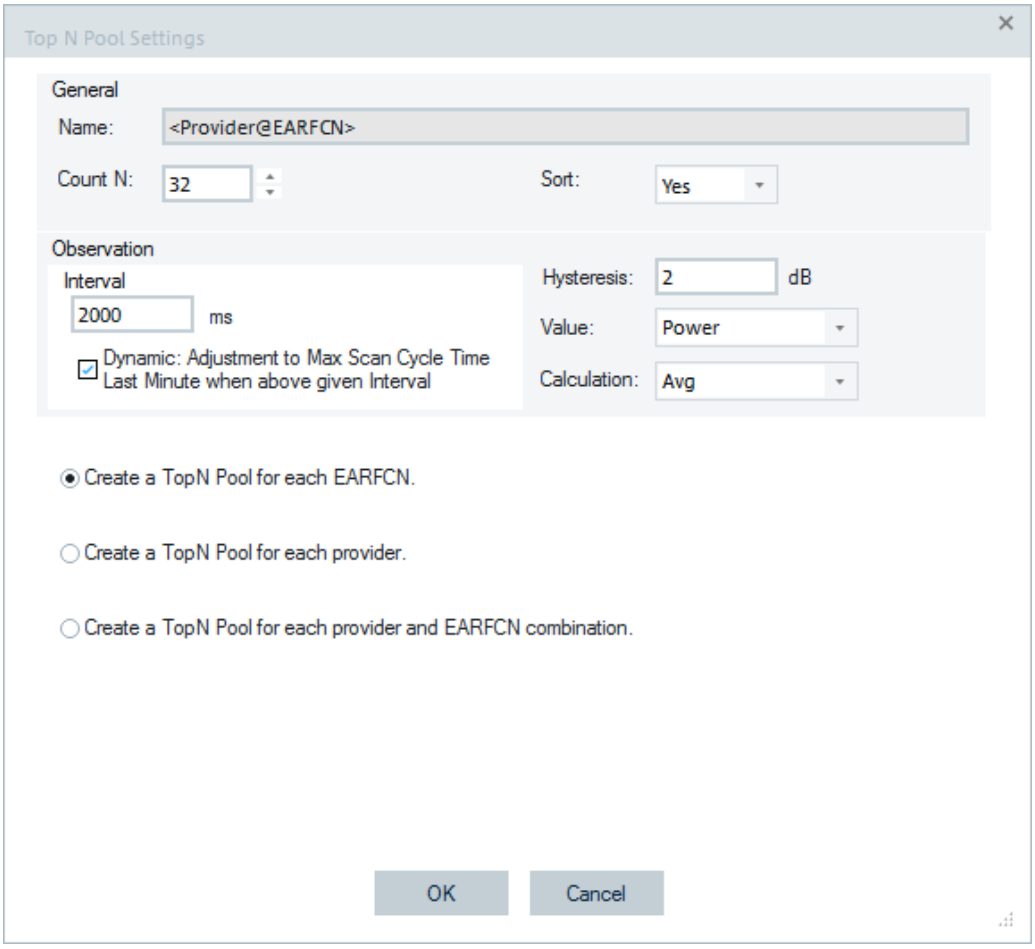


Figure 3-222: Automatic LTE Top N pool configuration

The properties in the "General" pane are basically the same as those properties of the manually configured Top N pools, see "Manual pool configuration" on page 328. The only difference is that the pool's name cannot be set. It is set automatically.

Select the criterion for the automatic Top N pool configuration among the following criteria:

- Channel-based selection
  If selected, evaluates Top N pool for each frequency (EARFCN) which is scanned.
- Provider-based selection
  If selected, evaluates Top N pool for each provider in the provider list. If provider has several channels, the Top N pool is evaluated for all those channels.
  Note: Transmitters are only added to the Top N pools evaluation from the point in time when the PLMN code has been decoded.
- Provider and EARFCN combination-based selection.
  If selected, evaluates Top N pool for all combinations of provider and channels. This option helps to separate provider from each other if they share the channels, e.g. at a country borders. The previous note applies to this selection.

Note: Automatic pool configuration removes the manually configured pools. In order to keep them, save the configuration as a template.

Manual Pool Configuration
This option shows a list of the LTE Top N pools configured in the current workspace. You can add more pools or modify the parameters values of the configured ones.

If this type of Top N pool configuration for filtering and ranking is selected, the following buttons are available:

- "Add"
- "Remove"
- "Properties"

Add ← Manual Pool Configuration
Lets you add additional pools with default settings to the list of Top N pools. To customize the Top N pool, modify it directly in the "Add" dialog or open the Top N pool later on via the "Properties" button.

Note: If the maximum number of Top N pools is set to "1", the "Add" button is inactive. You can edit the default manual Top N pool to make any necessary changes. To add an additional Top N pool, change the maximum number of Top N pools to 2. Changing the number of pools enables the "Add" manual pool configuration button.

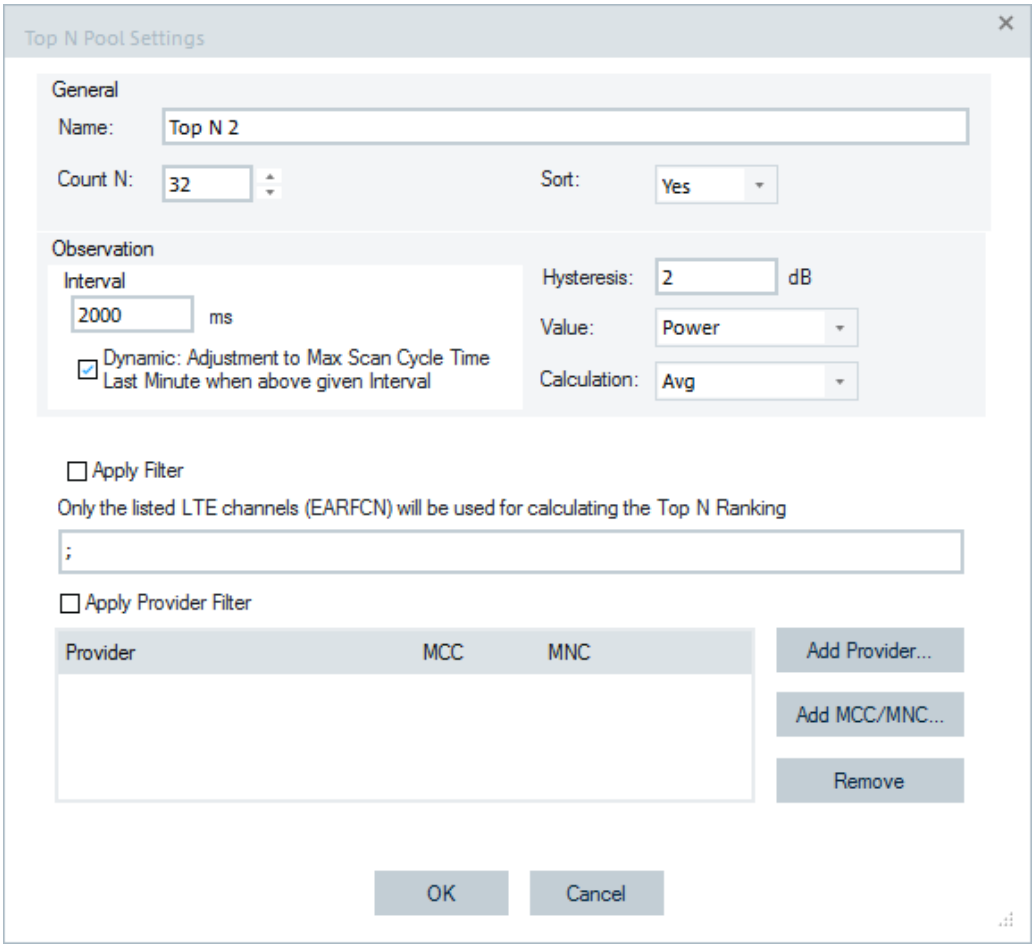


Figure 3-223: LTE Scanner Top N pool - Add/Properties

The page contains the following panes:

- "General"

- "Observation"
- "Apply Filter/ Apply Provider Filter"

"General" pane lets you define the following:

- "Name"
  Name of the LTE Scan Top N pool.
- "Count N"
  Number of Top N pool members, ranging from 1 to 64. The display of pool elements in the list of "Available Signals" is limited to the "Max. number of members per Top N pool".
  The number is limited to avoid a crash which can occur when entering too high max count of top N members. The actual number of elements can fall below N and vary if the system is not able to detect and analyze enough signals.
- "Sort"
  In an unsorted pool ("Sort: No"), the members remain at fixed positions unless they are replaced by a new member having a stronger selected signal ("Value") which is observed. Unsorted pools are suitable for monitoring an eNodeB or a fixed set of eNodeBs for an extended period of time. They are particularly easy to monitor in graphical diagrams where fixed positions always correspond to the same eNodeBs.
  In a sorted pool ("Sort: Yes"), the members are sorted according to a stronger signal which is observed. The positions are redistributed after each update, according to the observed signals strengths. Sorted pools are suitable for monitoring or comparing signals with definite strength, e.g. the strongest and second-strongest signal along a measurement tour, irrespective of the transmitting eNodeBs.

"Observation" lets you specify the update interval and the criteria for Top N pools evaluation and ranking.

- "Interval"
  The moving evaluation interval for the min/max/average/last value of the selected Power, SINR or Cue signal. The value is recalculated and the pool is updated every time the system receives new LTE PN scan data. All values of the selected signals received within the evaluation interval before the current time is entered into the calculation. Large evaluation intervals tend to stabilize the pool by delaying the exchange of pool elements.
  The observation interval is limited, see Interval.
- "Dynamic: Adjustment to Max Scan Cycle Time Last Minute when above given Interval"
  The Top N calculation dynamically adjusts the Top N calculation interval to the max. scan cycle time last minute when the above given interval is shorter.
  The option is switched on by default. The interval is automatically increased to the max. scan cycle time of the last minute, if this max. scan cycle time is larger than the interval given in milliseconds. If the interval is shorter, then the members of the Top N are a randomly changing set which is not useful.
  Before applying any Top N calculation, the first scan full cycle has to be completed.
  NOTE: A valid Top N needs at least one measurement of each frequency.
- "Hysteresis"
  The set hysteresis value (in dB) determines the hysteresis for the ranking of the pool members. To switch it off, enter 0 dB and set the sort mode to "Last".
- "Value"
  Indicates a signal type selected for ranking the Top N pools.

It is possible to select among the following signals:
– "Power"
– "SINR"
– "Cue, the UE emulation signal"
– "RSRP"

The first two signals make ranking according to power and quality, respectively. If you wish to rank the detected cells based on the UE emulation criterion, choose the third option. The ranking also supports reference signal (RS) received power signal.

- "Calculation"
  Determines if the min/max/average/last value of the previously selected parameter is used for ranking within one observation period.

Filtering options let you define the criteria for the Top N pools filtering.

- "Apply Filter"
  Used for Top N pool filtering based on configured LTE channels. If checked, only the listed LTE channels (EARFCN) entered by users are considered when ranking the Top N pool.
- "Only the listed LTE channels (EARFCN) will be...."
  A list of RF channels to be displayed in the Top N ranking list can be entered manually. In the channel list the absolute RF channel numbers are placed in in-creasing order of EARFCN. A range is specified by using the “-“ separator. Single EARFCNs are defined by using the separator “;”. For example, 2500-2510;2520 means that the Top N Pool includes all members (up to 16) having EARFCNs from 2500 to 2510 and the EARFCN 2520.
- "Apply Provider Filter"
  Used for Top N pool filtering based on configured provider. If selected, filters for Top N pool ranking only the selected providers.
  When the provider filtering is activated, BCH decoded signals for the selected providers with their MCC/MNC are displayed.
- "Add Provider/MCC/MNC"
  Via "Add Provider" and "Add MCC/MNC" you can add select a provider from the "Network Provider Database" or enter directly a combination of MCC and MNC.

The "Top N Signals" and "Top N Pools" are of dynamic concepts that means, the signal level from a specific eNodeB varies in time and according to the measurement position. The elements of a Top N pool are exchanged accordingly and even their number can change, if the system detects less than N signals.

Remove ← Manual Pool Configuration
Deletes the selected entry from the "Top N Pools" list, see "Remove" on page 311.

Properties ← Manual Pool Configuration
Shows the properties of an entry from the list and lets users modify the configured parameters values, see "Properties" on page 312.

Scan cycles signals of LTE scanner events

The following figure shows the implemented scan cycles signals in LTE scanner.

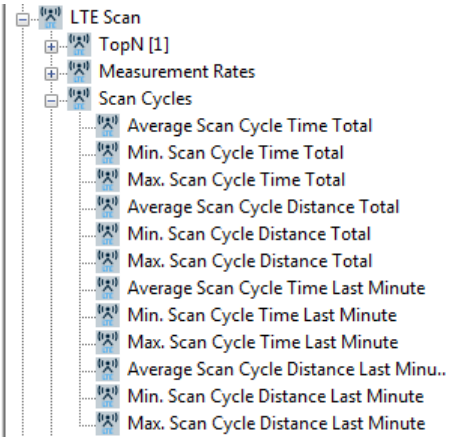


Figure 3-224: Scan cycle signals of LTE scanner

For details see "Scan cycles signals of GSM NWS events" on page 312.

LTE signals settings

In the "Signals Settings" page you can set the properties of the LTE signals.

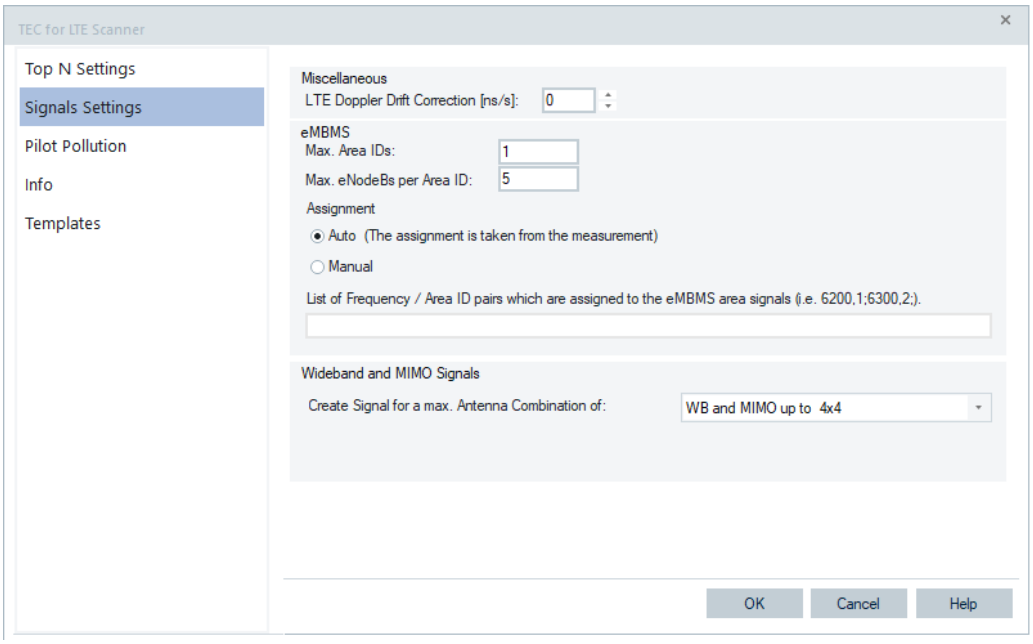


Figure 3-225: TEC for LTE Scanner – signals settings

The panes of the page provide the following setting options:

- "Miscelaneous"
  The "LTE Doppler Drift Correction" option is used to correct the Doppler effect, unit [ns/s]
- "eMBMS" lets you activate the eMBMS function by defining the following:
  – "Max Area IDs"

Maximum number of area IDs which can be assigned to the actual measured areas automatically or manually by definition of channel and area pairs, default 12

– "Max. eNodesB per Area ID"
Maximum number of eNodeBs per area ID, default 5.

– "Assignment"
Select between automatically or manually assignment of eMBMS areas to the measured eMBMS area signals.
If the manual assignment is selected the frequency / area ID pair have to have the format, e.g. 6100,1;6300,1;6300,2. This setting means that there are three assigned pairs: EARFCN 6200 and area ID 1; EARFCN 6200 and area ID 2; EARFCN 6300 and area ID 2.

– "List of Frequency / Area ID pairs ..."
A list of selected frequency and area ID pairs to be assigned to the eMBMS areas signals; a format as previously mentioned.

For eMBMS area ID and the eNodeBs signals which are measured and reported, see Chapter 4.8.6.5, "LTE scanner eMBMS view", on page 1232.

- "Wideband and MIMO Signals"
  – "Create Signal for a max. Antenna Combination of"
  The type and number of signals to be measured and reported by the LTE Scanner.
  The selected signals are shown in the "Top N List" of the "LTE Scanner Top N View" and in the "Signal Tree".

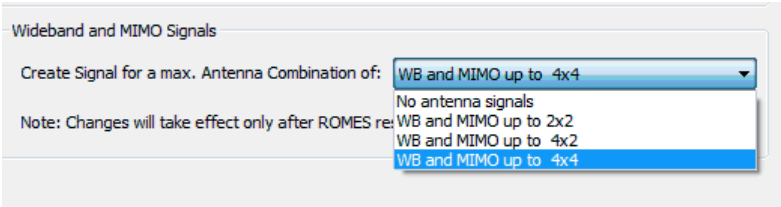


Figure 3-226: Wideband and MIMO signals

The changes take effect only after restart of R&S ROMES4.

Pilot pollution

Pilot pollution can be calculated for the measured LTE base stations on each channel. The calculation is done on the RSRP signals.

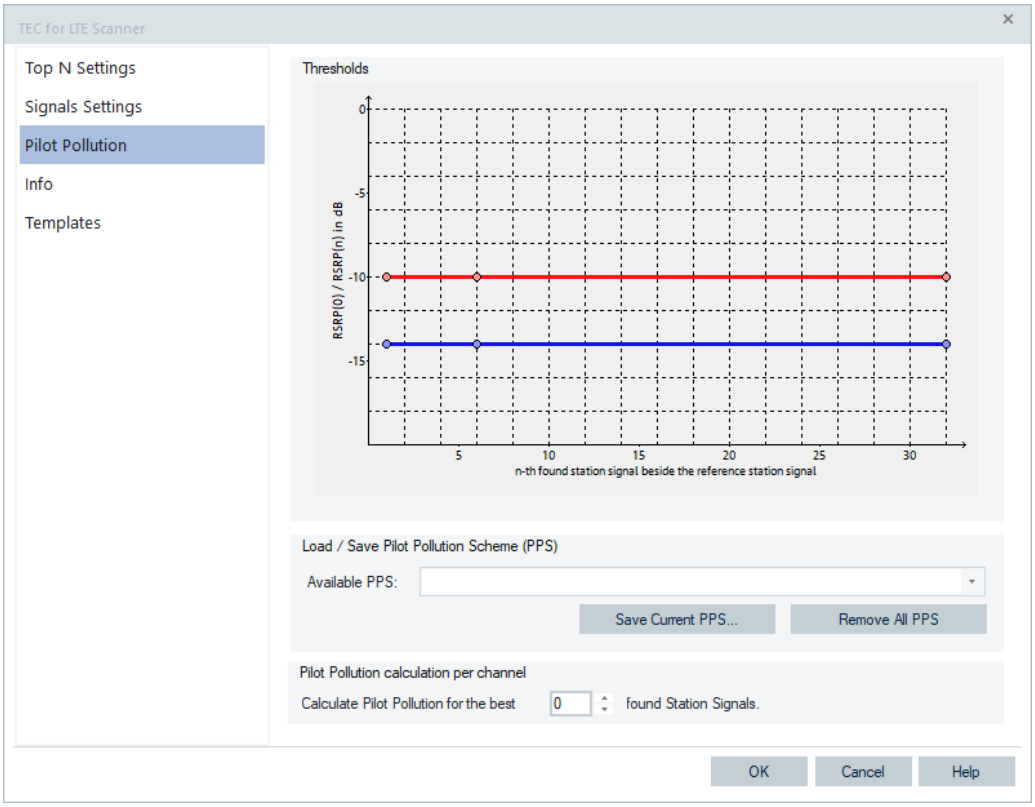


Figure 3-227: Pilot Pollution for LTE signals

The upper pane shows the “Pilot Pollution Scheme”, containing the default thresholds of the pilot pollution algorithm. This scheme can be customized.

The lower part lets you configure a constraint for the calculation, that is, derive the pilot pollution for the given count of stations on a channel only. The default is 1.

The results of the pilot pollution calculation are the Hard Pilot Pollution (HPP) and the Soft Pilot Pollution (SPP) signal values. Both values are available in the signal tree and can be analyzed in the generic R&S ROMES4 views, for example, in the "Alphanumeric View", if selected.

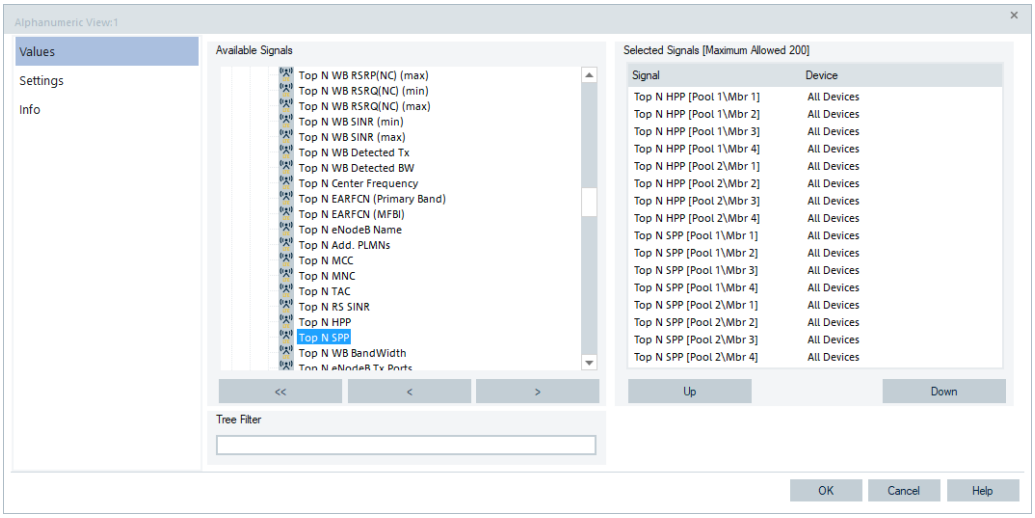


Figure 3-228: HPP and SPP Top N signals selection

The HPP and SPP Top N signals are by default off and have to be configured in the "Top N Settings" configuration page.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.13 TEC for NB-IoT scanner

Select the "Technologies" > "TEC for NB-IoT Scanner" menu to open the NB-IoT configuration pages:

- "Top N Settings"
- "Pilot Pollution"

The page has two more tabs, the "Info" and the "Templates" tab which are technology independent.

Top N settings

The page is divided into two panes:

- "Top N Pool Signal Settings" which lets you activate some optional signals.
- "Top N Pools" which lets you select between automatic or manual Top N pool configuration.

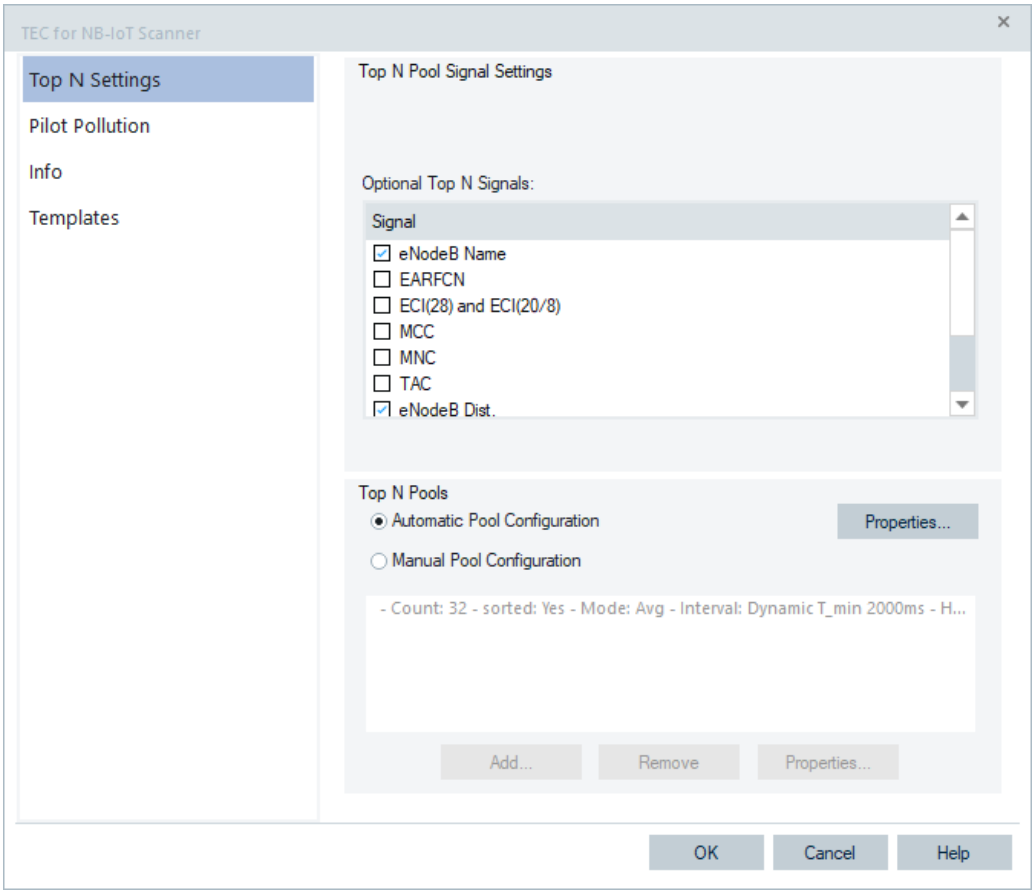


Figure 3-229: NB-IoT Scanner Top N settings

Top N pool signal settings

There is a single Top N node under the "Top N Templates" node instead of separate branch for each Top N pool and Top N member, see Chapter 4.8.8.1, "NB-IoT scanner signals tempates", on page 1297.

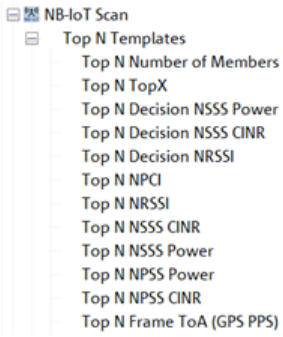


Figure 3-230: Single Top N node under the Top N templates

You can configure additional optional signals which are added then to the NB-IoT Top N signals and template signals. Changes of a setting affect the Top N signal and the template signal configuration.

The following optional signals are available in "Optional Top N Signals" > "Signals".

- "eNodeB Name"
  LTE base station's name.
- "EARFCN"
  E-UTRA Absolute Radio Frequency Channel Number.
- "ECI(20/8)", "EC(28)"
  EUTRAN Cell Identifier columns; Cell Identifier: CellID*256 (or << 16) + eNodeB ID.
- "MCC"
  Mobile Country Code
- "MNC"
  Mobile Network Code
- "TAC"
  Tracking Area Code
- "eNodeB Dist."
  Distance to the eNodeB.
- "Provider"
  A name of network provider.
- "Add. PLMNs"
  Additional PLMNs shared with this eNodeB

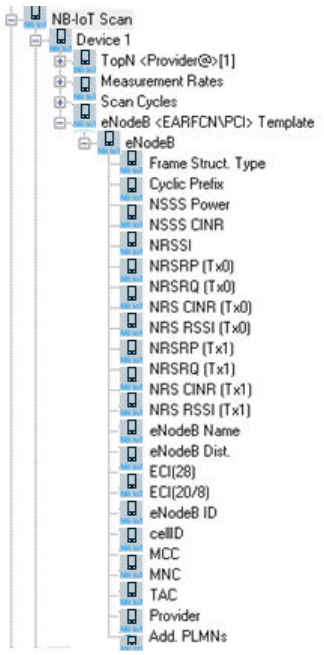


Figure 3-231: List of all eNodeB signals

To activate a changed signal configuration, R&S ROMES4 must be closed and restarted.

Top N pools

If you select automatic pool configuration, the "Properties" button becomes active.

Click the button to open the dialog which allows you to configure the parameters for the automatic Top N pool.

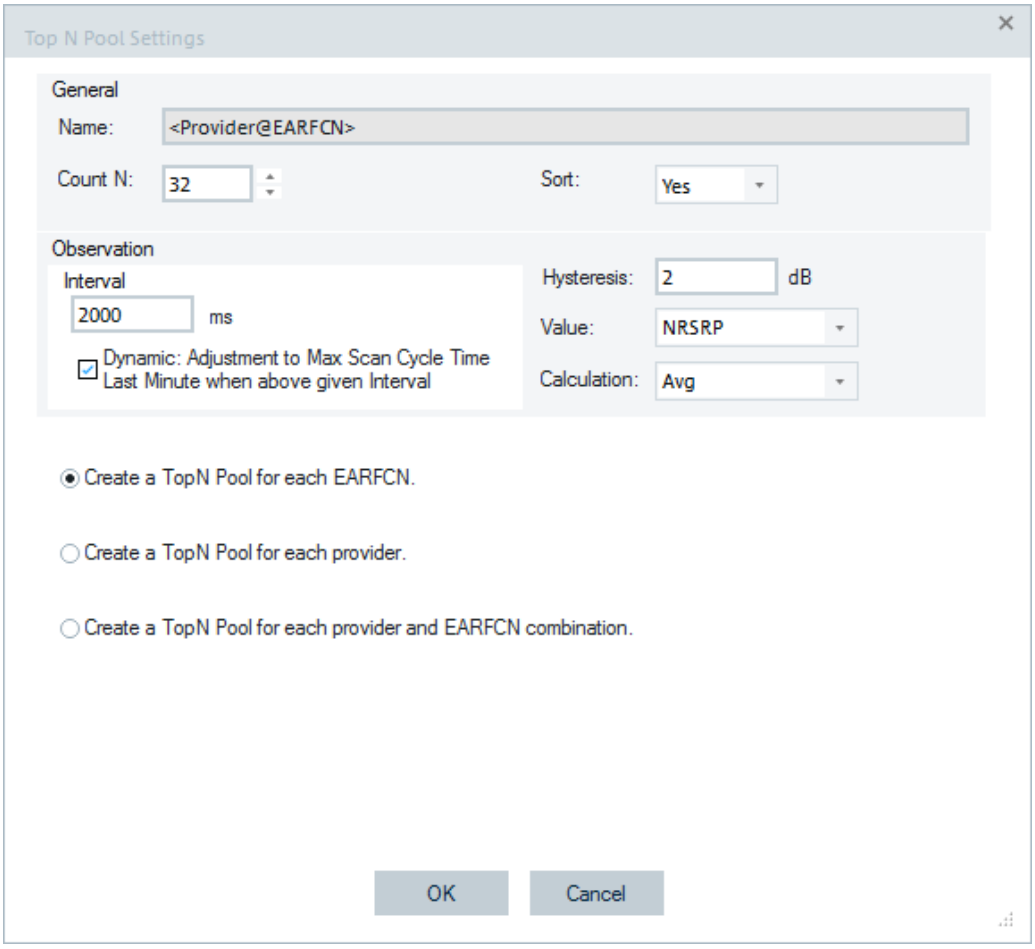
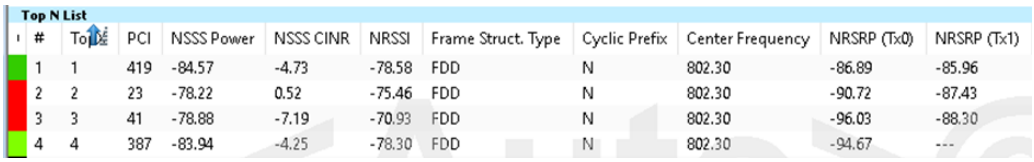


Figure 3-232: NB-IoT Scanner Top N pool settings

The ranking of the Top N pools can be based on selected signal in the "Observation" > "Value" drop-down box. Supported values are:

- NSSS CINR
- NRSSI
- NSSS Power
- NRSRP

If the NRSRP is selected, the algorithm uses the maximum of NRSRP (Tx0) and NRSRP (Tx1) to calculate the Top N ranking. If signal is not present (shown as "---"), it does not join the ranking.



#	Top	PCI	NSSS Power	NSSS CINR	NRSSI	Frame Struct. Type	Cyclic Prefix	Center Frequency	NRSRP (Tx0)	NRSRP (Tx1)
1	1	419	-84.57	-4.73	-78.58	FDD	N	802.30	-86.89	-85.96
2	2	23	-78.22	0.52	-75.46	FDD	N	802.30	-90.72	-87.43
3	3	41	-78.88	-7.19	-70.93	FDD	N	802.30	-96.03	-88.30
4	4	387	-83.94	-4.25	-78.30	FDD	N	802.30	-94.67	---

Figure 3-233: Ranking of Top N pools based on NRSRP

The display shows the current value that cannot reflect the correct ranking.

You can select one of the following Top N pool configurations:

- "Create a TopN Pool for each EARFCN"
  The selection is channel-based. Evaluated is Top N pool for each frequency (EARFCN) which is scanned.
- "Create a TopN Pool for each provider"
  The selection is provider-based. Evaluated is Top N Pool for each provider in the provider list. If provider has several channels, the Top N pool is evaluated for all those channels.
- "Create a TopN Pool for each provider and EARFCN combination"
  The selection is provider and EARFCN combination based. Evaluated is Top N pool for all combinations of provider and channels.

Pilot pollution

Pilot pollution can be calculated for the measured base stations on each channel. The calculation is done on the RSRP signals.

The upper pane shows the Pilot Pollution Scheme, which gives the thresholds for the pilot pollution algorithm. This scheme can be customized like in UMTS.

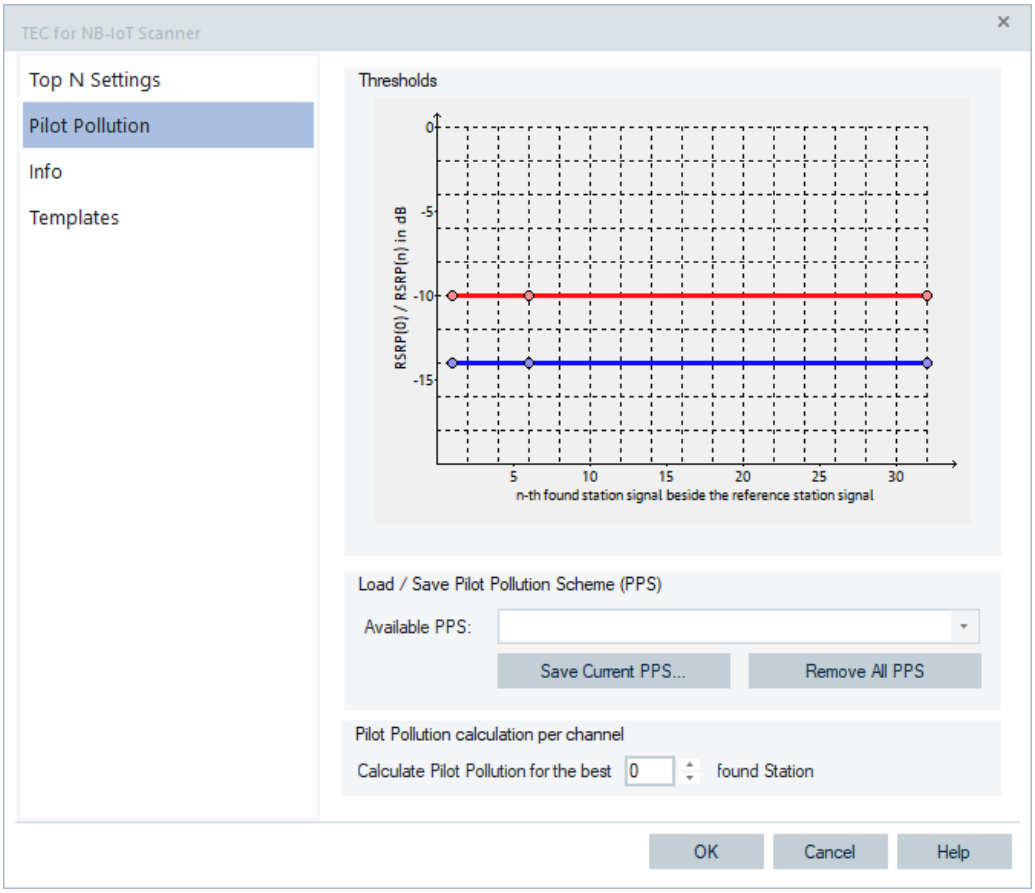


Figure 3-234: NB-IoT scanner Pilot Pollution page

The configuration is the same as for the TEC for LTE Scanner.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.14 TEC for LTE-M scanner

R&S ROMES4 supports the configuration of the LTE-M scanner in the "TEC for LTE-M Scanner" page.

Select the "Technologies" > "TEC for LTE-M Scanner" entry to open the page.

The page contains the following tabs:

- "Top N Setting", the opening page
- "Info"
- "Templates"

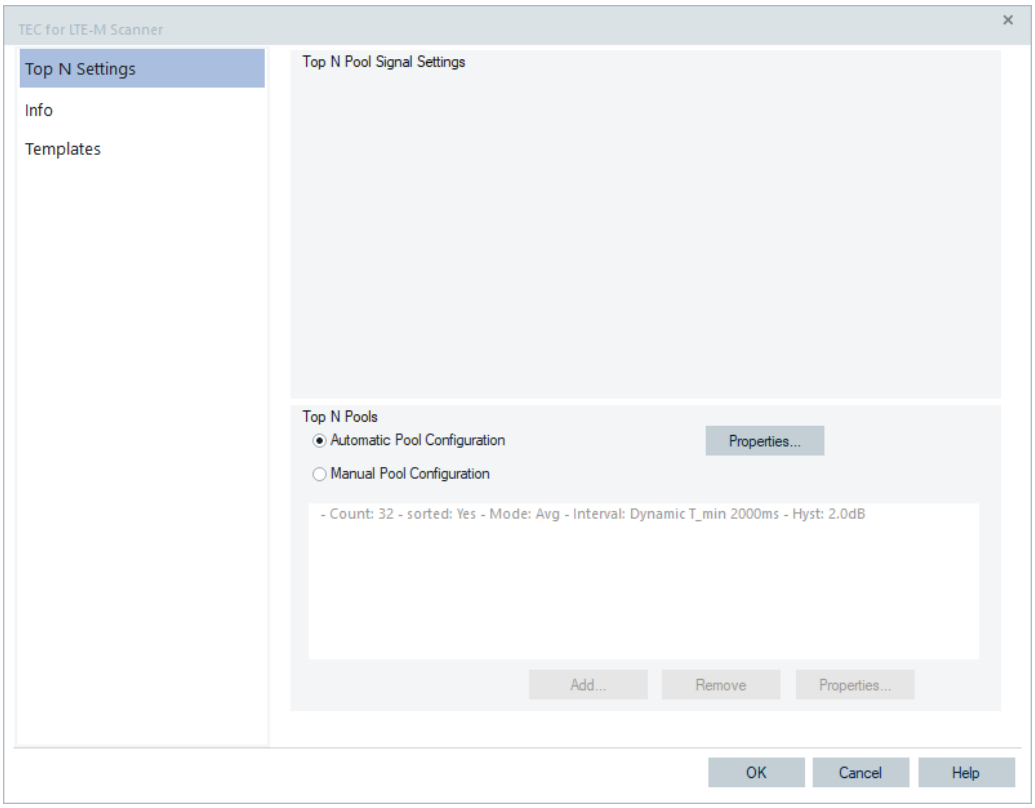


Figure 3-235: LTE-M Top N pool settings

The last two tabs are technology independent.

The LTE-M technology provides signals for the Top N pools and template signals. For the signal description, see "Description of the R&S ROMES4 Signals" document.

Top N settings

This configuration page is the standard page for the Top N pool signal settings made of two panes.

- "Top N Pool Signal Settings" without function
- "Top N Pool"

Top N pool signal settings

The upper pane of the page has no function as there is a single Top N node under the "Top N Templates" node, see Chapter 4.8.7.1, "LTE-M scanner signals templates", on page 1274.

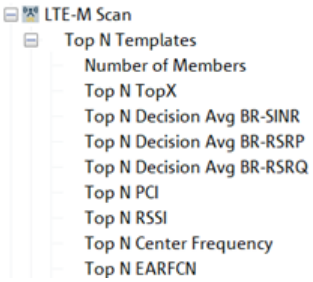


Figure 3-236: Top N node under the Top N templates

Top N pools

Specify whether to configure the Top N pool automatically or manually in the lower pane.

Automatic Pool Configuration
Automatic is the default Top N pool configuration option. It orders the scanner to use automatic Top N pool property configuration.

Click the "Properties" button next to the "Automatic Pool Configuration" button to launch the "Top N Pool Settings" page.

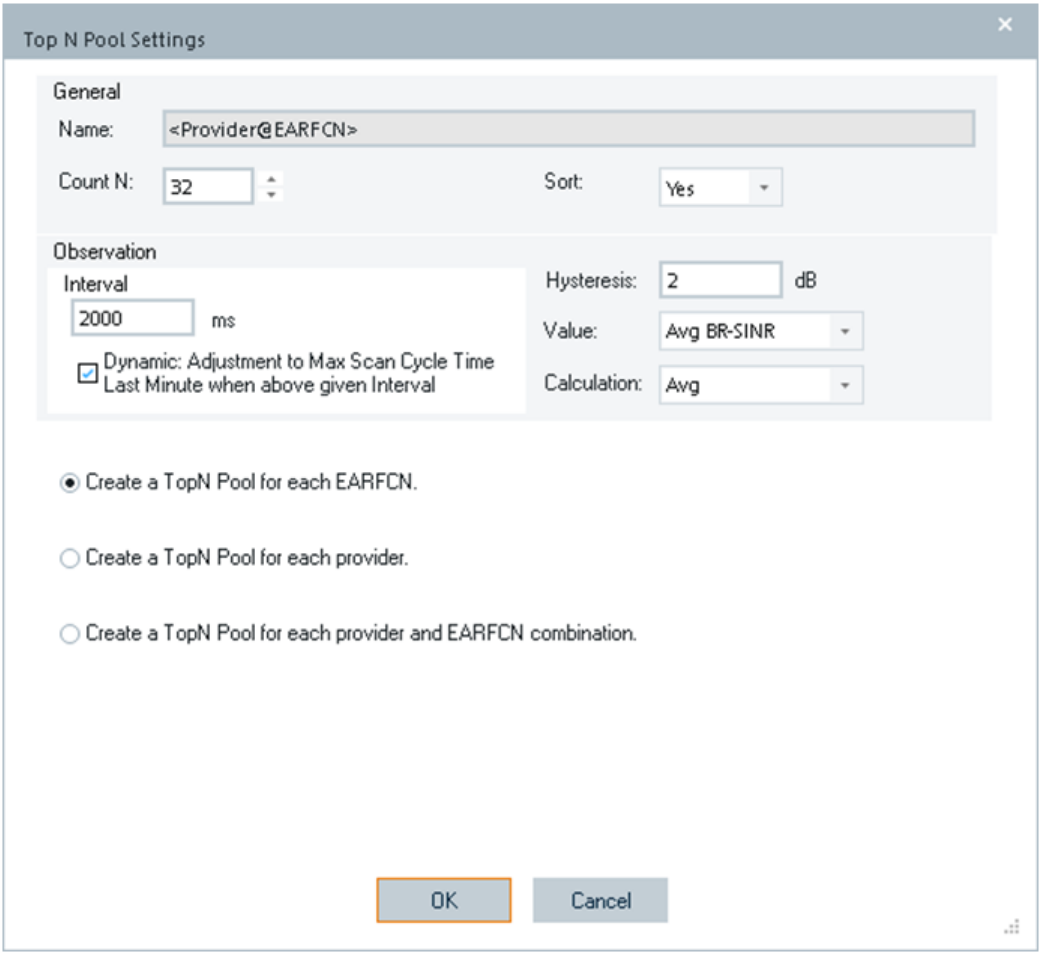


Figure 3-237: LTE-M automatic pool configuration

Specify the following entries in the "General" pane:

- "Name"
  Defines the name of Top N Pools.
  The specified name is displayed in "LTE-M Scanner Top N View" background and Top N drop-down "List".

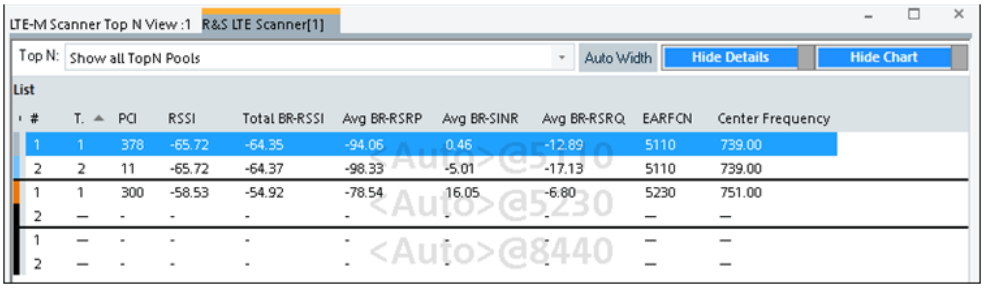


Figure 3-238: Top N pool names in background

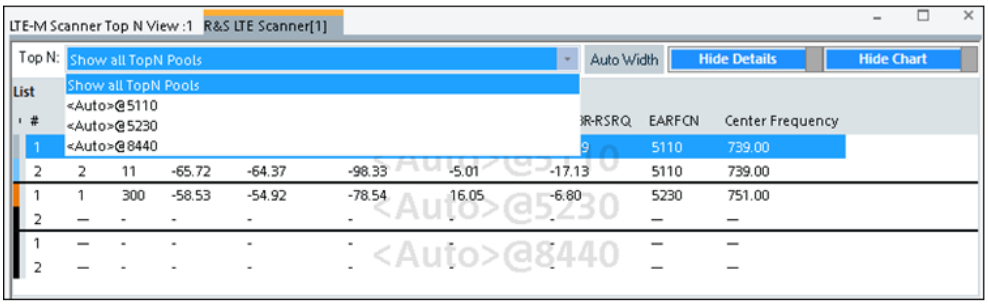


Figure 3-239: Top N pool names in the List

- "Count N"
  Specifies the number of top ranked items to display.
- "Sort"
  Specifies whether to sort the items in the Top N list or not.
- "Observation"
  - "Interval"
    Specifies the interval to refresh the values.
  - "Dynamic: Adjust to ..."
    The Top N calculation adjusts dynamically the Top N calculation interval to the max. scan cycle time last minute when the above given interval is shorter.
- "Value"
  Drop-down list to specify the decision value for Top N ranking. The possible values for ranking are:
  - Avg BR-SINR
  - Avg BR-RSRP
  - Avg BR-RSRQ
- "Calculation"
  Specifies how to calculate the selected decision value for Top N ranking. The possible options for calculation are:
  - Min
  - Max
  - Avg
  - Last

The lower part of this pane specifies the criterion for the automatic pool configuration.

Select the criterion among the following options:

- "Create a TopN Pool for each EARFCN"
- "Create a TopN Pool for each provider"
- "Create a TopN Pool for each provider and EARFCN combination"

Manual Pool Configuration

Click the "Manual Pool Configuration" radio button in the "Top N Settings" pane of the page, to activate the bottom section of the page.

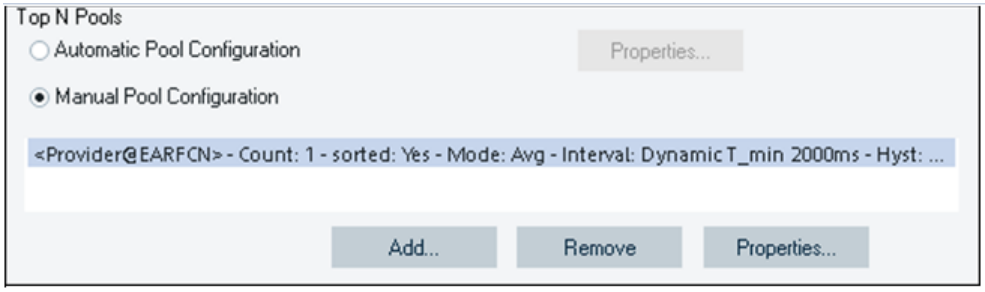


Figure 3-240: Bottom buttons active in manual pool configuration

The active buttons let you do the following:

- "Add"
  Adds a new entry to the list.
- "Remove"
  Removes the selected item from the list.
- "Properties"
  Launches the "Top N Pool Settings" page to specify the highlighted items.

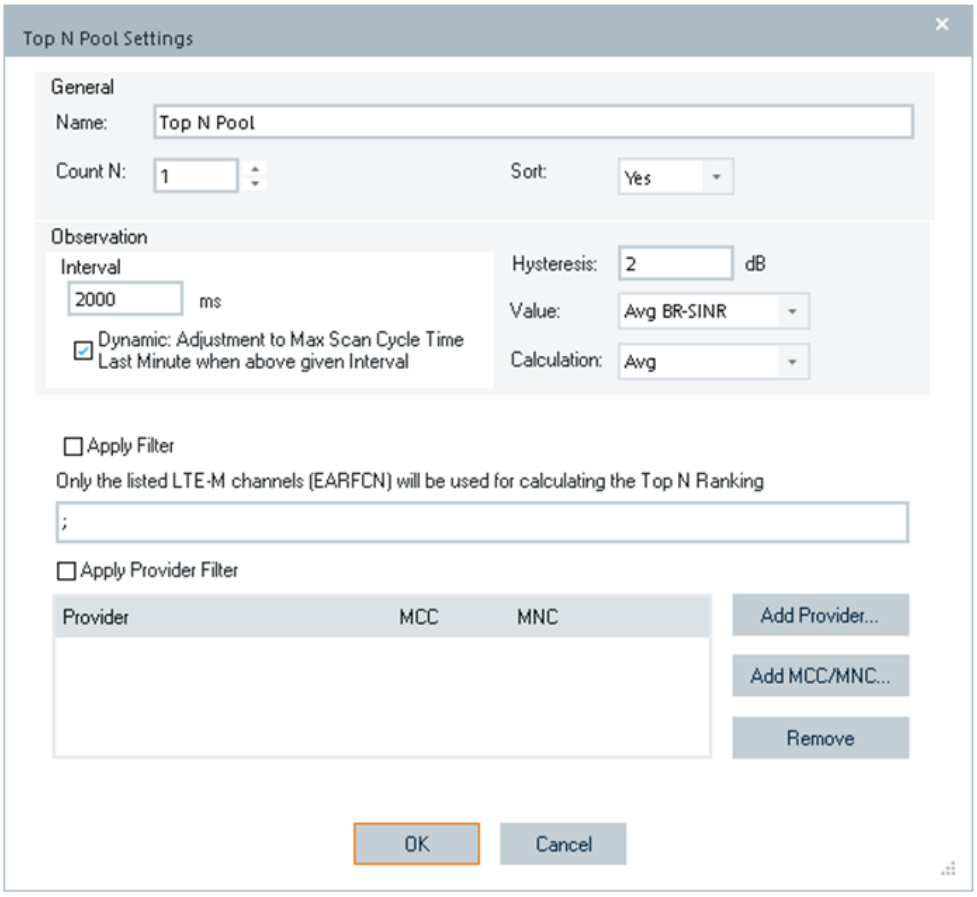


Figure 3-241: Top N pool settings for manual configuration

The "General" pane is the same as the one for automatic pool configuration. For the entries in this pane, see "Top N pools" on page 363.

The lower part of the "Properties" > "Top N Pool Settings" page has the following entries:

- "Apply Filter"
  If checked, the filter string specified in the edit box below is applied. Otherwise, no filter is applied.
- Filter String Box
  The filter string contains a semi-colon delimited EARFCNs. If "Apply Filter" is checked, only the EARFCNs in this string are shown in Top N list.
  Example: 5230;8448;5110;
- "Apply Filter Provider"
  Specifies the list of providers to be shown.
- Provider grid
  Specifies the list of providers to be shown.
- "Add Provider"
  The button is used to add provider.
- "Add MCC/MNC"
  The button is used to add provider by MCC/MNC.
- "Remove"
  Removes the selected provider.
- "OK"
  The button is used to accept the changes.
- "Cancel"
  The button is used to discard the changes.

Info tab

See "Info tab" on page 355. The name can be customized.

Templates tab

"Templates tab" on page 367.

Templates can be created (saved), deleted and exiting templates can be loaded.

3.8.2.15 TEC for QoS tester

Select "Technologies" > "TEC for QoS Tester" to open the QoS tester page.

The opening page "QoS Settings" lets you set the KPI definitions, that is, the KPI definition file and the KPI export definition file.

The R&S ROMES4 KPI generator is disabled by default as it increases the performance for default measurements,

To activate the KPI generator, check the "KPI Generator Active" check-box in the opening page.

The R&S ROMES4 KPI generator is based on the R&S ROMES4 `kpi.xml` file, which can be adapted if the corresponding option is available. Even if disabled, all trigger points are saved to the file, so that in a replay with the generator enabled all KPI are available.

The Qos KPIs are visible in the "QoS KPI Generator View" and relate to R&S ROMES4 generated KPIs only. KPIs generated by QualiPoc are not affected by this option.

To ease the switch between the different KPI definition and KPI export definition files, the page offers two drop-down edit controls.

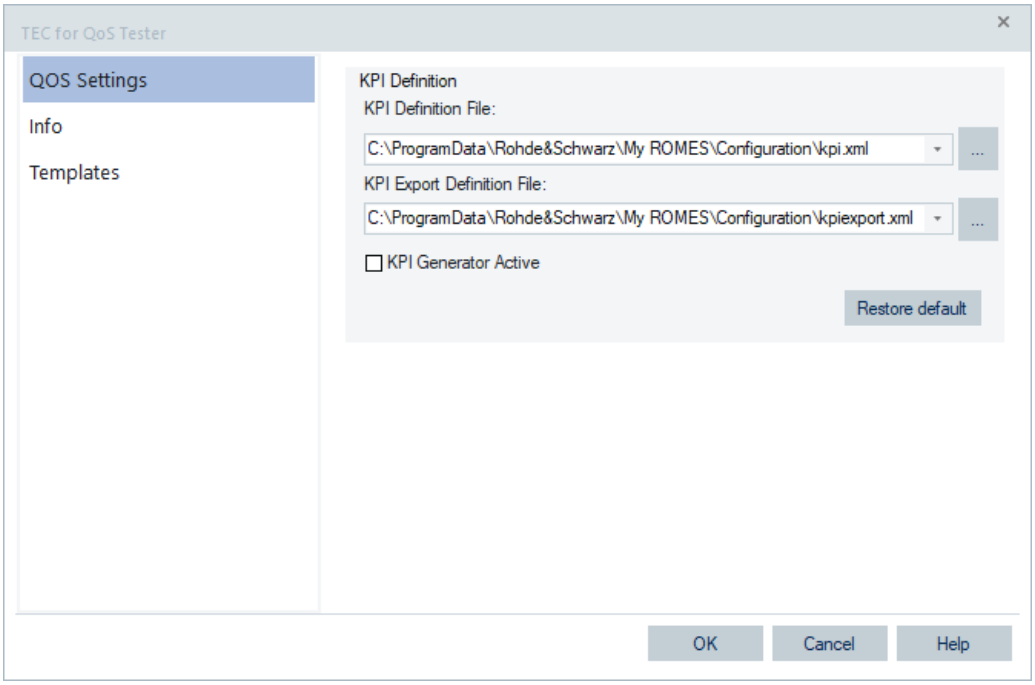


Figure 3-242: Selection of KPI and KPI export definition files

For calculating and exporting KPIs, the following two definition files in XML format are necessary:

- `kpi.xml`
- `kpiexport.xml`

Default files with basic definitions are delivered with the R&S ROMES4 installation located in the directory:

`[RomesAppliciationData]\configuration`.

These files can be copied to another location, for example `MyRomes`, otherwise they are overwritten with a later R&S ROMES4 version. The used definition files during runtime (replay and measurement) are defined in the "Technology Module" for QosTester configuration.

The definition of KPIs and the definition of KPI export is described in the document:
`KPI Definition File.doc`
An example is described in the document:
`KPI Definition HOWTO define a KPI.doc`
The KPI calculation is based on trigger points. All from R&S ROMES4 provided trigger points are described in the document:
`Trigger Point Definitions.doc`

When changes are made in a definition file, an open measurement must be closed and reloaded to see the resulting changes in the views.

To use an own KPI definition file or a KPI export definition file (edit or change definition to specific customer requests), the KPI Generator option ID is necessary. If the KPI Generator option ID is not available, these edit boxes are disabled. Without the KPI Generator option ID, the KPIs can be generated during measurement and replayed later, but only on the basic definition files. Changing and editing is not allowed, as each editing of the basic definition files is detected and results in usable files.

3.8.2.16 TEC for RF power scanner TSME

R&S ROMES4 supports the configuration of the RF Power Scanner in the "TEC for RF Power Scanner TSME" page.

Select "Technologies" > "TEC for RF Power Scanner TSME" entry to open the page.

The page contains the following tabs:

- "Signal Setting", the opening page
- "Info"
- "Templates"

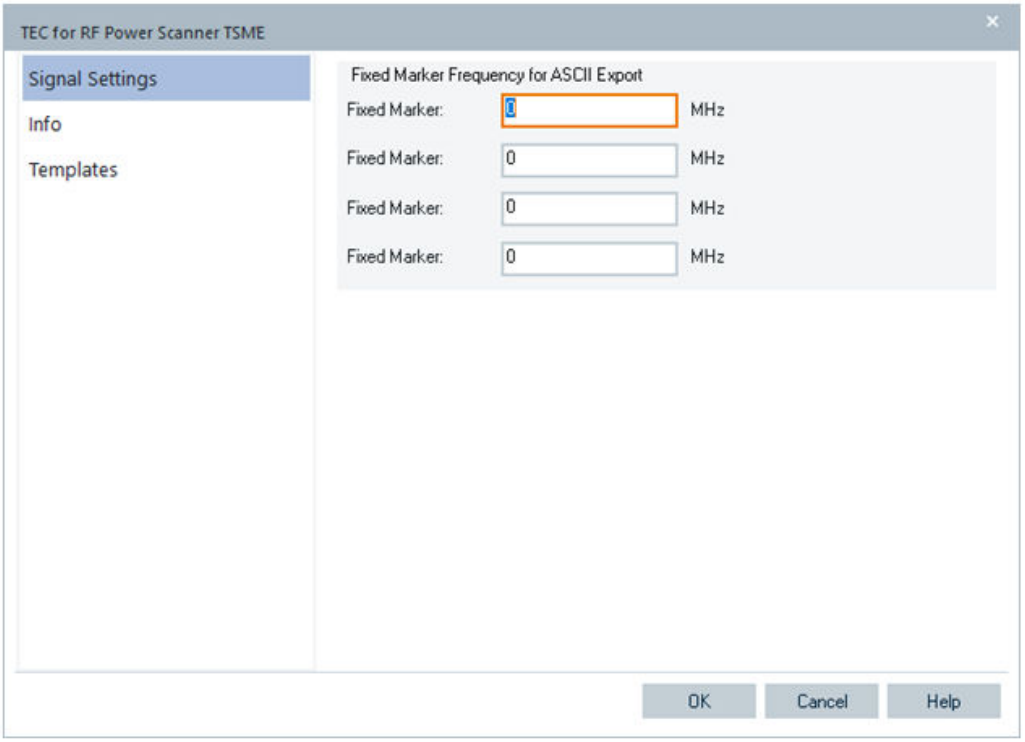


Figure 3-243: TEC for RF Power Scanner TSME – Signal Settings page

The last two tabs are technology independent.

Signal settings

The "Signal Settings" configuration page supports setting frequencies for four additional fixed markers. These fixed markers are applied at R&S ROMES4 ASCII export only, see Chapter 7.2.5.8, "RF power scanner data export", on page 2149.

The fixed markers do not interact with the other markers of the RF Power Spectrum View.

The channel signals configuration is not needed as the "All Channels" node is always available. The node is located in the "Sweep Template" branch of the "Signals Tree" > "RF Power Scan" tree, see Chapter 4.8.9.1, "RF power scanner sweep template", on page 1320.

R&S ROMES4 restart is not needed for changes in this page.

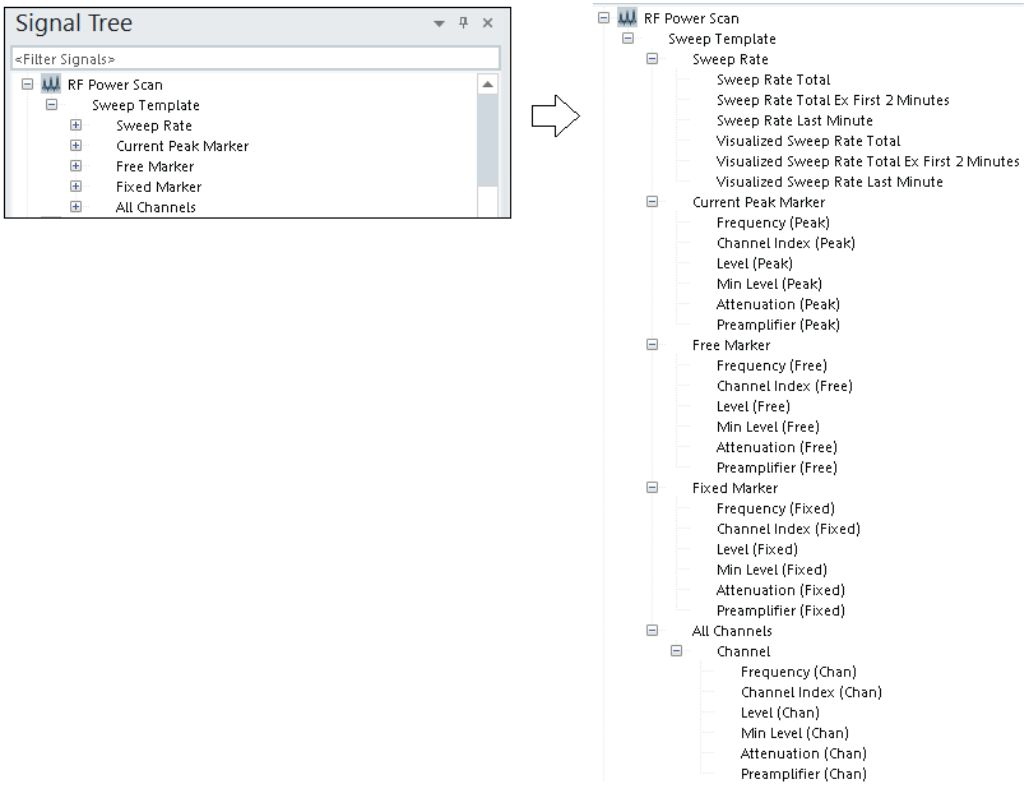


Figure 3-244: Extended signal tree of the RF Power Scanner

The all RF Power Scanner signals are structured in the following branches of "Sweep Template":

- "Sweep Rate"
- "Current Peak Marker", "Free Marker" and "Fixed Marker"
- "All Channels" (for each result value)

It is possible to define events for all available signals.

Signal tree of RF power scan

Sweep rate ← Signal tree of RF power scan

- "Sweep Rate Total"
  The sweep rate from the first to the last available measurement of a R&S TSME configured as RF Power Scanner.
- "Sweep Rate Total Ex First 2 Minutes"
  The sweep rate of the first measurement 2 minutes after the first measurement started to the last measurement.
- "Sweep Rate Last Minute"
  Sweep rate of the last minute. Within the first minute after the first measurement, the interval is shorter.
- "Visualized Sweep Rate Total"
  The update rate of the R&S ROMES4 views. The sweep rate is defined the same as "Sweep Rate Total".

- "Visualized Sweep Rate Total Ex First 2 Minutes"
  The update rate of the R&S ROMES4 views. The sweep rate is defined the same as "Sweep Rate Total Ex First 2 Minutes".
- "Visualized Sweep Rate Last Minute"
  The update rate of the R&S ROMES4 views. The sweep rate is defined the same as "Sweep Rate Last Minute".

The R&S TSME sweep rate is stored in the `rscmd` file. Therefore, it is in the replay mode the same as during the measurement.

The sweep rate of the visualization is calculated while replaying. The visualized sweep rate is rising with the replay speed.

Marker ← Signal tree of RF power scan
There are three types of markers:
- Current Peak Marker
- Free Marker
- Fixed Marker Frequency for ASCII export only

The "Current Peak Marker" signals are always filled. The "Free Marker" and "Fixed Marker Frequency..." signals are filled only if the markers are set active in the view, otherwise they are empty.

For all markers the following five signals are available:
- Frequency: Center frequency of the channel filter or the center frequency of the result biased on the frequency resolution.
- Channel Index: Index of the channel filter result (only available, if channel filter is active).
- Level: Power value biased on the frequency resolution respectively the channel filter settings and the frequency- and time-detector type.
- Min Level: value biased on the frequency resolution respectively the channel filter settings and the frequency- and time-detector type (only available if an Auto Detector is set).
- Attenuation: Attenuation setting (only available if a fixed attenuation is set in the scanner configuration).
- Preamplifier: Preamplifier setting (only available if the preamplifier is set in the scanner configuration).

All Channels ← Signal tree of RF power scan
The branch contains the signals of available channels, for example, frequency and channel index.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.2.17 TEC for TETRA

Select "Technologies" > "TEC for TETRA" to get the "TETRA Parameters" opening page.

The purpose of activating the "Include carrier for..." option is filtering not only by MCC, MNC and LA but also by carrier to avoid ambiguity if more than one cell of a provider within one LA.

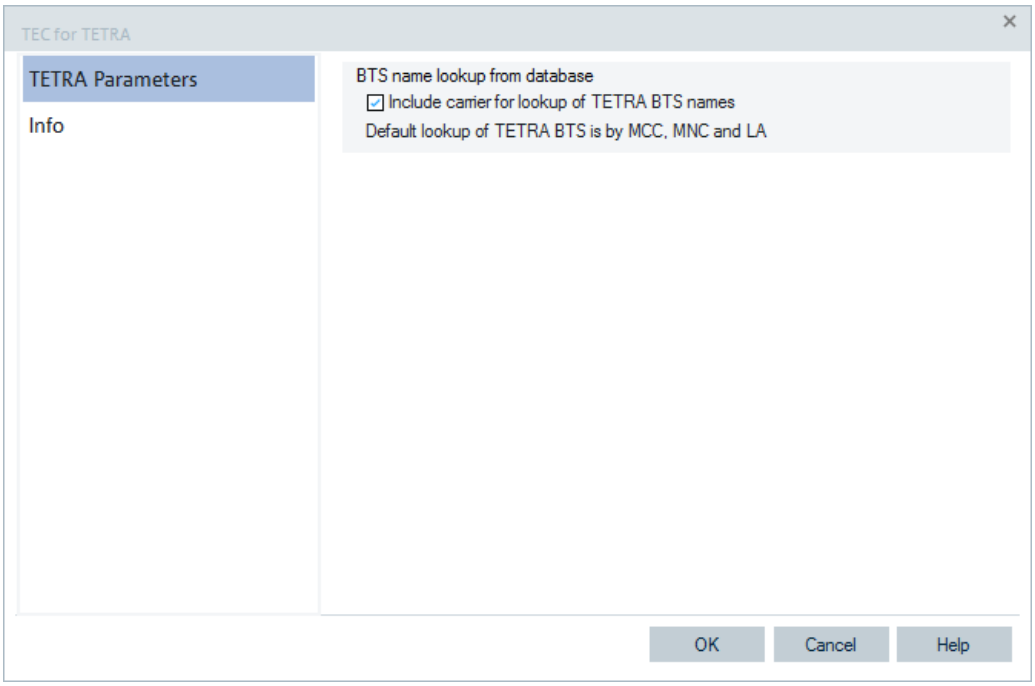


Figure 3-245: TEC for TETRA

3.8.2.18 TEC for TETRA scanner

Select the "Technologies" > "TEC for TETRA Scanner" to get the configuration pages with the following tabs:

- "Top N Settings", the opening page
- "Signal Settings"
- "Info"
- "Templates"

The "Info" and "Templates" tabs are technology independent.

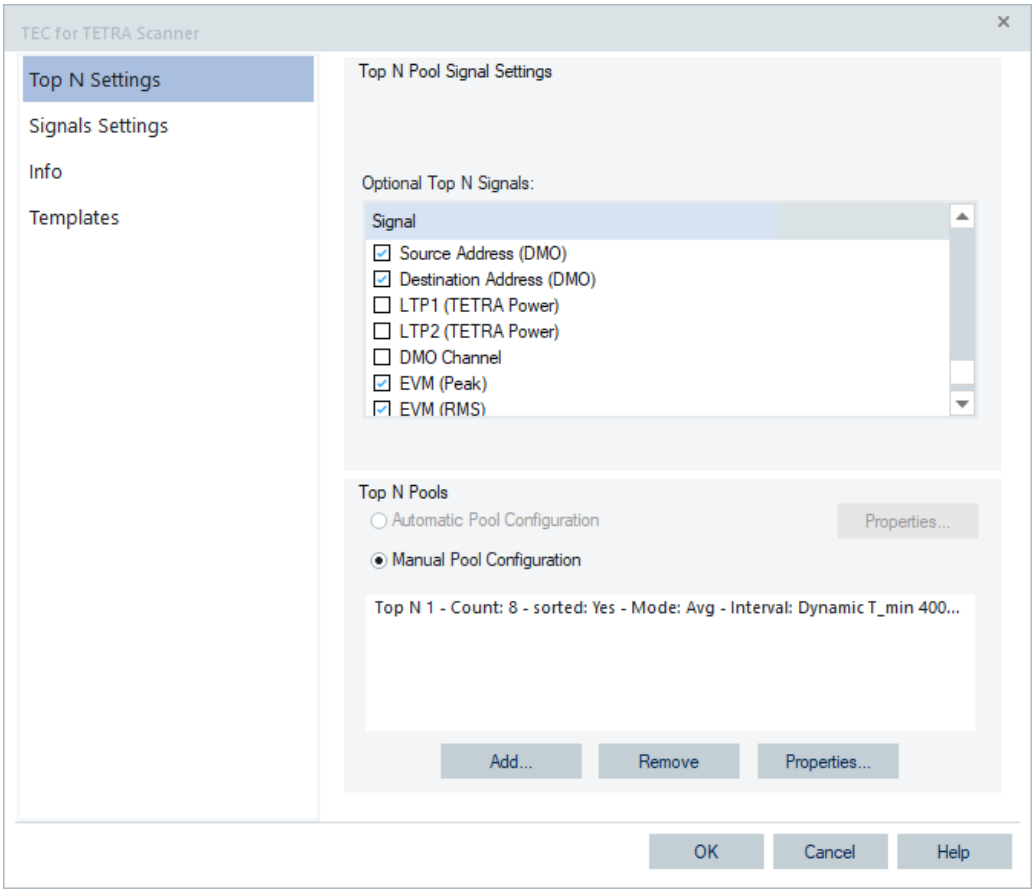


Figure 3-246: TEC for TETRA Scanner – Top N Settings

The configuration pages let you configure the Top N pools, the maximum number of members per pool and the signals which TETRA scanner collects.

TETRA scanner Top N settings

In "Top N Settings" you can set the number of Top N pools and the number of members of a pool. For each member,, a set of signals is created. Some of those signals are optional. Thus it is possible to select or unselect those signals in the "Optional Top N Signal" list.

The "Top N Settings" page is divided in an upper panel "Top N Pool Signal Settings" to set preferences for the Top N pool signals and a lower panel "Top N Pools" to administrate the Top N pools of the current workspace.

Top N Pool Signal Settings

- "Number of Top N pools in the signal configuration tree"
  Defines the maximum number of Top N pools in the list of "Available Signals", see Chapter 3.8.1.2, "Available signals configuration", on page 228.
- "Max. Number of members per Top N pool"
  Defines the maximum number of members per pool in the list of "Available Signals". This number is limited to 64.
- "Optional Top N Signals"
  Note: The optional signal settings are R&S ROMES4 specific settings. The selected signals are stored within the current R&S ROMES4 installation and not at the current workspace. if the current workspace opens with another R&S ROMES4 on another computer the optional selected signals are not selected anymore and have to be selected for this other R&S ROMES4 installation again.
  - "Main Carrier"
    Frequency of the MCCH extracted from SYSINFO PDU.
  - "TETRA Power [dBm]"
    Indicates the power of TETRA carrier. The default Top N pool has the TETRA Power as the observation value.
  - "C1"
    Path loss parameter C1; the calculation is based on the values of the broadcast channel and the configured maximum UE transmit power.
  - "FRA"
    The active state of Fast Reselection; the calculation is based on values of the broadcast channel.
  - "SRA"
    The active state of Slow Reselection; the calculation is based on values of the broadcast channel.
  - "FRT"
    Fast Reselection Threshold, range 0 [dB] to 15 [dB].
  - "SRT"
    Slow Reselection Threshold, range 0 [dB] to 15 [dB].
  - "#C-SCCH in use"
    Number of Common Secondary Control Channels in use.
  - "BER Pre-Viterbi"
    Ratio of estimated number of channel errors in block 1 and block 2 to the number of analyzed bits in block 1 and block 2 (comparison of received data and re-encoded after error correction). It has to be generated in the default configuration (together with main carrier and TETRA Power). BER Pre-Vit. is established as default quality parameter. The user has the possibility to choose the BER Pre-Vit. as the observation value for default Top N Pool definition and Top N signals, see Figure 3-247.
  - "BLER AACH"
    Block Error Rate of the Access Assign Channel.
  - "Freq-Error"
    Frequency error in Hz.
  - "Phase-Error"

RMS (Root-mean-square) phase error on the information symbols. Value in degree (°).

- "Delay Spread"
  Delay spread of arriving paths, the value given in µs.
- "Timeslot"
  Timeslot number extracted from SYNC PDU.
- "FN"
  Frame number extracted from SYNC PDU.
- "MFN"
  Multiframe number extracted from SYNC PDU.
- "MCCH BER Pre-Vit.[%]"
  Bit Error Rate on the Main Control Chanel (MCCH).
- "MCCH BER AACH [%]"
  Bit Error Rate on the Access Assignment Channel (AACH).
- "MCCH ER Payload CRC"
  Error Rate of the payload CRC.
- "MCCH BLER AACH"
  Block Error Rate on the Access Assignment Channel (AACH).
- "TETRA2 Active"
  TETRA Enhanced Data Service (TEDS) active.
- "Modulation Type"
  Used modulation in burst.
- "Code Rate"
  Code Rate in burst.
- "Burst Mod ER"
  Burst Modulation Error Ratio in dB.
- "Pilot Mod ER"
  Pilot Modulation Error Ratio in dB.
- "Header Mod ER"
  Header Modulation Error Ratio in dB.
- "Data MER"
  Data Modulation Error Ratio in dB.
  MER = Modulation Error Ratio (Mod ER in dB)
- "SICH Error Rate"
  Number of errors in the received SICH bits / total number of SICH bits.
- "AACH Error Rate"
  Number of errors in the received AACH bits / total number of AACH bits.
- "Data Error Rate"
  Number of errors in the received data bits/total number of data bits.
- "BLER Pre-Bit"
  Block Error Rate of the number of channel errors in block 1 and block 2 to the number of analyzed bits in block 1 and block 2 (comparison of received data and re-encoded data after error correction (Convolutional Code with Viterbi-Detector)).
- "Colour Code"
  Colour code extracted from the SYNC PDU.
- "Source Address (DMO)"
  Source address in direct mode operation.
- "Destination Address (DMO)"
  Destination address in direct mode operation.

– "LTP1 (TETRA Power)"
  If active, generates the LTP1 (TETRA Power) signal for each Top N pool; three LEE parameters are assigned to it in the signal tree, see "LTP calculation" on page 560.
  For example, it looks like LTP95(TETRA Power)[1][#1] for Top N 1 in the signal tree.
  The signal is not active by default but it persists over all workspaces as being stored in registry. The setting changes apply after R&S ROMES4 restart.
– "LTP2 (TETRA Power)"
  See the previous description.
– "DMO Channel"
  If activated, the DMO channel is available in the "TETRA Scanner Top N View" and "TETRA Scanner Spectrum View". It is ready for use in the "Signal Tree". R&S ROMES4 restart is needed after changing the setting of this parameter.
  If the ""Create Signals for each possible Carrier"" option is activated in "Signals Settings", the DMO channel is present as a carrier signal in the tree.
– "EVM (Peak)"
  Error Vector Magnitude, the peak value
– "EVM (RMS)"
  Error Vector Magnitude, the root mean square value

Top N Pools
The automatic Top N pool configuration is not supported by TETRA scanners. The option "Automatic Pool Configuration" is due to that grayed, see Figure 3-246.

This pane shows a list-box with the Top N pools manually configured in the current workspace. From here the Top N pool list can be amended, a list item deleted or the item's properties viewed and modified.

Add ← Top N Pools
Amends additional pools with default settings to the Top N pools list of the "Available Signals" page. To customize the Top N pool, modify it directly in "Add" or open the Top N pool later on via "Properties".

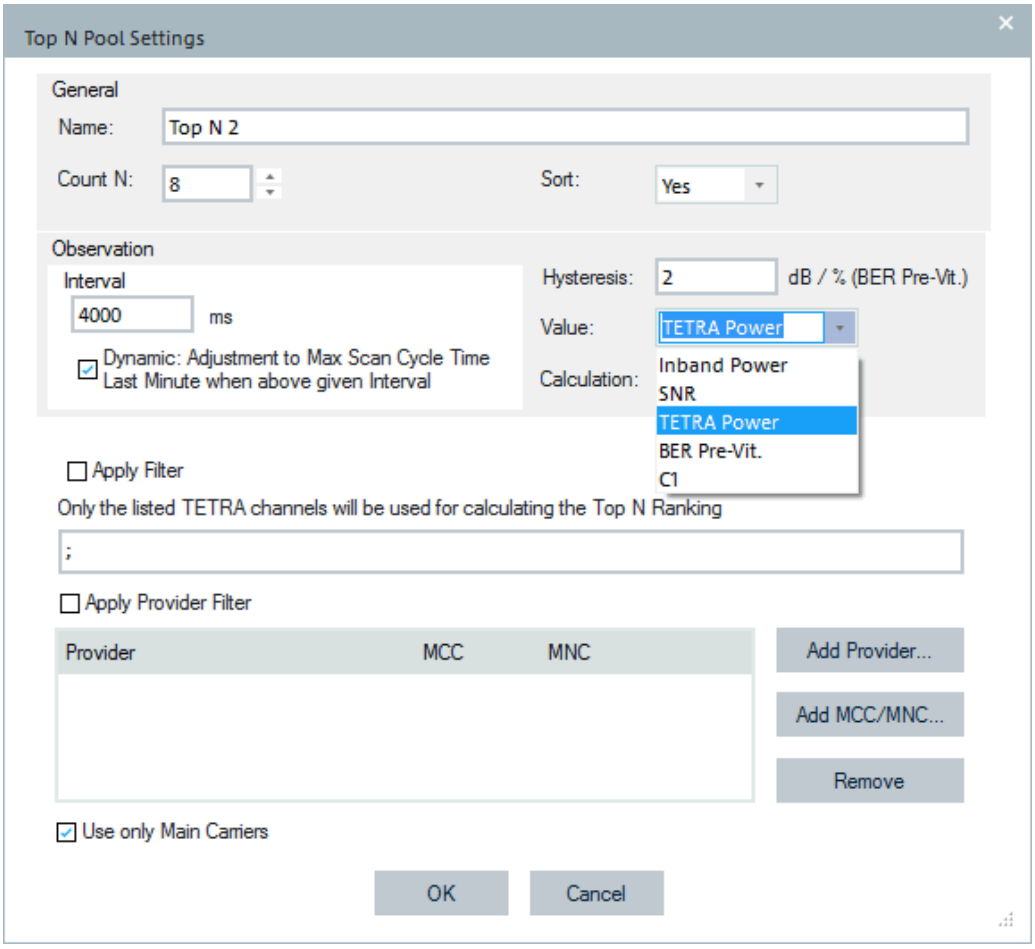


Figure 3-247: Add button - TETRA Top N pool settings

The "Add" dialog contains the following panels and entries:

"General"

- "Name"
  Name of the TETRA Scan Top N pool. The name has to be unique.
- "Count N"
  Sets the number of Top N pool members, ranging from 1 to 64. The number is limited to avoid a crash which can occur when entering too high max count of top N members. The display of pool elements in the list of "Available Signals" is limited to the "Max. number of members per Top N pool".
- "Sort"
  Allows sorting the members of a Top N pool.
  Every list member has an index which has nothing to do with any of the parameters. The index can also be found in the Top N parameters: 1. element = index 1, 2. element = index 2 and so on.
  If sorting is active ("Yes"), index and rank are the same as you have sorted your list by the rank. Therefore 1. element is rank 1, 2. element rank 2 and so on, see the following figure.

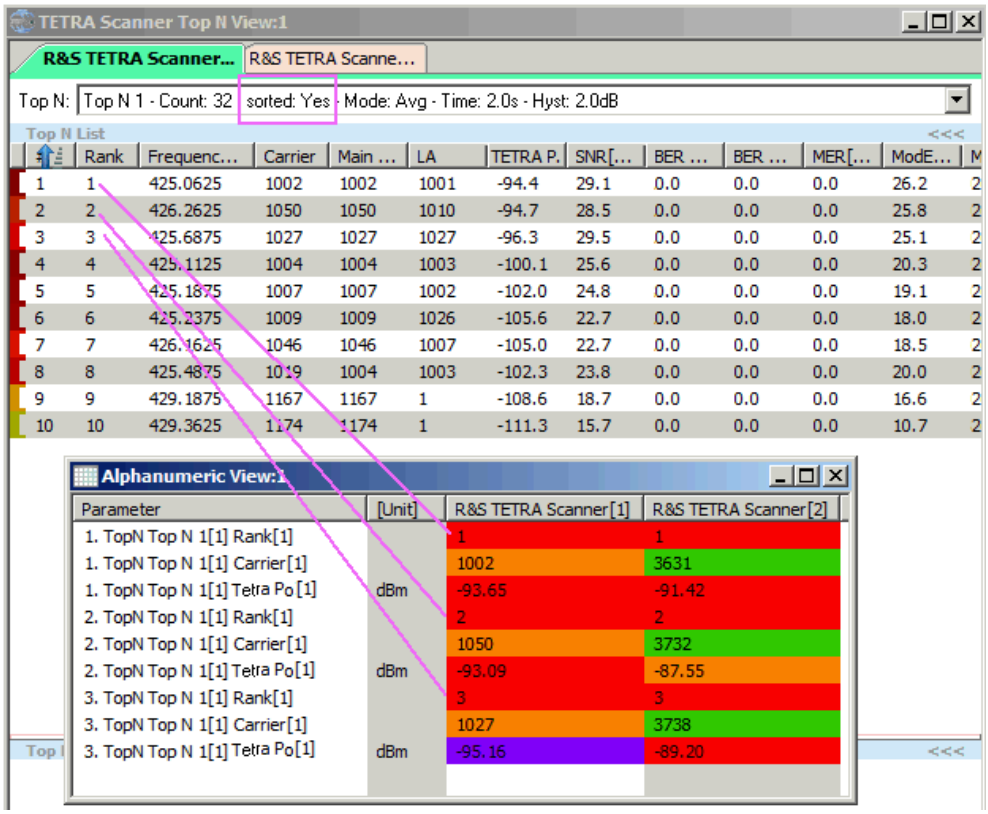


Figure 3-248: Top N list members sorted

If sorting is disabled, the ranking looks like shown in the following figure.

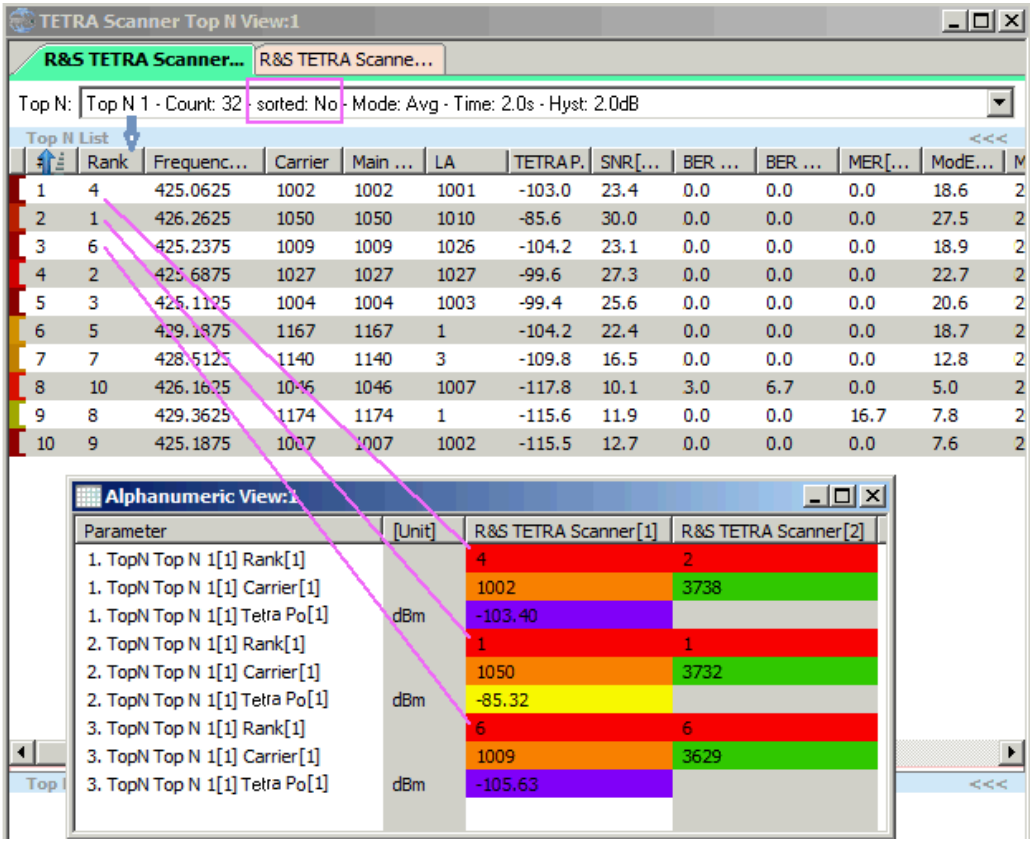


Figure 3-249: Top N list members not sorted

You could click on the rank column and then from top down you would have rank 1, 2, 3, and so on. The action however does not change the data in the "Alphanumeric View" and has nothing to do with the ranking itself.

"Observation"

- "Interval"
  Observation interval of the selected value given in ms.
  The observation interval is limited, see Interval.
- "Hysteresis"
  Hysteresis value (in dB or % dependent on selected "Value" signal) determines the hysteresis for the ranking of the pool members. To switch it off completely, enter value 0 and set the sort mode to "Last".
- "Value"
  The parameter is used for ranking the Top N pools. The members of a pool can be sorted by Inband Power, SNR, TETRA Power, BER Pre-Vit and UE emulation criterion C1, which emulates the selection behavior of a TETRA radio. The appropriate UE Emulation Option for TETRA is necessary in this case.
  The TETRA power based sorting is default, see Figure 3-247.
  The result of the observation interval which is responsible for the ranking can be observed for the selected parameter and for each pool member.

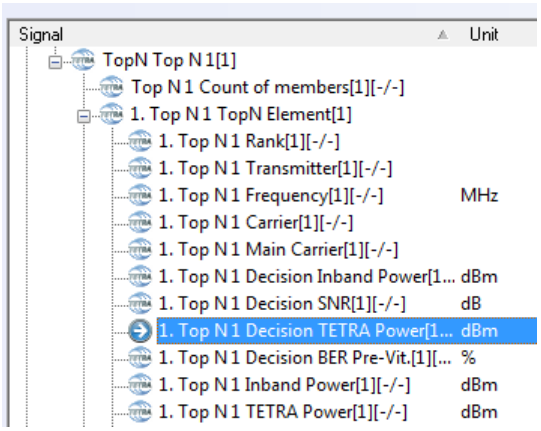
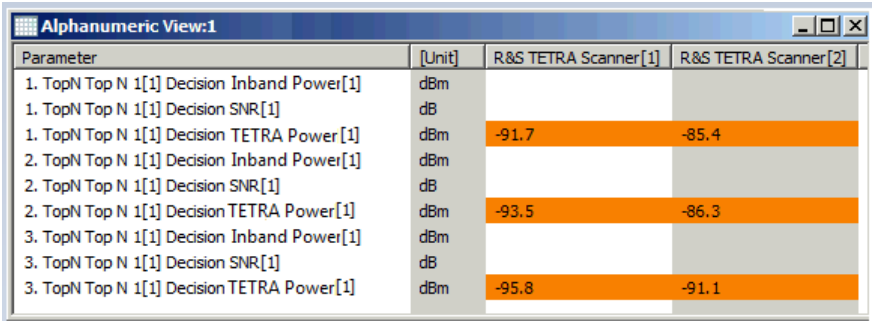


Figure 3-250: Ranking based on TETRA power



Parameter	[Unit]	R&S TETRA Scanner[1]	R&S TETRA Scanner[2]
1. TopN Top N 1[1] Decision Inband Power[1]	dBm		
1. TopN Top N 1[1] Decision SNR[1]	dB		
1. TopN Top N 1[1] Decision TETRA Power[1]	dBm	-91.7	-85.4
2. TopN Top N 1[1] Decision Inband Power[1]	dBm		
2. TopN Top N 1[1] Decision SNR[1]	dB		
2. TopN Top N 1[1] Decision TETRA Power[1]	dBm	-93.5	-86.3
3. TopN Top N 1[1] Decision Inband Power[1]	dBm		
3. TopN Top N 1[1] Decision SNR[1]	dB		
3. TopN Top N 1[1] Decision TETRA Power[1]	dBm	-95.8	-91.1

Figure 3-251: An example of the TETRA power selection

- "Calculation"
  Determines if the min/max/average//last value of the previously selected parameter is used for ranking within one observation period.

"Filter": A list of RF channels to be displayed in the Top N list can be entered manually. In the channel list the absolute RF channel numbers are placed in increasing order of ARFCN.

- "Apply Filter"
  If checked, the listed RF channels are not considered when calculating the ranking of the Top N pool.
  Otherwise, only the listed RF channels are taken into account when calculating the ranking of the Top N pool.
- "Channel list"
  Single RF channels are defined by using the separator ";". For example, 3600-3700; 3750 means RF channels from 3600 to 3700 and RF channel 3750.
- "Apply Provider Filter"
  Filter Top N Pool concerning the provider.
- "Provider/MCC/MNC"
  Via "Add Provider" and "Add MCC/MNC" select a provider from the "Network Provider Database" or enter directly a combination of MCC and MNC.
- "Use only Main Carriers"
  Option for using only main carriers for the Top N pool calculation. The option is per Top N pool, which allows to create pools which contain traffic channel and which do not.

Remove ← Top N Pools
Deletes the selected entry from the "Top N Pools" list, see "Remove" on page 311.

Properties ← Top N Pools
Allows the modification of the properties for the selected Top N pool. The "Properties" dialog contains the same panels as the "Add" dialog, all field descriptions are defined there.

TETRA scanner signals settings

The following panes are part of this page allowing you to set TETRA signals.

- "ROMES Signals"
- "C1 Calculation"
- "Percentile for LTP (TETRA Power) calculation"
- "TETRA Transmitter Colour"

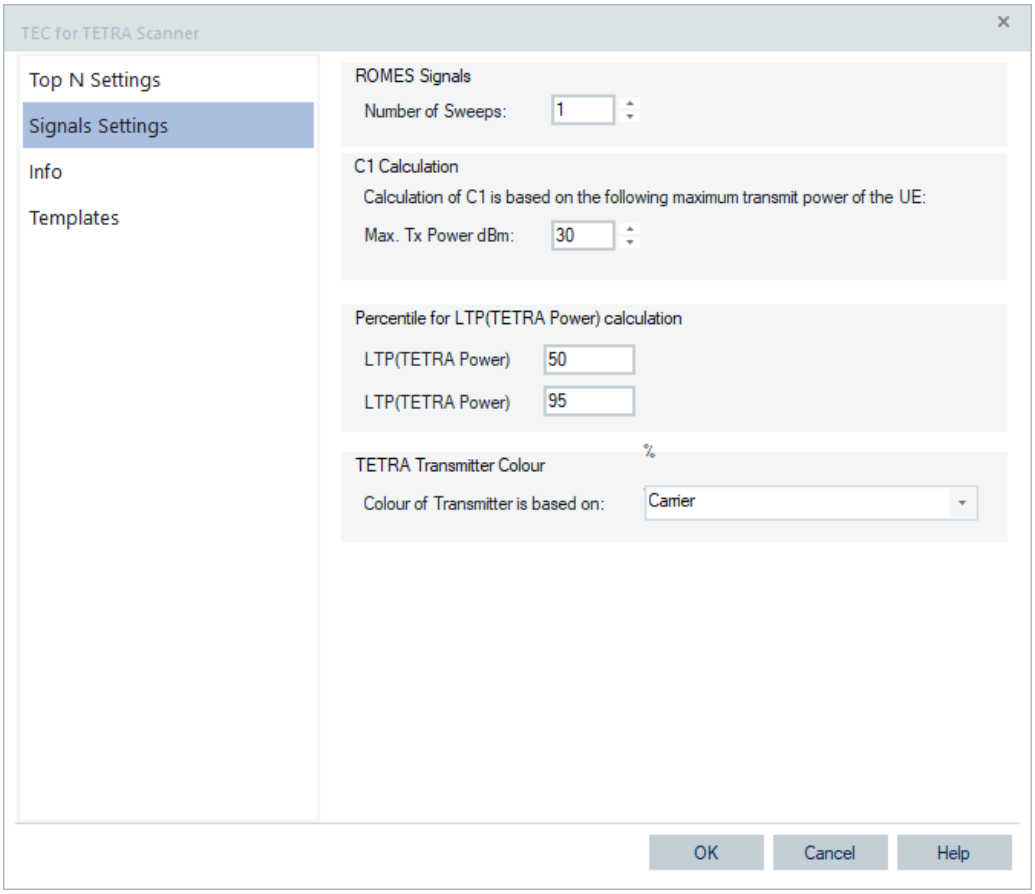


Figure 3-252: TEC for TETRA Scanner – Signals Settings

ROMES signals
- "Create Signals for each possible Carrier"

If activated, a set of signals is created for each carrier. The signals are visible in the "Available Signals" tree, under "TETRA Scanner" > "Device n" > "Carrier [#x, <variable>]".

- "Number of Sweeps"
  TETRA scanner supports multiple sweeps. This option allows the number of sweeps to set, that is, to configure more than one sweep for the TETRA signals. The configured sweeps are numbered from #1 to #n.
  TETRA signals and views are marked with "#'<Sweeps>", see TETRA Channels.

C1 calculation
The function calculates the C1 criteria as the scanner results. The C1 criterion is calculated from the values of the broadcast channel and the configured maximum UE transmit power.

- "Max. Tx Power dBm"
  Defines the maximum transmit power of the UE. This value is needed for correct calculation of the path loss parameter C1.

Percentile for LTP(TETRA Power) calculation
LTP(TETRA Power) is the probability of a certain TETRA Power over the Lee Time.

Within the Lee Time, all TETRA powers are put into a CDF. Taken the x percentile of Location Time Probability of TETRA power is a n'th value of sorted TETRA power and is named the LTPxx(TETRA Power). For example, LTP95(TETRA Power) stands for 95% percentile of LTP(TETRA Power).

Enter the wanted value for up to two LTP(TETRA Power) percentiles. These two parameters are stored to registry, therefore they persist over all workspaces.

TETRA Transmitter Colour
The function allows you to choose LA or carrier as a color indicator of the TETRA transmitter.

This color is used in the map for the underlays of radios and scanner signals and in the TETRA TopN View and TETRA Spectrum View. Together with the new auto-color feature, it offers a convenient way to display easily the LA for the transmitters.

Info tab

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

Templates tab

The "Templates" page is divided into two parts.

The upper "Available Templates" part allows loading or deleting a user-defined template for the technology.

In the lower "Save Current Settings as Template" part you can name a template and describe the template's entry before saving the current settings which is defined in the "TEC for <variable> Scanner".

The "Save" button opens the "Save As" page for the template file.

For how to use the template, see the general description in Chapter 3.8.2.2, "Technology scanner settings, info, templates", on page 285.

3.8.3 Coupled focus

Enables or disables the coupled focus between several views (see Chapter 3.1.3, "Coupled focus", on page 101).

3.8.4 Hold all views

Freezes the current measurement display of views for examination purposes without stopping the measurement.

3.8.5 Transmitter database

Click the "Tools" > "Transmitter Database" command to open the "Base stations" window.

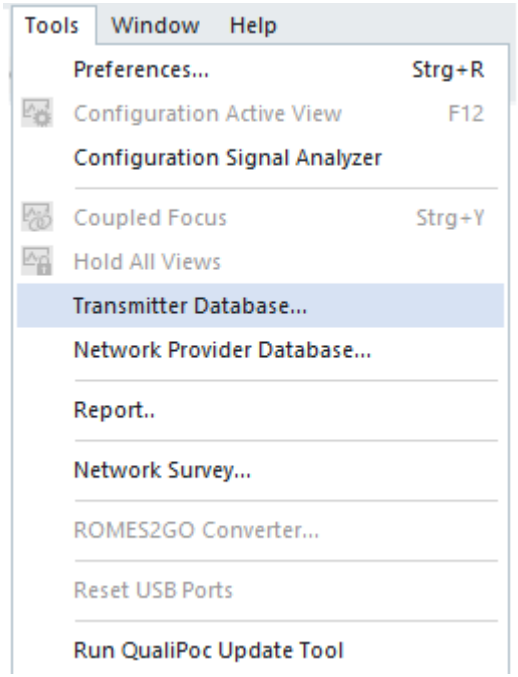


Figure 3-253: Opening Transmitter Database window

You can manage the cell database files of all mobile technologies base stations (BTS) in this window.

Click the arrow of the drop-down box in the "Technology" pane to select technology for which you want to manage cell database file.

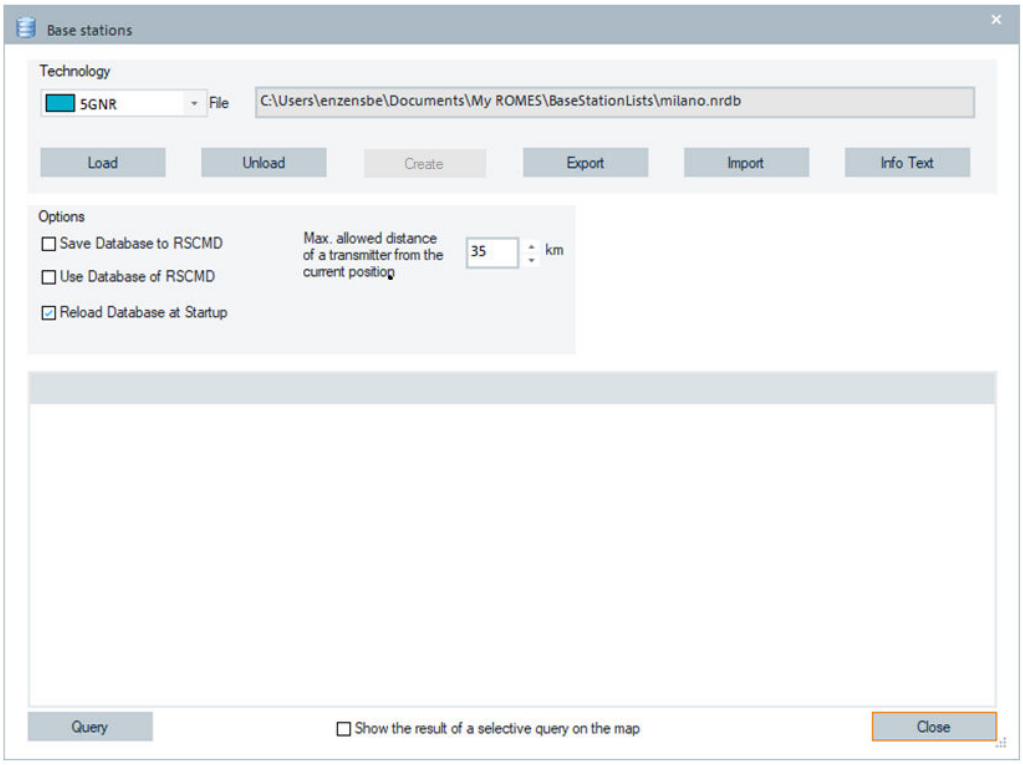


Figure 3-254: Base stations window

R&S ROMES4 supports common database, as one that R&S NESTOR uses, see Chapter 7.3.3, "CSV format definition for BTS list", on page 2182. The common database support helps in data management of huge databases and gives more flexibility across the products.

R&S ROMES4 uses the Nestor Rohde.Schwarz.CellDatabase server to import GSM, UMTS, LTE and 5G NR base station databases. The RohdeSchwarz.CelldDatabase server is installed while installing R&S ROMES4 and started with R&S ROMES4 start. This R&S ROMES4 additional process can be seen in "Task Manager".

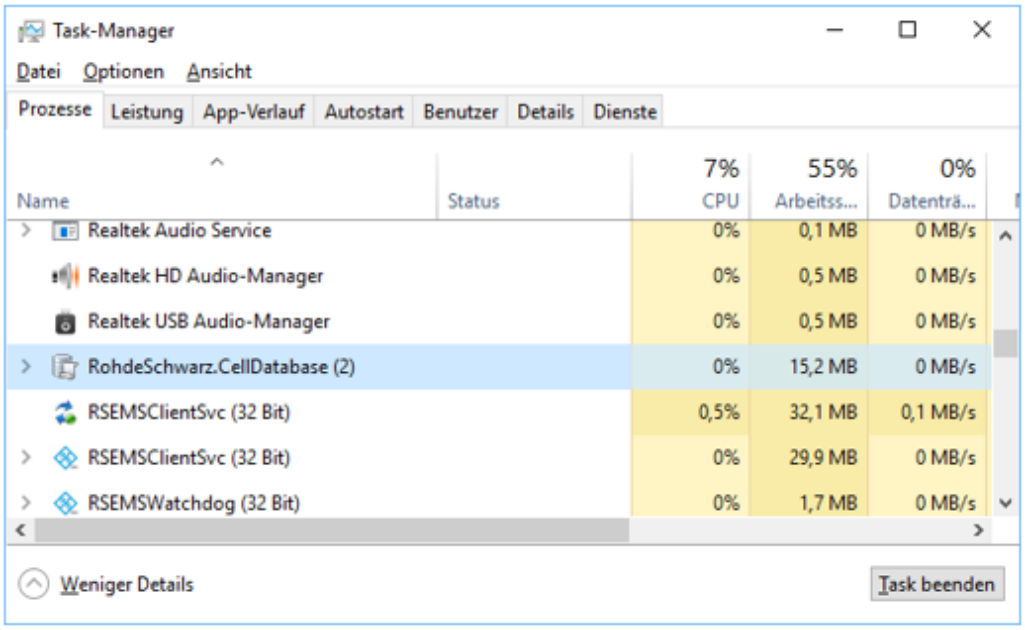


Figure 3-255: RohdeSchwarz.CellDatabase process

The old BTS DB files of the 3GPP defined technologies are not supported anymore since the newly created DB files have different filename extensions and formats (SQLite DB). For the database file extensions, see Table 3-9.

3.8.5.1 Technology

The designated transmitter database for the different technologies can be loaded and/or selected in the "Technology" window.

Further actions for the selected transmitter database are possible, for example, a database load/unload or export. The "Info Text" tab enables visualization of the BTS data in the "ROMESMAP Route Track View".

Drop-down menu
Switches between the databases of the different technologies.

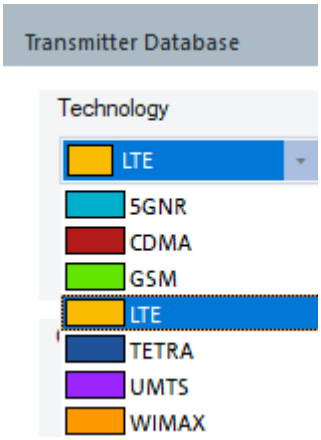


Figure 3-256: Technology selection via drop-down menu

Load
Opens a dialog to browse and select an existing database file. R&S ROMES4 accepts the file formats shown in the following table.

Table 3-9: Supported file formats for loading

Technology	File extension
5G NR	nrdb
LTE	ltedb (replacing the enbdb extension since R&S ROMES4 v.19.0)
UMTS	umtsdb (replacing the umtsdb extension since R&S ROMES4 v.19.0)
GSM	gsmdb (replacing the gsmdb extension since R&S ROMES4 v.19.0)
CDMA	cndb
TETRA	tdb
WiMAX	wmdb

Unload
Removes the conjunction of the current selected transmitter database with R&S ROMES4.

Select the technology database from the drop-down menu. Click the "Unload" button. If the action was performed successfully, the database disappears from the "File" information field.

Create
The tab is without a function.

Export
Exports the stored data from the transmitter databases to a file. The export function uses the TXT format-based files. The format of these files is specified so that other systems can use them.

Export of BTS databases to *.csv format for QualiPoc ← Export
Loaded transmitter databases of GSM, UMTS, LTE and 5G NR can be exported as `*.csv` files in QualiPoc format. Exporting into the QualiPoc format writes the file in UTF-8 coding.

QualiPoc displays non-ASCII characters in BTS names as question marks.

The function is found in the "Save as type" drop-down box of the "Transmitter Database" > "Export" > "Export Database" page.

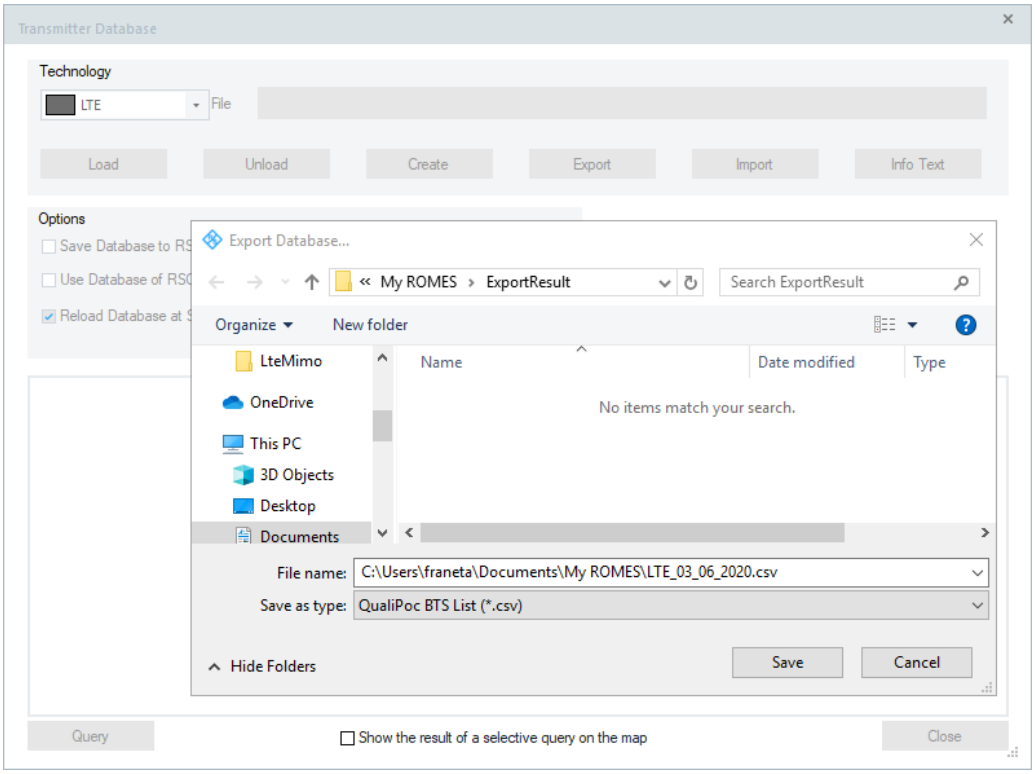


Figure 3-257: Export dialog of QualiPoc

Export of GSM databases to *.csv ← Export
The GSM databases support export to two CSV export formats.

- QualiPoc BTS List for generating CSV file which includes only the predefined mandatory columns.
- ROMES DB BTS List for generating CSV file which includes all columns supported by database.

Export Database...:

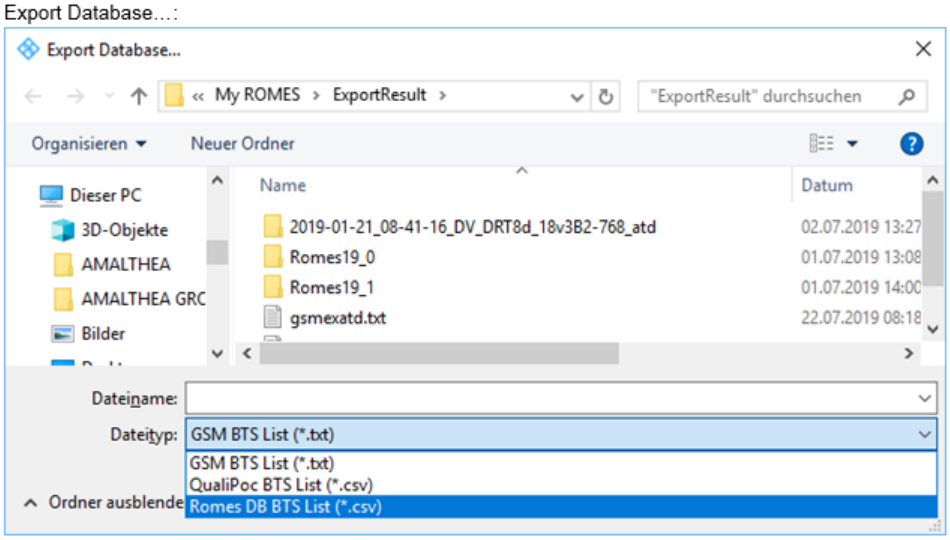


Figure 3-258: Supported GSM DB export formats

Import

Imports a file from the BTS list file into the database.

The import function uses the text format-based files. The format of these files is specified so that other systems can use them. The R&S ROMES4 import function supports the following file formats.

Table 3-10: File formats supported for import

Technology	File extension
5G NR	ATD, CSV
LTE	ATD, BUF, CDC/CDN, CSV
UMTS	ATD, BUF, CDC/CDN, CSV
GSM	ATD, BUF, CDC/CDN, VIG, CSV
CDMA	ATD
TETRA	ATD
WiMAX	ATD
Note: The recommended import format is ATD. The CSV format supported for import of GSM, UMTS, LT'E and 5G NR base stations brings to users no visible changes in the "Base station" window.	

Supported import formats are described in chapter "Data Processing", section Chapter 7.3, "BTS list formats", on page 2163.

For details, see Chapter 3.8.5.2, "Import of BTS list file into the database", on page 391.

Info Text
The tab opens the "Specify Info Text" dialog.

Check the combo box "Full" and "Short" or "Short(N)" associated to the transmitter parameters that you want to be displayed inside the "Bts Info" field and directly in the "Navigation Views" > "ROMESMAP Route Track View".

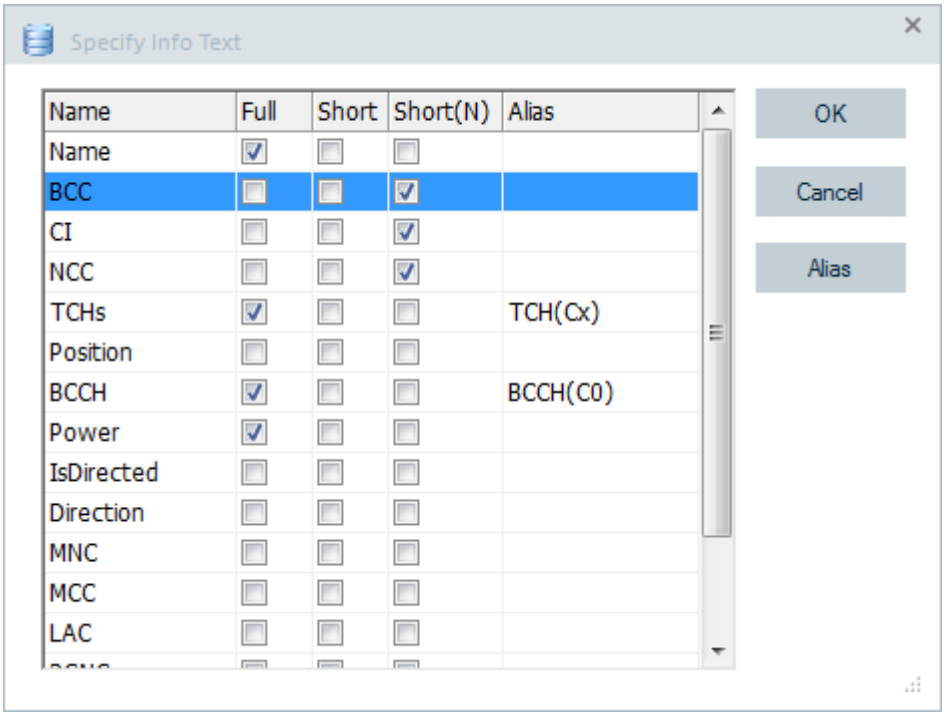


Figure 3-259: Data text to be shown

- "Name"
  Name of the column as used in the transmitter database, not editable.
- "Full"
  If checked, the parameter value is displayed in "Bts Info". To open this field, press SHIFT+ left mouse button when hovering over a transmitter symbol in "ROMESMAP Route Track View".
- "Short"
  If checked, the parameter value is displayed as a "quick" information directly at the transmitter symbol that is visible in the navigation view.
  TIP: To avoid too much text in the view, use a value adjustment in "ROMESMAP Route Track View" > "Route Tracking".
  TIP: To adjust the resolution threshold, enter the preferred value in "Bts Symbol" > "Bts Info Threshold" > "Short Info". The default value for showing info is 10 km per 1000 points screen resolution.
- "Short(N)"
  If checked instead of "Short", a full information is displayed, that is, the meaning of the displayed values.
- "Alias"
  To use an alias name instead of the original one from the database, select the target line and click "Alias". A dialog for entering or modifying the alias name is displayed. Enter the preferred name and confirm with "OK".

Figure 3-260: Short(N) BTS information

3.8.5.2 Import of BTS list file into the database

To import an existing BTS list file (`*.atd`, `*.buf`, `*.txt`, `*.cdc`) into the database:

1. Open the "Base stations" window.
2. Ensure that an empty or non-empty database file is available or create a file (see the previous section).
3. Select a RAT from list in the "Technology" box.
4. Click the "Import" button.

   The file selection dialog opens.
5. Select a BTS list file that you want to import into network database.
6. Click "Open" to import the BTS list file.

   Note:
   - If your BTS list file contains valid MCC and MNC information, proceed as indicated.
   - Otherwise, check the "MCC" and "MNC" boxes and enter your MCC and MNC in "Open" > "Import to NDB". Then proceed as indicated, that means, click "Open"
7. **For GSM only**

   a) If your BTS list file contains valid MCC and MNC information, go to step 6.
   b) Otherwise, check the "MCC" box.
   c) Continue by checking the "MNC" box.

d) Enter your MCC and MNC in the "Open" > "Import to NDB" field.

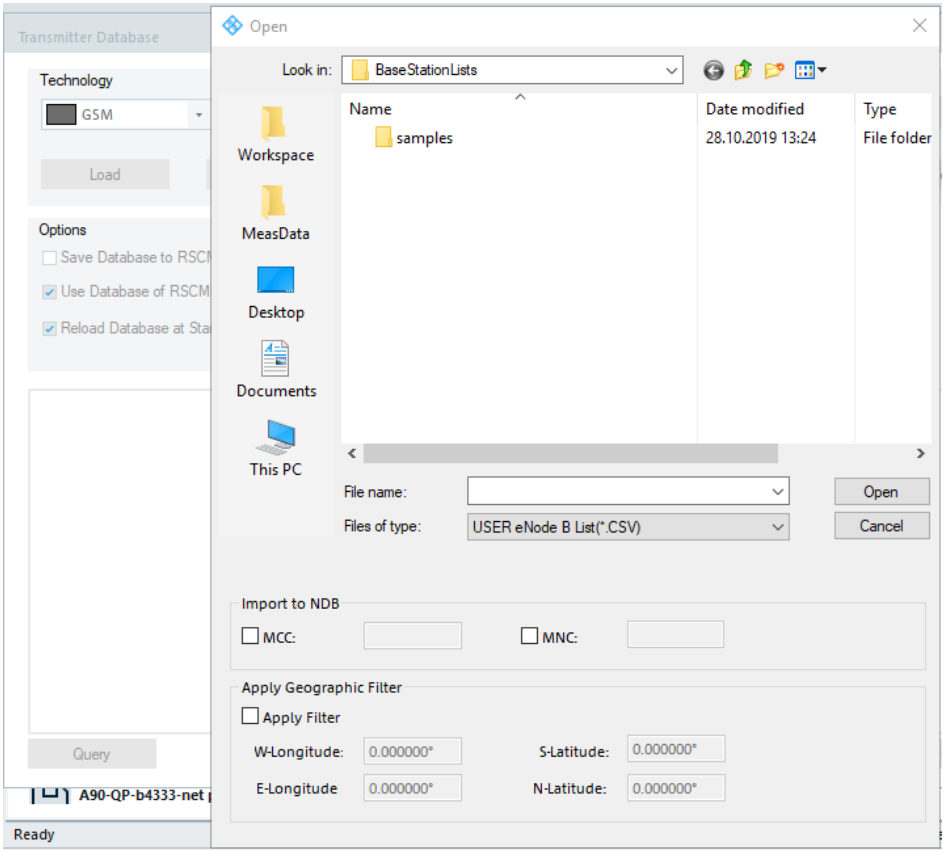


Figure 3-261: Selecting file for import

e) Click then the "Open" button to confirm the new entries.
f) Update the "MCC/MNC" list.

8. If the "Do you want to create a new database?" message box opens, click "No" to add the data to a selected database. If you want to create a database instead, click "Yes".

   The "Create Database" dialog shows.

9. Give the file name.

10. Click "Save"

11. **For GSM only**
    Define the GSM type in "Create Database" > "Network".
    The "Network" pull-down list defines the GSM hyper-band for the BTS database file. The band selection operates as a filter and prevents import of BTSs of other bands into the database file. For example, for databases containing both GSM900 and GSM1800 base stations, GSM 900 +GSM E + GSM R + GSM 1800 has to be selected.

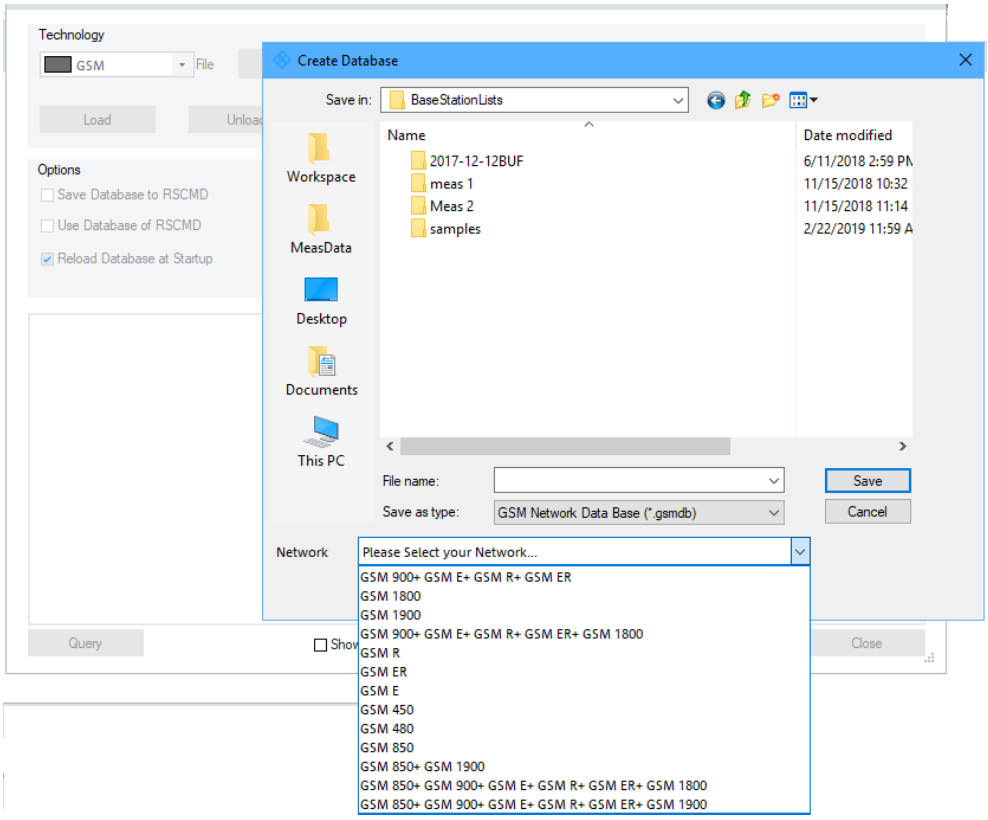


Figure 3-262: Create Database window for GSM

The file import is terminated.

The LTE neighbor cells import from CDC format input files into the GSM BTS database is supported.

Import of BTS list of CSV files

The import of BTS list of CSV files related to 3GPP specified technologies is simplified by the Transmitter List Formatter tool. Use the "Transmitter List Formatter" dialog of the tool to assign the content of the CSV file to the mandatory columns of the R&S ROMES4 database.

By importing the BTS list for a specific technology, the dialog switches to the corresponding mode automatically and shows all mandatory columns for the selected technology. The dialog tries to assign the CSV file column automatically to the mandatory database columns.

Verify the assignments, before you continue. Each combo box provides a Tooltip for detailed information of the expected data.

Although MNC, MCC and NCC (for GSM) are mandatory, these columns have not to be present in the source CSV file. It is possible to enter the corresponding values directly into the input fields. Those values are used for all cells in the CSV file.

It is also possible to use a CSV file, which contains cells of different technologies, if one column of the CSV file identifies the technology. In this case, specify this column as "System/RAT" and select the corresponding "System-Filter" for the technology to import.

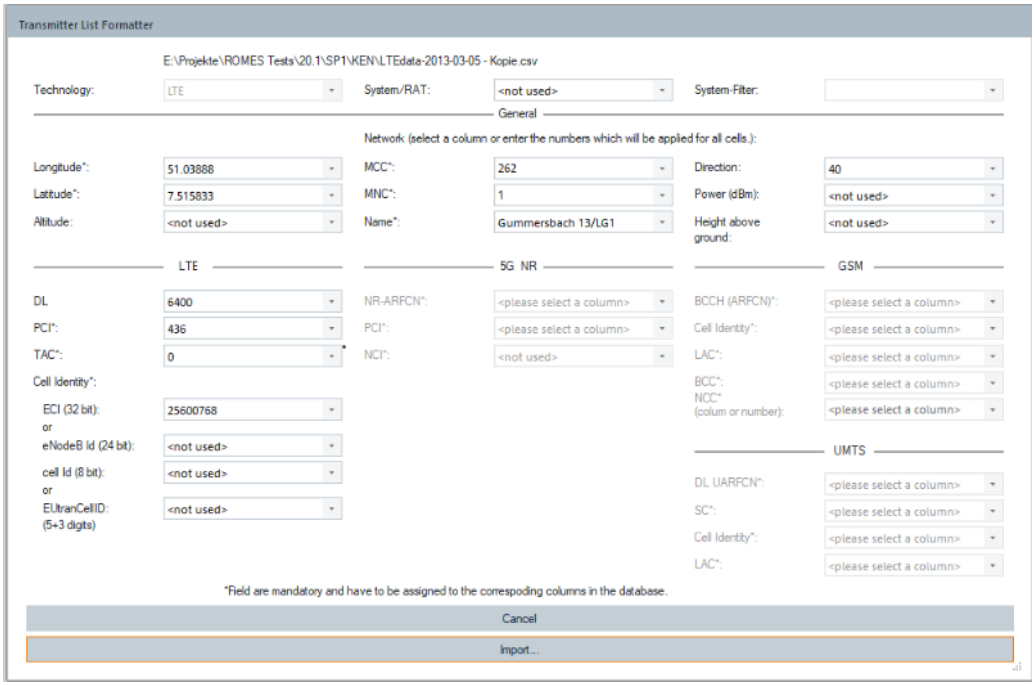


Figure 3-263: BTS list formatter dialog

After finishing an import, a message box is displayed if an error occurred.

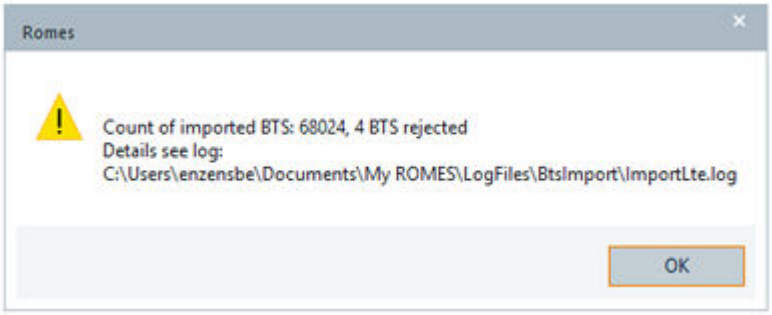


Figure 3-264: Reported error during the BTS list importing

Also a log file is created. The log file's sample looks as following:

Line: 1 Cell: NodeB Name - CellID invalid

Line: 67133 Cell: - CellID invalid

Line: 67231 Cell: - CellID invalid

Line: 67780 Cell: - CellID invalid

3.8.5.3 Query

Open the "Query" dialog to query BTS database.

It is possible to define geographic selection in the left part of the dialog.

- **Geographic selection by circle**
  Specifies the geographical center point and its radius in kilometers.
- **Geographic selection by rectangle**
  Specifies the W/E longitude and the N/S latitude.

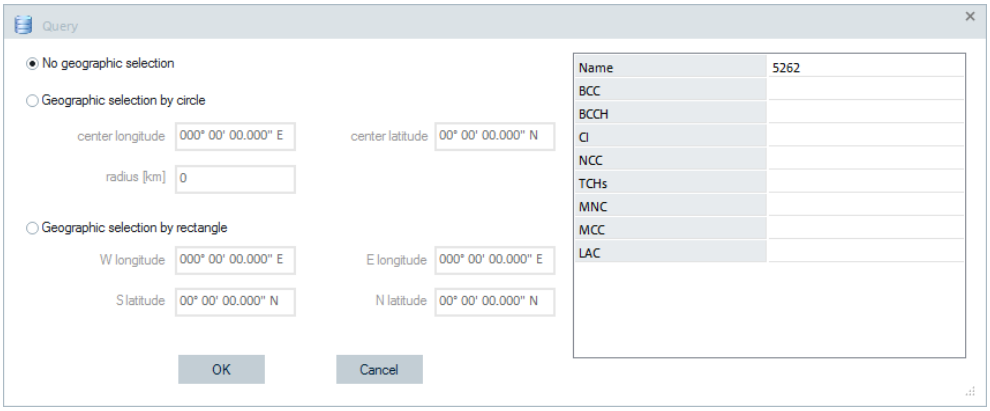


Figure 3-265: Query dialog window

The right part of the dialog window shows all available database columns. Specify in the list the values that the database columns have to contain. For example, the "Query" list has the value BTS for the "Name". The result of the parametric query is a table containing the data for those BTSs only whose name starts with the 5262 string.

Technology	Name	IsDirected	Direction	CI	NCC	Power	BCCH	BCC	Position	TCHs	MNC	MCC	LAC	2GNC
GSM	S262...	0	0	3..	2	30.00	15	0	011° 37'...		1	262	34...	
GSM	S262...	0	0	5..	0	30.00	43	2	011° 39'...		1	262	34...	
GSM	S262...	0	0	2..	1	30.00	33	5	011° 36'...		1	262	34...	
GSM	S262...	0	0	2..	2	30.00	94	0	011° 36'...		1	262	34...	

Figure 3-266: Result of parametric query

3.8.5.4 Expand BTS database - CSV import

To add custom defined values for CSV import, you have to add a "Tags" column to your CSV header. For each BTS define one or more custom values, separated by "#".

Example:

P	Q	R	S	T	U
TAC	EARFCN	CellID	PhyCellID	Tags	
13850	6400	25600512	488	HH2134#BB2134#CC2134	
13850	6400	25600513	486	HH2135#29.056	
13890	6400	25601024	219	HH2136	

Figure 3-267: Tags added to CSV header

After importing the CSV file, the "Transmitter Database" dialog lists for the selected technology all tags.

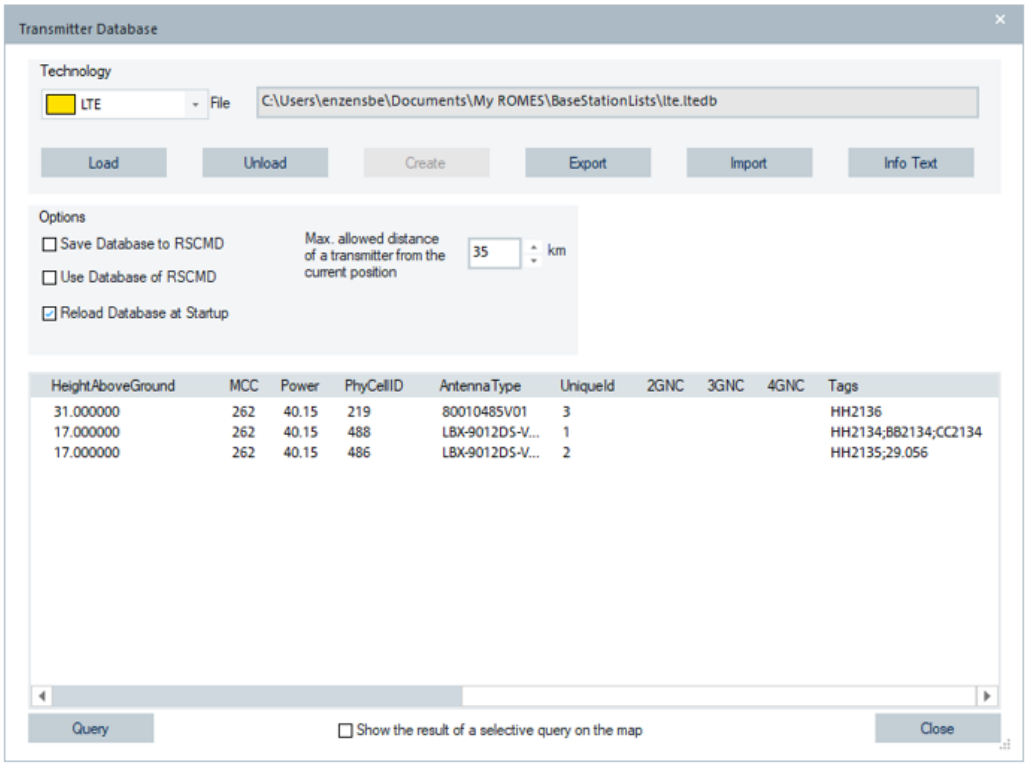


Figure 3-268: Listed tags of three LTE cells

To query the BTS database for defined "Tags" value, edit your search the string into the "Tags" section.

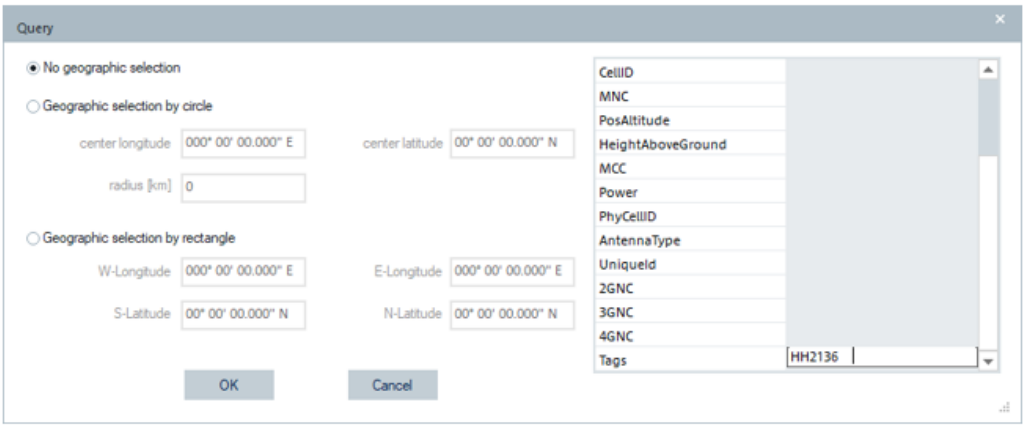


Figure 3-269: Query cell database by added tag

The following figure shows the cell's database query result.

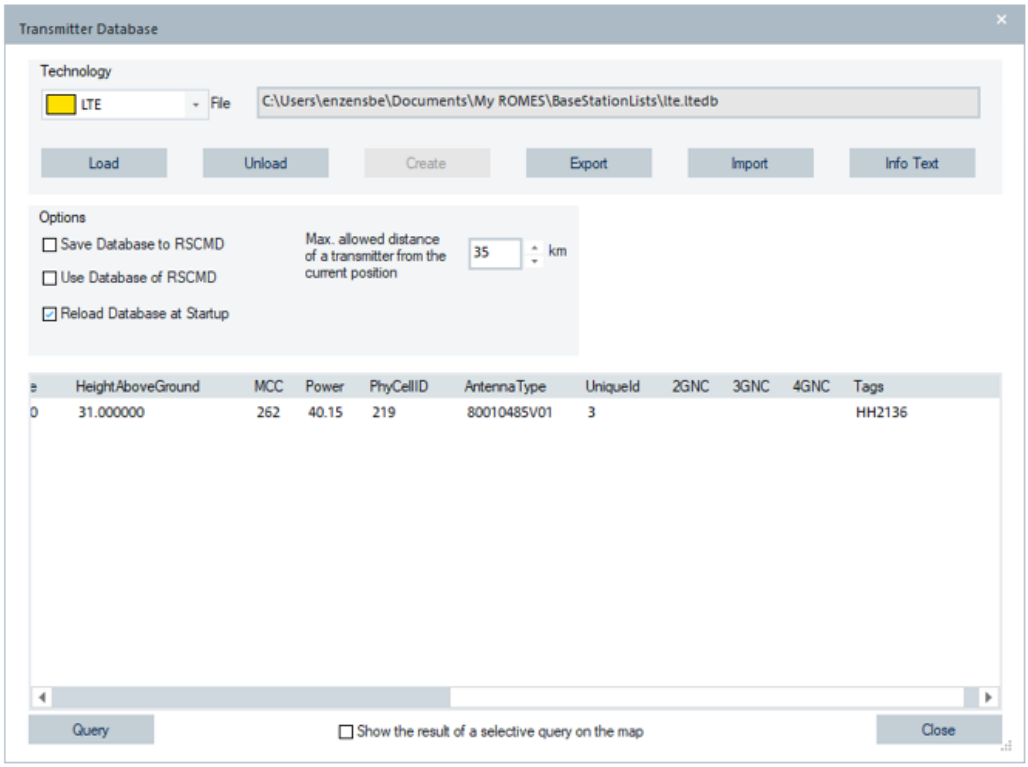


Figure 3-270: Result of the query with edited tag

From "Specify Info Text", select "Tags" entry to display tags value in "BTS Info" view.

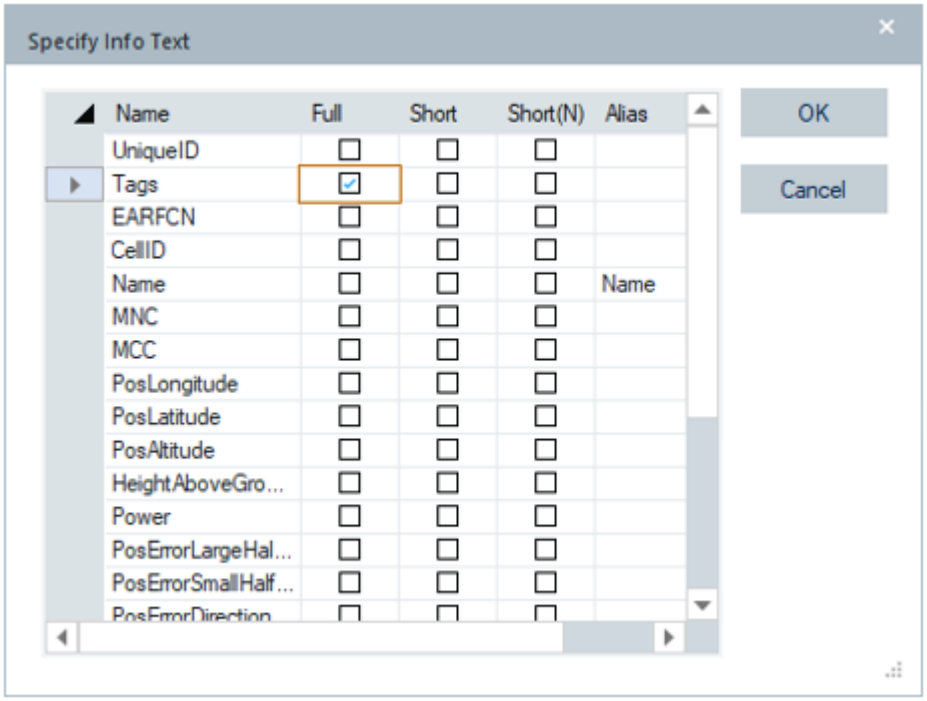


Figure 3-271: Tag selection

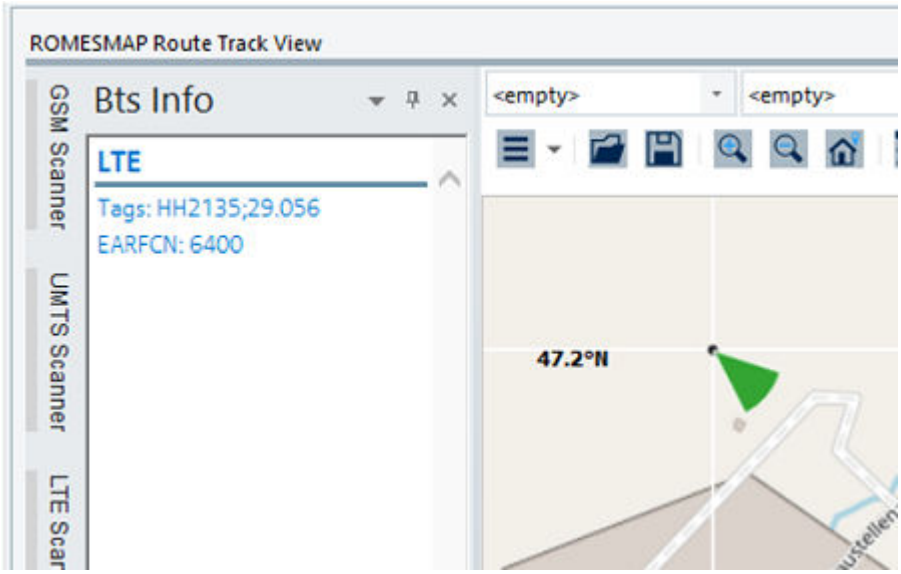


Figure 3-272: BTS info of LTE cell

3.8.5.5 GSM database station query

Case: 1

Open the "Transmitter Database" dialog to query GSM BTSs. The list of BTS stations is displayed.

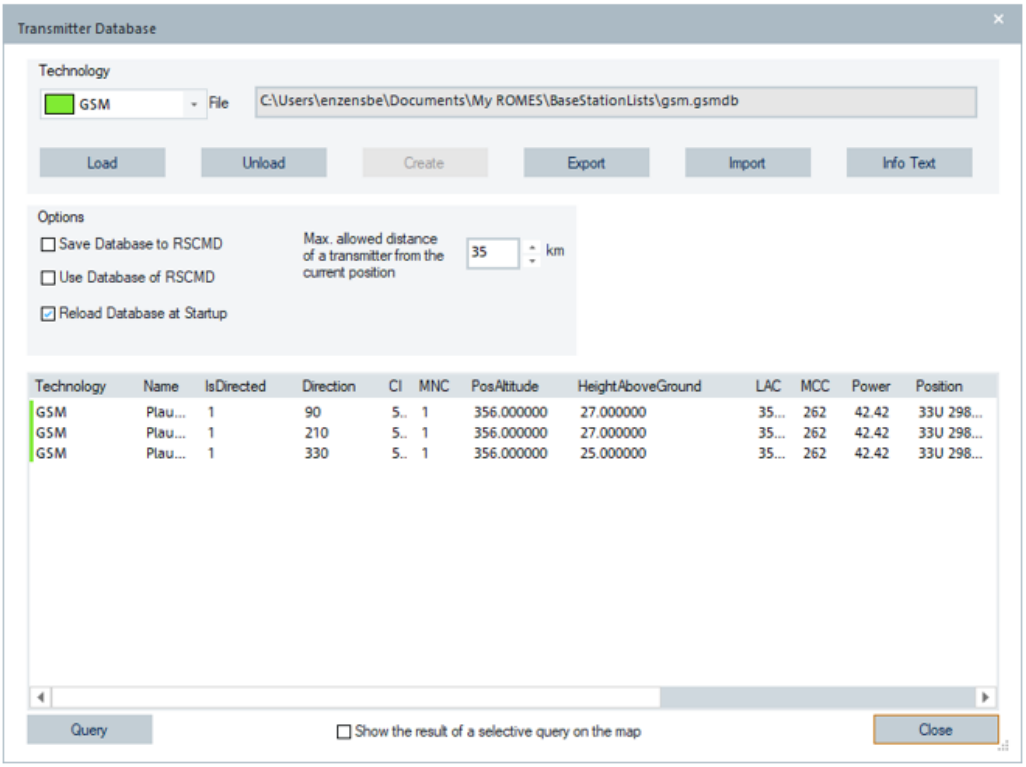


Figure 3-273: List of GSM cells

Click the "Query" button to open the "Query" dialog. All tags defined for GSM BTSs are available for query. For example, enter a query value for the "HeightAboveGround" parameter.

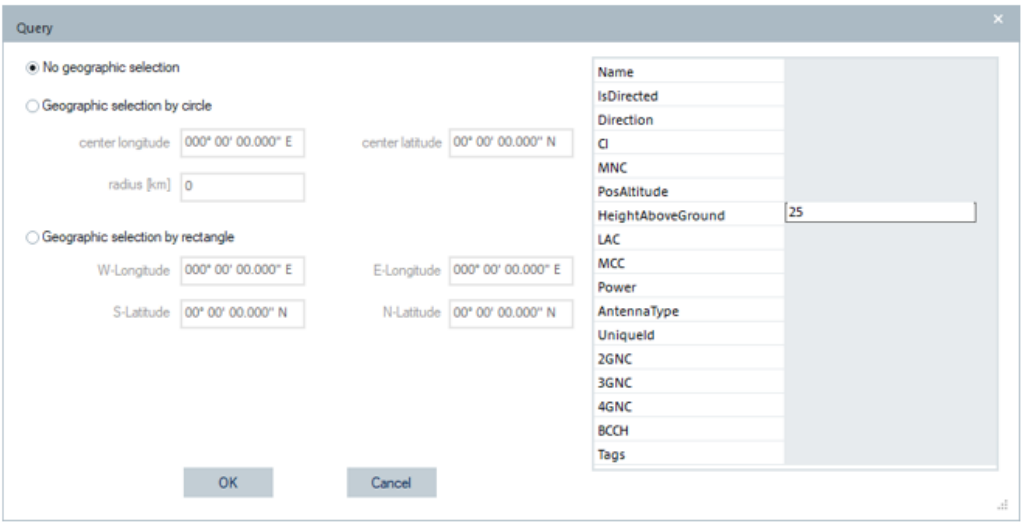


Figure 3-274: BTS query by HeightAboveGround

The query result is shown in the "Transmitter Database" dialog for BTSs that have the "HeightAboveGround" value as indicated in "Query".

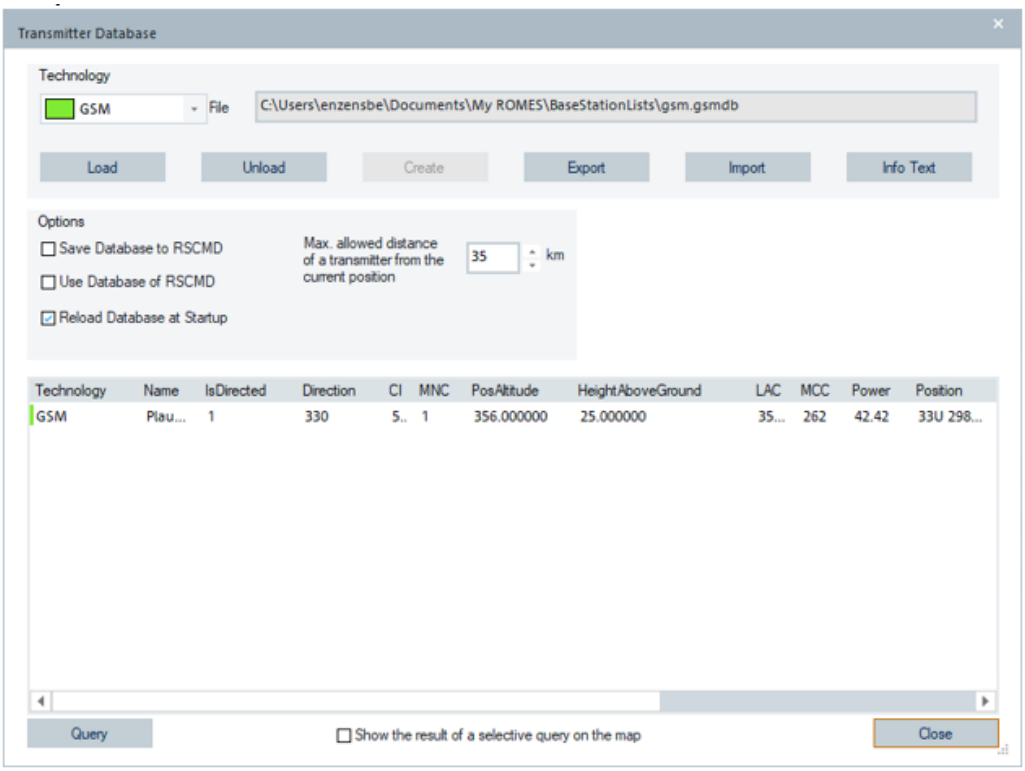


Figure 3-275: Result of the query of GSM BTS

Case: 2

Open the "Transmitter Database" dialog to query for "Tags" value of GSM BTSs. The list of BTS stations is displayed.

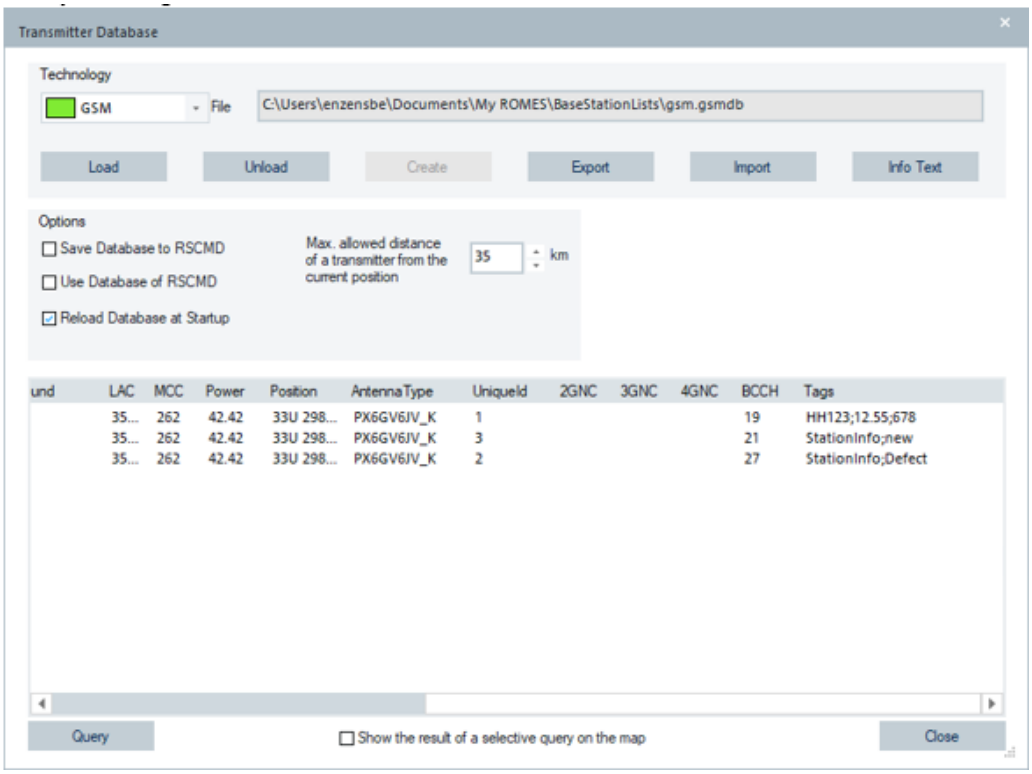


Figure 3-276: Configured tags of GSM cells

Edit the complete or part of custom defined "Tags"value.

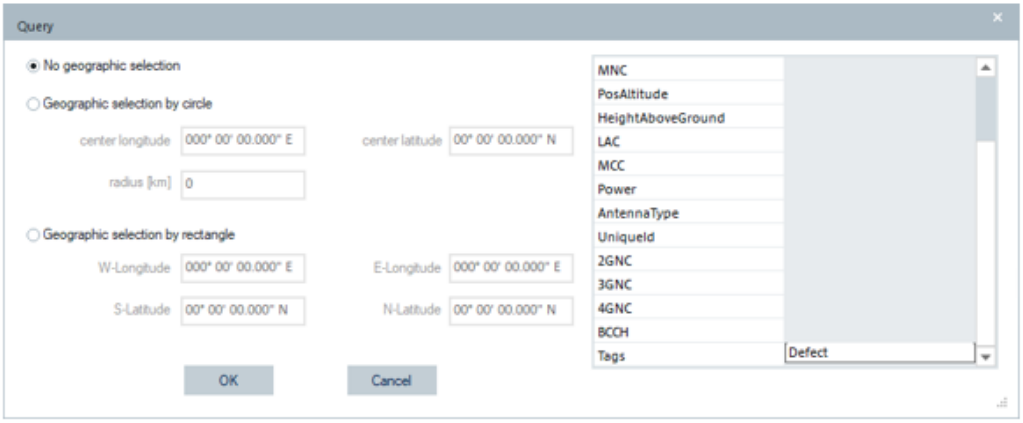


Figure 3-277: Query for GSM cells with tag defect

The query result is shown in the following figure.

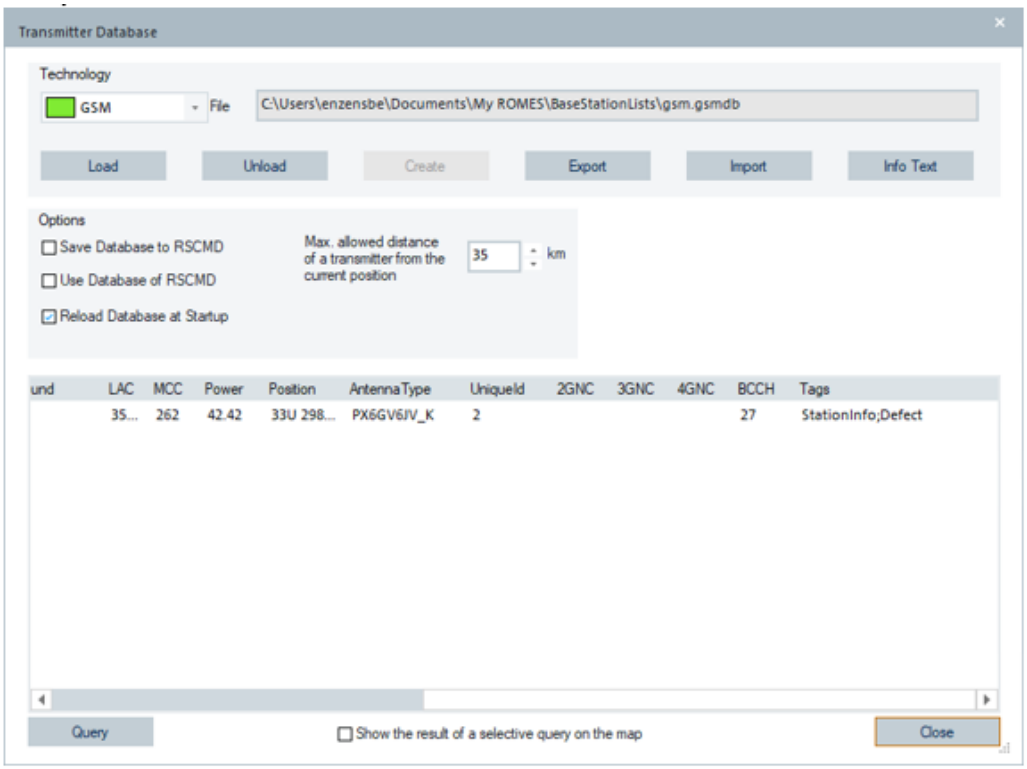


Figure 3-278: GSM cell with tag station info, defect

3.8.5.6 Options

- **Save Database to RSCMD**
  The current BTS database is included into the measurement file `*.rscmd` created for the next measurement.
- **Use Data of RSCMD**
  The next replay does not use the current BTS database but the BTS information included in an existing measurement file (`*.rscmd` or `*.cmd`).
- **Max. allowed distance of a transmitter from the current position**
  Assume that only BTSs within a definite radius around the measurement position have any influence. Excluding distant base stations saves processing time. For example, the maximum GSM cell radius of approx. 35 km is a good estimate for the maximum distance.
- **Reload database at startup**
  Reload database at startup. The database loaded when R&S ROMES4 shuts down will be reloaded next time R&S ROMES4 starts.

3.8.5.7 Show the result of a selective query on the map

If selected, the red BTS marker functionality of the ROMESMAP Route Track View is available for the queried BTS. Click the red BTS marker to get the info field, see the Figure 3-260.

3.8.6 Network provider database

The R&S ROMES4 "Tools" > "Network Provider Database" menu opens the "Edit, Add or Remove Network Providers" window.

The window is divided into two panes. The left part of the window, the "Countries" pane, shows the configured worldwide moble network operators saved in the database. The right "Provider" pane displays the details of a selected previously configured provider or of a new created provider. The information available in this pane is the provider's name, a country it belongs to, its MNC, the provider associated color and the supported RATs. The associated color is used then system-wide.

The buttons on the bottom of the window change dependent on the selected items and actions.

Apart from possibility to select and edit information on existing providers, you can add new providers to a country or remove the selected provider. The + button added next to the "Country" dropdown box lets you add or modify a provider's Mobility Country Code. The button becomes functional when you click "Add Provider" or, for the selected provider, the "Edit Provider" button.

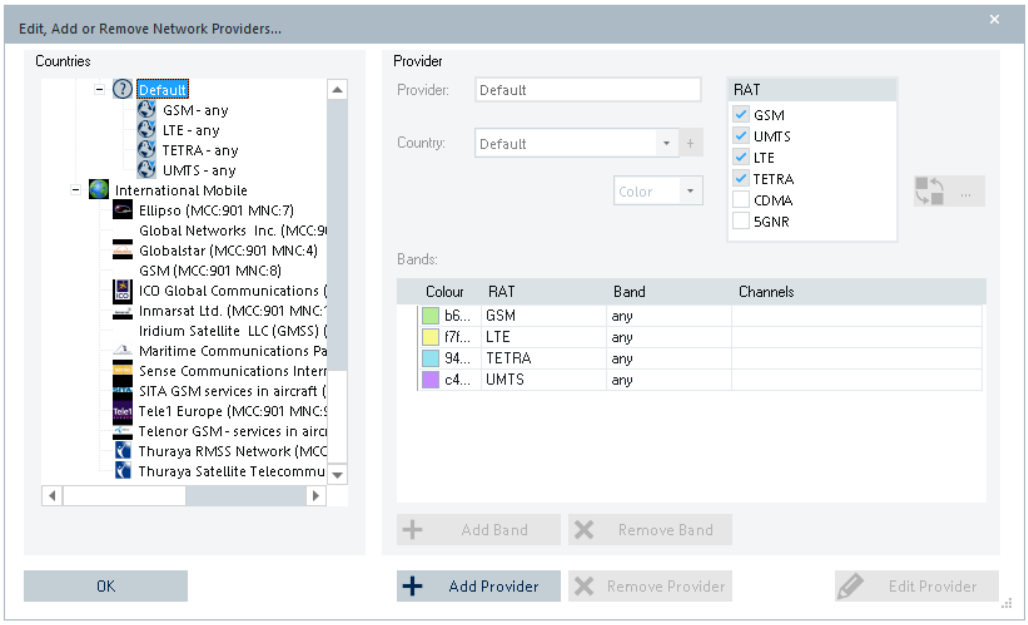


Figure 3-279: Network provider database window

The ... button is also functional when you click the "Add Provider" or the "Edit Provider" button. It lets you attach the preferred icon to a selected or added provider from the set of icon `*.ico` files. If the button is clicked, the "Open" window pops-up. Browse a folder where the icon files are stored.

The network provider database file is located in the user-specific directory

`..."…\My Documents\My Romes\Configuration`

The file is put at this location during the R&S ROMES4 startup. If not found, check the "Update Directory Structure at Startup" box in the "Tools" > "Preferences" window.

In rare cases, a message is issued if the opening database file for writing is not possible.

3.8.6.1 Define color scheme for views

To distinguish the network provider's different channels on the map, the option to set the color of the channels of the supported technologies is applicable. It is necessary to define bands the configured channels belong to in the network provider database. There is the possibility not only to select different colors for bands of different technologies, but also to distinguish by color different channels within one band. You can define the same band, different channels using different colors. Defining those entries is done in the "Band" graph.

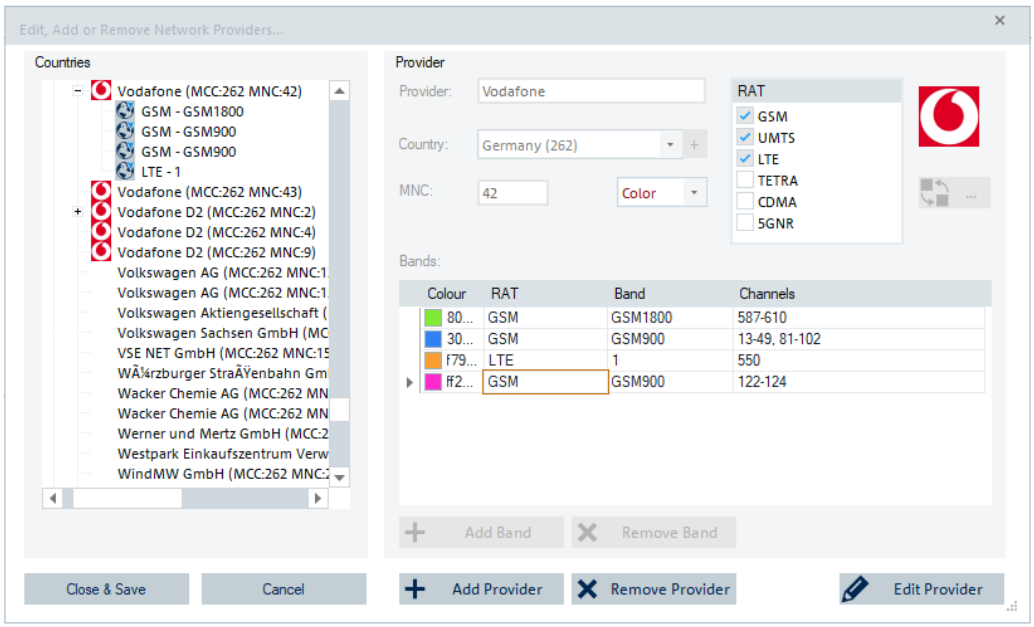


Figure 3-280: Network provider database window – Edit mode

After the colors of technologies, bands and channels are selected chose the button "Apply Changes" to make the selections executable. At the end, click the "Close & Save" button to make the change persistent.

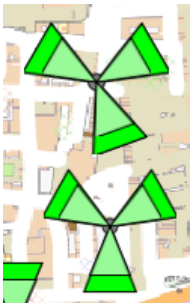
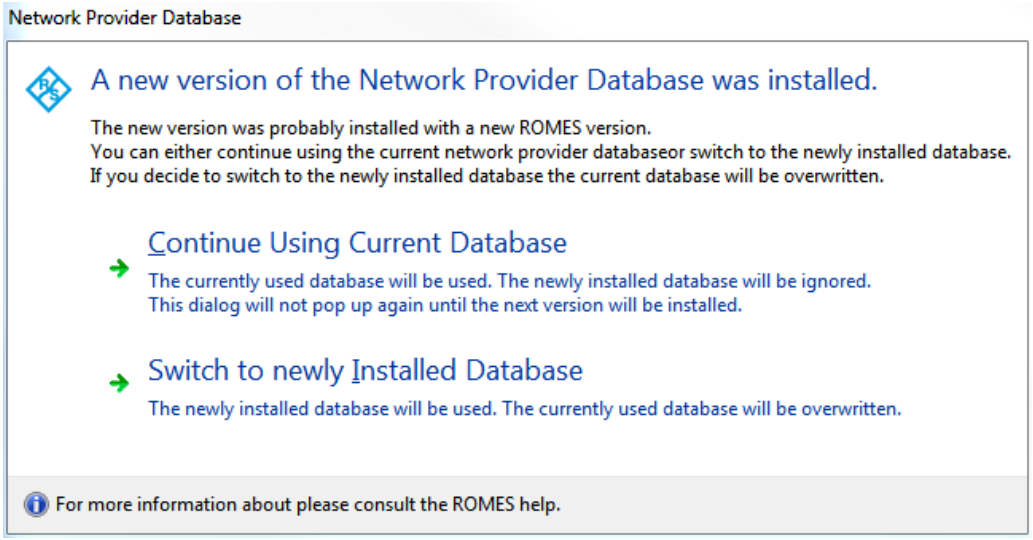


Figure 3-281: GSM base stations

With the installation of a new R&S ROMES4 version, a new network provider database is also installed. If the currently used database differs from the originally installed one, you are asked what you want to do. You can continue using the current database, which can contain your adaptions or use the new database which is coming with the installed version.



3.8.6.2 Add/Edit network provider

The steps to add a new network provider and to edit the existing one slightly differ.

Adding network provider

1. Select the R&S ROMES4 "Tools" > "Network Provider Database" menu.

   The main window of the "Network Provider Database" opens. The left part of the window is grayed out.

2. Click the "Add Provider" button if you want to add a new provider to the database.

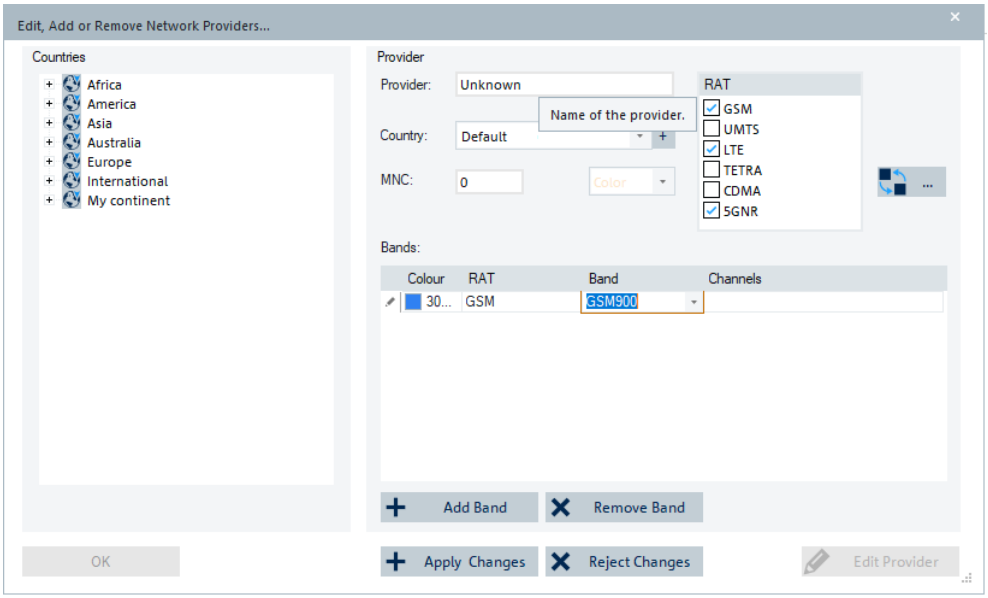


Figure 3-282: Create entry in the Network Provider Database

The left part of the window changes. It becomes functional and lets you specify provider's details, that is, provider name, country, RATs to be recorded, the providers color, bands and the MCC.

3. The + button changes to +. Click the button. The "Add Mobile Country Code" dialog pops-up where you can specify the new provider, country and the MCC.

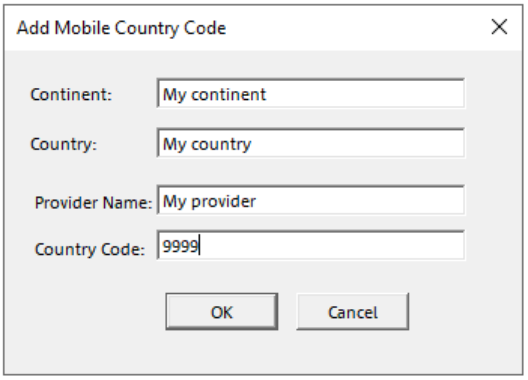


Figure 3-283: Adding new provider

4. Click "OK"

   The added provider is included in the list of the network providers in the "Countries" pane.

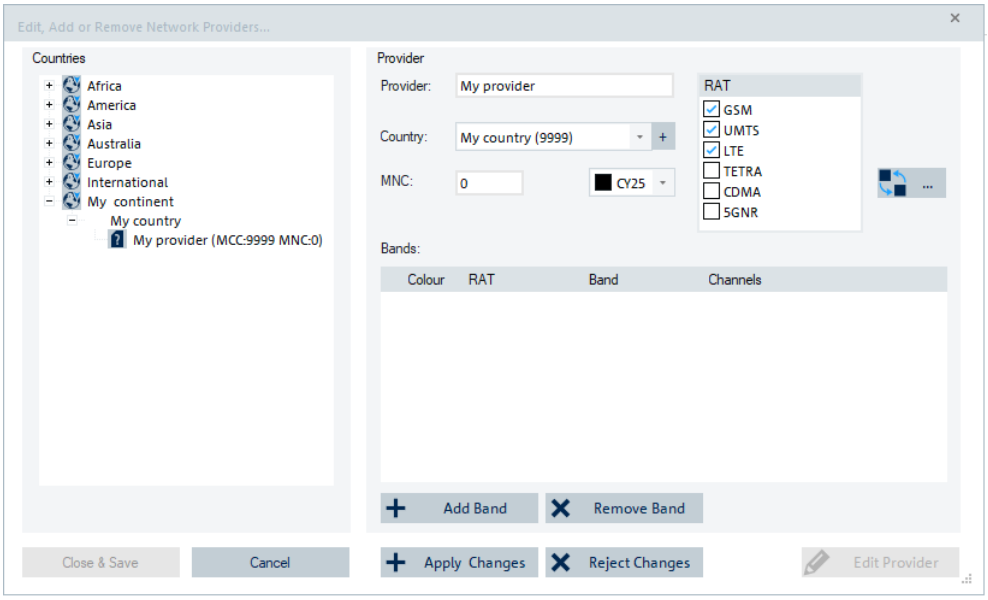


Figure 3-284: The added provider included in the database

5. Click the "Apply Changes" button for addition of the new provider to the database.

   The "Close & Save" button becomes now functional.

6. Click the "Close & Save" button to finish the procedure and save the changes in the database, providing the change persistency.

Editing network provider to modify MCC

1. Select the network provider in the "Countries" pane if the provider is present in the database and you want to edit and modify data.

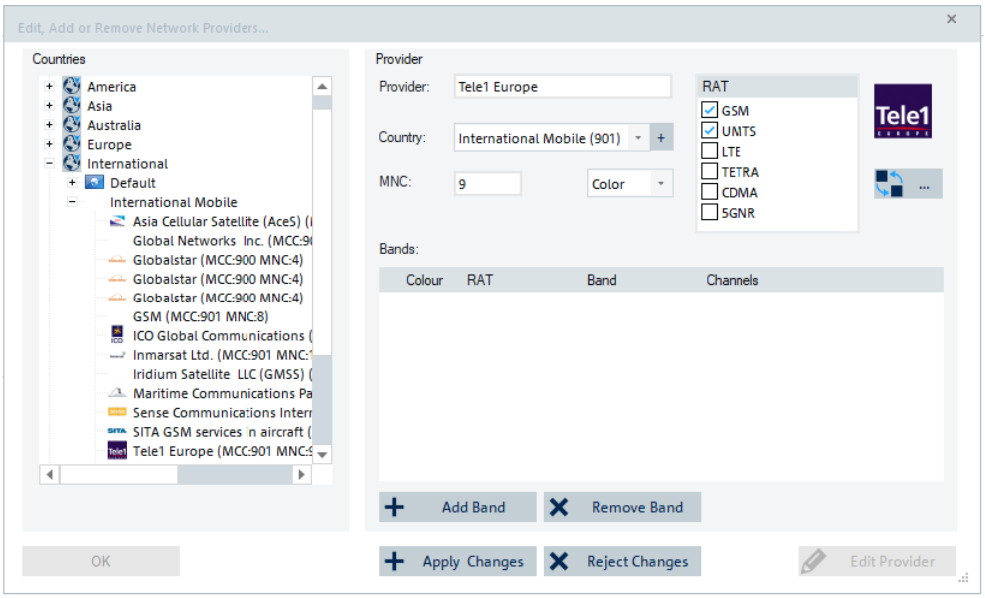


Figure 3-285: Edit an entry of the Network Provider Database

2. Click the "Edit Provider" button for selected provider.
3. The + button changes to +. Click the button to modify MCC.
4. The "Add Mobile Country Code" dialog pops-up.

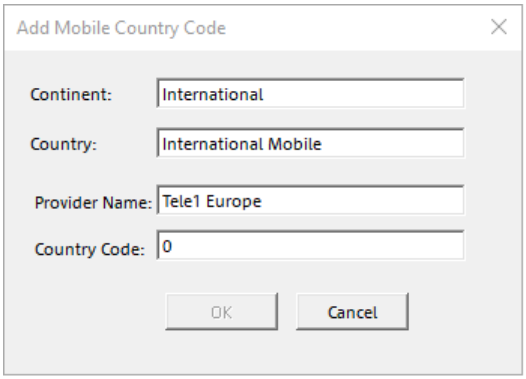


Figure 3-286: Edited provider data

5. Specify the value in the "Country Code", for example 999.

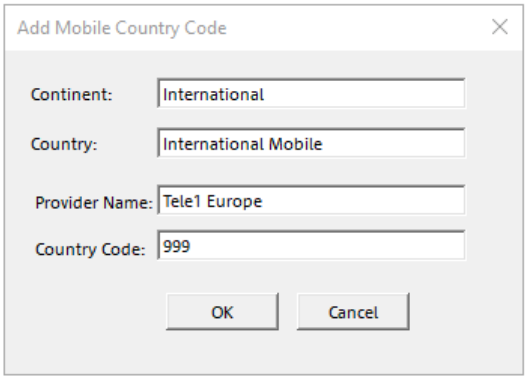
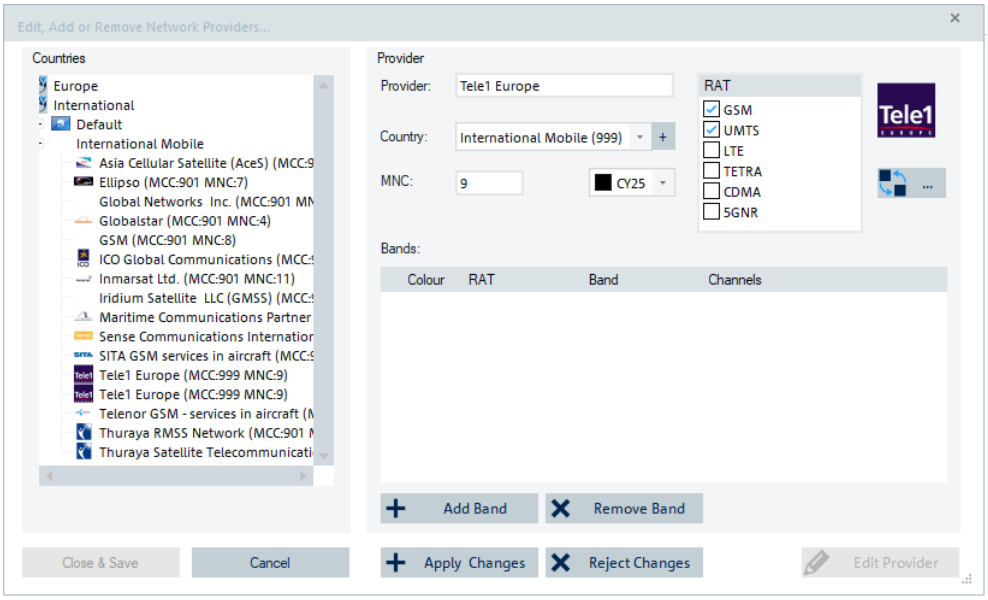


Figure 3-287: Modified provider data

6. Click "OK".
   The changed MCC is added for this provider in the list in the "Countries" pane.



7. Repeat the steps 5. and 6. from the previous procedure.

   The modified MCC is saved in the network provider database, providing the change persistency.

Otherwise, applicable for both procedures, click the "Reject Changes" button to discard the previous actions.

Add mobile country code

The "Continent", "Country" and "Provider Name" are auto-populated if they are available in the "Countries" pane selection.

- If a provider is selected in the "Countries" pane, the continent, country and provider are available.

- If a country is selected in the "Countries" pane, the continent and country are available. Provider is populated with private provider.

- If a continent is selected in the "Countries" pane, the continent is available. Country and provider are populated with private country and private provider, respectively.

- If none is selected in the "Countries" pane, continent, country and provider are populated with private continent, private country and private provider, respectively. This case occurs when a provider is deleted and not accepted.

You can use the auto-populated values, or change the populated continent, country and provider to anything but do not leave them blank.

When you enter a value in the "Country Code", the "OK" button is functional if:

1. None of the boxes are blank.

2. The entered country code does not match any existing code in the database.

3. The entered country name is not associated with exiting different continent.

3.8.6.3 Remove network provider entry

1. Select the "Tools" > "Network Provider Database" entry.
2. The "Edit, Add or Remove Network Providers" window opens.
3. Select within the left window area one provider.
4. Click the "Remove Provider" button.

   The provider is removed from the list in the "Countires" pane.
5. Click the "Apply Changes" button to accept the removal of the provider.

   The "Close & Save" button becomes now functional.
6. Click the "Close & Save" button to remove the provider from the database, providing the change persistency.

3.8.7 Network survey

The Network Survey feature supports GSM, UMTS, LTE, NB-IoT and 5G NR technologies.

For all supported technologies, the network survey lets you monitor the state of a network. The network state in this context means a set of demodulated transmitter signals and their power values per technology.

Select "Tools" > "Network Survey" to get the configuration page. Check the "Activate Network Survey" check box to activate the function.

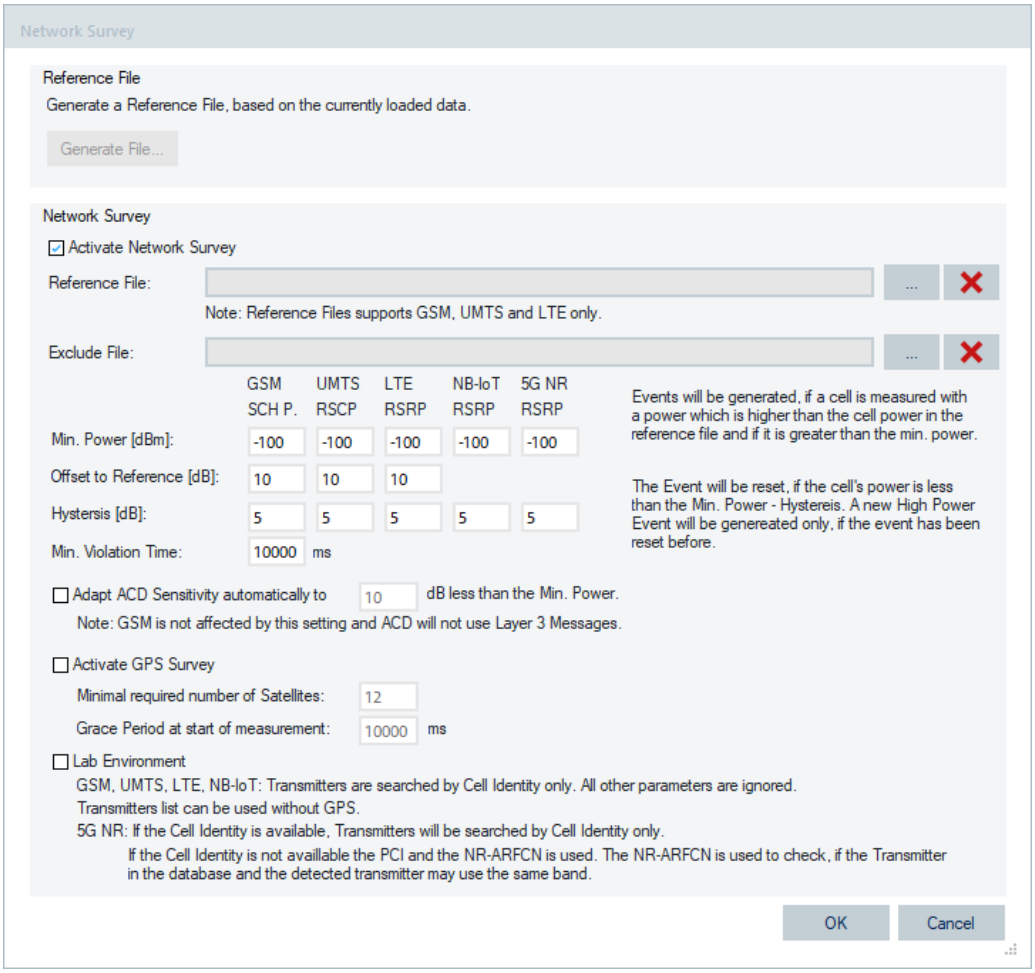


Figure 3-288: Network survey dialog

The "Reference File" option of the feature is not supported by NB-IoT and 5G NR.

The feature can work without a reference file. Therefore, no need to create such a file. If a reference file is specified, only the "Offset to Reference [dB]" values are used.

It is possible to specify an "Exclude File" which allows transmitters to specify, which are assumed to be OK and do not trigger any events. The format of such a file is CSV format.

```
RAT;MCC;MNC;LAC;CI;NR-ARFCN;PCI;Beam
```

The wildcard * is allowed and ignores the column. For example, if you want to exclude all GSM transmitters with MCC 123 and MNC 45 specify the line:

```
GSM;123;45;*;*
```

If the received power of a measured cell is higher than the required "Min. Power [dBm]" and higher than the cell's power in a reference file plus the specified "Offset to Reference [dB]", the network survey events are generated. The offset to reference is considered in a period longer than the period set in "Min. Violation Time".

GSM, UMTS, LTE and NB-IoT transmitters are searched by Cell Identity only.

As for 5G NR networks, transmiters are searched by Cell Identity only if available. If Cell Identity is not available, used is the PCI and the NR-ARFCN, see the Table 3-11.

The "Hysteresis [dB]:" value specified per technology is used to avoid ping-pong events which occur when a transmitter detects whose power is around the given "Min. Power [dBm]:" threshold. After the “high power” event has been activated, the transmitter is disabled only if the power drops below "Min. Power [dBm]:" – "Hysteresis [dB]:" value. Once it dropped below this value, a new “high power” value can be triggered.

For example, for GSM configured is a Min. power of -51 dBm and a hysteresis of 3 dB. The first time a transmitter is detected with power higher than -51 dBm (for the "Min Violation Time") a “high power” event is triggered. The corresponding “low power” event is triggered when the transmitter’s power drops below -51 dBm - 3 dB = -54 dBm. Only in this case a new “high power” event can be triggered once the power passes the -51 dBm threshold again.

Adapt ACD Sensitivity automatically
The 5G NR, LTE, NB-IoT and UMTS networks survey support automatic adaptation of the associated ACD thresholds, relative to the configured minimal power values. Check the "Adapt ACD Sensitivity automatically to" box and specify the threshold to make the function active.

Note: GSM is not affected by this setting. GSM does not use the ACD.

Activate GPS Survey
If a GPS is connected, and the option is checked, the Network Survey function checks if the minimum number of satellites are currently available. Whenever the threshold is passed, an event is generated. The "Too Less Satellites" event or the "Enough Satellites again" event can be triggered. To get these events, it is necessary to activate them in the "Network Survey" branch of the "ROMES Events" in the "Available Events" > "Events" pane, see Figure 3-129.

The GPS survey can be deactivated at the beginning of the measurement. The "Grace Period at the start..." can be specified in the "Network Survey" dialog. Only after the given amount of time the GPS data is surveyed and events are triggered.

Lab Environment
The "Lab Environment" function enables a set of features, which help when special needs come up in a stationary lab environment. The set of features can increase in the future, but for now this feature focuses on the handling of a transmitter database.

If "Lab Environment" is checked, the transmitter monitoring works without a GPS signal. The position of the transmitter is not considered.

Import of transmitter database without GPS position set is supported for ATD and CSV formats only.

The ATD/TXT format of transmiter database can be imported without position definition. A default position is set then to all BTSs.

To support the CSV format, you have to add the "PosLongitude" and "PosLatitude" definition to the header. No position values are required to import. A default position is set then for all BTSs.

The selection of the transmitter from the database in "Lab Environment" mode differs from the usual drive test mode.

Note: The complete set of transmitters is loaded into the application. This loading can consume some memory, but we do not consider it as a problem up to some hundreds of transmitter entries.

Depending on the technology, the selection method of a transmitter is as the following:

Table 3-11: Lab environment table

Technology	Method
GSM	Cell Identity
UMTS	Cell Identity
LTE	Cell Identity
NB-IoT	Cell Identity Note: The same Transmitter Database as for LTE is used. The NB-IoT Cell Identities have to differ from the LTE Cell Identities.
5G NR	If the Cell Identity is available, the Cell Identity is used. If the Cell Identity is not available, the PCI is used. Also the NR-ARFCN is used. The method does the following: 1. Get a set A of 5G NR bands, which are possible for the NR-ARFCN of the detected cell, 2. Get a set B of 5G NR bands, which are possible for the NR-ARFCN of the cell in the database, 3. Compare set A with set B; if at least one band is contained by both sets, the transmitter is accepted. 4. If more than one transmitter is possible, the names of the possible transmitters are concatenated.

Network survey event information

The "Event View" of the network survey events contains in the "Information" column the text that follows the following pattern:

Tec, Power, Frequency, Channel, Cell Identity, physical ID, Mode, Name

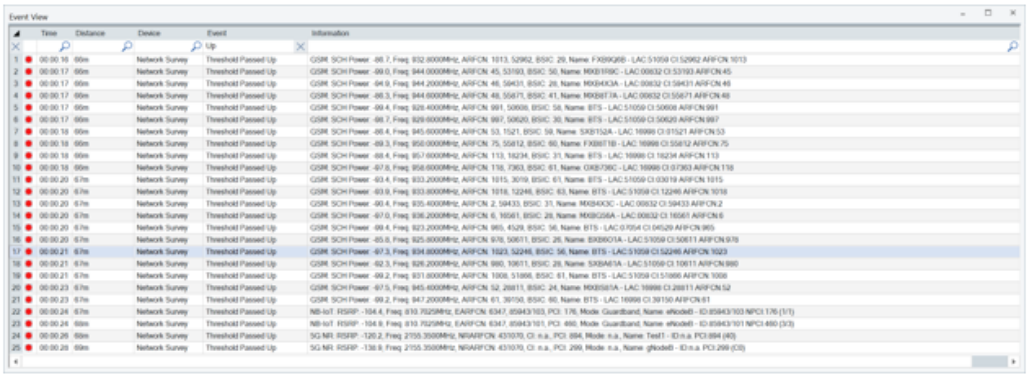


Figure 3-289: GSM network survey - event threshold passed up

The "Mode:" tag of the events for 5G and NB-IoT are at the end of the event description.

For the "Event View" page, see Chapter 4.2.6, "Event view", on page 498.

3.8.8 Reset USB ports

R&S ROMES4 supports the Cleware GmbH USB cutter. All detected USB cutters will disable the USB link and enable the link again after five seconds, if the "Reset USB Ports" command is selected.

3.8.9 Run QualiPoc update tool

If clicked, the "Run QualiPoc Update Tool" menu item opens the tool to run QualiPoc update. The following warning message precedes running the tool as this action closes the R&S ROMES4 application.

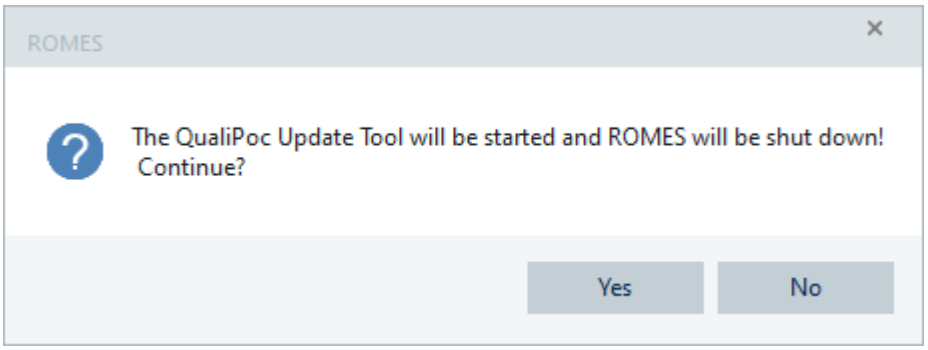


Figure 3-290: Warning if running QP update tool

The QualiPoc update tool can be started also independently on R&S ROMES4 from the Windows "Start" > "R&S ROMES" menu, see Chapter 5.4, "QualiPoc update tool", on page 1436.

3.9 Window menu

The "Window" menu offers commands for arranging and handling the view windows and shows a list of all open views.

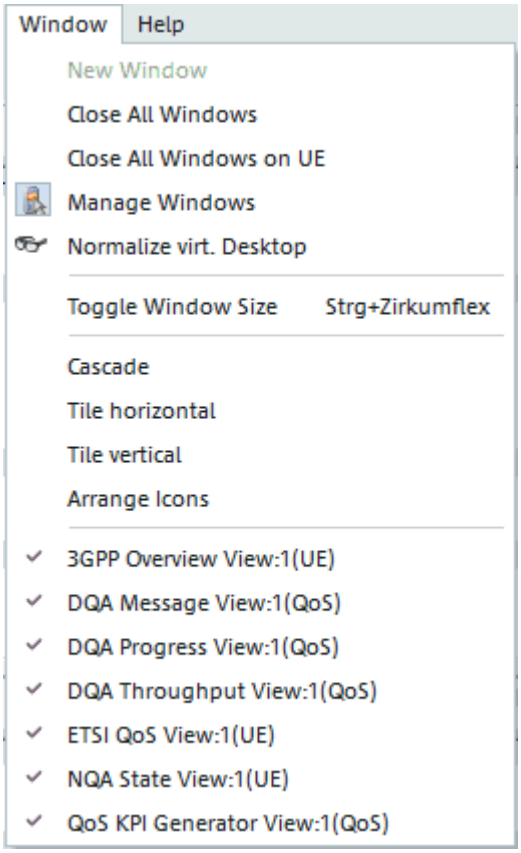


Figure 3-291: Window menu

Multiple Document Interface (MDI) window allows changing a child frame size and its position in the view area according to application size change. Use the "Grow/Shrink windows" switch to turn this option on or off. It is a button in the toolbar.

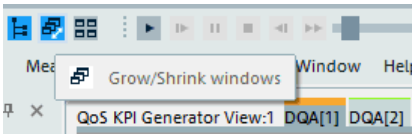


Figure 3-292: Button for changing a child frame size

With the R&S ROMES4 installation, the status of this function is stored in the registry together with other options and used when the R&S ROMES4 is started again.

The function is disabled (grayed) when there are no open child windows in the client area (for example, when the Welcome view is active).

New Window
Create a view of the same type as the active window.

The "New Window" command enables multiple view types. Those types are characterized by a current number behind the view title (e.g. "Measurement Report View: 1"). The "New Window" is also available in the context menu associated to multiple views.

Close All Windows
Closes all windows on all View Areas.

Close All Windows on <S>
Closes all windows on the View Area named <S>.

Manage Windows
Changes child frame size and a position in one or more view areas according to the changes of application size.

If this item is active (checked) and there are opened views, for example, the "Message View" and some more, their windows grow/shrink with the R&S ROMES4 main window. Also they slightly change their positions.

Normalize vitr. Desktop
Resizes the virtual desktop. The tiles are split and arranged equally within the available desktop space.

Toggle Windows Size
Toggles the size of child frames if pressed Strg+Circumflex.

Cascade
Superimpose all opened view windows showing each one’s title bar. The active window is placed in the foreground.

Tile horizontal/vertical
Places all open view windows side by side (or stacked vertically) so that they do not overlap.

Arrange Icons
Arranges the minimized views to the bottom of the visible view area.

3.10 Help menu

The "Help" menu provides online help and general information on R&S ROMES4.

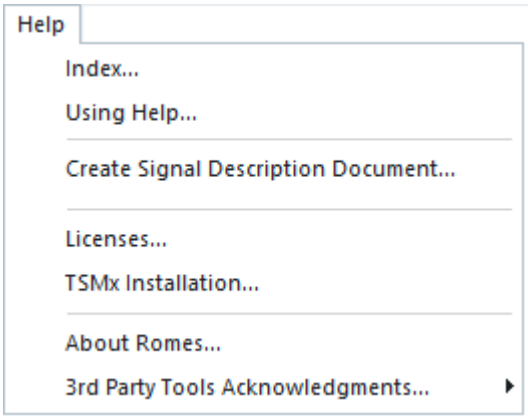


Figure 3-293: Help menu

3.10.1 Index

Opens the start page of the online help.

The opening page helps you to find all information needed for using the R&S ROMES4 via the navigation tools such as the table of contents, index of keywords and hyperlinks quickly.

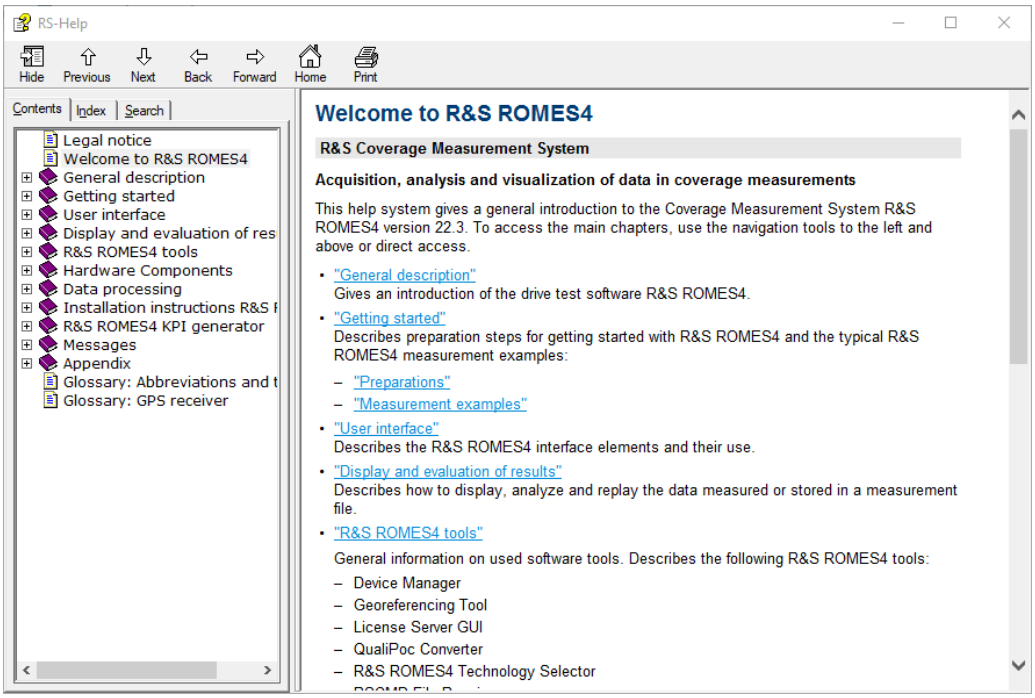


Figure 3-294: Online help

3.10.2 Using help

The online help system itself is accessible by clicking "Help" > "Index" or the F1 key.

R&S ROMES4 is equipped with a context-sensitive help function. A help page is available for most windows and can be called anytime during operation.

The context-sensitive help page is a part of a comprehensive help system. To get the help page of an open window, the left mouse button click in the window's area or title bar and press then the F1 key.

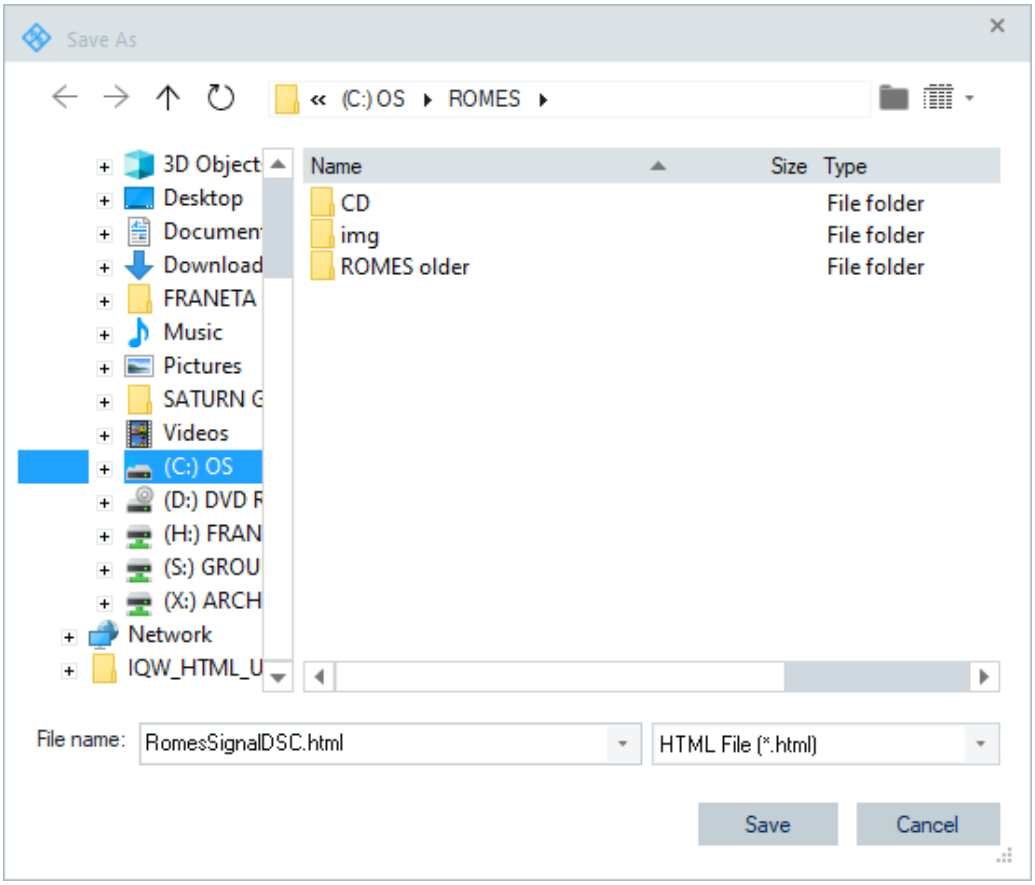
It is possible to move from the context-sensitive page to any page of the help system.

The help function is provided with a navigation bar. Other help pages are called from the context-sensitive page via the table of contents, index, arrows for scrolling and page-internal links.

The help file (`*.chm`) is available on the installation folder and can be used as a standalone help.

3.10.3 Create signal description document

R&S ROMES4 can compile a single document, which contains all signal descriptions, see Chapter 3.3.7.2, "Tooltips for R&S ROMES4 signals", on page 162. The result is an HTML file, which can be displayed in the Internet Explorer and printed as a PDF document, if desired.



3.10.4 Licenses

The "Help" > "Licenses" entry unifies licensing information on R&S TSMx scanner (see Note, QualiPoc and expired licenses within one dialog.

If you click the "Help" > "Licenses" command, the "Licenses Overview" dialog is displayed. There are four tabs available in this dialog, each exposing the licensing information.

The "Available Options" displays all software modules available in the current R&S ROMES4 installation.

The licensing information, like installed or missing licenses and up to which R&S ROMES4 version is an installed device licensed, is displayed in the middle part of the dialog, named as "Detailed Information". For the selected device, this information is displayed.

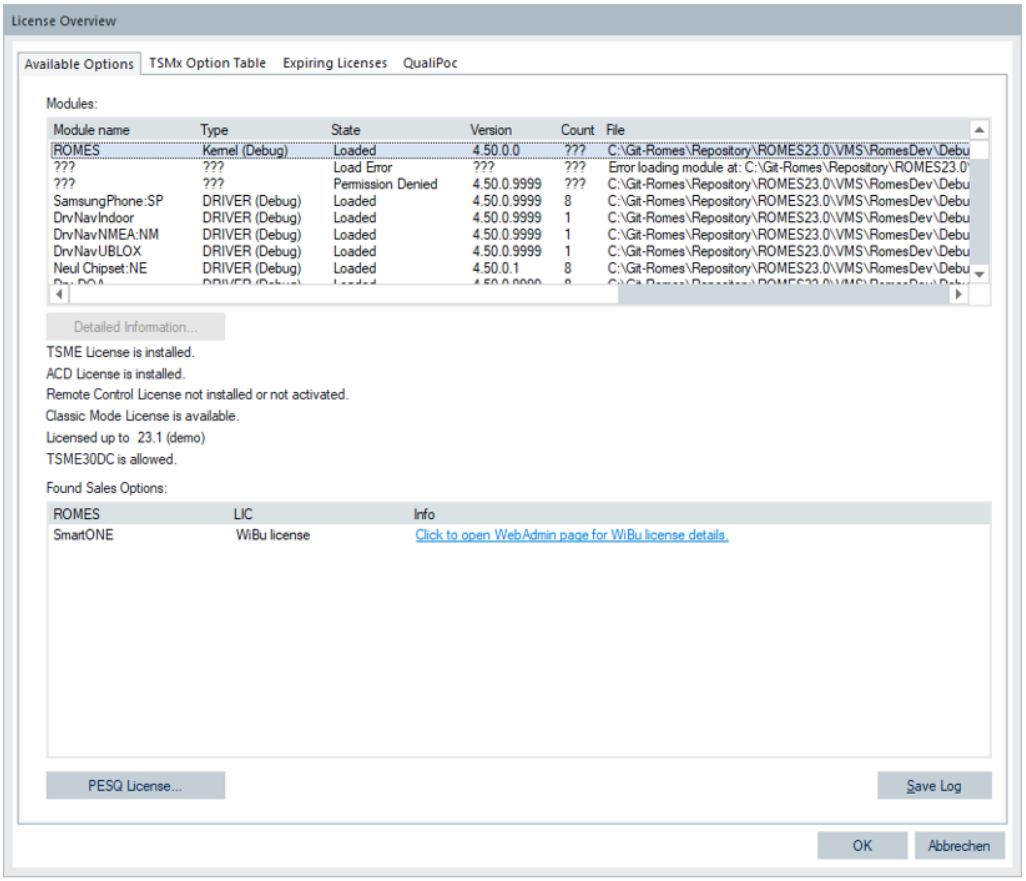


Figure 3-295: Licenses dialog - Available Options

The lowest part displays the found sales options which can be ordered. The "Info" column provides link for the license details of the found options.

The "PESQ License" button lets you modify the PESQ license in the dialog of the same name. The PESQ license is the only license which can be modified. The "OK" button becomes active when you select a PESQ file.

Figure 3-296: Active PESQ file browse button

The "Save Log" button writes the list of modules shown in "Available Options" to a text file. The name and directory of the file are shown in a pop-up dialog.

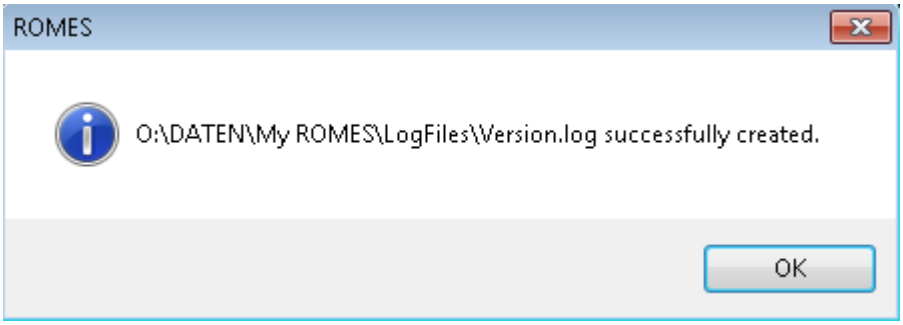
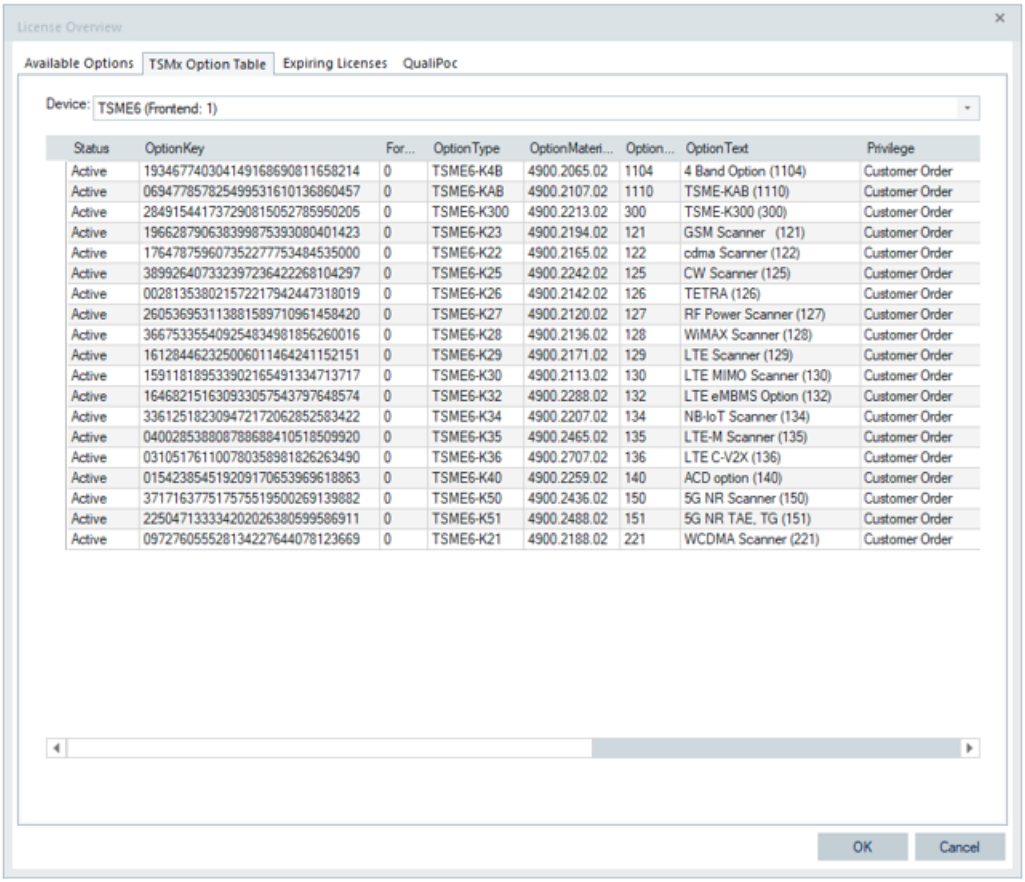


Figure 3-297: Versions log file created

The "OK" and "Cancel" buttons let you confirm or cancel the selection, respectively, and close the "Licenses Overview" dialog.

3.10.4.1 TSMx option table

The "Licenses Overview" > "TSMx Option Table" tab opens the dialog in which you can see the complete options associated to a selected scanner and the status of provided options' licenses. The scanner is selected in the "Device" drop-down list.



Status	OptionKey	For...	OptionType	OptionMateri...	Option...	OptionText	Privilege
Active	193467740304149168690811658214	0	TSME6-K4B	4900.2065.02	1104	4 Band Option (1104)	Customer Order
Active	069477857825499531610136860457	0	TSME6-KAB	4900.2107.02	1110	TSME-KAB (1110)	Customer Order
Active	284915441737290815052785950205	0	TSME6-K300	4900.2213.02	300	TSME-K300 (300)	Customer Order
Active	196628790638399875393080401423	0	TSME6-K23	4900.2194.02	121	GSM Scanner (121)	Customer Order
Active	176478759607352277753484535000	0	TSME6-K22	4900.2165.02	122	cdma Scanner (122)	Customer Order
Active	389926407332397236422268104297	0	TSME6-K25	4900.2242.02	125	CW Scanner (125)	Customer Order
Active	002813538021572217942447318019	0	TSME6-K26	4900.2142.02	126	TETRA (126)	Customer Order
Active	260536953113881589710961458420	0	TSME6-K27	4900.2120.02	127	RF Power Scanner (127)	Customer Order
Active	366753355409254834981856260016	0	TSME6-K28	4900.2136.02	128	WiMAX Scanner (128)	Customer Order
Active	161284462325006011464241152151	0	TSME6-K29	4900.2171.02	129	LTE Scanner (129)	Customer Order
Active	159118189533902165491334713717	0	TSME6-K30	4900.2113.02	130	LTE MIMO Scanner (130)	Customer Order
Active	164682151630933057543797648574	0	TSME6-K32	4900.2288.02	132	LTE eMBMS Option (132)	Customer Order
Active	336125182309472172062852583422	0	TSME6-K34	4900.2207.02	134	NB-IoT Scanner (134)	Customer Order
Active	040028538808788688410518509920	0	TSME6-K35	4900.2465.02	135	LTE-M Scanner (135)	Customer Order
Active	031051761100780358981826263490	0	TSME6-K36	4900.2707.02	136	LTE C-V2X (136)	Customer Order
Active	015423854519209170653969618863	0	TSME6-K40	4900.2259.02	140	ACD option (140)	Customer Order
Active	371716377517575519500269139882	0	TSME6-K50	4900.2436.02	150	5G NR Scanner (150)	Customer Order
Active	225047133334202026380599586911	0	TSME6-K51	4900.2488.02	151	5G NR TAE, TG (151)	Customer Order
Active	097276055528134227644078123669	0	TSME6-K21	4900.2188.02	221	WCDMA Scanner (221)	Customer Order

Figure 3-298: Complete table of R&S TSME6 scanner options

The R&S TSMx scanner licenses can be time limited.

To inform you about the expiry of the licenses of the R&S TSMx scanner within next 30 days, R&S ROMES4 provides a warning.

The R&S TSMx scanner is the naming of all scanners of the R&S TSME family.

How many hours trigger the warning can be adapted by the following registry key:

In how many hours to trigger the warning about expiry of the R&S TSMx licenses is adaptable by the following registry key:

Computer\HKEY_CURRENT_USER\SOFTWARE\Rohde & Schwarz\Romes<version>\General

TSMxExpMinHoursForWarning DWORD (32-bit) value key

Every time R&S ROMES4 scans for scanner, it checks the licenses and shows the warning. It is possible to suppress the warning for the current session.

Already deactivated licenses do not trigger the warning.

3.10.4.2 Expiring licenses

The "Licenses" > "Licenses Overview" > "Expiring Licenses" tab opens the dialog which shows the expired licenses.

The dialog automatically pops-up at the startup and is automatically closed after 30 seconds if there is no user interaction (no screenshot, since no change).

The two options, "OK" and "Cancel" to proceed within this time are available. You can continue the start of R&S ROMES4 or exit.

If you continue, some functionality cannot work as before, since the licensed features that expired are disabled.

If R&S ROMES4 is started again after the license expiration is shown, the dialog does not come up again unless there is new expiration information available.

To enable the expired licenses again, reload them.

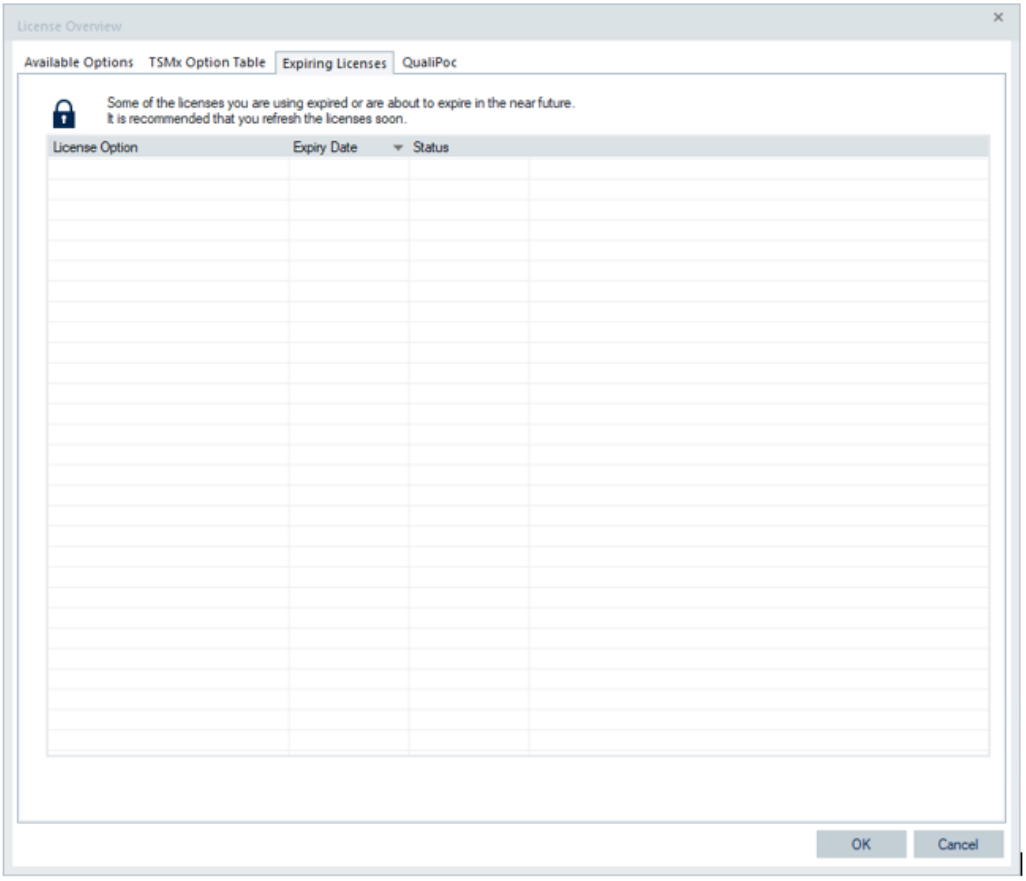


Figure 3-299: Expired licenses dialog

The dialog of expired licenses is always recallable via the "Expired Licenses" tab.

3.10.4.3 QualiPoc licenses

An information table similar to the one from the "QualiPoc Update Tool" is shown in this license dialog.

The "QualiPoc" dialog is automatically updated when R&S ROMES4 detects changes in the connection status with the mobile/QualiPoc.

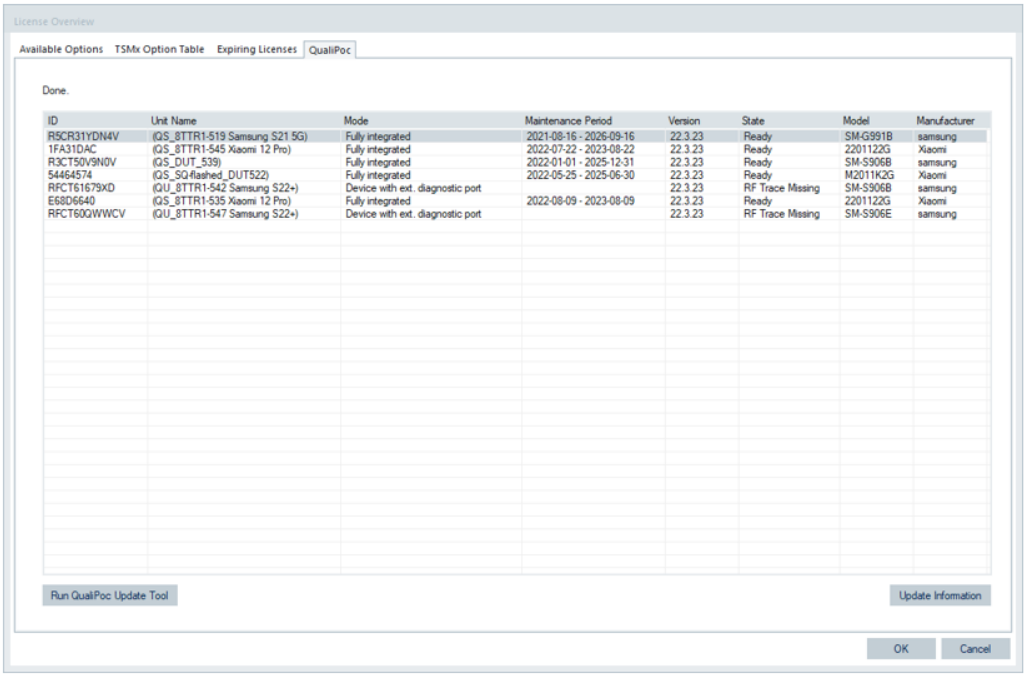


Figure 3-300: QualiPoc licenses dialog

The "Update Information" button rescans all mobiles and refreshes the information in the table. If a change is not detected by R&S ROMES4, you can force a refresh of the data with this button.

QualiPoc licenses reporting

The QualiPoc software of release 22.3 and higher, reports licenses related information to a central cloud instance. This information is uploaded during each start-up of the QualiPoc application. The following are advantages of the feature QualiPoc Licenses Reporting:

- Better customer support on maintenance issues

- Minimizes the effort for license-related support issues for customer and R&S

- Getting better understanding of the devices and software versions used in the field

The reported information is:

- License used to operate this QualiPoc instance (serial number the license is bound to, license options, maintenance period, time limited options)

- Version number of the used QualiPoc build

- Device-related information (model, firmware, region code/CSC)

The information which is not transferred is:

- Location information (longitude, latitude...)

- Information about product usage, configured jobs or measurement files

- Any other information which is stored on a device under test

The feature is activated by default. Each customer can deactivate the related reporting in the "Settings" menu of the QualiPoc application.

Click "Settings" > "Advanced Analysis" > "License Reporting" in QualiPoc menu.

3.10.5 TSMx installation

The command opens the "TSMx Installation" dialog showing all the R&S TSMx-related software modules available in the current R&S ROMES4 installation.

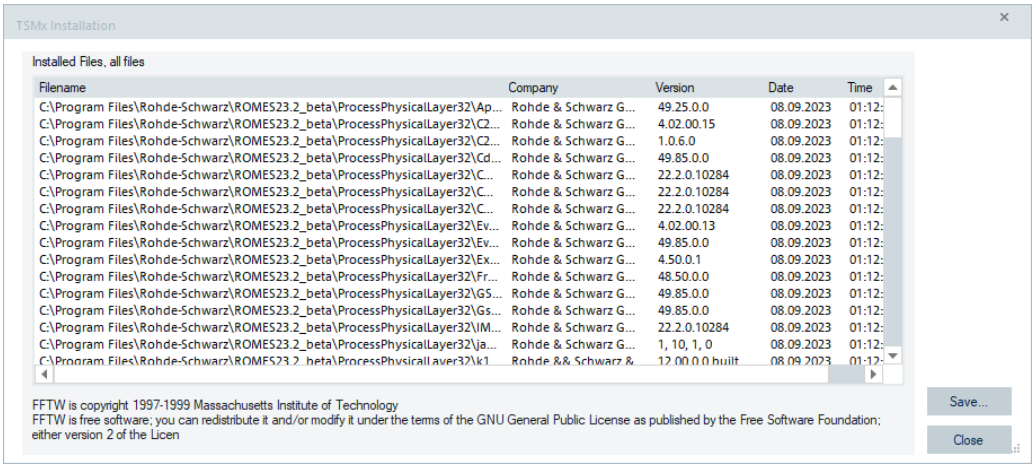
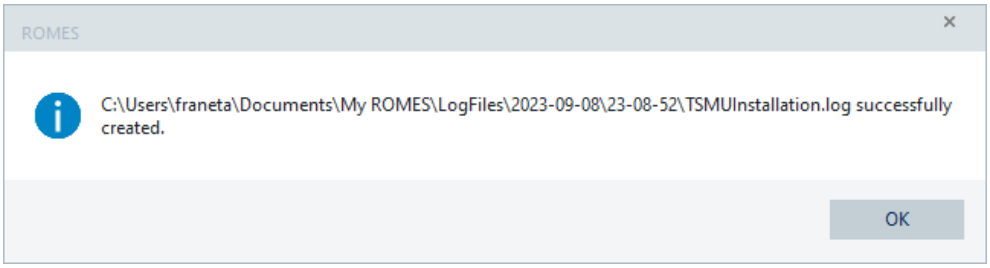


Figure 3-301: TSMx Installation dialog

- "Save"
  Writes the selected module shown in the "TSMx Installation" dialog to a text file. The name and directory of the file are shown in a popup window.



- "Close"
  Closes the "TSMx Installation" dialog.

3.10.6 About R&S ROMES4

Displays the R&S ROMES4 startup window indicating the name and version number of your R&S ROMES4 copy.

In addition, the window provides a selection of useful URL links, that is, the support contacts.

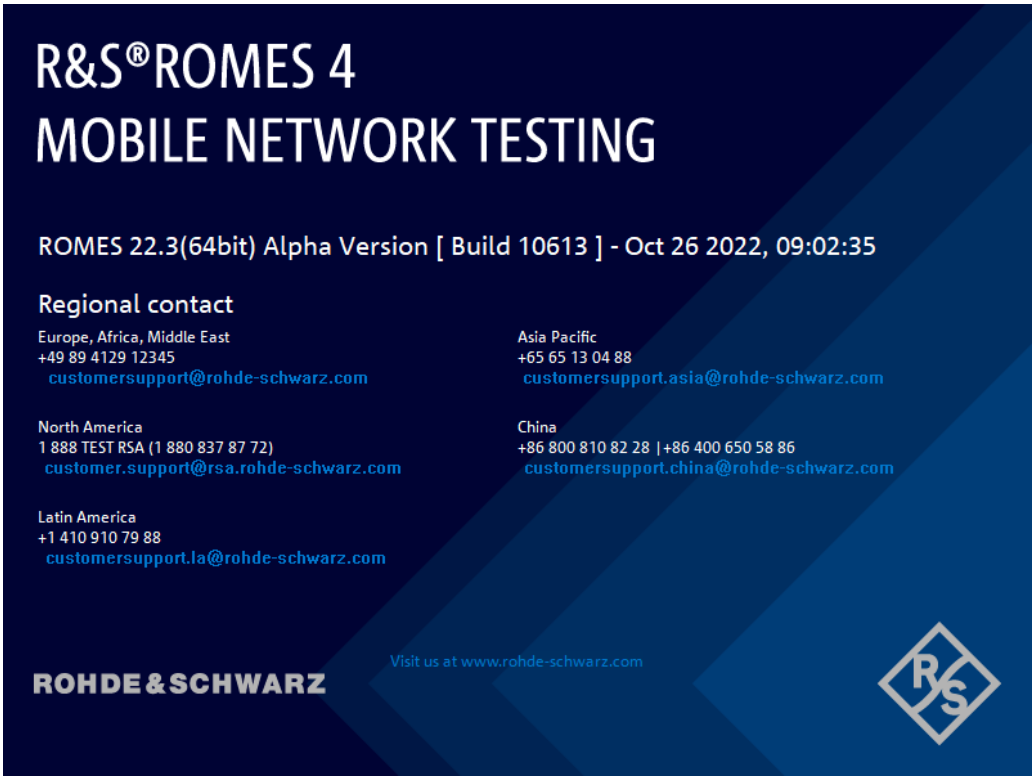
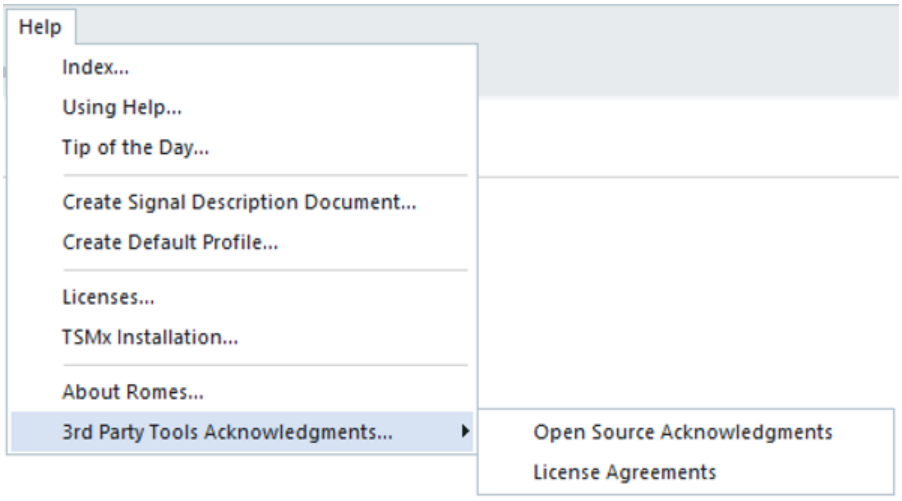


Figure 3-302: "About ROMES ..." information

Click the contact data of your region to create an e-mail.

3.10.7 3rd party tools acknowledgments

The "Help" > "3rd Pary Tools Acknowledgements" entry summarizes two entries, the "Open Source Acknowledgments" and the "License Agreements".



3.10.7.1 Open source acknowledgments

If you click the "Open Source Acknowledgments" command, the "R&S ROMES4 Drive Test Software <version> Open Source Acknowledgment" document is displayed.

3.10.7.2 License agreements

The ASIO redistribution license agreement is shown if you click the "License Agreements" command. R&S ROMES4 Drive Test SW is using licensed ASIO product for Speech Quality purposes.

ASIO is a trademark and software of Steinberg Media Technologies GmbH.

4 Display and evaluation of results

This chapter describes how to display and analyze the data measured or stored in a measurement file and replayed. Data selection and configuration of the view properties is performed in the "Tools" > "Configure Active View" window.

A view configuration is also possible from the individual view's window - the right mouse button click the window's area and select the "Configure" entry from the pop-up window.

The view windows are called up in the "View" menu.

For an overview of all menus and menu commands refer to Chapter 3.3, "View menu", on page 134.

- Common properties of R&S ROMES4 views....428
- Basic views....445
- Navigation views....548
- Mobile views....686
- CW views....1058
- QoS views....1059
- WLAN views....1103
- Scanner views....1117

4.1 Common properties of R&S ROMES4 views

The R&S ROMES4 views are optimized to visualize different data types obtained from different sources. Therefore the views vary in appearance and functionality. However, some properties are common to many or even all views.

Figure 4-1: General view properties - example

The following entries are part of each view.

4.1.1 View title

The title bar contains the name of the view and three icons to minimize, maximize and close the view. A sequence number (: 1) behind the view's name indicates that it is allowed to open several views of the same type.

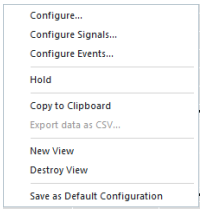
4.1.2 Device tabs

Many views include separate tabs to display the data originating from different test devices (e.g. different test mobiles, receivers, etc.). A mouse click the tab corresponding to a device, places its view into the foreground.

The device tabs in all open views are coupled. Selecting a device tab in anyone view, activates the same tab in all other views. The "Control" key disables this coupling mechanism.

4.1.3 Context menu

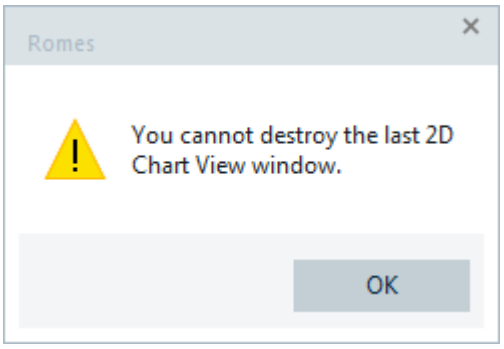
Most views provide a context menu to access typical configurations and perform actions.



A right mouse click a point anywhere in the View Area opens the context menu. The following context menu commands are often used:

- "Configure"
  Opens the configuration menu associated with the view; see below.
- "Configure Signals"
  Opens the "Available Signals" tab of the Chapter 3.8.1, "System configuration (preferences)", on page 223 to configure the signals available for viewing.
- "Configure Events"
  Opens the "Available Events" tab of the Chapter 3.8.1, "System configuration (preferences)", on page 223. Here you can select the signal events to be recorded during the measurement and configure the additional user and comment events.
- "Hold"
  This function "freezes" the current measurement display for examination purposes without stopping the measurement. A view on hold can be released, which updates the view to reflect the actual measurement status.
- "Copy to Clipboard"
  Copy a screenshot of the current view to the clipboard to paste it into another application.
- "New View"
  Opens an additional view of the same type. A practically unlimited number of views can be opened at the same time. Views of the same type are distinguished by the current number in the title bar indicating the order in which they have been created. Example given, the 1 in the Figure 4-1 figure.

- "Destroy View"
  Deletes the active view with its contents. New View cannot restore a deleted view. A workspace must contain at least one view of each type, so "Destroy View..." is disabled for the last view of each type. R&S ROMES4 generates a warning:



- "Save as Default Configuration"
  Saves a current configuration of the view to an ASCII file named `Master.rsxks` in the Workspace subdirectory of R&S ROMES4 program directory. The file contains everything defined in the configuration menu of the view, including the selected signals.
  The default view configuration is used whenever a new view of the same type is created, irrespective of the current workspace. It is changed if a new default view configuration is saved. The new configured file is reset by deleting the previous one.
- "Move to"
  Opens a secondary context menu which contains all currently available view areas. This command is dimmed if the current workspace contains only one view area.
- "Remove Signals"
  Opens a secondary context menu with all signals selected for display. Clicking a signal removes it from the "Selected Param." list. "Remove Signal" is not shown if the "Selected Param." list is empty.

4.1.4 Configuration menu

Some views are associated with a configuration entry that can be opened from the context-sensitive menu. The configuration entries provide view-specific settings.

4.1.4.1 Info

The "Info" tab provides the information on the current view version. It is common for each view and present in each view configuration menu.

Use the "Module Properties" > "Custom Name" box to assign a custom name to an active view in the view's title bar.

Different connected devices can be associated with different custom names using this option. For example, use it to separate mobiles in different networks or if simultaneously operated mobiles perform different tasks.

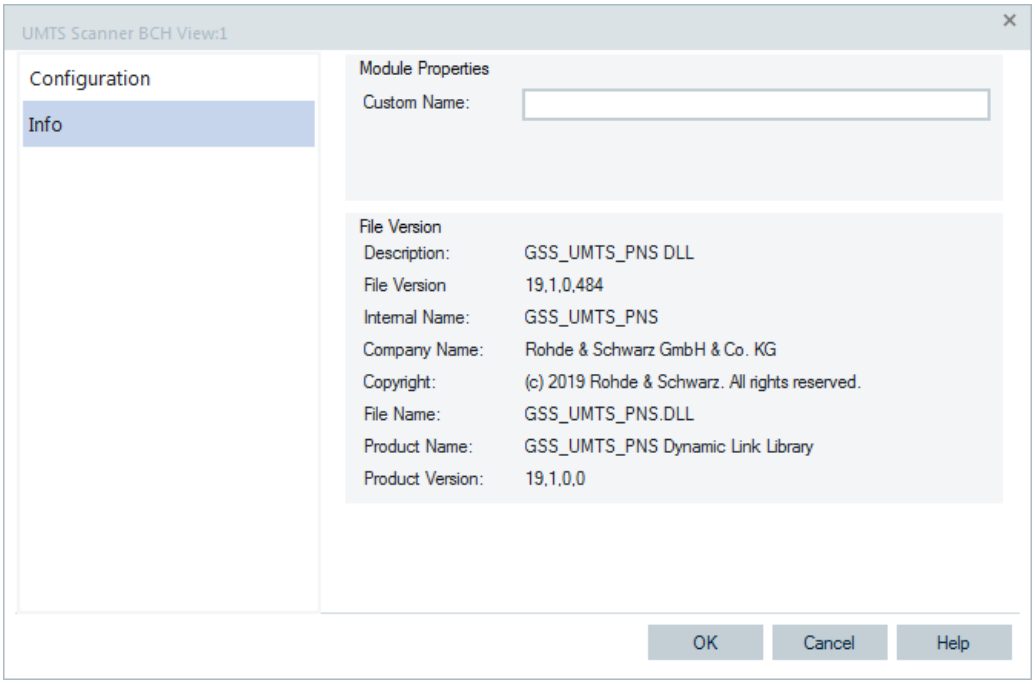


Figure 4-2: Info tab

As the "Info" tabs are analog for all view types, we omit them in the following views description.

4.1.5 Replay jump to timestamp

In many views (e.g. the "Layer 3 View", "2D Chart View", "Route Track View" etc.), it is possible to initiate a replay jump to a particular message, event or characteristic position spotted in the view (in general, to a particular timestamp in the message file). This type of replay jump must be initiated during a replay pause. The replay is continued at the selected timestamp.

To initiate a replay jump to a timestamp (e.g. in the "Layer 3 View"), proceed as follows:

1. Open the view, replay a measurement file ("Step One Data Set Forward" or) Pause the replay ("Measurement – Replay Pause" or).
2. Keep the [Ctrl] key on your keyboard pressed.
3. The cursor icon has the clock symbol.
4. Double-click a particular message.

   The screen is refreshed. After clicking again, the replay starts with the message selected in the last step.

4.1.6 Coupled focus

Many views provide graphical tools to highlight special areas and read a particular result. The focus in several views can be coupled, which makes it easier to analyze different aspects of a coverage measurement at a particular position using a set of appropriate views. For details, see Chapter 3.8.3, "Coupled focus", on page 384.

4.1.7 Unifying the transmitter signals

Several views use colors to identify a certain transmitter. For example, the Top N views print the color of a transmitter at the first column of the table or, the "ROMESMAP Route Track Vew" uses the colors to underlie the tracks.

R&S ROMES4 uses the same color for the same values. The actual color is derived from the value of a RAT-specific signal. The RAT-specific signals from UE and scanners are linked together. If you change the color scale of one R&S ROMES4 signal, the color scale of the others is changed automatically.

There is only one color scale used by the different R&S ROMES4 signals.

RAT	UE	Scanner
GSM	BCC	TopN Pool 1 BCC
UMTS	Scrambling Code	TopN Pool 1 Scrambling Code
LTE/5G NR	PCI	TopN Pool 1 PCI
cdma/EVDO	PN offset	TopN Pool 1 PN offset
TETRA	Carrier or LA (dependent on setting in the "TEC for TETRA Scanner"	TopN Pool 1 Carrier or LA
WiMAX	-	TopN Pool 1 Preamble Index

4.1.8 Extended grid view

Some R&S ROMES4 views independently of type are called grid views as the layout of the main window is a grid or contains several grids.

A grid contains column filter where text can be entered to filter grid lines. Grid lines are removed if the lines do not contain the filter text. The following screenshot of the "View" > "Basic Views" > "Event View" shows a grid with filter bars.

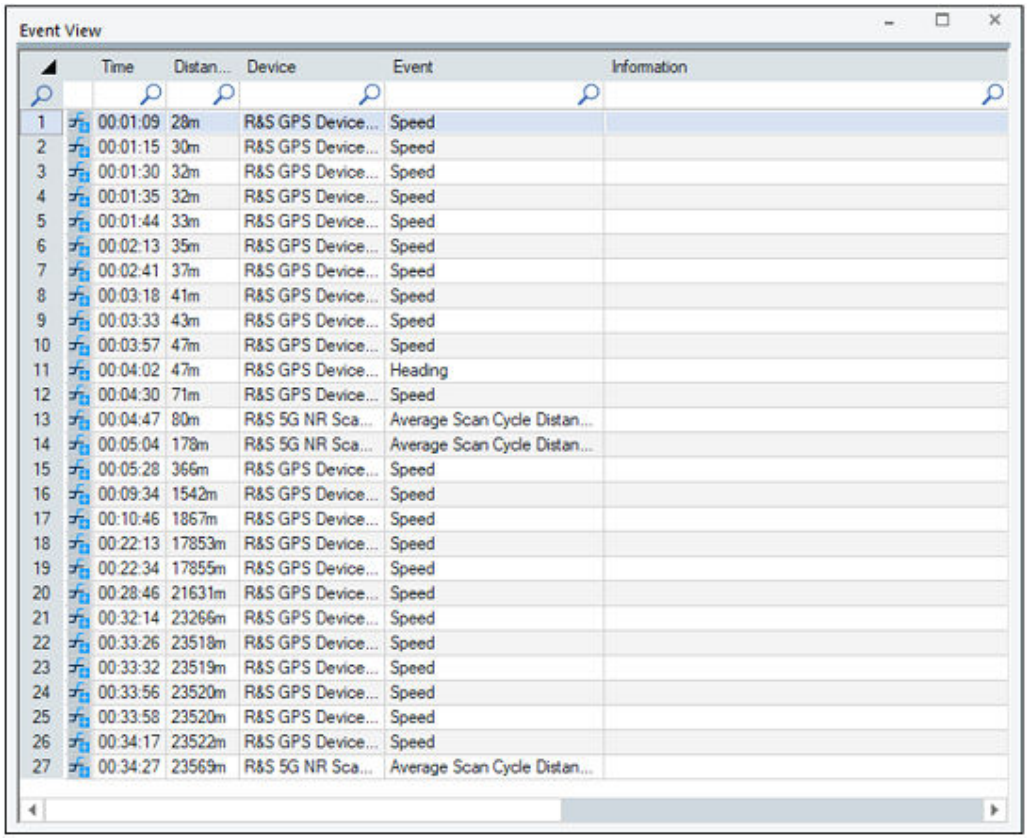


Figure 4-3: Grid view - example

The extended grid view supports, apart from the mentioned "Event View", the "LTE/ 5GNR RRM Mobility Analysis View" in the "View" > "Mobility View".

4.1.8.1 Extended grid filter marker

Grid in a view can be extended to include markers for highlighting grid cell text with colors. The grid column filter in extended grid allows you to mark custom text.

The general marker syntax is

`$C:TEXT$` where

- $ is the marker start and stop token. A valid marker must be included with two ‘$’s.

- C is the color specifier, can be any of following colors:

r:	o:	y:	b:	g:
red	orange	yellow	blue	green

- : is a separator for separating color specifier and marker text

- TEXT is the marker text to be marked or highlighted. The marker text is case insensitive.

Example:

Filter $g:gps$

The meaning is: mark all “gps” parts of the column's texts green.

The following screenshot illustrates this example of the "Event View".

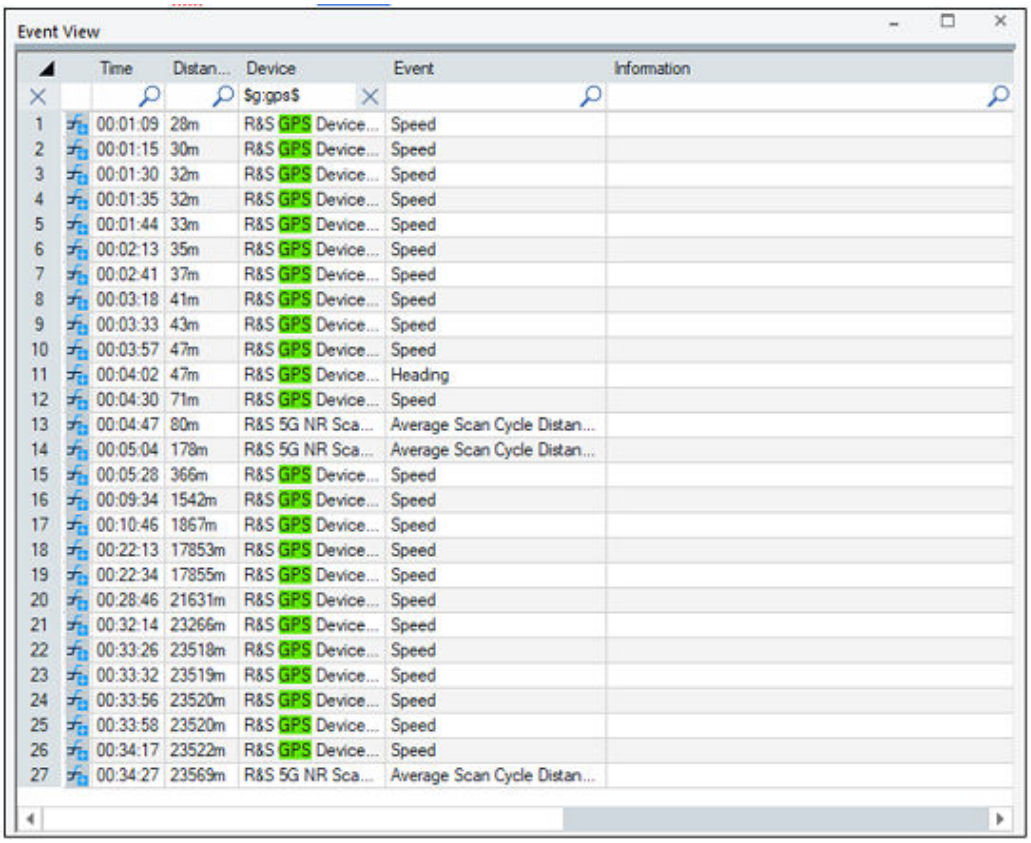


Figure 4-4: GPS events marked in green

4.1.8.2 Multiple extended grid markers

Multiple color markers per line and filter are allowed.

Example:

Filter $g:gps$$r:device$

The meaning is: mark all “gps” parts of the column's texts green and all “device” parts red.

The following screenshot illustrates this example.

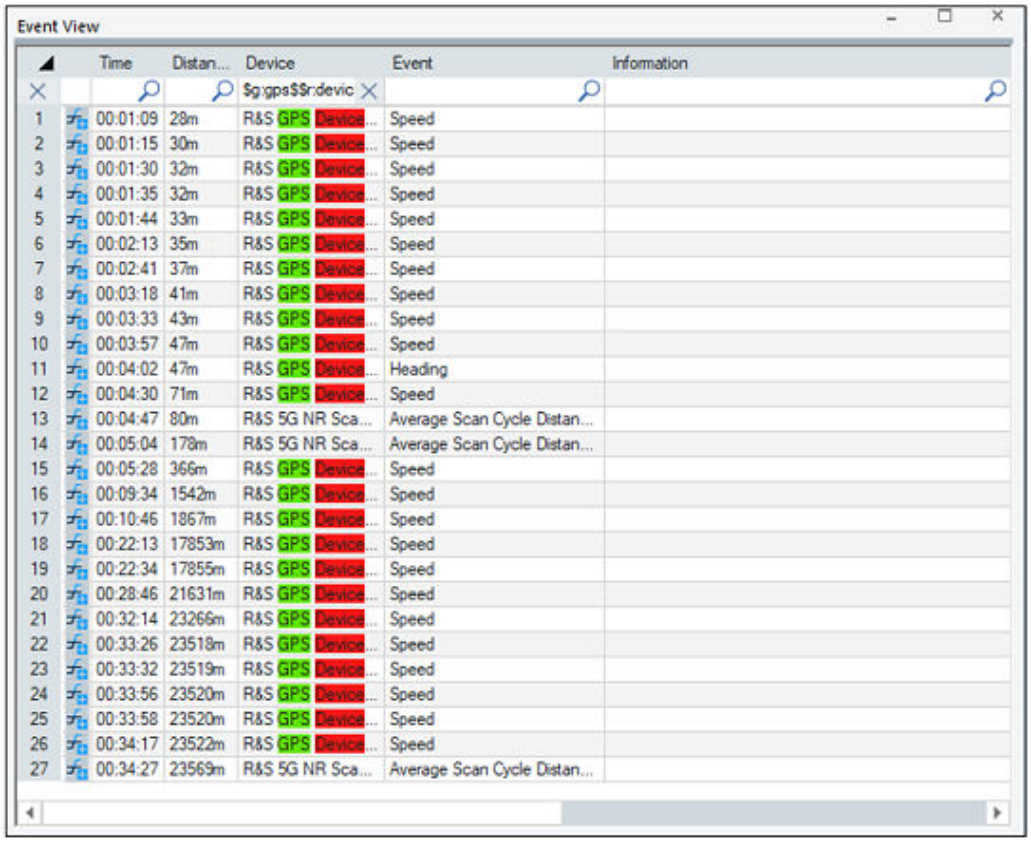


Figure 4-5: GPS and device events marked

4.1.8.3 Grid filter

The grid filter works the same way as preciously described. The actual columns filter text is the text in the filter bar with all markers removed.

Example:

Filter “gps $g:gps$$r:device$”

This means: the grid is filtered with “gps“ and colored by “$g:gps$$r:device$”.

Press return key to filter the grid.

- The grid is filtered.
- Color marker takes effect immediately when the second marker token “$” is entered if the marker is valid.
- Filtering takes effect only after return key is pressed.
- Blanks or anything between two extended filter markers is a part of filter text. For example, “gps $g:gps$ $r:device$” empties the grid, because the actual filter text is “gps “

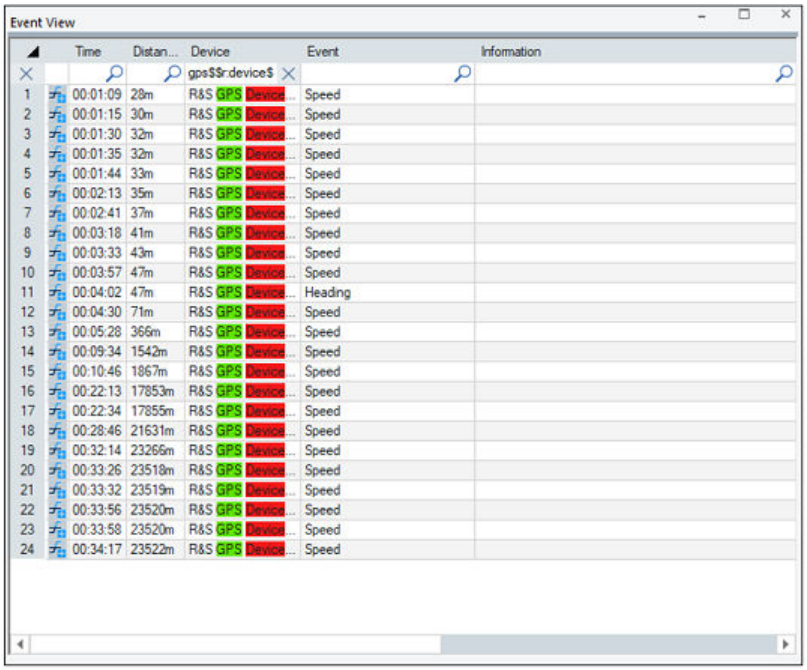


Figure 4-6: Filtered grid

4.1.9 Drag and drop signals between views

In general, signals can be drag-dropped from some basic views and the "3GPP Overview View" to other views. The signals are dragged from so called source views and dropped to so called target views. The "Copy Signals between Views" feature is applicable to the following views.

The source views from which you can drag a signal are:

- "2D Chart View" (Legend Pane)
- "Alphanumeric View"
- "ROMESMAP Route Track View"
- "3GPP Overview View"

The target views in which you can drop the signal are:

- "2D Chart View" (Legend Pane)
- "Alphanumeric View"
- "ROMESMAP Route Track View"
- "X-Y Grap"
- "Statistic Histogram"
- "Grid View" (Configuration Mode)

The device filter dialog automatically pops-up that let you choose a device depending on the device's availability in source view and the device's requirement in target view.

4.1.9.1 Drag and drop signals from/to the basic views

The R&S ROMES4 signals are usually first selected from the "Signal Tree" and dropped into a source view. Once signals are available in the source view, they can then be drag-dropped to other target views.

If a view does not support character string signals, e.g. the "2D Chart View", string type signals cannot be dropped into such a view.

In the following, illustrated is this signals drag-drop feature for all views previously listed.

Drag signals from 2D chart view

Selected signals in the "2D Chart View" are shown in the row header which is present in the "Chart 3" of the following screenshot. The 1st, 3rd and 5th signals are selected there.

The signal sets (RSS0, RSS4) can also be selected in this view. When dragging a signal set, all signals in a signal set are copied.

Single signal is drag-dropped inside the "2D Chart View" between/inside groups. Multiple selected signals can be drag-dropped to other target views.

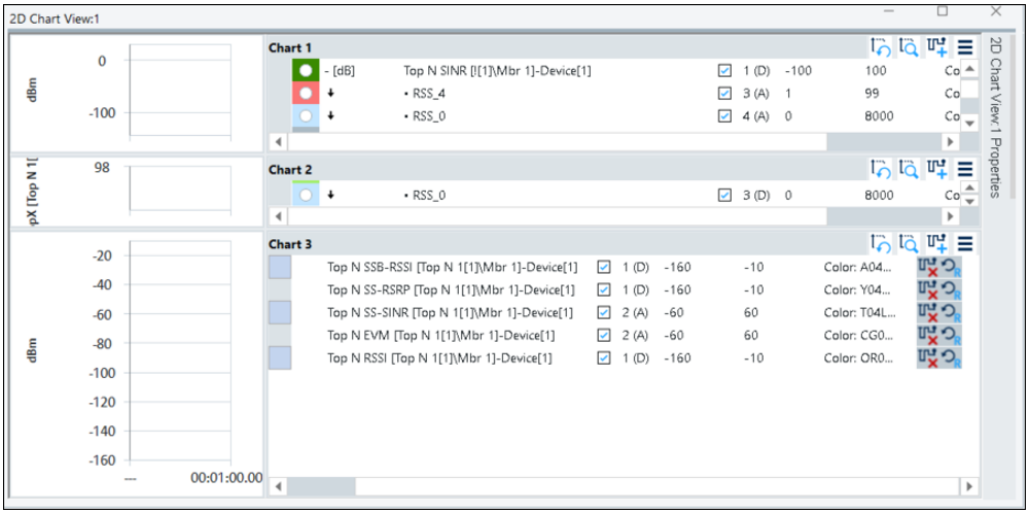


Figure 4-7: Chart 3 shows the drag-dropped signals

Drag signals from alphanumeric view

The screenshot of the "Alphanumeric View" shows three selected signals (blue lines) that can be dragged into any target view. Drag/drop a signal inside the view changes its position in the view.

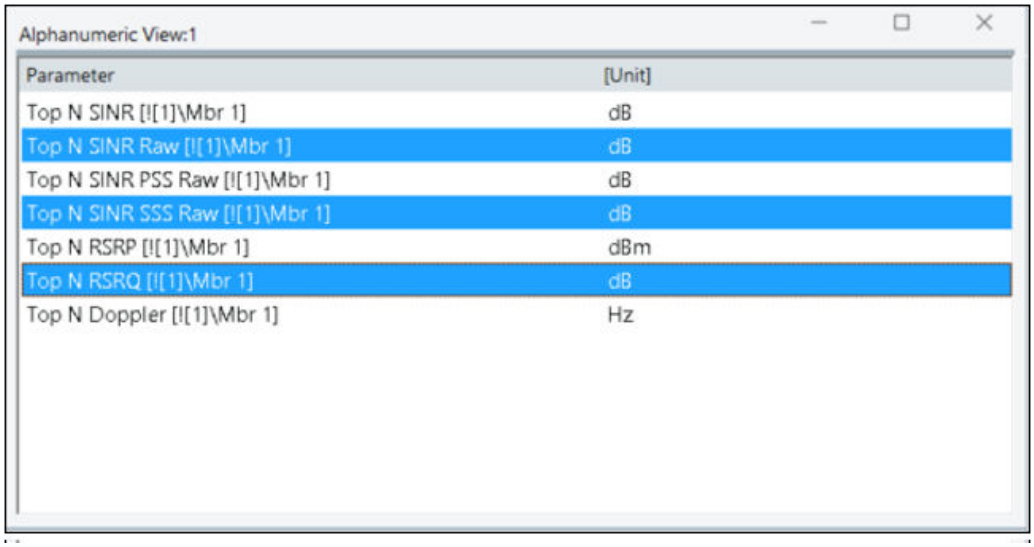


Figure 4-8: Selected signals for drag-drop in Alphanumeric View

Drag signals from statistic view

Similarly, selected are three signals in the "Statistic view" that can be dragged to any target view.

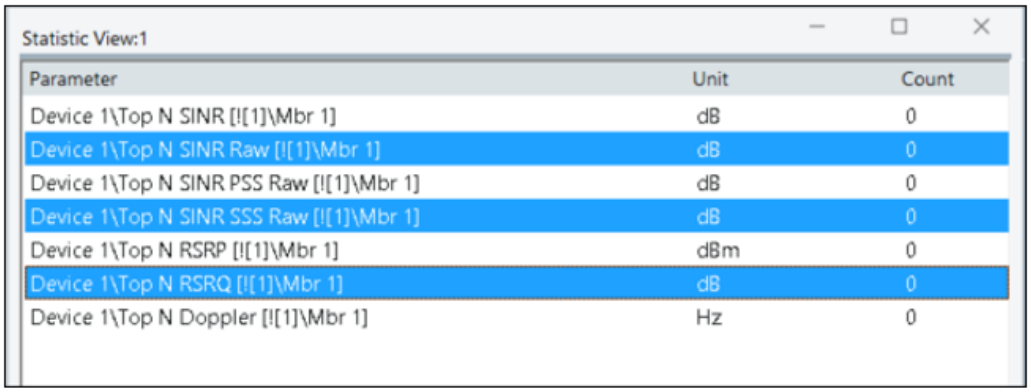


Figure 4-9: Selected signals for drag-drop in Statistic View

4.1.9.2 Drag and drop signals from ROMESMAP route track view

The signals in the "ROMESMAP Route Track View" are listed in the dropdown list of the dialog on the top-left side of the view. The screenshot shows in that box RSSI (PCell) signal. The associated device is stored in the dropdown list of the box next to the previous one, shown as "<empty>" in the screenshot. The selected signal can be dragged and dropped by pressing the "Value" area on the top.

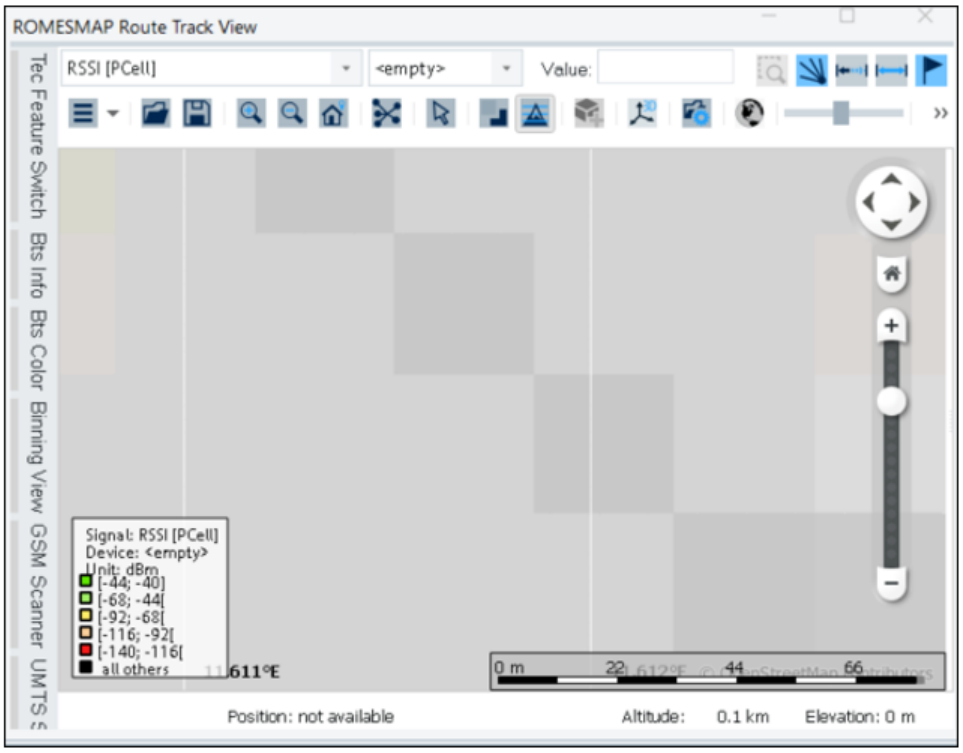


Figure 4-10: ROMESMAP Route Track View showing the selected signal

Hover mouse over the "Value" box to get the Tooltip of that box.

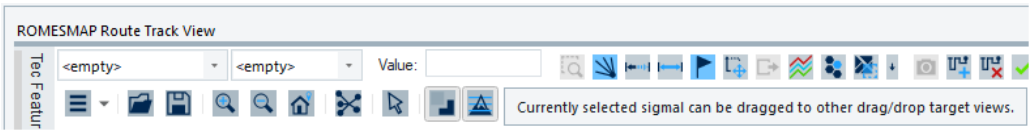


Figure 4-11: Tooltip of the Value box

A signal from other view can be dropped into the legend or the box on the top-left side of the view.

4.1.9.3 Drag and drop signals from 3GPP overview view

The "3GPP Overview View" deals with only UE (i.e. mobile) signals. In the view, there are "Label" and "Data cells" signals and both can be dragged and dropped.

General top sections and default RAT

The following screenshot shows the "3GPP Overview View" in general, without measurement file or closed measurement file. The default RAT is LTE.

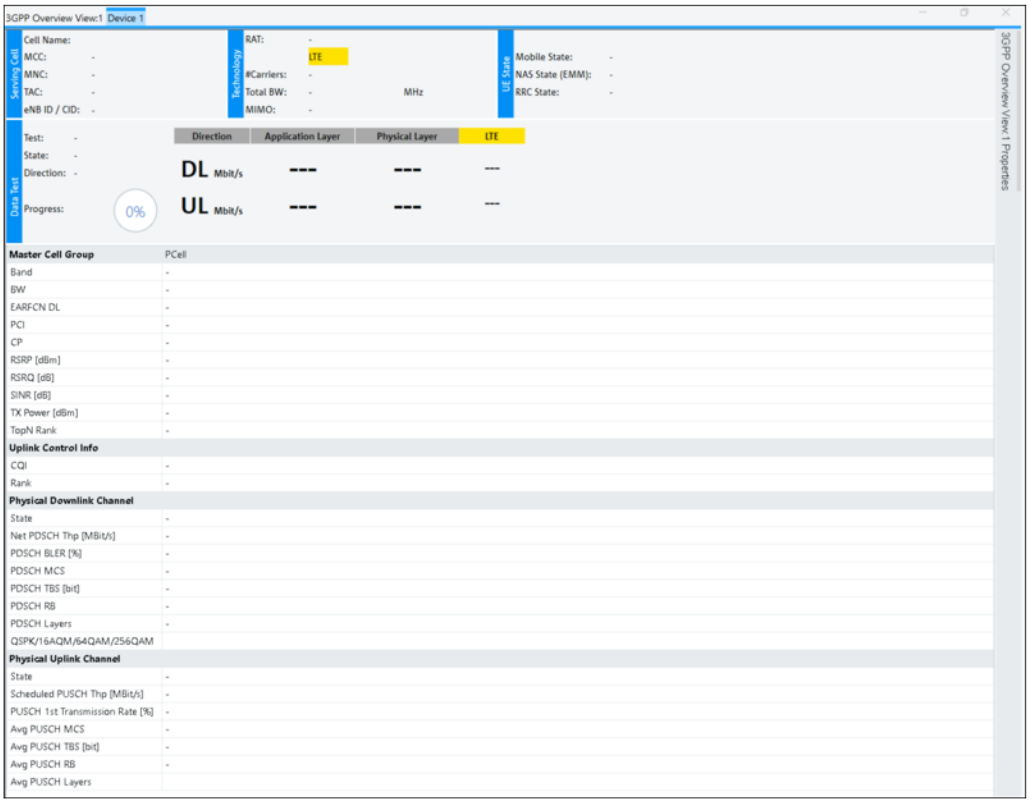
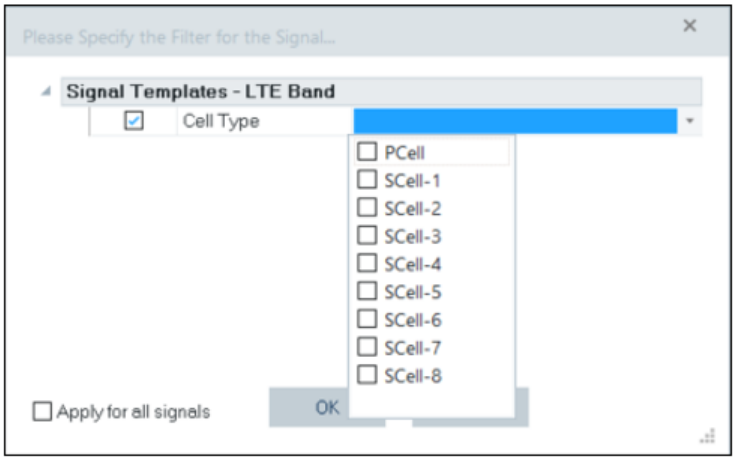


Figure 4-12: Default 3GPP Overview View

The signals in two top sections of the view are draggable, but only the data cells. The labels, as cell name, MCC, MNC, test, state, direction etc., are not draggable.

Dragging on a label signal, e.g. "Band", the default view is applied. A "Cell Type" filter dialog pops-up for user to select cell type, PCell and SCells. If the signal does not support PCell, the "Cell Type" dialog is not displayed.



When replay or measurement starts, the associated RAT is populated in the view. Draggable cells change accordingly.

LTE and 5G NR label and data cells

If the measurement file contains measured both LTE and 5G NR cells, the LTE and 5G RAT data cells populate accordingly the "3GPP Overview View" grid. The RAT can change in time.

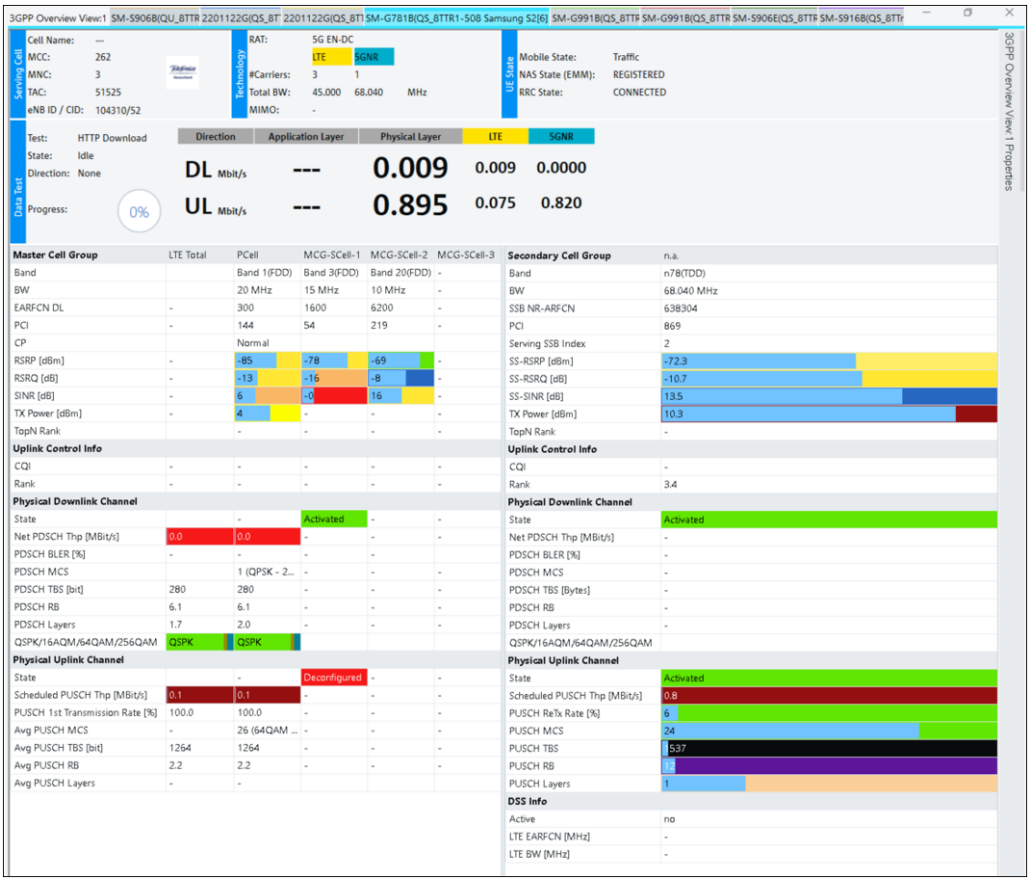


Figure 4-13: LTE cell data and 5G NR cells data populate 3GPP Overview View

1. If a label is associated with multiple signals, all them are copied during drag-drop, such as QSPK/16AQM/64QAM/256QAM.

2. More SCell data cells can be available.

3. RAT for 5G cells is optional.

4. A signal can be associated with devices, the devices are shown in different tabs.

5. AvgPUSCH Layers is not draggable.

NB-IoT label and data cells

Dragging label and data cells are the same for NB-IoT in the "3GPP Overview View". Data cell column is "NB-IoT Total". All NB-IoT signals are draggable in this view.

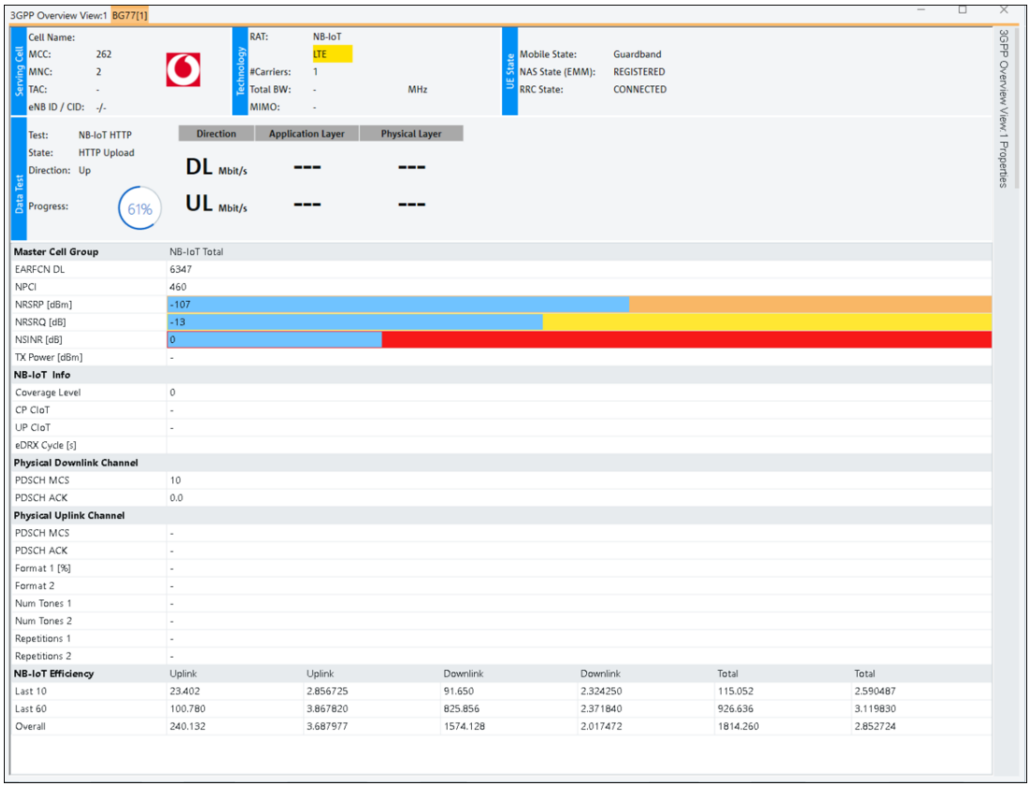


Figure 4-14: NB-IoT cell data populate 3GPP Overview View

UMTS label and data cells

Dragging label and data cells are the same for UMTS in the "3GPP Overview View". Data cell column is "Serving Cell". All UMTS signals are draggable in this view. Dragging QSPK/16AQM/64QAM/256QAM drags all four signals.

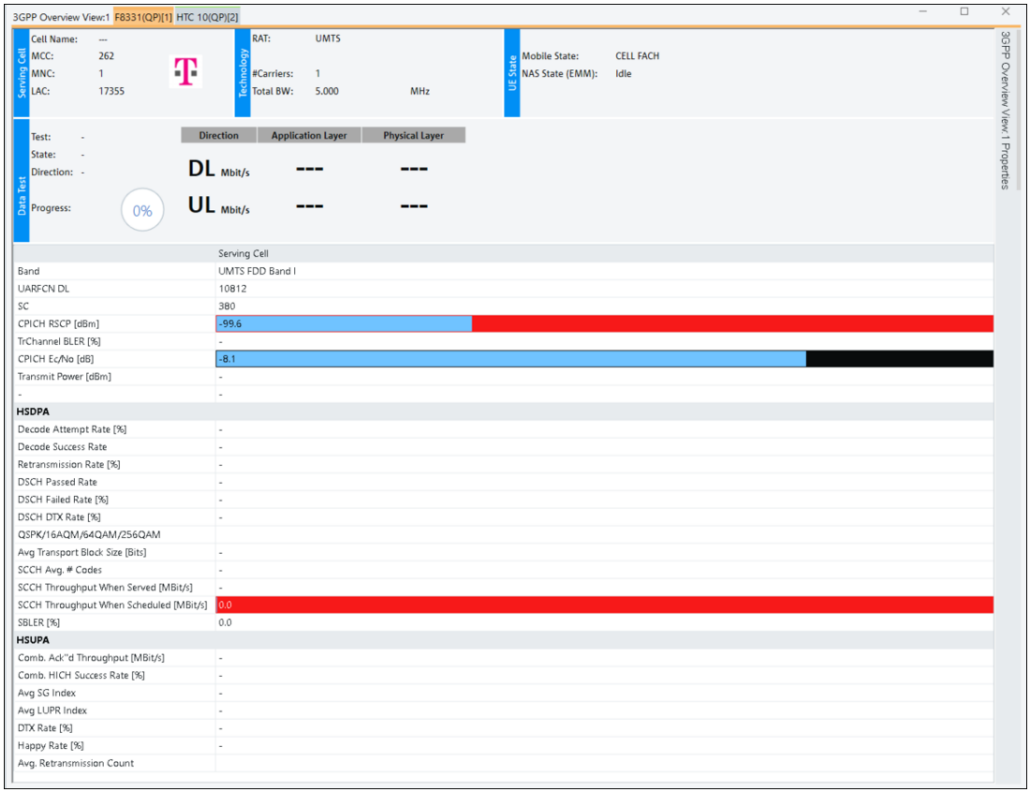


Figure 4-15: UMTS cell data populate 3GPP Overview View

GSM label and data cells

Dragging label and data cells are the same for GSM in the "3GPP Overview View". Dragging label and data cells are the same. Data cell column is "Serving Cell".

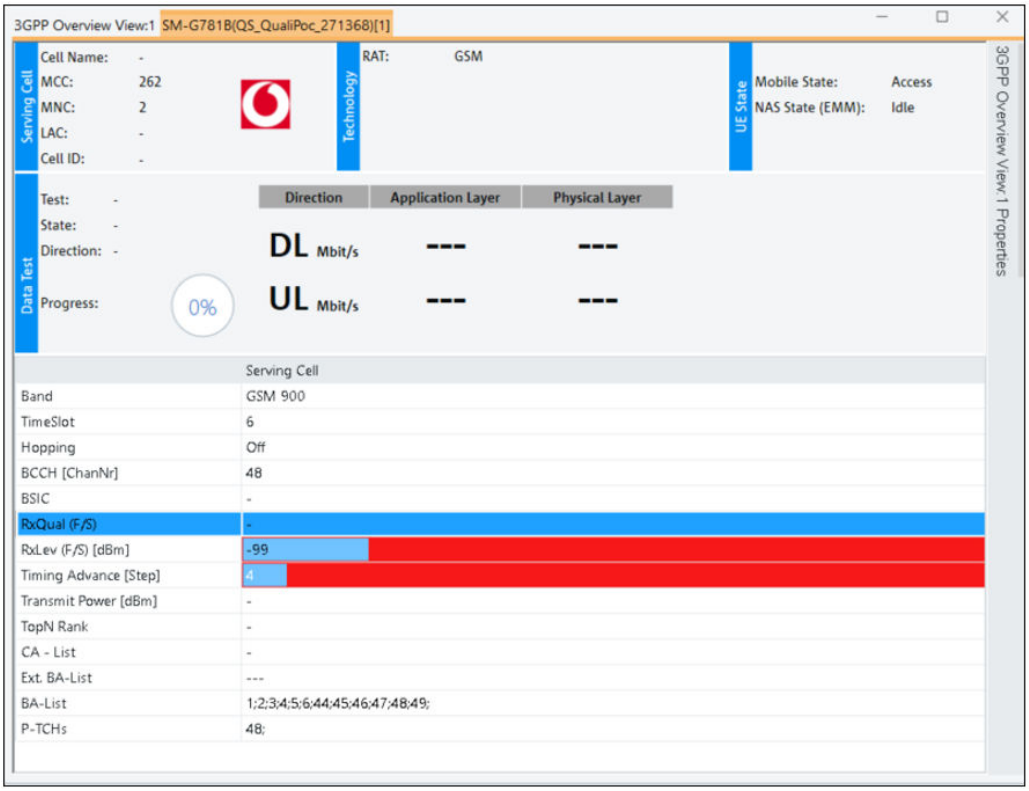


Figure 4-16: GSM cell data populate 3GPP Overview View

Not draggable GSM signals are:

- Hopping

- Top Rank

- CA-List

- P-TCHs

4.1.9.4 Drag the Top N signals from the <TEC> scanner TopN view

The Top N signals can also be dragged from the Top N list and dropped to other views. If the list items are displayed, all the "List" columns, except for the "#" column, can be dragged.

The signals in theTopN view are copied/dragged in the following way:

1. TopN pools and members are associated with the row.

2. TopN devices and/or TETRA sweeps are associated with the tabs.

3. If dragging on an empty area, but still under a TopN column in the TopN view, the filter dialog displays pools and members.

4. Signal can be dragged even if no measurement file is loaded. The filter displays pools and members.

The Top N signals cannot be dragged in the following situations:

1. If dragging on a point that is outside of Top N columns, nothing happens. For example, dragging on a point far right-hand side of the TopN view.

2. Signals copying is not supported in "Details" pane of the "5G NR Scanner Top N View".

3. Signals copying is not supported in the "cdma2000/1xEV-DO Scanner Top N View" and "WiMAX Scanner Top N View".

4.2 Basic views

The R&S ROMES4 basic views can be used to analyze data from various sources. The views are available irrespective of a kind of measurement performed or a type of measurement data replayed.

A basic view can be selected from the "View" > "Basic Views" menu of R&S ROMES4 menu bar, when the mouse pauses over the view you want to be displayed.

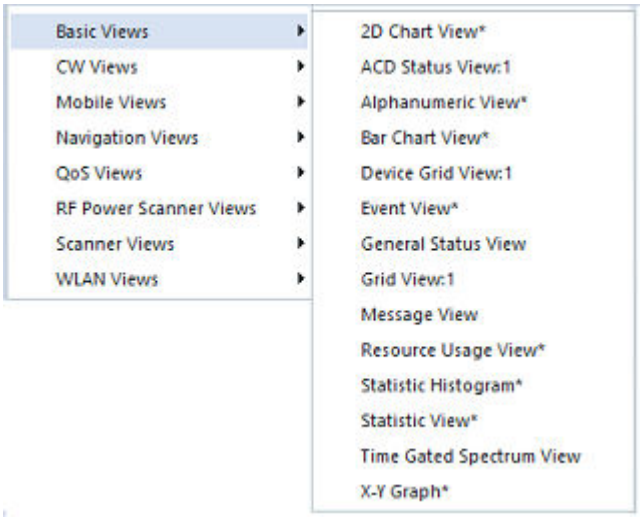


Figure 4-17: Basic Views menu

The configuration page "Values" of some basic views contains the options which help the user to find the required signal faster and in a more convenient way.

Available functions in this page are:

- "Available Signals"
  Shows the list of signals available to be selected for viewing.
- "Selected Signals"
  Shows the list of signals selected for viewing.
- "Tree Filter" makes it possible to filter the trees in the "Available Signals" list just by entering the tree's name or a part of its name as a filter.

The following views contain these options:

- Alphanumeric View

- 2D Chart View
- Statistics Histogram
- Statistics View
- ROMESMAP Route Track View

All views respect the general performance settings regarding the visual update rate done in the "Tools" > "Preferences" > "Performance" menu. The view individual settings are not supported.

Basic views as default views

It is possible to define several basic views including their different configuration settings using the R&S ROMES4 Default Views feature.

Pre-configured basic views can be used as the default views for the corresponding technologies.

R&S ROMES4 opens default views for each device after it has been connected successfully to the application. Which views have to be loaded is specified in the file `DefaultViews460.xml` which is located in the MyROMES\Configuration folder.

It is possible to define basic views, for example, the Alphanumeric View and load a specific configuration. The xml `CfgCustomName` attribute lets you specify the specific view of the config file.

Also, a Tec "Industry40" is defined. If the data quality tester (DQA) runs in Classic Mode 2, it returns "Industry40" as supported Tec.

To create desired default view, perform the following:

1. Create a workspace.
2. Configure the basic views, as you would like to have them opened automatically.
3. Click the"Info" tab in the view configuration dialog.
4. Give each basic view a custom name in the "Custom Name" box. It is important, that each view gets its unique custom name, as the names are used to find the correct configuration later.

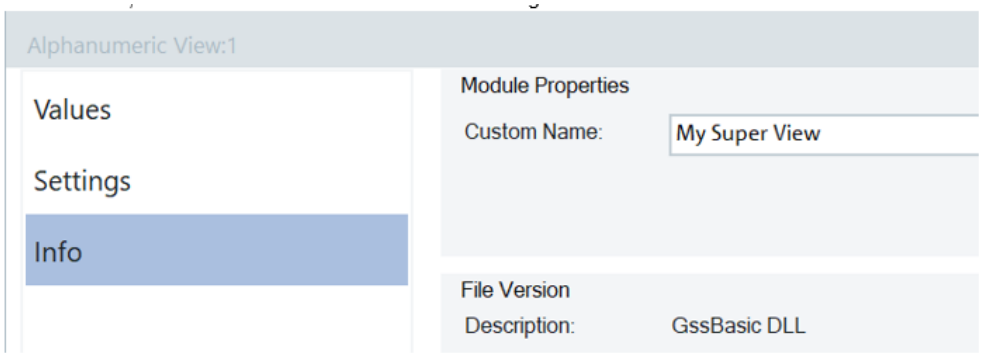


Figure 4-18: Naming the default view

5. Save the workspace to the MyROMES\Configuration folder. It is the folder in which the `DefaultViews460.xml` is located.
6. Open the `DefaultViews.xml` in a text editor.
7. Add the desired default views.

The "Device Grid View" and "Grid View" are not supported.

Example:

Adding the Interactivity Test View and two Alphanumeric Views for Industry 4.0

```
<!--============== Industry 4.0 ============================-->
<DefaultView          Name="Interactivity Test Summary View"
                      OverviewSheet="I4.0"
                      Tec1="Industry40"/>
<DefaultView          Name="Alphanumeric View"
                      OverviewSheet="I4.0"
                      Tec1="Industry40"
                      CfgFile="I40.rsxks"
                      CfgCustomName="Interactivity Results"/>
<DefaultView          Name="Alphanumeric View"
                      OverviewSheet="I4.0"
                      Tec1="Industry40"
                      CfgFile="I40.rsxks"
                      CfgCustomName="="iPerf Results"/>
```

The `Name` attribute gets the basic view's name.

The `CfgCustomName` attribute specifies the custom name as a set in the "info" tab of the basic view's configuration dialog.

The `CfgFile` attribute specified the name of the workspace which contains the configurations of the custom views. The workspace has to be located in the MyROMES\Configuration folder.

- 2D chart view 448
- ACD status view 461
- Alphanumeric view 466
- Bar chart view 471
- Device grid view 477
- Event view 498
- General status view 501
- Grid view 504
- Message view 515
- Resource usage view 517
- Statistic histogram 525
- Statistic view 532
- Time gated spectrum view 540
- X-Y graph view 543

4.2.1 2D chart view

The "2D Chart View" contains a Cartesian diagram showing one signal, the R&S ROMES4 signal sets or both as a function of time or covered distance.

Figure 4-19: Basic 2D Chart View

The view supports visualization of the configured signals both in line and bar chart. How to enable the bar charts, see Chapter 4.2.1.4, "Chart group menu", on page 455.

R&S ROMES4 allows several independent diagrams to open superimposing many quantities in the same diagram simultaneously.

You can add signals you want to be displayed in the view in the following way:

- drag and drop signal from the "Signal Tree"

- click the "Add Signal/Signal Set" button in the "Chart<variable>" legend title bar. The action brings up by default a pop-up window containing the list of available signals.

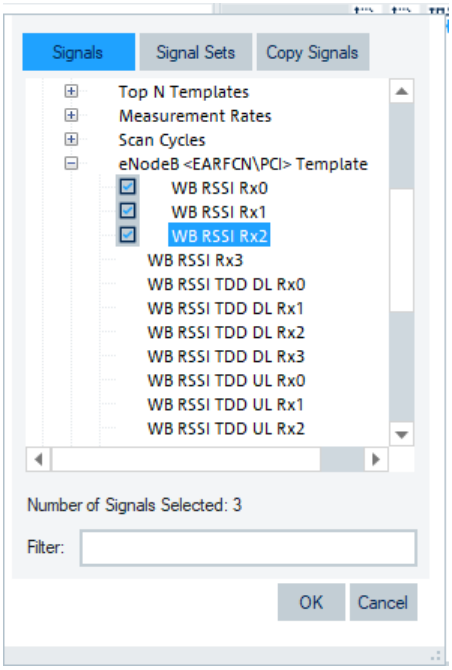


Figure 4-20: List of available signals

It is possible to select one or more signals from the list by double click the desired signals. The selected signals are marked in the list with the check mark next to the signals' names. After selection of all desired signals, click "OK" to add the signals to the "2D Chart View".

If a signal without available data is selected (for example, RxQual while the mobile is in "Scan" mode), no trace is plotted.

Instead, you can select a signal set if you click the "Signal Set" button in the previously mentioned pop-up window.

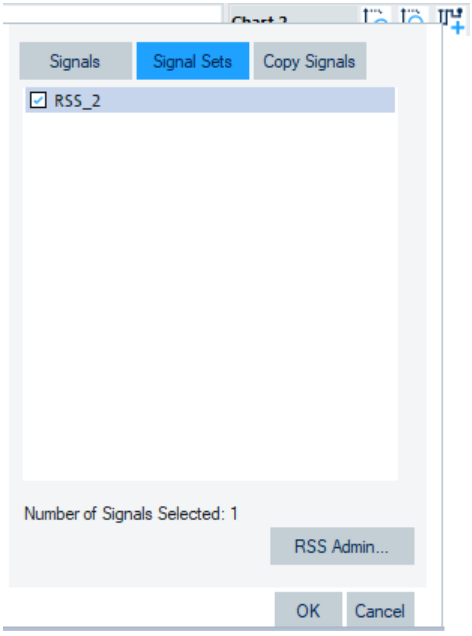


Figure 4-21: Added signal sets for display

You can modify the signal sets by clicking the "RSS Admin" button. If you want to return to add signals pop up, you need again to click the icon after the mentioned signal set modification.

The "Copy Signal" option lets you copy the selected signal or signal sets to the template filter.

4.2.1.1 2D chart view as bar chart

Adding the signals to bar chart is the same as adding them to line chart of the view. You can add them from "Signal Tree" or "Add Signal/Signal Set" button. The last mention is the only way to add signal set.

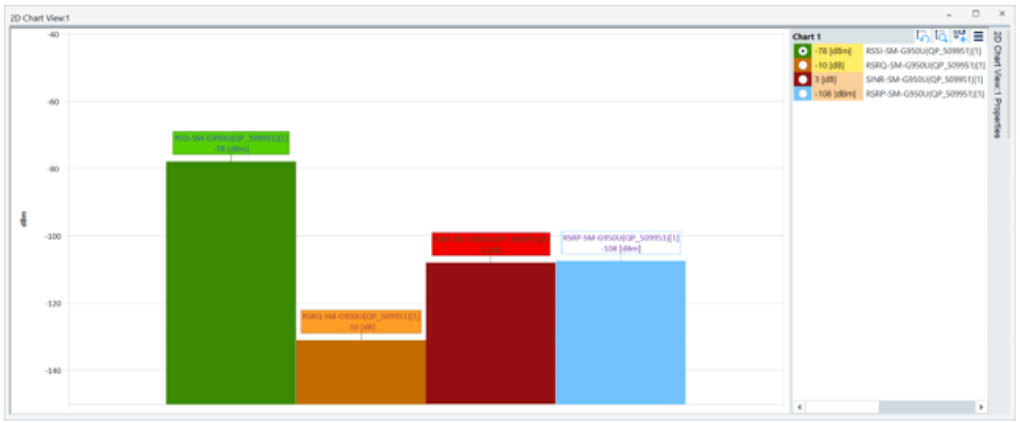


Figure 4-22: ROMES signals displayed as bar chart

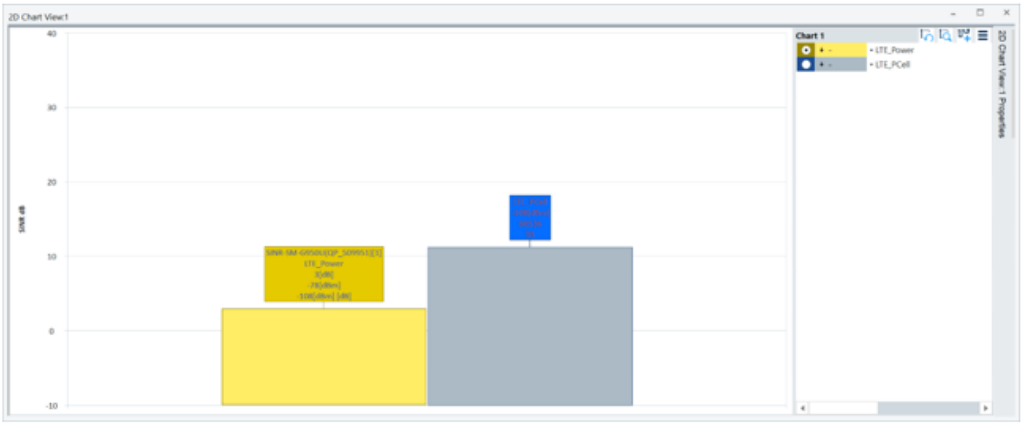


Figure 4-23: ROMES signal sets displayed as bar chart

If multiple chart groups are configured, a signal can be configured in up to 2 different chart groups. To duplicate a signal, drag and drop the signal from one group to another while holding the “CTRL” key. The same applies while dragging entire groups.

If a signal is configured in more than one group and you want to delete it, the signal must be deleted from each group separately by default. However, both signals can be deleted at the same time by holding down the “CTRL” key when delete either of the signals.

There is Incompatibility with the existing workspaces.

Redo each existing R&S ROMES4 workspace that contains configured old bar chart view with an instance of the configured "2D Chart View" with bar charts. R&S ROMES4 does not convert automatically the old "2D Bar Chart View" entries in the workspace to the new version of the view.

4.2.1.2 Chart group legend

Signals configured for a chart group are displayed in the chart group legend.

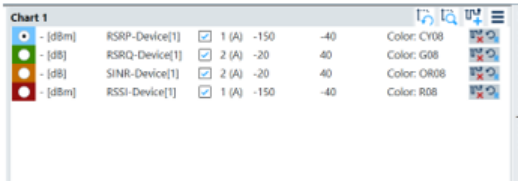


Figure 4-24: Chart field and the various group legends

Table 4-1: Entires in the Chart field

Column	Meaning
1	Indicates the color of a signal in the chart and also the selected signal. The selected signal is shown on the chart with a thicker plot line. The selected signal can be changed by clicking different signal. Only one signal at a time can be selected.
2	Indicates the current signal value and unit.

Column	Meaning
3	Indicates the signal name.
4	Shows or hides a signal on the chart. Check the box to get the signal on the chart.
5	Indicates the axis group number and the auto zoom to fit status. Signals with the same axis group number share a Y-axis setting on the chart. Signals that share the axis are determined automatically by R&S ROMES4 with the same relationship id or same unit value. Automatic zoom to fit X-axis status is A for automatic zoom to fit enabled or D for automatic zoom to fit disabled. Automatic zoom to fit is disabled under the following conditions: • Automatic zoom to fit is disabled in the properties menu. • Y-axes for the values are manually set by the user for the axis group that the signal is a part of.
6	Indicates the minimum Y-axis value. The default minimum Y-axis value for an axis group is calculated by taking the lowest Y-axis value of all signals in the group.
7	Indicates the maximum Y-axis value. The default maximum Y-axis value for an axis group is calculated by taking the highest Y-axis value of all signals in the group.
8	Indicates the signal configuration used to show the signal on the chart. To change the value, click the column and bring up the pop-up menu.
9	Contains two icon buttons. removes the signal from the chart group. resets Y-axis values to default calculated values for this signal and all signals in the signal group.

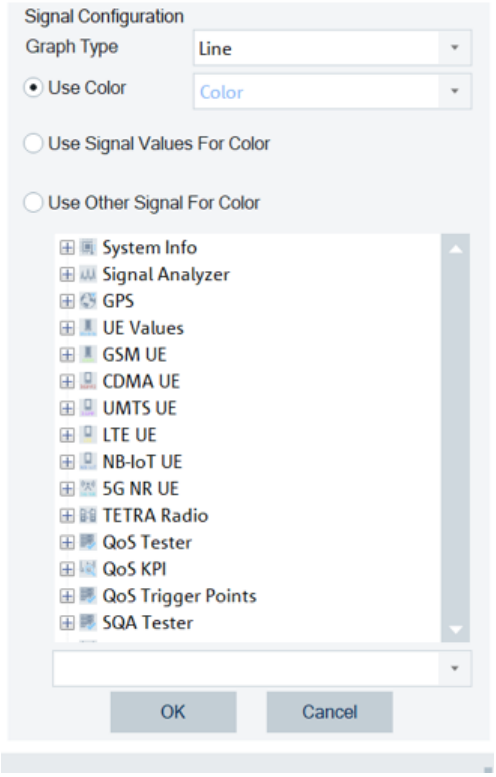


Figure 4-25: Changing signal value - clicking the column 8

Related to column 8 in the "Chart" field, the following options to change are:

- "Graph Type" - the graph type used for data display, which can be selected between:
  - "Line" - standard 2D chart line graph
  - "Vertical Line" - shows data points as a series of vertical lines instead a single horizontal line

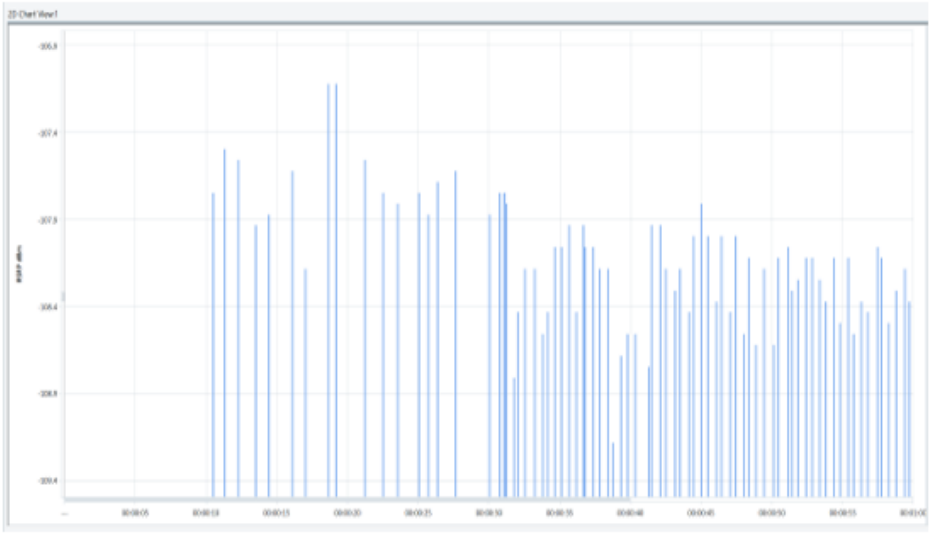


Figure 4-26: Layout of Vertical line graph

  - "Scatter Circle"
  - "Scatter Triangle"
  - "Scatter Rectangle"
  - "Scatter Rhombus"
  - "Scatter Triangle Left"
  - "Scatter Triangle Down"
  - "Scatter Triangle Right"
  - "Scatter Pentagon"
  - "Scatter Hexagon"
  - "Scatter Star"
  - "Scatter Cross"
    In general, scatter chart shows only data points using the defined shape (screen shot shows Scatter Circle)

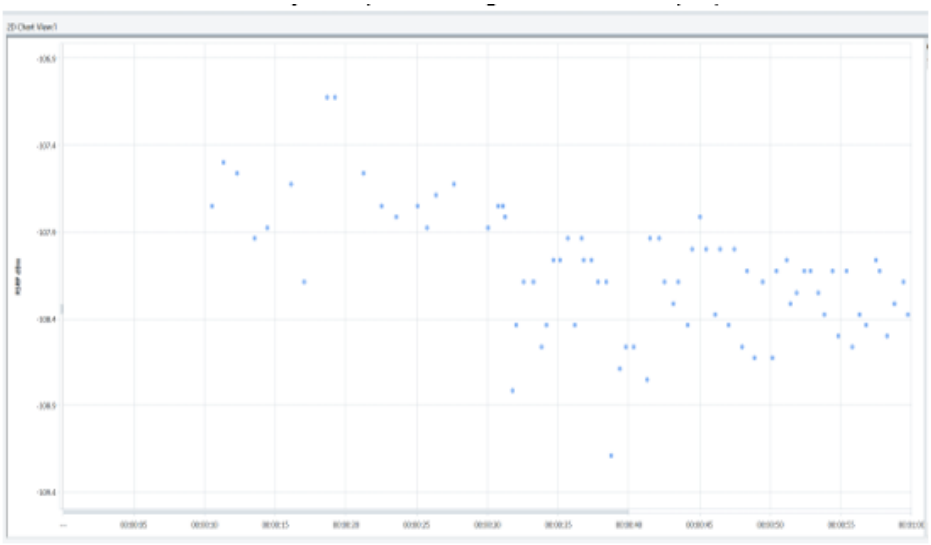


Figure 4-27: Scatter chart example - scatter circle

- "Use Color" allows for a single color to represent the signal in the chart.
- "Use Signal Value Color", the color on the chart corresponds to the current value of the signal.
- "Use Other Signal For Color", the color on the chat corresponds to the current value of the selected signal.

4.2.1.3 Chart group title

A chart group title by default is the "Chart x" where x is the chart number. This value can be changed in the "2D Chart View:x Properties" menu by changing the title in the "Group Configuration" > "Chart x" > "Title" field for the chart. The screenshot shows selection of Chart 1 for display and for title change.

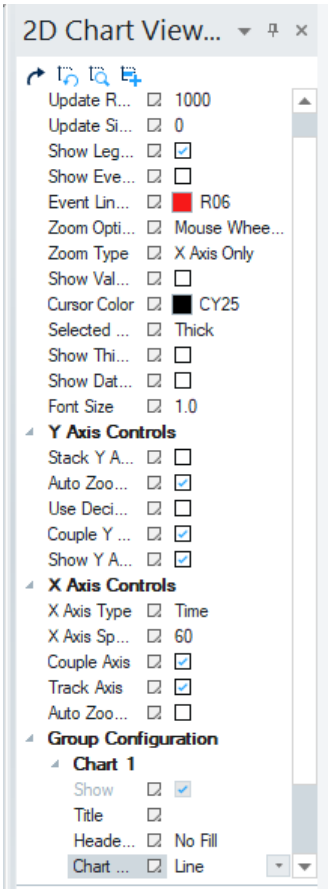


Figure 4-28: Properties field - chart 1

The option "Chart" in the "Group Configuration" > "Chart n" lets you switch from the line chart number n to the bar chart if the box is checked.

The default background color can also be changed here by selecting a color in the "Header Color" field.

4.2.1.4 Chart group menu

The ≡ "Show / Hide Chart Group" button of this menu has the following options:

- "Hide Chart" - hides the chart group.
- "Remove Chart" - removes the chart group.
- "Show All" - shows all hidden chart groups.
- "Add Chart Group" - adds a new chart group at the end of the current chart groups.
- "Remove All Signals" - removes all configured signals from the chart group.
- "X Axes Zoom To Fit" - zoom X axis to show the entire replay or measurement. Zoom applies to all chart groups if the "Couple X Axis" is checked in the properties menu. If the "Couple X Axis" is unchecked, the option applies to the specific chart group. (Applicable only during reply or measurement.)

- "X Axis Reset" - resets X axis to default values. Reset applies to all chart groups if the "Couple X Axis" is checked in the properties menu. If the "Couple X Axis" is unchecked, the option applies to the specific chart group. (Applicable only during reply or measurement.)
- "Y Axes Zoom To Fit" - zoom the Y axis of the specific chart group to current values in the chart. (Applicable only during replay or measurement.)
- "Y Axis Reset" - reset the Y axis of the specific chart group to the default values. (Applicable only during replay or measurement.)

The "Add Signal/Signal Set" icon adds wanted signal or signal set in the view.

The "Zoom To Fit X Axis" icon resets the X axis to default values if you press the “CTRL” key while clicking the icon.

The icon resets the Y axis of the specific chart group to default values. Press “CTRL” key while clicking this button icon to zoom to fit the Y axis.

Adding chart group

Click the "Show / Hide Chart Group" > "Add Chart Group" to add a new chart group (the view supports up to 8 chart groups), or click the "Add Chart Group" in the "2D Chart View: 1 Properties" menu.

Moving chart groups

Chart group order can be changed by clicking and holding a chart group title bar and then dragging it to a new location in the view.

Moving signals

Signals can be moved to a new position within the same chart group or to a new chart group. Click and hold on the signal's name and then drag to a new location.

Properties menu

The "2D Chart View: 1 Properties" pane holds the following entries, see the Figure 4-28.

"Global"

- "Update Rate In MS" – shows how often is the view redrawn during replay or measurement.
- "Update Signal Rate in MS" – shows how often are signals updated in milliseconds.
- "Show Legend" – shows/hides the chart legend.
- "Show Events" – shows/hides the chart event windows. This window shows configured R&S ROMES4 events for the measurement/replay.

Figure 4-29: 2D chart view shows events

- "Event Line Color" – select a color to represent event markers in the chart.
- Available are the following "Zoom Options":
  - "Mouse Wheel & Pan" - to zoom, use the mouse wheel. Click and hold on the chart to pan the chart.
  - "Magnify" – to zoom on the chart, click the left mouse button to zoom in and the right mouse button to zoom out.
  - "Select" – to zoom into selected area in the chart, use mouse, place the cursor on the area and zoom into it.
- "Zoom Type" – what axis zooming applies to.
  - "X Axis Only" – zooming applies to only the x axis.
  - " Y Axis Only" – zooming applies to only the y axis.
  - "Both" – zooming applies to both the x and y axis simultaneously.
- "Show Values on Mouse Over" – show or hide the values in the chart for the current mouse position. (In the following screenshot these values are listed in the upper left corner of the view.)

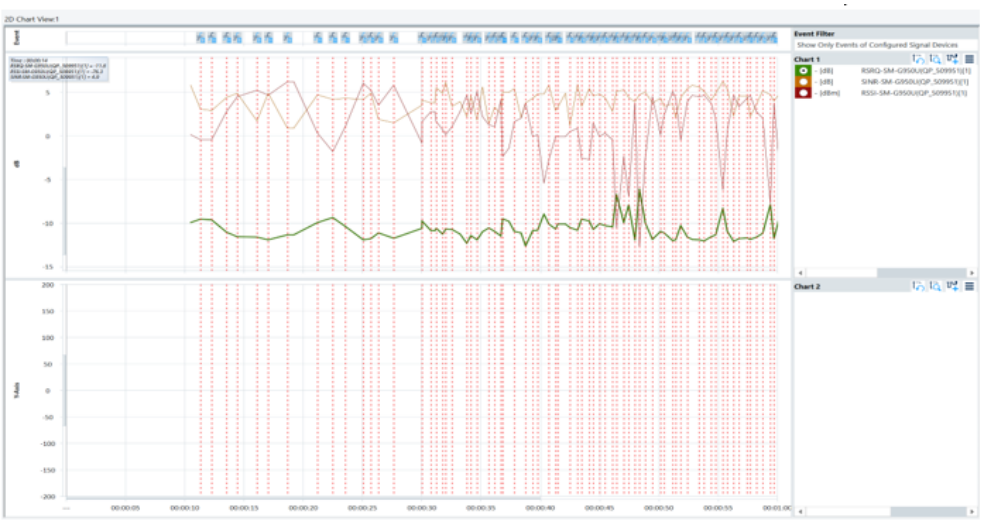


Figure 4-30: Values shown in the chart

- "Cursor Color" – changes the color of the current position cursor.
- "Selected Signal Style" – the chart style of the selected signal for each chart group.
  - "Thick" – selected signal represented by a single thick line. (Thick line only applies if the selected signal is a line type. If the select signal is configured as a vertical line or scatter type, that type is displayed as filled instead of a thick line.)

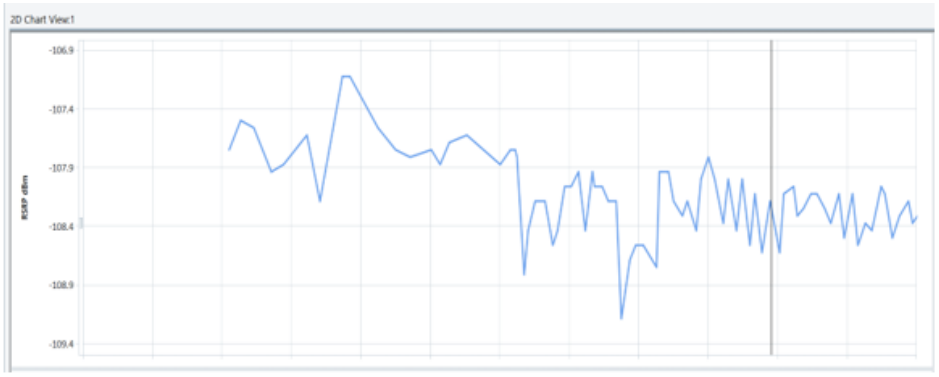


Figure 4-31: Tick line signal style

  - "Filled" – the selected signal is represented by filled area.

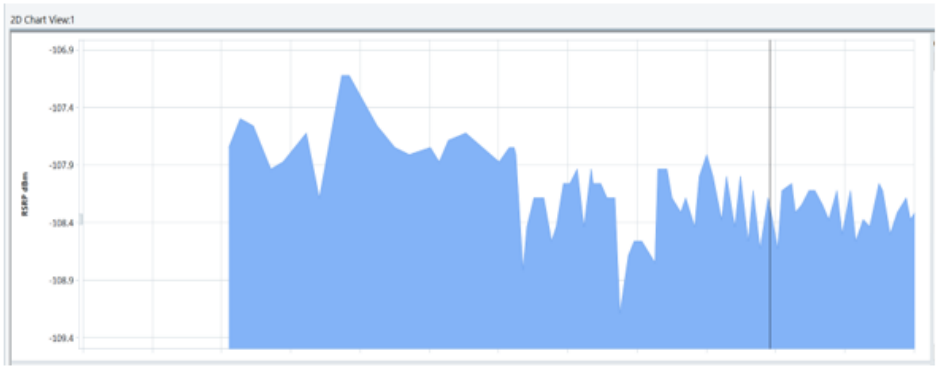


Figure 4-32: Filled signal style

– "Tick and Fill" – the selected signal is represented by a thick line and filled area.

- "Show Thick Line" – the option increases the thickness of the all lines in the chart both the cursor and signal lines.

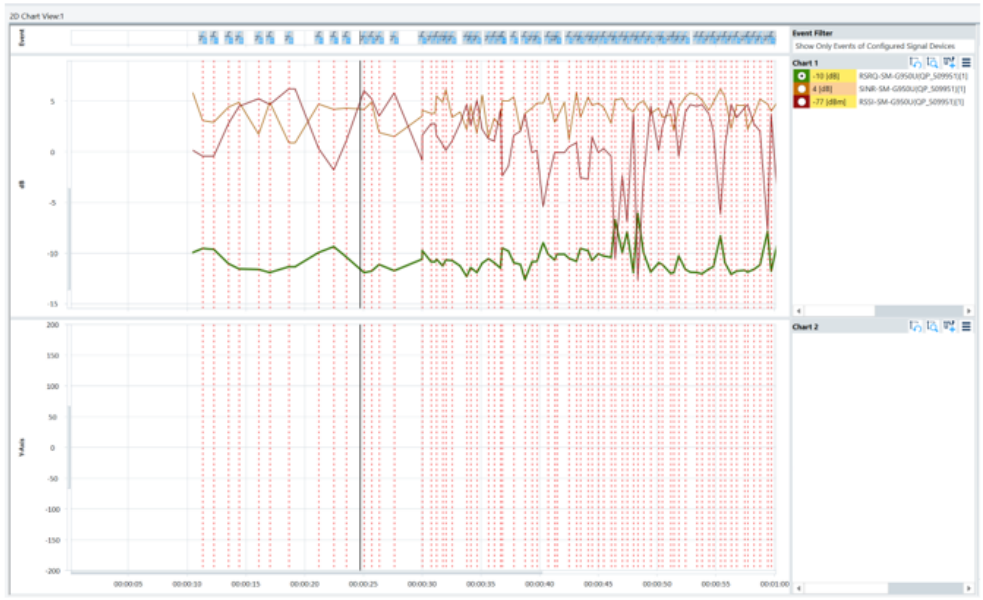


Figure 4-33: Display of the tick lines

- "Show Data Point Marker" – shows individual data point markers in the chart. (Applicable only to signals configured as a line type.)

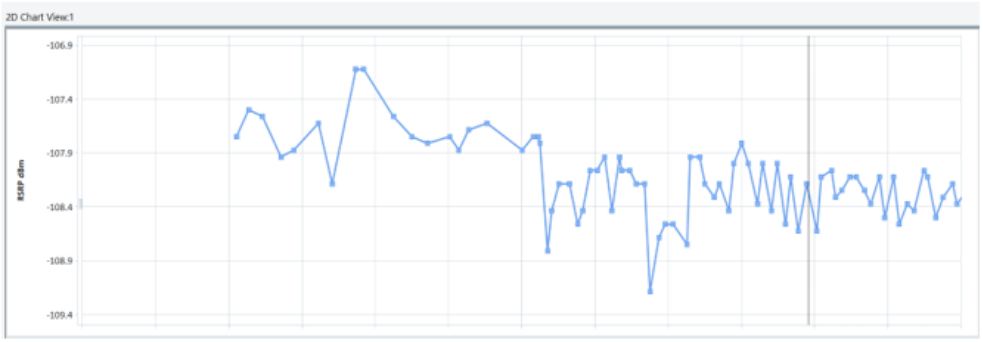


Figure 4-34: Data point marker display

- "Font Size" – font size of the text in the chart legend.

"Y Axis Controls"

- "Stack Y Axis" – if uncheck, only the axis values and title of the selected signal's axis group is displayed. If check, the axis values and all axis groups are displayed.

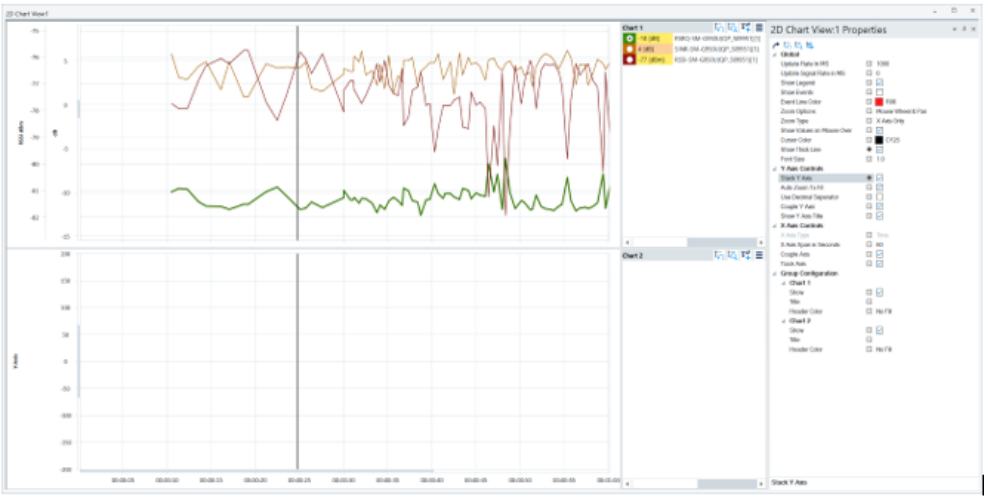


Figure 4-35: Stack Y-axis selection

- "Auto Zoom To Fit" – if checked, the y axis is automatically zoomed to the minimum and maximum values for the current replay / measurement.
- "Use Decimal Separator" – axis values are displayed using a decimal separator.
- "Couple Y Axis" – if checked, R&S ROMES4 automatically groups the signals with the same signal relationship ID or unit value on the same axis. If unchecked, all signals are shown on a separator axis.

"X Axis Controls"

- "X Axis Type" – X-axis is displayed in the time values or distance values.
- "X Axis Span in Seconds" – span of the X-axis in seconds.
- "Couple Axis" – all charts share the X-axis if checked. All charts have the separate X-axes if unchecked.
- "Track Axis" – during measurement or replay the X-axis of the chart is automatically scrolled to the current location of the measurement/replay. If unchecked, the X-axis is not scrolled unless done by the user.

"Group Configuration"

- "Chart X" – this section is repeated for each configured chart group.
- "Show" – shows/hides the chart group.
- "Title" – configures a custom title for a chart group. Empty the field removes the custom title for the chart group.
- "Header Color" – selects a custom color for the chart group header.

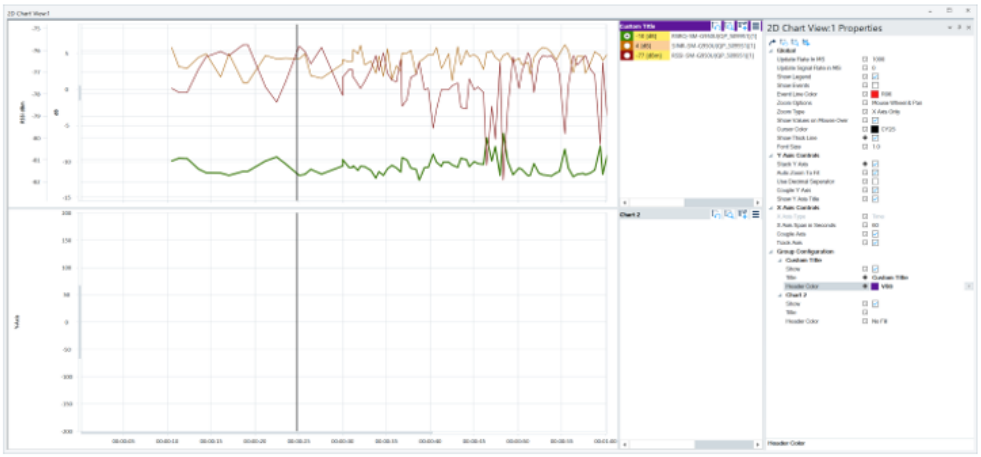
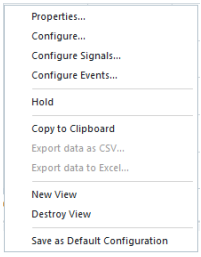


Figure 4-36: Stack Y-axis chart with selected header color

4.2.1.5 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.2.2 ACD status view

The "ACD Status View" displays the current status of the ACD use cases for various technologies, namely, for 5G NR, LTE, NB-IoT, LTE-M, UMTS , GSM, cdma2000, TETRA and WiMAX.

The detected bands which overlap in terms of frequency range are included in the view. If spectra overlap, they share the horizontal space of the display.

The following figure shows bands sharing between technologies in the "ACD Status View". The LTE Band 3 is shared between 2G and 4G, and the LTE Band 1 is shared between 3G and 4G. The thin bars in the figure display the ACD status view of NB-IoT.

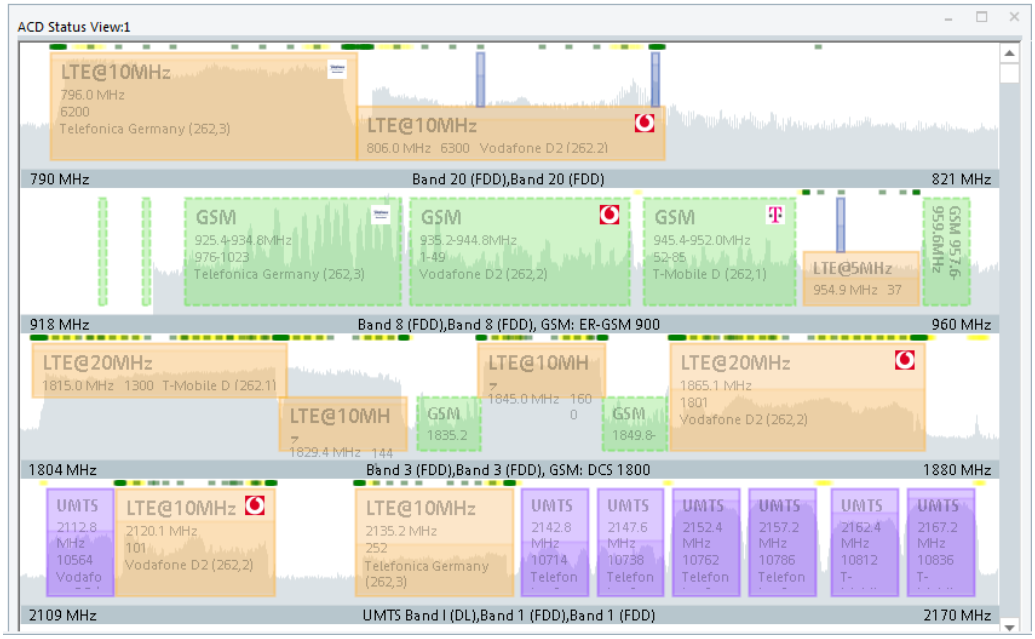


Figure 4-37: LTE bandwidths at band 3 overlap

Each band which has been selected for the ACD is represented by one horizontal line. If the GSM network scanner is active, its ACD status is represented by the lines for each scanned GSM band. If a GSM band is fully covered by any other technology ACD band, for example, by an LTE band, the GSM band is merged into that band.

The view can also display the UL channels of the detected frequencies if they are within the frequency range of any sweep.

If the band scanning is based on ACD monitoring use cases, the RF Power Scan spectrum is displayed as light gray background picture for that band (not applicable for 5G NR scanning). The update rate of the spectrum is about 10 seconds. For the ACD, refer to Chapter 3.8.2.1, "Technologies", on page 280 and Chapter 6.4.15.2, "Configuration LTE scanner", on page 1728.

The frequencies which still have to be tested by the ACD are represented by small green and yellow squares above the spectrum. A green square means that a frequency is currently under the test, a yellow square that the frequency still has to be tested.

By detecting the carrier, the corresponding part of the spectrum (frequency bandwidth) is covered by a rectangle. The color of the rectangle represents the RAT of the detected carrier.

A dotted rectangle means that the actual bandwidth of the carrier is not detected yet. The dotted rectangle appears when MIB of LTE channels MIB is still not decoded or GSM frequency ranges are not detected.

A spectrum display in the "ACD Status View" explodes to the normal size if a mouse hovers over it, showing its details.

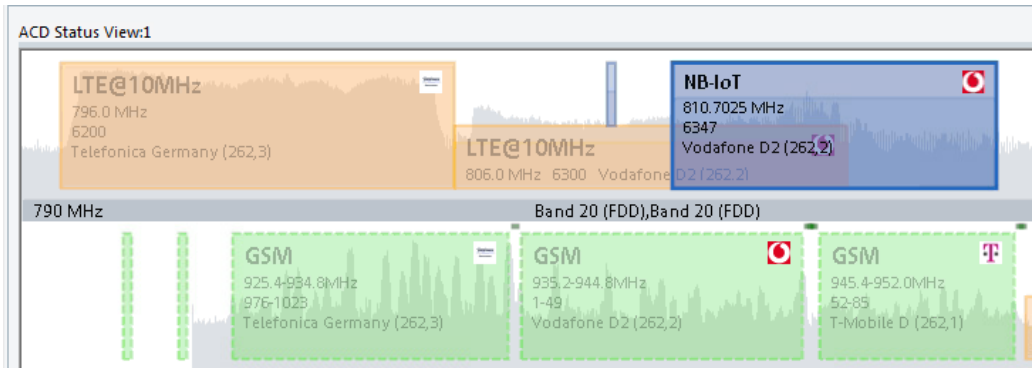


Figure 4-38: ACD details

The rectangle contains the following details:

- Radio Access Technology name (for example LTE and 5G NR)
- Center frequency/frequency range in GSM
- Channel number/channel number range in GSM
- Logo of provider if found in the database
- Name of provider followed by the MCC and MNC values
  Included MCC and MNC allow a quick check the expected numeric values of both parameters.

The last power of the carrier that was reported by the scanner to the ACD is represented by the lower more opaque part of the rectangle. If a detected carrier has not been measured for one minute, it starts to get transparent. After two minutes, the transparency does not increase anymore. An asterisk is appended to the RAT name as long as it has not been measured again by the corresponding scanner.

The "ACD Status View" of the 5G NR technology displays the content of demodulated SIB1, which is a provider's name, MCC and MNC and carrier frequency. To pop up the Tooltip which holds the mentioned SIB1 content, hover with mouse over the detected spectrum. In case that the Initial Bandwidth Part (IBWP) is not identical with the carrier, the IBWP is shown explicitly, see the following figure. If the 5G Demodulator v47.97 or higher is used during recording, the view provides the 5G NR mode of operation per provider. Displayed is in this case the superset of all possible modes of gNodeBs demodulated for the particular provider.

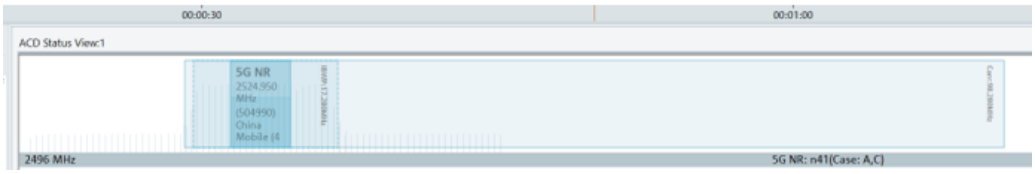


Figure 4-39: 5G NR SIB1 content

If the detected 5G NR SSB contains a SIB1 with the corresponding information, the specific carriers bandwidth is shown around the SSB block. The bandwidth is taken from the first demodulated NodeB which contains the information.

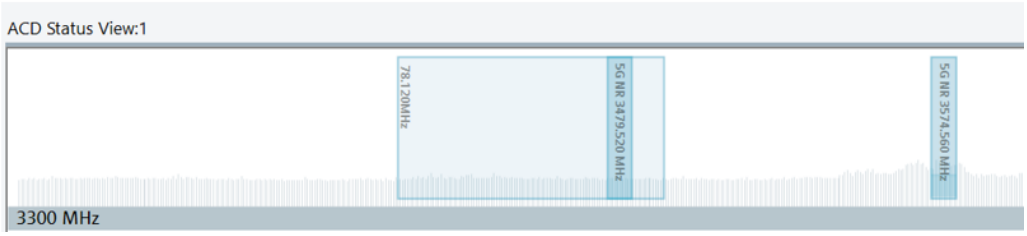


Figure 4-40: ACD status view of 5G NR

ACD status view export

The ACD status view supports export of the view's content to a file of CSV format. All identified downlink spectra are exported.

To trigger the view export, click the "Export data as CSV" context menu entry.

4.2.2.1 Deactivating automatic channel detection

The ACD algorithm automatically adds detected channels to active scanners. You can deactivate this behavior by unchecking the "Auto Start Scan" option in the ACD configuration page of each scanner.

If you uncheck the option, all detected channels are displayed gray in the "ACD View".

Figure 4-41: ACD view - UMTS channel detection deactivated

To enable the scan of a detected channel, click it and confirm your intention.

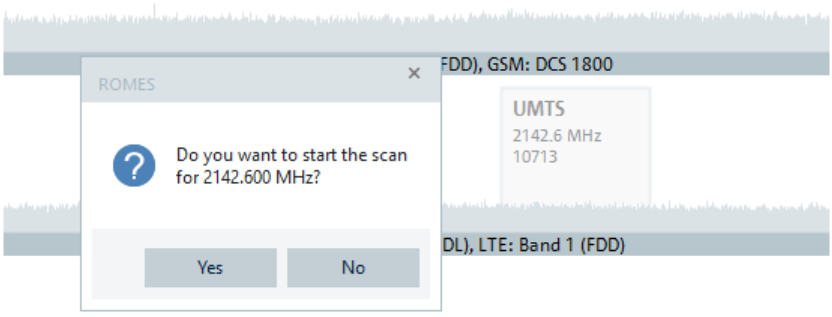


Figure 4-42: Inquiry to start scanning UMTS channel

Once the scanner is started to measure, the corresponding rectangle gets colored.

Figure 4-43: ACD view - UMTS channel scan active

4.2.2.2 Special ACD case - GSM

As GSM is not a part of the ACD, the GSM frequency blocks have to be retrieved out of the result for the scan of several GSM channels. This algorithm accounts all GSM channels which have been scanned within the last two minutes. GSM frequency blocks are always represented by a dotted rectangle, because there is not fixed bandwidth of this block.

By default, only GSM BCCHs are accounted for the GSM frequency blocks. TCHs are not represented in the graph unless SI Type 1 is decoded by the scanner. In that case the channels of the CA list are counted analogue to the counting of BCCHs.

The GSM frequency blocks are calculated every 10 seconds and are based on the measurements of the last minute.

The update is not synchronous to the "Transmitter Scan View".

4.2.3 Alphanumeric view

The "Alphanumeric View" displays current values of the signals selected in the corresponding configuration menu. The values are continuously updated while the measurement or replay session is going on.

Example: Several devices

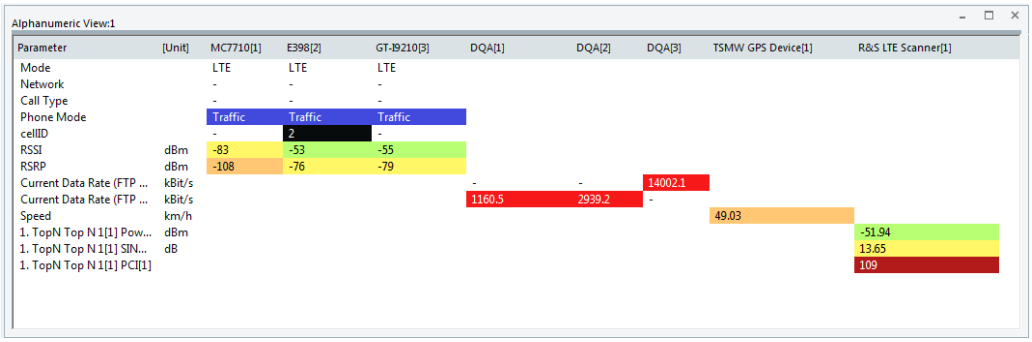


Figure 4-44: Alphanumeric View

In the "Alphanumeric View" signals from different measurement devices (e.g. from different GSM or CDMA devices) are displayed in different columns. If only mobile phone parameters are viewed, a device name for each column is unambiguous and therefore indicated in the table heading.

Device parameters from other technologies, e.g. from test receivers or GPS receivers, are always displayed in the first column.

If the first column contains parameters from several devices, the table headings read "Device [1]", "Device [2]" etc. The device for each parameter value can still be obtained: It is indicated in a yellow popup window when the pointer is placed on the parameter value.

After clicking a parameter (or selecting a group of parameters using the shift or control keys), it is possible to change the order or remove the parameters from the view.

Note that the "Serving Cell" name can only be displayed if a correct BTS list is provided. In this case, also the distance to the BTS is displayed (example: BTS1 (2.6 km)).

The channel assignment option for 3GPP RATs (see Figure 3-225), visualizes the technologies' assigned channels (e.g. EARFCN or UARFCN) for the measured signals. The following figure illustrates for LTE the channel assignment.

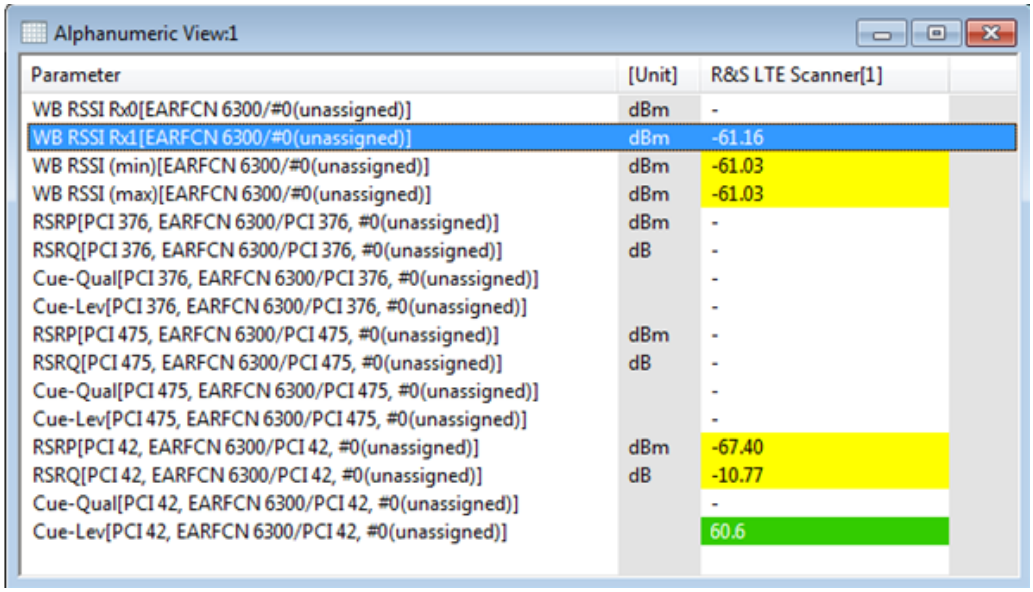


Figure 4-45: Measured signals and assigned channel number

LTE scanner's narrowband (NB) and wideband (WB) measurement rate signals have each their own configurable measurement rates. Based on that fact, the NB and WB measurement rate signals are displayed separately in the "Alphanumeric View".

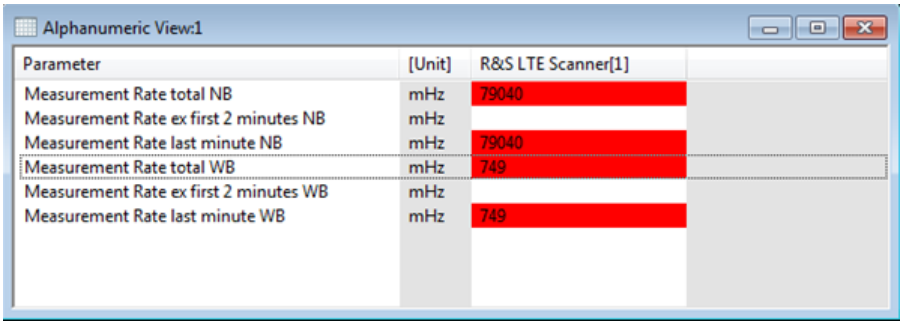
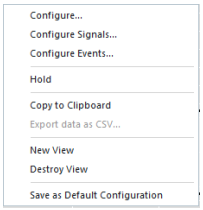


Figure 4-46: Separated NB and WB measurement rates

4.2.3.1 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.2.3.2 Alphanumeric view configuration

The "Alphanumeric View" window lets you select the signals to be displayed, set the colors for the signals and the view's layout. The information on the current view's version is also available.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

4.2.3.3 Values tab

Selects the signals to be displayed in a generic (basic) and some mobile views. The connected devices can be indicated in the "Selected Signals [Maximum Allowed <variable>]" list for some signals. The "Values" tab is analogous to the "Values" tab of the "Alphanumeric View".

For further description of the tab, see Chapter 4.2.3.3, "Values tab", on page 468.

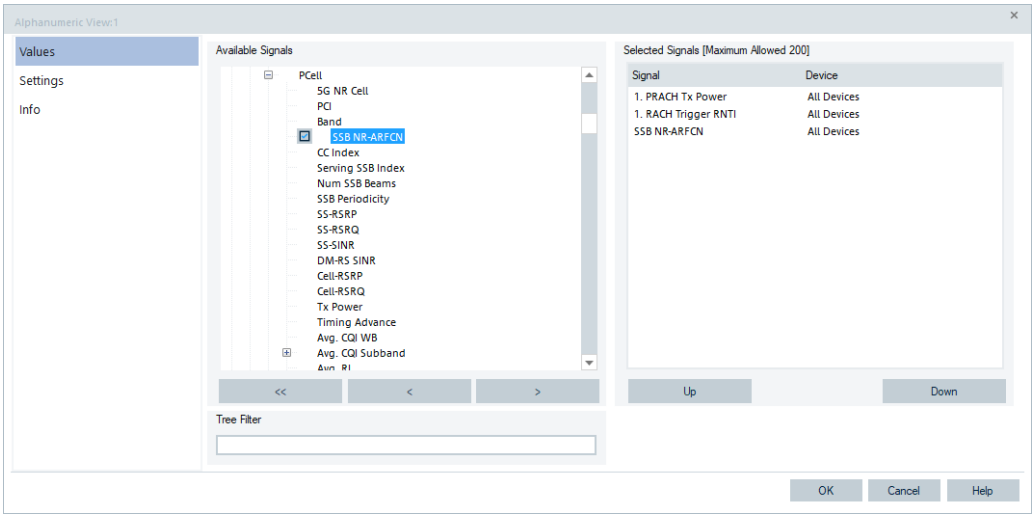


Figure 4-47: Alphanumeric View - Values tab

To add a signal in the "Alphanumeric View":

1. Click in the "Alphanumeric View" area to get the context menu. Select the "Configuration" command.

   The "Alphanumeric View" > "Configuration" window opens.

2. Select in the "Available Signals" list a signal for display in the view. Click ">".

   The selected signal is shown in the "Selected Signals [Maximum Allowed 200]" list.

3. Click "OK".

   The selected signal is now present in the "Alphanumeric View" in the "Parameter" column.

To display the optional signals in the list, activate them in the TEC window.

For example, the HPP / SPP, MIMO and the WB signals of LTE cells (of each possible physical cell ID) are present in the view's list only if they are activated in "TEC for LTE Scanner" > "Top N Pool Settings" > "Optional Top N Signals".

Configuration of a scanner Top N signals

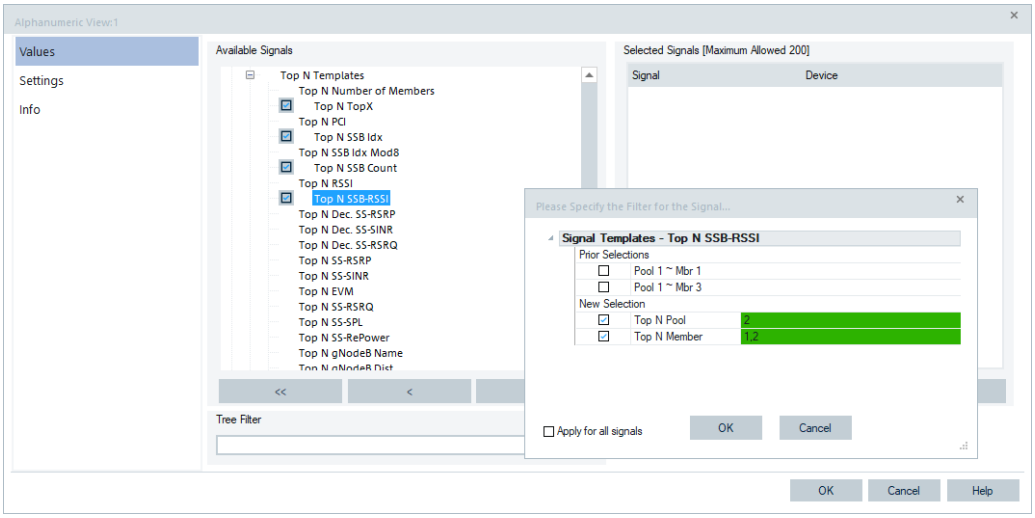


Figure 4-48: Adding the signals for all Top N pools

The view's available Top N signals of the "TEC for <variable> Scanner" can be configured in the "Top N Templates" branches of a technology scanner. The function lets you configure signals as Top N template signals.

1. Select a signal in the "Top N Templates" branch and click ">" or double click the selected signal.

The "Please Specify the Filter for the Signal" window pops-up.

2. Specify the filtering criteria for the (new) selection. There is the option to apply the filtering criteria to all signals.

3.Click "OK"

The selected Top N signals are displayed now in the "Selected Signals [Maximum Allowed 200]" pane.

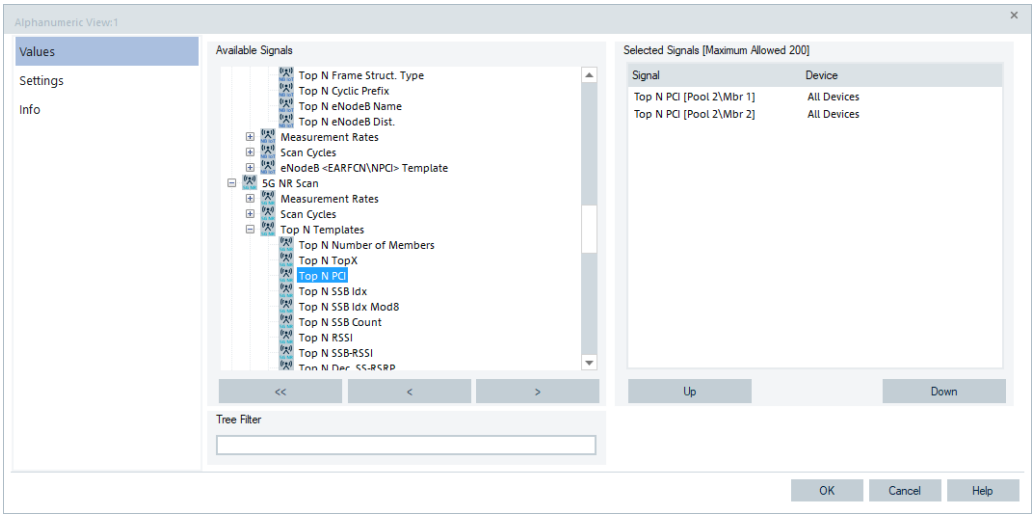


Figure 4-49: Result of the signals selection

Tree Filter
Makes it possible to search for a tree in the "Available Signals" list by entering just the tree's name or a part of its name as a filter.

4.2.3.4 Alphanumeric view configuration: Settings tab

Click the tab to set the layout of the "Alphanumeric View".

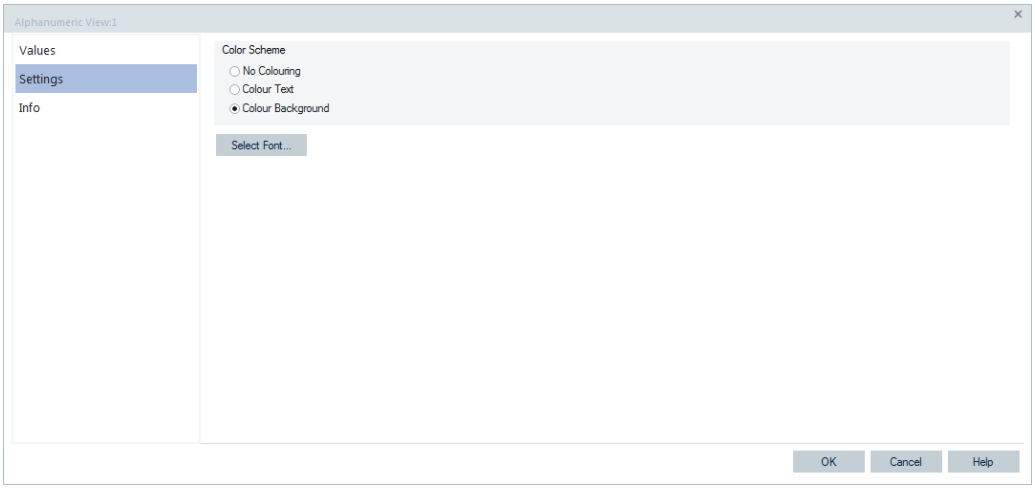


Figure 4-50: Alphanumeric View - Settings tab

Color Scheme
Within the "Color Scheme" pane, you can select colors for the text and the background. A colored text or background makes it easier to distinguish when a signal value changes.

The signals color settings are made in "Tools" > "Preferences" > "Available Signals", see "Color Scale Configuration" on page 230.

Select Font
Click the "Select Font" button to open a window which allows the font attributes to be set for this view. The font attributes are: font, font style and font size.

4.2.4 Bar chart view

The R&S ROMES4 "Bar Chart View" is a basic view intended to present measurement data in a flexible bar chart.

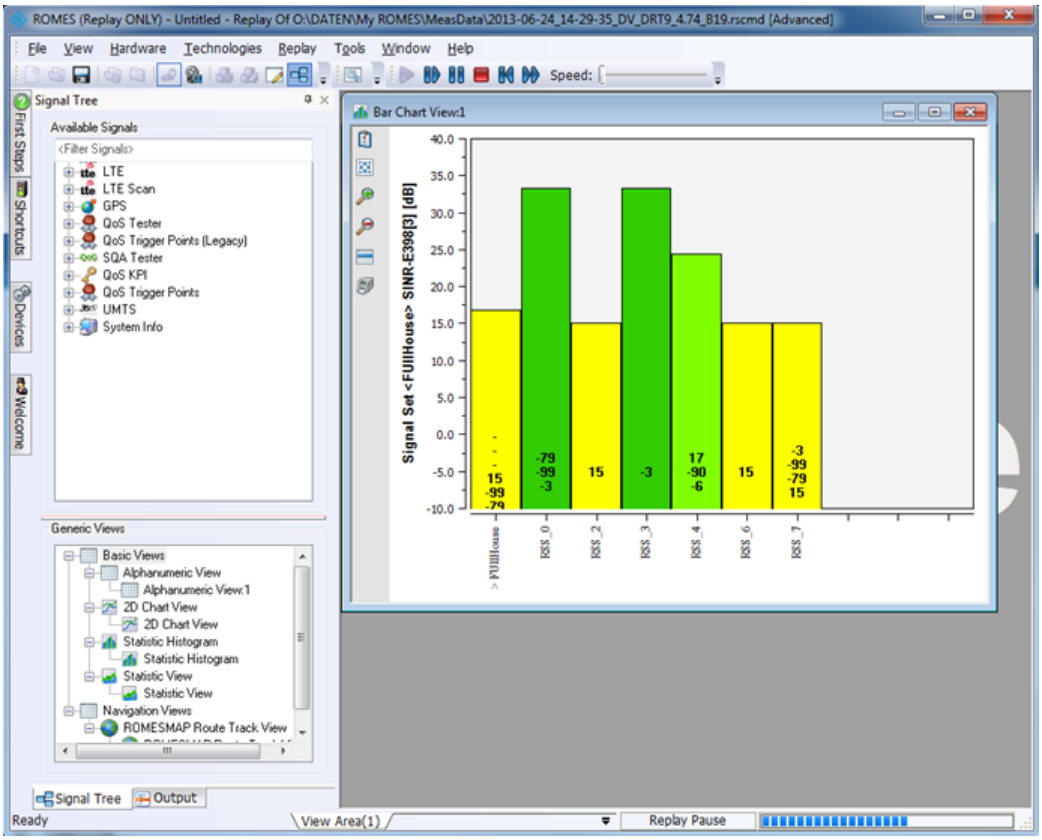


Figure 4-51: Measurement shown in Bar Chart View

The "Bar Chart View" provides a bar chart. Each bar represents one ROMES Signal Set (RSS).

- ROMES signal set....471
- Information in the bar chart view....473
- Bar chart view configuration....477

4.2.4.1 ROMES signal set

The RSS is a set of one to n ROMES signals. It represents a set of individual signals. One signal defines the bar height whereas the same or any other signal defines the bar color. The RSS can be configured freely by using all available ROMES signals and easily assigned to the "Bar Chart View".

Each RSS is saved as an XML file and stored within the folder

`My ROMES\Configuration\SignalSets`

At least one signal must be marked to define the bar height and one signal must be marked to define the bar color. One or more can be marked to provide long and / or short information.

- **Bar Height**
  One and only one signal can be used to define the height of the bar. This signal has to be a numerical signal. Signal sets without a signal specified for bar height are not valid and cannot be used. Therefore they are ignored.
- **Bar Color**
  One and only one signal can define the color of the bar. In case the signal set does not specify a signal for bar color the first signal in the sequence is used for coloring.
- **Short Information**
  All signals can be used for generating the short information. For the short information the current value of the signal is used. Short information is shown vertically inside the bar. The user is responsible to select the best signals to get the short info shown properly. Invalid values or missing values are shown with “-“.

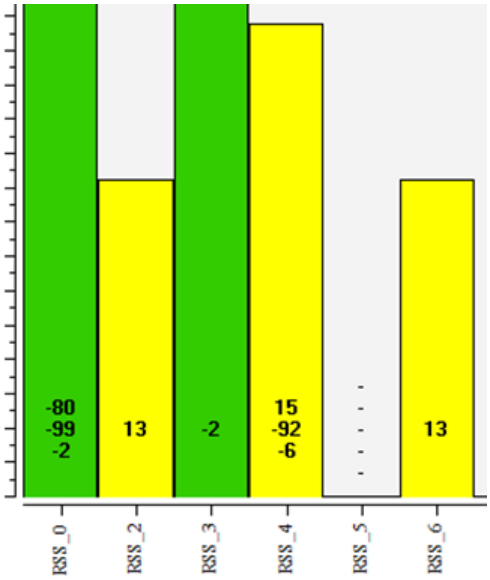


Figure 4-52: RSS short information

- **Long Information**
  All signals can be used for generating the long information. Long information is shown as a ToolTip on the top of the related bar. The long information contains for each signal the signal name, the current value and the signal unit.

RSS administration

The RSS administration dialog can be used to maintain the RSS. With this dialog the RSS can be created, deleted, renamed or modified.

The following figure shows all available signal sets in the "Available Signal Sets" list.

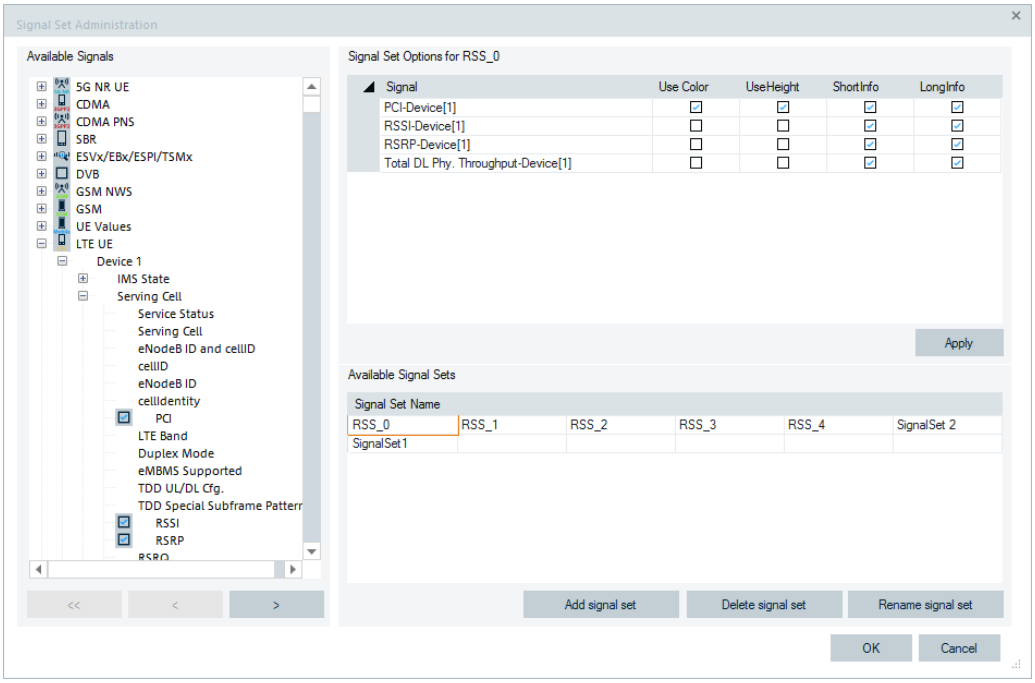


Figure 4-53: RSS administration

The RSS "RSS_0" is selected and its signals are listed within the "Signal Set Options for RSS_0" list. For each signal there are some options which can be set or unset. Only numeric signals can be used for bar height.

The RSS administration dialog can open from the bar chart configuration dialog with the button "RSS Admin", see Figure 4-56.

4.2.4.2 Information in the bar chart view

The "Bar Chart View" is a basic view and can be instantiated many times.

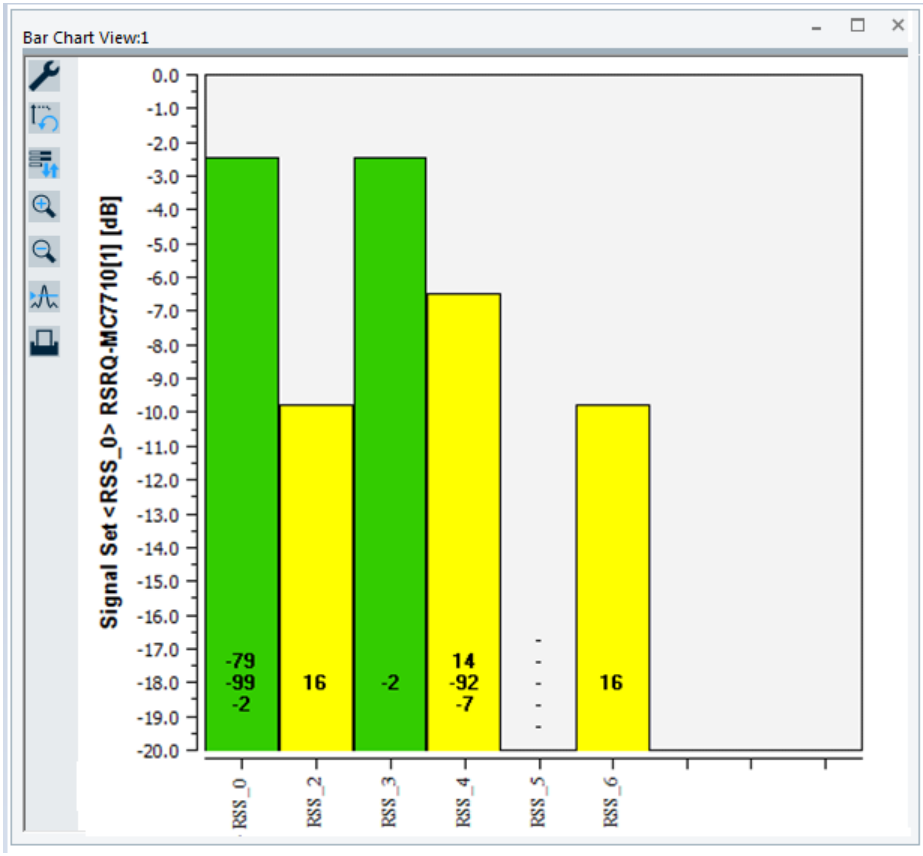


Figure 4-54: Chart bar view for RSS_0

The figure shows a bar chart view with six RSS configured. The RSS "RSS_0" is selected and the y-axis shows the related signal information according to "RSS_0". Each bar shows also some short information.

The bar width is calculated automatically and depends on the number of RSS assigned to the bar chart view and the visual width of the "Bar Chat View" dialog. There is no limitation how many RSS a bar chart view can show (it mainly depends on the usability).

The x-axis shows all configured RSS and can be used to select an RSS. The y-axis is always synchronized with the signal defined for the height of the selected RSS.

Bar chart views work only with the RSS. Thus, it is not possible to drop a signal to any bar chart view. To define which RSS shall be visible within a bar chart view the related configuration dialog must be used. Signal sets are part of the R&S ROMES configuration and not stored within individual workspace. Only the information which RSS are defined for a bar chart views is stored into the workspace.

Bar

A bar within the chart can be specified freely by the user. The configuration of a bar consists of the RSS and a signal independent configuration set. The bar has the following properties which can be used for visualization:

- Bar Height

The height of the bar reflects the value of one of the signals of the RSS. At least one signal of the RSS must be configured for height. If not, the first signal is used.

- Bar Color
  The color of the bar reflects the value of one of the signals of the RSS. The color is given by the color scale, which can be configured in the "Preferences" > "Available Signals" dialog. At least one signal of the RSS must be configured for color. If not, the first signal is used.
- Afterglow
  Optionally, the chart keeps visible the last maximum value. Default setting is "Off".
- X-Axis Label
  All RSS assigned to the bar chart view are shown on the x-axis. The currently selected RSS is marked and the selection can be changed.
- Y-Axis
  The y-axis of the bar chart view changes according to the currently selected RSS (bar).
- Y-Axis Label
  The y-axis label is the name of the currently selected RSS.
- v
  The short information is a text which is displayed in the graph. This text should be quite short to avoid overlapping with other element of the chart. It is the user's responsibility to select a convenient set of signals. The value of the text is given by one to n signals from the RSS.
- Long Information
  The long information is a text which is displayed in the graph only as a ToolTip (mouse-over) for a certain bar. The value of the text is given by 1 to n signals from the RSS.

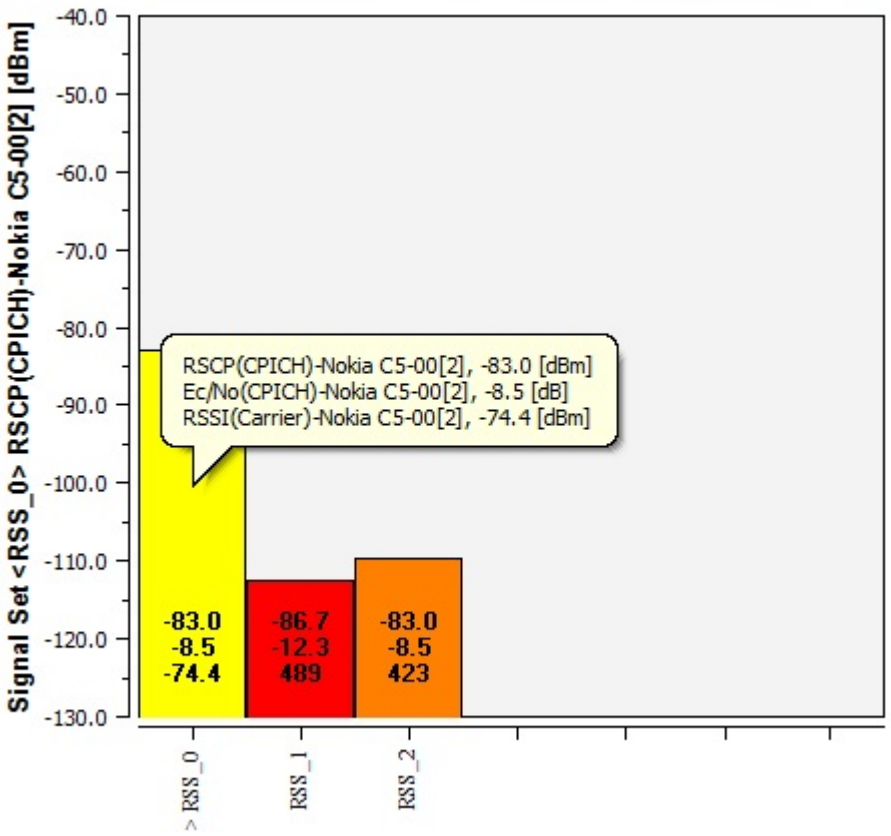


Figure 4-55: ToolTip as a bar's long information

- Bar Chart View Toolbar

  The "Bar Chat View" toolbar offers the following functions:

  – Open bar chart view configuration, the button
  – Reset y-axis, the button
  – Choose Y-axis selection, the button
  – Zoom In, the button
  – Zoom Out, the button
  – Show or hide limit lines (two red horizontal lines), the icon in the toolbar
  – Print, the icon in the toolbar

- Coupled Focus

  The "Bar Chart View" is a passive coupled focus view. This means it will be synchronized, if the coupled focus was initiated by clicking into another view. But this view will not be able to initiate a coupled focus, as it only displays a snapshot.

- Printable

  The view can be printed as a screenshot.

- Multi View

  The view can be created several times.

4.2.4.3 Bar chart view configuration

In the "Signal Sets" dialog it is possible to select signal sets you want to be shown on the bar chart view.

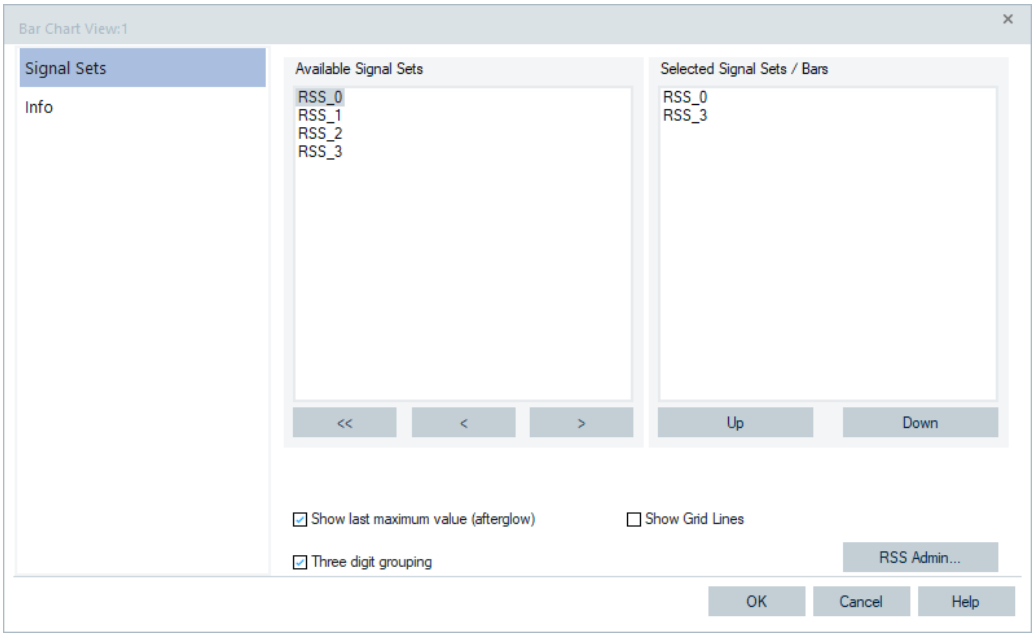


Figure 4-56: Bar Chart View - configuration page

With ">" and "<" add and remove the signals from the view, respectively.

With "Up" and "Down" in "Selected Signal Sets / Bars" change the RSS sequence shown in the bar chart view.

If you change some configuration parameters in the "Signal Sets" dialog and click "OK", the all affected bar chart views are updated.

To maintain the RSS, open the "RSS Administration" dialog. In case of one or more RSS have been changed, the all opened bar chart views are informed and updated.

4.2.5 Device grid view

The "Device Grid View" allows viewing any available signal during replay or measurement with R&S ROMES4. You can create your own view similar to the already available 3GPP Overview View.

R&S ROMES4 generic grid view abilities are:

- Ability to merge multiple cell to form a single larger cell.
- Ability to display in a cell a line chart of the last 30 seconds of the cells value.

The advantage of the Device Grid View is the extended flexibility in the view layout. The content of the cells of Device Grid View can be defined independently. Each cell can contain text, R&S ROMES4 signal values, names or sources. Values can be visualized by numbers bars and/or colors.

Define the view before the measurement starts. The view is not supposed to be reconfigured dynamically like, for example, the Alphanumeric View.

The "Device Grid View" offers a grid for each device, but does not create tab for each one.

The view offers additionally the capability to switch between grids depending on the value of a certain R&S ROMES4 signal. This allows the user to create views, which show different signal, depending, for example, on the RAT or the phone mode.

4.2.5.1 Starting device grid view

To access the "Device Grid View", select "View" > "Basic View" > "Device Grid View" in the R&S ROMES4 tool bar.

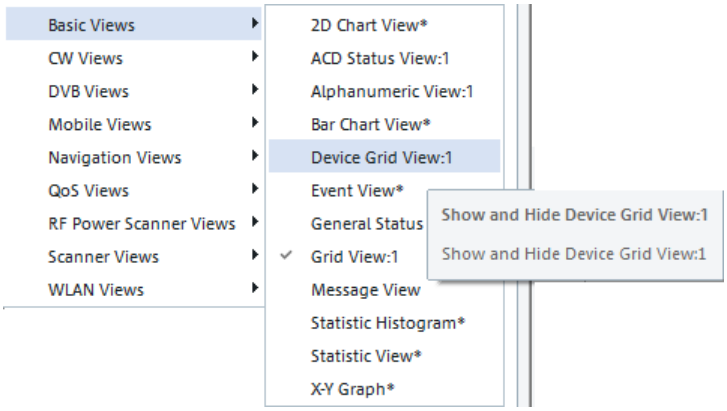


Figure 4-57: Accessing Device Grid View

You can access the view also by right-mouse click the view area and choosing "Basic View" > "Device Grid View".

Device grid view default

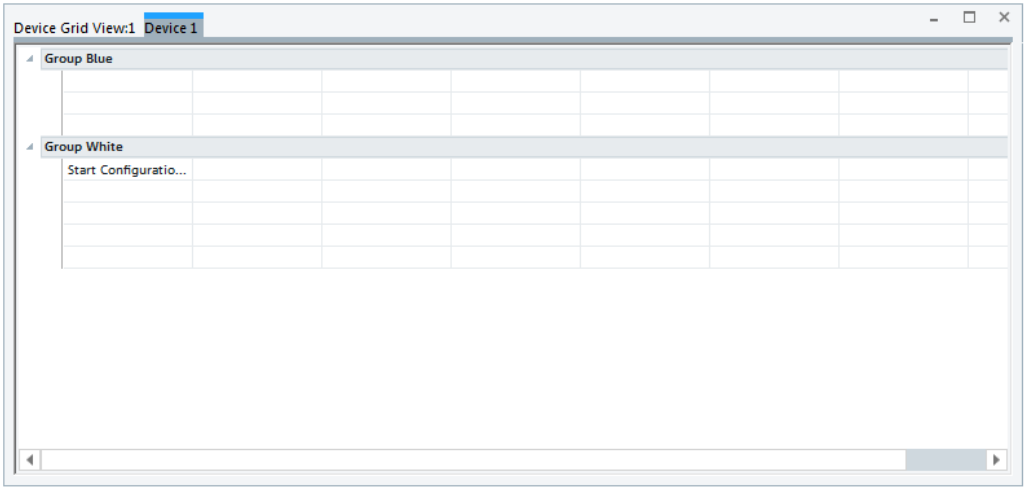


Figure 4-58: Default Device Grid View

The default "Device Grid View" pane contains two groups, "Group Blue" and "Group White" and a default static cell text ("Start Configuration via Context Menu"). The view is configurable via context menu.

Device grid view configuration

Configuration of the "Device Grid View" can be done by launching the configuration mode via the context menu.

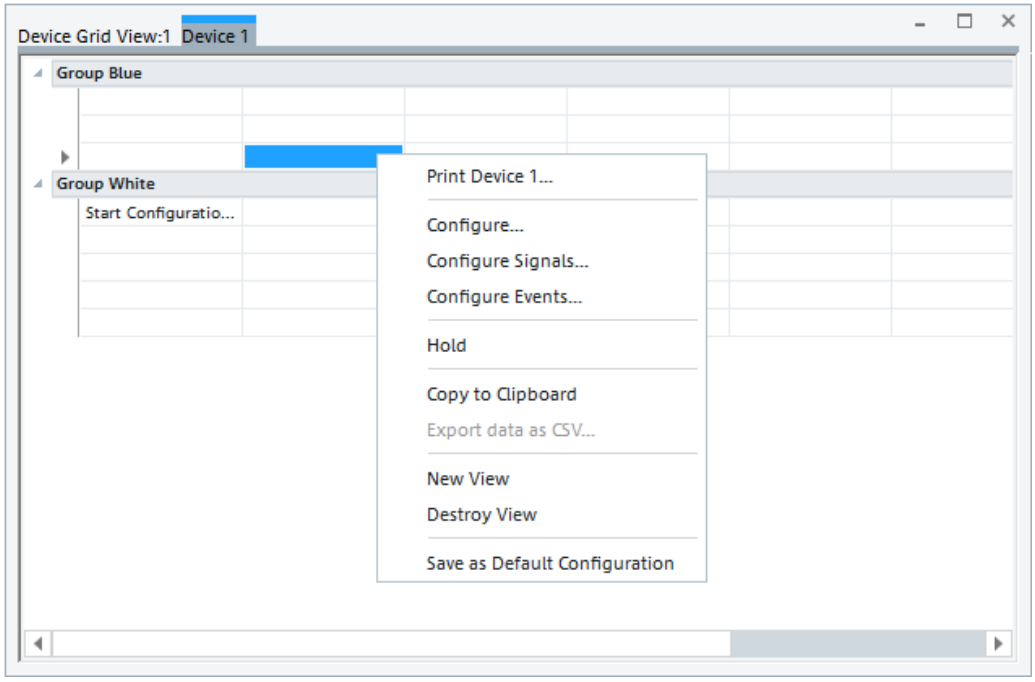


Figure 4-59: Launch configuration mode

Click "Configuration" to place the "Device Grid View" in configuration mode. Configuration is only available if there is no measurement in progress or opened measurement file.

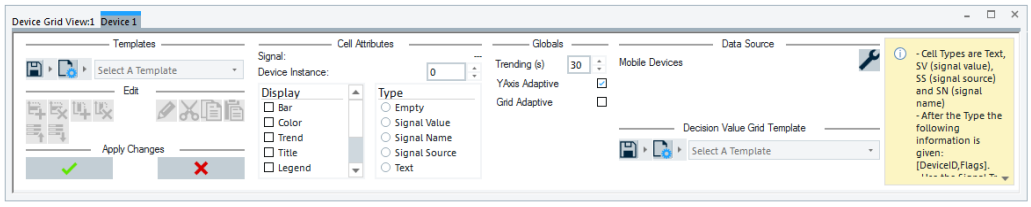


Figure 4-60: Device Grid View - configuration

Decision signal

The Device Grid View may be configured so that a different grid can be configured for different response values of a given signal. For example, setting the decision signal to RAT type allows the grid configuration for UMTS, GSM, CDMA, LTE, TETRA, EDVO, WIFI, 5G and NB-IoT.

The decision signal has to be a part of the Data Source signal set. All signals which offer an enumerator/alias are allowed as decision signals.

The decision signal is configured via "Data Sources" of the configuration dialog.

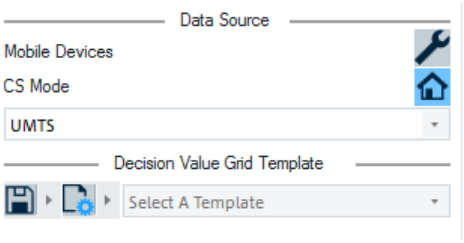


Figure 4-61: Data source dialog

To start a decision signal that the view will use to switch grids, one must be selected.

To select the signal, click . This pops-up the dialog shown in the following figure, which allows you to do the selection.

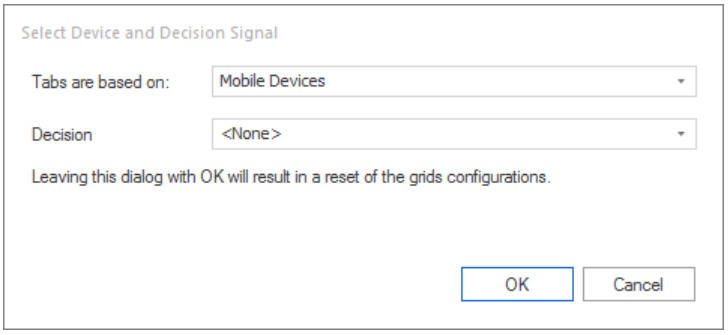


Figure 4-62: Dialog to select decision signal

First, select the type that the tabs in the view are based on. This fills the decision combo box with only the signals available for that type. The available values are "Mobile Devices" and "DQA".

Then choose the signal from the drop-down "Decision" box to switch on. Click "OK" to save the selection.

Changing the decision signal erases any other currently configured grids.

The view now fills in the available responses for the chosen decision signal. Each time a selection is made from this drop-down box, the grid for that response will be generated and presented for configuration.

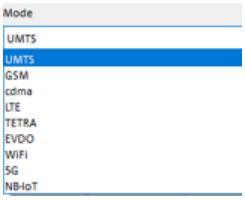


Figure 4-63: Configured mode

If a given response was not previously selected, a default grid is shown. It is not required to configure a grid for all possible response values of the decision signal. A default grid that will be presented during measurement or replay, when the decision signal value is a value for which a grid has not been configured, may be chosen by clicking the favorite icon .

For example, in the previous selection of "Mode" (RAT Type) only the response value of LTE, GSM, UMTS may be configured.

The LTE response could then be marked as the default grid by clicking . This results in the LTE grid being displayed when the "Mode" signal value is any value other than LTE, GSM or UMTS. The view then displays the LTE grid when the "Mode" value was "LTE", the GSM grid when the "Mode" value was "GSM" and the UMTS gird when the "Mode" value was UMTS.

To enable easier configuration of the decision based grids there is also the ability to save and reload an individual grid as a template.

To load an existing template use the "Decision Value Grid Template" section of the configuration dialog. Click the load template button or select one of the pre-loaded templates from the drop down list.

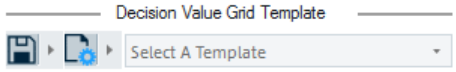


Figure 4-64: Selecting Device Grid View template

Choose "Open" from the template menu to prompt for a location of the template file to be opened. The chosen template is then placed in the template list. In that way it may be referenced later.

Opening a template erases any items currently configured in the grid for the currently selected decision signal.

To reload a template, select it from the drop list of available temples or click the template, open button and press "Reload". Pressing "Reload" does not prompt for a template to reload. Instead, that reloads the currently selected template in the drop down list. If a template is not currently selected, a prompt for the location of the template to load will be generated.

To change the location of the template directory (where the template list is filled from), click and then click the "Change Template Director" item. This will prompt for a location of the template directory.

Once a template file has been modified by changing any cell within the grid, the template's name in the template list becomes blue in color.

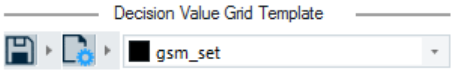


Figure 4-65: Template's color

To save a template, click the file save button.

To save the file with the same name as the currently loaded template, click the left side of the button.

Clicking the arrow to the right, pops-up a menu with the options "Save" and "Save As". Click "Save" to save the template with the same name as the currently selected file. Click "Save As" to prompt for a new location and a file's name to be saved as the template. After the file is successfully saved, the template's name in the template list becomes black in color to indicate that the template has no outstanding changes.

Signals

Signals may be added to the grid by dragging available signals from the R&S ROMES4 signal tree.

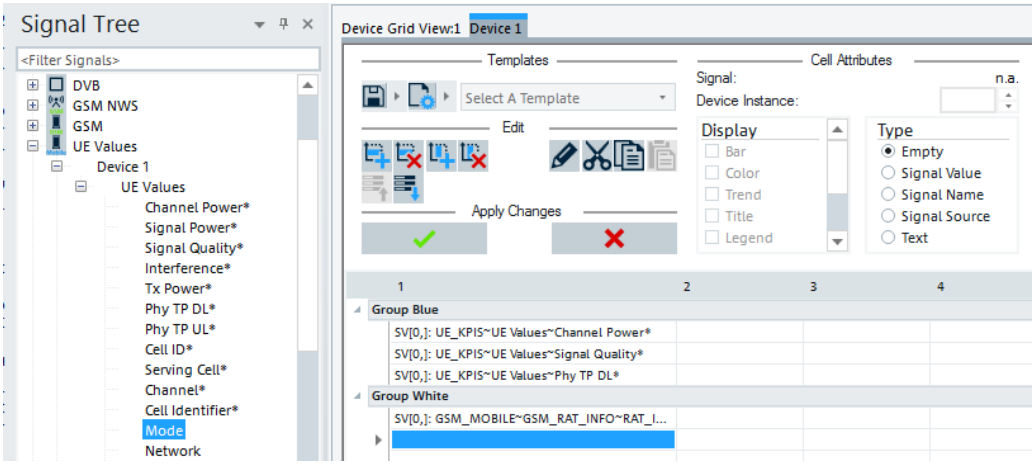


Figure 4-66: Selection of signal

A signal displayed on the grid is one of the following:

- Signal Value - Shows the current value of the signal during the measurement or replay.
- Signal Name - Shows the name of the signal.
- Signal Source - Shows the name of the signal source (device name).

Dragging the signal onto the grid without holding additional keys adds the signal to the grid by value. Holding down the CTRL key adds the signal as a signal name. Holding the CTRL +SHIFT key while dragging adds the signal as a signal source.

While in the configuration mode, the signal name will be proceeded by a label that indicates the current signal configuration.

The labels are:

- SV{x] - Signal value where x is the device id of the signal

- SN{x] - Signal name where x is the device id of the signal
- SS{x] - Signal source where x is the device id of the signal

Exiting the configuration mode removes a label from the cell.

- Empty - Pops-up the dialog which lets you clear the selected signal.

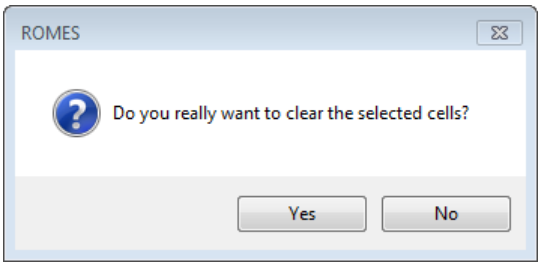


Figure 4-67: Device instance - empty signal

- Text - Pops-up the dialog which lets you change the cell content.

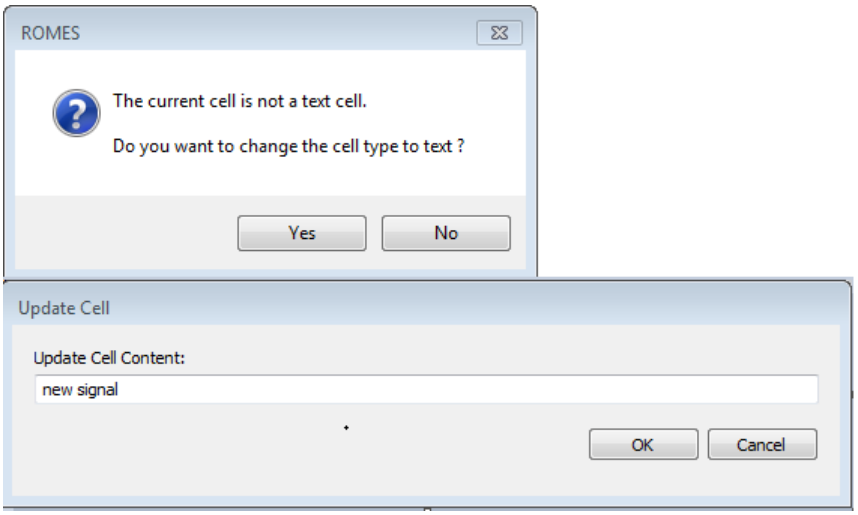


Figure 4-68: Device instance -text

Multiple signals

A cell may contain multiple R&S ROMES4 signals by first configuring a cell as line, column, or range chart.

Multiple signals may be added to the cell by dragging and dropping the desired signals from the "Signals Tree".

The signals can also be added by changing a cell type from Empty to Signal Value and adding the signals from the cell configuration screen. The screen may be accessed for a cell that has been previously configured as a line, column or range type by double clicking that cell.

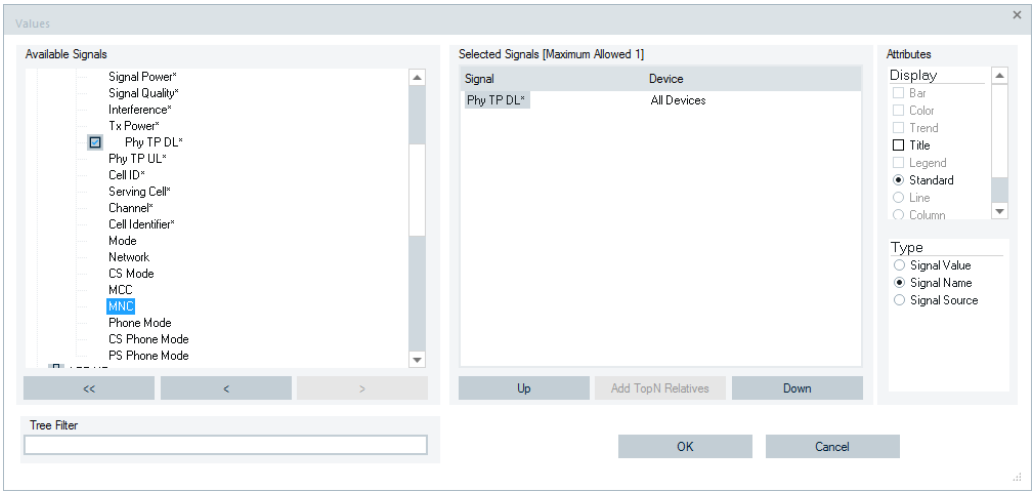


Figure 4-69: Signal configuration

To add the signals on the screen, drag and drop the desired signals from the "Available Signals" onto "Selected Signal" tree.

Instead, click ">" to add the signals into the "Selected Signals" pane.

The maximum number of signals that are allowed to be added is determined by the configured cell type. For the Signal Value, Signal Name and Signal Source standard cell type only one signal is allowed to be added. For Line and Column chart types a maximum of 4 signals is allowed. For the Range chart type a maximum of 8 signals is allowed. You may see the maximum allowed signals for the selected chart type by looking at the "Selected Signals [Maximum Allowed n]" text label.

Once the signals are added to the selected signals pane, the order of the signals my be changed by selecting a signal and clicking the "Up" or "Down" button to move the signal up or down in the signal order.

To remove one or several signals from the cell, select the signals in the selected signals pane and click the "<" button. To remove all currently selected signals from the cell, click "<<".

If a cell contains multiple signals and the cell type is changed to a type that allows for fewer signals, the signals over the maximum number of signals for the newly configured cell type will be automatically removed.

Cell attributes - display and type

A type of configured signal may be also changed via the configuration dialog in the "Cell Attributes" section, by changing the cell type to the desired value.

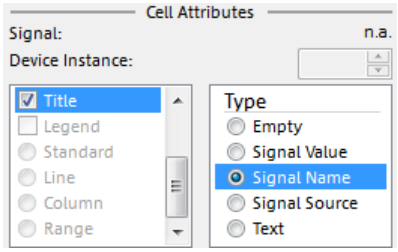
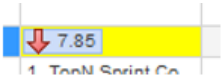


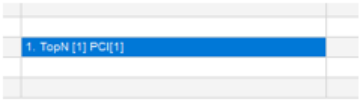
Figure 4-70: Configured cell attribute

Signal Value may have the following attributes:

- Bar - Shows the signal value as bar graph.
- Color - Shows the signal with the configured color for the signal.
  The color of the signal may be configured by right clicking the view and choosing "Configure Signals". This must be done when no measurement file is currently loading
- Trend - Shows a trending value (up or down) of the signal during the measurement or replay.



- Title - May have this additional attribute. If not in configuration mode, the signal name and signal source have a blue background.



- Legend - For a cell configured with the "Line", "Range" or "Column" chart option, display the legend in the chart of the cell.
- Standard - Cell configured to display the value of a single signal with optionally a "Bar", "Color" or "Trend" attribute
- Line - Tracks the signal values of a range of 30 seconds of the replay or measurement, see Chapter 4.2.5.1, "Starting device grid view", on page 478.
- Column - Signals in the cell configured to be displayed in a column type chart, see Chapter 4.2.5.1, "Starting device grid view", on page 478.
- Range - Signals in the cell configured to be displayed in a range type chart, see Chapter 4.2.5.1, "Starting device grid view", on page 478.

All mentioned attributes may be modified for the selected cell(s) in "Display", the cell attributes section display list.

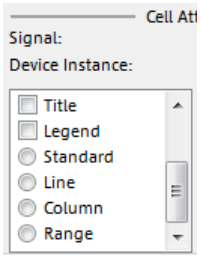


Figure 4-71: Display list

Only the attributes that apply to the currently selected cell type are active and allow to be chosen.

Table 4-2: Relationship Cell type - Available attributes

Cell type	Available attributes
Signal value	Bar/Color/Trend/Legend/Standard/Line/column/Range
Signal name	Title
Signal source	Title
Text	Title

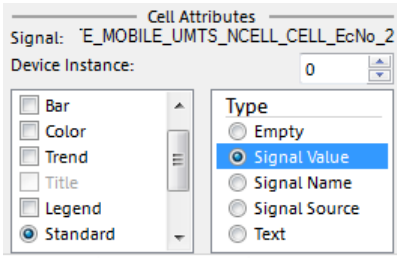


Figure 4-72: An illustration of the relationship

The device id of the signal may also be modified from the dialog screen by use the Device Instance entry field.

The device id specifies from which device the value shall be displayed. The id of the first device of a certain type is 0, of the second 1 and so on. For example, if you have connected two test UEs and you want to show the RSSI of both, you have to add the RSSI signal to two cells and specify the device id of one cell to 0 and of the other to 1.

It is recommended to add the signal source cells to grid to be able to clearly identify the source of each signal.

The view displays signal values for the signal on the device that corresponds to the device id for the active measurement or replay.

Line charts

A cell configured with the line chart attribute displays the configured signals in a line graph type of chart. This line chart will track the signal values of a range of 30 seconds of the replay or measurement.

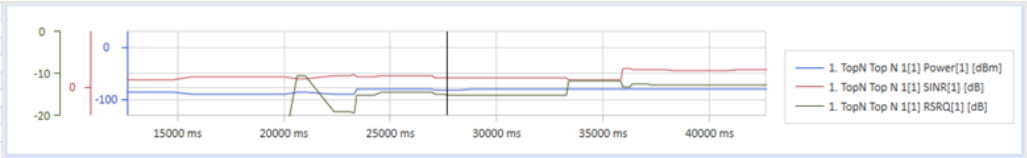


Figure 4-73: Line chart

The displayed black line represents the current time of the replay or measurement. For replay with a file scanning, the graph shows a range of ±15 seconds from the current time of the replay. This range may be changed by changing the settings of trading seconds in the "Globals" > "Trending (s)" filed on the configuration screen.

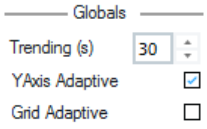


Figure 4-74: Globals

If "Globals" > "Grid Adaptive" is checked, the grid automatically adjusts the size of columns and rows to fill all available space within the view.

For measurements and replays without file scanning, the graph by default shows a range of -27 seconds to + 3 seconds. This range can be changed by changing the trending seconds setting on the configuration screen. The low end of the range is –90% of the configured value and the high end is 10% of the configured value.

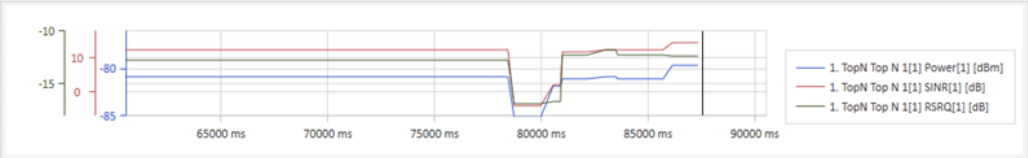


Figure 4-75: Changed trading seconds

If all selected signals are of the same type, only one Y axis is configured for the chart.

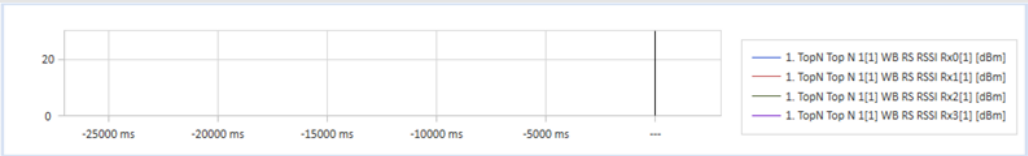


Figure 4-76: One y-axes in line chart

If more than one type of signal is configured, each signal has its' own axis label on the chart.

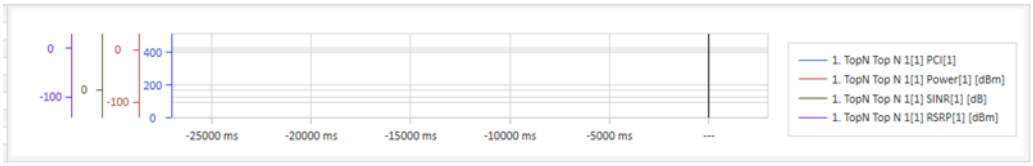


Figure 4-77: Four Y-axes for four signals in line chart

The display of the chart legend is optional and may be hidden by deselecting the "Legend" attribute from the "Cell Attributes" > "Display/Type" list on the configuration screen.

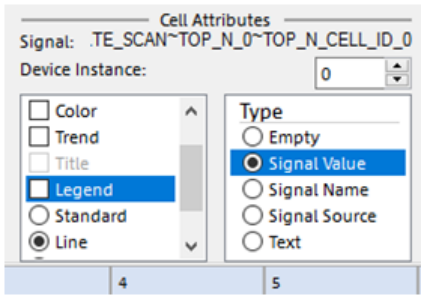


Figure 4-78: Deselected legend in line chart

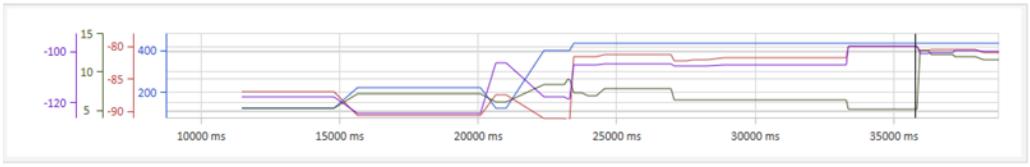


Figure 4-79: Line chart w/o legend

Column chart

A cell configured with the "Column" attribute displays the current value of the configured signals in a column type of chart.

Figure 4-80: Column chart

If all selected signals are of the same type, only one Y axis is configured for the chart.

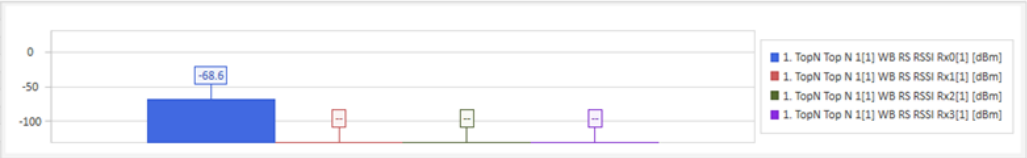


Figure 4-81: One y-axes in column chart

If more than one type of signal is configured, each signal has its' own axis label on the chart.

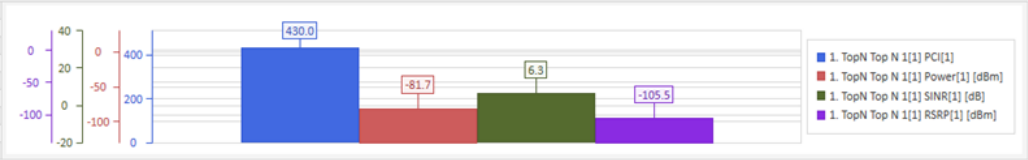


Figure 4-82: Four y-axes for four signals in column chart

The display of the chart's legend is optional and may hidden by deselecting the "Legend" attribute.

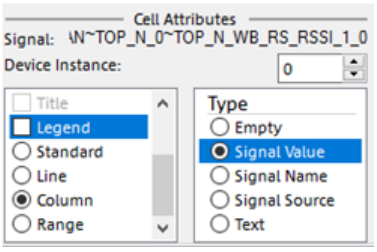


Figure 4-83: Deselected legend in column chart

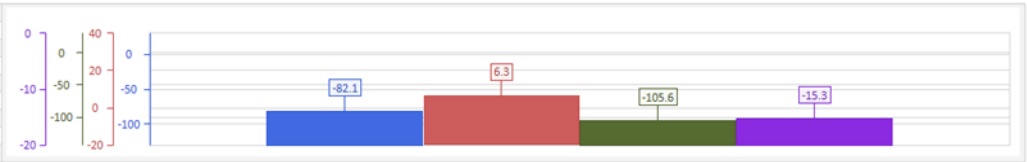


Figure 4-84: Column chart w/o legend

Range chart

A cell configured with the "Range" chart attribute displays the configured signals in a range graph type of chart.

This type of chart tracks a signal's state changes. The bar shows encompassing the time of signal changed to that state till the time the signal changed to a different state. The range chart tracks the signal values of a range of 30 seconds of the replay or measurement.

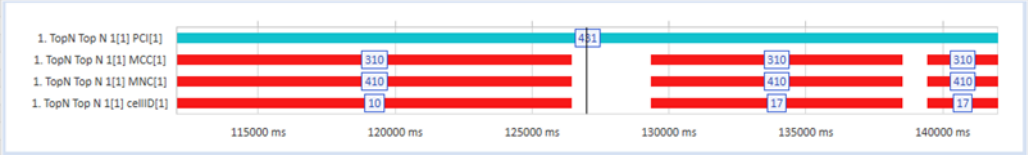


Figure 4-85: Range chart

The displayed black line represents the current time of the replay or measurement.

For replay with file scanning, the graph shows a range of ±15 seconds from the current time of the replay.

This range may be changed by changing the settings of trading seconds in the "Trending (s)" filed on the configuration screen.

For measurements and replays without file scanning, the graph by default shows a range of -27 seconds to + 3 seconds. This range can be changed by changing the trending seconds setting on the configuration screen. The low end of the range is –90% of the configured value and the high end is 10% of the configured value.

Chart error conditions

To correctly draw the column, line, or range chart, the view requires a minimum amount of space. A single cell is typically not sufficient to allow this. The minimum merge range of cell is 5x2 to allow for a type chart to drawn.

If you attempt to change a cell that has a merge range of less than 5x2 to a line in the column or range chart, the following error message is presented

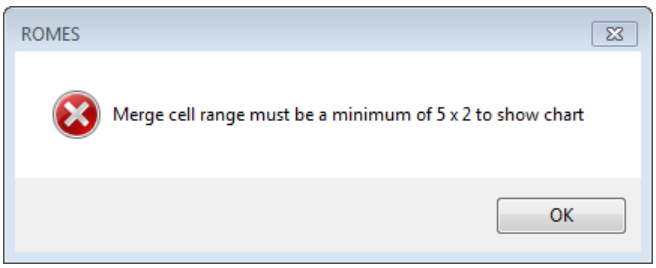


Figure 4-86: Reported errored conditions

There are also occasions where a chart that is set to the minimum of 5x2 cell can still not be shown. These occasions are based on other configuration factors such as the length of the signal names and presence of a legend. In this condition, once the view is taken out of configuration mode the cell will show a "Chart N/A" message in place of the chart and the cell background will be changed to red.

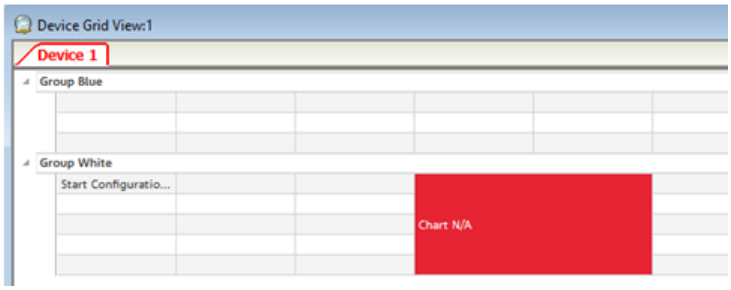


Figure 4-87: Chart not available

Text labels

A static text label may be placed on the grid by double-clicking the desired cell and then entering the desired label. The same can be achieved if you select the desired cell and click the edit cell text button .

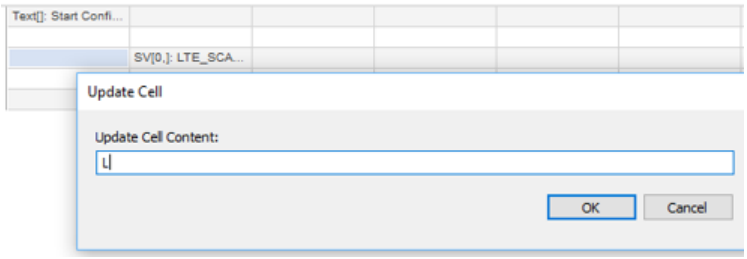


Figure 4-88: Updating cell

The static text may have the following optional configuration value.

- Title – Shows the static text with a blue background if not in configuration mode.

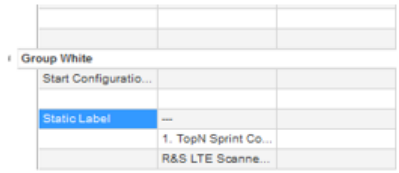


Figure 4-89: Static label

The Title attribute may also be applied for the currently selected cell(s) via the "Cell Attributes" section of the configuration dialog.

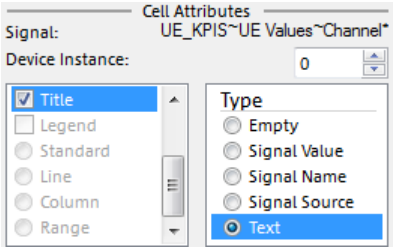


Figure 4-90: Text attribute - title

While in configuration mode, a static cell text is appended with a Text [x] marker where x is the optional title configuration. For example, the upper label has the notation *Text[T]: Static Label*.

Group

The signals of the grid may be set for easier viewing and classification into groups in the grid. Additional groups may be added by clicking one of the existing groups and clicking the add group button on the configuration dialog. In this way you add a new group after the highlighted group.

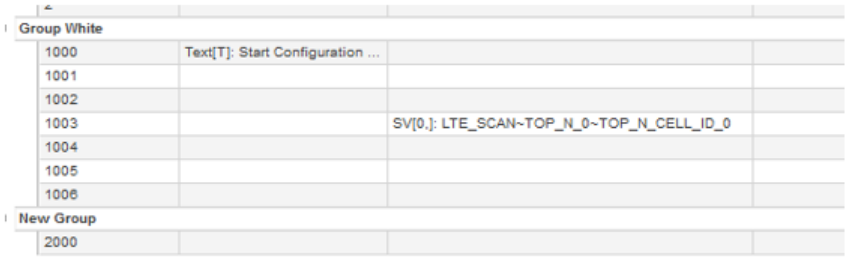


Figure 4-91: Adding group

Holding the CTRL key while clicking the button provides a new group label before the selected group.

To edit the name of an existing group, click the desired group and press the button.

To delete a group, select the desired group and click the remove group button. The group is removed.

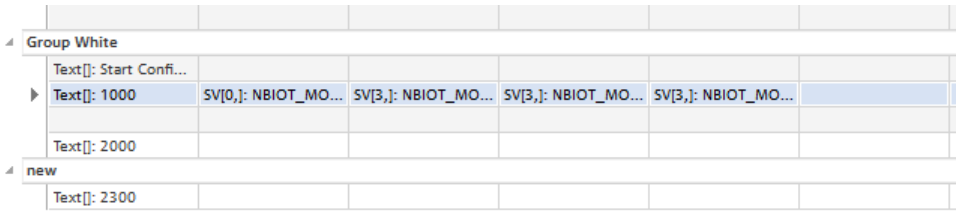


Figure 4-92: Selecting group for removing

Deleting a group deletes all rows and columns within that group.

Adding/removing or deleting rows and columns

Under "Edit" there are the control buttons allowing to add additional rows and columns to the grid. For this, selecting an existing row or column on the grid and click the or button, respectively, on the configuration dialog.

By default, the new row or column will be added after the selected row or column. To add a row or column before the selected row or column hold the CTRL key down while clicking the add row or column button.

Multiple rows or columns may be added by selecting the desired number of rows or columns and clicking add row or column. For example, if you wish to add 5 columns to the grid, select five cells and click .

To remove a row or column click the row or column to be deleted and then click the remove row or remove column button.

Additional controls in edit

Under "Edit" there are also the control buttons allowing the following tasks:

- Merging and de-merging of selected cells via available icons and .
- Selection of a signal cell as a line chart
- Controls that determine the amount of time displayed in the line chart and if the y-axis of the line chart is adaptive.

Merging cells together

The "Device Grid View" allows multiple cells to be merged together to form a single larger cell.

To merge the cells together highlight the cells that are to be merged together

1. Highlight the cells that are to be merged together.

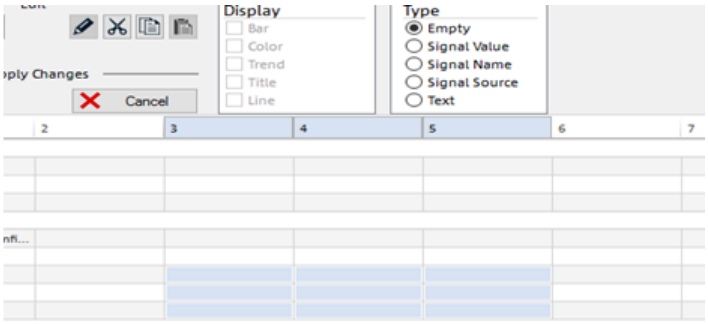


Figure 4-93: Cells selected for merging

2. Click the merge cell button.

   The cells are merged together.

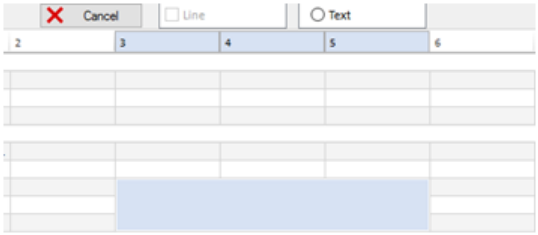


Figure 4-94: Merged cell

The merged cell is interactive as any other cell in the grid,

Signals can be drop into the cell.

Figure 4-95: Dropped signal into the merged cell

You can type a static text in the merged cell.

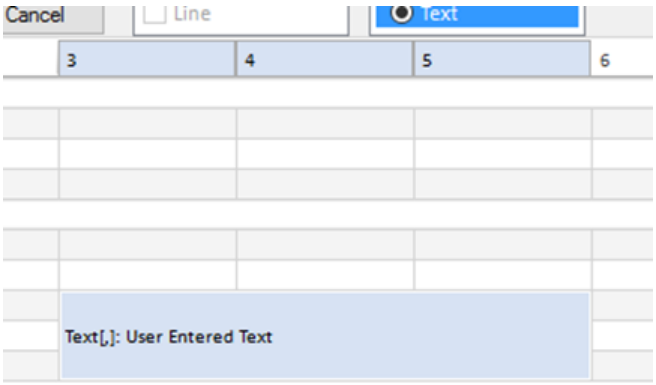


Figure 4-96: Added text in the merged cell

Demerging of merged cells

Once a group of cells has been merged together the group may be demerged.

Selecting the merged cell you want to demerge and click the unmerge cell button . Demerging the cell results in the content of the merged cell be placed in the upper left most cell of the merged cell range.

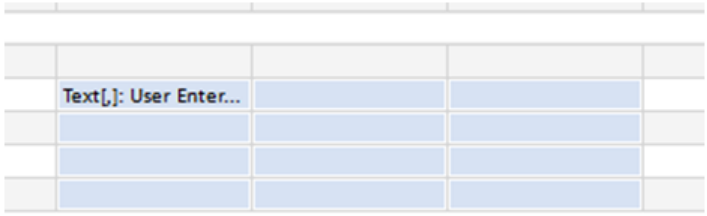


Figure 4-97: Placement of demerged cells

Moving cells within the grid

Existing cells may be moved within the grid by dragging and dropping the cell to a new location.

The cells may also be moved via copy and paste.

To copy a cell, select the desired cell(s) and the click the copy button. The same is performed if you press the CTRL + C keyboard combination.

To paste the cell then into a new cell location, click the desired new cell(s) location and press the paste button. The same is performed if you press the CTRL + V keyboard combination.

If the currently selected cell contains existing content, R&S ROMES4 prompts for confirmation to overwrite the existing content.

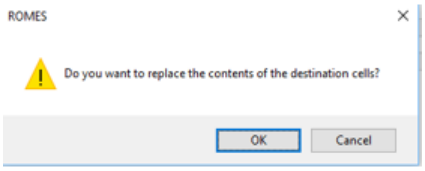


Figure 4-98: Warning message

The existing content may be moved to a new cell. To do that, cut the cell (this removes the content from the existing cell) and then paste the content into a new cell.

To cut an existing cell, click the desired cell(s) and then click the cut button or press the CTRL + X keyboard combination.

Templates

Once a grid has been configured, it may be saved as a template for later reloading, modifying or reusing purpose.

Loading an existing template may be done from the template section of the configuration dialog. To load a template, click the load template button or select one of the preloaded templates from the drop down list.

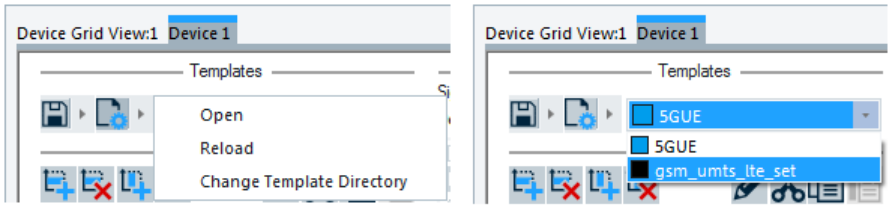


Figure 4-99: Selection of preloaded template

Choosing "Open" from the template's open menu prompts for a location of the template file to open. The chosen template is then placed in the template's list. In that way it may be referenced later.

Opening a template erases any items currently configured in the Device Grid View.

To reload a template, select it from the drop list of available temples or click the template, open button and press "Reload". Pressing "Reload" does not prompt for a template to reload. Instead, that reloads the currently selected template in the drop down list. If a template is not currently selected, a prompt for the location of the template to load will be generated.

To change the location of the template directory (where the template list is filled from), click and then click the "Change Template Director" item. This will prompt for a location of the template directory.

Once a template file has been modified by changing any cell within the grid, the template's name in the template list becomes blue in color.

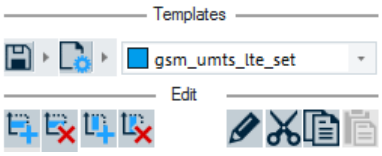


Figure 4-100: Template's color

To save a template, click the file save button.

To save the file with the same name as the currently loaded template, click the left side of the button.

Clicking the arrow to the right, pops-up a menu with the options "Save" and "Save As". Click "Save" to save the template with the same name as the currently selected file. Click "Save As" to prompt for a new location and a file's name to be saved as the template. After the file is successfully saved, the template's name in the template list becomes black in color to indicate that the template has no outstanding changes.

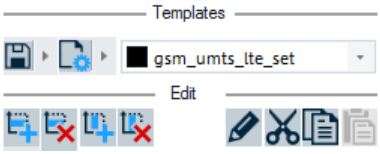


Figure 4-101: No outstanding changes

Exiting configuration mode

To exit the configuration mode of the Grid View:

- Click check button to keep any configuration changes.
- Click "x" button to avoid any current configuration changes.

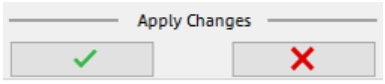


Figure 4-102: Two ways to exit

Clicking "OK" will not save the changes made to the current workspace until the current workspace has been saved.

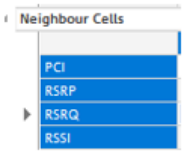
Device grid view measurement or replay

During measurement or replay the following items may be displayed by the Device Grid View:

- Decision Signal Value Switching – If the Device Grid View has been configured with a decision signal and the value of that signal changes during measurement or replay the grid for that value will be loaded and presented. If no grid has been configured for the current response value then the grid configured as the default grid

will be shown until the decision signal again change to a value that has a grid configured.

- Static text - Configured static text items are displayed as entered during configuration. If the text item is configured with a "Title" attribute, the cell is displayed with blue back ground.

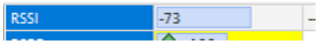


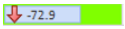
The values in the static text cell remain the same throughout the measurement or replay.

- Signal value – Items configured as signal value type display the current value for the selected device id filter of the signal. If the signal does not have a value, "-" is displayed. Any coupled focus changes made to the replay will be observed by the Grid View and the displayed values updated to the correct time in the measurement or replay.

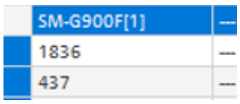
Figure 4-103: Signal value - PCI value

  - If the cell is configured with the "Bar" attribute, the cell displays the values as a bar graph.



  - If the cell is configured with the "Trend" attribute, the cell displays an up arrow graphic if the value is tending up, displays a down arrow  if the value is tending down and a side ways arrow. if the value is tending steady.
  - If the cell is configured with a "Color" attribute, the cell displays the configured color for the signal.

- Signal source – Items configured as signal source display the device source of the configured signal.



- Signal name – Items configured as signal name display the name of the configured signal in the cell. If the cell has the "Title" attribute applied, the cell appears with a blue background.

- Groups name – Group name remains static thoughout the replay or measurement. Nevertheless, the group sections may be minimized by double clicking the group label or by clicking the group minimize button.

4.2.5.2 Custom views

The Device Grid View is added as a template option in the custom views configuration.

The Device Grid View is set as a custom view via "View" > "Custom View" > "Create New" command.

Choose the "Device Grid View" in the "Select a Template" drop-down box of the "Create Custom View" > "Properties" pane.

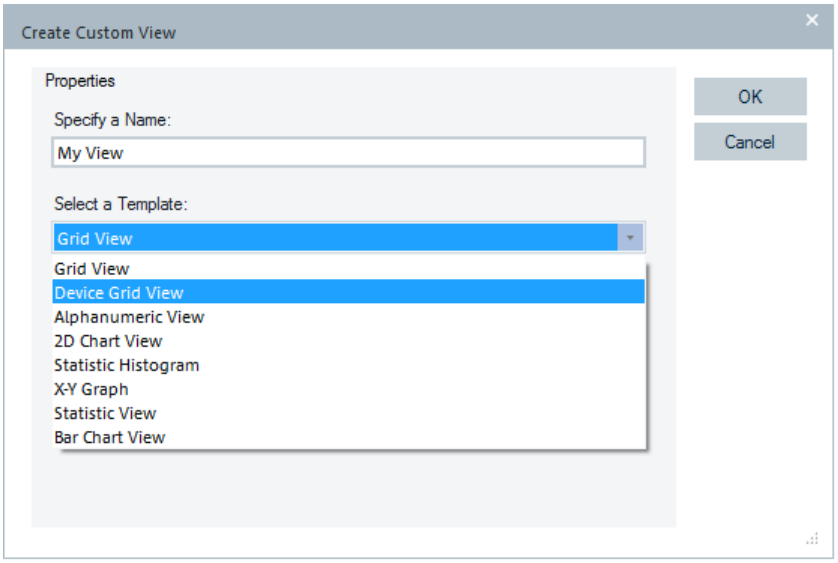


Figure 4-104: Device Grid View selected as template

One the view is created as the custom view, the configurations described in previous sections can be configured.

4.2.6 Event view

The "Event View" displays a chronological record of all events that occurred during the measurement. What represents an event is defined in the "Available Events" tab of the "Preferences" menu, see Figure 3-123. It is possible to combine expression with the pipe "|" to get all lines which fulfill at least one of the given conditions.

The "Event View" has a grid layout. The view offers filter possibilities. The grid cells information text can be marked and highlighted with colors. For the extended grid view handling, see Chapter 4.1.8, "Extended grid view", on page 432.

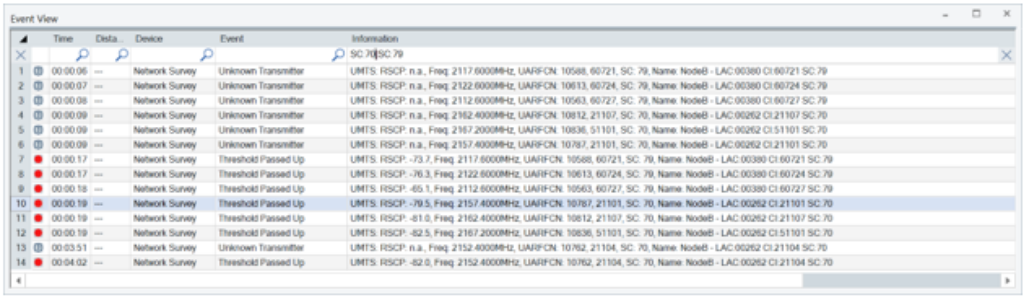


Figure 4-105: Events view

The notification center can write `*.json` log files for R&S ROMES4 events.

It is composed as follows (the json extension is not shown).

`Year-Month-Day-Hour-Minute-Second-Milliseconds[Number]_EventName`

For example, `2021-12-29-09-38-52-307[0]_Threshold Passed Up.json`.

"Milliseconds" and "Number" are necessary to be able to write several `*.json` files for the same event which occurs at the same point in time.

4.2.6.1 View table

The events are displayed in tabular form:

- "Symbol"
  The symbol indicates detected event.
- "Time"
  Time of the event, the scale is relative to the start time of the measurement.
- "Distance"
  The traveled distance between the shown events.
- "Device"
  Device (mobile phone type, fax terminal, test receiver etc.) that triggered the event.
- "Event"
  Short notes concerning events.
  The notes can be entered by pressing the CTRL+F12 keys during measurement, for example to record a note about an observation. The note cannot be longer than 500 characters. As the result, the comment event text is shown as an entry in this column.
  During replay, the "Edit Comment Event Text" entry of the context-sensitive configuration menu allows the field of an event to open and edit.
  Select the event in the "Event" column, click the right mouse button to get configuration menu and choose the mentioned entry. Opens the editor. Press the "OK" button to update the comment editor after editing the text.
  The text is also patched into the measurement file for later processing, for example for ASCII export.

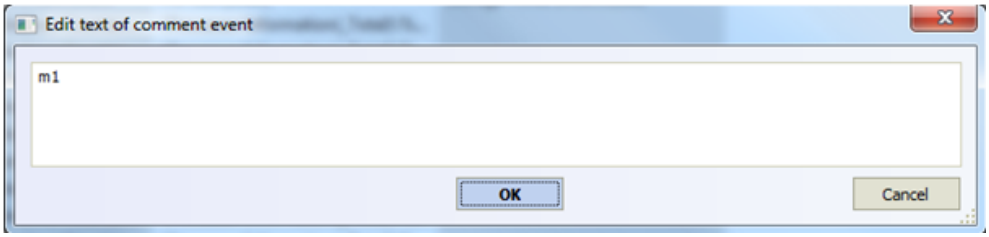
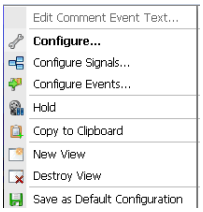


Figure 4-106: Text field of the comment editor

- **Information**
  Additional event information, e.g. the entered event comment.

4.2.6.2 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.2.6.3 Event view configuration

You can select in the "Event View > Event View Configuration" dialog devices whose configured events you want to be displayed.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

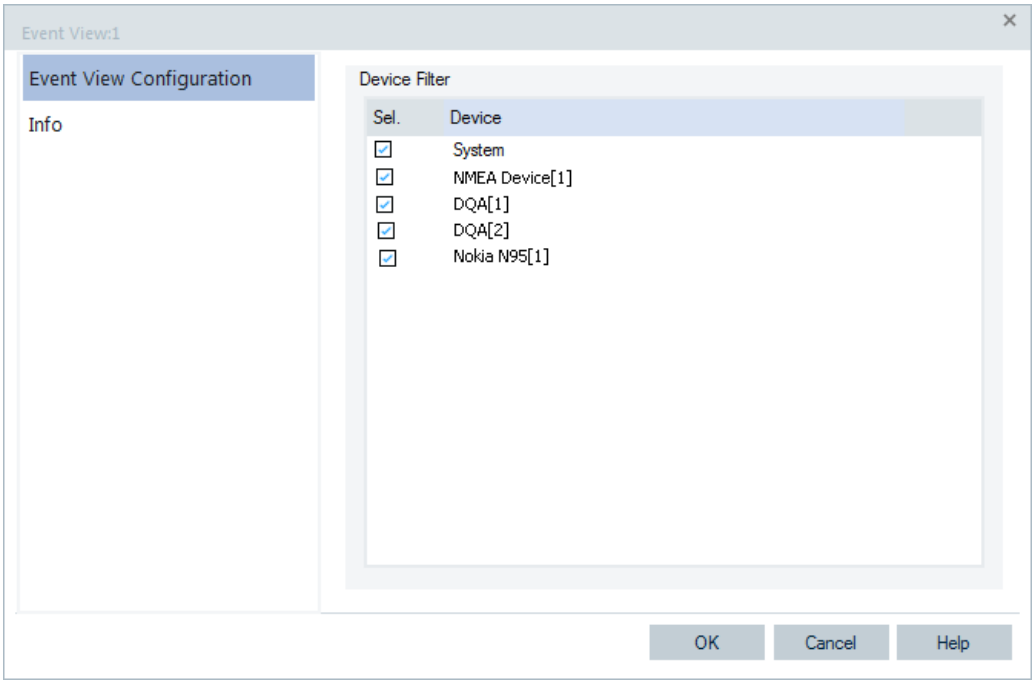


Figure 4-107: Event View - device filter selection

Event view information

The "Info" tab lets user see the current view version.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.2.7 General status view

The "General Status View" displays text messages of general interest, for example, the application events reported during the measurement.

The NQA messages are displayed in the view if, for example, the "NQA" > "NQA monitoring active" option of a device configuration is activated.

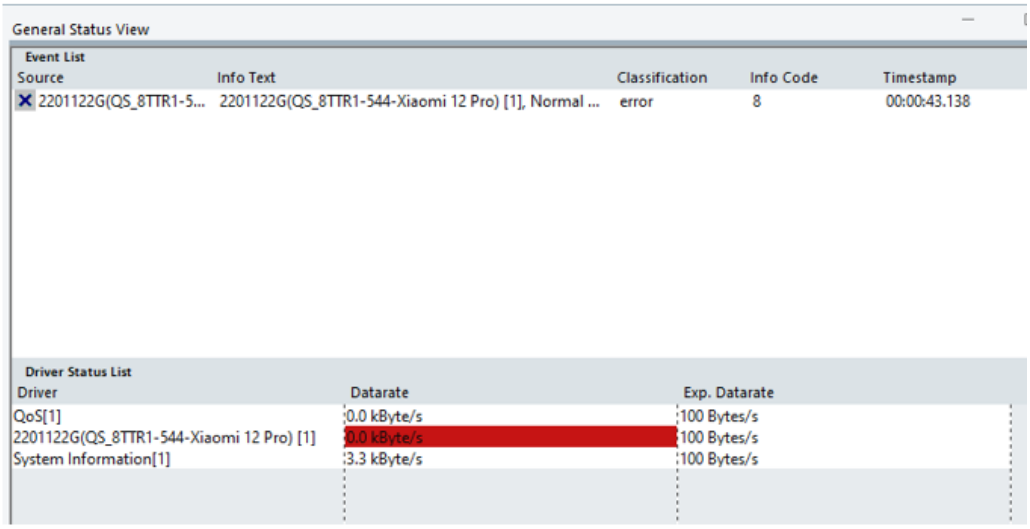


Figure 4-108: General Status View

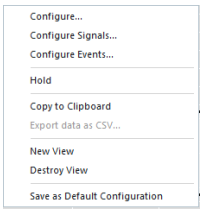
The view is divided into two parts. The upper part, "Event List", shows the list of events with the associated data. The existing event line is marked with a simplified icon "X". The lower "Driver Status List" part shows the amount of produced data per device. If a device does not produce any data, the corresponding line is marked red. However, no data generated is just an indication for a possible problem (e.g., the Indoor device does not generate data, unless you reach a new waypoint).

During measurements, the amount of generated data per device is logged. Every 10 seconds the average amount of data is calculated and stored to the measurement file. The amount of data is displayed for each device in the "General Status View" > "Driver Status List".

The alerts about low data rate from devices which occur during a measurement are visible in the "General Status View" during the measurement file replay. The visualization is supported since R&S ROMES4.92.

The view shows events during recording and "Replay Only", but not during a measurement. If the measurement runs without problems, no messages appear for an extended period.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.2.7.1 General status view configuration

The "General Status View" configuration activates the remote display and shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The remote display R&S TS95-RD makes it easier to monitor the process of data recording. It is connected to the measurement system via a printer connector. During the measurement tour, the LEDs of the remote display inform whether the measurement yields valid data, a warning, or an error.

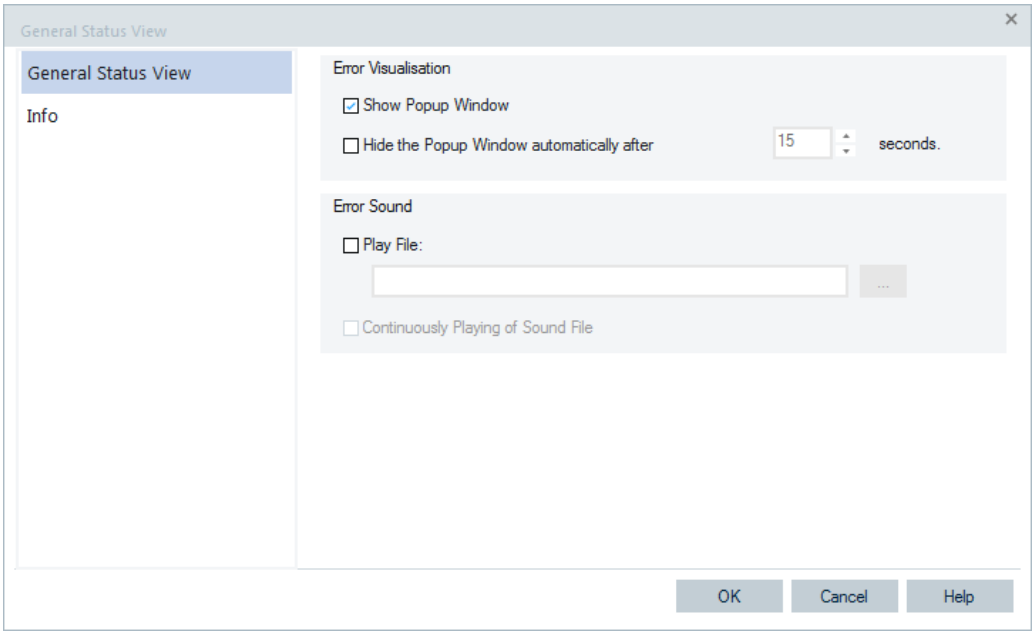


Figure 4-109: General Status View - configuration

Error Visualization
For each detected error, an error message can be displayed in a pop-up window that remains on screen or is automatically closed after a definite time (option "Hide the Popup" checked). The display time of the pop-up is set in the "after...seconds" field.

Error Sound
For each detected error, an error sound is played if the "Play File" box is checked.

A wave file (`*.wav`) can be selected by the "..." button if the "Continuously Playing" option is checked. The sound is continuously repeated.

4.2.8 Grid view

The "Grid View" allows viewing any available signal during replay or measurement with R&S ROMES4. You can create your own view similar to the already available "3GPP Overview View".

R&S ROMES4 generic grid view abilities are:

- Ability to merge multiple cell to form a single larger cell.
- Ability to display in a cell a line chart of the last 30 seconds of the cells value.

The advantage of the "Grid View" is the extended flexibility in the view layout. The cells content of the "Grid View" can be defined independently. Each cell can contain text, R&S ROMES4 signal values, names or sources. Values can be visualized by numbers bars and/or colors.

Define the view before the measurement starts. The view is not supposed to be reconfigured dynamically like, for example, the "Alphanumeric View".

The "Grid View" offers a tab for each device, but one grid for all devices.

To access the view, select "View" > "Basic View" > "Grid View" in the R&S ROMES4 tool bar.

You can access the view also by right-mouse click the view area and choosing "Basic View" > "Grid View".

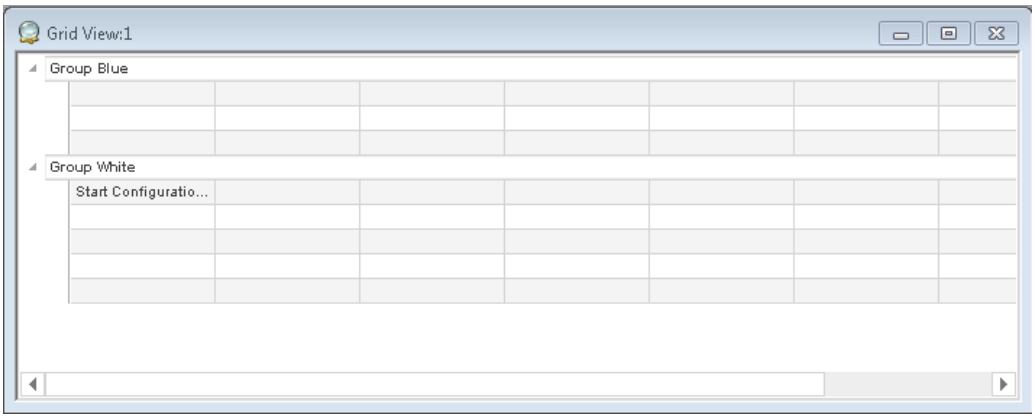


Figure 4-110: Default Grid View

The default "Grid View" contains two groups, "Group Blue" and "Group White", and a default static cell text ("Start Configuration via Context Menu"). the view is configurable via context menu.

4.2.8.1 Grid view configuration

Configuration of the Grid View can be done by launching configuration mode via the context menu.

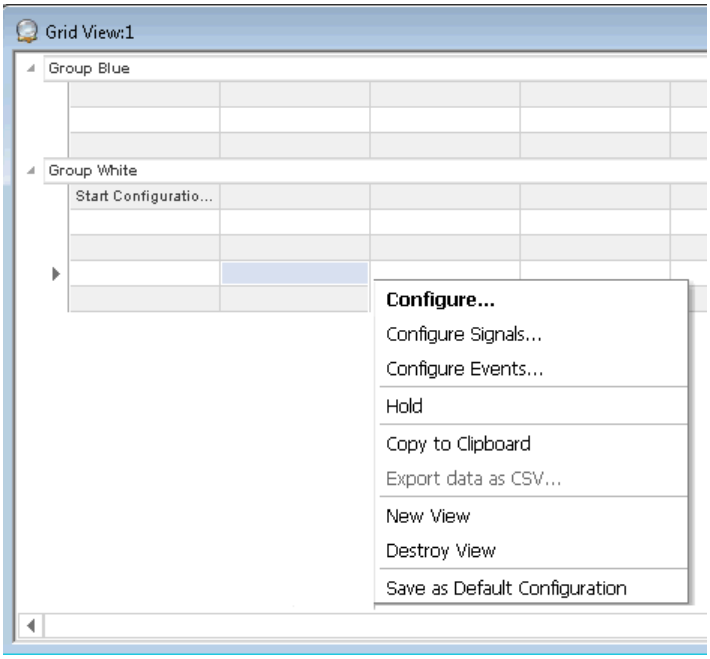


Figure 4-111: Launching configuration mode

Select "Configuration" to place "Grid View" in configuration mode. Configuration is only available if there is no measurement in progress or opened measurement file.

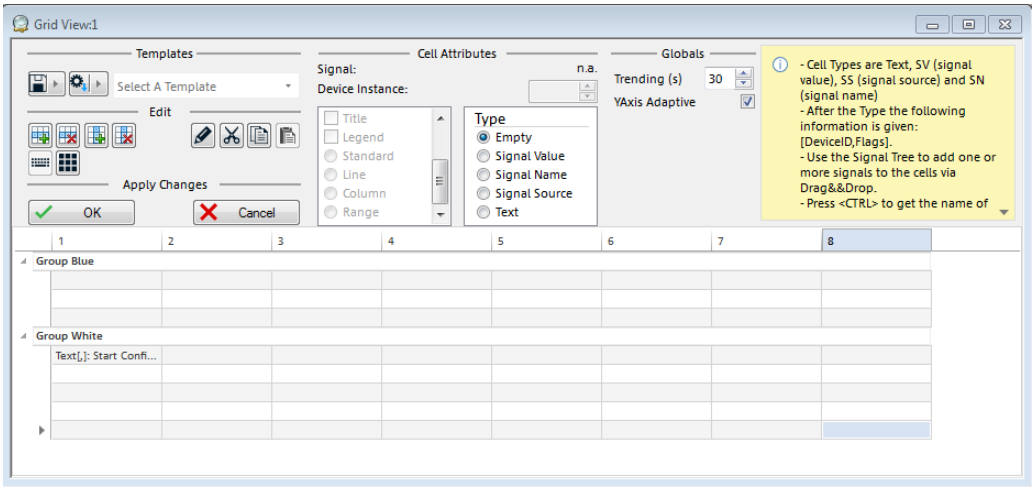


Figure 4-112: Configuration mode - details

Signals

Signals may be added to the grid by dragging available signals from the R&S ROMES4 signal tree.

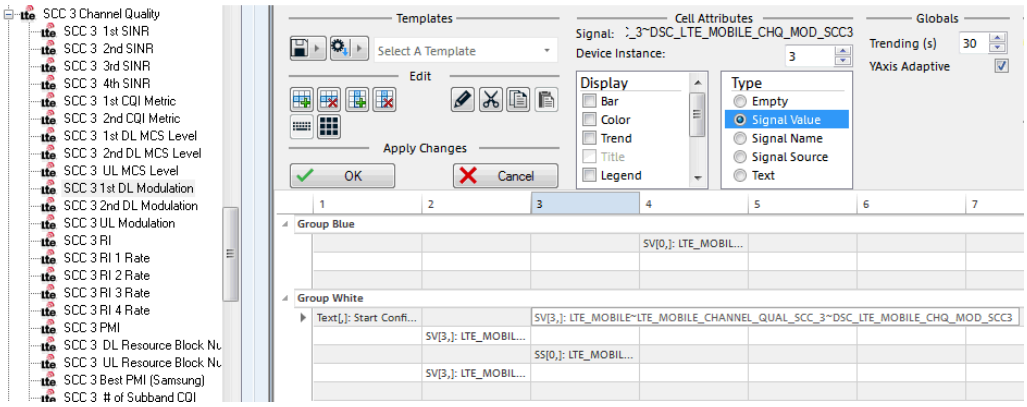


Figure 4-113: Selection of signals

A signal may be displayed on the grid in one of three ways:

- Signal Value - Shows the current value of the signal during the measurement or replay.
- Signal Name - Shows the name of the signal.
- Signal Source - Show the name of the signal source (device name).

Dragging the signal onto the grid without holding additional keys adds the signal to the grid by value.

Holding down the CTRL key adds the signal as a signal name and holding the CTRL +SHIFT key while dragging adds the signal as a signal source.

While in the configuration mode, the signal name will be proceeded by a label that indicates the current signal configuration.

The labels are:

- SV{x] - Signal value where x is the device id of the signal
- SN{x] - Signal name where x is the device id of the signal
- SS{x] - Signal source where x is the device id of the signal

Exiting the configuration mode removes a label from the cell.

- Empty - Pops-up the dialog which lets you clear the selected signal.

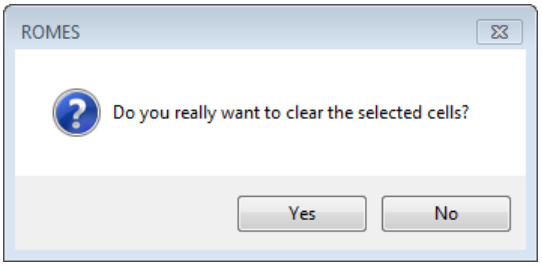


Figure 4-114: Device instance - empty signal

- Text - Pops-up the dialog which lets you change the cell content.

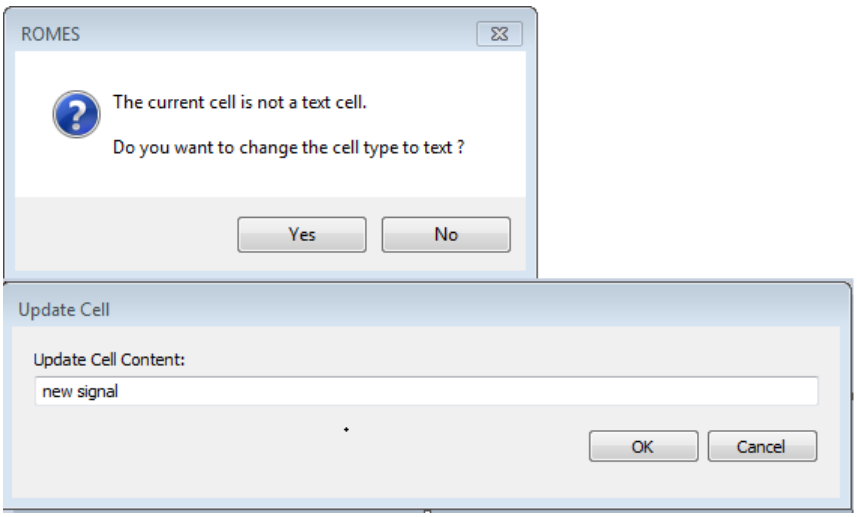


Figure 4-115: Device instance -text

Multiple signals

For details, see "Multiple signals" on page 483.

Cell attributes - display and type

A type of configured signal may be also changed via the configuration dialog in the "Cell Attributes" section, by changing the cell type to the desired value.

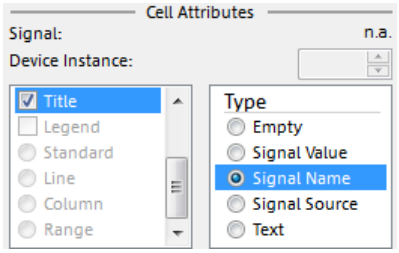
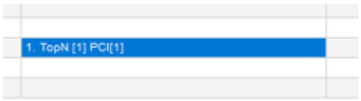


Figure 4-116: Configured cell attribute

Signal Values may also have the following additional attributes:

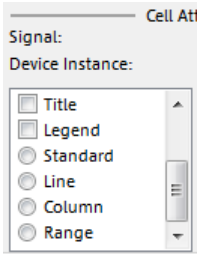
- Bar - Show the signal value as bar graph.
- Color - Show the signal with the configured color for the signal.
  The color of the signal may be configured by right clicking the view and choosing "Configure Signals". This must be done when no measurement file is currently loading
- Trend - Shows a trending value (up or down) of the signal during the measurement or replay or .

- Title - May have this additional attribute. If not in configuration mode, the signal name and signal source have a blue background.



- Legend - For a cell configured with the "Line" or "Column" chart option, display the legend in the chart of the cell.
- Standard - Cell configured to display the value of a single signal with optionally a "Bar", "Color" or "Trend" attribute.
- Line - Tracks the signal values of a range of 30 seconds of the replay or measurement.
- Column - Signals in the cell configured to be displayed in a column type chart.
- Range - Signals in the cell configured to be displayed in a range type chart, see Chapter 4.2.5.1, "Starting device grid view", on page 478.

All mentioned additional attributes may be modified for the selected cell(s) in the cell attributes section display list.



Only the attributes that apply to the currently selected cell type are active and allow to be chosen.

Table 4-3: Relationship Cell type - Available attributes

Cell type	Available attributes
Signal value	Bar/Color/Trend/Legend/Standard/Line/column/Range
Signal name	Title
Signal source	Title
Text	Title

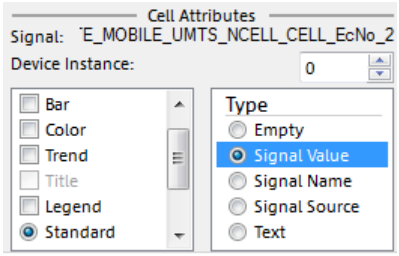


Figure 4-117: An illustration of the relationship

The device id of the signal may also be modified from the dialog screen by use the Device Instance entry field.

The device id specifies from which device the value shall be displayed. The id of the first device of a certain type is 0, of the second device is 1 and so on. For example, if you have connected two test UEs and you want to show the RSSI of both, you have to add the RSSI signal to two cells and specify the device id of one cell to 0 and of the other to 1.

It is recommended to add the signal source cells to grid to be able to clearly identify the source of each signal.

The view displays signal values for the signal on the device that corresponds to the device id for the active measurement or replay.

Line chart

Refer to Chapter 4.2.5.1, "Starting device grid view", on page 478.

Column chart

Refer to Chapter 4.2.5.1, "Starting device grid view", on page 478.

Range chart

Refer to Chapter 4.2.5.1, "Starting device grid view", on page 478.

Chart error

Refer to "Chart error conditions" on page 490.

Text labels

A static text label may be placed on the grid by double-clicking the desired cell and then entering the desired label. The same can be achieved if you select the desired cell and click the edit cell text button .

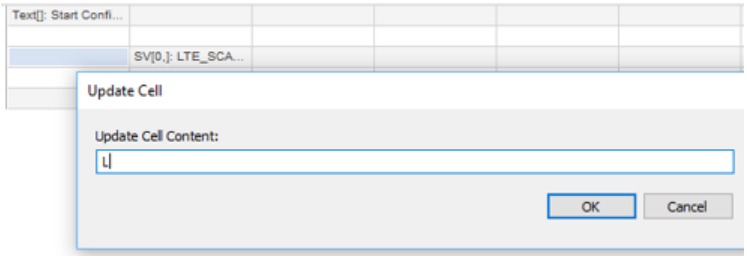


Figure 4-118: Updating cell

The static text may have the following optional configuration value.

- Title – Shows the static text with a blue background if not in configuration mode.

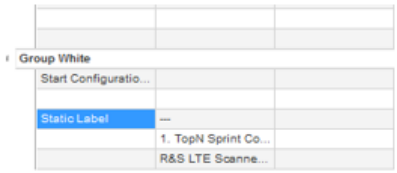


Figure 4-119: Static label

The Title attribute may also be applied for the currently selected cell(s) via the "Cell Attributes" section of the configuration dialog.

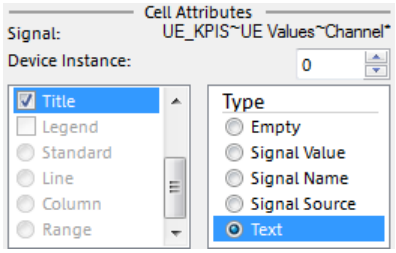


Figure 4-120: Text attribute - title

While in configuration mode, a static cell text is appended with a Text [x] marker where x is the optional title configuration. For example, the upper label has the notation *Text[T]: Static Label*.

Group

The signals of the grid may be set for easier viewing and classification into groups in the grid. Additional groups may be added by clicking one of the existing groups and clicking the add group button on the configuration dialog. In this way you add a new group after the highlighted group.

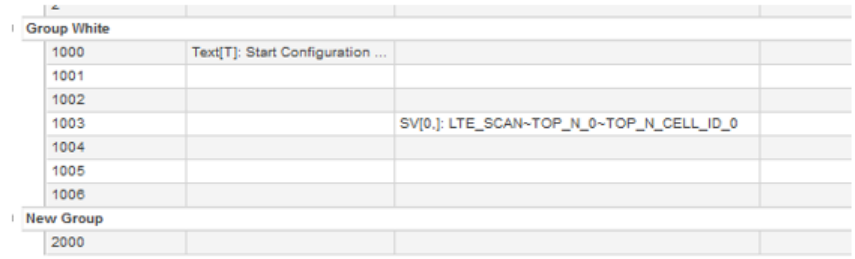


Figure 4-121: Adding group

Holding the CTRL key while clicking the button provides a new group label before the selected group.

To edit the name of an existing group, click the desired group and press the button.

To delete a group, select the desired group and click the remove group button. The group is removed.

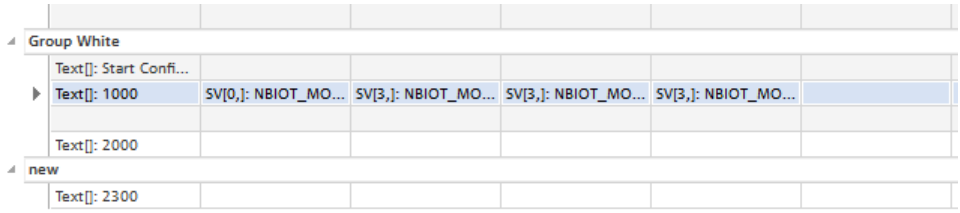


Figure 4-122: Selecting group for removing

Deleting a group deletes all rows and columns within that group.

Adding/removing or deleting rows and columns

Under "Edit" there are control buttons allowing to add additional rows and columns to the grid. For this, selecting an existing row or column on the grid and click the or button, respectively, on the configuration dialog.

By default, the new row or column will be added after the selected row or column. To add a row or column before the selected row or column hold the CTRL key down while clicking the add row or column button.

Multiple rows or columns may be added by selecting the desired number of rows or columns and clicking add row or column. For example, if you wish to add 5 columns to the grid, select five cells and click .

To remove a row or column click the row or column to be deleted and then click the remove row or remove column button.

Additional controls in edit

Under "Edit" there are also the control buttons allowing the following tasks:

- Merging and de-merging of cells via available icons and .
- Selection of a signal cell as a line chart
- Controls that determine the amount of time displayed in the line chart and if the y-axis of the line chart is adaptive.

For the merging/demerging of the cells details, see Chapter 4.2.5.1, "Starting device grid view", on page 478

Moving cells within the grid

Existing cells may be moved within the grid by dragging and dropping the cell to a new location.

The cells may also be moved via copy and paste.

To copy a cell, select the desired cell(s) and the click the copy button. The same is performed if you press the CTRL + C keyboard combination.

To paste the cell then into a new cell location, click the desired new cell(s) location and press the paste button. The same is performed if you press the CTRL + V keyboard combination.

If the currently selected cell contains existing content, R&S ROMES4 prompts for confirmation to overwrite the existing content.

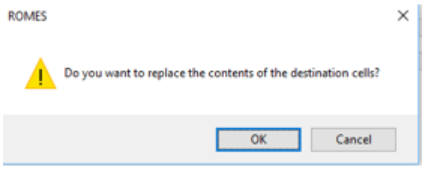


Figure 4-123: Warning message

The existing content may be moved to a new cell. To do that, cut the cell (this removes the content from the existing cell) and then paste the content into a new cell.

To cut an existing cell, click the desired cell(s) and then click the cut button or press the CTRL + X keyboard combination.

Templates

Once a grid has been configured, it may be saved as a template for later reloading, modifying or reusing purpose.

Loading an existing template may be done from the template section of the configuration dialog. To load a template, click the load template button or select one of the preloaded templates from the drop down list.

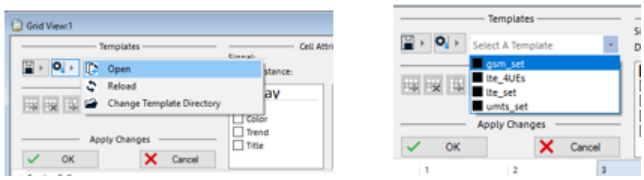


Figure 4-124: Selection of preloaded template

Choosing "Open" from the template's open menu prompts for a location of the template file to open. The chosen template is then placed in the template's list. In that way it may be referenced later.

Opening a template erases any items currently configured in the "Grid View".

To reload a template, select it from the drop list of available temples or click the template, open button and press "Reload". Pressing "Reload" does not prompt for a template to reload. Instead, that reloads the currently selected template in the drop down list. If a template is not currently selected, a prompt for the location of the template to load will be generated.

To change the location of the template directory (where the template list is filled from), click and then click the "Change Template Director" item. This will prompt for a location of the template directory.

Once a template file has been modified by changing any cell within the grid, the template's name in the template list becomes blue in color.

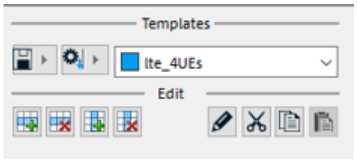


Figure 4-125: Template's color

To save a template, click the file save button.

To save the file with the same name as the currently loaded template, click the left side of the button.

Clicking the arrow to the right, pops-up a menu with the options "Save" and "Save As". Click "Save" to save the template with the same name as the currently selected file. Click "Save As" to prompt for a new location and a file's name to be saved as the template. After the file is successfully saved, the template's name in the template list becomes black in color to indicate that the template has no outstanding changes.

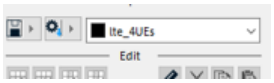


Figure 4-126: No outstanding changes

Exiting configuration mode

To exit the configuration mode of the Grid View:

- Click "OK" to keep any configuration changes.
- Click "Cancel" to avoid any current configuration changes.

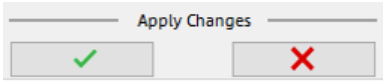


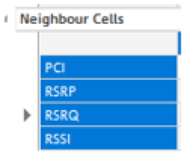
Figure 4-127: Two ways to exit

Clicking "OK" will not save the changes made to the current workspace until the current workspace has been saved.

4.2.8.2 Grid view during measurement and replay

During measurement or replay the following items may be displayed by the Grid View:

- Static text – Configured static text items are displayed as entered during configuration. If the text item is configured with a "Title" attribute, the cell is displayed with blue back ground.

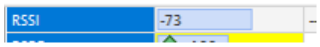


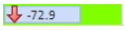
The values in the static text cell remain the same thoughout the measurement or replay.

- Signal value – Items configured as signal value type display the current value for the selected device id filter of the signal. If the signal does not have a value, "-" is displayed. Any coupled focus changes made to the replay will be observed by the Grid View and the displayed values updated to the correct time in the measurement or replay.

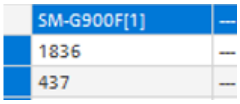
Figure 4-128: Signal value - PCI value

  - If the cell is configured with the "Bar" attribute, the cell displays the values as a bar graph.



  - If the cell is configured with the "Trend" attribute, the cell displays an up arrow graphic if the value is tending up, displays a down arrow  if the value is tending down and a side ways arrow if the value is tending steady.
  - If the cell is configured with a "Color" attribute, the cell displays the configured color for the signal.

- Signal source – Items configured as signal source display the device source of the configured signal.



- Signal name – Items configured as signal name display the name of the configured signal in the cell. If the cell has the "Title" attribute applied, the cell appears with a blue background.

- Groups name – Group name remains static thoughout the replay or measurement. Nevertheless, the group sections may be minimized by double clicking the group label or by clicking the group minimize button.

4.2.8.3 Custom views

The Grid View is added as a template option in the custom views configuration.

The Grid View is set as a custom view via "View" > "Custom View" > "Create New" command.

Choose the "Grid View" in the "Select a Template" drop-down box of the "Create Custom View" > "Properties" pane.

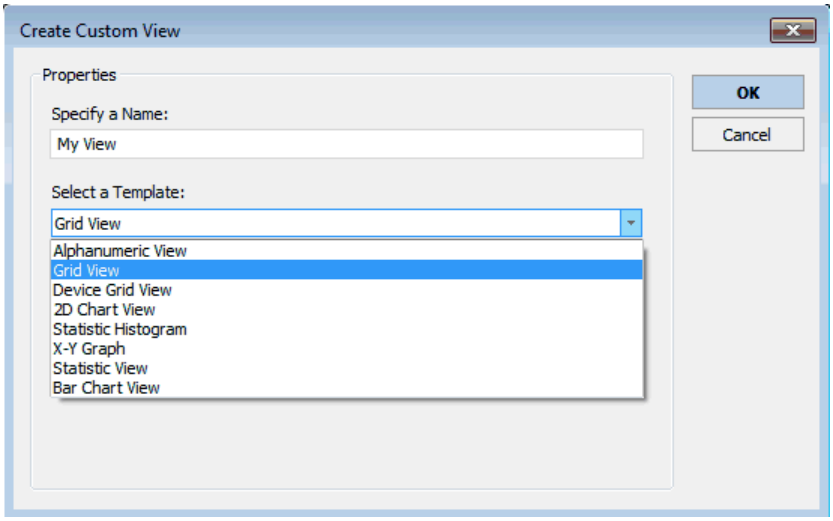


Figure 4-129: Grid View selected as template

One the view is created as the custom view, the configurations described in previous sections can be configured.

Custom views are persistent on the current system. This means, the new custom view will behave as any other view and will be available whenever R&S ROMES4 starts.

If the workspace contains a Custom View which is not available at the system, the custom view is created temporarily. In this case, it disappears once R&S ROMES4 is restarted.

4.2.9 Message view

The "Message View" displays a detailed chronological record of certain system messages generated during measurement or file export.

The displayed time format for the messages is always *HH:MM:SS*, irrespective of the time format settings elsewhere in R&S ROMES4.

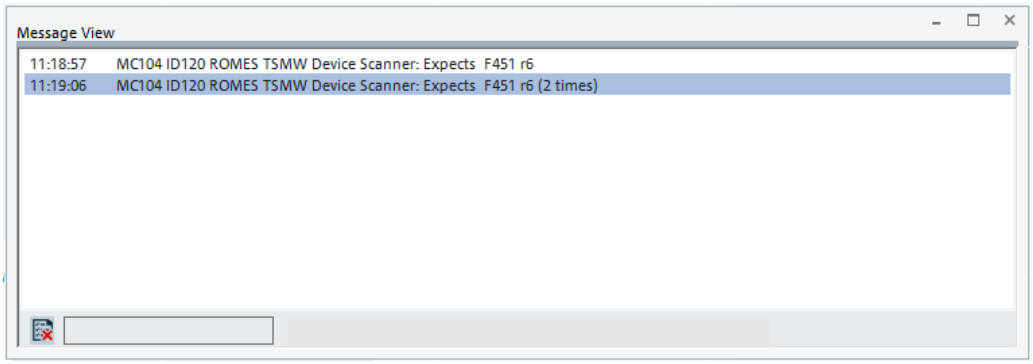


Figure 4-130: Message View

Not all messages displayed during recording are stored in the measurement file. For this reason, some messages are not displayed when replaying the file later.

Message	Description
C:\RuS\ROMES\D1026T17.58 created	A new Transmitter Scan file with the given name was created.
BTS appended	A BTS was appended successfully to the database. This message occurs only when the BTS was appended via the BTS edit function.
BTS deleted	Indicates that a BTS was deleted successfully from the database.
BTS time offset evaluation started	Starts the update of the database.
Database updated	This message shows the update of the database, which usually occurs every two minutes.
Frequency correction = ... Hz	The result of this frequency correction.
Frequency correction stopped	The frequency correction is calculated with help of at least 4 sectors. If fewer than 4 sectors are available, the frequency correction could not be performed and this message appears.
Just ... MB memory left	To be able to run the software, there must be at least 80 MByte of free disk space available. If this message occurs, check your free disk space and verify that the disk is not fragmented.
Sector skipped: (Reason)	After reading a sector from the base station text file, the program checks, whether all entries have consistent values. E.g., if there is a sector in the GSM band with channel 1283, the sector is not taken into the database.
Skip sector	During reading a base station text file, a sector did not have all mandatory entries. The corresponding sector is skipped and the program continues with reading the next sector.
System nonlinear to network	One or more BTSs have a drift beyond the allowed range. In this case, a new Transmitter Scan file is created.
Transmitter Scan Overlap: m Sectors, n Identified Sectors	When a new Transmitter Scan file is opened, m recently measured BTS are also taken in the new file to avoid a loss of overlap. On "n" of these sectors, the CI could be identified.
TS File ... added to database	Every Transmitter Scan file which is manually added to the database is shown.

The Message View has no configuration menu.

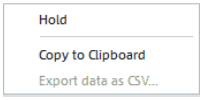
The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.2.9.1 View contents

The messages are displayed in consecutive lines together with the time when they were recorded. In general, all messages are self-explanatory.

Clicking the icon in the lower left corner of the view deletes all messages in the view and clears a space for new messages.

4.2.9.2 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "Message View" has no configuration menu.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.2.10 Resource usage view

The "Resource Usage View" shows the resource usages that are reported by Phylis kernels. The purpose of the view and the associated signals is to show the resource utilization for modules.

The resource usage information includes:

- Time since measurement starts
- Time modules spend on kernel and/or user mode
- IQ-related time and counts
- Usage information in recent seconds (1, 5, or 15 seconds)

The listed resource usage information, that is, the available usage times and counters signals are counted from measurement statistics.

Resource usage signals as information on usage are available under the "Signal Tree" > "System Info" > "Resource Usage Template" branch. Signals can be drag and drop from there to a basic view, for example, Alphanumeric View or 2D Chart View as shown in the screenshot.

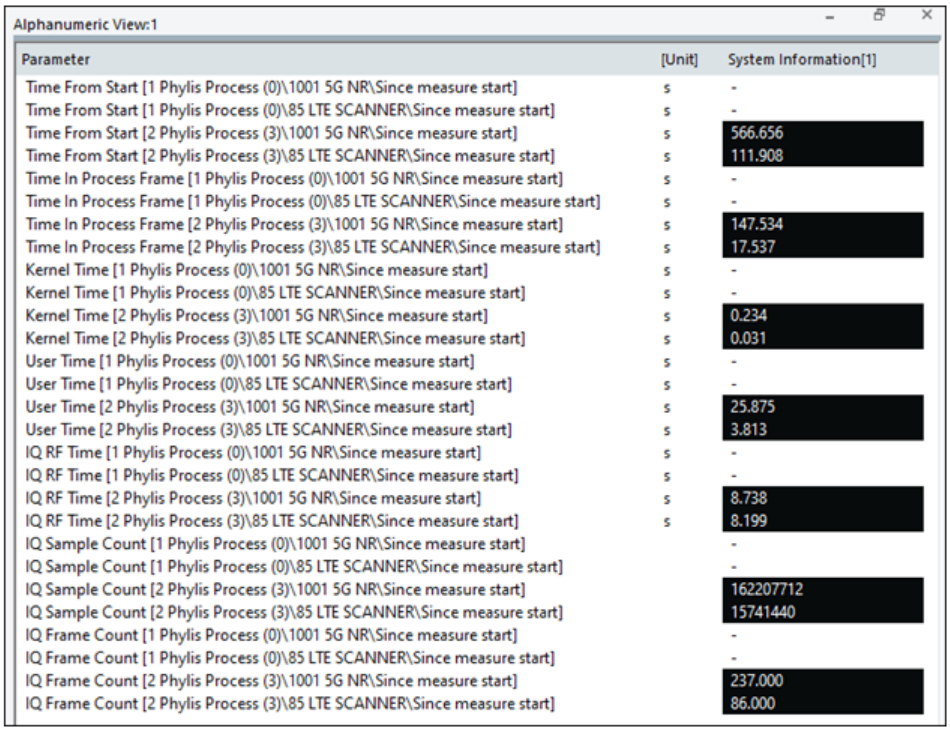


Figure 4-131: Resource usage signals in Alphanumeric view

To get info on a resource usage signal hover with mouse over the signal. A ToolTip shows the signal description and unit or refer to "Description of R&S ROMES4 Signals" document.

4.2.10.1 Resource usage monitor service

The following definitions apply when considering this basic view type:

1. Resource Usage Monitor Service is an internal service that sends queries to all active kernel processes for the resource usage information about every 10 seconds. The usage information is compiled and inserted into frames and distributed. It starts when R&S ROMES4 starts (different from the "Resource Usage View" that is not launched until user starts it).

- It does not start collecting data until measurement starts.

- It stops collecting data when measurement stops.

- Resource Usage Data Provider retrieves the usage information to be used by views and template signals.

- Resource Usage View shows the collected information.

- Resource Usage Template Signals can be dragged and dropped into basic views for display.

The System Info SW device is added automatically whenever user adds any scanner. The screenshot shows that both LTE scanner and System Information are added to the "Loaded Devices" list.

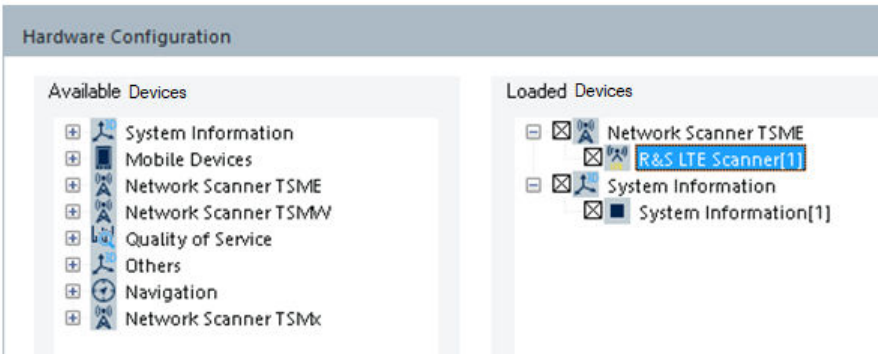


Figure 4-132: System Info automatically added with a scanner addition

4.2.10.2 Resource usage view launching

To launch the "Resource Usage View", select "View" > "Basic Views" > "Resource Usage View".

You can launch the view also when selecting the "Basic Views" > "Resource Usage View" from the menu which pops-up if right-mouse button click anywhere an empty view area.

The view is a lazy view, meaning that it is not launched when R&S ROMES4 starts.

4.2.10.3 Details of resource usage view

Collected times and counters are module-based.

There are two types of resource usage values:

- Initial Resource Values - the first collected times and counters
- Current Resource Values - any later collected times and counters

The "Resource Usage View" shows the differences between the Current Response Values and the Initial Response Values for all modules.

Multiple modules can be grouped.

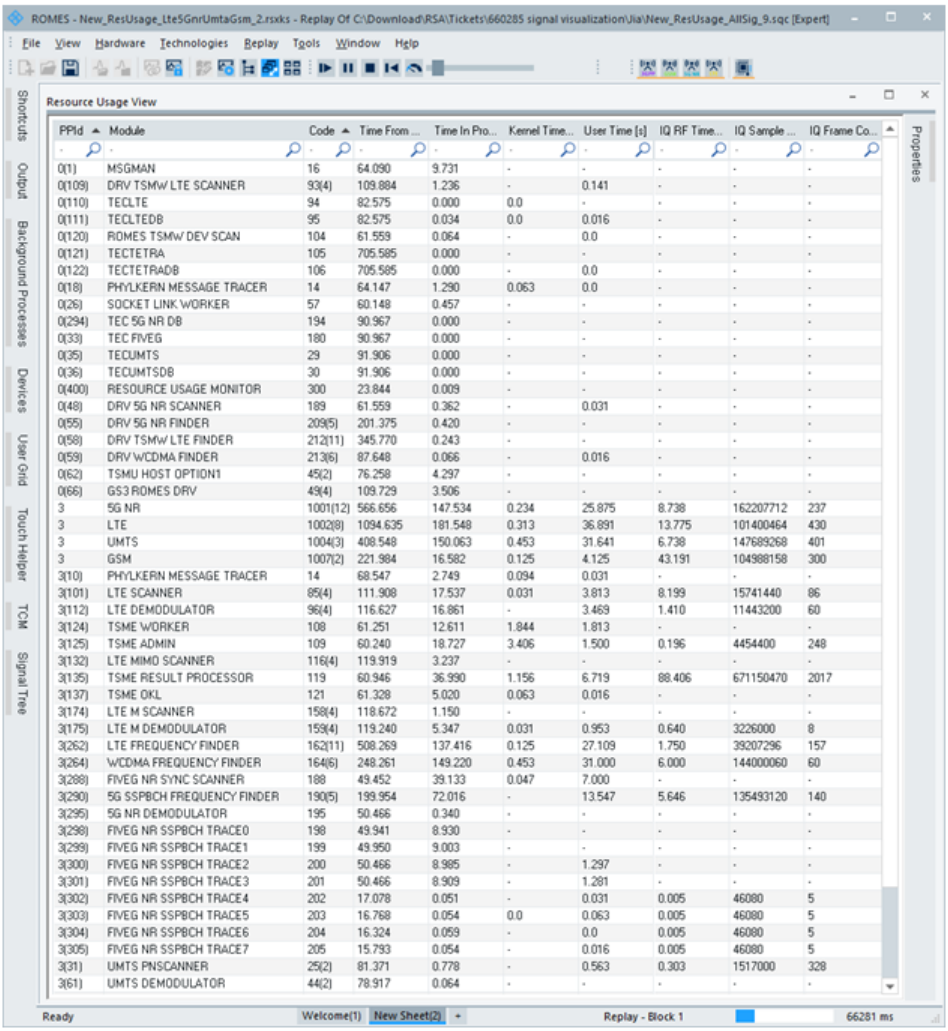


Figure 4-133: Resource usage view

Resource usage view layout

The "Resource Usage View" uses Resource Usage Provider to collect resource usage times and counters. The collected times and counters are displayed in the view. If the collected data is not available, the corresponding cell shows "-".

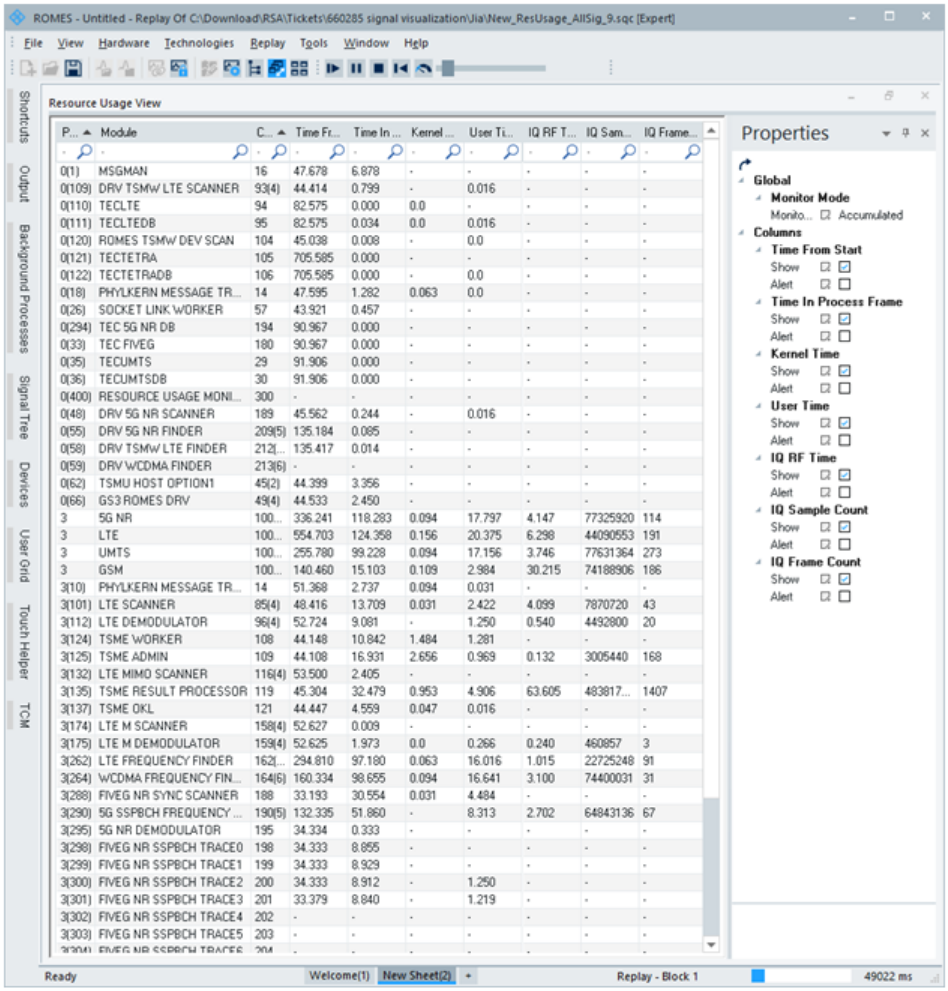


Figure 4-134: Properties of Resource Usage View

Apart from "Time" and "Count" columns showing time and count values, the view contains the following columns.

- "PPId" column
  The first "PPId" column is a Phylis Process Id, followed by a "Primary Module ID" in parentheses if available. "PPId" identifies and distinguishes different Phylis processes. For grouped modules, the row has the Phylis Process Id, but not the Primary Module ID.
  Resource usage data are collected from different Phylis processes. R&S ROMES4 itself is a local process. At least one external Phylis process exists to handle signal scanning, demodulation and so on.
- "Module"
  Represents module or group name.
- "Code"
  Represents module code or group ID.
  – Module code for modules is displayed and represents an internal module identifier.

– Group contains a list of related modules. A module is not shared by more than one group. If a module is shared, it does not join any group and is listed as an individual module. The number after the group ID is the number of modules defined in the group. The group ID definitions are shown in the following table.

Group Name	5G NR	LTE	NB-IoT	UMTS	TD-SDMA	C2K+EVDO	GSM	WiMax	TETRA	CW	Spectrum
Group ID	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011

- Rest of columns are resource usage times and counters already introduced in Chapter 4.2.10, "Resource usage view", on page 517.

The "Resource Usage View" contains two parts, the grid and the property bar.

Resource usage view grid

The "Resource Usage View" grid's rows and columns have the following meaning:

- Each row is a module or group with the same module code or group id.
- Each column indicates a usage time or counter
  – The first column is the module or group name
  – The second column is the module code or group ID column
  If a number is displayed in parentheses next to the module code, the number is an instance number, indicating that more multiple instances are running.

The usage frames are created about every 15 seconds or slightly longer. The data starts showing up in 10 to 20 or more seconds depending on the system load.

The view depends on the received frames to display grid data. The resource usage runs in a normal thread and if system is busy running other high priority threads, the frames delivery is delayed.

The template signals and data displayed in the "Resource Usage View" can not be well synchronized because frame delivery time differs. The view's property bar settings can be saved in workspace and they will be reloaded next time loading the workspace.

Resource usage view properties bar

The entries contained in the "Properties" pane which you can activate/deactivate for display in the grid are shown in the following screenshot.

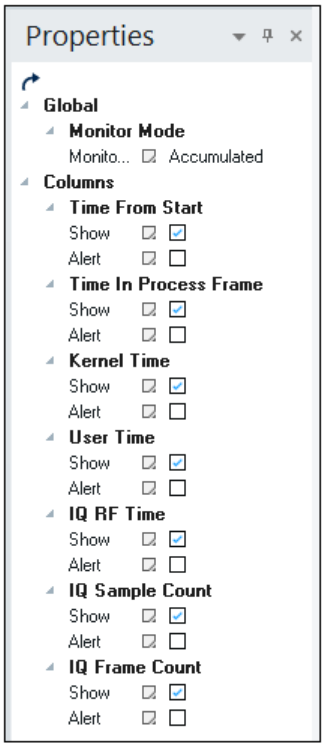


Figure 4-135: Properties bar

The following entries in "Properties" are available:

- "Global" > "Monitor Mode"
  - "Accumulated" shows the value from start of measuring.
  - "Instantaneous" shows the value for the recent x seconds, where x can be 1, 5 or 15 seconds, so called instantaneous seconds.
- "Columns"

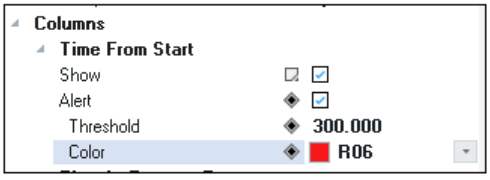


Figure 4-136: Columns properties

"Columns" properties are for customizing each column. A column in the view can be selectively made visible if the "Show" check-box is checked or invisible otherwise. An alert with a threshold and alert color can be set if the "Alert" check-box is checked.

The previous screenshot shows the selected settings for the Time From Start signal, but the meaning of the entries is common for all other monitored signals.

The Time From Start is the time duration from measurement start up to a current time. As "Show" is checked, the "Time..." column is shown in the "Resource Usage View".

As "Alert" is checked, alerting is activated and other two properties, the "Threshold" and the "Color" are displayed.

- Threshold: enter the threshold value of double type

- Color: select a color from the color picker control

When value exceeds the threshold, the value's background color changes as shown in the following screenshot.

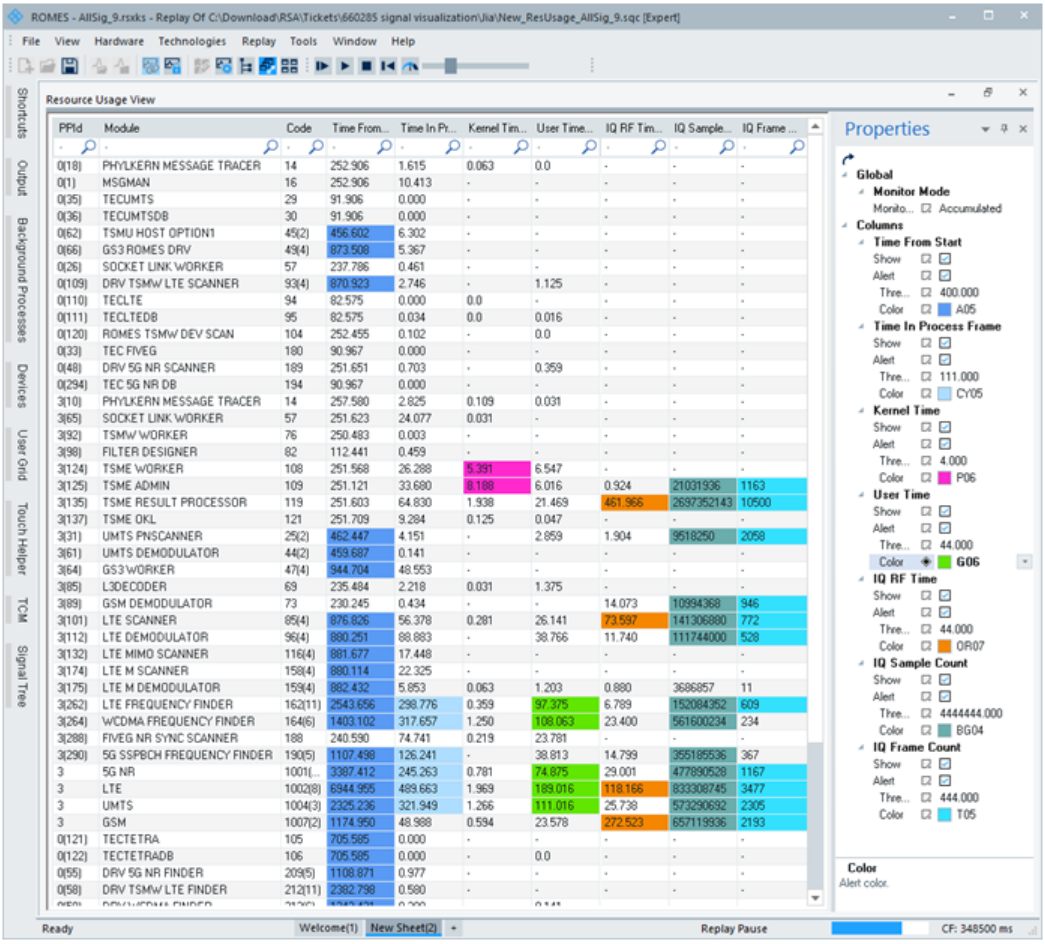


Figure 4-137: Alerts raised for some resource usage signals per module

The property bar settings can be saved in workspace.

Resource usage signal filter

Resource usage signal filter is used to specify the criteria to filter the signals.

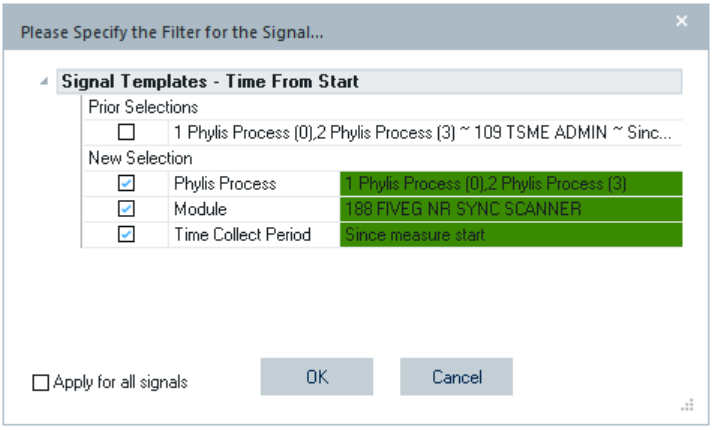


Figure 4-138: Resource usage signal template

The first parameter in the filter is Phylis Process Id. Select one or more from drop-down box. The first number is the index to the drop-down list, the second number in parentheses is the Phylis Process Id (PPId). When a measurement file is not opened or is closed, the PPId is not available, and therefore not displayed.

The second parameter is a module that reports its resources usage. The module is displayed with its name and code.

4.2.11 Statistic histogram

The "Statistic Histogram" shows statistical evaluation of a signal. The evaluation results are shown in a graph mode and in a table.

The table can be displayed below the graph if necessary. The range of the Y-axis is calculated automatically.

If an invalid signal is selected (for example, RxQual while the mobile is in scan mode), the diagrams remain empty. R&S ROMES4 allows several statistic histograms to open simultaneously.

The "Statistic Histogram" complements the Chapter 4.2.1, "2D chart view", on page 448, which displays the actual values of different signals.

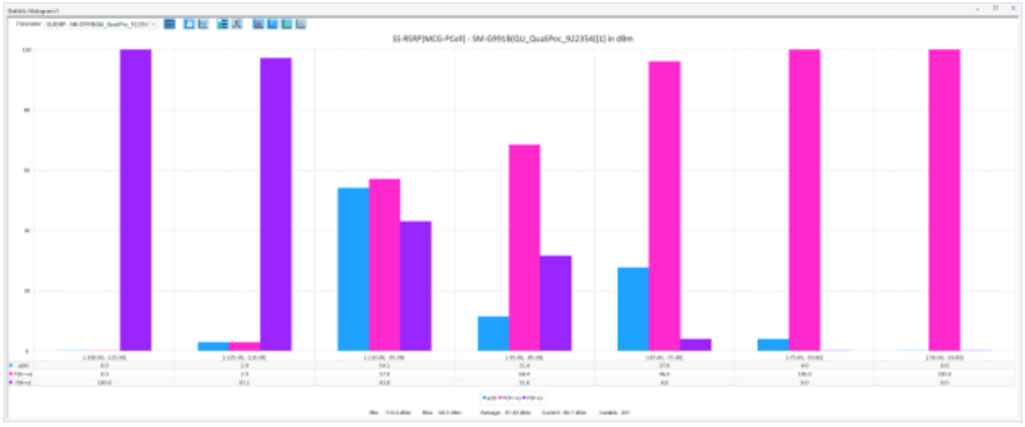


Figure 4-139: Statistic Histogram

The default colors are adapted to the R&S color scheme.

4.2.11.1 Diagram / table

The diagram or table shows the distribution of the signal values. The available signals appear in the "Parameter" pull-down list after they have been selected in the "Values" configuration menu.

The "Show table" button lets you choose between a graphical mode only (the button is gray) or a tabular mode (the button becomes blue).

Figure 4-140: Show table

The values are displayed in a table as well.

Figure 4-141: Show bar chart

The values are displayed as a bar chart in the graph mode.

Figure 4-142: Show plot chart

The values are displayed in a 2D-chart with a continuous (polygonal) curve.

The following table corresponds to the bars in the figure above:

	Z107[2]	
RSSI(Carrier) in dBm	%	#
[-130.00, -125.50[	0.0%	0
[-125.50, -121.00[	0.0%	0
[-121.00, -116.50[	0.0%	0
[-116.50, -112.00[	0.0%	0
[-112.00, -107.50[	0.0%	0
[-107.50, -103.00[	0.0%	0
[-103.00, -98.50[	0.0%	0
[-98.50, -94.00[	0.0%	0
[-94.00, -89.50[	0.0%	0
[-89.50, -85.00[	0.0%	0
[-85.00, -80.50[	2.9%	141
[-80.50, -76.00[	11.0%	543
[-76.00, -71.50[	13.8%	678
[-71.50, -67.00[	14.1%	695
[-67.00, -62.50[	24.9%	1225
[-62.50, -58.00[	23.4%	1151
[-58.00, -53.50[	7.3%	358
[-53.50, -49.00[	1.8%	89
[-49.00, -44.50[	0.8%	37
[-44.50, -40.00[	0.0%	2

4.2.11.2 Legend and marker

Figure 4-143: Show / hide legend

Displays or hides the legend on the right side of the diagram

Figure 4-144: Show / hide marker

Displays or hides the marker line and an info field. The info field shows the x-axis variable and the value of the relative and accumulated bars/curves (if activated) at the marker line. The marker line can be shifted to the left and to the right by the corresponding cursor keys. A double click places the marker to the desired position.

4.2.11.3 Accumulated bars

The following icons display or hide the bars or curves for the relative or accumulated frequency of each value. Several types of bars/curves can be active at the same time:

Figure 4-145: Show/hide density graph P(X=x)

Displays the relative frequency of all values in percent (p(X)) in the Figure 4-139.

Figure 4-146: Show/hide cumulative density graph P(X<=x)

Displays the accumulated frequency in ascending order, i.e. the sum of the frequencies of all signal values below the current value (P(X<x) in the same figure.

Figure 4-147: Show/hide complementary cumulative density graph P(X>x)

Displays the accumulated frequency in descending order, i.e. the sum of the frequencies of all signal values above and including the current value (P(X>=x) in the same figure.

The first bar/first value of the curve always starts at 100%. The sum of the accumulated frequencies equals to 100% for all signal values:

P(X<x) + P(X>=x) = 100% for all X

Figure 4-148: Enable comparison of multiple devices

Shows or hides the device name in the legend and the marker.

The colors of the bars or curves and the scale of the y-axis are set in the "Settings" tab of the configuration menu.

4.2.11.4 Scaling

The x-axis is scaled by the expected value range of the analyzed signal. The expected range is set automatically for each signal but can be changed in the "Available Signals" tab of the "Tools" > "Preferences" menu (see Figure 3-114).

"Exp. Min." and "Exp. Max." define the first and last value on the x-axis.

The intermediate x-axis values depend on the nature of the analyzed signal.

Many signals are defined on a step scale with a fixed number of discrete values. For example, RxLev of a GSM mobile is an integer number between 0 and 63.

For those signals, "Step" is displayed in the legend below the diagram. The x-axis is labeled with all values between the minimum and the maximum expected value. Each step represents a class for the statistical evaluation, i.e. it is represented by a single bar or point on the view curve.

For continuous signals, classes are defined by dividing the expected value range by an integer number ("Number of Classes") set in the "Settings" tab of the configuration menu. The classes are thus intervals of equal width. The center values of each interval label the x-axis.

4.2.11.5 Legends

The Statistic Histogram displays on the top-right side already mentioned icons for relative or accumulated frequencies of the current signal.

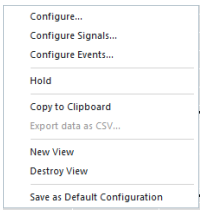
The statistical parameters of the current signal are placed across the bottom of the histogram.

- "Min. / Max."
  Minimum and maximum value ever measured or replayed
- "Average"
  Arithmetic means value of all values ever measured
- "Current"
  Current measured value
- "Invalid"
  Number of invalid values in the signal

The invalid values are excluded from the diagram.

The sum of all individual frequencies p(X) always amounts to 100%.

4.2.11.6 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.2.11.7 Statistic histogram configuration

The "Statistic Histogram" configuration menu defines the signals to be viewed, configures the diagram and shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Statistic histogram configuration: value tab

Selects the signals to be displayed in a generic (basic) and some mobile views. The connected devices can be indicated in the "Selected Signals [Maximum Allowed <variable>]" list for some signals. The "Values" tab is analogous to the "Values" tab of the "Alphanumeric View".

For further description of the tab, see Chapter 4.2.3.3, "Values tab", on page 468.

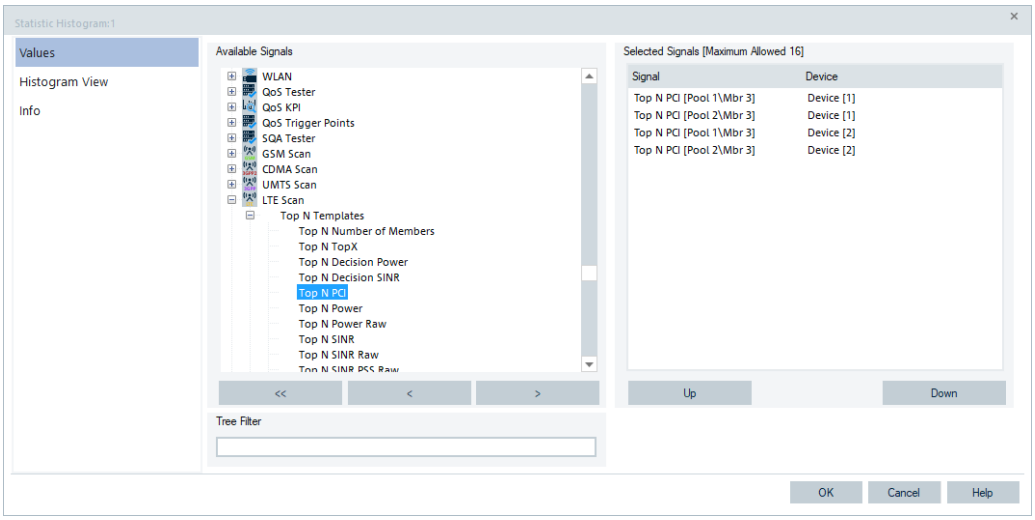


Figure 4-149: Statistic Histogram configuration - Values tab

Statistic histogram configuration: histogram view tab

The "Histogram View" tab lets you select which statistic classes to show in the view based on signal coloring, select the way of statistic calculation and configure the y-axis scale.

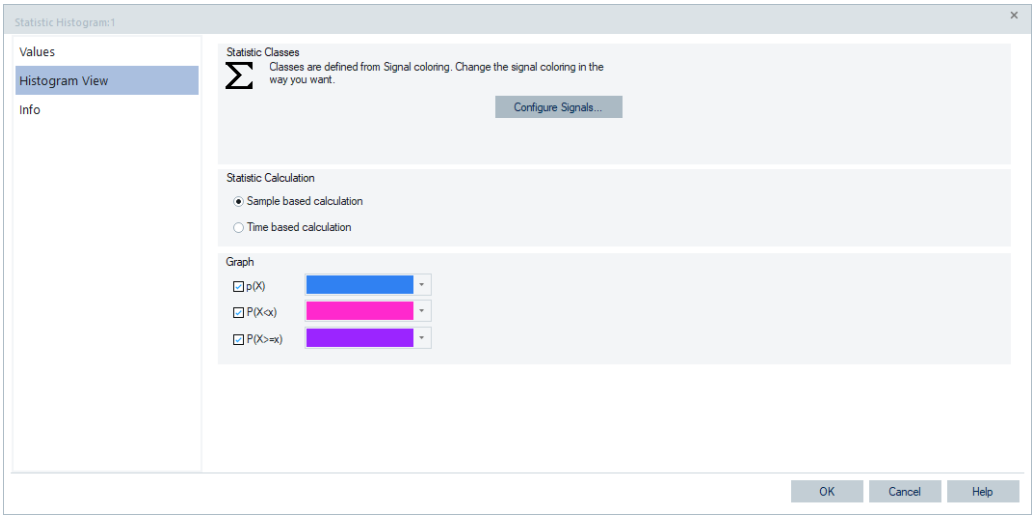


Figure 4-150: Statistic Histogram configuration - Histogram View tab

Statistic Classes
The classes within the view are defined from signal coloring only. The approach is an automatic statistic classes configuration according to the signal color scale. Benefit is that each signal has its own classes configuration which fits to the individual range and partition.

Use "Configure Signals" to open the signal configuration. All R&S ROMES available signals are shown. Nearly all signals have a color scale configuration, which can be altered in an adequate way. Changes are stored in registry and therefore persist over all workspaces.

As a result, the statistic classes are set according to the color scale settings.

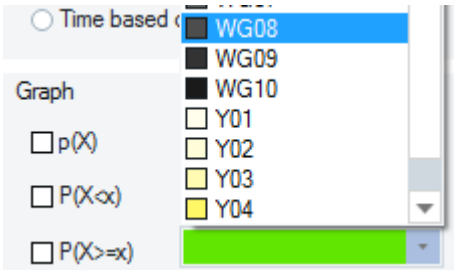
Note: If auto-coloring for a certain signal, the classes are not defined by signal-coloring. In that case, used is just one class with borders set to minimum/maximum range of the signal.

Statistic Calculation
The height of the bars can be calculated in two alternative ways.

- If "Sample based calculation" is selected, the height of each bar is proportional to the number of samples in the class.

If "Time based calculation" is selected, the height of each bar is proportional to the amount of time that the signal values fall inside the class.

Graph
Selects the bar types/curves to be displayed, the display colors and the y-axis scale. The three check boxes p(X), P(X<x) and P(X>=x) show (if checked) or hide the bar graphs or curves for the relative frequency of the values per class and the accumulated frequencies. They are equivalent to the corresponding icons in the view. The "Choose Color" pull-down lists select the display color for each bar graph or curve:



OK
Apply all configured settings and close the configuration menu.

Cancel
Discard all configured settings and close the configuration menu.

Statistic histogram configuration: info tab

The "Info" tab is similar for all view types. For a short description, refer to Chapter 4.1, "Common properties of R&S ROMES4 views", on page 428.

4.2.12 Statistic view

The "Statistic View" displays the most common statistical key indicators of any R&S ROMES4 signal. To get wanted signal statistic, select an available signal from the "Signal Tree" and drag&drop in the view. The approach is common for basic views, for example, the same applies for "2D Chart View" or "Alphanumeric View".

The "Statistic View" provides the "Stat","Data", "Histogram" table in the statistic center dialog (in the "Parameter" window). In addition, the "CDF" and "PDF" charts are supported for selected signal.

The "Histogram" is based on the "Statistic Histogram" view, and therefore offers chart mode as well.

The change in statistic classes has no effect once a signal is evaluated. For the statistic classes, see "Statistic view configuration: histogram view tab" on page 539.

R&S ROMES4 detects the important changes in the "Statistic View" configuration page and starts rescan of the RSCMD file. The important changes are, for example, adding or removing a signal or the change in number of classes or width.

4.2.12.1 Statistic view analyzer

For each configured signal shown in the statistic center dialog, a specialized analyzer window can be opened (mentioned "Stat", "Data" "Histogram". It provides additional views on the signal data. The chart/table shows the statistical key indicators of the signal values.

A double click a signal row in "Parameter" opens the analyzer panel. Alternatively, a single mouse click on the row and a right click with the "Open Analyzer" item of the context menu also opens the analyzer.

The following statistical indicators are calculated and shown in the "Parameter" for the selected signal:

- Unit of the selected signal
- Number of samples (valid & invalid "Count")
- Number of invalid samples ("Invalids")
- Mean
- Standard deviation ("Dev.")
- Minimum and Maximum
- Percentiles (1%, 5%, 25%, 50%, 75%, 90%, 95%, 99%)

Stat panel

The upper part of the "Stat" panel shows a box plot and the lower part shows the associated indicators in a table.

A box plot shows summarizing the distribution of the scores of a group of numerical data in a graphical way.

The blue box in the box plot shows the median score as a line and the first (25th percentile) and third quartile (75th percentile) of the score distribution as the lower and upper parts of the box.

The median is the score at the 50% percentile: half of all numerical data get a score higher than the median, and 50% get a score lower. It is the middle point in the distribution of scores.

The 25th percentile is the point at which 25% of the numerical data score lower (and 75% score higher). The 75th percentile is the point at which 75% of the numerical data score lower (and 25% score higher). Thus, the area in the "box" represents the middle 50% of the patients.

Data panel

The "Data" panel displays the time stamps of the selected signal, the value of the statistical parameter and the label of the class the parameter value belongs to ("Histogram Class").

The number of the most recent values displayed can be configured using the function "Performance" on page 538.

Histogram panel

The "Histogram" panel shows the signal parameter values as bar chart and table.

The "Histogram" is based on the "Statistic Histogram". The diagram types, the legend, and the accumulated bars are described in Chapter 4.2.11, "Statistic histogram", on page 525.

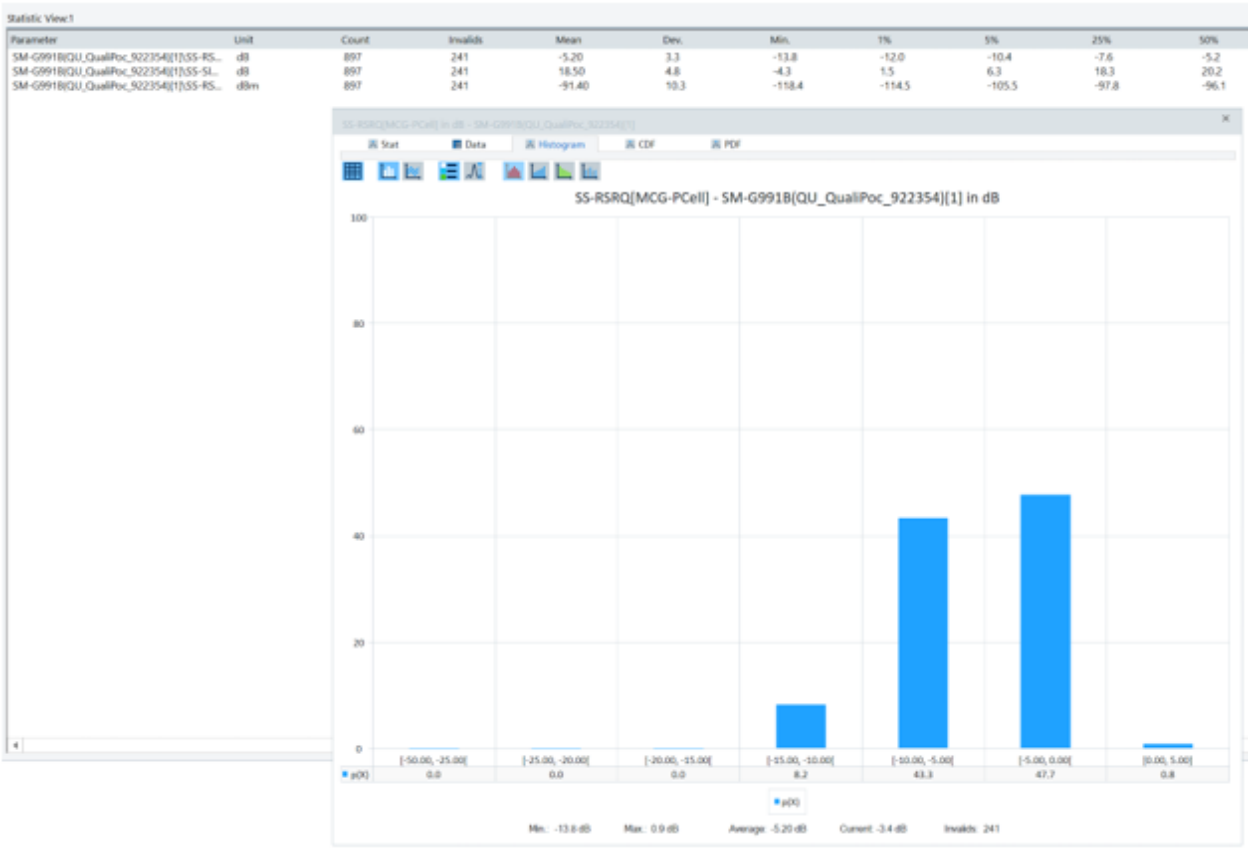


Figure 4-151: Statistic View - histogram panel

CDF panel

This panel displays the Cumulative Distribution Function (CDF) of the selected signal data.

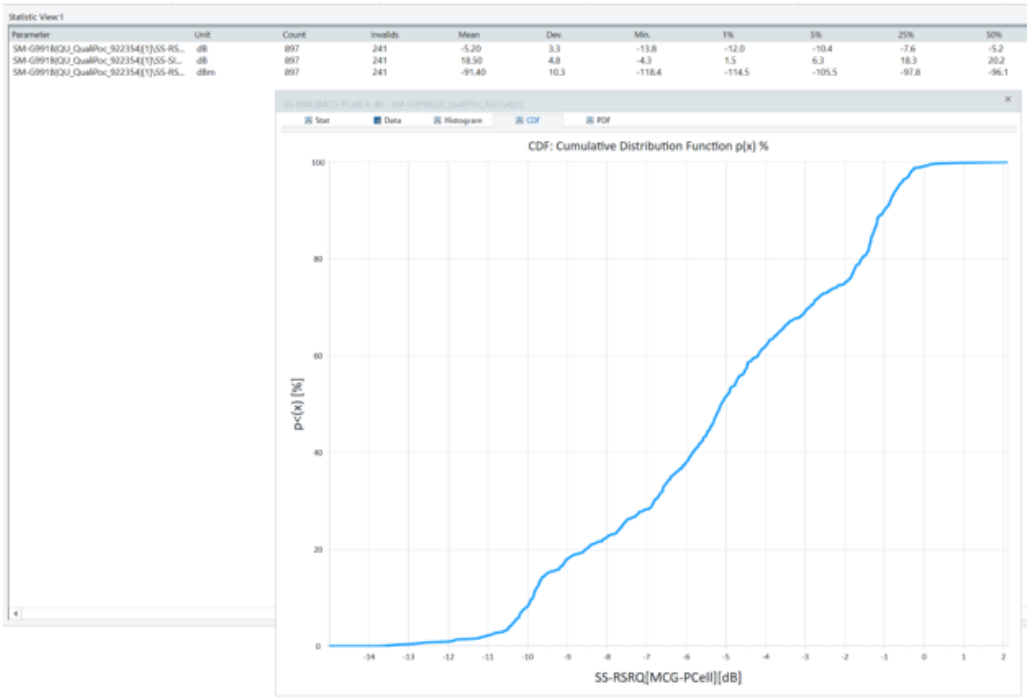


Figure 4-152: Statistic View - CDF panel

PDF panel

This panel displays the Probability Distribution Function (PDF) of the selected signal data.

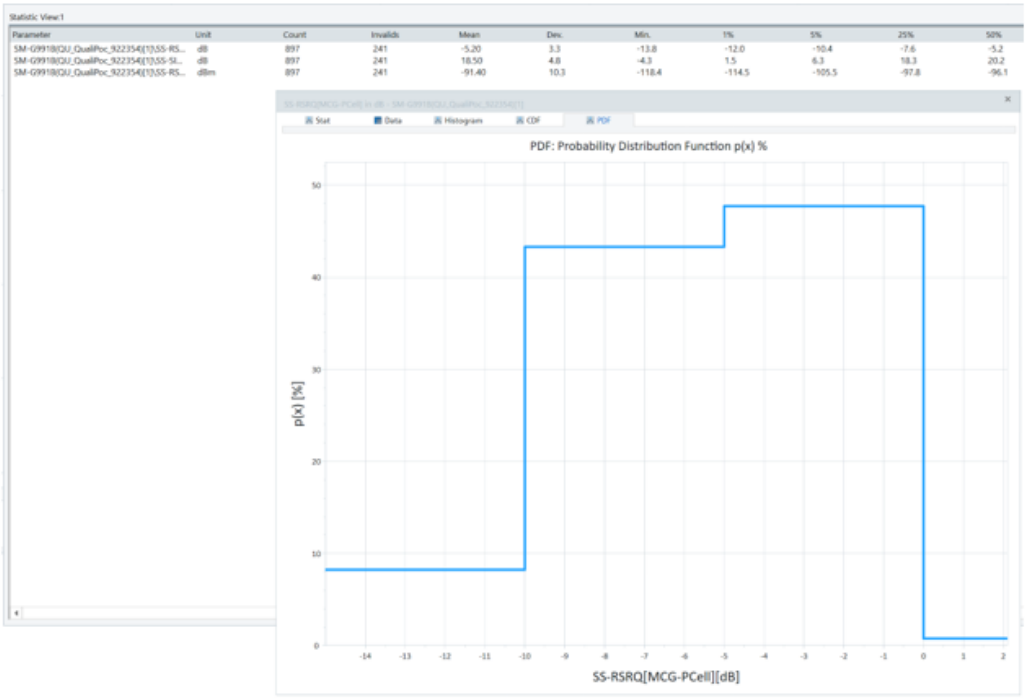
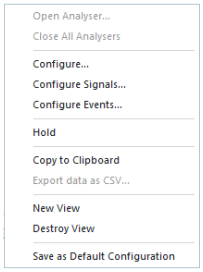


Figure 4-153: Statistic View - PDF panel

4.2.12.2 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The tables of the "Statistic View" can be exported as CSV file formats. Click the "Export data as CSV" entry of the context menu to export the view. All data in the view are exported.

4.2.12.3 Statistic view configuration

Statistic view configuration: values tab

The "Statistic View" configuration lets you select and control the signals for displaying and get information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

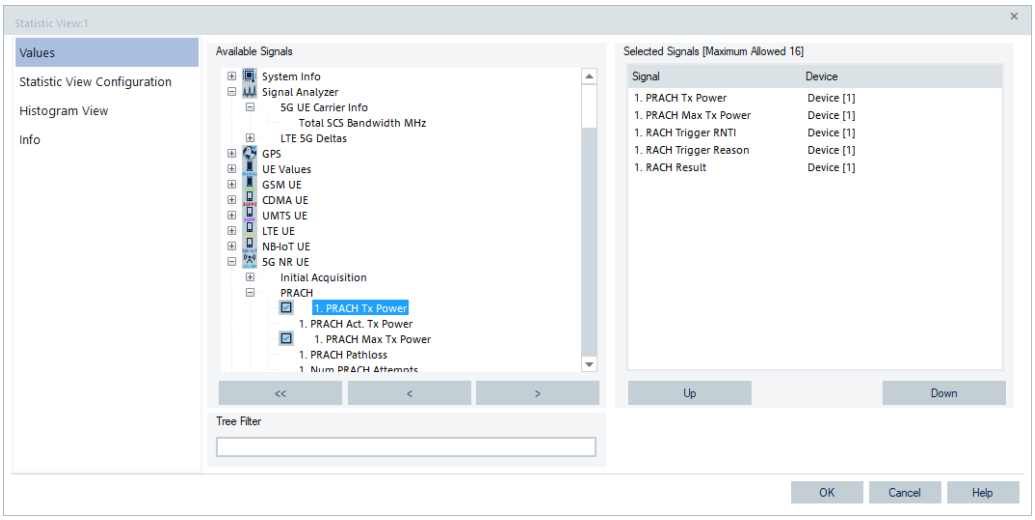


Figure 4-154: Statistic View configuration - Values

Selects the signals to be displayed in a generic (basic) and some mobile views. The connected devices can be indicated in the "Selected Signals [Maximum Allowed <variable>]" list for some signals. The "Values" tab is analogous to the "Values" tab of the "Alphanumeric View".

For further description of the tab, see Chapter 4.2.3.3, "Values tab", on page 468.

Statistic view configuration: statistic view configuration tab

The "Calculation" > "Statistic View Configuration" tab lets you set the upper and lower threshold for selected signal, the signal evaluation mode and the number of stored signal values for performance control purposes.

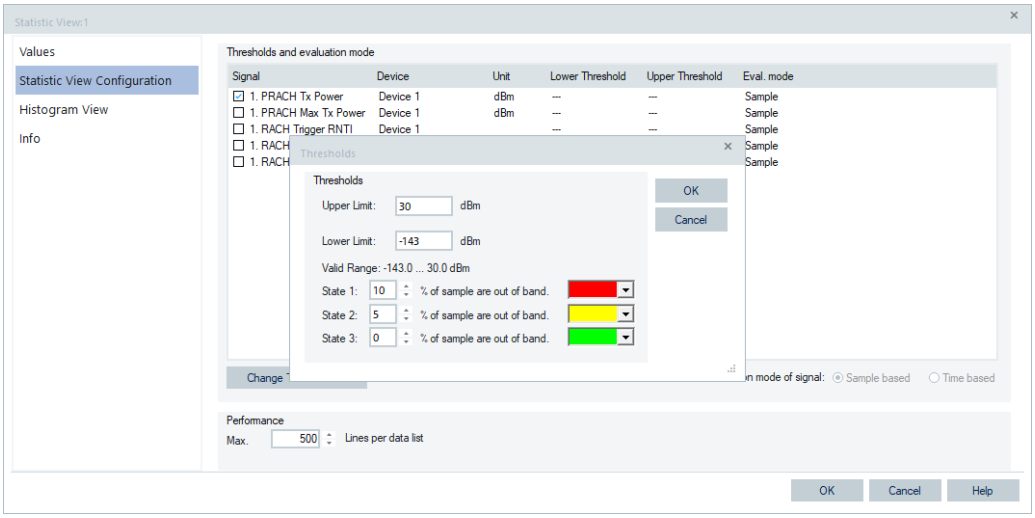


Figure 4-155: Statistic View Configuration - setting thresholds

Thresholds and evaluation mode
If you check the check box of a signal, the associated thresholds of the selected signal can be defined in the dialog which opens automatically.

The dialog also opens if you select an already configured signal and click the "Change Thresholds" button. In this case you can change the configured thresholds.

Thresholds ← Thresholds and evaluation mode
The "Upper Limit" and "Lower Limits" must be within the valid range that is displayed for the signal. The signal states and the state indicating colors can be defined using the percentiles and the color selection list boxes below the limit entry fields.

Evaluation mode of signal ← Thresholds and evaluation mode
Selected evaluation mode defines the statistic calculation that is the height of the bars in the view.

The Evaluation mode of the signal can be defined as following:

- "Sample based", where the number of samples is used in the measurement. The height of each bar is proportional to the number of samples in the class.
- "Time based", where the amount of time determines the number of samples. The height of each bar is proportional to the amount of time that the signal values fall inside the class.

Performance
The number of "Lines per data" limits the stored results shown in "Analyzer Data", see "Data panel" on page 533. The "Updates/s" field defines the refresh rate of the signal display, where a value of "0" means that the signal data is displayed immediately (i.e.when the data is available).

OK
Apply all configured settings and close the configuration menu.

Cancel
Discard all configured settings and close the configuration menu.

Statistic view configuration: histogram view tab

"Histogram View" lets you configure signals for statistic, the way of calculation, which bar types/curves to display, the display colors and the y-axis scale.

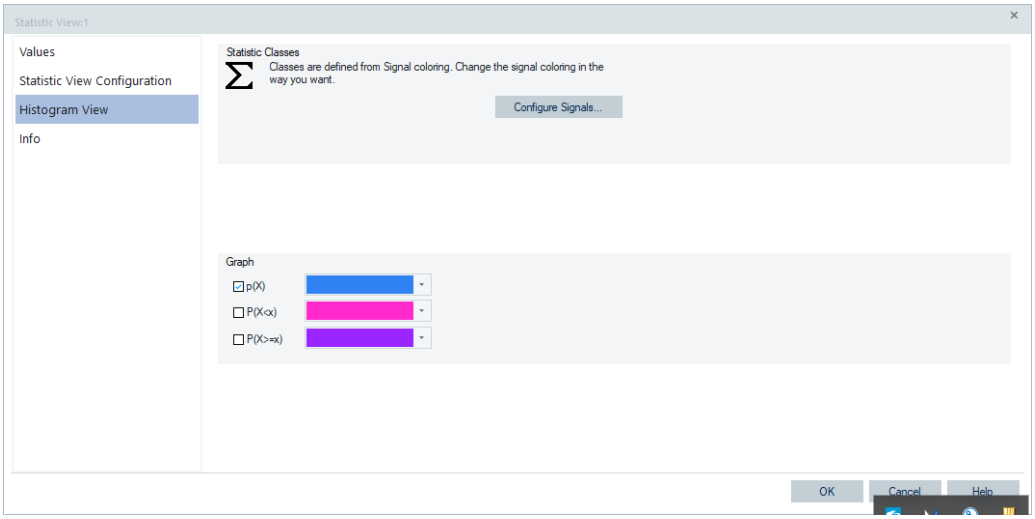


Figure 4-156: Statistic View configuration - Histogram View

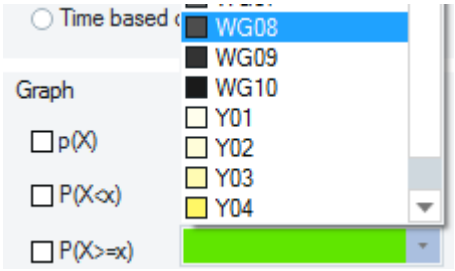
Statistic Classes
The classes within the view are defined from signal coloring only. The approach is an automatic statistic classes configuration according to the signal color scale. Benefit is that each signal has its own classes configuration which fits to the individual range and partition.

Use "Configure Signals" to open the signal configuration. All R&S ROMES available signals are shown. Nearly all signals have a color scale configuration, which can be altered in an adequate way. Changes are stored in registry and therefore persist over all workspaces.

As a result, the statistic classes are set according to the color scale settings.

Note: If auto-coloring for a certain signal, the classes are not defined by signal-coloring. In that case, used is just one class with borders set to minimum/maximum range of the signal.

Graph
Selects the bar types/curves to be displayed, the display colors and the y-axis scale. The three check boxes p(X), P(X<x) and P(X>=x) show (if checked) or hide the bar graphs or curves for the relative frequency of the values per class and the accumulated frequencies. They are equivalent to the corresponding icons in the view. The "Choose Color" pull-down lists select the display color for each bar graph or curve:



OK
Apply all configured settings and close the configuration menu.

Cancel
Discard all configured settings and close the configuration menu.

Statistic view configuration: info tab

The "Info" tab is similar for all view types. For a short description, refer to Chapter 4.1, "Common properties of R&S ROMES4 views", on page 428.

4.2.13 Time gated spectrum view

The "Basic Views" > "Time Gated Spectrum View" shows the results of the Time Gated Spectrum scanner.

The Time Gated Spectrum scanner starts when the 5G NR scanner detects a gNodeB.

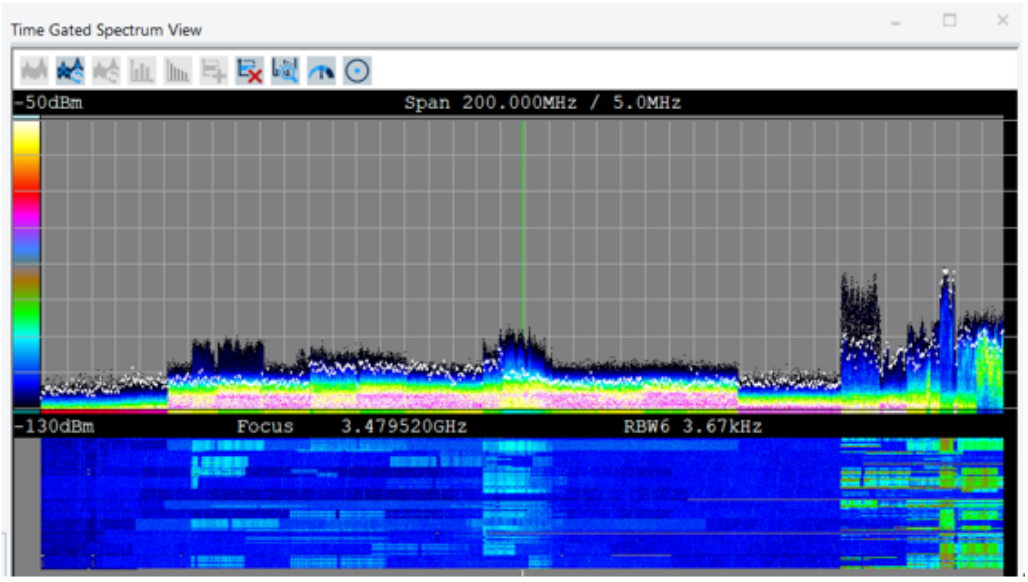


Figure 4-157: Time gated spectrum panoramic view

The view allows between the different display modes of the time gated spectrum scanner to switch. After the Time Gated Spectrum scanner has started, the 5G NR scanner's data is not required anymore for the Time Gated Spectrum scanner.

If you are not interested in the 5G NR scanner's measurement data, you can reduce its measurement by clicking the button. This action reduces any gaps in the spectrum to a minimum.

The panoramic view that is displayed in the previous screenshot gives an overview of the spectrum of interest. When the frequency of interest has been found, the view can be focused by clicking that frequency.

When clicking the button, the view switches to the hunting view to investigate a potential interferer.

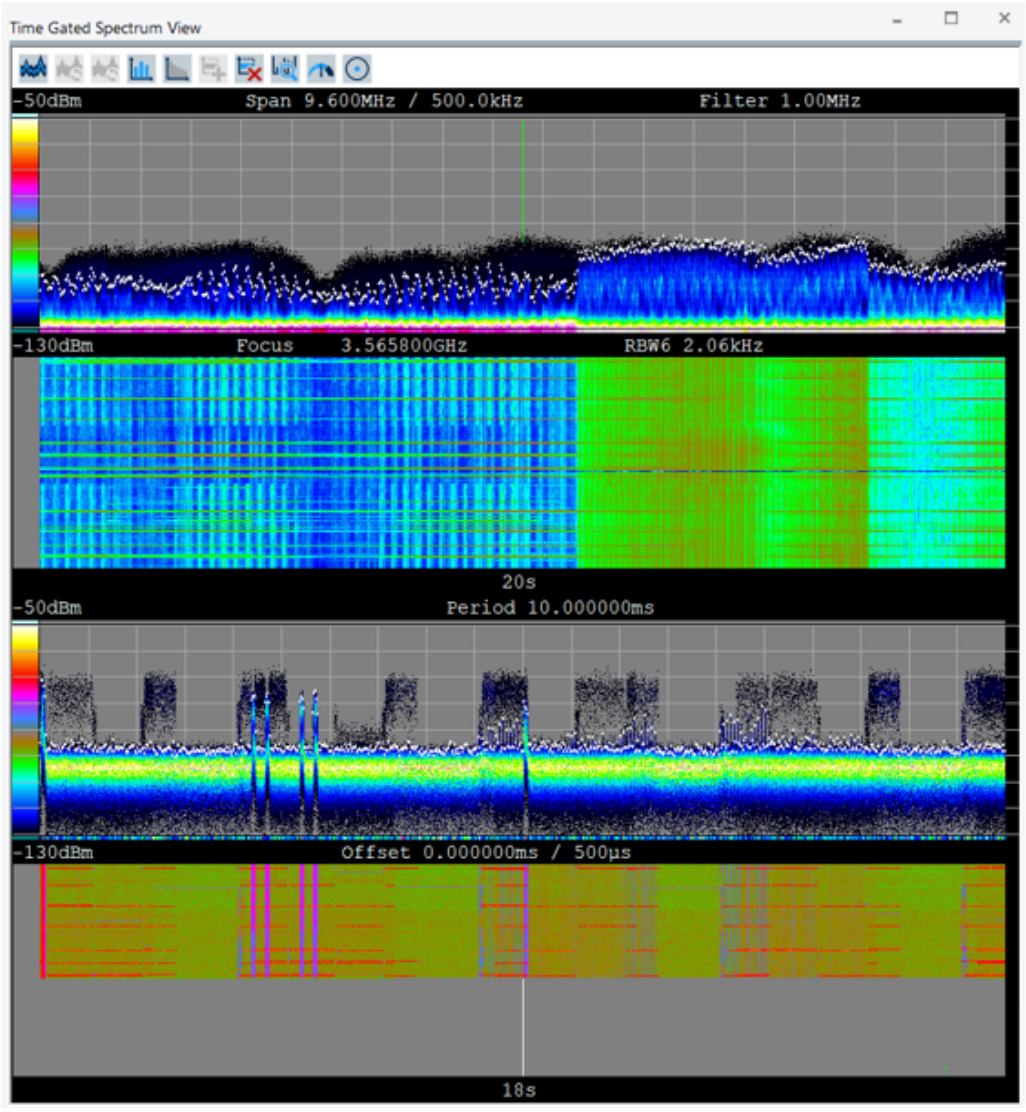


Figure 4-158: Time gated spectrum hunting view

The screenshot of the hunting view shows in the upper part that the spectrum is reduced to 9.6MHz. The focus is set to the signal on the right side displayed in the panoramic view, thus the focus frequency has changed. In the lower half of the screenshot, the time gated view is shown with a period of 10ms. All settings can be changed

by clicking them. You can set up the color scale when you click the upper or lower limit. The same approach for setting applies to period and span.

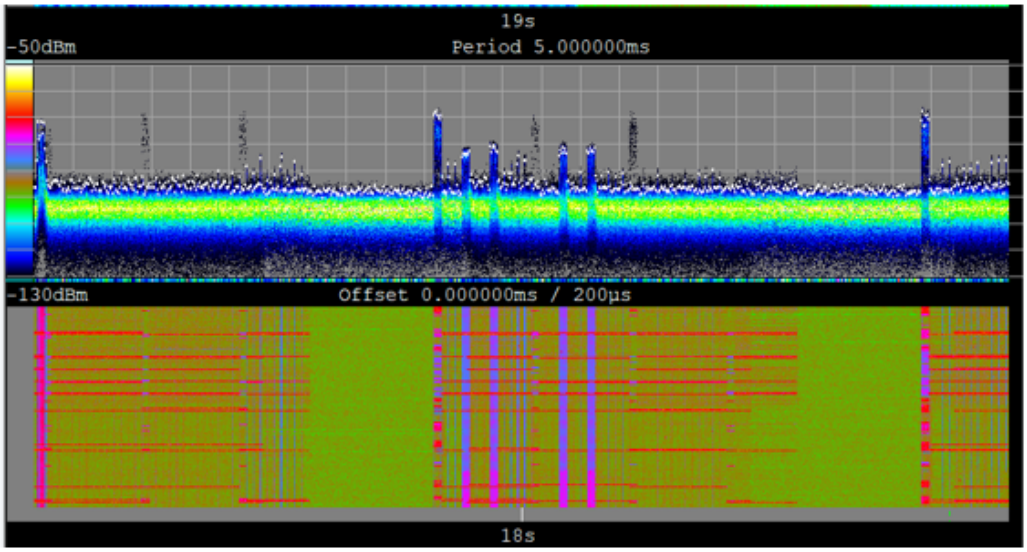


Figure 4-159: Changed color scale in the hunting view

The measurement data of the Time Gated Spectrum scanner is NOT stored to the measurement file as having hudge amount of data by default,

You can activate/deactivate storing the Time Gated Spectrum scanner's measurement data during the R&S ROMES4 measurement, by clicking the save button. If the measurement data is stored to the R&S ROMES4 measurement file, the replay shows the same display mode as during the measurement. It is not possible to change the display mode (panorama or hunting) during replay.

The following table lists the function of the buttons on view's upper left.

Button	Name	Function
	Panoramic view	The wide frequency range gives a good overview. Provides max. 5650 MHz span, spectrum histogram, no time periodic histogram.
	Switch to hunting view	Less frequency range, parallel spectrum and time gate view.
	Reset hunting view	Reset hunting view with frequency and time gate display.
/	Show only frequency view / time gate view	The buttons are applicable only in hunting mode.
/	Waterfall on / off	Toggle waterfall on and off.
	Resize chart	Resize chart after changing the window size

Button	Name	Function
	Change scanner speed	•Reduce the scanner speed to allow the time gated measurements more frontend time.
	Store spectrum data to the measurement file	Toggle recording of the spectrum and time gate views to the measurement file

4.2.14 X-Y graph view

The X-Y graph (or scatter plot) can be used to set two selectable signals in correlation to each other. That is, the value of one signal is used as x value, the value of another signal as y value.

For example, the correlation between RxQual and RxLev can be of interest. This configuration is shown in the figure below.

Note that the quantity of an x-y-pair is shown using the color and the radius of the circle. The larger the radius, the more samples have been found for that pair. Same applies to the darkness of the color. The darker the color, the more pairs are detected.

To calculate these indicators, all pairs found are set in relation to each other, i.e. their quantity is normalized.

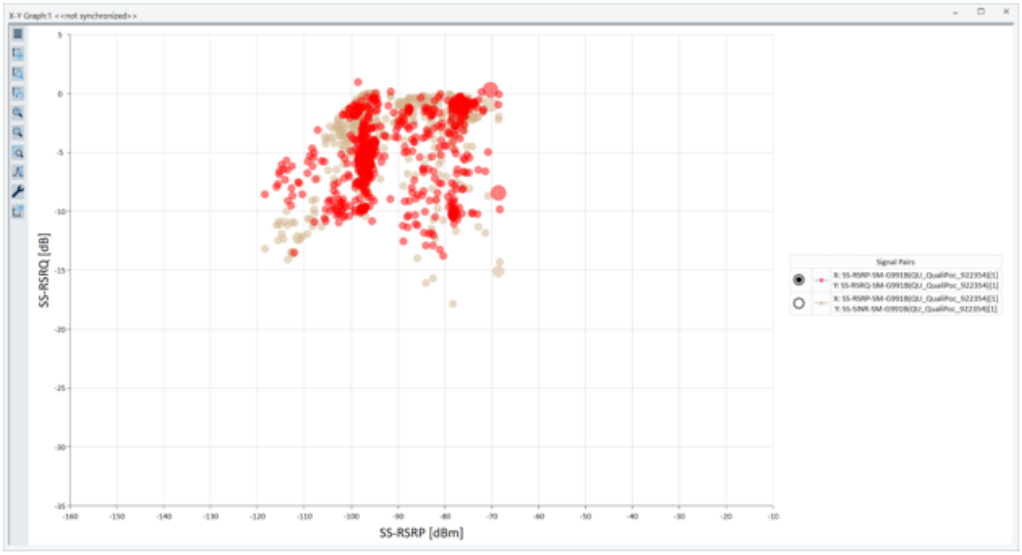


Figure 4-160: X-Y Graph View

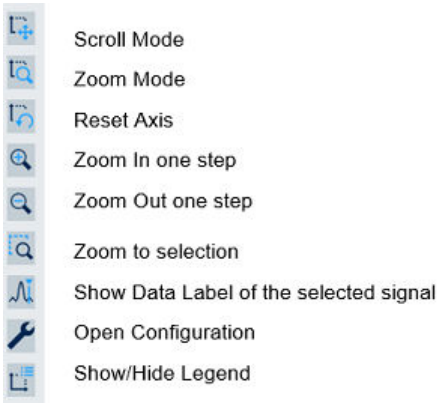
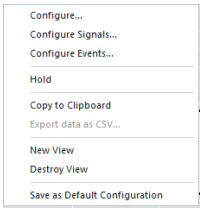


Figure 4-161: X-Y chart buttons

To zoom in and out, use mouse wheel in "Scroll Mode" and the left mouse button to pan.

To zoom in and out, use the left mouse button and ALT + right button, respectively, in "Scroll Mode". Use the mouse wheel to pan the x-axis and CTRL + mouse wheel to pan the y-axis.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.2.14.1 X-Y graph view configuration: values tab

The "X-Y Graph View" configuration selects and controls the signals to be displayed and shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

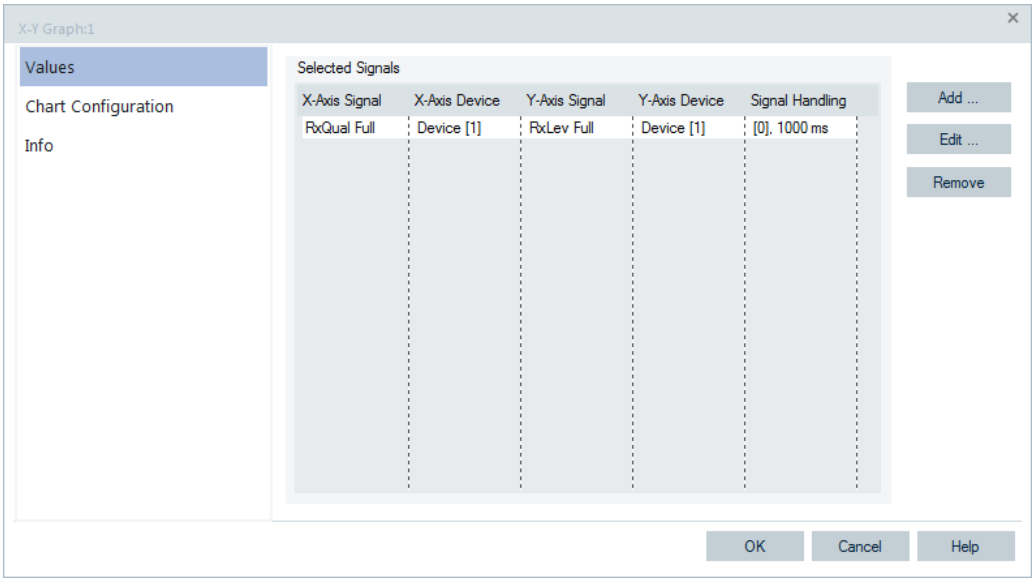


Figure 4-162: X-Y Graph View: Configuration - Values

Selected Signals

The "Selected Signals" table on the "Values" panel shows the configured signals and associated devices of the scatter plot axes.

- "X-Axis Signal"
  List of all signals selected for display on the X-axis.
- "X-Axis Device"
  Associated device of the signal selected for display on the X-axis.
- "Y-Axis Signal"
  List of all signals selected for display on the Y-axis.
- "Y-Axis Device"
  Associated device of the signal selected for display on the Y-axis.
- "Signal Handling"
  This column shows the plot mode number and the selected timeslot.

Available Signals

- "Add"
  This button opens a menu to add the signals available for the X and Y-axes.
- "Edit"
  This button opens a menu to modify the signals available for the X and Y-axes.
- "Remove"
  Removes the complete signal row from the table.

Example:

The example shows selection of the signals to be shown in "X-Y Graph View" and parameters for kind of signal handling and slicing period.

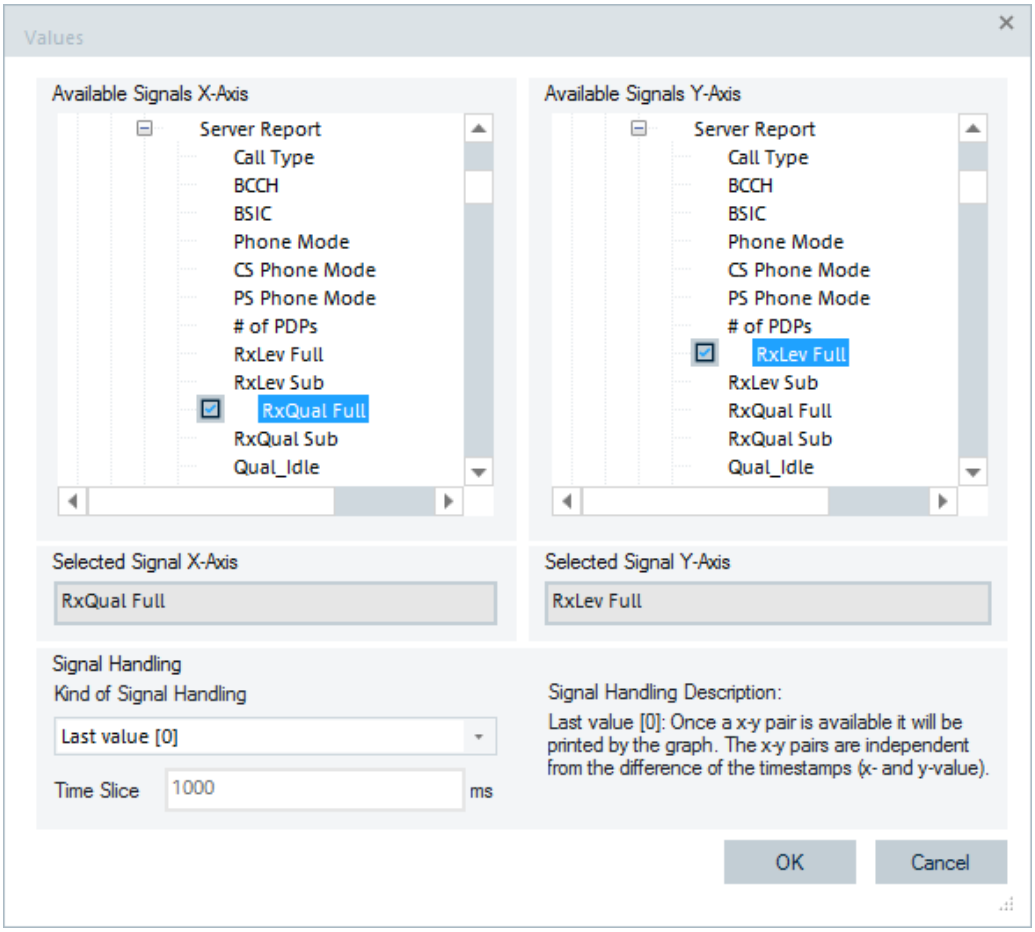


Figure 4-163: Configured signals for display on x- and y-axes

Signal Handling

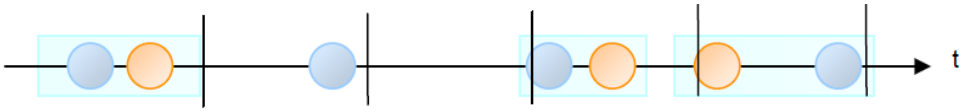
Since many signals cannot be matched directly because they are measured/reported at different points in time, the scatter plot can be configured how to match an x-y pair.

The following signal handling modes are available:

- "Last Value [0]:"
  X, Y values are matched without the need of any time-constraint; the time slice is preset to 1s. Once an x-y pair is available, it is displayed by the graph.

- "Time Slots [1]:"
  X, Y values are matched if both occur within a given time interval. If one signal has a valid value, then a pair is built if the other signal reports a valid value within a specified time range.

- **Equidistant Time Slices (last value)[2]:**
  The time axis is split in time-slots of the same size. If in each time-slot at least one value for each X and Y signal is found, then this pair is used as input for the graph. Only one pair per time-slot is built and the most-recent values for each signal are used. The length of the time slot is defined by the time slice value entry field.



- **Equidistant Time Slices value)[3]:**
  Similar to the mode [2] above, but all reported values in a time-slot for one signal are averaged. The length of the time slot is defined by the time slice value entry field.

4.2.14.2 X-Y graph view configuration: chart configuration tab

The "Chart Configuration" page lets you define the colors of the curves and the scaling for x- and y-axes.

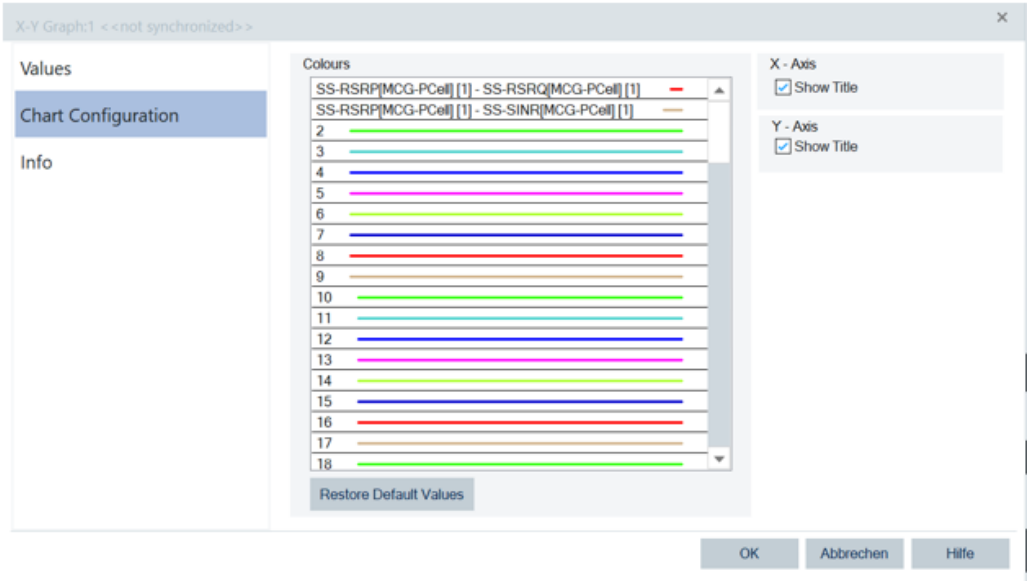


Figure 4-164: Colors configured for SS-RSRP signal pairs

Colors
The colors of up to 199 signal curves can be defined in "ROMES Color Picker" opened if double-click a field of the "Colors" column in the "Color Scale for <variable" > "Settings" section, see Figure 3-119.

The "Restore Default Values" button resets all colors to their default values.

X-Axis/Y-Axis
The axis' ranges are the expected minimum/maximum range as configured in the "Tools" > "Preferences" menu. To select the active signal, use the radio buttons in the legend.

"Show Title" shows or hides the x-axis/y.axis title (only visible if the view window is high enough for the title display).

4.3 Navigation views

The "Navigation Views" lets you visualize measured quantities with valid geographic coordinates and retrieve the geographic coordinates of an individual measured value.

The following navigation views are displayed if hover a mouse over the "View" > "Navigation Views" menu:

- "GPS Info View"
- "Panorama View"
- "ROMESMAP Route Track View"

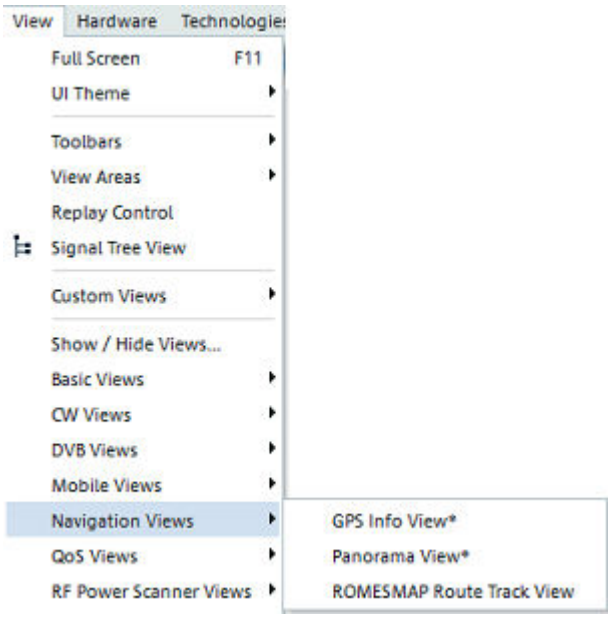


Figure 4-165: Navigation Views

- GPS info view 548
- Panorama view 551
- ROMESMAP route track view 562

4.3.1 GPS info view

R&S ROMES4 supports the GPS, the BeiDou, the Galileo and the GLONASS satellite system as the GNSS.

Valid time and position data is displayed for all available navigation systems. The satellite information (satellite ID and SNR) for up to 20 satellites is included in the "GPS info View". The satellites are sorted according to their SNR.in the view.

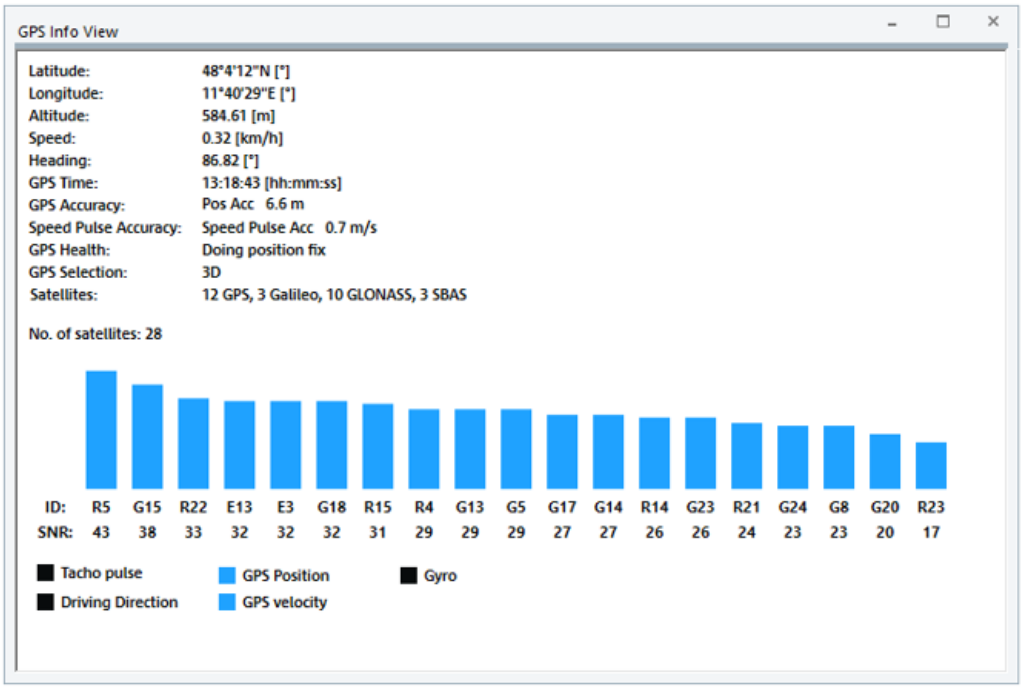


Figure 4-166: GPS Info view

In good receiving situations there can be 40 satellites and more. To differentiate among detected and used GNSS, a character is introduced denoting the used GNSS. The characters which denote GNSS are:

- Bxx stands for BeiDou

- Exx stands for Galileo

- Gxx stands for GPS

Rxx stands for GLONASS

GLONASS and GPS cannot be active simultaneously in µBlox modules generation 7 and lower.

BeiDou, Galileo and GLONASS are available only with NMEA protocol version 4.1 or higher (µBlox modules can be configured to use NMEA 4.1 in the µ-Center).

The "GPS Info View" shows the recorded satellite information, that is, the satellite ID and SNR and the calculated direction and speed of the test vehicle. Compass heading and speed are displayed in a compass and speedometer if the receiver provides these quantities.

For the details about the satellites, hover the mouse over the bars. The ToolTip appears with the information.

The bars are marked with their Ids and the The colors of the bars indicate the following states of a satellite:

- Blue - signal is OK
  - Code Lock on Signal
  - Code and Carrier locked
  - Code and Carrier locked, receiving 50 bps data
- Yellow - signal is not usable
  - Signal detected but unusable
  - Channel is searching
- Red - Error on channel

If the R&S ROMES4 measurement setup is equipped with a µBlox satellite receiver, the additional Car Sensor Info is shown in the "GPS Info View" as black/blue squares (LEDs) below the bars.

The µBlox unit is supported, but it is not available from Rohde & Schwarz. The LED is blue, if the car sensor is available.

The squares (LEDs) indicate the status of the associated elements. The LEDs remain black until the first status has been arrived.

LEDs "GPS Position" and "GPS velocity" change to blue if valid longitude / latitude and speed data is available. In case of configuration with ADR (configuration ADR car sensors connected is enabled), the remaining LEDs may change to blue. Otherwise, these LEDs are black.

The calibration statuses are shown for an ADR configuration. Usually, the status display starts with "In Progress", the next status is "Coarse Calibration". The best status is "Fine Calibration". This status is not always permanent. During improvement, the status may fall back to coarse.

The calibration status related to pulses is shown. It changes from 'In Progress' to 'Coarse Calibration' and to 'Fine Calibration' after a while of driving.

LED "Tacho pulse" changes to blue, when sensor data arrives.

LED "Gyro" remains black as long as the calibration of the Gyro has not started. It changes to blue when the calibration begins.

LED "Driving Direction" changes immediately to blue, as sensor data is available. It shows the result forwards or backwards.

Latitude / Longitude / Altitude

Shows the geographic coordinates of the current measurement point.

GPS Time / GPS Accuracy

Shows the Universal Time Coordinated (UTC) or Universal Transversal Mercator (UTM) projection of the current measurement point and the position accuracy.

GPS Health

Shows the operating conditions of the satellite receiver. The condition messages are, for example, "Doing position fix", "No usable satellite", "Only 1 satellite" and so on.

GPS Selection

Shows the validity of the current results. The following status messages are possible:

- **2D GPS**
  Data with valid longitude and latitude coordinates
- **3D GPS**
  Data with valid longitude and latitude and altitude coordinates
- **2D DGPS**
  Data with valid longitude and latitude coordinates, only with DGPS (differential GPS) receiver
- **3D DGPS**
  Data with valid longitude and latitude and altitude coordinates, only with DGPS (differential GPS) receiver
- **DR**
  Dead Reckoning, only if provided by GPS receiver
- **GPS + DR**
  Both GPS and Dead Reckoning used for highest accuracy, only if DR is provided by GPS receiver

Satellites

Shows how many satellites per GNSS technology are available in addition to the total number of detected satellites. The detected satellites are marked with their IDs. The bar graphs show the relative quality of the received GNSS signals.

4.3.2 Panorama view

The "Panorama View" visualizes the panorama measurement. The purpose of panorama measurement is a polar measurement on a fixed place.

Panorama measurements with a normal antenna are performed in manual mode. The user is asked to direct the antenna to a given direction.

The R&S HE300 directional antenna makes it possible to measure power signal dependent on the direction. In fact, the power signal measurement results of an R&S scanner or receiver are paired with the direction information from the R&S HE300 to get the polar measurement.

For some R&S HE300 details, see Chapter 6.6.1.6, "R&S HE300 GPS compass", on page 2080 and refer to "R&S HE300 User Manual".

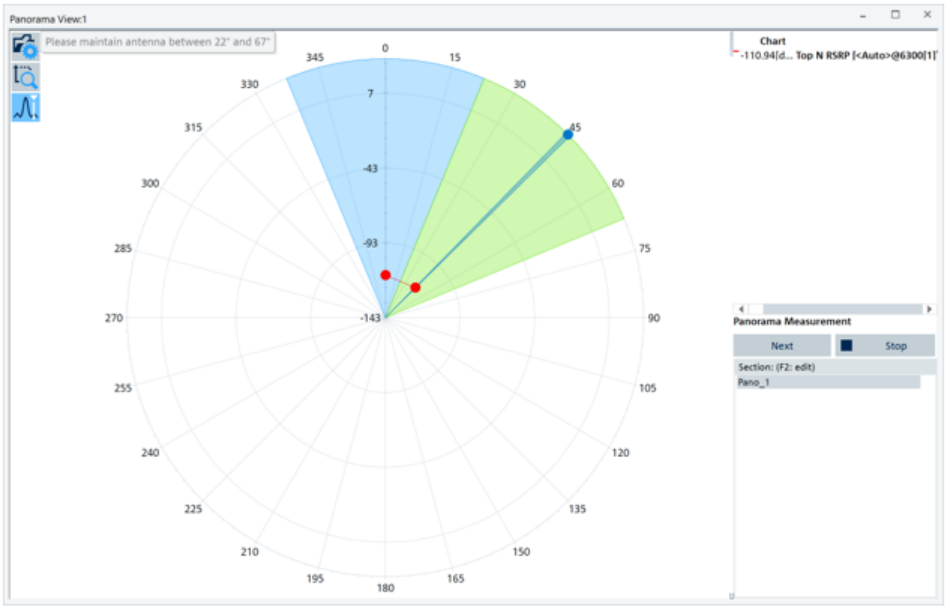


Figure 4-167: Panorama view, an example

4.3.2.1 Panorama view details

The polar chart is divided into segments. The results whose angles fall into one segment are assigned to the middle of a segment. A result in the polar chart is the averaged result of the incoming measurement results from a signal for a certain segment. If the unit is dBm or dB, a conversion dBm -> mW -> averaging -> dBm is performed.

The segments which are currently measuring are colored green. Blue is used to color the already measured segments. The blue marker in the view is the automatic antenna or current segment marker.

The tool bar on the top left-hand side of the view contains three buttons.

Table 4-4: Tool bar buttons

Button (Icon)	Meaning and function
	"Open Configuration" - if clicked, opens the configuration page.
	"Zoom to fit on/off" - toggle between the expected range of the signal and zoom to fit.
	"Heading Marker on/off" - show/hide the marker of the chart.

The marker shows the actual angle of the compass of the directional antenna. Showing the angle helps positioning the antenna in the wanted direction. The marker is visible for all panorama modes, not only the automatic mode with electronic compass.

There is the "Chart" on the top right-hand side of the view. It lets you add or remove signals. It shows signals that are currently measuring and the measurement results. Double-click a signal's name grays the line and hides that signal.

The "Panorama Measurement" list on the low right-hand side, shows the existing measurements. The associated "Start" /"Next" and "Stop" buttons allow the panorama measurement to start/contine or stop.

Whenever a panorama measurement is started/stopped, an event is thrown.

Enable "Start Panorama Measurement"/"Stop Panorama Measurement" for the notification of these events in wanted views, like shown in the following figures.

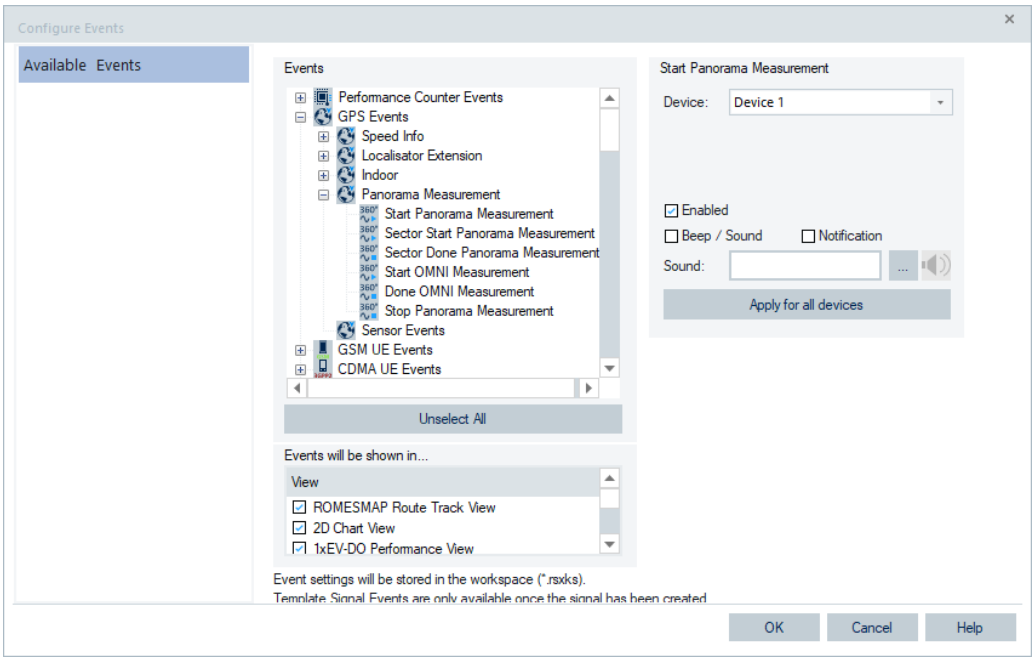


Figure 4-168: Panorama view - configure events

In that way, whenever a panorama measurement is started or stopped, a message is written in the Event View and General Status View.

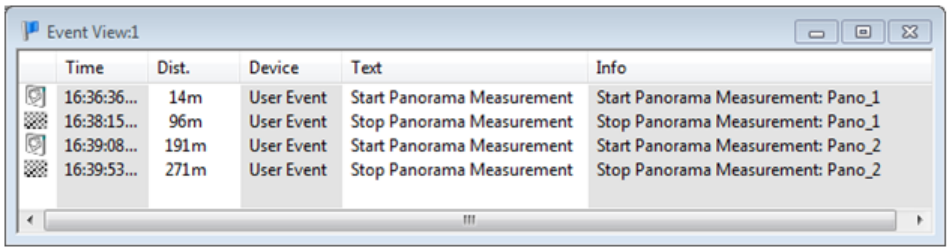


Figure 4-169: Panorama measurements event view

To meet the LEE criteria, the device must not exceed the Lee speed. If the driven speed is more than the Lee speed, an overspeed info is written to the "General Status View".

If the speed falls below the Lee speed, an overspeed end info is written.

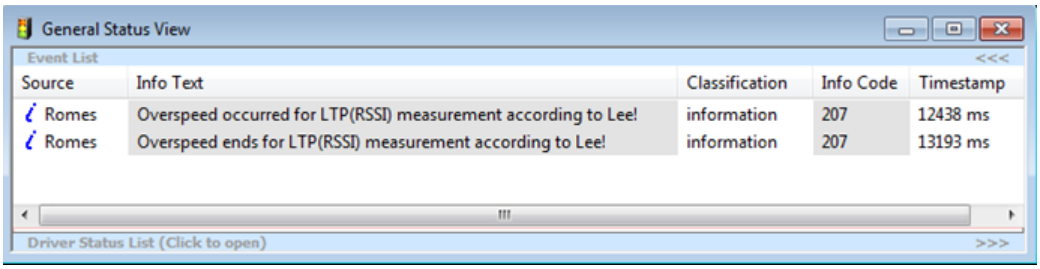


Figure 4-170: Overspeed occurred for LTP(RSSI)

If there is a valid position given from an existing GPS, a"Start Panorama Measurement" button appears in the "ROMESMAP Route Track View".

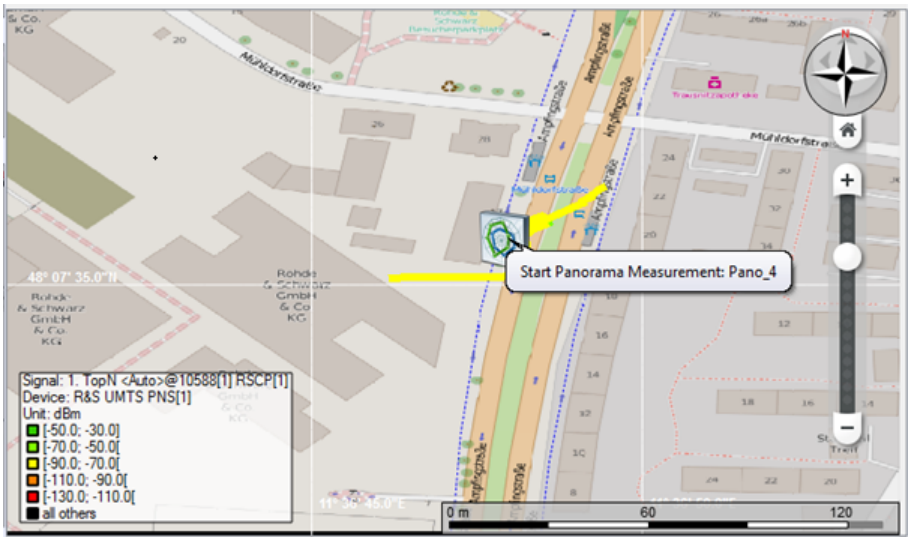


Figure 4-171: Start Panorama Measurement

The button appears in the view only if the position is valid.

Direct the antenna in the given direction at the panorama measurement with normal antenna, which supposes manual mode.

At ASCII export, it is important to know which measurement values belong to which direction. For panorama measurements in manual mode, the event Panorama Measurement: Next Manual Direction tells which direction angle is applied.

```
[DESCRIPTION]
Timestamp [hh:mm:ss.ss]
Events
TETRA Scan\TOP N Pool 1\1. TOP N Pool 1 TETRA Power[1], 1. TOP N Pool 1 TETRA Power[1][#1] [dBm] : [1]
TETRA Scan\TOP N Pool 1\2. TOP N Pool 1 TETRA Power[1], 2. TOP N Pool 1 TETRA Power[1][#1] [dBm] : [1]
TETRA Scan\TOP N Pool 1\3. TOP N Pool 1 TETRA Power[1], 3. TOP N Pool 1 TETRA Power[1][#1] [dBm] : [1]

[DATA]
13:46:25.124    ?   -96.13  -96.59  -103.22
13:46:25.591    ?   -96.15  -96.90  -102.52
13:46:25.945    ?   -96.06  -97.09  -102.88
13:46:26.403    ?   -96.03  -96.78  -103.19
13:46:26.801    Start Panorama Measurement: Pano_1_CL 1x Pano15Grad ?   ?   ?
13:46:26.801    Panorama Measurement: Next Manual Direction: 0.0    ?   ?   ?
13:46:27.110    ?   -95.72  -95.98  -102.47
13:46:27.569    ?   -95.53  -96.25  -102.90
13:46:28.033    ?   -95.92  -96.76  -102.76
...
13:46:51.383    ?   -96.35  -97.30  -102.96
13:46:52.081    ?   -96.73  -97.29  -102.92
13:46:52.549    ?   -96.57  -97.45  -102.78
13:46:53.016    ?   -96.25  -97.02  -103.09
13:46:53.197    Panorama Measurement: Next Manual Direction: 15.0   ?   ?   ?
13:46:53.601    ?   -96.27  -96.69  -103.64
13:46:54.069    ?   -96.48  -97.15  -102.90
13:46:54.642    ?   -96.37  -97.08  -102.71
13:46:54.993    ?   -96.20  -96.63  -102.84
...
13:46:58.020    ?   -96.15  -97.35  -102.90
13:46:58.593    ?   -96.88  -97.40  -103.08
13:46:58.906    Panorama Measurement: Next Manual Direction: 30.0   ?   ?   ?
13:46:58.943    ?   -96.62  -96.87  -102.58
13:46:59.524    ?   -96.48  -97.47  -102.54
...
13:47:32.649    ?   -97.02  -97.48  -103.51
13:47:33.116    ?   -96.53  -97.00  -103.22
13:47:33.523    Stop Panorama Measurement: Pano_1_CL 1x Pano15Grad  ?   ?   ?
13:47:33.576    ?   -96.66  -96.99  -103.09
13:47:34.038    ?   -96.52  -97.27  -103.00
```

Figure 4-172: Exporting data gives segment info

To get this information, check "Export Events" in the "ASCII export" > "Settings" page, see Figure 7-9.

"Panorama Measurement: Next Manual Direction" events are not available at automatic mode, where an electronic compass gives the compass direction.

4.3.2.2 Configuration of panorama view

1. Select the "Panorama View" item in the "View" > "Navigations View" pop-up menu.

   The "Panorama View" window appears.

2. Click with the right-mouse button any point in the view's window.

   The list of commands is displayed.

3. Select the "Configure" command.

   The configuration page opens, showing the "Values" page.
   The "Values" page lets you add or remove signals from the panorama view.
   The "Chart Configuration" allows the colors of the signals to alter and restore their default values.

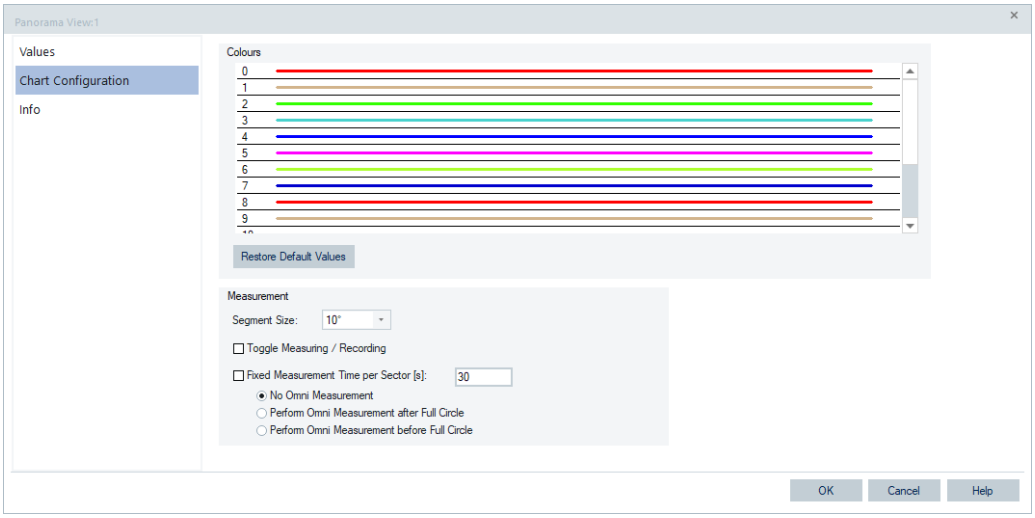


Figure 4-173: Panorama View - configuration

Other possible configurations on this window are:

- "Segment Size"
  The segment size determines the width of a segment.
  The polar chart is divided into segments. Results which angle falls into one segment are assigned to the middle of a segment. Small segments need more measurements and are more difficult to meet.
  If a measurement file is loaded, the combo-box is grayed to prevent from changing,
- "Toggle Measuring / Recording"
  The option helps to prevent unwanted measurement data and large measurement files. Enabling this feature means whenever a panorama measurement is started the measurement mode changes to recording. Whenever a panorama measurement is stopped the measurement mode changes to measuring.
- "Fixed Measurement Time per Sector [s]"
  The option allows you to include an OMNI antenna measurement into the workflow. Also, it is possible to stop automatically the section measurement after a predefined number of seconds.

4.3.2.3 Panorama measurement

Panorama measurement is a section in a R&S ROMES4 measurement, where starting and stopping markers cover the panorama measurement.

Ideally, the directional antenna R&S HE300 is turned slowly in a 360° circle to cover all angles.

Within a R&S ROMES4 measurement, there can be several panorama measurements. From the scanners point of view, those measurements are just a long measurement. With a direction/location information and the panorama start/stop markers, it is possible to extract panorama measurement.

Panorama curve drown from end to start point

Doing the panorama measurement groups the measurement data in several segments in a polar diagram.

The circle is closed if all segments contain measured data. Stopping a panorama measurement after some segments are measured does not result in a closed curve.

The feature "Panorama curve drown from end to start point" corrects previously mentioned drawback.

Panorama measurement requires the option ROMES4PAN. Replaying the panorama measurement is always possible, no option is needed.

Panorama measurements with R&S HE300 Var03

Having a R&S HE300 Var03 which gives direction information, the panorama measurement is assumed to be in automatic mode. However, the user has to start the R&S ROMES4 measurement.

Without starting R&S ROMES4 panorama measurement, the actual signals are filled and an enabled marker shows the actual direction.

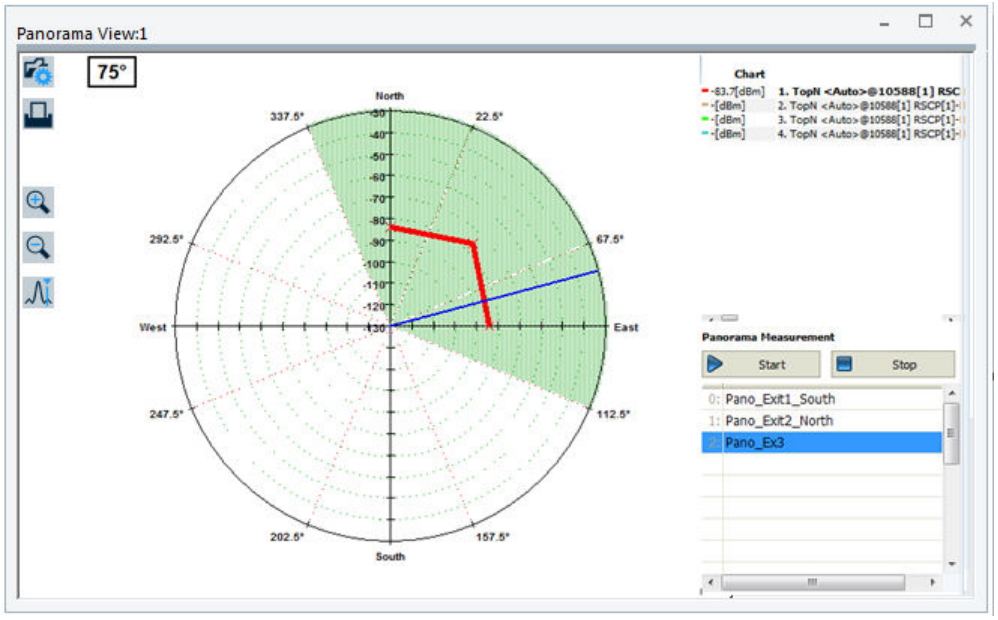


Figure 4-174: Panorama measurement with R&S HE300

Start the R&S ROMES4 panorama measurement by pressing the "Start" button. Each segment that has measurement data is marked as a green pie. The marker helps to direct the antenna to the next segment, turning the R&S HE300 in a 360° circle until each segment becomes green.

If a single segment was not hit, direct to that direction to complete all segments.

Stop the panorama measurement by button "Stop".

A panorama measurement is automatically named to Pano_x, where x = 1,2,3… Click the "Pano_" text to alter the name. The text is written to a `*.rscmd` file.

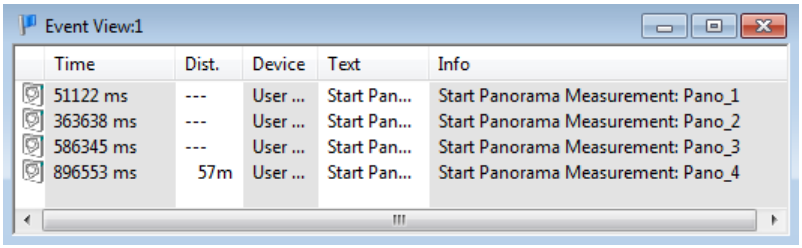


Figure 4-175: Panorama measurement events

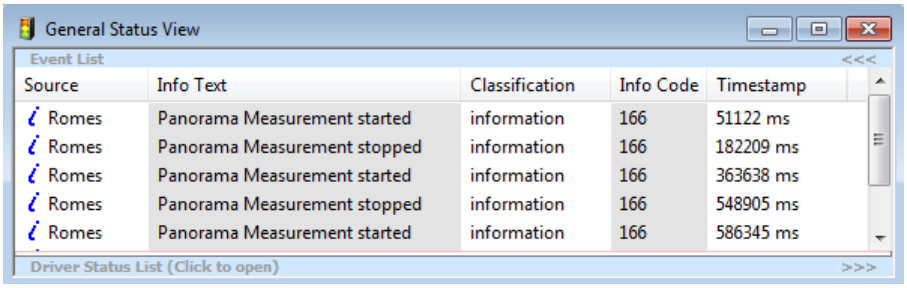


Figure 4-176: Status of panorama measurement

Either stop the R&S ROMES measurement now or proceed to the next wanted location and do another panorama measurement.

Panorama measurements without R&S HE300 Var03

This section considers the usage of any directional antenna and magnetic compass instead of the R&S HE300 device.

As in this case the R&S HE300 compass is not detected, the panorama measurement is assumed to be in manual mode.

The manual mode means lack of direction information. The panorama measurement indicates just a segment to which you have to point the direction antenna.

Nevertheless, R&S ROMES4 panorama measurement has to be started.

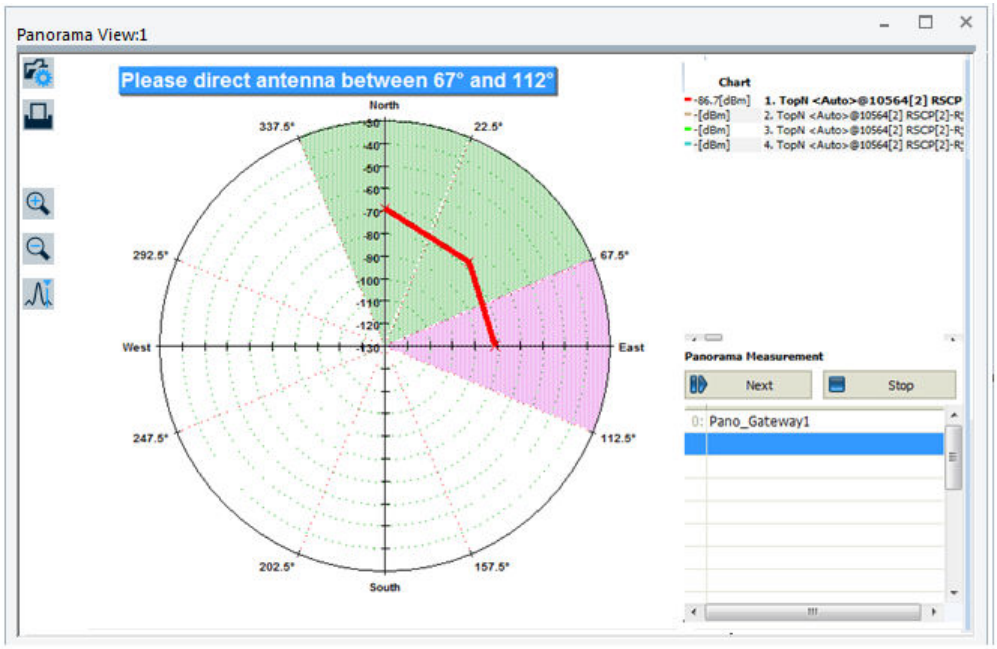


Figure 4-177: Panorama measurement without R&S HE300

Without starting the measurement, the actual signals are filled. No marker is shown by default.

Start the panorama measurement by clicking the "Start" button. The first segment is marked as a violet pie. A violet pie denotes the segment where the antenna needs to be directed.

In parallel, the order "Please direct antenna between 67° and 112°" is displayed and the "Start" button changes to "Next". Turn the directional antenna in that segment. A segment that had measurement data in the past is marked as a green pie, while the actual one is violet.

As the antenna has to be turned manually to the wanted segment, measurement in the polar chart is omitted for 3s. The "Next" button is grayed for that time.

Wait at least until a measurement value is shown in the polar chart. After some seconds, press "Next". The next pie gets violet and a new order asks for turning the antenna into that new segment. Proceed in this way until each segment becomes green. There is no chance to go back to an already measured segment.

Stop the panorama measurement clicking the "Stop" button.

A panorama measurement is automatically named to Pano_x, where x = 1,2,3… Click the "Pano_text" to alter the name. The text is written to the `*.rscmd` file. Either stop the R&S ROMES4 measurement now or proceed to the next wanted location and do another panorama measurement.

Location time probability of RSSI measurements

Location Time Probability of RSSI measurement (further in text LTP(RSSI)) is the probability of measuring a certain number of RSSIs over the specified time.

LTP(RSSI) measurement is only implemented for RSSI from the TETRA scanner. No other technology or other power is supported. For configuration, see "TETRA scanner Top N settings" on page 374 and "TETRA scanner signals settings" on page 382.

RSSI of each TETRA carrier is put into an array and sorted for the power. Taken an n-th value is the n-th percentile of LTP of RSSI. According to the LEE criteria, power values are sampled near the wavelength of the carrier to reach a certain confidence interval.

The LEE criteria recommends 36 measurements in 40 wavelength. Following this criteria, the measurement tries to reach a minimum of 36 RSSI measurements in 40 wavelength.

LTP calculation

The LTP calculation considers, according to LEE requirements, the following LEE parameters:

- **Lee Speed**
  Maximum driving speed in [km/h] the device drives, whereby the Lee criteria (36 RSSI measurements in 40 wavelength) is fulfilled. It is calculated as the ratio between Current Analysis Measurement Rate and carrier frequency. If the device goes less the Lee speed, more RSSIs are taken into the LTP calculation
- **Lee Distance**
  Distance in [m] of 40 wavelength; it is calculated as 40xspeed of light/carrier frequency.
- **Lee Time**
  Time in [s] needed for minimum 36 measurements within 40 wavelength. It is calculated as 36/Current Analysis Measurement Rate.

Within the Lee Time, all RSSIs are put into a CDF.

Taken the x percentile of Location Time Probability of RSSI is an n-th value of sorted RSSI. It is named the LTPxx(RSSI), for example, LTP95(RSSI) means the 95% percentile of LTP(RSSI).

At the calculation, each incoming RSSI from one carrier measured within the Lee Time is put into an array which is sorted by RSSI. The RSSIs, which exceed the Lee Time are removed. If there are enough RSSI measurements (>=36) in the array, a RSSI for a certain percentile can be requested and displayed. Depending on the TETRA scanner measurement settings, the Current Analysis Measurement Rate differs in a tremendous way and affects the Lee Time and Lee Speed. See the following tables as an example of LEE parameters dependency of Current Analysis Measurement Rate for 400MHz frequency.

Current Analysis Meas Rate[1/s]	1	2	5	10	15	16	18	20
LEE distance[m]					30			

Figure 4-178: Lee distance for different Analysis Measurement Rates

LEE time[s]	36	18	7,2	3,6	2,4	2,25	2,0	1,8
LEE speed[km/h]	3	6	15	30	45	48	54	60

Figure 4-179: Lee Time versus Lee Speed

4.3.2.4 Exporting panorama measurement data

Having a panorama measurement, it is possible to export the data. Panorama measurement values have associated exported degrees.

Click with the right mouse button within the "Panorama View" area to open the context menu. Select "Export data as CSV". The command exports all panorama measurement data into a `*.csv` file. It is possible to specify name and directory.

Export of Panorama Measurement								
Measurement file:		D:\...\2017-10-23_13-58-55.P9.Pano1_3Seg_45Grad.rscmd						
[DESCRIPTION]								
	[1]	1. TopN TETRA Power[1][#1]-R&S TETRA Scanner (TSME)[1]						
	[2]	2. TopN TETRA Power[1][#1]-R&S TETRA Scanner (TSME)[1]						
Panorama Measurement:		Pano_1_Railway_North						
	Signal	0°	45°	90°	135°	180°	225°	270°	315°
	[1]	-99.00	-98.20	-97.78	-97.65	-97.23	-98.01	-99.89	-99.90
	[2]	-100.73	-99.70	-99.02	-98.90	-98.60	-99.66	-100.50	-100.31

Figure 4-180: Exported degrees for measured signal

This measurement data is the averaged data for a signal which falls into a certain segment. To see the raw data, use the ROMES ASCII Export.

4.3.2.5 Replaying panorama measurements

The measurements fill the "panorama measurement list" while loading a R&S ROMES4 measurement containing the panorama measurements.

Double-click the line to fill the polar diagram.

Replaying the `*.rscmd` file, fills all the signals to polar chart.

The polar chart is filled with the final averaged results when reaching the start panorama measurement. The line of the active panorama measurement is marked.

There is no more update. The contents of the polar chart is erased by reaching the stop of a panorama measurement.

During replay, the "Start"/"Stop" buttons are invisible.

To alter the panorama measurement name, click the "Pano_text" and edit. The new name is written to the `*.rscmd` file.

Click the Start Panorama Measurement icon in the "ROMESMAP Route Track View" to fill the polar chart of the "Panorama View".

4.3.3 ROMESMAP route track view

The ROMESMAP Route Track View functionality supports 5G NR, NB-IoT, LTE, GSM, UMTS, CDMA2000 and TETRA technologies.

The "ROMESMAP Route Track View" page visualizes a measurement tour and the behavior of the measured signals. For this task, it uses a projection onto a background map that can be loaded and positioned into the view. Events and specific technology features can be visualized.

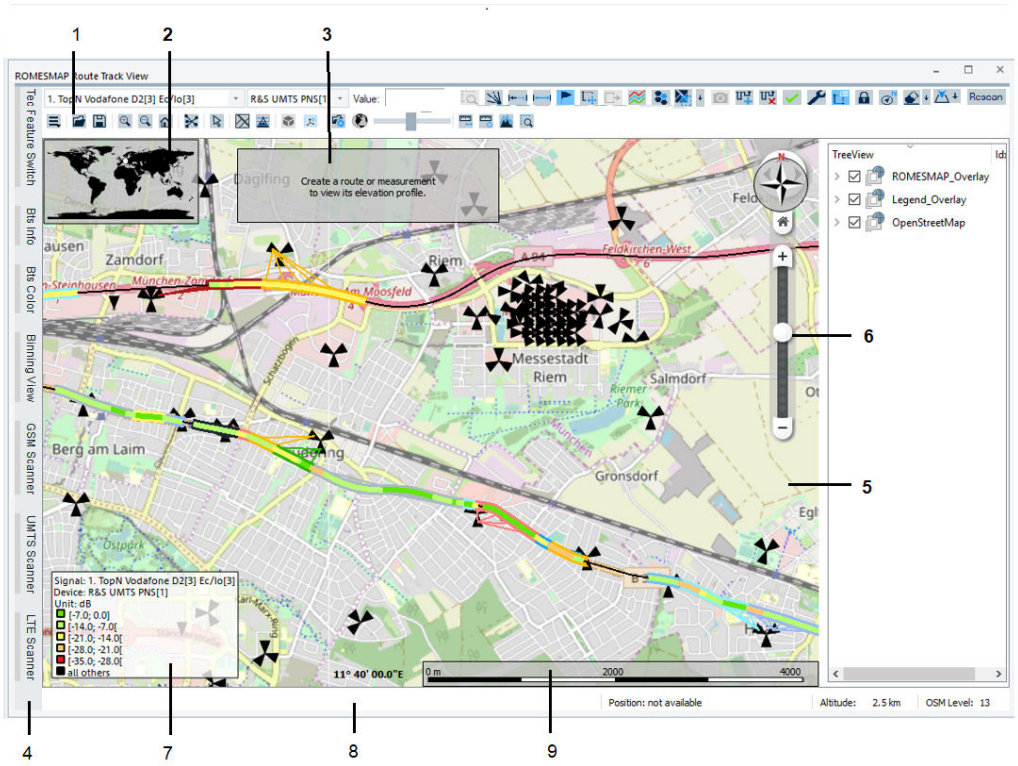


Figure 4-181: ROMESMAP Route Track View

① = Toolbar
② = Overview Map: Shows a world map and the placemark shows the location of the current map .
③ = Elevation Profile: Creates a route or measurement to view its elevation profile.
④ = Docking bar
⑤ = Map view
⑥ = Navigation: Provides the map view with additional navigation possibilities like scroll, zoom and go home.
⑦ = Legend, see Legend.
⑧ = Status bar: Contains the information on position of the cursor, the altitude over the map and the elevation or zoom level value, see Status bar.
⑨ = Scale bar: Shows the current scale area

The view includes the possibility to show the neighbor cells of the selected cell, see "Neighbor cell display" on page 580.

The ROMESMAP Route Track View functionality provides a common map view interface to a range of map servers, for example, SRTM, PCMAP or R&S Map server. The maps and map servers can be ordered from R&S. For a complete list, ask the R&S customer support or see the R&S ROMES4 data sheet.

The ROMESMAP Route Track View functionality integrates the redesigned R&S ROMES4 "MapView" component. This component optimizes the work with tiled maps (tiles) like OpenStreetMap.

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4.3.3.1 Examples of supported scanners

The "ROMESMAP Route Track View" offers the mentioned features for evaluating the coverage of the 5G NR signals measured by a 5G scanner as it offers them for other 3GPP RATs. The evaluation is based on a beam-based Top N pool. Only the beam-based Top N pools are listed in the combo-box.

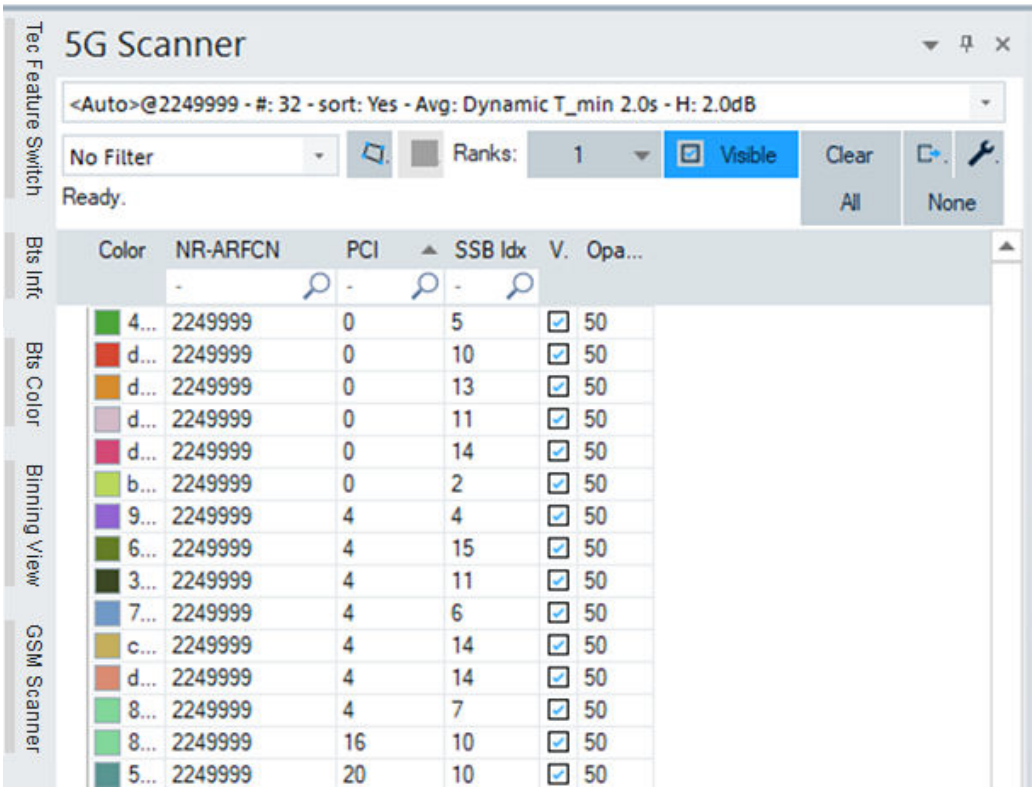


Figure 4-182: 5G NR beam-based TopN pools

If none of beam-based Top N pools are configured, a corresponding message is displayed.

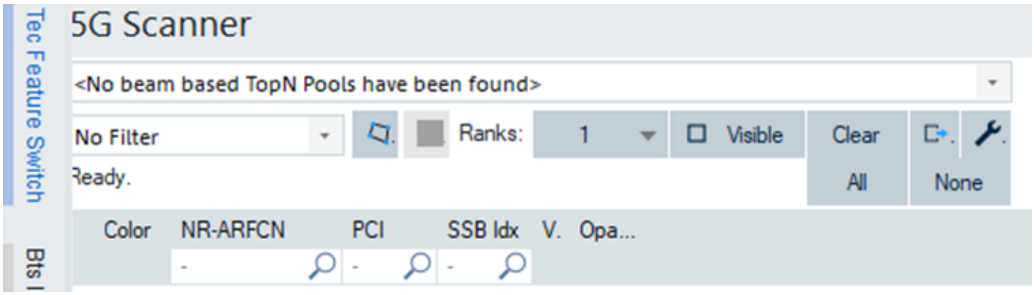


Figure 4-183: No beam-based TopN pools case

All beams of the selected Top N pool are listed in a "5G NR TopN Scanner". You can filter the list by NR-ARFCN, PCI, SSB-Index and by the geographic polygon-filter.

The displayed values on the map are synchronized automatically with the list. The color of the circles depends on the beam, its size of the Top N decision value (RSRP, SINR or RSRQ). Click the visible button to show the values. It is also possible to show/hide specific beam or change its color.

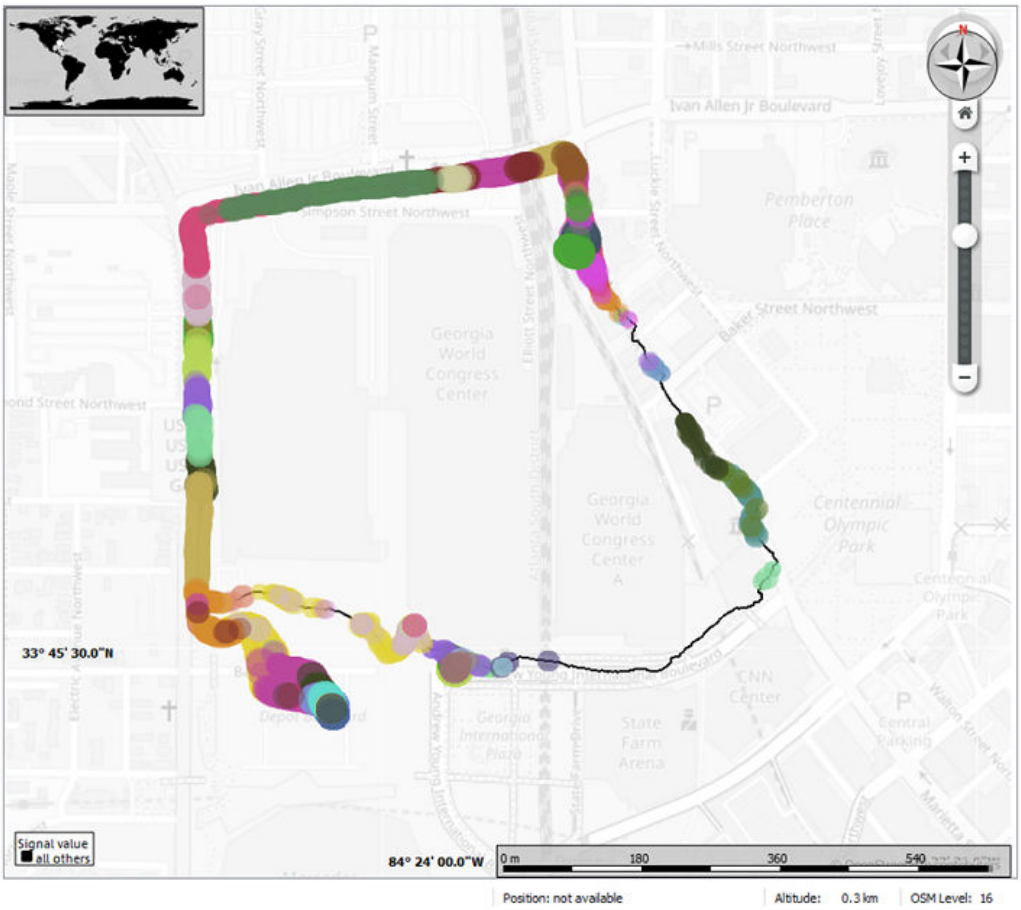


Figure 4-184: 5G NR scanner - ROMESMAP Route Track View

All layers related to NB-IoT scanner (best route underlay, server lines, server highlighting) are also supported with "ROMESMAP Route Track View".

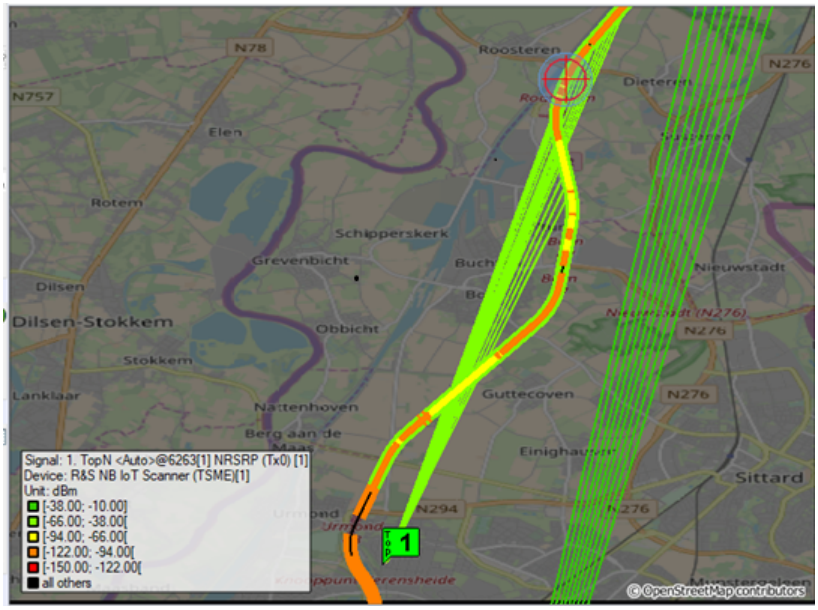


Figure 4-185: NB-IoT scanner - ROMESMAP Route Track View

4.3.3.2 View area

The entire view area is horizontally split into three parts.

On the left side of the view area, there is a string of switches.

- Toolbar (top section), see the "Toolbar" on page 583
  Contains combo boxes and a toolbar to modify functions for the map view.
- Middle section
  The middle section is vertically split into three parts: docking bar and its dialogs if selected, "Map View" and "TreeView".
  - "Docking bar" on page 567 (left section)
    The switches of the docking bar enable the fast access to the visibility of BTS info, Bts color and technology-specific features.
  - "Map View" on page 573 (middle section)
    "Map View" shows signal legend, BTS symbols, signal route, signal route underlay, lines to best server, event symbols and cursor symbol. It is organized in layers. The signals along a measurement tour, event symbols, base stations, and arbitrary bitmaps of the explored area can be projected onto background map. Backgrounds maps are always shown together with a length scale.
  - Tree view (right section)
    The "TreeView" shows all the loaded layers of the "ROMESMAP Route Track View". The overlays, layers, objects and the corresponding properties can be shown, modified and saved via this view. The tree entries can be made visible or invisible on the map view. To show/hide an overlay, a layer or an object simply add/remove the related check box marker of the entry. See also Chapter 4.3.3.6, "Maps menu", on page 606.
- Status bar (bottom section)

Shows the position of the cursor in selected format, the geographic coordinates of the current measurement point and the current scale factor.

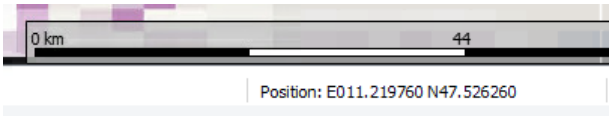


Figure 4-186: Status bar - current mouse position

A zoom level indicator showing a value after a zoom operation is on the right from the position data. The zoom value is a relative value which must be interpreted in the context of the currently loaded map.
The current OpenStreetMap zoom level is shown in the following figure.

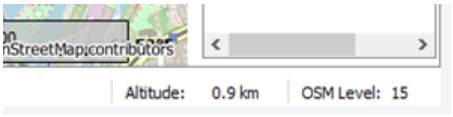


Figure 4-187: Status bar - current OSM zoom level

If an elevation shading layer is active, then the elevation value is shown in this place.

Docking bar
The docking bar assumes switches on the left border of the "ROMESMAP Route Track View". The switches enable fast access to the dialogs which show BTS info, BTS color, scanners and the parameters included in the "Tec Feature Switch", like BTS symbols, server lines, best server, position estimator if you click them.

The access to the mentioned dialogs is also possible via the context menu of the "ROMESMAP RouteTrack View".

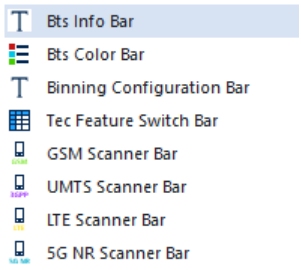


Figure 4-188: Option to open a dialog of docking bar

BTS Info ← Docking bar
"Bts Info" dialog gives the details on BTS configuration parameters like name, BSCI and ARFCN.

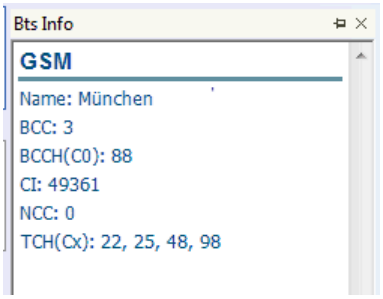


Figure 4-189: BTS info pane

BTS Color ← Docking bar
"BTS Color" shows the color settings of different BTSs.

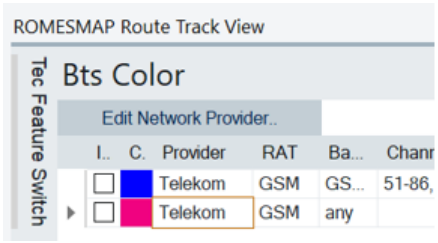


Figure 4-190: BTS color pane

To change the provider's color, click the "Tools" > "Network Provider Database" command.

Instead, use the "Edit Network Provider" > "Edit, Add or Remove Providers" option which offers a shortcut for opening the network provider's dialog. If you select a provider in the "BTS Colors" list, the network provider dialog is scrolled to that provider.

Tec Feature Switch ← Docking bar
The access to the visibility of features like BTS symbols, server lines or position estimation, is centralized in the "Tec Feature Switch" dialog.

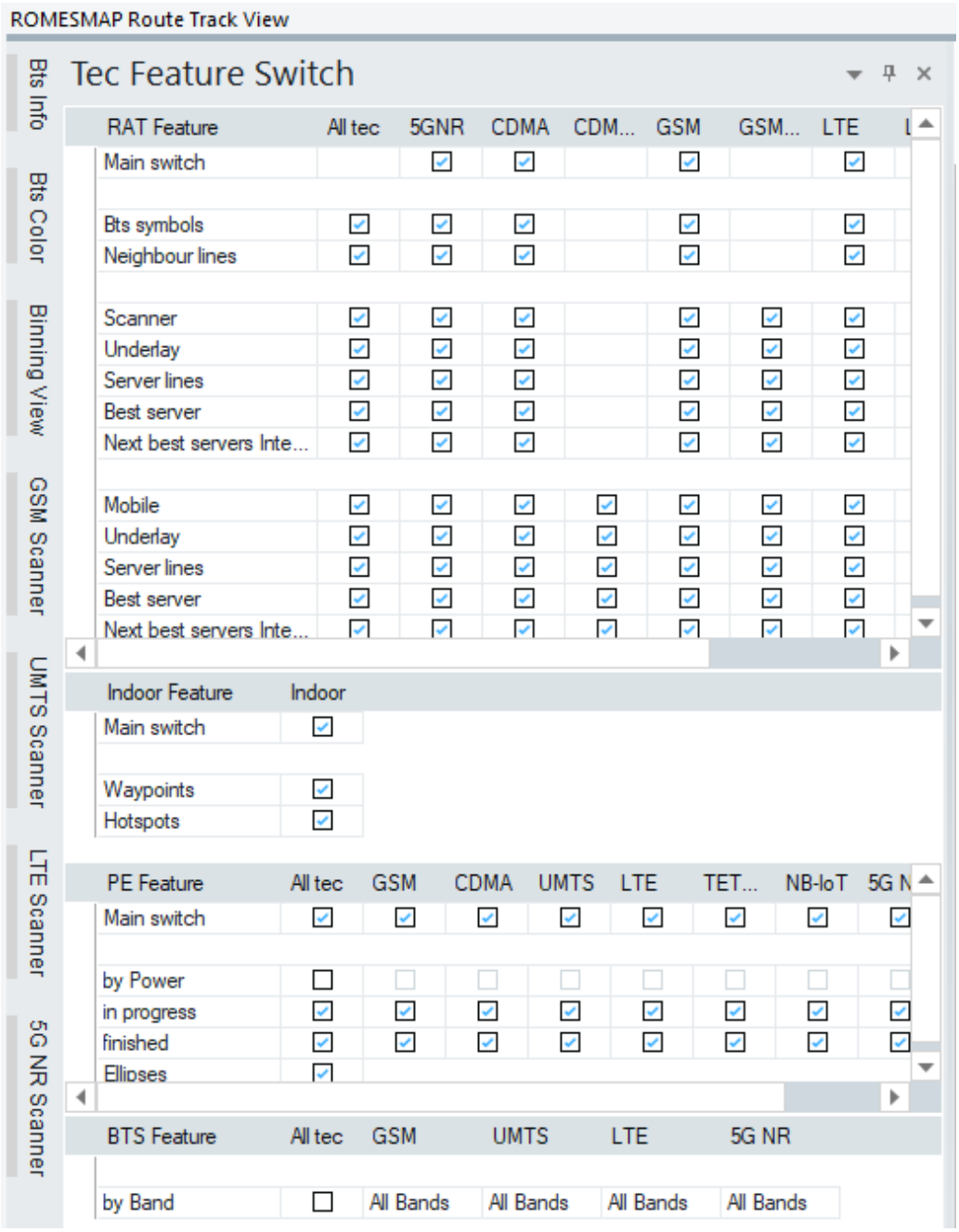


Figure 4-191: Tec feature switches

The upper part of the dialog shows the grid of switches for the visibility of the supported mobile technologies. The lower part shows the switches for the indoor features and the Position Estimator (PE) features.

Besides the already known mobile switches for layer visibility and underlay (etc.) visibility, which were scattered across many different menus and configuration pages, additional switches are inserted:

- Switches for the BTS symbol layers under "RAT Feature"

- Switches for the neighbor lines under "RAT Feature"

- Switches for scanner layers under "RAT Feature"

- Indoor switches "Indoor Feature"

- Position Estimator switches "PE Feature"

- Switch for selectively display of BTS stations filtered by bands "BTS Feature", available for GSM, UMTS, LTE and NR5G.

The dialog itself is a windows control bar and can be opened with the "Tec Feature Switch" button on the left border of the view. Like the other control bars, it can be docked and undocked or automatically opened/closed.

The configuration items are present in the menus and technology configuration pages. The ALT+CTRL keyboard controls are also available.

Description of Tech Feature Switch behavior

For the "RAT Feature" per technology and the "Indoor Feature" switches the following applies:

- If the "Main Switch" is not selected, all individual switches in a column of the technology and indoor features, respectively, are erased. If selected again, the previous setting of individual switches re-establishes.

For the "RAT Feature" switches also applies:

- If a switch under the "All tec" per RAT feature group ("Bts symbols", "Scanner", "Mobile") is not selected, all individual switches for that group are inactive (dimmed).
- If a switch under the "All tec" per single visibility parameter is not selected (for example, "Underlay", "Server lines"), the complete row of individual switches is dimmed, see the following screenshot.

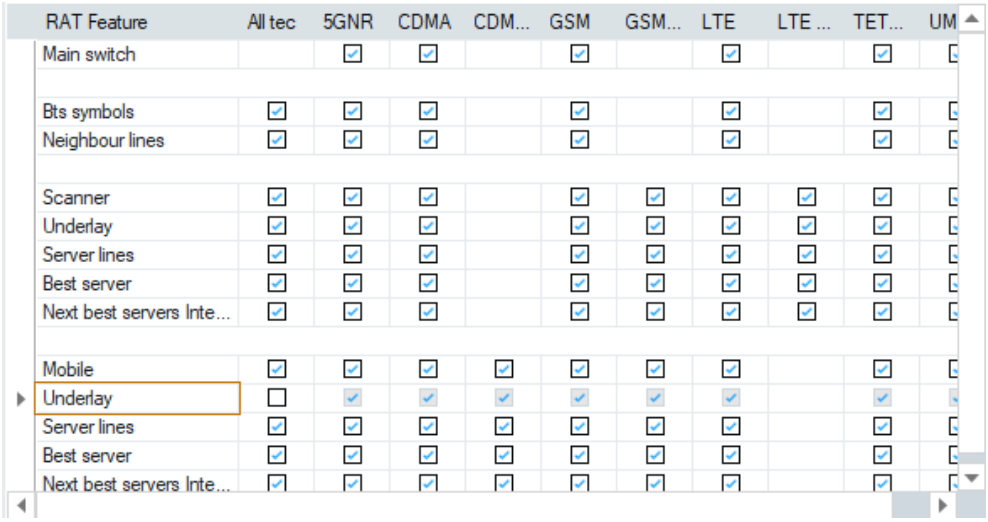


Figure 4-192: Switch "All tec" for underlay and server lines visibility not selected

Selecting the switch in the last two cases re-establishes the previous setting of individual switches.

For the "PE Feature" switches, the following applies:

- If the "Main Switch" per technology is not selected, all switches in all columns for a technology are not activated (dimmed).

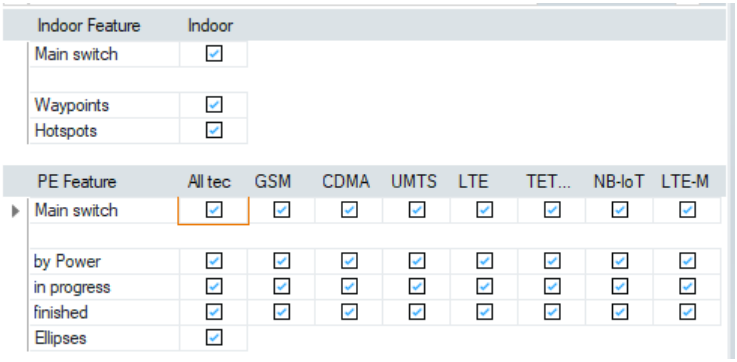


Figure 4-193: Switch "All tec" by power visibility ticked

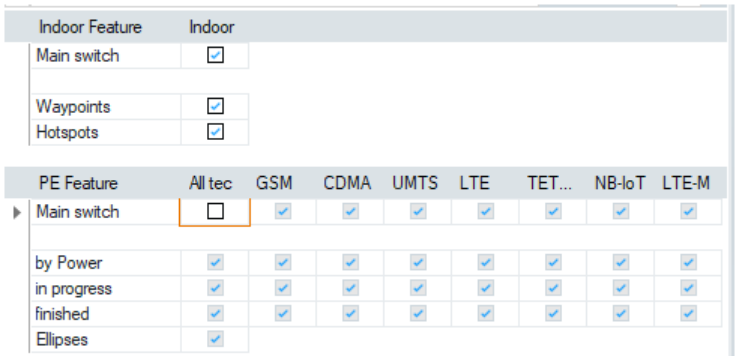


Figure 4-194: Switch "All tec" by power visibility not selected

- If the "All tec" per single visibility parameter is not selected, all individual switches in a row are inactive (dimmed).
- If the "All tec" "Main Switch" is not selected, all individual switches are inactive.
- If the "All tec" "by Band" switch in the "BTS Feature" grid is not selected, the list boxes of all technologies there are inactive. If selected, the list boxes offer available bands based on corresponding database after loading BTS databases. For more of the usage of the "BTS Feature", see the next section.

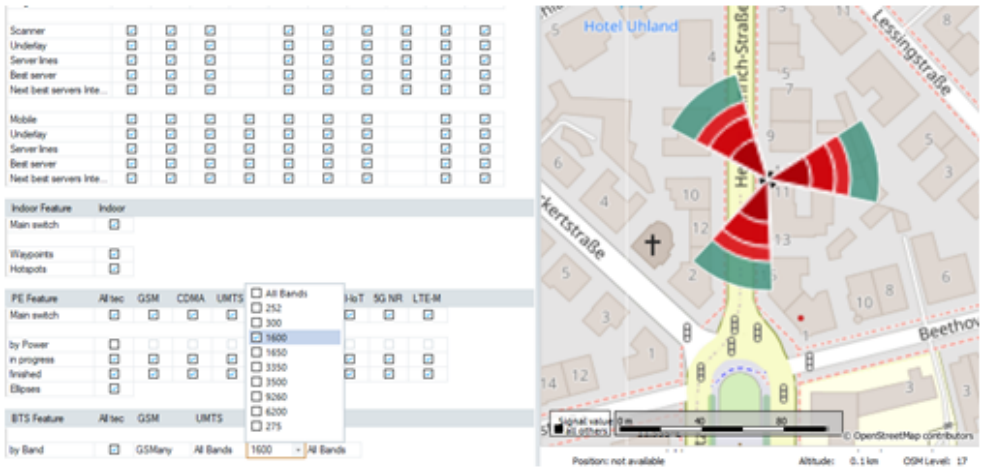


Figure 4-195: All tec switch of BTS feature activated - LTE bands displayed

The "Main Switch" per technology and the "All tec" switch per visibility parameter are used to indicate whether all technologies are switched on (selected and green), or at least one of them is switched off (not selected and red).

Tec Feature Switch - BTS Feature ← Tec Feature Switch ← Docking bar
After loading BTS databases, the technology list boxes offer available bands based on corresponding database.

Select one or more bands to display BTS stations selectively. The following screenshots show the BTS's layout in the "ROMESMAP Route Track View" for LTE and 5G NR bands selection.

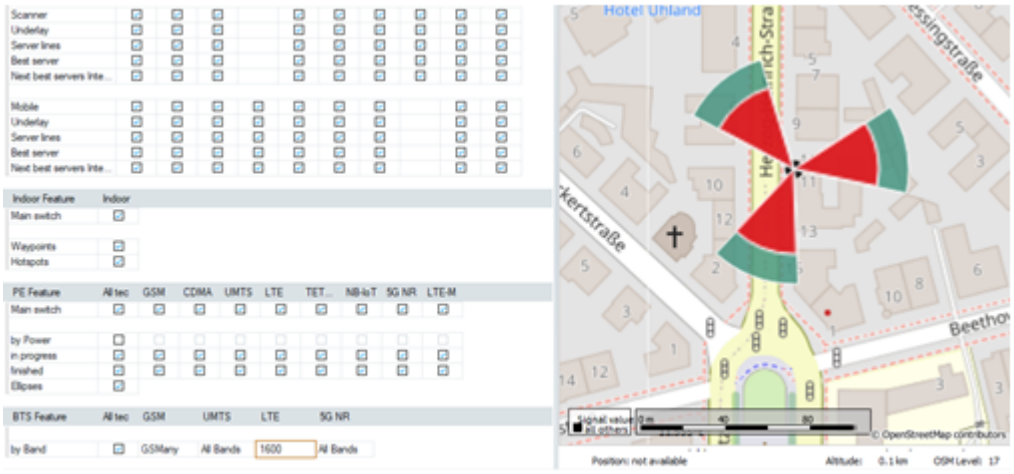


Figure 4-196: LTE stations display corresponding to selected band

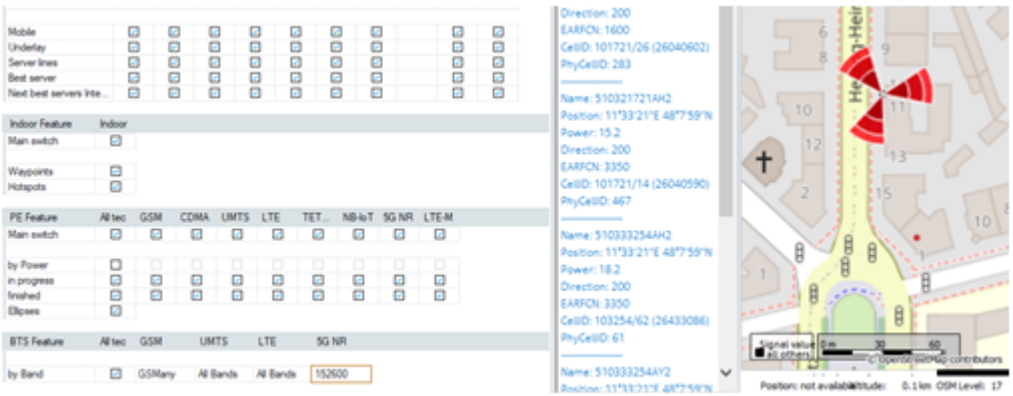


Figure 4-197: 5G NR stations display corresponding to selected band

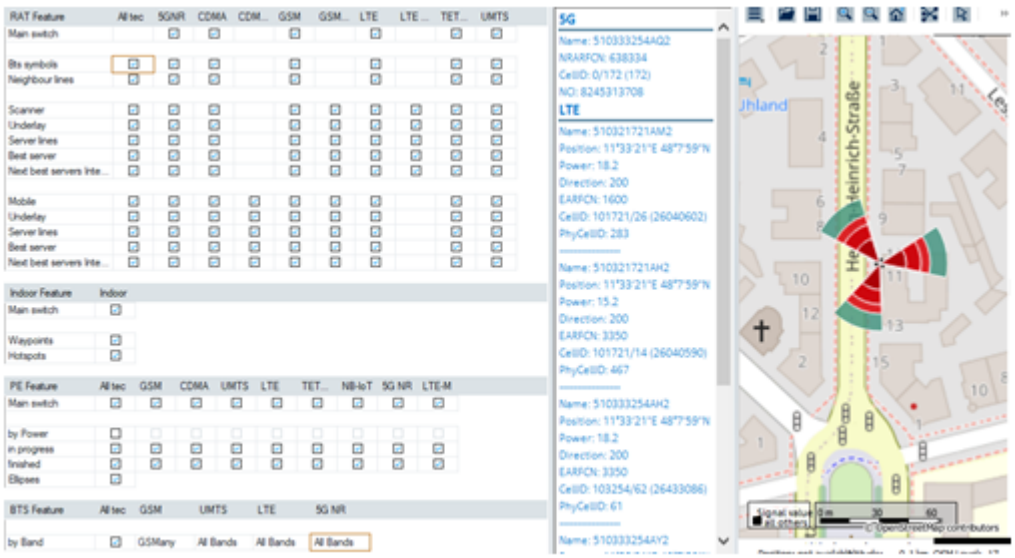
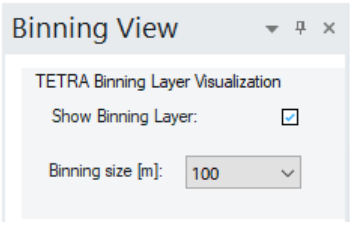


Figure 4-198: LTE and 5G NR stations display corresponding to selected bands

Binning View ← Docking bar

The "Binning View" allows you to visualize bin layer and set the bin size in a map. You can choose the bin size selecting a value between 5 m and 1000 m or set it automatically ("Binning Size" > "Auto"). If set to "Auto", R&S ROMES4 adapts the bin size automatically according to the currently selected zoom level.



To open the "Binning View", click the same named vertical bar on the left side of the "ROMESMAP Route Track View". Alternatively, click the "Binning Configuration Bar" in the context menu of the "ROMESMAP Route Track View".

The configuration dialog hides the bin layer if the "Show Binning Layer" check-box is deselected. The currently selected bin size is reflected in the "TETRA Scanner Report View" automatically.

Map View

The middle section of the view is the main display area for a measured route track.

The display area is composed of a stack of layers.

- The lowest layers are maps selected from the set of location maps provided by a location map server.
  For example, the lowest layer can be a European map with the countries in different colors and the second layer is a detailed map of a city area.
- The next layers above the geographical maps show the locations of the BTS. The main transmit direction of the BTS is shown by the middle axis of the triangles which originate from a true geographical location.

The following two figures show the typical symbol of a BTS with three cells and antennas and the symbol of an omnidirectional cell.

Figure 4-199: Directed cell with three sectors

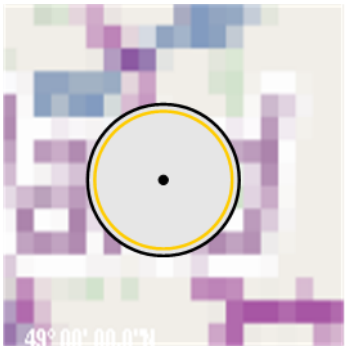


Figure 4-200: Omnidirectional cell

The size of the symbols is configurable. The color of the symbols has a default value for each technology. The color can be customized and can be made dependent on MCC/MNC.

- The layers above the BTS layers are the "Route Underlays" and "Lines to Best Server" which are colored by the CellId.
- The default route track layer follows the previous one. A thin black line shows the route in case no signal is configured or the current signal is invalid.
- The next layer is a set of layers for the configured signals, from which only one is visible while others are hidden. The signal route covers the default route track as long as it is valid.
- On the top of the signal layers, there are event layers, one for each device. Only one of the event layers is shown depending on the device or the current signal. The other events are hidden. The event layers show different symbols which symbolize the events. The events info is available in the info-box located left or right from the route if you place the cursor over a symbol and click left mouse button + SHIFT key. The info-box of the event shows.

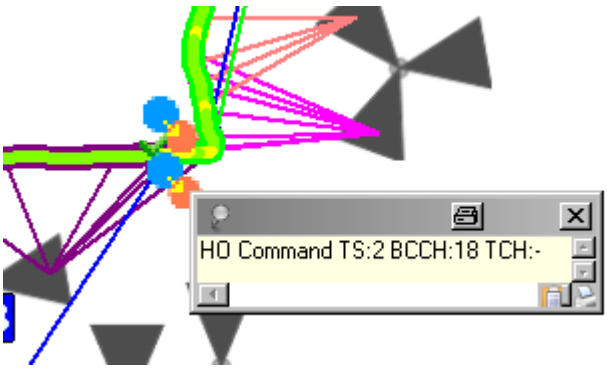


Figure 4-201: Example of a Handover Command event display as icon

- On top of the event layers, there are the layers for the "Best Server" symbols. For example, for LTE the current best server is symbolized by a green (default) flag "Top1". The next best servers are colored blue (default) and show the Text "Top2" etc.
- On top of the "Best Server" symbols is the layer for the "Bts Markers". The "Bts Markers" show the location of selected BTS on a map and are activated from other views (like the BCH view). A color of the marker is configured in the views which use this function.

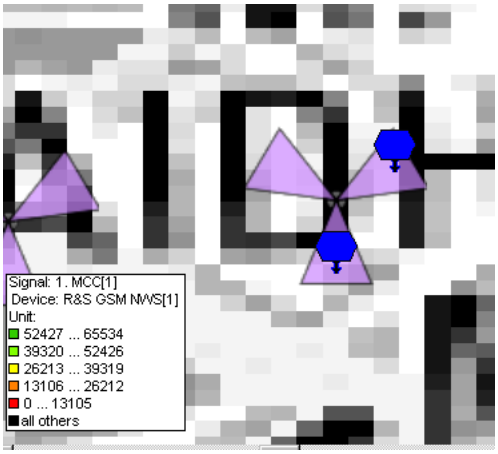


Figure 4-202: BTS Marker

The BTS marker function is set in the "Tools" > "Transmitter Database" > "Query" dialog if a BTS is selected from loaded BTSs.
For more details about the "Query" dialog, see Chapter 3.8.5, "Transmitter database", on page 384.

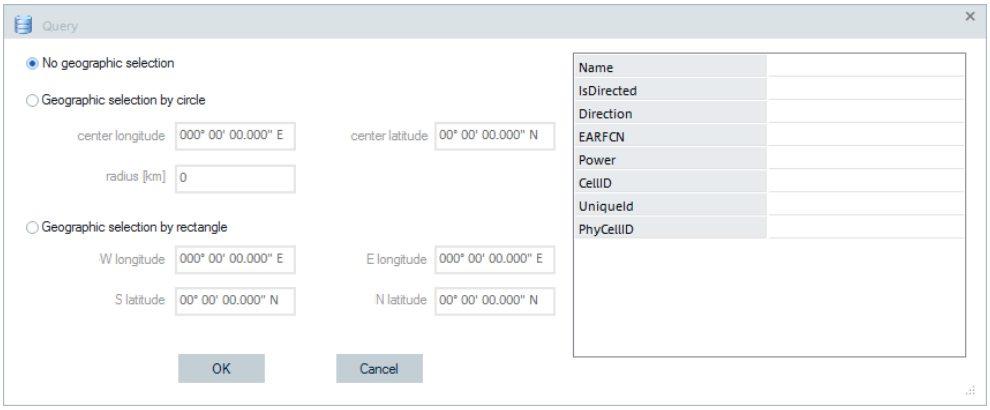


Figure 4-203: BTS Query dialog

The selection results are shown in the following figure.

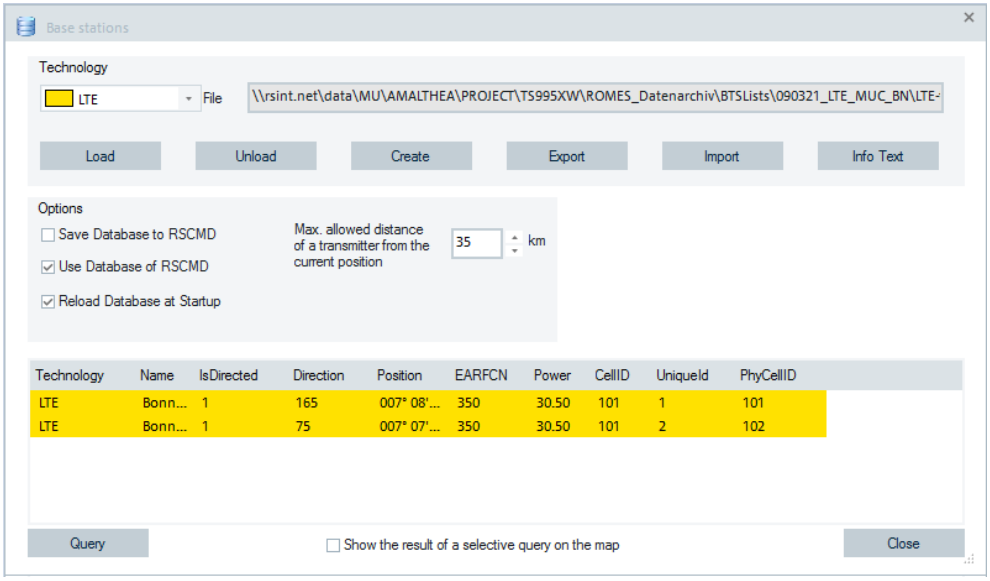


Figure 4-204: Results displayed in the Base stations window

The "Show the result of a selective query on map" check-box lets you switch the marker function on and off.

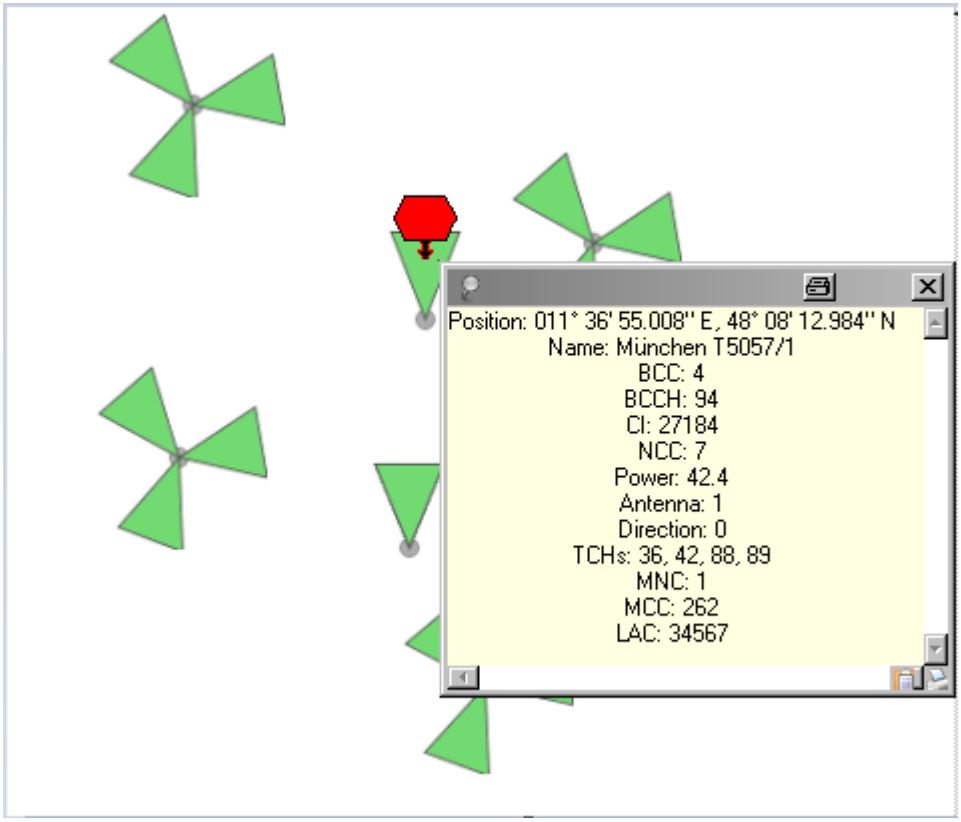


Figure 4-205: BTS red marker and the BTS info bar

The red marker points to the BTS of the query result. Multiple markers can be shown for larger query results. If selection is not done in the query and all BTS are in the result set, the result is not marked.
The markers can be deleted by the entry in the context menu "Remove All Bts Query Markers" or by the next query.

- On top of all other layers, there are the cursor layers. The cursor is never hidden by any other element.

Note: If the LTE cell identities (CI) match, a mismatch in the physical cell identities (PCI) is ignored. The choice is in the lookup of the LTE cell name in the "LTE Overview View", see Chapter 4.4.12, "3GPP overview view", on page 923.

Cursors in the map view ← Map View
The map component on the "ROMESMAP Route Track View" shows four different cursors (arrow, closed hand, pointing hand, open hand) depending on its internal state.

The "Sync Views" state, representing the coupled focus, is indicated by green color of the cursors, see Figure 4-213 and Chapter 3.1.3, "Coupled focus", on page 101.

The “Jump to Timestamp” state is indicated by additional clock symbol in the cursors.

Table 4-5: Map View cursors

Cursor symbol	Not Synchronized View	Synchronized View	Jump to Timestamp
Arrow			
Closed hand			
Pointing hand			
Open hand			

Map level out horizontally ← Map View

If the "Switch on / off rotating the map" function is activated ( ) so that the map rotating is enabled, you can level out the map horizontally.

1. Press the CTRL key.
2. Select two points of the desired horizontal line in the map by clicking with the mouse's left button on them.
3. The figure shows the map layout after clicking the red spots.

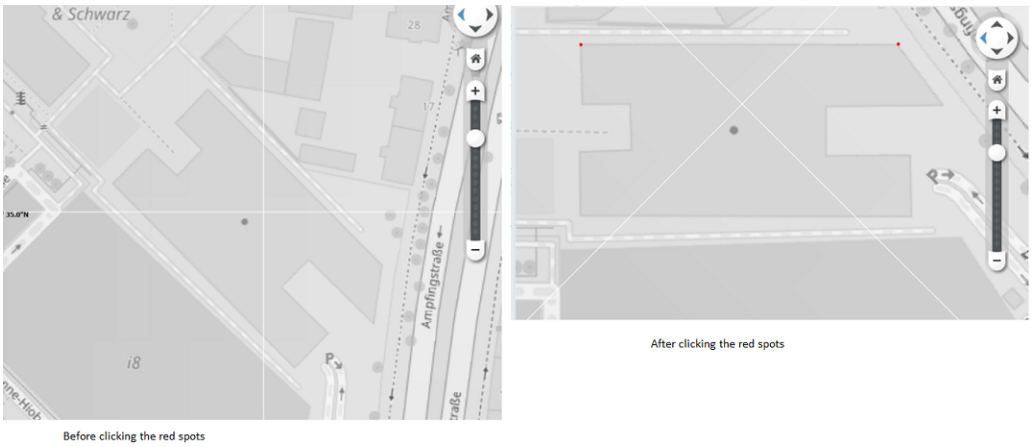


Figure 4-206: Map leveled out horizontally

Show BTS Info

An info field containing a detail information on BTS sectors can be opened by [SHIFT] + left mouse button click the sector symbol (triangle). This action opens the "Bts Info" pane.

For example, for a GSM base station visualization stated in "Info Text" on page 390, displayed are BTS color code (BCC), BCCH channel number, cell identity (CI), network color code (NCC).

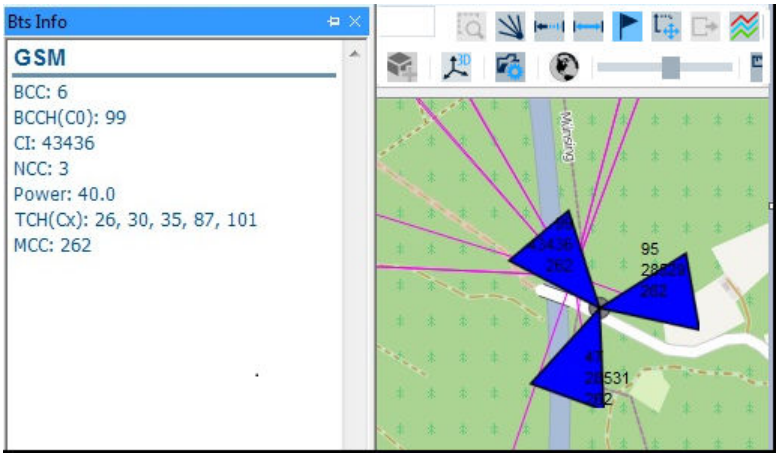


Figure 4-207: Example for the BTS information

If multiple sectors overlap at a position, the info of the nearest BTS sector to this position is issued. The current position is the black dot of the BTS symbol.

The radius of the hot zone can be configured in the "Bts Layer" dialog.

The "BTS Info" pane for Position Estimator displays the corresponding confidence interval value next to the direction value.

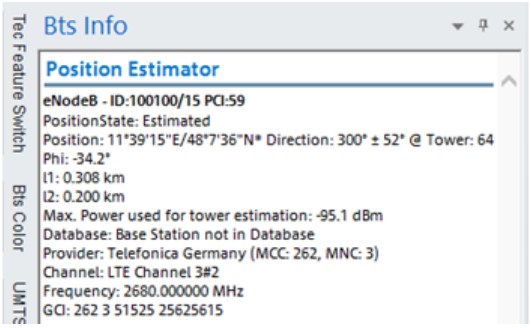


Figure 4-208: BTS info on PE

The confidence interval is +/- 52° in the figure. Starting from BTS antenna direction of 300°, an underlaying red sector of 104° (+/- 52°) is drawn.

The BTS confidence interval is displayed as a red colored, transparent sector under the antenna sector in the "ROMESMAP Route TRACK View".

Figure 4-209: Red sectors show BTS confidence interval

Coloring server lines

Coloring server lines changes to auto-color for all scanner technologies.

Whenever a scanner decodes the typical identifier of a BTS, NodeB or eNodeB, server lines are drawn from that BTS to the actual route in the route track view. A change of a cell is an important information.

Scanner signals which are used for server lines are colored in different colors to detect the change. Having R&S ROMES4 18.0 or higher installation or unchanged the default coloring for the signals, the color scale changes to auto-color. Sixteen colors are used to distinguish the characteristic cells. These colors are used in repetition.

Neighbor cell display

The "Neighbour Cell Display" shows the neighbor cells of the selected BTS. It uses the existing neighbor data (2G, 3G and 4G neighbor cell) in the BTS data bases. This feature is coupled to the BTS selection of the “Bts Info” feature, which is activated by “mouse over” at the location of a BTS symbol.

The neighbors of the BTS are displayed by drawing colored lines to them, as shown in the following figure.

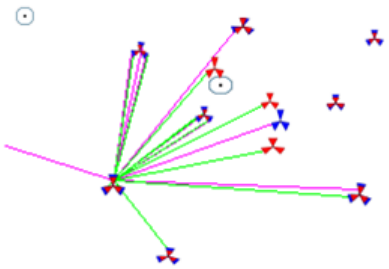


Figure 4-210: Colored lines between the selected cell and its neighbor cells

Multiple BTS supporting different technologies (GSM, UMTS, and so on) if selected by the "mouse over", shows simultaneously the lines to neighbors of multiple technologies.

To sort the things between the many possible lineouts, the two methods are available:

- If the multiple BTS is selected by the "mouse over", the "Neighbour Cell Selection Control" option allows a single BTS selection from the list.
  The method reduces the displayed lines to the neighbors of a single BTS.

- The lines are colored differently for 2G, 3G and 4G neighbors, as shown in the previous figure.

Example: GSM and UMTS sample

Sample display with a GSM and an UMTS selected BTS shows the sum of all 2G and 3G neighbor cells.

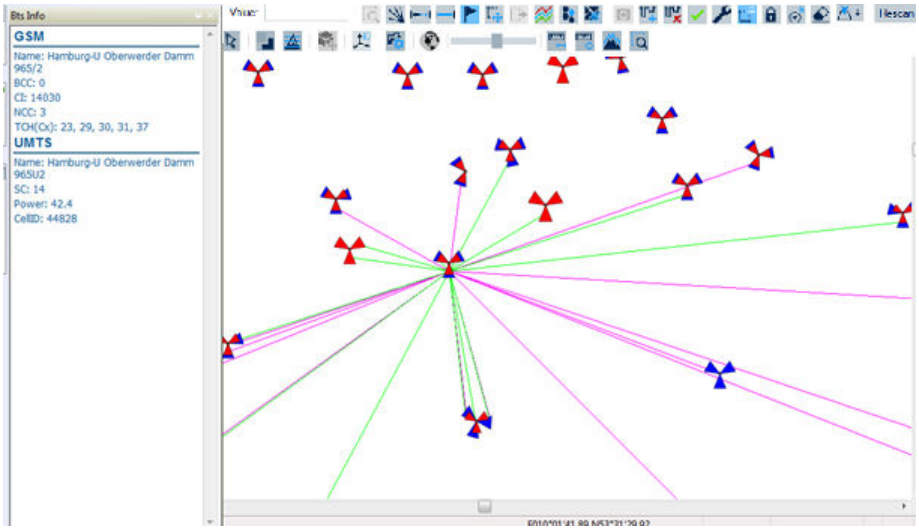


Figure 4-211: GSM and UMTS neighbor cells

The figure shows server lines in the UMTS part of the route with the Multi RAT feature applied. The feature works also for mobiles which switch between GSM-UMTS-LTE or other multi-RAT configurations.

Example: GSM sample

A GSM sample is displayed with the 2G neighbor cells of the selected GSM BTS in the "Neighbour cell display control" window.

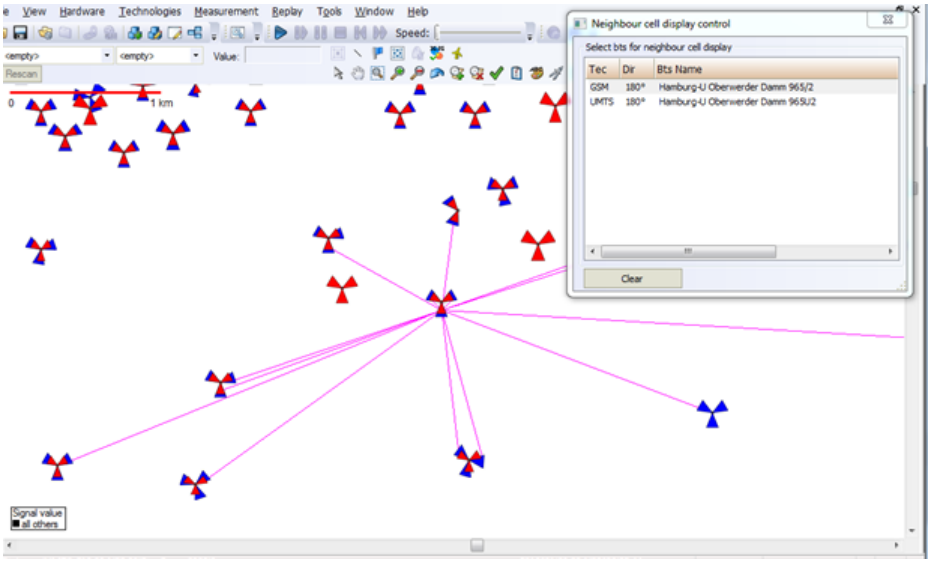


Figure 4-212: GSM neighbor cells

The example shows only the GSM part of the route.

The "Neighbour cell display control" window can be toggled in two ways:

- Click the button, see Show / Hide Neighbour Cell Control.
- Select the entry in the context menu of the view.

The display can be cleared also in two ways:

- Click the "Clear" button in the "Neighbour cell display control" window.
- Select the "Clear Neighbour Cell Display" entry in the context menu of the view.

Measurement curve

It is a polygonal curve connecting the individual measurement points projected onto the background map. The curve's coloring indicates the signal values as written in the legend. That is, the legend only shows the colors of signal values which actually have been measured for the selected device, see "Legend" on page 589.

The plotted signal, the device type and number and the signal value of the current measurement point are indicated above the diagram.

For how to create a polygon, see Chapter 4.3.3.4, "Scanner data on map view", on page 594.

Note: "Display entire measurement route at once"
You can display the entire measurement route stored in a measurement file (`*.rscmd` or `*.cmd`) immediately at opening the file. Activate the measurement file scanning option in the "Preferences" > "General" menu.

Coupled focus

The Coupled Focus functions are available with [ALT + left] mouse click in the map area. The replay jump to the timestamp of the nearest route position is done by "CTRL + left" mouse click.

The following figure shows a coupled focus. A synchronized map view is indicated with the green cursor, see "Cursors in the map view" on page 577.

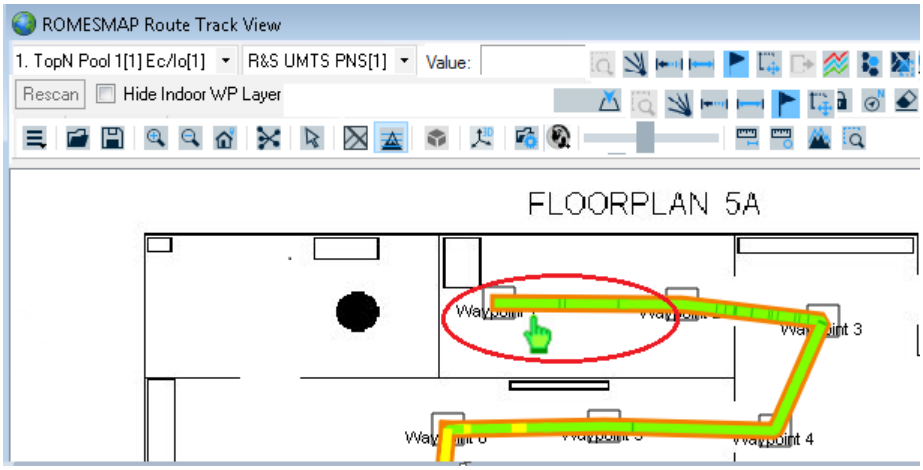


Figure 4-213: Cursor symbol for synchronized view

Toolbar

The toolbar offers the selected signal, device list and map, shows the signal value at the current measurement point and provides map tools.

Map settings ← Toolbar

Table 4-6: Toolbar - Pull down lists

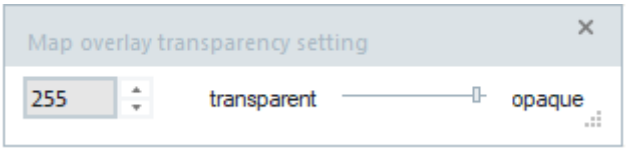
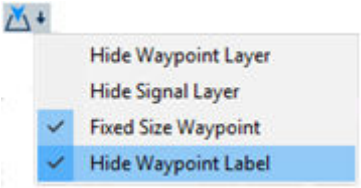
1	**Parameters** list of all signals selected in the configuration menu. The selected signal is visualized in the map view.
2	**Devices** Pull down list of all devices measured or contained in the measurement file replayed. The measurement curve in the diagram shows the signal for the current device. The device selection is also for selecting the events, which are device-specific. If no measurement file is open, then the device selection shows <empty>.
3	**Signal value** Value of the current signal and device at the current measurement point.

Map tools (buttons) ← Toolbar

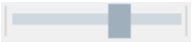
The buttons showed in the following table, offer the tools for carrying out the actions for customizing the map view. Click a button to carry out the corresponding action.

Table 4-7: Toolbar - Buttons

Button	Description
	Zoom to driven area During replay or measurement zooms the view to the driven area of the measurement file.

	Serverlines off / on Hides or shows the server line.
	Serverlines Transparency Changes quickly the server line transparency. For details see "LTE RTM Bts layer configuration: scanner layers" on page 669.
	Serverlines Repetition Distance Changes quickly the server line repetition distance, see also Figure 4-316.
	Event symbols off / on Hides or shows the event symbols.
	Show / Hide Layer Mover Shows or hides the Layer Mover.
	Apply the stored layer mover settings from the workspace Reads the values from the workspace and shows the selected signal and the other signals with offsets. For more details, see Apply the stored....
	Multi RAT: Show features (server lines etc.) for all RAT of the selected mobile server lines, BTS markers, short info texts etc. can be shown by selecting this icon, see GSM and UMTS neighbor cells.
	Show / Hide Neighbour Cell Control Shows or hides the neighbor cells of the selected cell.
	Show / Hide Map Overlay Transparency Control Sets the transparency of loaded map layer overlay of the MapInfo location map (`*.lmxml`) or top image (`*.kml`) type. The transparency control is a floating dialog which remembers its position in the registry. The transparency values are 1 to 255, where 255 is the opaque value. The value 0 is a special: Auto. For the Source/Dest. operation, for example, the b/w images have all white pixels fully transparent.  The setting is stored in the workspace and is applied to the overlay when loading the workspace.
	Adapt toolbar Two "Adapt toolbar" buttons open the "Toolbar" dialogs in which the group of to them associated toolbar buttons can be selected or deselected for appearance in the bar, see "Adapt toolbar dialog" on page 587.
	Indoor Layer Manager Opens the "Indoor Floor Plans" dialog, see Chapter 4.3.3.7, "Indoor floorplan manager", on page 633. If the associated arrow is clicked, the context menu to select indoor waypoints presentation opens, see "Indoor measurement" on page 654. 

Rescan	**Rescan** Rescans the entire measurement file, see the following "Rescan and refresh" section.
	Screenshot Wizard Helps to create screenshots per signal and/or floorplan automatically, see Chapter 4.3.3.8, "Screenshot wizard", on page 657.
	Add Routes from Measurement Files Opens the dialog to add a further measurement route on the map. The command opens the file chooser for `*.rscmd` files. Multiple files can be selected as well. The selected `*.rscmd` files are scanned for their routes and a set of black lines is displayed on the map showing the routes of the measurements.
	Delete Routes Deletes all currently displayed routes. The action cannot be undone. Therefore before the action is performed a message box for confirmation is displayed.
	Disable Disables or enables the updating of the view.
	Opens the configuration dialog Calls up the configuration dialog, see ROMESMAP route track view configuration.
	Switch Legend on / off Shows or hides the legend.
	Auto Move/Zoom the Map on / off If activated, the view follows the geographical measurement position so that the current location is always visible. If Auto mode is off, opening another measurement file does not rescale the map.
	Switch on / off rotating the Map If on, rotates the map. The view is rotated by pressing the right mouse button and moving the mouse. If rotate map is active, the context menu is available only in the top dialog of the view.
	Clean up (clear) the current measurement route during measurement or replay During measurement and replay (without file scan) deletes the elements of the route track up to the current position. This measurement can be useful, for example, to get a clear view before driving the same route in the reverse direction.
	Top Map Layer Opens the menu of map's view. The "Load Map" command shows the pull-down list of available maps.
	Open Location Map Opens a window to select a `*.lmxml` location map file for loading.
	Save Location Map Saves a `*.lmxml` location map file with a given name to a selected directory.

	Zoom in Magnifies the entire map. When zoomed, a loaded bitmap appears with a shaded pattern which is removed when the Set anchor tool is set. The following two options are available: • Put the "Zoom in" icon to the center of the area that you want to magnify. The map is magnified by a factor of 2.The position of the icon becoming the center of the magnified map window. • Left-click a point on the map, keep the cursor button pressed and move to another point to draw a rectangle. On releasing the cursor button. The border of the rectangle becomes the border of the magnified map window
	Zoom out Scales down the entire map. When zoomed, a loaded bitmap appears with a shaded pattern which is removed when the Set anchor tool is set. Proceed as follows: Put the "Zoom out" icon to the center of the area that you want to make smaller. The map is scaled down by a factor of 2. The position of the icon becoming the center of the scaled down map window. The max. "Zoom out" is defined by the "world window" which is set by the MapView component and is normally the bounds of the map.
	Home Sets home location.
	Cluster Activates the cluster in "TreeView"
	Disable selection Default mouse pointer used for selections like selecting a specific timestamp during coupled focus. The pointer coordinates are indicated in the legend.
	Grayscaled mode Grayed the map view.
	Elevation shading Shades the elevation points.
	Import buildings Starting with OSM zoom level 15, this button is activated, see "TreeView" on page 614.
	Toggle 2D/3D view Allows from ROMESMAP 2D to 3D view to switch.
	Settings Calls up the map view settings dialog. General settings like units, map quality and labels are changed here. If your internet connection is behind a proxy, you have to configure the proxy settings first.
	RS Maps Studio Basemaps offered by the local running mapserver RSMapsStudio. OpenstreetMap is supported by the server.
	**Dimmer** Changes the brightness of the map view.

	Measure Starts the distance tool mode of the cursor: A special ruler cursor is shown. If the mouse is pressed and then moved while holding down, a distance line is shown. Also, the value of the distance and the direction is displayed in the box at the left side of the map view. The mode is terminated by the mouse double-click.
	Measure Circle See the previous button's description. The line shows a circle's radius in this case.
	Elevation Profile Creates a route or measurement to view its elevation profile.
	Zoom To Rect Changes the cursor to a cross and allows the selection of a rectangle with the mouse (left button pressed). The view is zoomed on release of the mouse button.

Adapt toolbar dialog ← Map tools (buttons) ← Toolbar
Click the "Adapt toolbar" button to open the "Toolbar" dialog.

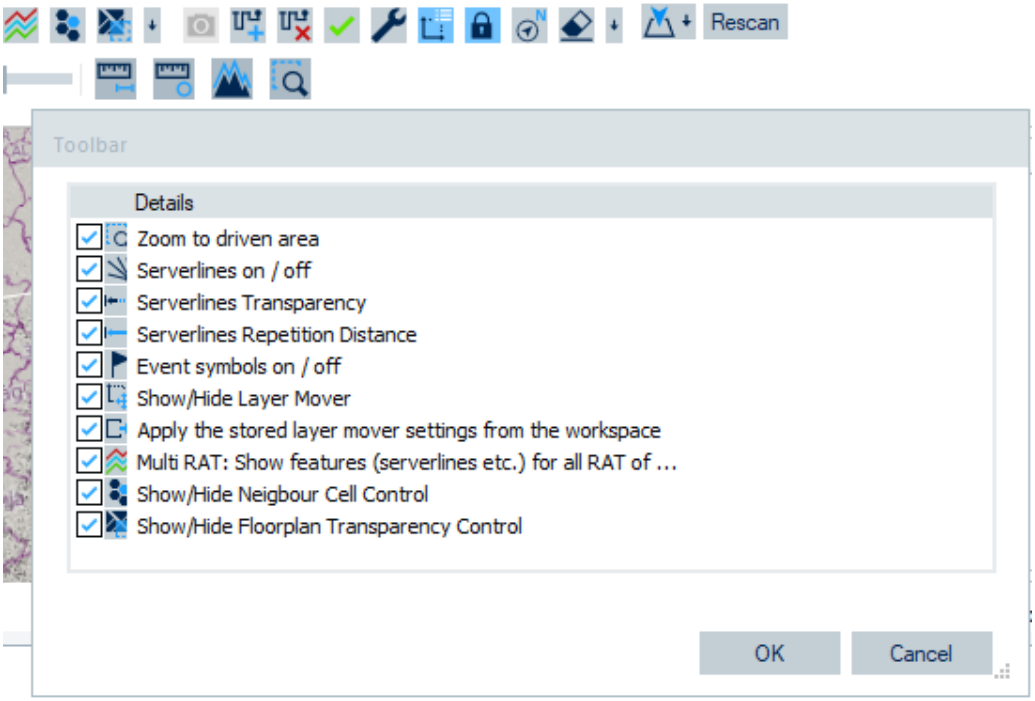


Figure 4-214: Toolbar buttons available

The dialog lets you add or remove a button to/from the toolbar. The visibility state of the buttons is stored in the registry.

Rescan and refresh ← Map tools (buttons) ← Toolbar

Navigation map full rescan""

Navigation map full scan/rescan scans the entire measurement file. The full scan/ rescan of navigation map takes place in following scenarios:

- First time when opening a measurement file.

- Addition of new signals requires full rescan.

Click CTRL-SHIFT-"Rescan" to start a full rescan manually.

"Fast rescan"

Fast rescan uses file-based cached frames to improve performance, as being faster than full rescan. It can be used to synchronize the map view.

Click "Rescan" button to start fast rescan.

"Refresh"

After navigation map configuration change, refresh occurs automatically. Refresh uses file-based cached server lines to redraw updated server lines.

Refresh is faster than fast rescan.

"Transparency changes without refresh"

If the configuration changes involve only in server line transparency, the changes take effect immediately without refresh.

Toggle 2D/3D view ← Map tools (buttons) ← Toolbar
The "Toggle 2D/3D view" button is only functional if the following options are available/ configured:

- Sales Option: ROMES43DM
- Option name: SYS_3D_Maps
- Option ID: 458

If the options are available, click the toggle button to get the 3D ROMESMAP Route Track view.

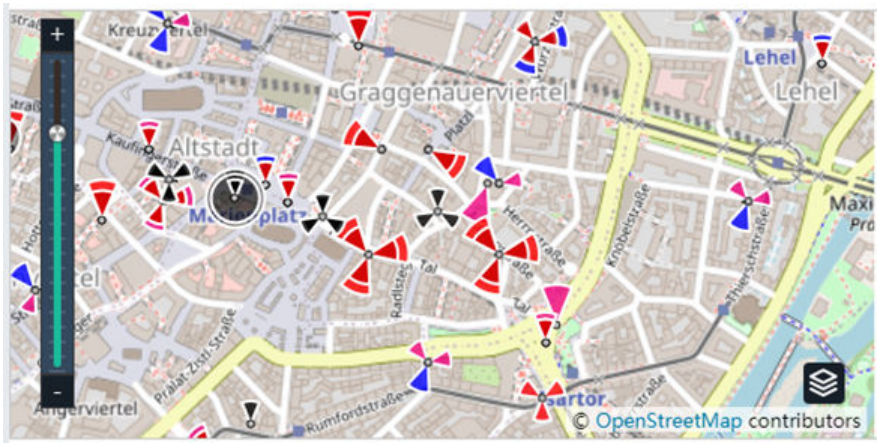
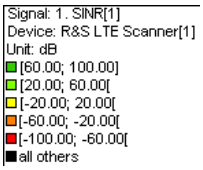


Figure 4-215: 3D ROMESMAP Route Track View - BTS layer

For details about 3D view, see "TreeView" on page 614.

Zoom via rectangle ← Map tools (buttons) ← Toolbar
The "Zoom To Rect" button offers much faster and more precise control of the shown area, as illustrated in the following figure.

Figure 4-216: Zoom via rectangle



Legend

The legend shows a signal value or value ranges symbolized by the different colors of the measurement curve. Define by the color scale configuration in "Preferences" > "Available Signals" > "Color Scale Configuration" which signal and which colors of selected signal's values (ranges) to be shown in a map, see "Color Scale Configuration" on page 230.

Any change in the signal value is shown based on the auto-color function after selecting the set of signal colors. The legend shows the color scale only for the signal values, which actually have been measured for the selected device. The repetition has a range of 2 to 100.

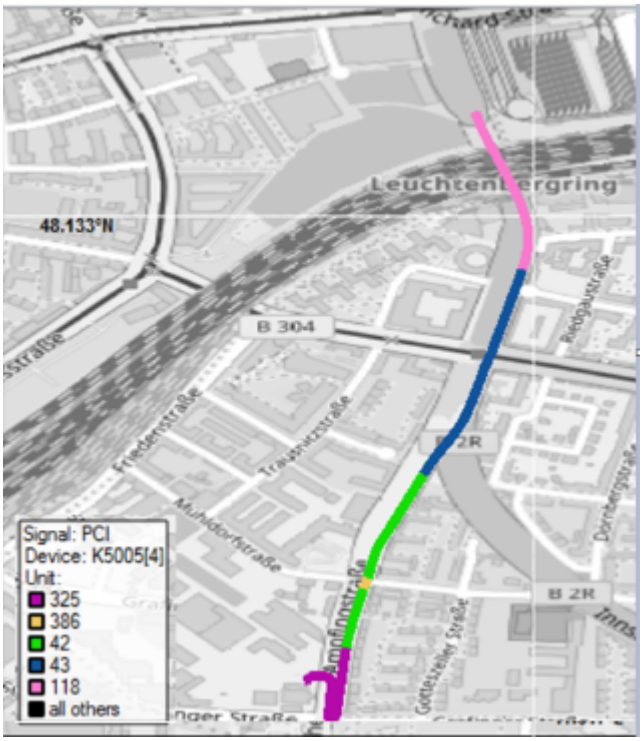


Figure 4-217: ROMESMAP route track auto-coloring

The geographic coordinates of the current measurement point are shown in the status bar. For more details on this issue, see Chapter 4.3, "Navigation views", on page 548.

4.3.3.3 Context menu

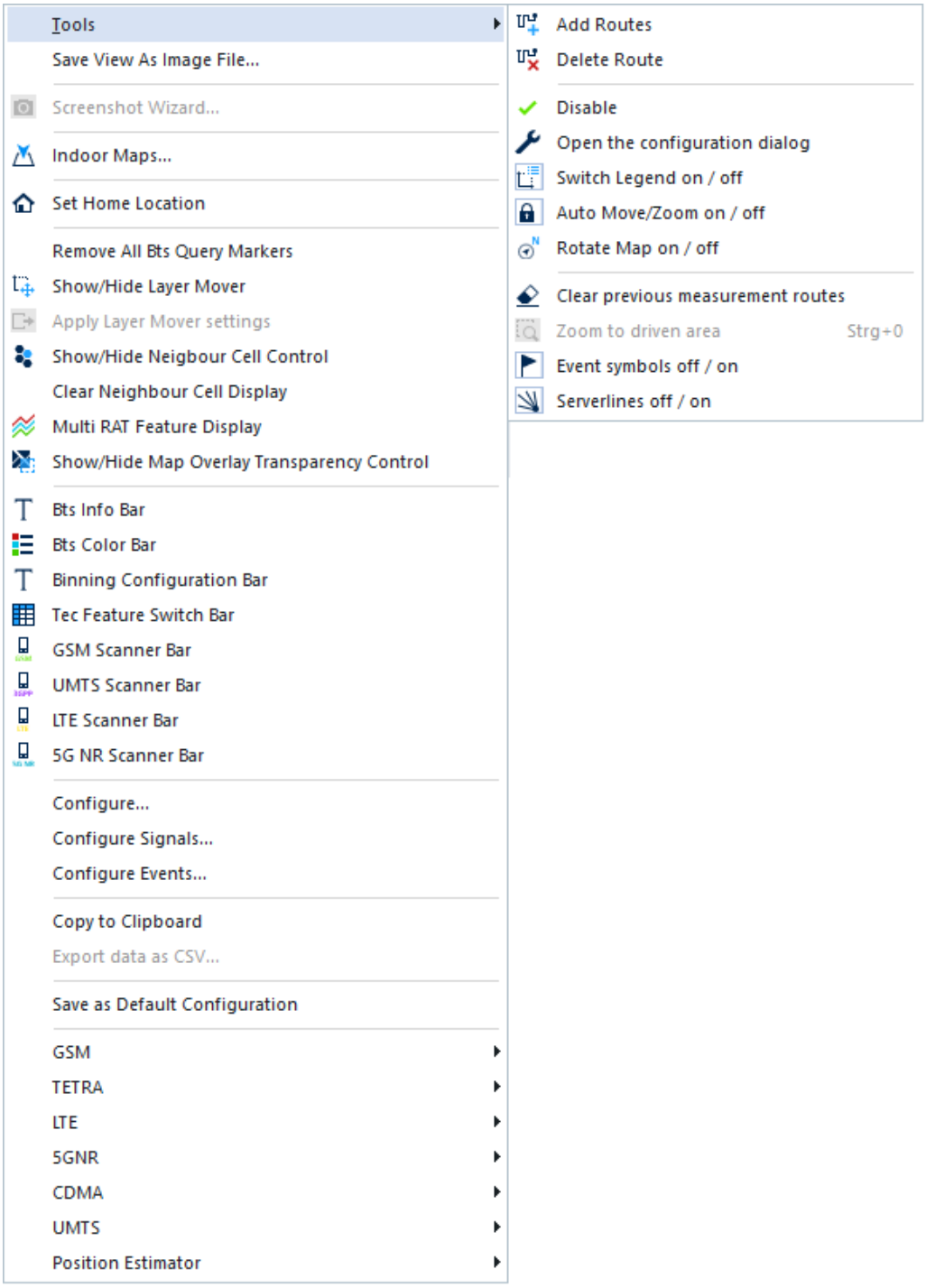


Figure 4-218: ROMESMAP Route Track View - context sensitive menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The functions included in the context menu are described in the following sections.

Tools
Opens a submenu providing tools for customizing the current view. The map tools are also accessible via the buttons on the toolbar menu, see "Toolbar" on page 583.

Save View As Image File
Saves the opened "ROMESMAP Route Track View" as an image file.

Remove All Bts Query Markers
Deletes all BTS markers from the map.

Show/Hide Layer Mover
Opens or closes the "Layer Mover" dialog. The dialog contains all the signals selected in the "ROMESMAP route track view configuration: values tab" on page 595 configuration dialog.

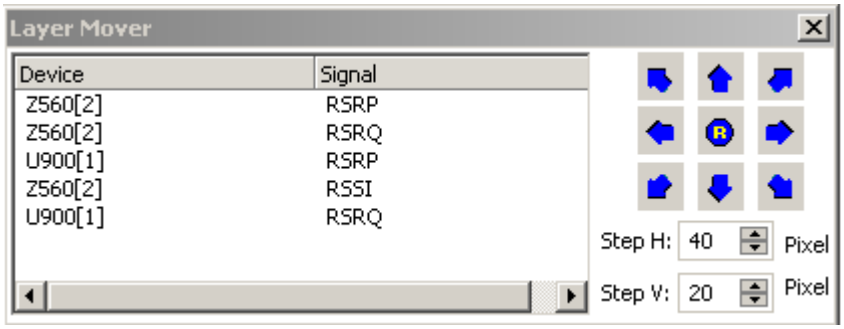


Figure 4-219: Layer Mover window

The dialog can display several signals along a route track with a relative offset so that the signal values can be read simultaneously. Simply select a signal in the list and click the arrow buttons for the signal position. Click the R to reset (superimpose) the signals.

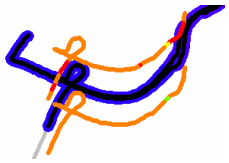


Figure 4-220: Example of layer offset on the display

The layer mover function generates legends for each visible signal.

Figure 4-221: Legends for moved signals

If a layer is moved, the appropriate legend for the moved signal is displayed.

Note: The legends are stacked vertically. It can happen that not all legends fit onto the screen.

Apply the Stored Layer Mover Settings
"Apply the stored layer mover settings from the workspace" reads the values from the workspace and shows the selected signal plus the other signals with offsets.

The function is a part of the feature "Save settings of the Layer Mover". The other part is the function to store the name of the main signal plus the names and offsets of the other signals in the workspace.

The setting is stored while saving the workspace.

Note: The storage is temporarily. It is possible to restore the offset after another movement if the layers have been moved and stored via save workspace. But this only works if the workspace is still open. If the workspace is closed, the setting is lost.

Show/Hide Neighbour Cell Control
Shows or hides the neighbor cells of the selected cell.

Clear Neighbour Cell Display
Removes the neighbor cell view.

Multi RAT: Show Features (server lines etc.) for all RATs
Shows server lines, BTS markers, short info texts and so on.

Bts Info Bar
Shows/hides the Bts information, see "Docking bar" on page 567.

Bts Color Bar
Shows/hides the Bts color legend, see "Docking bar" on page 567.

TEC Feature Switch Bar
Shows/hides the TEC Feature Switch dialog, see "Docking bar" on page 567.

GSM/UMTS/LTE Scanner Bar
Provides some means to visualize and analyze the results for a certain Top N. In this way the user gets a good overview of a network under the investigation.

The cell table shows all detected cells, which fulfill the selection done by using the controls at the top of the dialog:

- "Top N pool"
  Only results of this Top N pool are count. Only those cells are listed, which have been ranked as specified by the rank control in this Top N pool.
- "Geographic Area"
  It is possible to shrink the selection of cells to cells, which have been ranked as specified by the rank control in the selected geographic area. The geographic areas are polygons, which have to be defined.
- "Ranks"
  Only the cells that are listed are the cells which have been ranked at least once with one of the selected ranks.

The following figure shows this dialog.

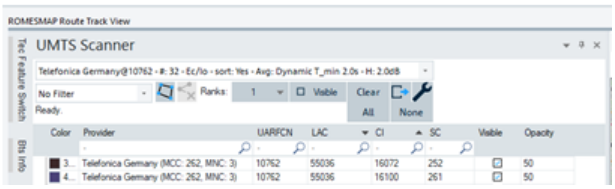


Figure 4-222: 3GPP technology scanner bar

For how to create a polygon, filter the table and display the driven routes, see Chapter 4.3.3.4, "Scanner data on map view", on page 594.

GSM/TETRA/LTE/CDMA/UMTS/Position Estimator
Opens a submenu for the Route Track Modules (RTM).

RTMs are the technology-specific extensions of the "ROMESMAP Route Track View", which show online the estimated BTS positions during the measurement on the map, see Chapter 4.3.3.16, "Position estimator layer configuration", on page 680.

For position estimation details, see Chapter 6.4.28, "BTS position estimation", on page 1870.

The different technologies RTMs share many similarities but also have some extras dependent on technology, mainly in the mobile devices section. These differences are:

- Serving cell and neighbors extras for GSM
- Active set, candidates and neighbors extras for CDMA. CDMA has two modes, CDMA2000 and EVDO
- Active set and neighbor set extras for UMTS

The view elements, the menus and the configuration pages are similar for all technologies. Nevertheless, some specific extensions per technology exist. For details, see

Chapter 4.3.3.10, "GSM layer configuration", on page 663

Chapter 4.3.3.11, "TETRA layer configuration", on page 666

Chapter 4.3.3.12, "LTE layer configuration", on page 667

Chapter 4.3.3.13, "5G NR layer configuration", on page 675

Chapter 4.3.3.14, "CDMA2000 1xEV-DO layer configuration", on page 677

Chapter 4.3.3.15, "UMTS layer configuration", on page 679

Chapter 4.3.3.16, "Position estimator layer configuration", on page 680

4.3.3.4 Scanner data on map view

The map view displays a colored driven route of received signal and the rank as specified. If more than one rank is chosen, the layers of the lower ranks are above the layers of the higher ranks. The color of the route represents the color of the cell in the table (in the figure, it is the black route of the first cell). The size of the route represents the scaling parameter value, which has been used for ranking.

In an UE emulation, this scaling parameter is the Cue criterion.

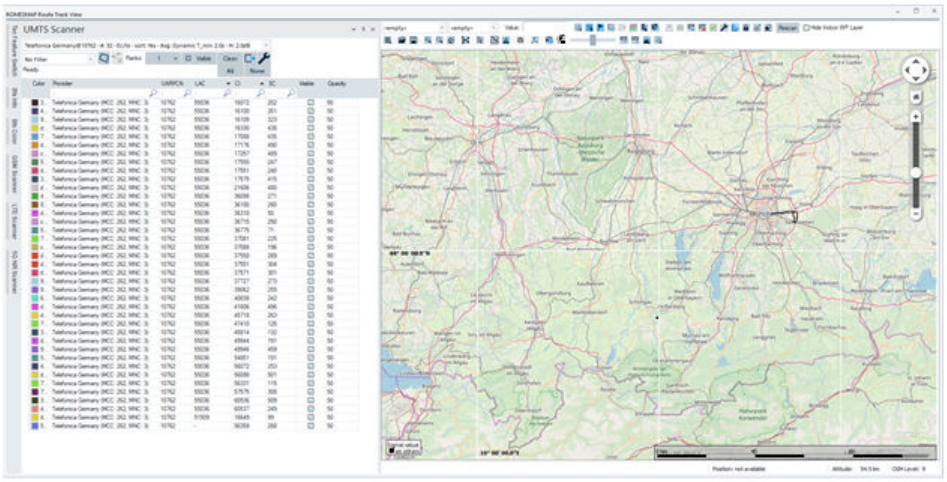


Figure 4-223: Scanner Top N pool map view

The columns of any scanner in the "ROMESMAP Route Track View" can be sorted by multiple columns. Which column is selected can be seen from the arrows in the column header. If all columns are not sorted (no arrows), the original order, which is the insertion order of the entries, is restored.

The color can be changed per cell. Each cell can be switched on and off by checking or unchecking the "Visible" combo-box.

To toggle the visibility of layers, use the Visible button.

The table of detected cells can be filtered also by using also a column.

To clear all table filters, click the "Clear" button.

To set all cells in the current list visible or invisible, click the "Clear All" or "None" button

If a geographic area filter is applied, listed are only the cells which have been ranked in this area. The rank values are displayed only in this area.

The content of the current list can be extracted to a `*.scv` file by using the button.

To open the dialog for zooming the scaling parameters, click the icon. The "Measurement Point Display Parameter" dialog pops-up where you can define the scaling parameters values for a technology.

Creating a polygon:

1. Click the button.

The "Map View" changes to the "Enter Polygon" mode.

2. Define the polygon on the map.
3. Finish the polygon with a double-click for the last corner.

   The polygon is stored in the `My ROMES\mapdata\polygons\` directory.

Deleting a polygon:

► Click the button.

The polygon is removed from the combo-box and deleted from the `My ROMES\mapdata\polygons\` directory.

The accidental dropping of a column is not possible, whereas permutation is still enabled. If a column is dragged and then dropped outside a valid area, nothing changes.

4.3.3.5 ROMESMAP route track view configuration

The "ROMESMAP Route Track View" configuration menu defines the signals to be viewed and shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

ROMESMAP route track view configuration: values tab

Selects the signals to be displayed in a generic (basic) and some mobile views. The connected devices can be indicated in the "Selected Signals [Maximum Allowed <variable>]" list for some signals. The "Values" tab is analogous to the "Values" tab of the "Alphanumeric View".

For further description of the tab, see Chapter 4.2.3.3, "Values tab", on page 468.

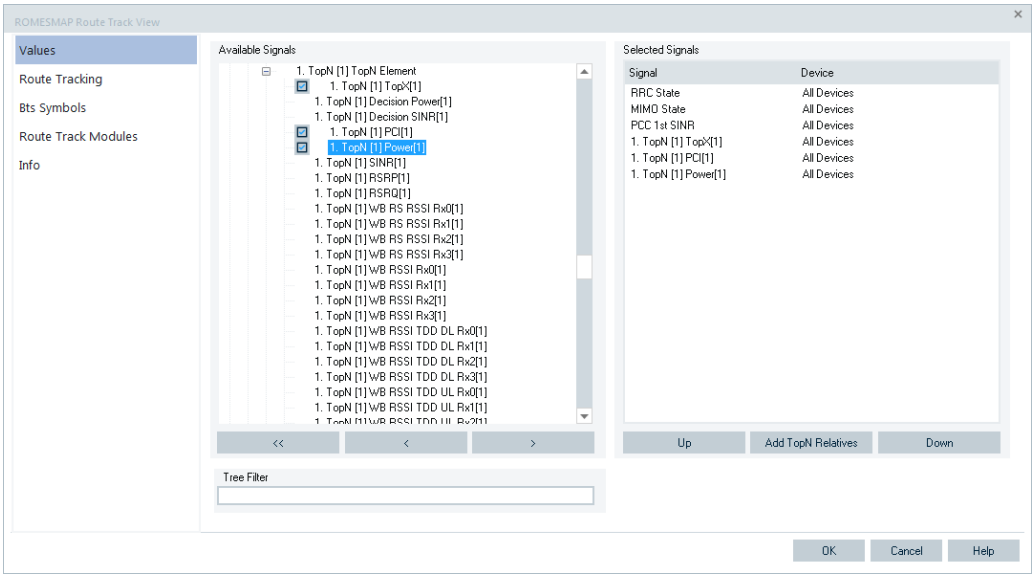


Figure 4-224: ROMESMAP Route Track View - Values

For the meaning of the "Tree Filter" option, see Chapter 4.2, "Basic views", on page 445.

ROMESMAP route track view configuration: route tracking tab

The "Route Tracking" page provides the general options for the map view configuration.

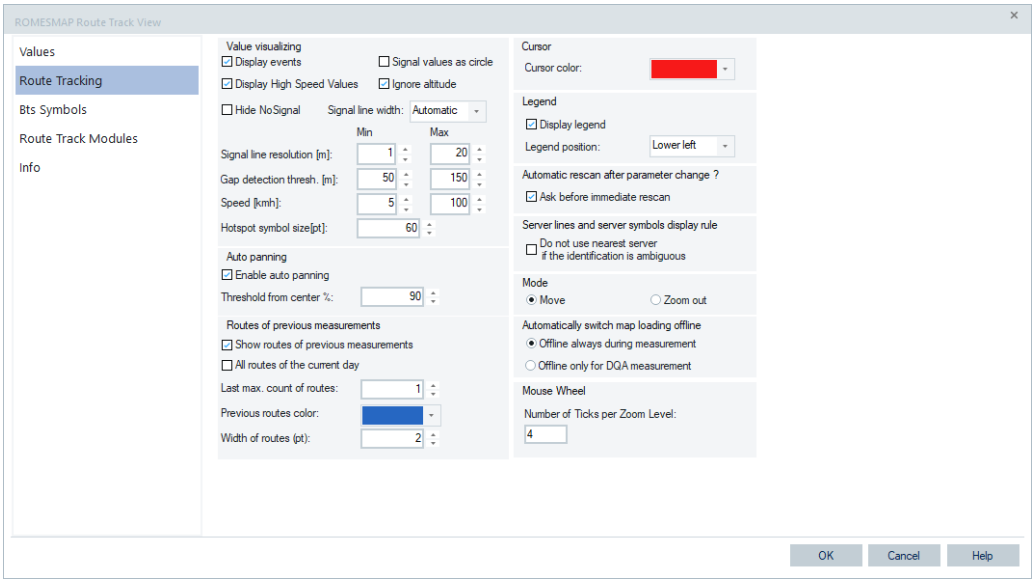


Figure 4-225: ROMESMAP Route Track View - Route Tracking

Value visualizing

- "Display events"

If the box is checked, the events selected in "Tools" > "Preferences" > "Available Events" are displayed along the measurement tour, see Figure 3-111.

- "Display High Speed Values"
  The option is used to display data obtained from the 5G NR scanner high-speed measurements.
- "Hide No Signal"
  The option to switch off black line on the ROMESMAP route track during drive test, which is by default shown. Check the "Hide No Signal" box to remove the line from the map.

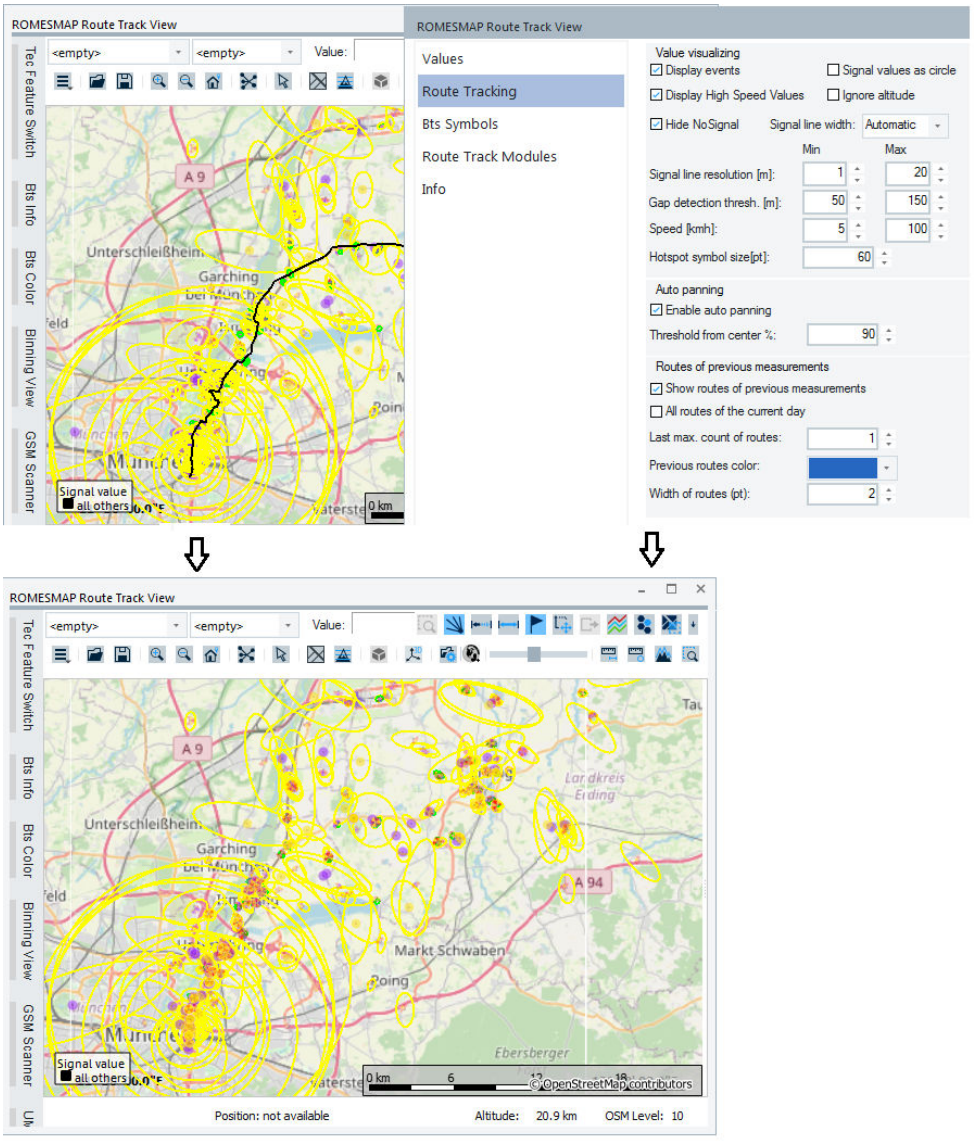


Figure 4-226: Show-hide the black route line

If the box is checked, the "No Signal" layer disappears after closing the "ROMESMAP Route Tracking View" dialog, as shown in the previous figure.

- "Signal values as circle"
  The route track is displayed as a line after loading a measurement file.

This function displays a route track as the measurement points instead of lines. If "Signal values as circle" is checked, the route track is displayed as a single circle for each measurement point after submitting the configuration (click "OK") and finishing the prompted rescan.

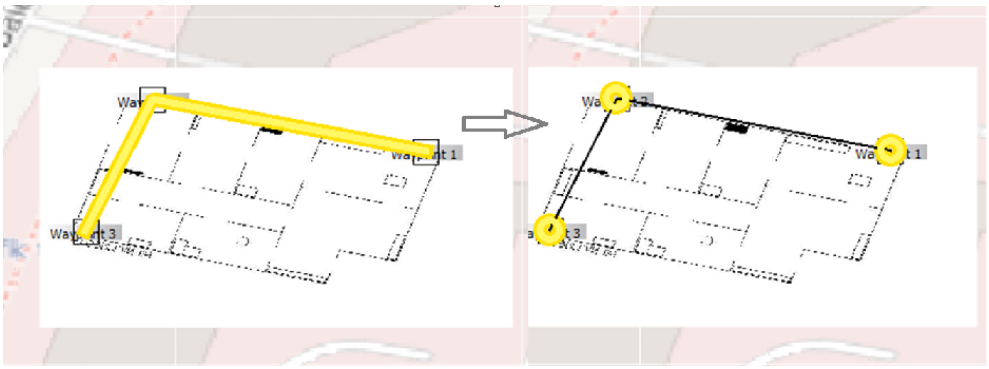


Figure 4-227: Route track display after applying the function

- "Ignore altitude"
  If checked, a signal route is painted as grounded in the 3D map view, that is, the altitude values are ignored.
- "Signal line width"
  Sets the line thickness of the polygonal curve along the measurement tour on a scale between 1 (thin line) and 7 (thick line). If the "Automatic" option is set, the line width is adapted to the shape of the curve.
- "Signal line resolution [m]"
  The signal line resolution defines the segment length of the route track (1 m to 100 m).
  The route-tracking segment lengths are gauged to the speed of travel ranging between the configurable minimum and maximum value. The route-tracking segment lengths are generated as the speed-dependent (dynamically reckoned) ones. However, the non-dynamic value can be simulated by setting the signal line resolution max. and min. values to the same value, see the Figure 4-225.
  The track is actually a polygon of segments and the resolution is a parameter which influences the performance. A finer resolution has more segments and higher data volume and lower performance.
- "Gap detection thresh. [m]"
  The gap detection threshold defines the transmission interruption of the positioning data to display a gap in the connection line (1 m to 1000 m).
  The route-tracking segment lengths are gauged to the actual speed of travel ranging between the configurable minimum and maximum value. The route-tracking segment lengths are generated as the speed-dependent (dynamically reckoned) ones. However, the non-dynamic value can be simulated by setting the gap detection threshold max. and min. values to the same value.
- "Speed [km/h]"
  The speed of travel value is dynamic, ranging between the configurable minimum and maximum value (0 km/h to 100 km/h).
  At speeds greater than the configured maximum speed value, the signal line resolution and the gap detection threshold values stay at their maximum.
  At speeds less than the minimum value, the signal line resolution and the gap detection threshold values stay at their minimum.

- "Hotspot symbol size [pt]"
  The size of the hotspot symbol in points (15 pt to 150 pt).

The values for the signal line resolution and the gap detection threshold remain at their configured maximum and minimum at speeds which exceed/fall below the configured max. and min. values, respectively.

Auto panning
The function recenters the map whenever the cursor is about to leave the visible map during measurement or replay.

- "Enable auto panning"
  If checked, the auto panning function is activated.
- "Threshold from center %"
  The threshold is configurable between 0% and 100% of the distance between the center and the edge of the visible map. The default value is 90%.
  NOTE: A low threshold can cause frequent map moves and high CPU activity.

Routes of previous measurements
The routes of previous measurements are shown as thin lines to help keeping a track of already driven routes.

Select between the two possible ways to show routes:

- "Show routes of previous measurements"
  If checked, the previous measurement routes are shown. The function keeps in memory the last “max. count” measurement routes and displays them as blue line.
- "All routes of the current day"
  If checked, the data of the routes made on current day is recorded in files within directory …\My Romes\DrivenRoutes. The data is also available after the R&S ROMES4 restart.
  This function is an alternative to the previously mentioned function "Show routes of previous measurements".
  For indoor measurements, the records storage is unchanged, which means that daily routes are stored per map.

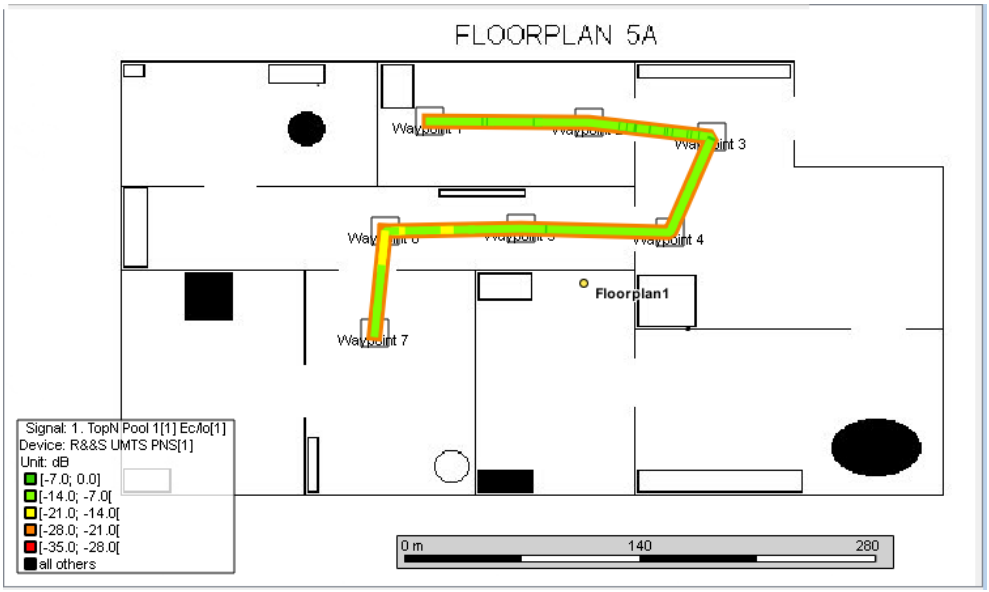


Figure 4-228: Daily route

- "Last max. count of routes"
  Defines max. count of shown routes. The function is not applicable if the "All routes of the current day" function is active.
- "Previous routes color"
  The color of the previous routes, applicable for both route types.
- "Width of routes (pt)"
  Defines the line thickness of the previous routes, applicable for both route types.

Both the route types can be deleted with the "Delete Routes" toolbar button.

Cursor

- "Cursor Color"
  You can configure cursor color to make the cursor more visible on some maps, for example mostly red colored maps.

Legend

- "Display legend"
  If checked, the legend is shown in the map display.
- "Legend position"
  As default, the legend is positioned on the left bottom corner. To use another place, select from the drop-down list.

Automatic Rescan After Parameter Change ?

The rescan of the view is immediately executed by default if you press "OK" after some route tracking setting changes. The changes take effect and are visible only after rescan.

If the "Ask before immediate rescan" flag is checked, R&S ROMES4 offers to choose how to do rescan after parameters change. The "ROMES" > "Rescan Immediately?" dialog is displayed offering to do rescan immediately (press "Yes") or to do a manual rescan later (press "No").

Server lines and server symbols display rule
Sometimes a BTS cannot be clearly identified from the measurement values. For example, if the cell identity is not available but the lower-level Information, like SC, BSIC and PCI reused nearby, is available, the BTS cannot be identified. If more than one BTS with matching values is found in a radius, the situation is ambiguous.

One option to avoid this ambiguity is to select the nearest BTS by distance and mark the result like it is done with the BTS names in many views ("+" is added to show this condition). This approach cannot be applied to server lines.

- "Do not use nearest server if the identification is ambiguous"
  This option allows the server lines suppression in ambiguous situations.

Mode
The following modes are available:

- "Move"
  The center of the map moves accordingly without changing the zoom factor.
- "Zoom out"
  The zoom factor is reduced to zoom out from the map and to see the current position on the route track. The center of the card is always the same.

Automatically switch map loading offline
The function lets you choose in which case the automatic switch to offline for map loading to be performed during measurement, if at all. The given options are:

- "Offline always during measurement"
- "Offline only for DQA measurement"
- "No automatic Offline"

Mouse Wheel
The "Number of Ticks per Zoom Level" option lets you specify the number of ticks on the mouse wheel necessary to change from one zoom level to the next one.

ROMESMAP route track view configuration: Bts symbols tab

The "Bts Symbols" dialog provides for base stations the display options on the map. The position and transmission characteristics of base stations in the view area are indicated with colored symbols in the route track view. A BTS with an omnidirectional antenna is symbolized by a circle. A BTS with directed antennas is symbolized by a dot with up to three triangles indicating the sectors with their maximum transmission directions.

The tab is analogous for all technologies.

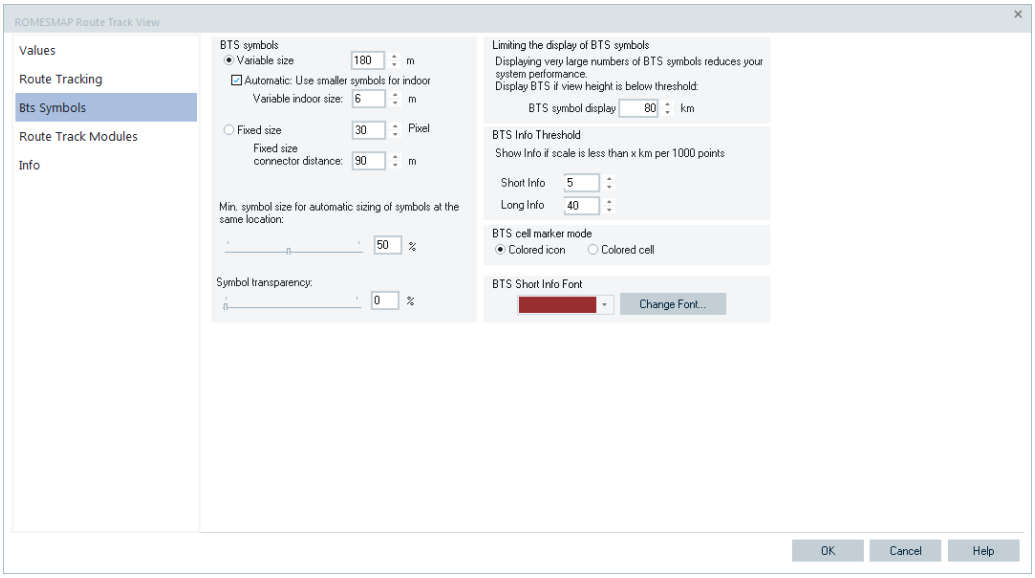


Figure 4-229: ROMESMAP Route Track View - Bts Symbols

Bts Symbols

The following parameters define the size of the base station symbols:

- "Variable size"
  Distance between a user position and a BTS, ranging from 0 m to 180 m, defines the size of the BTS symbol. It changes with the zoom.
- "Automatic: Use smaller symbol for indoor"
  The default variable size of BTS symbols on the "ROMESMAP Route Track View" is optimized for good visibility of drive test results. For indoor measurements however the symbols are much too large. This parameter, by default active, switches automatically to smaller BTS symbols for indoor measurements made with the indoor device.
  – "Variable indoor size"
    Applies the specified smaller BTS symbols size for the indoor display.
    The following two figures illustrate the BTS symbol presentation in the "ROMESMAP Route Track View" when this function is inactive and active.

Figure 4-230: BTS symbols presentation with the unchecked parameter

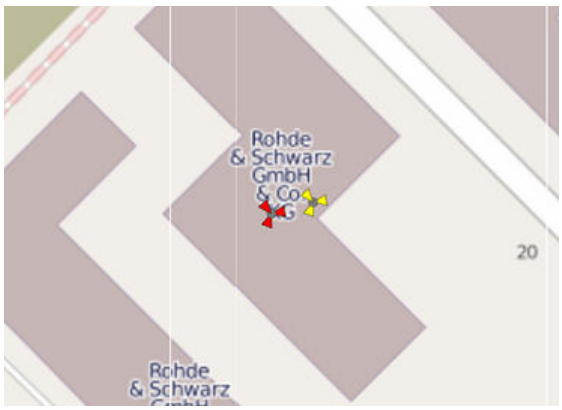


Figure 4-231: BTS symbols presentation with the checked parameter

- "Fixed size"
  All BTSs have the same size, ranging from 0 pixel to 49 pixels, irrespectively of its distance to the current position. The size does not change with zoom.
- "Fixed size connector distance"
  End point of lines to best server is not recalculated when fixed BTS size is used. Server lines, BTS markers and short info texts are positioned at an invisible “connector” near the end of the wings of the BTS symbols. For fixed size BTS symbols, there is a problem as the “connector” position depends on the zoom level. For the optimal solution, all “connector” positions have to be recalculated after a zoom and all server lines and markers have to be repositioned or redrawn. The action is not possible in short time. Implemented compromise uses the fixed “connector” positions, also for the fixed size BTS symbols. You can adjust this compromise for best results by "Fixed size connector distance". The default is 90 m.
- "Minimum symbol size for automatic sizing of symbols"
  Defines the minimum symbol size for automatic sizing in percentage.
- "Symbol transparency"
  Transparency of a BTS symbol can be adjusted to make visible the contents of other layers behind the BTS symbol.

Limiting the Display of BTS Symbols

Only the BTS symbols within a given radius (in meters) around the current position are displayed. Displaying large number of BTS symbols reduces the system performance in sense of memory and processing capacity. For the optimization reason, only the BTSs which are of interest in the current measurement situation and near to a measurement location has to be displayed.

- "BTS symbol display"
  The threshold introduced is the vertical size of the map in [km]. If the vertical size is below the threshold, all BTS symbols in the view are automatically displayed. If the initial vertical size of the view is above the threshold, only BTS cell symbols as place holders in areas where BTSs are located are displayed. One BTS symbol per area of 1 square degree (°) is shown.

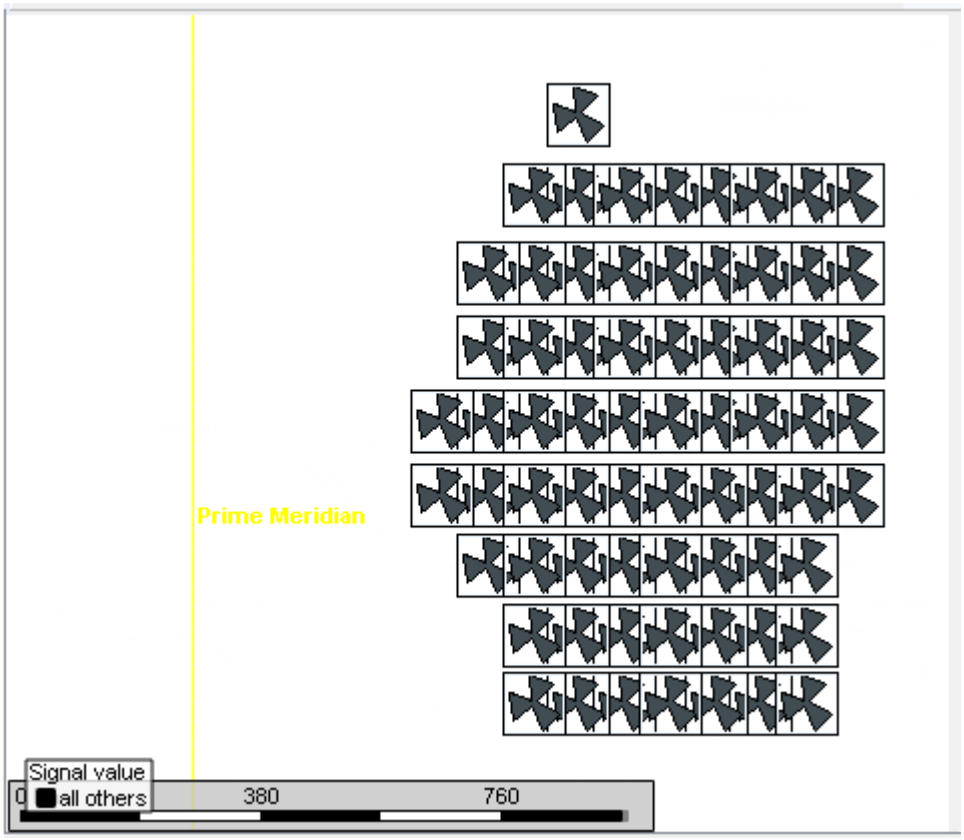


Figure 4-232: Limited display - only BTS symbols displayed

The BTS cell symbols can be expanded into BTS symbols:

- Manually, by [Shift+click] a BTS cell symbol
- Automatically by zooming deep enough, so that the vertical view size goes below the threshold

Once a BTS cell symbol is expanded into BTS symbols, it stays expanded until the BTSs are deleted or redrawn because of configuration changes.

Zooming in on the BTS cell symbol does not mean to zoom in on a real BTS symbol, but to the cell area which contains at least one BTS symbol.

BTS Info Threshold

- "Short Info"
  Limits the radius to display the short information in the Bts Info bar.
  Also avoids too much text in the "ROMESMAP Route Track View". Enter the preferred value in the box to adjust the threshold of resolution below which no short info text is displayed.
- "Long Info"
  Activates the long information display in the "Bts Info" bar only if the map is shown in detail (deep zoom in), that means, if the set resolution threshold is exceeded, see Bts red marker and the Bts info bar.
  If being zoomed out, it is only annoying to have the "Bts Info" bar open while moving the mouse over the Bts symbols.

BTS cell maker mode
The default "Colored icon" option of the "BTS cell maker mode" function marks the serving cell and the neighbors as icons.

The "Colored cell" option-selected switches to colored cell symbols.

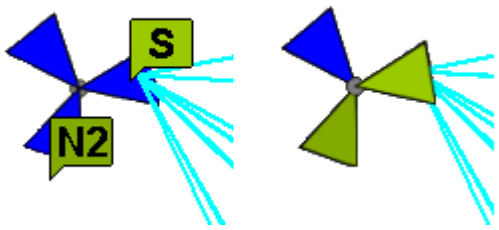


Figure 4-233: BTS cell marker mode - colored icon and colored cell

BTS Short Info Font
Sets a font type and the color of the font in the BTS short info texts displayed on the "Map View".

Note: The "Map View" does not support all available fonts. In case the selected font is not supported, the most similar supported font is chosen automatically.

ROMESMAP route track view configuration: RTM tab

The "Route Track Modules" tab lets you select the available modules (the technology-specific extensions) and make global configuration. Therefore, the function loads route tracks of the technologies and selects between mobile or scanner layer data per each track. The visibility of the route tracks in the map can be adjusted using this tab.

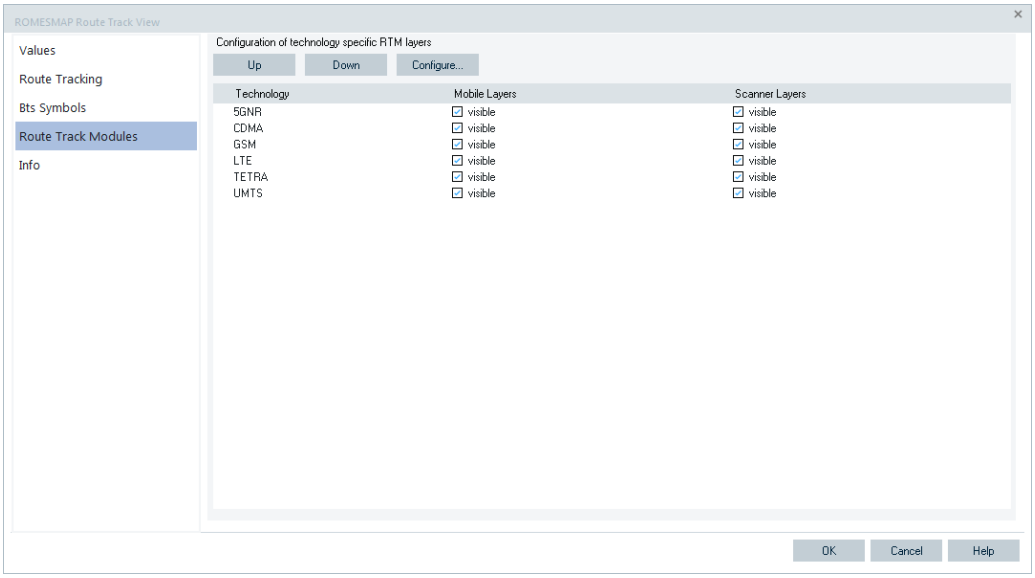


Figure 4-234: ROMESMAP Route Track View configuration - RTM

Up/Down
These buttons manage the order of the RTM layer. If more than one technology-specific layer is made visible, the order can be managed. By default, all technology layers are visible, see the previous figure.

Configuration
Select a technology from the list and click the "Configuration" button.

The configuration dialog for the selected technology opens. For how to configure the technologies, refer to:

Chapter 4.3.3.13, "5G NR layer configuration", on page 675

Chapter 4.3.3.10, "GSM layer configuration", on page 663

Chapter 4.3.3.11, "TETRA layer configuration", on page 666

Chapter 4.3.3.12, "LTE layer configuration", on page 667

Chapter 4.3.3.14, "CDMA2000 1xEV-DO layer configuration", on page 677

Chapter 4.3.3.15, "UMTS layer configuration", on page 679

Chapter 4.3.3.16, "Position estimator layer configuration", on page 680

4.3.3.6 Maps menu

The ≡ button opens the context sensitive menu dealing with map files. The menu offers loading and positioning raster images to the "ROMESMAP Route TrackView", for example, the background maps.

The valid MapInfo map files have a standard bitmap format. The geographic positioning information assigned to a bitmap is stored in a TAB file, i.e. a text file with the same name but with the extension `*.tab`.

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TreeView 614
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- 3D View 616
  - Visualization of 5G dron measurement 617
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Load Map

Click the "Load Map" menu to see the basemaps offered by the locally running server, the RsMapsStudio.

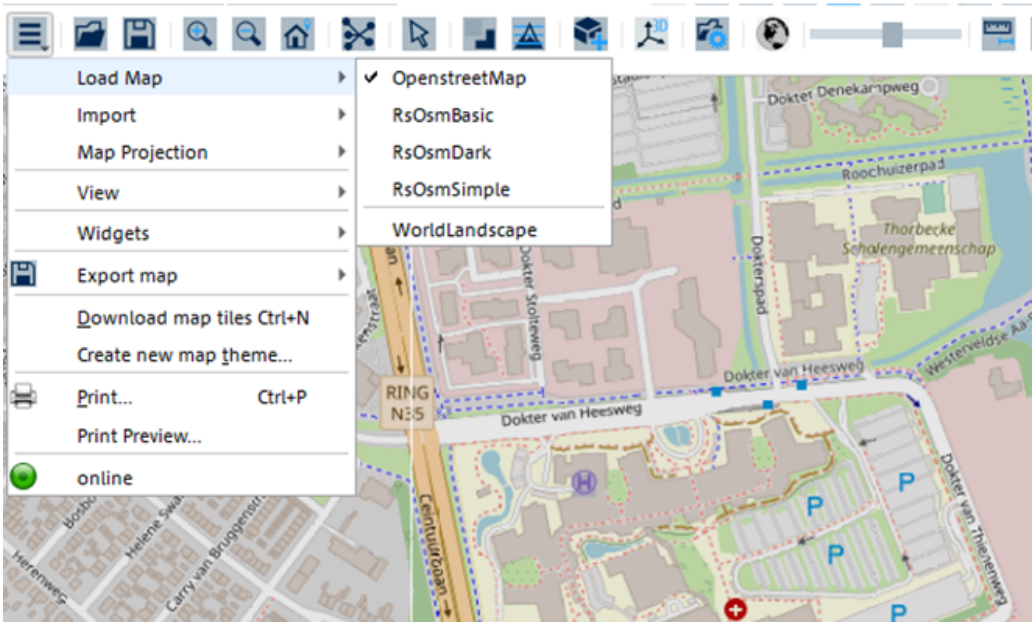


Figure 4-235: Maps menu – OpenstreetMap

The SmartOne setup installs the RsMapsStudio.

If successfully installed, RsMapsStudio map server runs a windows service.

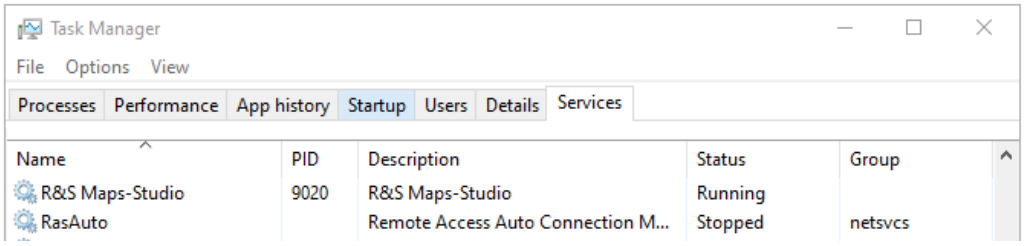


Figure 4-236: RsMapsStudio service runs

The RsMapsStudio setup supports the OpenstreetMap. Also, the server supports the "RsOsmBasic", "RsOsmDark" and "RsOsmSimple" basemaps which do not offer high zoom level details.

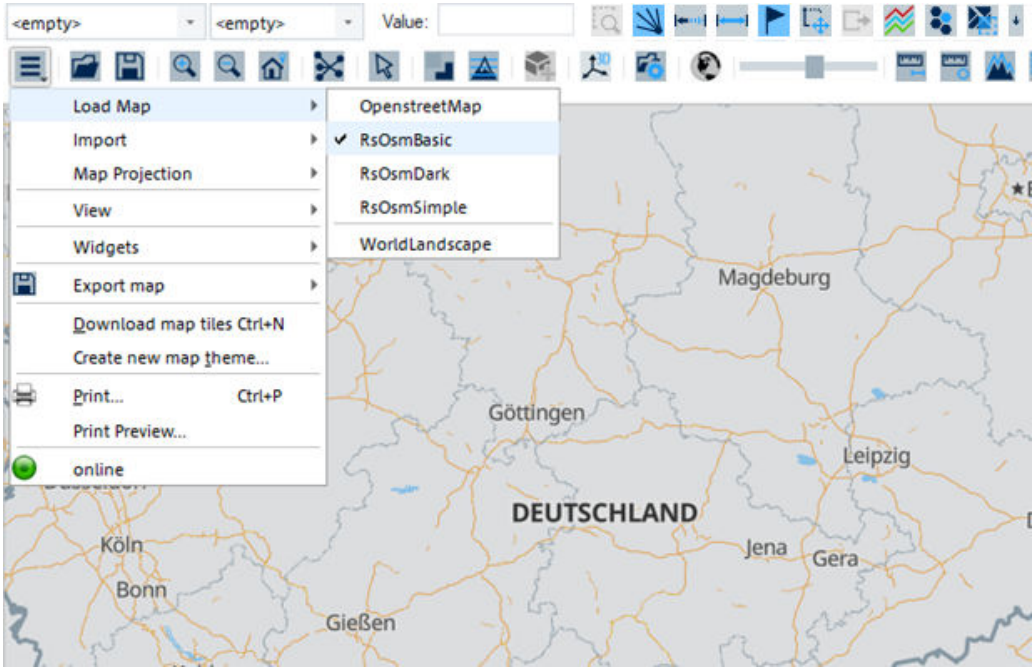


Figure 4-237: RSOsmBasic map

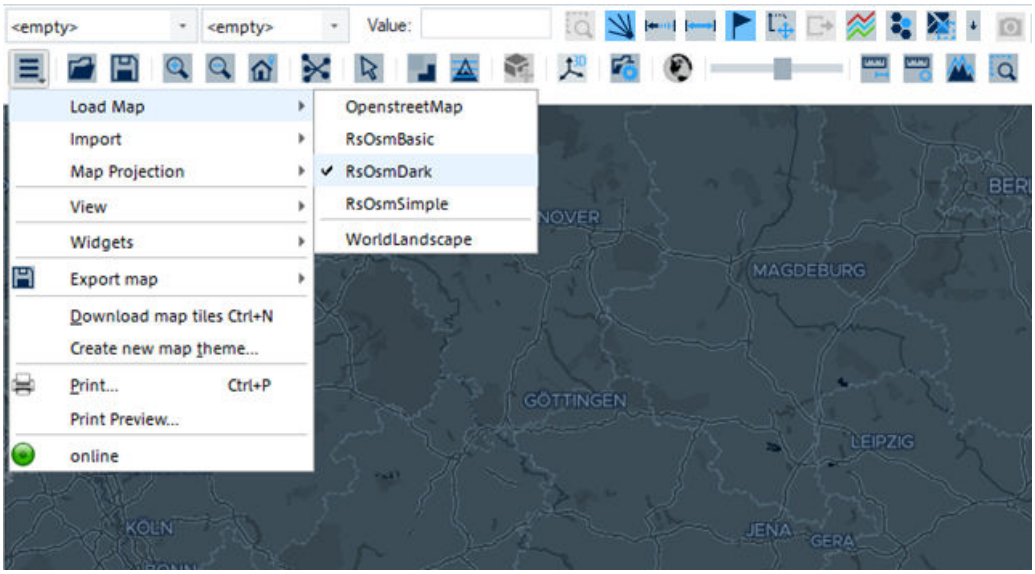


Figure 4-238: RSOsmDark map

To install a map for the RsMapsStudio:

1. Download the detailed, high zoom level mapdata (offline maps) for RsMapsStudio from GLORIS. Use the following link for download:

https://gloris.rohde-schwarz.com/irj/portal/interop?NavigationTarget=ROLES://portal_content/rus/core-ext/Anonymous/LogonCustomSamlRedirector&iFrameMode=true&forceLogonRedirectUrl=/irj/portal/mnt_product_page?uvs-visible-tabs-config=product&uvs-tab=rusext-gloris-tab-all&uvs-searchterm=*

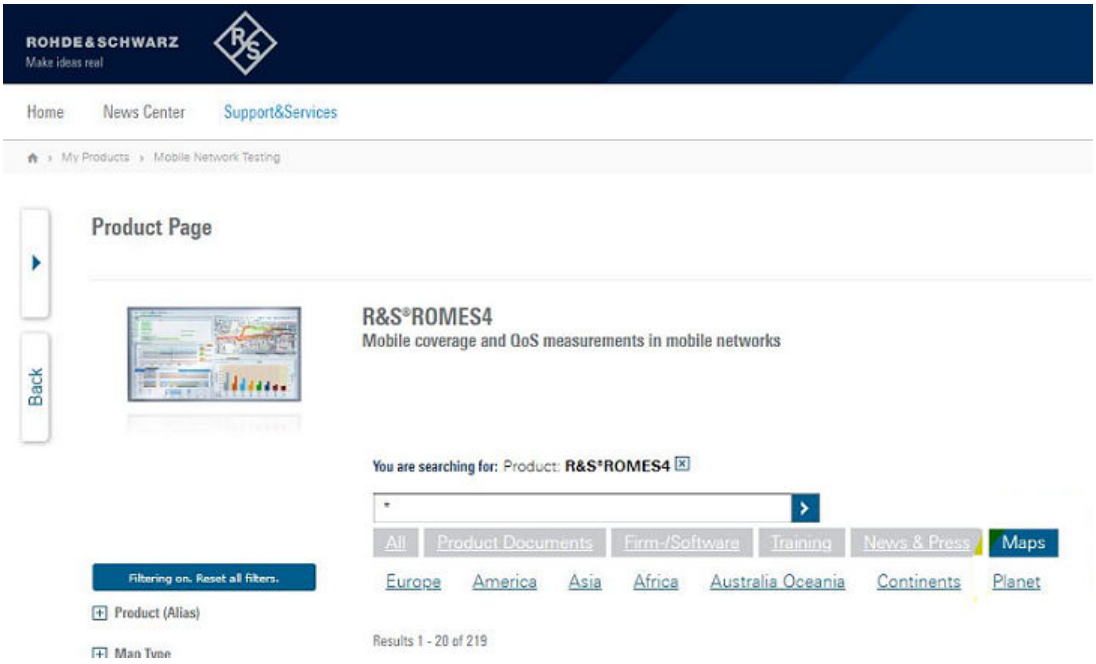


Figure 4-239: Location of the offline maps for RsMapsStudio

The maps are located under the "Maps" > "Planet" in the GLORIS.

2. Launch MapsStudio by clicking the button.

3. This action launches the RsMapsStudio WebApp.

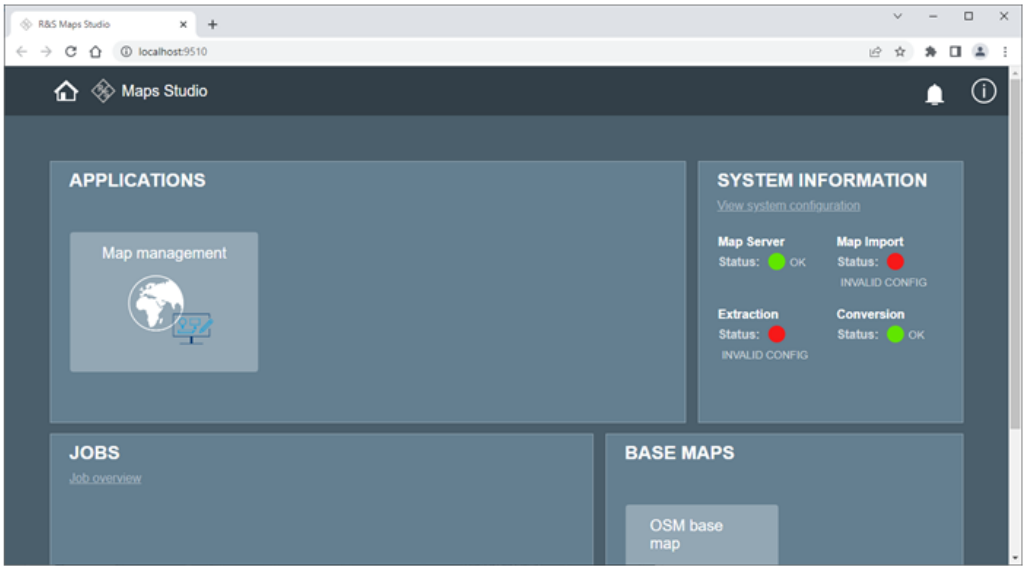


Figure 4-240: RsMapsStudio WebApp

4. Click the info button on the right top-corner. The "Maps Studio" > "ABOUT" window pops-up.

5. Click the "Show User Manual" to get the detailed information how to install new maps for MapsStudio.

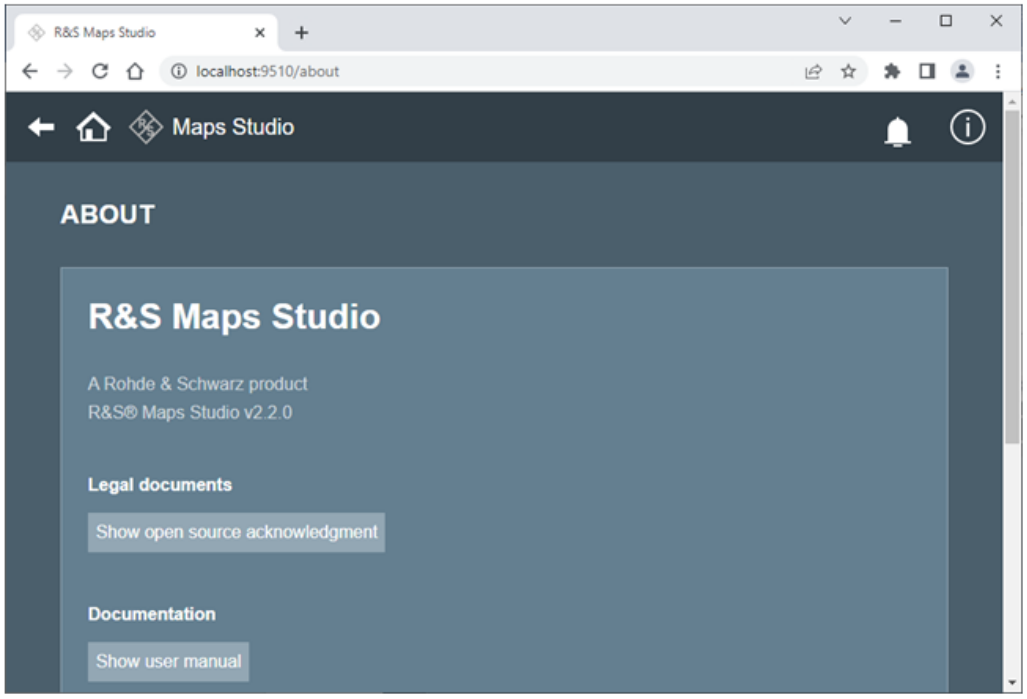


Figure 4-241: Available R&S Maps Studio user manual

Note: Instead of requesting the offline maps from the R&S second-level support, you can download maps from R&S GLORIS.

OpenStreetMap (*.dgml) ← Load Map
The OpenStreetMap (OSM) server is embedded in the R&S Map server. Hence, the OpenStreetMap is available from the R&S Map server of the ROMESMAP Route Track. OpenStreetMaps are downloaded from the OpenStreetMap Community and cached for use in R&S ROMES4.

During start-up, the R&S Map server checks whether it is on- or off-line. If on-line, all map data which is needed but not found in the local cache, is downloaded immediately and cached for further use. If off-line, only cached map data is used.

Note: Impact on measurement results. Do not start the "ROMESMAP Route Track View" with an OpenStreetMap server while a DQA measurement is active. The map server data presumably uses the DQA RAS connection which has an impact on the measurement result.

Start the OpenStreetMap server by loading it.

1. To load the OpenStreetMaps in the "ROMESMAP Route Track View", click > "Load Map" > "OpenStreetMap".

In case the PC is behind a proxy, you have to set the proxy first. Click to open the proxy settings dialog.

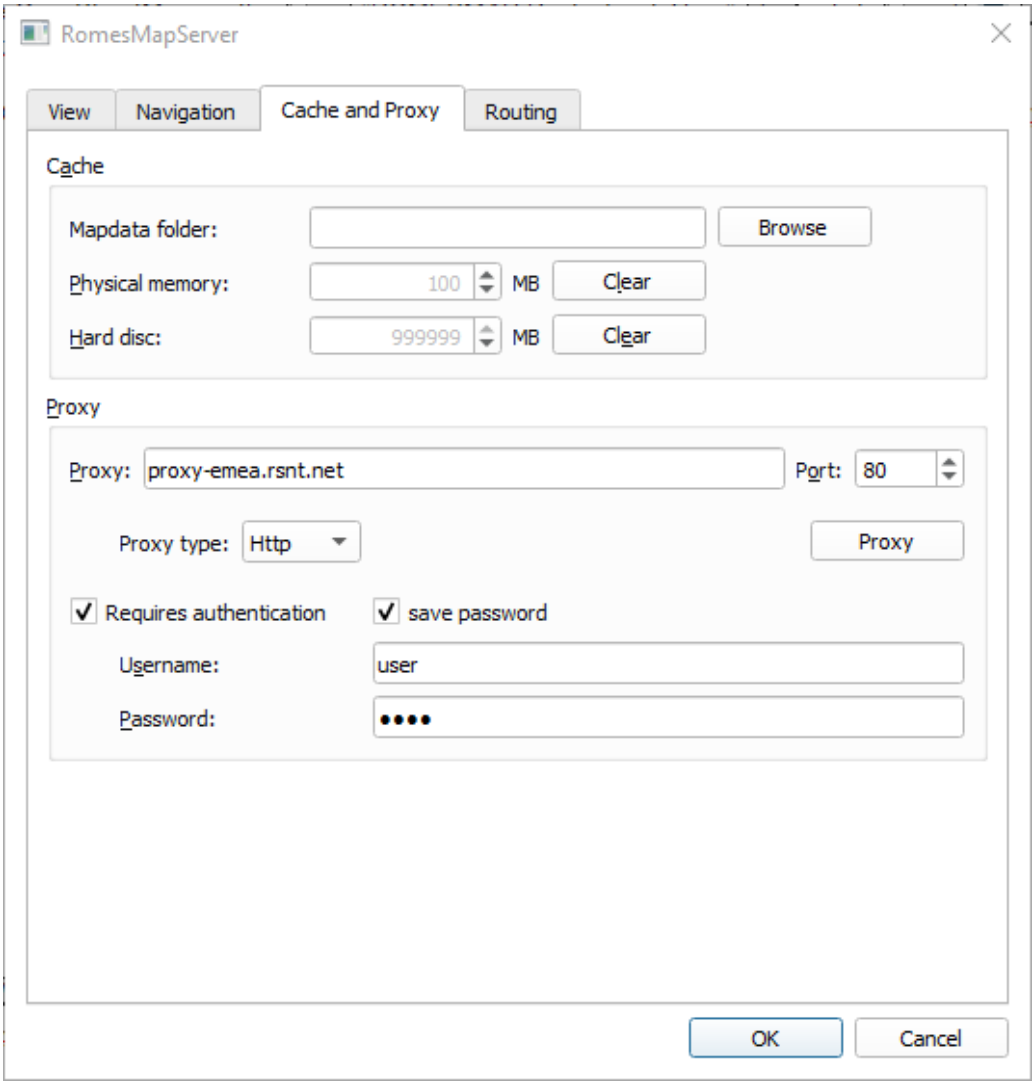


Figure 4-242: Proxy settings dialog

2. Enter the proxy data and select "save password".

3. Click "OK" to confirm the settings.

Map data is downloaded and copied to a cache storage on the local disk, as needed for display for each map and zoom level. Otherwise, only the world map with the lowest zoom level is available.

Maps are updated on request. Whenever a new area or a new zoom level for an area has to be displayed, the map data is downloaded automatically. Downloading lasts as long as there are no configured DQA job within the R&S ROMES4 measurement. Whenever a measurement containing a DQA session is active, other downloads are suppressed by the R&S ROMES4 automatically.

Configuration of the OpenStreetMap Server

Configuration of the OpenStreetMap server is only needed, if you want to have your own server for OpenStreetMaps. The configuration data is stored in the file `openstreetmap.dgml`, which is loaded during the server start-up.

The link to the server is stored in the following lines:

```
<downloadUrl protocol="http" host="a.tile.openstreetmap.org" path="/" />
<downloadUrl protocol="http" host="b.tile.openstreetmap.org" path="/" />
<downloadUrl protocol="http" host="c.tile.openstreetmap.org" path="/" />
```

These lines can be changed freely. Up to three links are accepted. The "path" in the link points to the location, where the tiled maps are stored. For the OpenStreetMap server, this path must contain "/". If the server of your company stores these files, for example in "tiles", a valid link is:

```
<downloadUrl protocol="http" host="www.myopenstreets.de" path="/tiles" />
```

During installation, this file is stored and updated in the application data section of all users.

Import

The "Map View" supports import of raster/vector layers.

- "GeoData"
  Supported formats are: Google KML/KMZ, Garmin GPX, MicroWorld Database II (*.pnt), S57 marine vector data.
- "Image layer"
  Supported formats are: Georeferenced images (GeoTiff). Other formats like JPEG, PNG are supported if a Word file is available. Also there is a resolution.
  Limitation depends on your graphic device. If import fails, use the R&S GeoRefWizard to crunch your image into small tile maps.
- "ESRI layer"
  Supported formats are: ESRI Shape `*.shp`, ESRI Grid `*.adf`, ArcInfo `*.e00`.
- "MapInfo layer"
  Supported formats are: MapInfo Tab (`*.tab` raster/vector layer), MapInfo Mif (`*.mif`) and MapInfo Mid (`*.mid`).
- "Add Image"
  Use this option for not referenced images of indoor measurements. A `*.kml` file with a default referencing is created.
  Click "Add Image" to get a dialog where a projection, resolution and a fix point can be defined for creating default TAB file for the image.

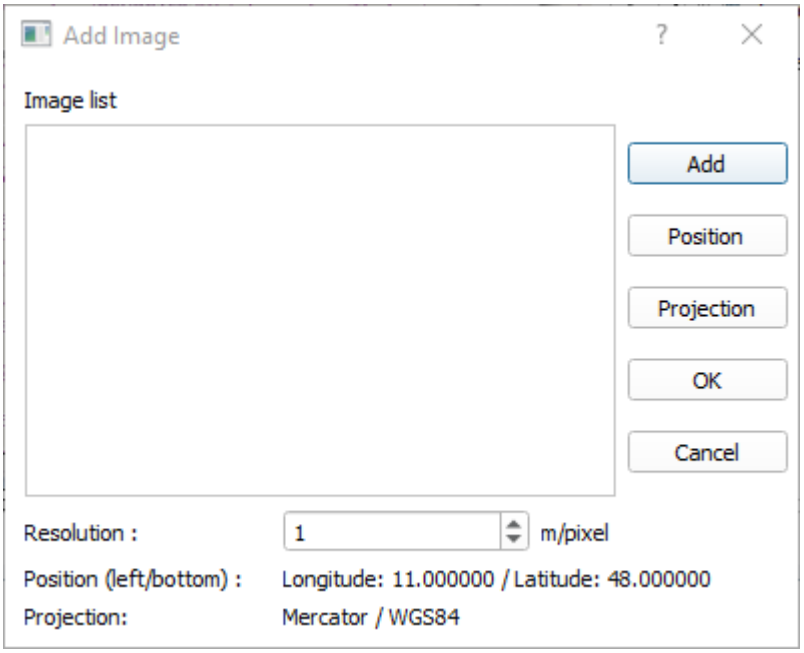


Figure 4-243: Add Image

– "Add"
An image file must be selected. If pressed, the "Select one or more files" dialog appears where you can choose a file for loading. Supported image formats are: PNG, JPG, TIF and BMP.
– "Position"
Selects the Geo coordinate format. The selected position is shown in the "Position (left/bottom)" line of the "Add Image" dialog.

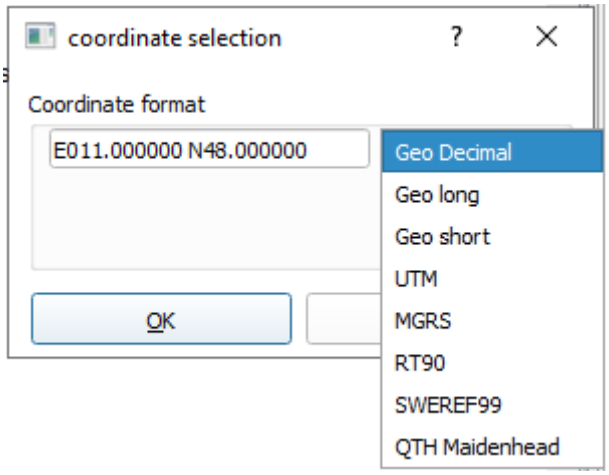


Figure 4-244: Select the preferred coordinate format

– "Projection"
Lets you select a projection type or create your own in the "Projection settings" dialog which is displayed when the Projection entry is clicked.

Note: If the projection of the used map and the one used in R&S ROMES4 do not match 100%, the displayed route can be slightly shifted during panning and/or zooming.

  - "Resolution"
    Resolution in meters per pixel.
  - "OK"
    Selected image is loaded and a `*.tab` file is created with the parameters described previously.
  - "Cancel"
    Cancels loading the selected image.

- "Add Indoor Floorplans"
  The function adds/imports indoor floorplans into the ROMESMAP view by activating the Indoor Floorplan Manager.
  The R&S ROMES4 handles indoor floorplans differently than "normal" map layers in a way that it offers the Indoor Floorplan Manager functions to handle both georeferenced and non-georeferenced maps. For details see Chapter 4.3.3.7, "Indoor floorplan manager", on page 633

Map Projection
The "Map Projection" menu offers three map projections:
- "Globe": Spherical Mercator
- "Mercator"
- "Flat Map": Equirectangular

The WGS84 ellipsoid is used by all projections.

TreeView
Shows/hides the "TreeView" of the "ROMESMAP Route Track View". The "TreeView" is by default closed.

To open it, click and select the "View" > "TreeView" entry in the pop-up menu of the "ROMESMAP Route Track View" tool bar. Move the vertical splitter to the right to adjust the view size.

The "TreeView" offers to set the ROMESMAP and legend overlays and select layout of the OpenStreetMap.

Insert Buildings ← TreeView
If is activated, the raw OSM buildings height data is downloaded and stored in *...\mapdata\buildings*.

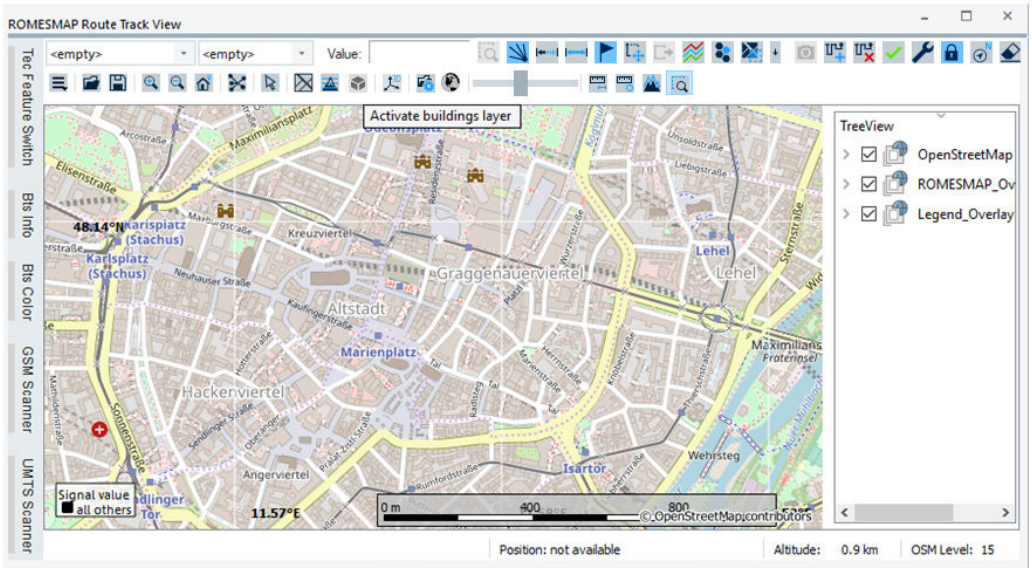


Figure 4-245: Button to activate buildings layers

The function is activated starting with OSM zoom level 15.

Also, the buildings are rendered over the map.

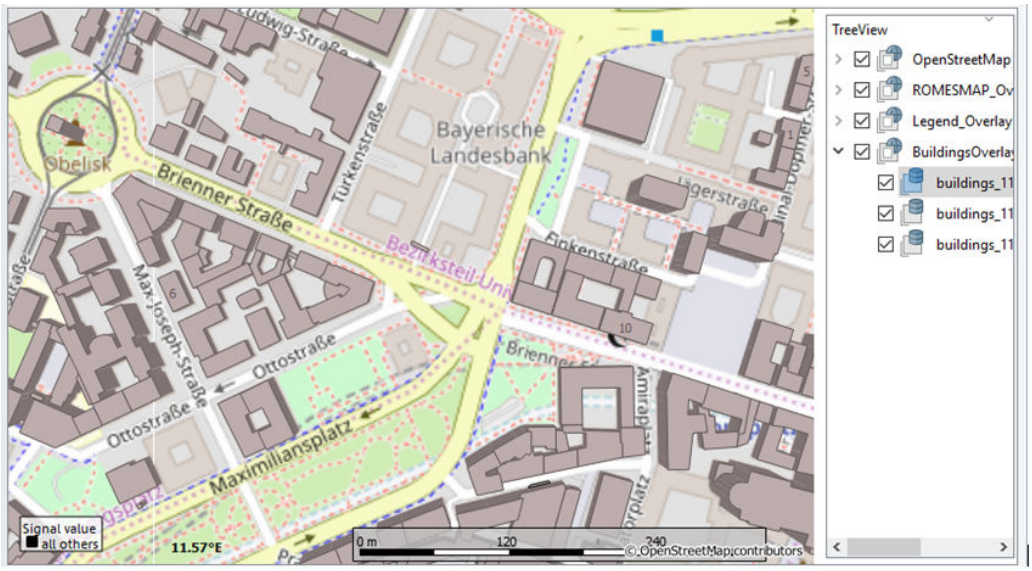


Figure 4-246: Buildings presentation in ROMESMAP Route Track View

If you want to remove one or all building layers, use the "TreeView" > "BuildingsOverlay" > "Delete" context menu command.

To load existing `*.osm` file, click , that is, the "Insert buildings" function.

To use downloaded `*.osm` files on other systems, copy them into *...My ROMES\mapdata\buildings* directory. If the directory does not exist, create it.

3D View ← TreeView

The navigation through the 3D "ROMESMAP Route Track View" map can be:

- Pan map - press and hold the left mouse button, move mouse; the map moves in all directions.
- Rotate map - press and hold the right mouse button, move mouse left-right.
- Tilt map - press and hold the right mouse button, move mouse up-down.
- Zoom map - use navigation control (the roller on the left side) or the mouse wheel to zoom in/out the map.

BTS symbols are grouped to clusters, starting with the map zoom level less than 13.

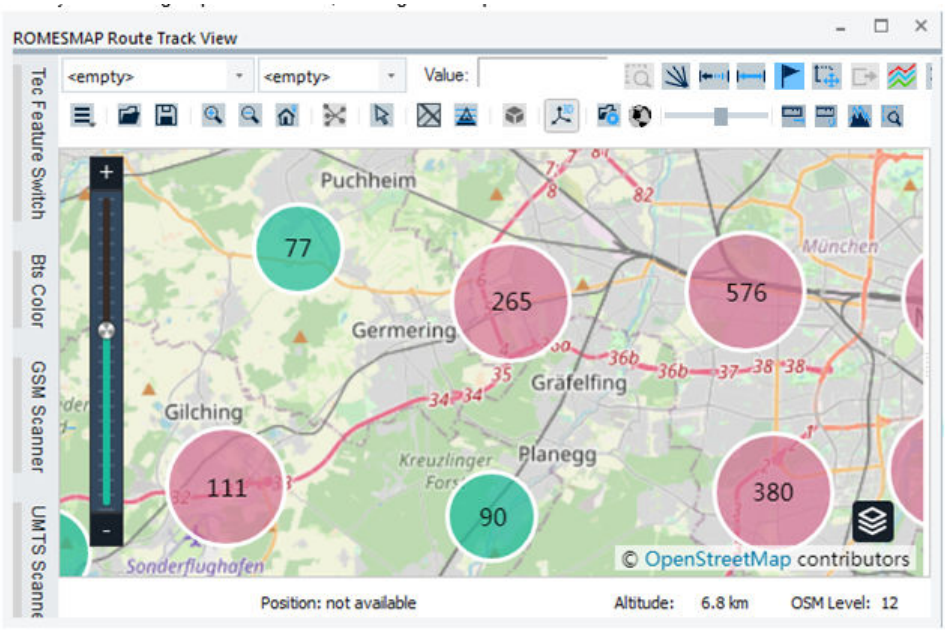


Figure 4-247: Clusters of grouped BTS symbols

For seamless map zoom, the zoom step resolution can be changed.

Click the button to open the RomesMapServer settings dialog. Select "Navigation" and change the seamless zoom step. Check the "seamless zoom" box and choose the number of seamless zoom steps in the "seamless zoom stepes" dropdown box. If the value 12 is chosen, the choice means that you need 12 mouse wheel ticks to zoom a full OSM zoom level. For example, 12 mouse wheel ticks to change from OSM level 10 to level 11.

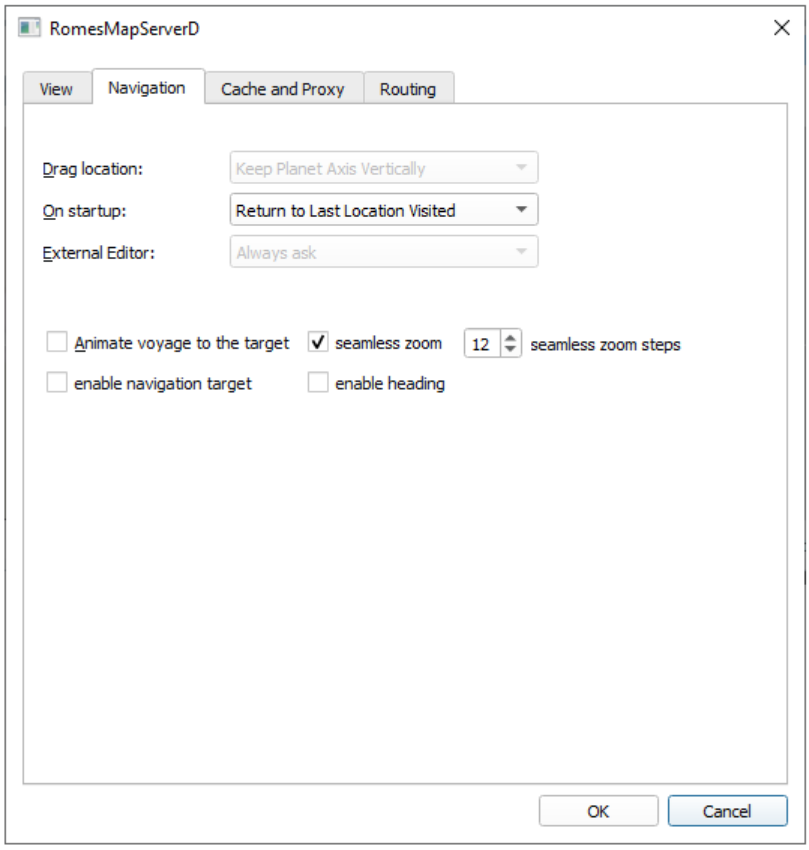


Figure 4-248: Set seamless zoom steps

Note: If the "ROMESMAP Route Track View" is used in 3D mode, changes in Window's "Display" > "Scale and layout" settings require R&S ROMES4 restart. Otherwise, the legend disappears. Other unwanted issues can occur.

Visualization of 5G dron measurement ← 3D View ← TreeView
The "ROMESMAP Route Track View" can visualize a 5G drone measurement file and 5G BTS stations with height above ground values.

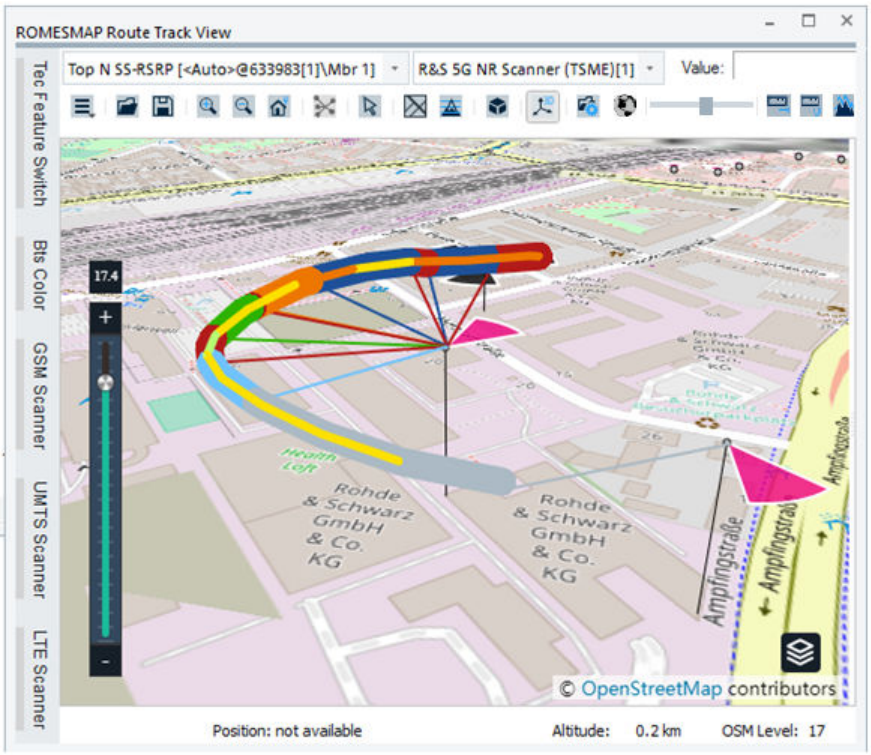


Figure 4-249: Visualization of a 5G drone measurement

The mentioned visualization capability means that R&S ROMES4 supports the height above ground (HAG) parameter.

If you hover mouse over a BTS or a signal route (dependent on availability of each), a HAG value is displayed next to the "Position" (Longitude/Latitude) section.

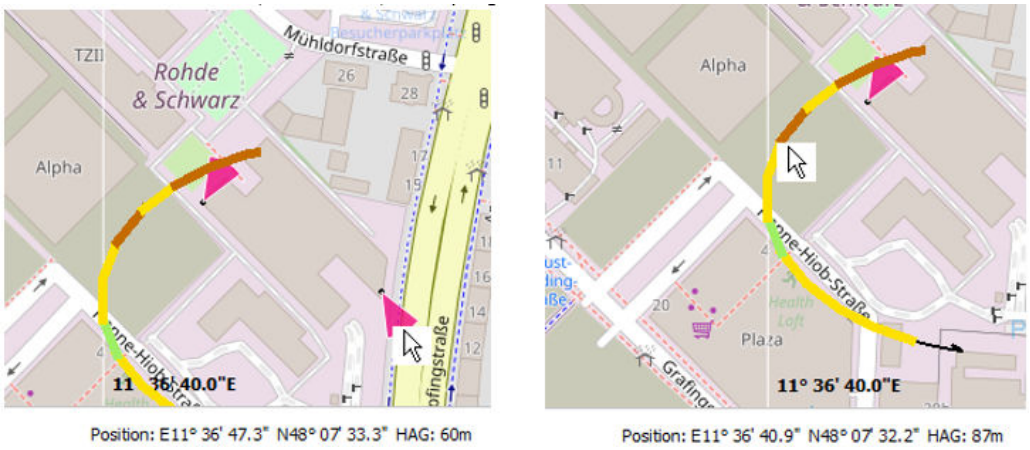


Figure 4-250: HAG value displayed if mouse hovers over BTS or signal route

3D Building Layer ← 3D View ← TreeView

If the map zoom level is higher than 12, you can activate building layer for display.

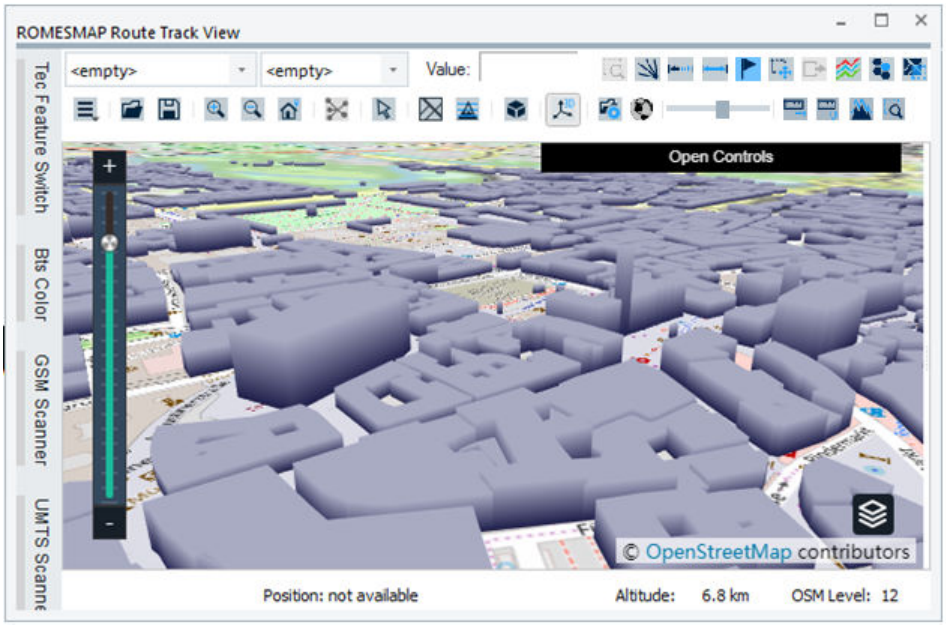


Figure 4-251: Activated building layer in 3D view

The buildings layer data is downloaded and rendered for a predefined area around the current map center.

Use the "Layers" control (the right-bottom button) to enable/disable buildings layer. The button lets you select between the "Bulidings" and "BTS" layer.

Pan the map to a new center and activate buildings button again to download and render changed area.

Use the "Open Controls" button on the top-right of the view to control/change some settings (for example, buildings color or opacity).

Note: Enabling the building layer in 3D view requires the Internet connection availability.

Add Compas Control ← 3D View ← TreeView
The 3D ROMESMAP Route Track view offers adding the compass control. The compass control, located right-top, visualizes current rotation.

Figure 4-252: Compass usage in 3D view

Double click left mouse-button resets rotation and pitches compass to zero.

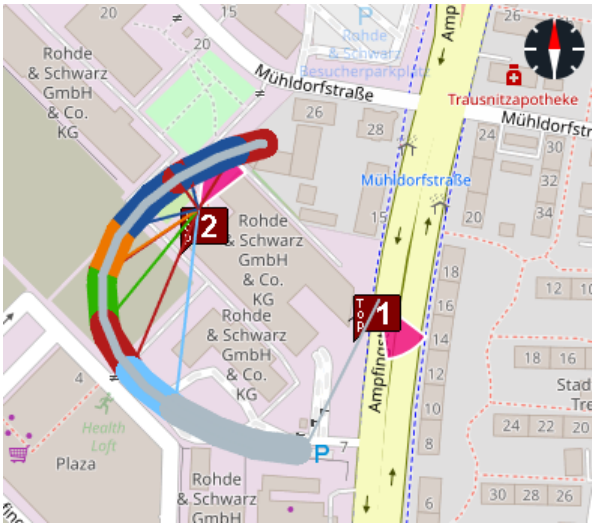


Figure 4-253: Reset rotation

Altitude Mode for 3D View ← 3D View ← TreeView
By default, signal route in 3D view is painted by respecting altitude values.

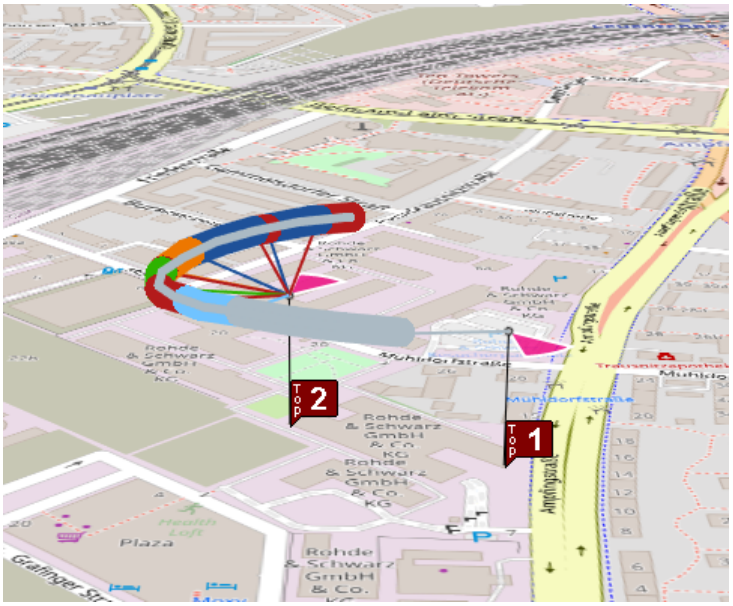


Figure 4-254: Respective altitude values of signal routes

To ignore altitude values, click any point in the ROMESMAP Route Track area to open the "Configure" dialog, select the "Route Tracking" tab and tick the "Ignore altitude" check box.

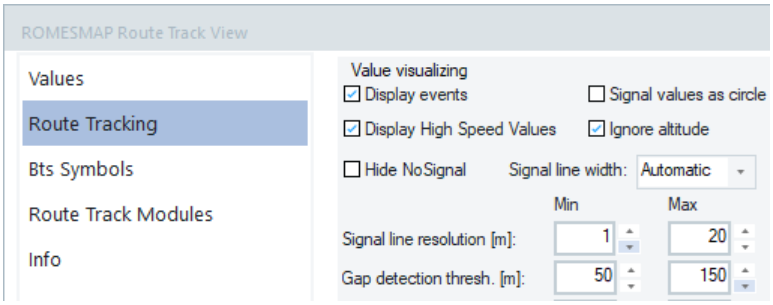


Figure 4-255: Segment of the Route Tracking dialog

Ignoring altitude values means to paint a signal route as grounded, as shown in the following figure.

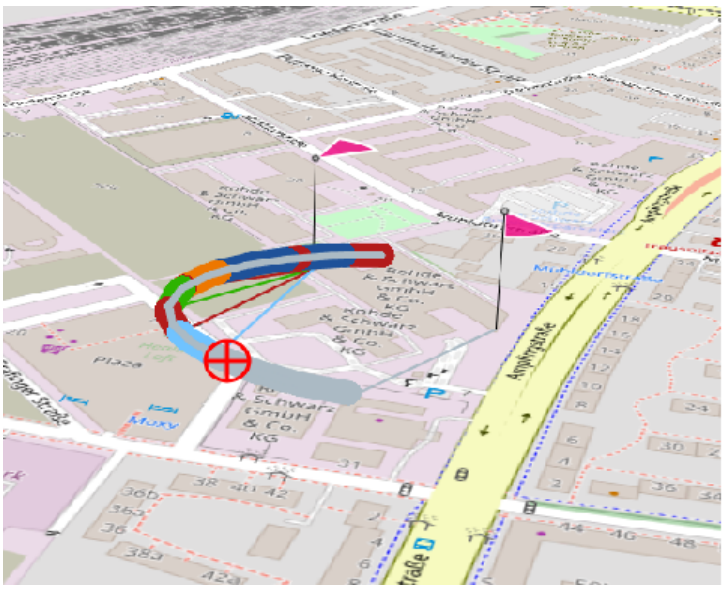


Figure 4-256: 3D view shows grounded route

Note: After changing the configuration, switch to 3D view and select the "3DView reload" command in the menu of map's view.

Add Legend to 3D View ← 3D View ← TreeView
"Legend" can be switched on/off via "Layers" control.

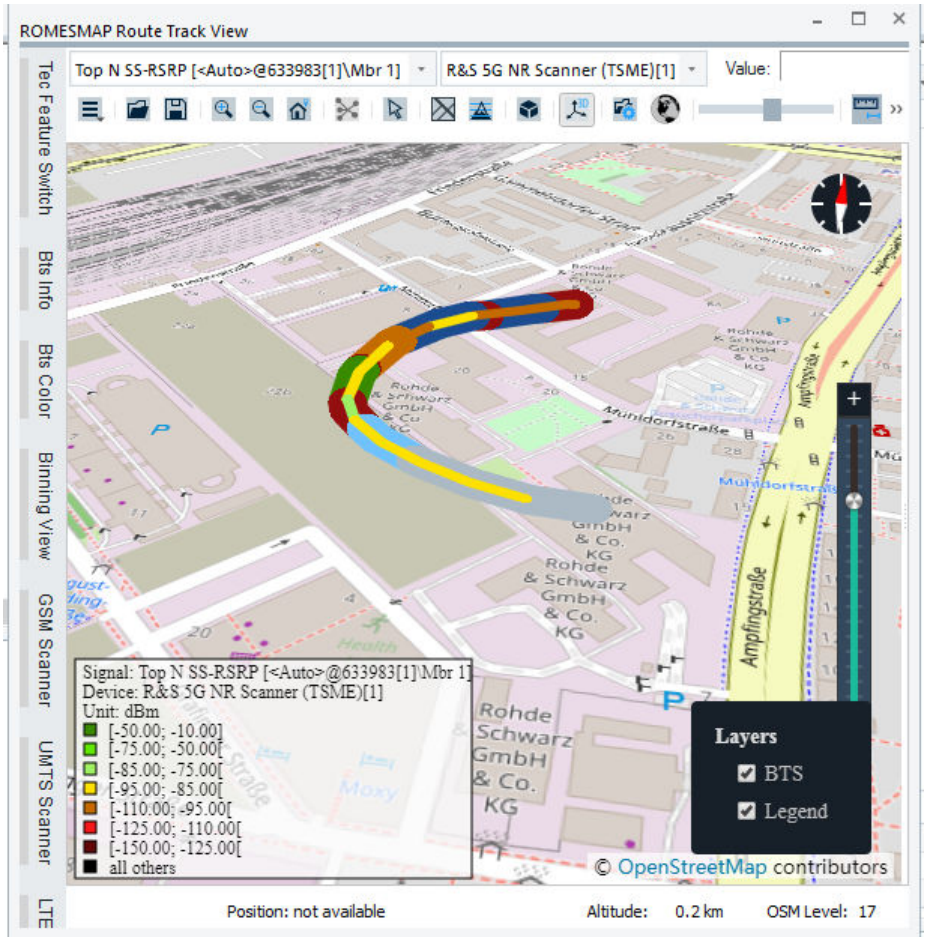


Figure 4-257: Activation of legend in 3D view

Add Layer Mover ← 3D View ← TreeView

Click the "Layer Mover" button to open the "Layer Moved" dialog. Select a signal in the dialog and move to one of the available directions. The selected signal moves correspondently in the view.

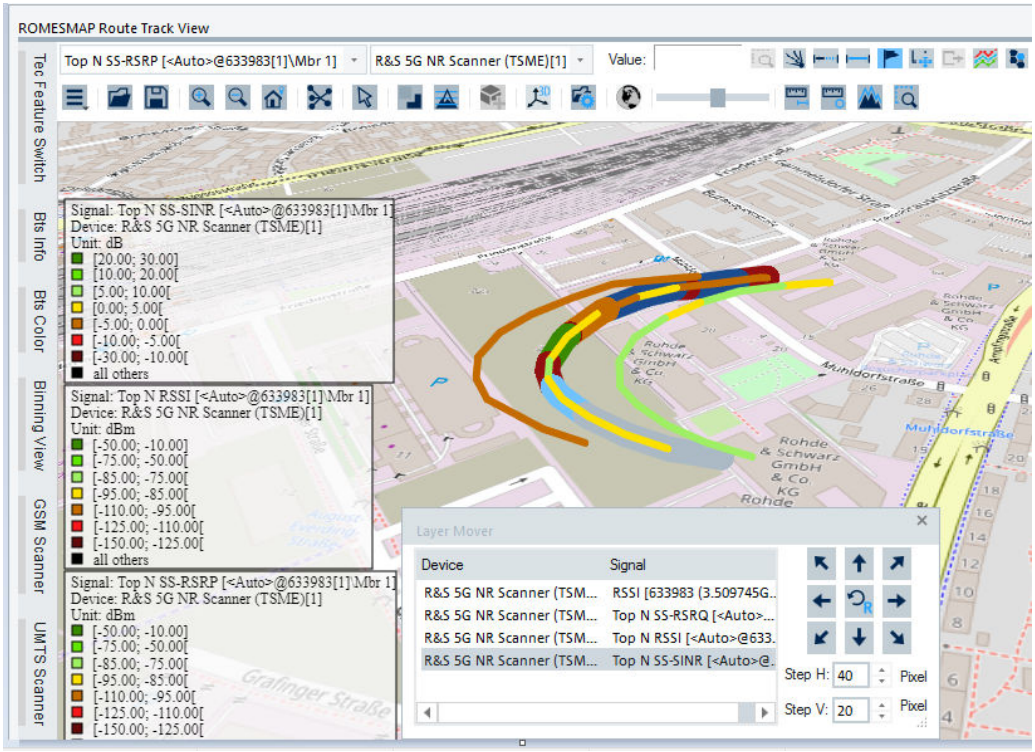


Figure 4-258: Layer mover in 3D view

Drag and Drop in 3D View ← 3D View ← TreeView

Drag&Drop function is supported in 3D ROMESMAP Route Track View.

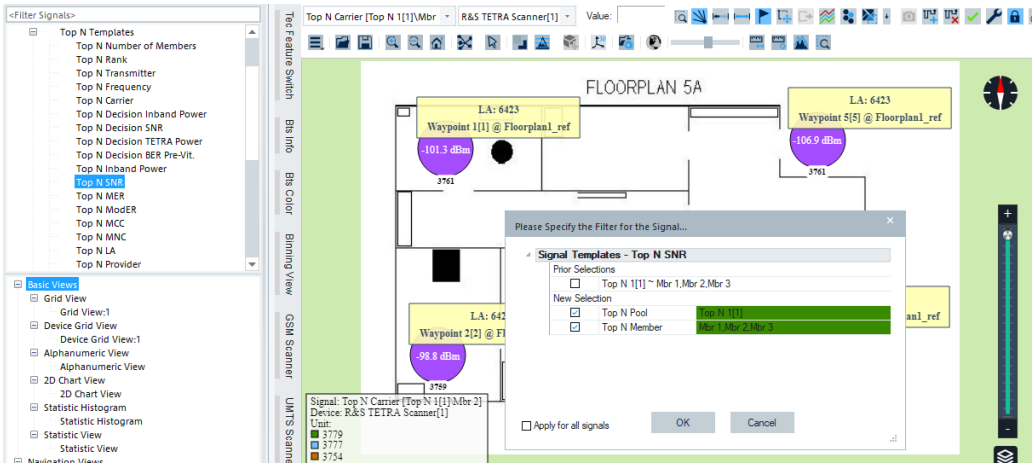


Figure 4-259: Drag&Drop support in 3D view

3D View Reply Mode ← 3D View ← TreeView

The replay mode of the 3D ROMESMAP Route Track view is shown in the following figure.

Figure 4-260: Replay mode of 3D view

Switching to other bitmaps is done by using the same menu as in 2D view. Click the "Top Map Layer" icon and select the wanted map in "Load Map".

You can select various 3D view layouts if using the available tool buttons. The following figure shows the grayscaled mode and the elevation shading layer activated by corresponding buttons explicitly named in the figure.

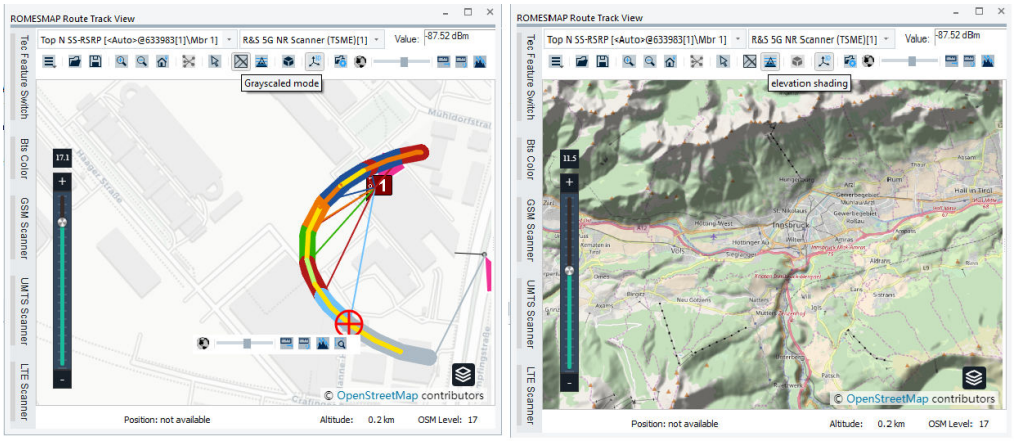


Figure 4-261: 3D view - grayscaled mode and elevation shading layer

The signal values in the 3D ROMESMAP Route Track view can be shown as circles.

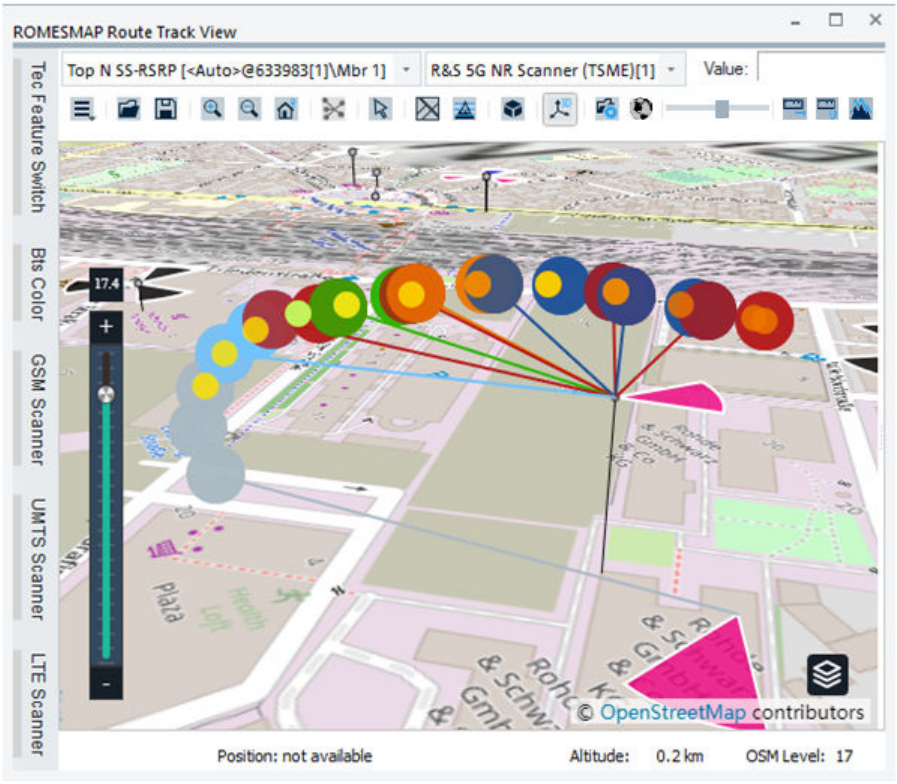


Figure 4-262: Signal values shown as circles in 3D view

If a Position Estimator (PE) measurement file is loaded, the estimated BTS stations along with confidence sector are displayed.

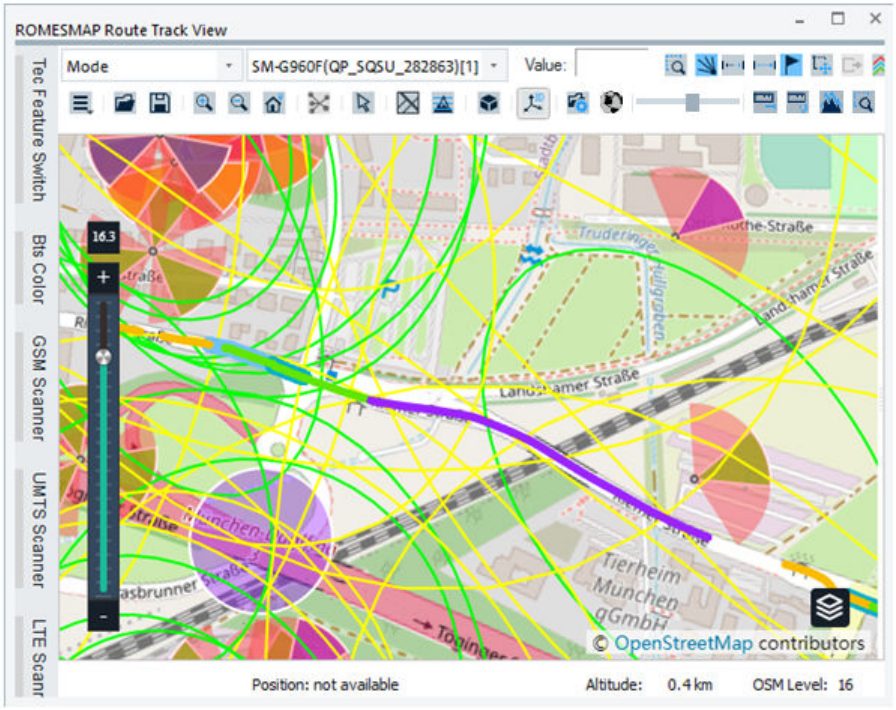


Figure 4-263: Estimated BTS stations

If a 3D view rendering error occurs, use the "View" > "3D View reload" command of the "Top Map Layer" button.

Widgets

The following widgets are available:

- "Compass"
  Displays right/top on the map; In case the map is turned, use left click into the compass rose to reset turning.
- "Elevation Profile"
  Creates a route or measurement to view its elevation profile.
- "Scale Bar"
  The scale bar shows the current scale. Right click on the scale bar to open context menu, enable or disable "Ratio scale".
- "Navigation"
  Provides the map view with additional navigation possibilities like scroll, zoom and go home, as described in Figure 4-181.
- "Overview Map"
  Shows a world map. The placemark shows the location of the current map area, as described in Figure 4-181.
- "Download Progress"
  Some base maps relay on on-line services like OpenStreetMap (OSM). If a requested map tile is not saved to cache, the MapView function tries to download that tile from Internet. To see if currently download request is active, enable this option. A small circle is displayed at the right/bottom on the map showing the download progress.
- "Routing"

Provides the additional navigation information and route configuration, that is, the Marble configuration to speak driving instruction.

- "TouchNav"
  See the "Navigation" widget.
- "License"
  Displays the available licenses.

Export map

"Export map" offers to export screenshot or the high-resolution map of the current view to an image file. Supported formats are JPEG and PNG.

Download map tiles

Opens the "Download Region" dialog where you can specify:

- Way of region selection in the "Selection Method" pane,
- Part of the "ROMESMAP Route Track View" layout where to download the elevation data from the SRTM elevation data or map tiles in the "Elevation Data" pane,
- Download tile level range from start- to end-zoom level and view the number of tiles to download for specified levels in the "Zoom" pane.

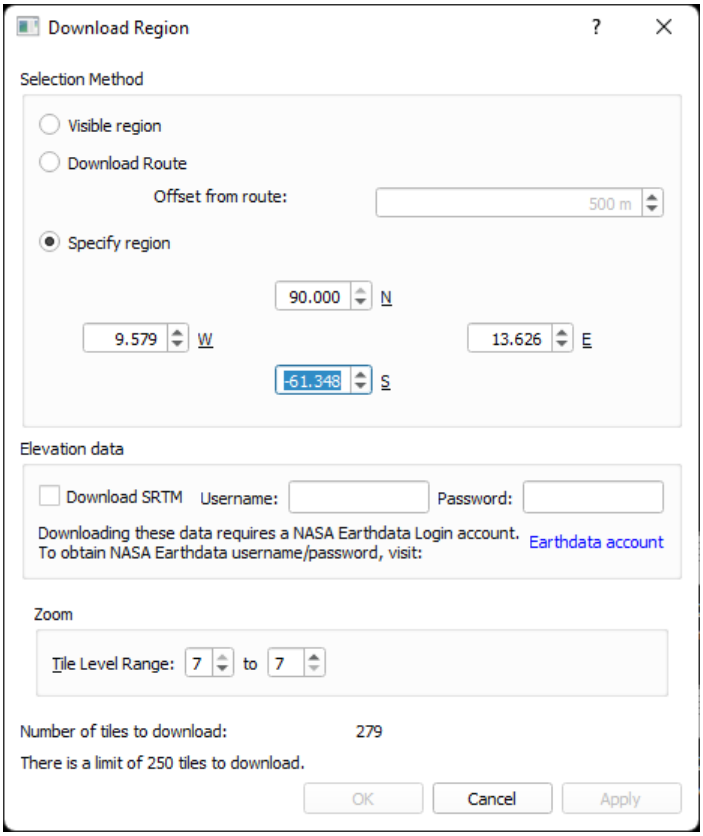


Figure 4-264: Download map tiles limit checked

Selection Method ← Download map tiles

- "Visible region"
  If selected, the region for which elevation data is downloaded is specified via zoom in/out or pan the map.

- "Download Route"/"Offset from route"
  Currently not supported.
- "Specify region"
  If selected, the region for which elevation data has to be downloaded is specified by entering the area coordinates.

Elevation data ← Download map tiles
The SRTM files contain elevation information. R&S ROMES4 needs SRTM elevation data download to calculate the heights above ground.

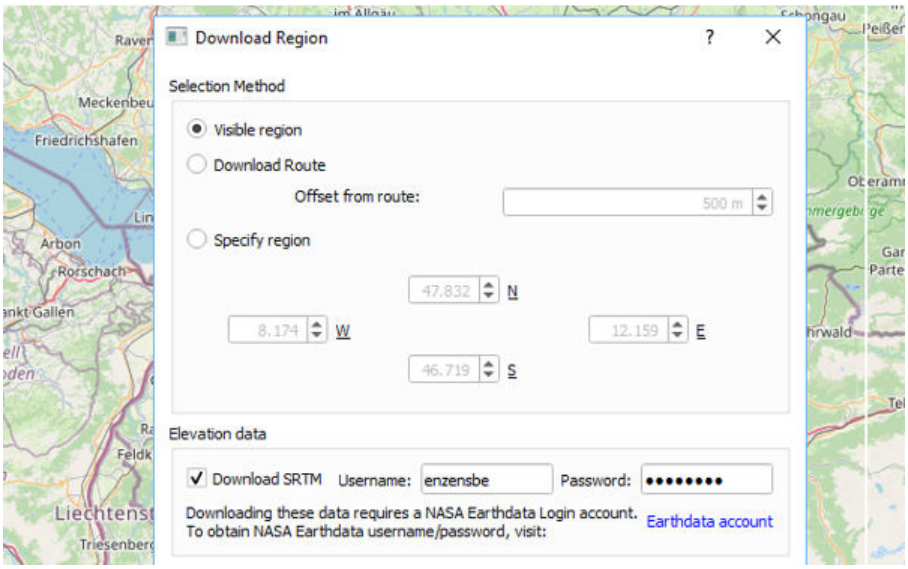


Figure 4-265: Activated download of elevation data

There are two parameters which set the BTS height when importing a BTS station list from the supported file formats (ATD, CSV, CDC, BUF). These parameters are:

- PosAltitude which defines the BTS height above sea level

- HightAboveGround which defines the BTS height above ground (HAG)

If the HightAboveGround parameter is not available in the BTS list, R&S ROMES4 calculates the height above ground from the PosAltitude parameter in the BTS list and the available SRTM elevation data.

To download SRTM elevation data files, proceed as following:

1. Set the current map view to an area for which you want to download SRTM files.

2. Mark the "Download SRTM" check-box in the opened "Downloads map tiles" > "Download Region" dialog.

3. Enter your "Earthdata" credentials.

Note: SRTM elevation data download requires a NASA Earthdata login account. To create an account, use the Earthdata account link. Set "Username" and "Password" obtained by your account.

4. Click "OK" or "Apply" to start SRTM data download. Downloaded files are stored locally as `*.hgt` files in ...\mapdata\srtm folder.

If you select "OK", the dialog "Download Region" closes and download runs in background. To observe download progress, click "Apply".

If "Download SRTM" is unchecked, the map tiles are downloaded.

The map tiles are stored in mapdata folder. The exact folder path is according to "zoom level{x-coordinate{y-coordinate" and depends on active basemap. For example, for the OpenstreetMap (OSM) the path is ..\mapdata\earth\openstreetmap\z\x\y.png.

SRTM server only supports SRTM data from 60° south to 60° north. SRTM data north of 60° are only available by request from R&S. If you set the download area north of 60°, a hint to request data from R&S is displayed.

Zoom ← Download map tiles
In the "Download Region" > "Zoom" > "Tile Level Range" combo-boxes select a download range from start- to end-zoom level.

The current OSM zoom level can be viewed as the "OSM" value in the status bar of the "ROMESMAP Route Track View".

Note: Count of SRTM elevation data size for download is a map zoom level dependent and limited to 50.
Count of tiles for download is a map zoom level dependent and limited to 250.000.

Number of tiles to download ← Download map tiles
Shows the number of tiles to download and the map tiles download limit, see Figure 4-264.

Elevation shading data map ← Download map tiles
For the 3D map, the function is a height display on a map important.

If the elevation shading data function is active, map tiles are rendered and the map is shaded corresponding to terrain height information.

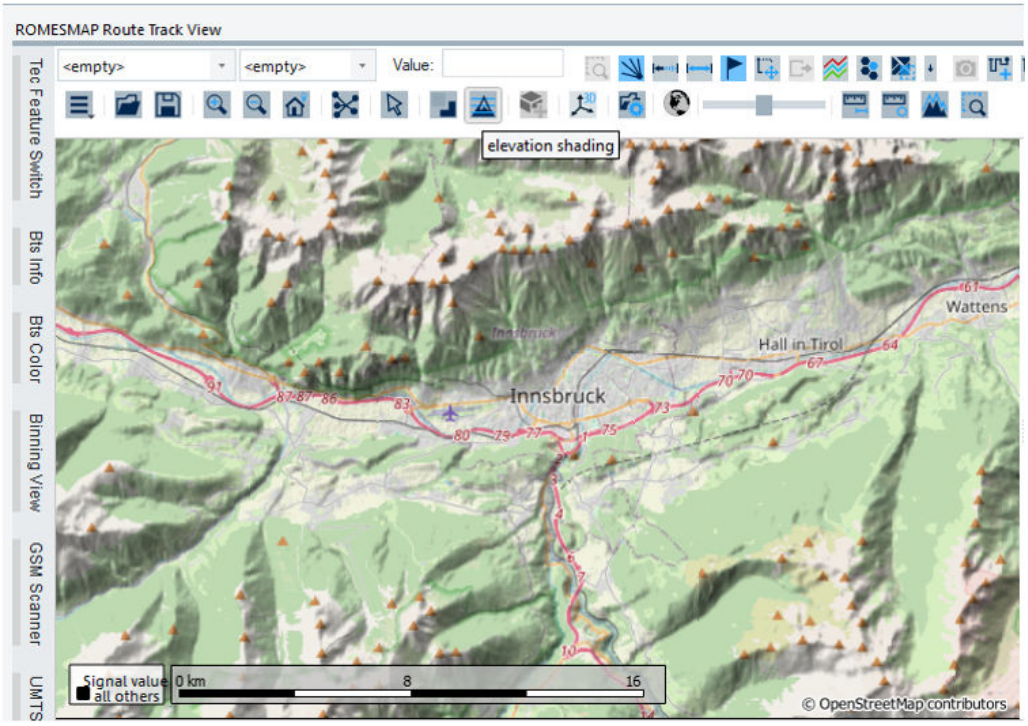


Figure 4-266: Example of elevation shading map

To enable this ROMESMAP Route Track feature, click the elevation shading button, . The elevation information is contained in the TSM server which is on-line unavailable. Therefore, the information cannot be downloaded from the server. To overcome this obstacle and display the elevation shading data, create these tiles from the SRTM elevation data files using R&S ROMES4 and the GeoRefWizard application.

Proceed as following to create elevation shading map tiles:

1. In Windows 10 search for the "R&S ROMES" > "Georeferencing Tool<version>" to open the "GeoRefWizard" dialog,

2. Select the "Open image" button in the top-left corner of the dialog, navigate to SRTM folder previously mentioned in the "Download map tiles" on page 628 and select one SRTM file from the <SRTM ('.hgt)> file type list to load.

3. The new elevation map tile has to be stored in *C:\Users\[username]\Documents\My ROMES\mapdata\maps\earth\elevation-shading*.

To set this map tile as output folder, select the ... button next to "Referenced file" and execute the choice.

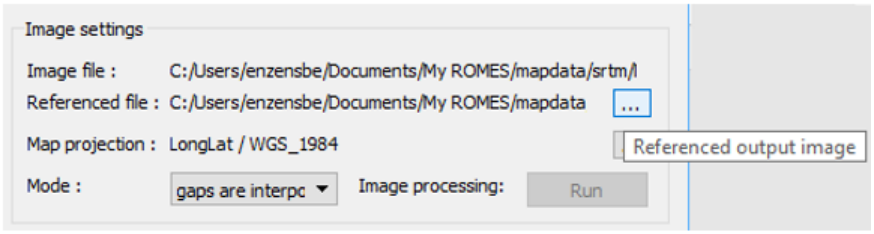


Figure 4-267: Setting map tile

4. Click "Create" to start elevation map tiles rendering.

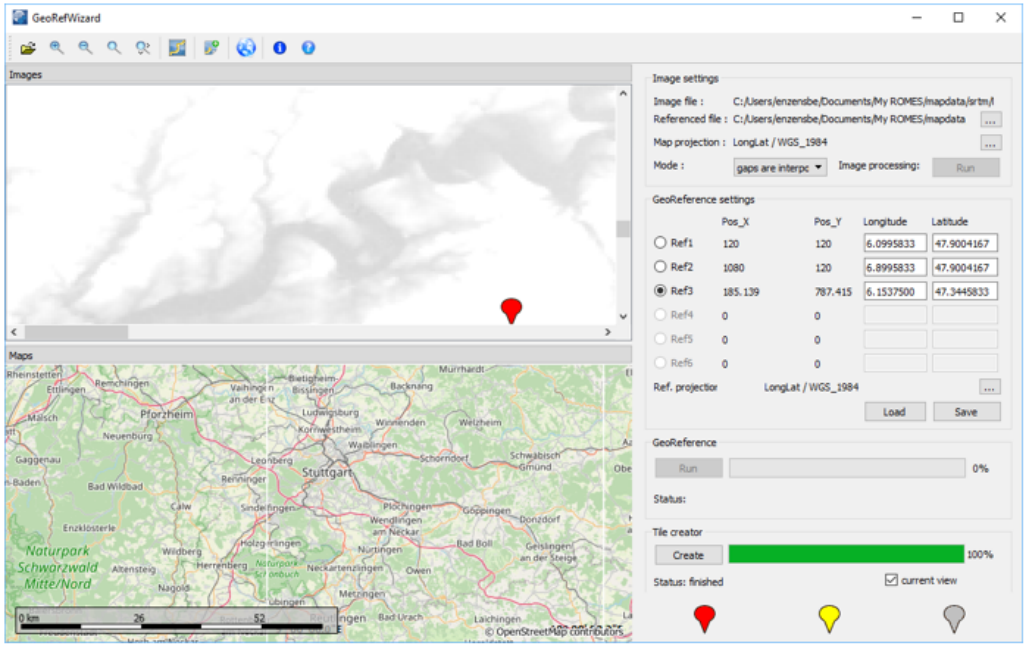


Figure 4-268: Create tile

Note: By default, the GeoRefWizard creates elevation map tiles from all SRTM files found in the selected folder, so it is not needed to open one `*.hgt` file after another. However, creation of elevation map tiles from all SRTM files can be time consuming as depends on SRTM files count. R&S recommends creating only tiles for a specified area.

To create tiles for specified area only, set your current map view to that area and mark the "current view" check box before start rendering.

Create new map theme
Opens the "MapView Map Theme Creation Wizard". With this wizard, it is possible to install new maps from servers which support the WMS (Web Map Service) interface. For example, browse the http://geoint.nrlssc.navy.mil/nrltileserver/wms to load the LANDsat7 map or the http://www.nasa.network.com/wms for i-cubed Landsat.

How to: Chapter 4.3.3.9, "Map theme creation wizard", on page 658.

After R&S ROMES4 shutdown and restart, the additional map is available in the "ROMESMAP Route Track View".

Print ... (Ctrl+P)
Prints the current map view and offers modifying the printer settings.

To control the appearance of the hardcopy, use the print preview option.

The "Print" option is an alternative to taking screenshots via the clipboard (see Chapter 7.4, "Obtaining screenshots", on page 2188). R&S ROMES4 uses the standard "Print" menu familiar from other MS Windows applications. Printing to a file or a configurable printer with selectable page numbers is possible. For details use the context-sensitive help.

To control the appearance of the hardcopy, use the "Print Preview" option.

Print Preview
Show a preview of the hardcopy to be created.

offline/online
The map view can either work in offline or online mode. For online mode, an internet connection has to be available. If online mode is enabled, the map tries to download detailed map tiles according to current zoom level. Depending on the mode set, menu entry is switched to visualize current mode.

If your internet connection is behind a proxy, the map view automatically prompts you to set your proxy authentication, see Figure 4-242.

Your settings are stored for further use, your password is stored encrypted.

If the DQA tester is loaded for a measurement, the map view is automatically switched to offline to avoid the maps download measuring as additional load. After the end of the measurement, the online state is automatically restored.

4.3.3.7 Indoor floorplan manager

Indoor Floorplan Manager manages to set of the user's indoor floorplan maps. The manager can handle both geo-referenced and non-georeferenced indoor floorplans.

To open the manager's dialog, click the button in the toolbar of the view or use the button, "Import" > "Add Indoor Floorplans" command.

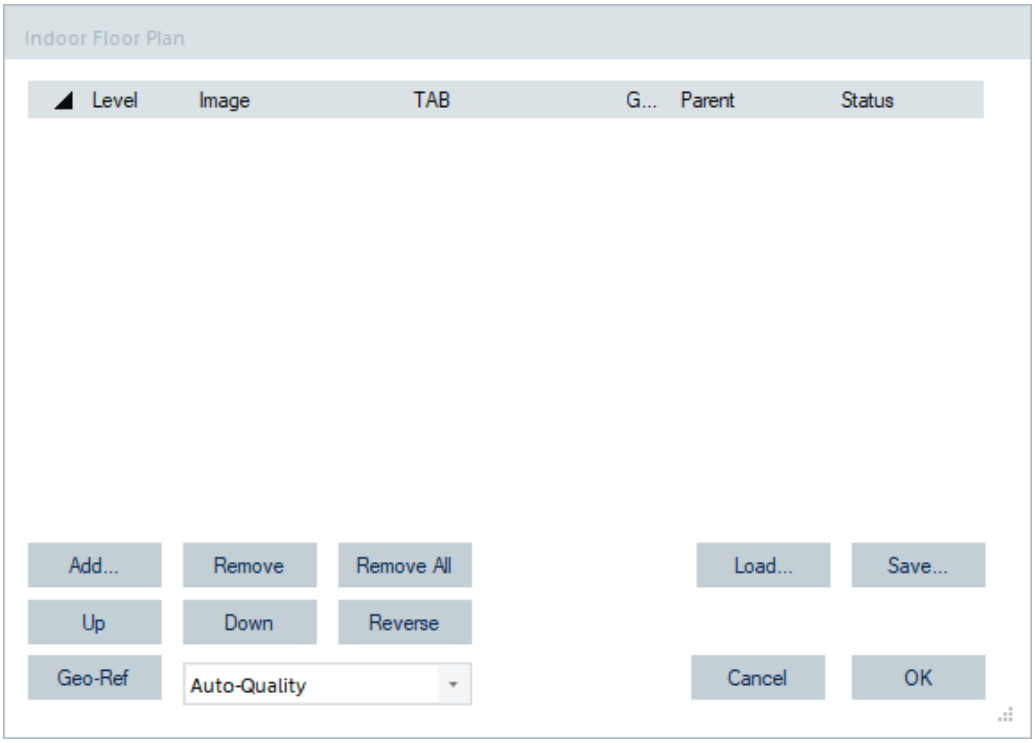


Figure 4-269: Indoor Floor Plan dialog

The following table shows the formats the Indoor Floorplan Manager can read.

Table 4-8: File formats supported by the Indoor Floorplan Manager

Extension	Type	Remark
tab	Georeferenced, Non-Georeferenced	TAB file with image file A TAB file has for unit either meter or degree. For georeferenced maps, unit degree is used. For non-georeferenced ones unit meter is used. Georeferenced maps do not have to have the north direction port to the top of the image. During the import process, the image is rotated accordingly and saved as `<image>_ref.<ext>` and `<tabfilename>_ref.tab`. When loading a TAB file, R&S ROMES4 checks for the _ref tag in the file name. If the file name contains this tag, it is assumed that the tab is georeferenced. If it is not found, R&S ROMES4 looks for the according file in the same folder. If it finds this TAB file, it loads the _ref tab file instead of the originally defined file.
jpg, tif, bmp, png	Non-Georeferenced	A simple image which is imported as non-georeferenced map.
GeoPdf	Georeferenced	A GeoPdf can consist of one or more map layers, those layers can be raster and vector types.
ibwc	Georeferenced, Non-Georeferenced	The IBWC files created from an iBWave project are loaded into the Indoor Floorplan Manager. For details on loading TAB files, refer to the "tab" row of this table. The names of the map layers are entered as in the "Image" column.
dxf	Non-Georeferenced	R&S ROMES4 supports the AutoCAD format DXF. This support allows user to import such AutoCAD files into R&S ROMES4 and use them for indoor measurements.

Indoor floor plan dialog

The "Indoor Floor Plan" dialog shows the list of added indoor floorplan maps.

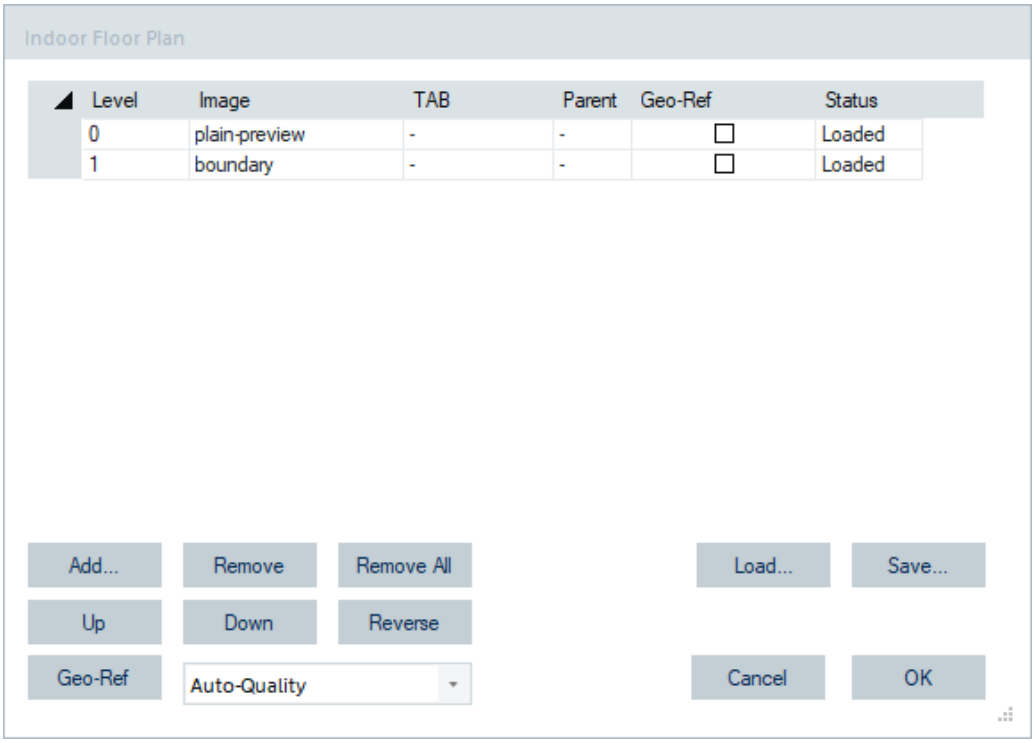


Figure 4-270: Added images in the indoor floor plan

- "Level"
  Defines the level of a floor. The level can be a negative number. Default is 0.
- "Image"
  Floorplan name of a layer.
- "TAB"
  Associated TAB format file.
- "Geo-Ref"
  The layer is geo-referenced or not; you can change this parameter.
- "Parent"
  Container of a layer if applicable (for example, an IBWC file's name).

The following buttons are located at the bottom of the dialog:

- "Add"
  Lets you add TAB, AutoCAD or image map file in the "Indoor Floor Plan" dialog's list.
- "Remove"
  Removes the currently selected map.
- "Remove All"
  Removes all maps in the list.
- "Up/Down"
  Shifts the selection of maps one layer up/down. The arrow in the "Level" field lets you the maps ordering as well.
- "Reverse"
  Reverses the order of the maps. The last map becomes the first and vice versa.

- "Geo-Ref"
  Creates geo-referencing floorplan map from the selected images in the list and loads the map in the "Floorplanmap" area which is at the time related to active "ROMESMAP Route Track View" map area.

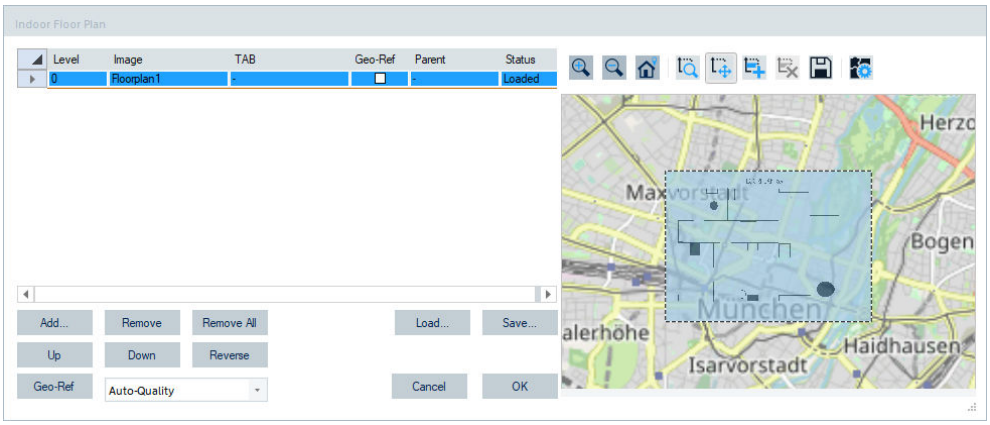


Figure 4-271: Loaded map into the floorplanmap area

- Quality settings drop-box
  The quality settings applied to raster maps first time the maps are imported as TAB files and after the first import. You can choose between the auto-quality (default), high, middle and low quality.
  The better is the quality, the longer the processing time for the first import is. If the auto-quality is selected, R&S ROMES4 adapts the quality depending on the size of the raster image file.
  Typical processing times for a 12 MB raster image on an i5 processor are shown in the following figure.

Quality	Processing Time
High	8 minutes
Middle	3 minutes
Low	1,5 minute

- "Load"
  Lets you load the ROMES Floor Plan Set or IBWC (ibWave) files into the "Indoor Floor Plan" dialog.
- "Save"
  Saves the current set of maps.
- "OK"
  Press the button to confirm the configuration. R&S ROMES4 loads then all the added layers to the "ROMESMAP Route Track View" and deletes all the removed layers from the actual view. If only non-georeferenced maps were loaded, R&S ROMES4 switches the geographic maps automatically off.

The indoor floorplan maps are associated with the workspace. Thus, they are also associated with each measurement, as each measurement file contains the current workspace. By changing the workspace, the "Indoor Floor Plan" resets and the all indoor floorplans are removed from the "ROMESMAP Route Track View".

The workspace of a measurement file has to be loaded if you want to replay an indoor measurement and get the floorplans of that measurement file.

If more than one file has to be imported, the files are imported in parallel.

Handling of georeferenced floorplans

To create correct georeferenced floorplan:

1. Select a floorplan in the list of the "Indoor Floor Plan" dialog.
2. Click the "Geo-Ref" button.

   The loaded floorplan image is displayed in the "Floorplanmap" pane of the dialog, see Figure 4-271.

The toolbar with the functional buttons is associated to the pane.

Table 4-9: Floorplanmap toolbar buttons

1	2	3	4	5	6	7	8	9
ZoomOut	ZoomIn	Home	Center floorplan	Floorplan select mode	Floorplan connec-tion mode	Remove connec-tion	Create geo-refer-encing floorplan	Proper-ties

Using "ZoomOut"/"ZoomIn" or mouse wheel you can increase/decrease the displayed floorplan image.

Floorplan select mode
The "Floorplan select mode" function (the button 5 in the Table 4-9) is by default active. Use this mode to resize and move a floorplan. You have to set-up the floorplan position for geo-referencing first.

How to move the floorplan map: Move mouse over the map, click and hold left mouse button, move the mouse to pan the map. Zoom-in/-out the map to the area that your floorplan building belongs to.

Center floorplan
Click the "Center floorplan" button (the button 4 in the Table 4-9) to center the floorplan image in the visible floorplanmap area you adjusted in the previous action.

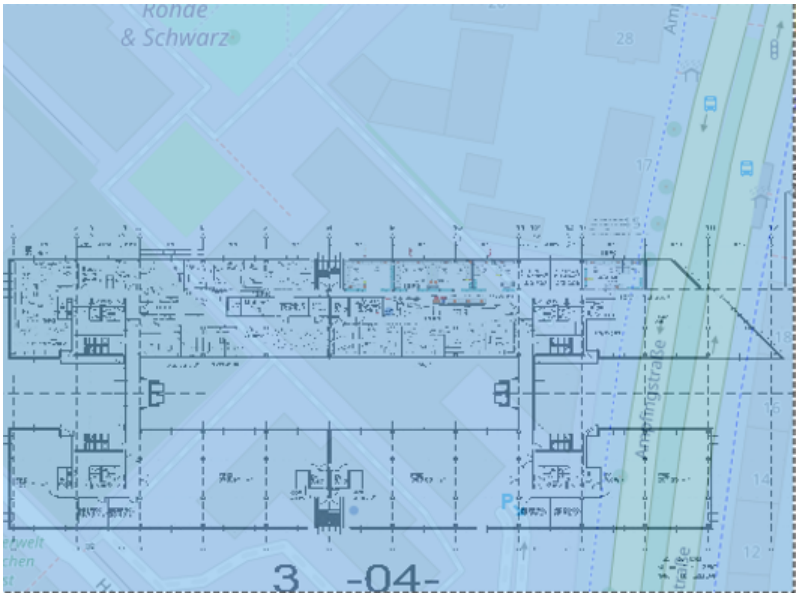


Figure 4-272: Centered floorplan image in the map area

Zoom-out the map with button or mouse wheel to get an overview.

While moving the mouse over the floorplan, cursor is shown as a white cross with arrows. If you move the mouse over a floorplan image edge, the cursor changes to black cross.

To resize the floorplan, hold the left mouse button. Resizing is limited to default minimal floorplan size.

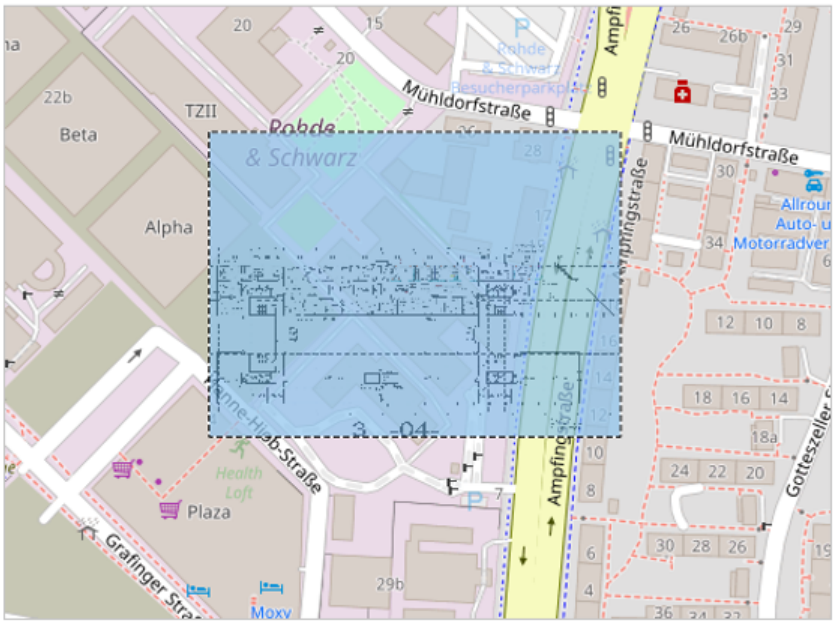


Figure 4-273: Floorplan resized and centrally positioned

Floorplan connection mode

This function (the button 6 in Table 4-9) lets you position the floorplan at the map and floorplan building.

Click and hold left mouse button, move the mouse to move the floorplan to a position near the map building. Resize the floorplan and/or zoom-in the map to get a view where both buildings (the floorplan and the map building) are visible. If floorplan position matches your needs, activate floorplan connection mode.

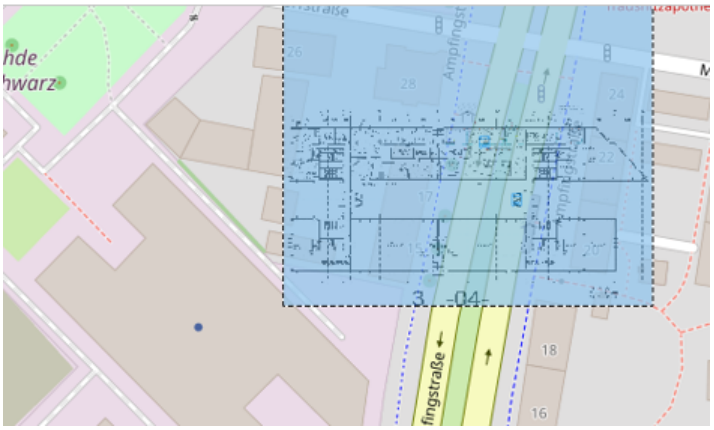


Figure 4-274: Floorplan positioned according to building position

In "Floorplan connection mode" cursor is shown as an arrow along with a plus sign.

1. Connect four floorplan reference points with corresponding map reference points.
2. Move the mouse over a floorplan reference point.
3. Set a marker with left mouse button click.
4. Move mouse over the corresponding map reference point and with left mouse button click again.
5. The marker is set and the connection line is displayed.

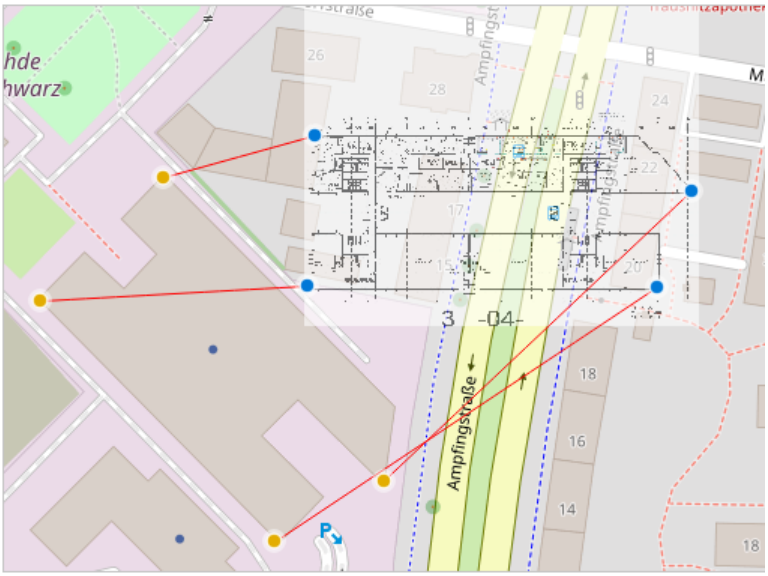


Figure 4-275: Connection lines bind floorplan with building in map

After the fourth connection line is set, mouse cursor changes. The "Create geo-referenced floorplan" button (the button 8 in the table) is activated.

If you want to fine-tune the connection point position, move the mouse over a connection point marker. Then, click and hold left mouse button and move the mouse to change the position. Use "Remove connection" toolbar button to remove the last connection line.

Create geo-referenced floorplan

The "Create geo-referenced floorplan" function starts the geo-referencing. The new geo-referenced floorplan is displayed in the "Floorplanmap" pane after referencing is finished.

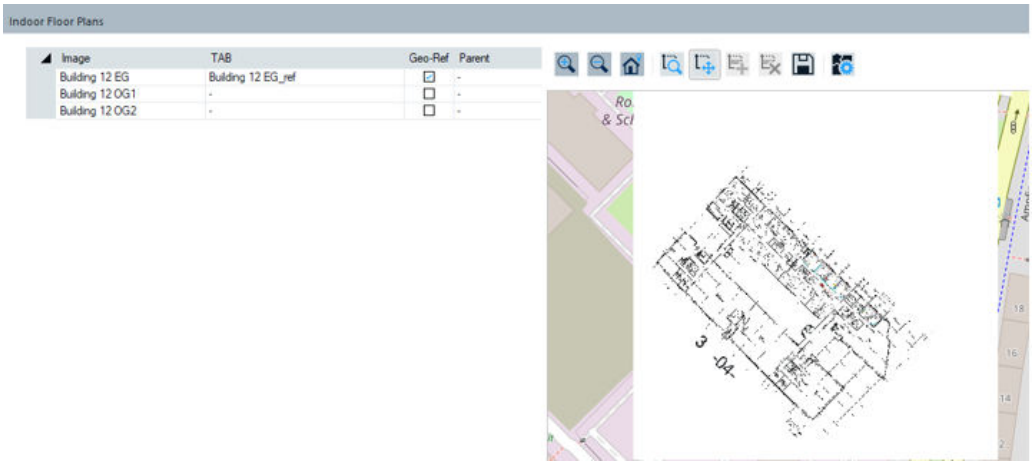


Figure 4-276: Created new geo-referenced floorplan

The "TAB" entry from the floorplan list is set to the new created floorplan TAB filename. Also the "Geo-Ref" check box is marked.

To verify geo-referencing, you can set the floorplan transparency. For the transparency, move mouse over the floorplan, right click to open a context menu and select "Properties" to get the properties dialog. Instead click the "Properties" toolbar button.

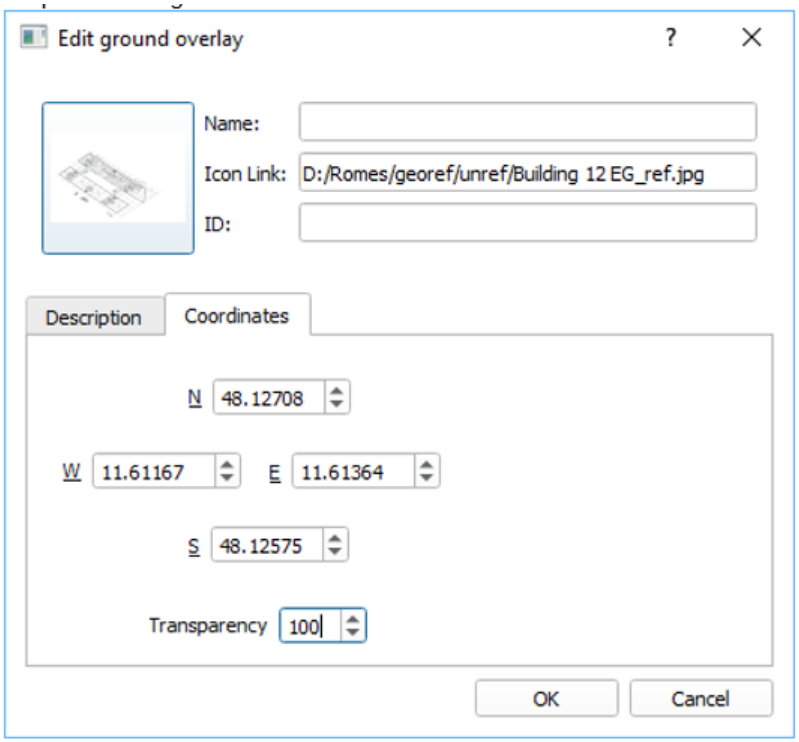


Figure 4-277: Properties dialog

For transparency, enter the value between 0 and 255 (255 means opaque) in the "Transparency" combo-box.

Click "OK" to close the dialog. The new geo-referenced floorplan is added to the basemap, exactly positioned over the basemap building.

Figure 4-278: Adjusted building position

By default, floorplans are displayed opaque, as the following screenshot shows.

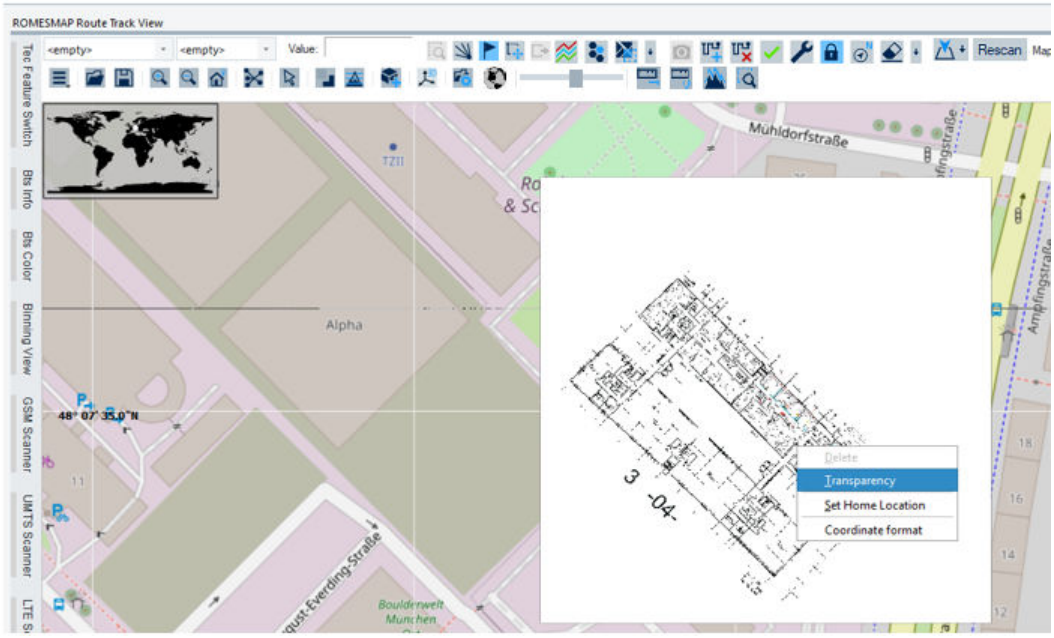


Figure 4-279: Opaque display of floorplan

The right mouse button click on any point in the floorplan opens a context menu. The context menu lets you select "Transparency" to set floorplan transparency within the "ROMESMAP Route Track View" area.

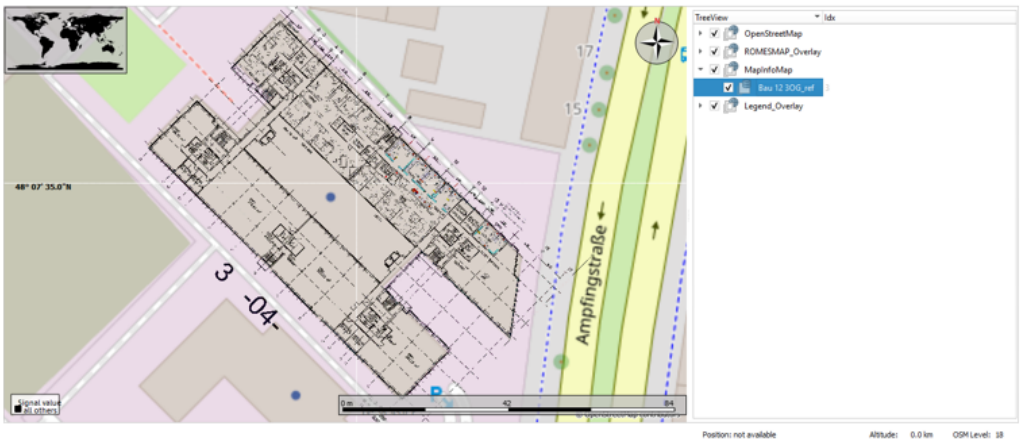


Figure 4-280: Transparency display of floorplan

Handling of GeoPdf map files for indoor floor plan

R&S ROMES4 supports GeoPdf format map files in indoor import.

To add a GeoPdf map to an indoor floor plan:

1. Click the "Add" button in the"Indoor Floor Plan" dialog.
   The "Load Indoor Floor Plan" dialog opens.
2. Open the file type drop-down list in this dialog to select the "GeoPdf" file type.

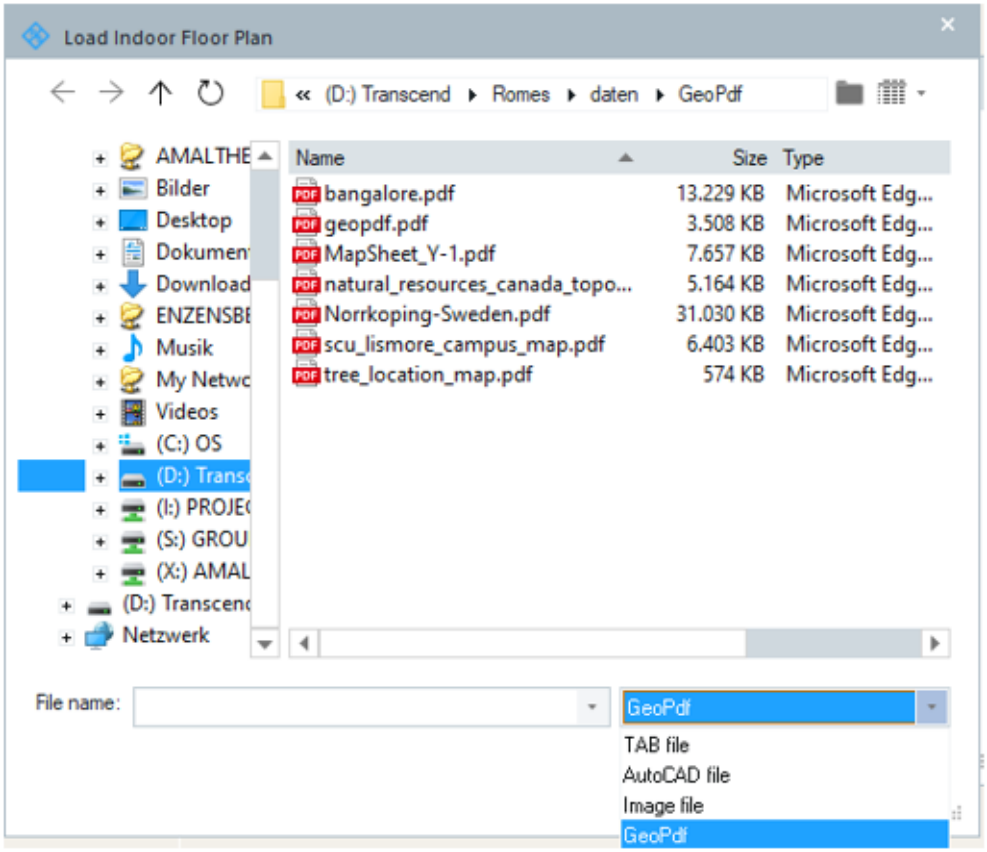
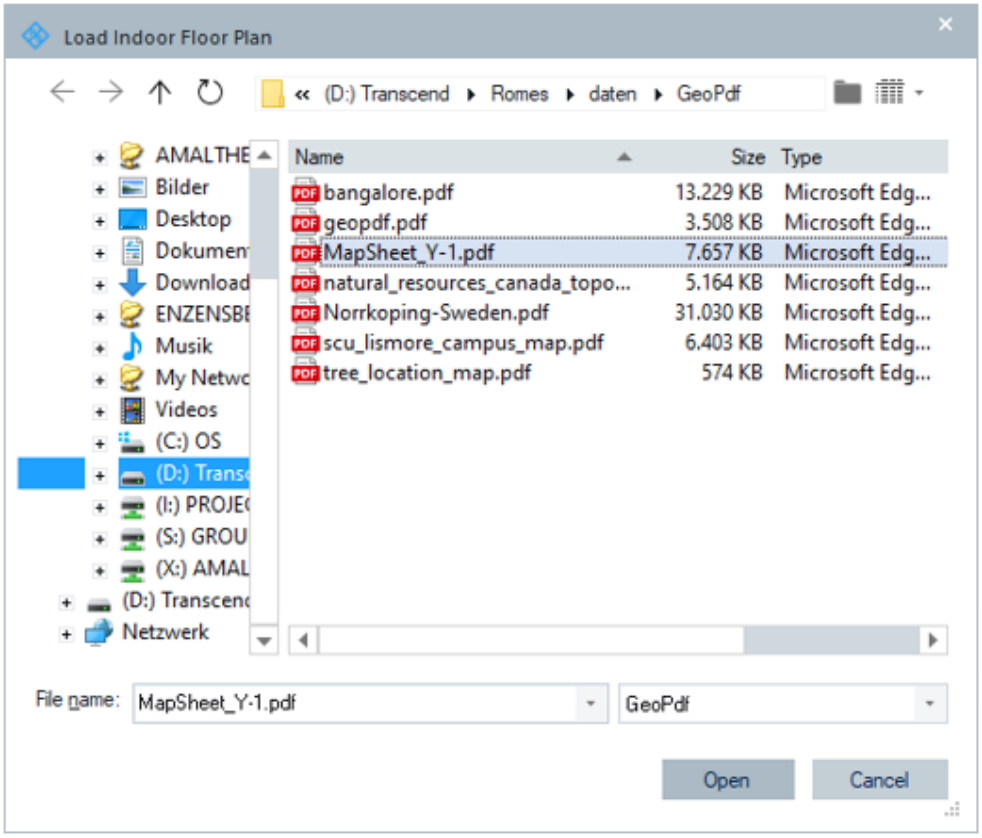


Figure 4-281: Selection of the map file type

The list of GeoPdf files is displayed.

3. Select the file from the list.



4. Click "Open" to add the GeoPdf map file to the import list. Multi-selection is supported.

   The selection is added to the "Indoor Floor Plan" list.

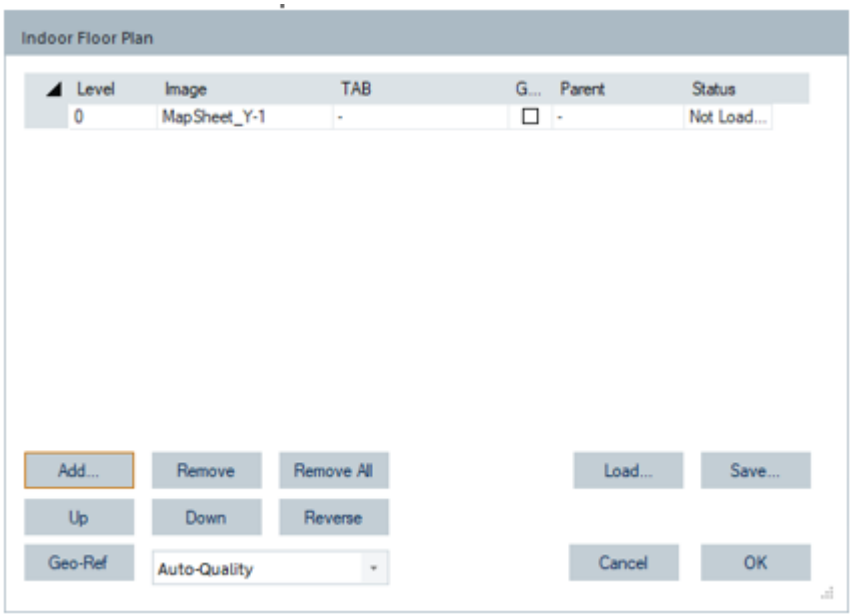


Figure 4-282: Added GeoPdf map file

5. Click "OK" to start import.

   The import runs. As long as an import is running, displayed is the blue progress bar in the StatusBar, placed left to position info.

Figure 4-283: GeoPdf map file is importing

Depending on count of layers and complexity of map, importing a GeoPdf could be time consuming.

After import finishes, the GeoPdf map is displayed.

Figure 4-284: GeoPdf map imported and displayed

To handle a GeoPdf as an indoor floorplan, ROMESMAP import renders all layers into one single GeoTiff. After finished import, the GeoTiff file is added to "ROMESMAP RouteTrack View".

Along to the GeoTiff, an additional corresponding MapInfo TAB file is created. Storing an Indoor measurement file does not add the original GeoPdf file but the GeoTiff and TAB files.

Handling of IBWC files for indoor floor plan

IBWC files are created from an iBwave project where the measurements are reimported. Other floorplans are not added to this IBWC floorplan, as not needed. Therefore, loading an IBWC file is done via the "Load" button in the "Indoor Floor Plan [IBWC]" dialog.

IBWC files can be saved using the "Save" button. Saving the files is possible if an IBWC file was loaded before.

If an IBWC file was imported (and edited), a link to this file is saved into the workspace file as well.

The following two features are introduced to support loading R&S ROMES4 measurements into Actix:

- The original (unchanged) IBWC input is stored in the SQC file root directory with the suffix `.origibwc` if an indoor measurement based on an IBWC file is performed in R&S ROMES4.
- The patched IBWC file intended for the usage in Actix is stored in the Asset directory.

  The file patching includes the following:
  - 1) Collection name is used as the input in the "Indoor Floor Plan" dialog, instead of formerly used mapset name ROMES_Floorplan_[ibwc filename].
  - 2) Building name is used as the input in the dialog, instead of one provided automatically.
  - 3) Layout names are entered as in the dialog (the "Image" column), instead of ones provided automatically as, example given, Floorplan1, Floorplan2.
  - 4) Level entered in the "Level" column can be input, instead of one provided automatically and starting with 0. The values in the column are used for the levels ordering.

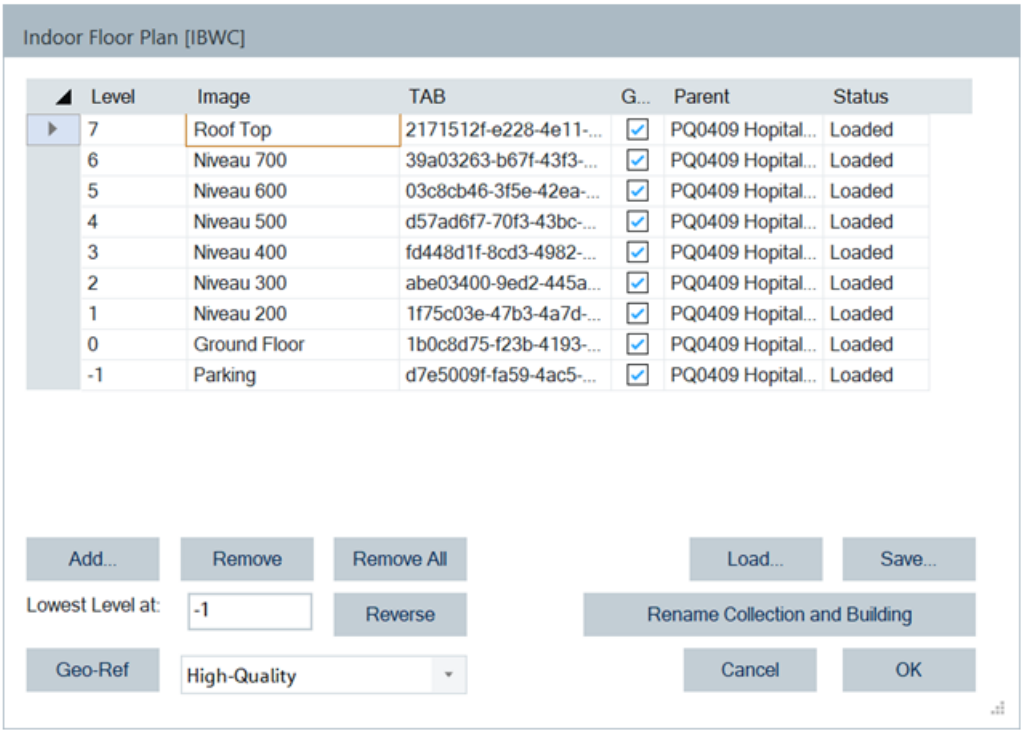


Figure 4-285: Loaded IBWC floor plan map

For the level editing, there are some helpers:

- "Lowest Level at"
  Defines the level of the lowest floor. The level can be a negative number. Default is 0.
- "Reverse"
  Used to reverse the values of the level column only.
- "Rename Collection and Building"
  Used to change names of collections and buildings.

The buttons "Up" and "Down" visible in the "Indoor FloorPlan" dialog are removed in this IBWC dialog since ordering is done via "Level".

These functions are only available, if an IBWC floor plan map has been loaded. Otherwise, the dialog looks like Figure 4-270.

Support of AutoCAD format DXF

Indoor measurements with DXF files are always non-georeferenced, and cannot be georeferenced later.

Only single DXF files are supported. The DXF master files, which include links to other DXF files are supported.

DWG file can be converted to a DXF file by using some tools, like, for example, the Teigha®File Converter (free) tool. Ensure that the output file format is ASCII DXF.

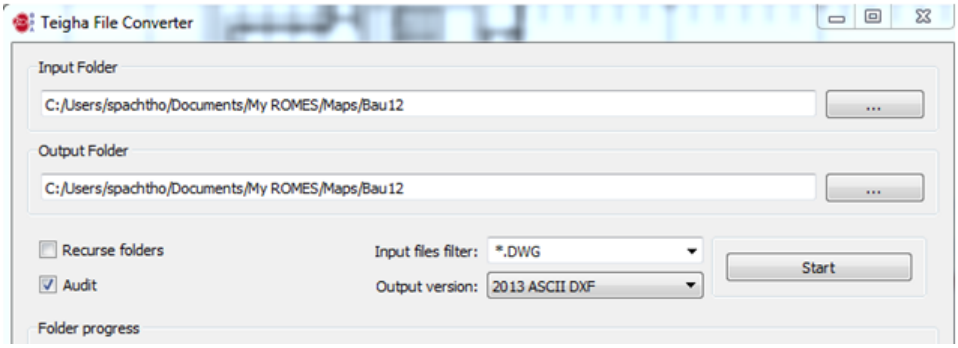


Figure 4-286: Converting DXF file format to DWG

The DXF file can be loaded like other indoor maps using the Indoor Floorplan Manager.

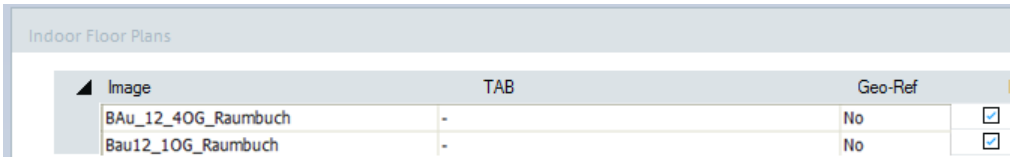


Figure 4-287: Loading DXF file with Indoor Floorplan Manager

Floorplan multi-selection

In case you have several floorplans with identical dimensions, where each floorplan represents different building levels, it is possible to create the geo-referencing for all at once.

1. Press Ctrl – Key and select all floorplans for which you want to create identical geo-referencing.
2. Click the "Geo-Ref" button.

   In the "Floorplanmap" displayed is now the first floorplan from your multi-selection.

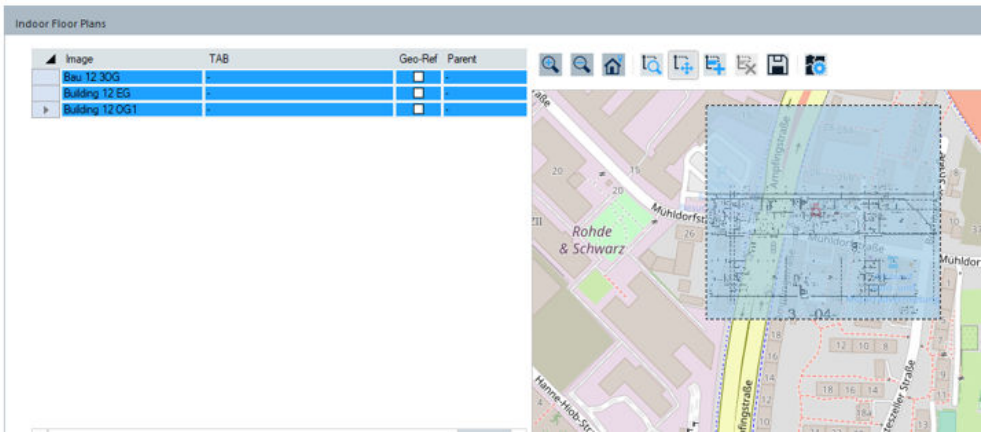


Figure 4-288: Selection of several floorplans

3. Resize and move that floorplan.
4. Click the "Floorplan connection mode" toolbar button.
5. Set the four connections.
6. Click "Create geo-referennced floorplan".

   For all selected floorplans, the corresponding `*.tab` file is created. The floorplan listbox shows TAB name entry for all selected floorplans and the corresponding "Geo-Ref" check-boxes are marked.

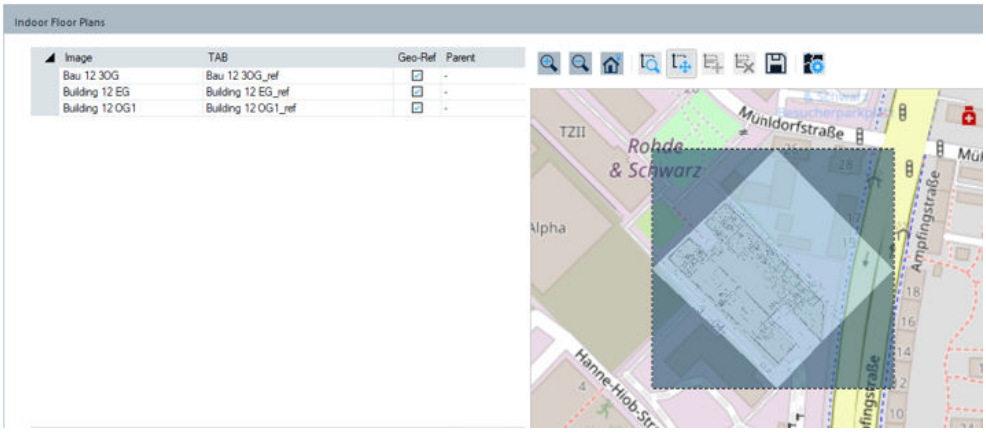


Figure 4-289: Display of multi-selected floorplans

Click "OK" to add all floorplans on the basemap. All floorplans are now located on same position with same dimension.

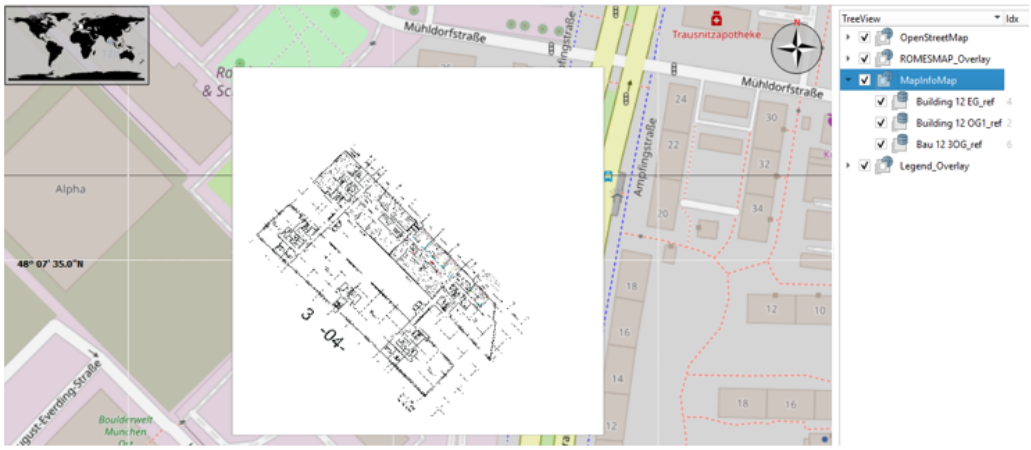


Figure 4-290: Mapinfo map for multi-selected floorplans

The floorplan "Properties" dialog is now filled with the building data what is visible if you click the "Properties" toolbar button.

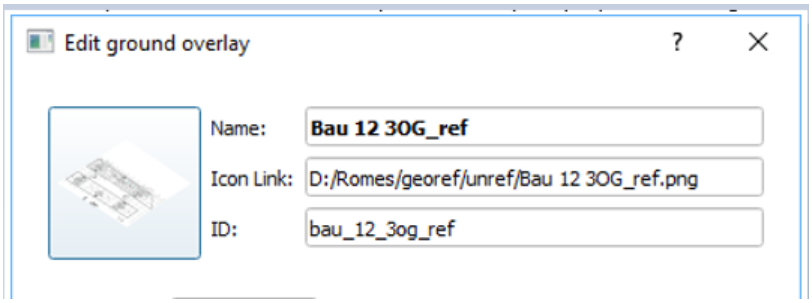


Figure 4-291: Geo-referenced floorplan

To move the loaded floorplan to a known map position, edit the coordinate fields. For coordinates refer to Figure 4-277.

To set the floorplan transparency, enter a value between 0 and 255. The floorplan "Properties" dialog can be opened by floorplan context menu if you click right mouse button.

Figure 4-292: Option to get the properties dialog

Indoormap image at the home location

An unreferenced indoor floor plan image is loaded according to the current map center and scale.

If the map scale is higher than 2000 m, the geographic image width and height are calculated depending on image resolution - 1 pixel (width and height) equates 1 m.

The following screenshots show the indoormap floor plan images when the map scale in the "ROMESMAP Route Track View" changes from 8000 m to 180 m.

An image of resolution 4844x4871 is imported in the "Indoor Floor Plans" at the map scale set to 8000 m first.

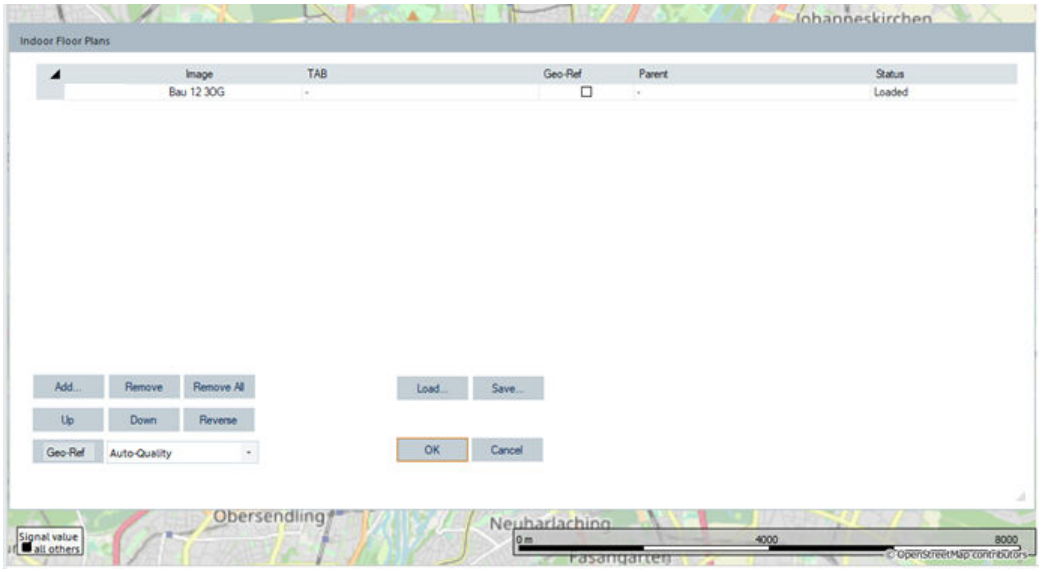


Figure 4-293: Map scale set to 8000 m

The first import result is the image of geographic width 4844 m and geographic height 4871 m.

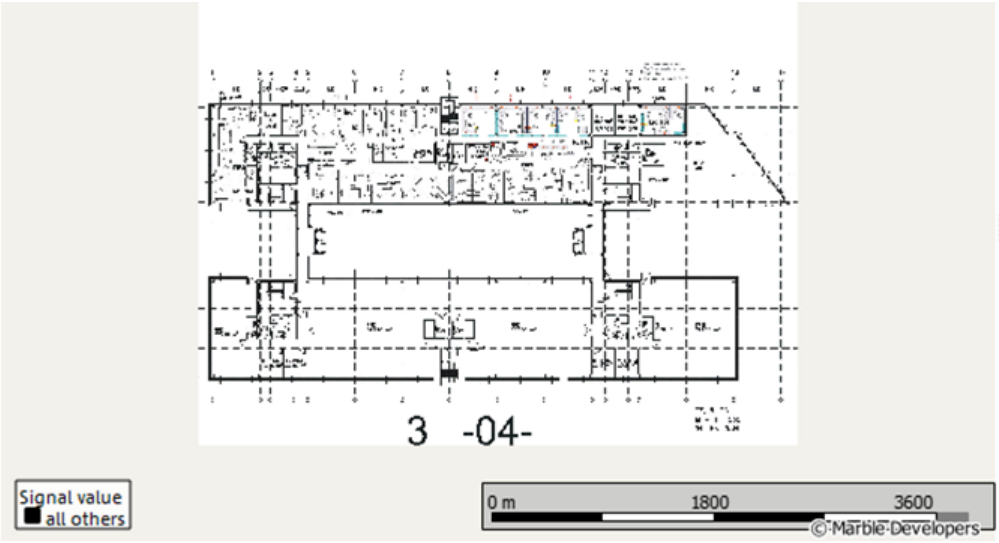


Figure 4-294: Image with the map scale set to 8000 m

The second import of the same image (resolution 4844x4871) in the "Indoor Floor Plans" is done with the map scale set to 180 m.

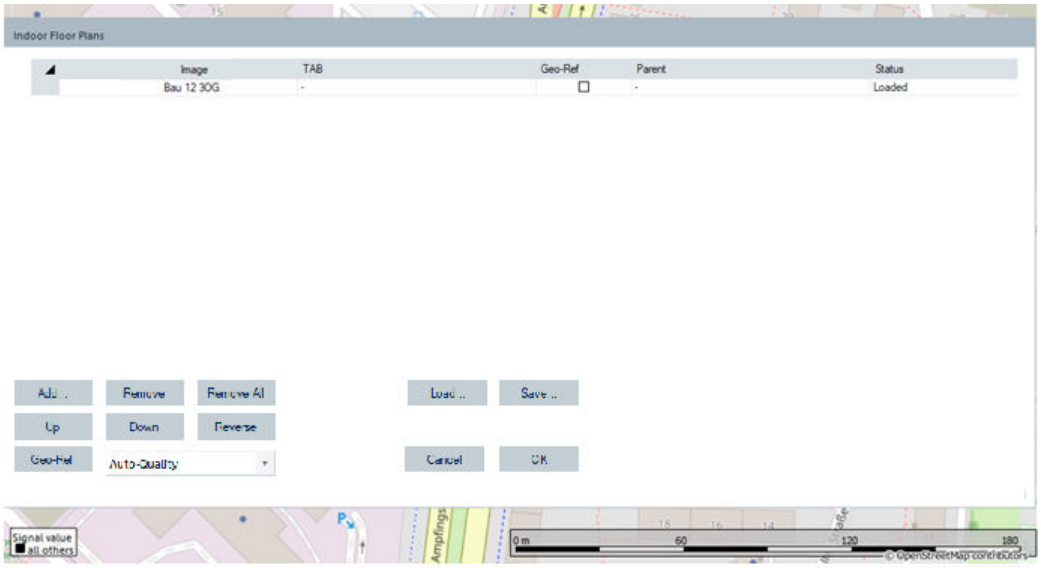


Figure 4-295: Map scale set to 180 m

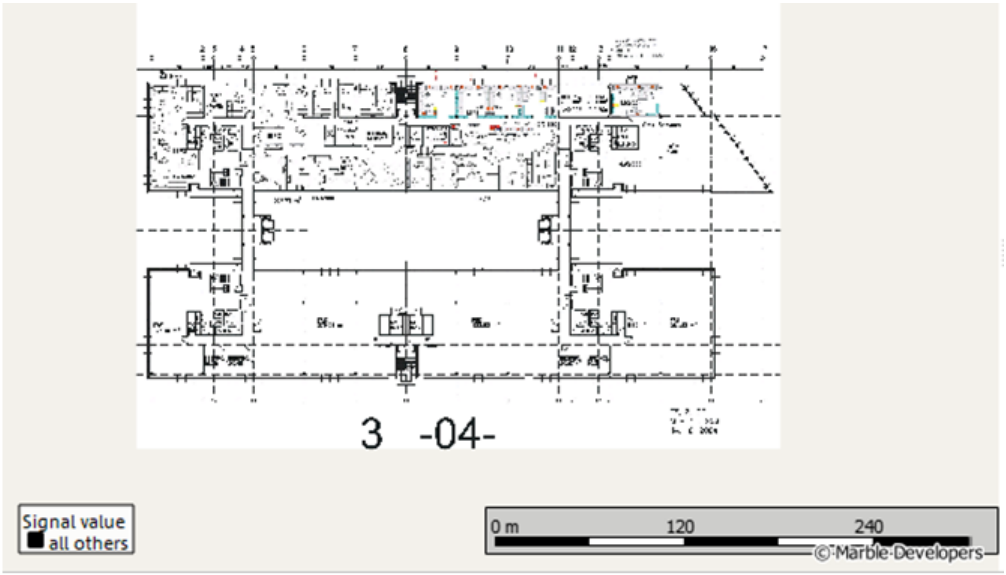


Figure 4-296: Image with the map scale set to 180 m

The second import result is the image of geographic width 360 m and geographic height 364 m.

Indoor measurement

To zoom in a specific indoor layer, double click the appropriate layer in the indoor measurement dialog.

If the waypoints (WP) are editing during a measurement, the corresponding R&S ROMES4 signal lines are adapted on the fly in the "ROMESMAP Route Track View".

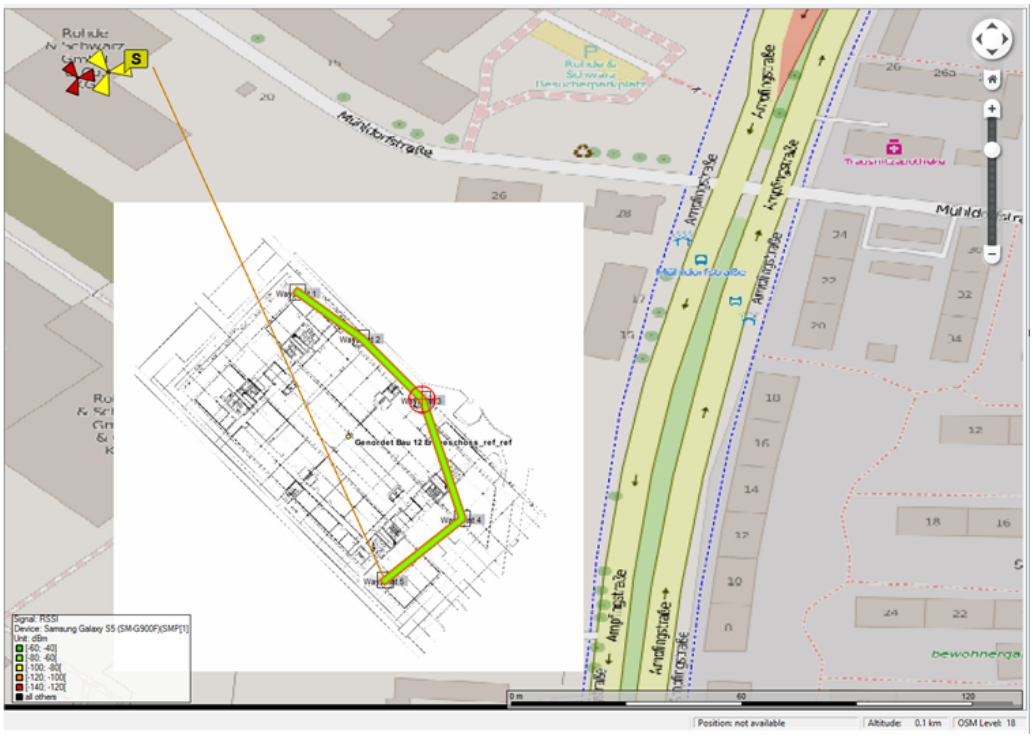
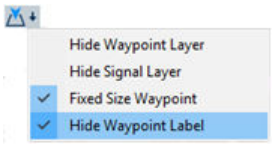


Figure 4-297: Indoor waypoints

Hide waypoint layer

The indoor waypoint layers are displayed by default in the "ROMESMAP Route Track View".

Click the icon's arrow to open the pop-up menu where you can select the option to hide the indoor waypoint layers.



In the displayed pop-up menu check the "Hide Waypoint Layer"context sensitive menu to make the indoor waypoint layers invisible.

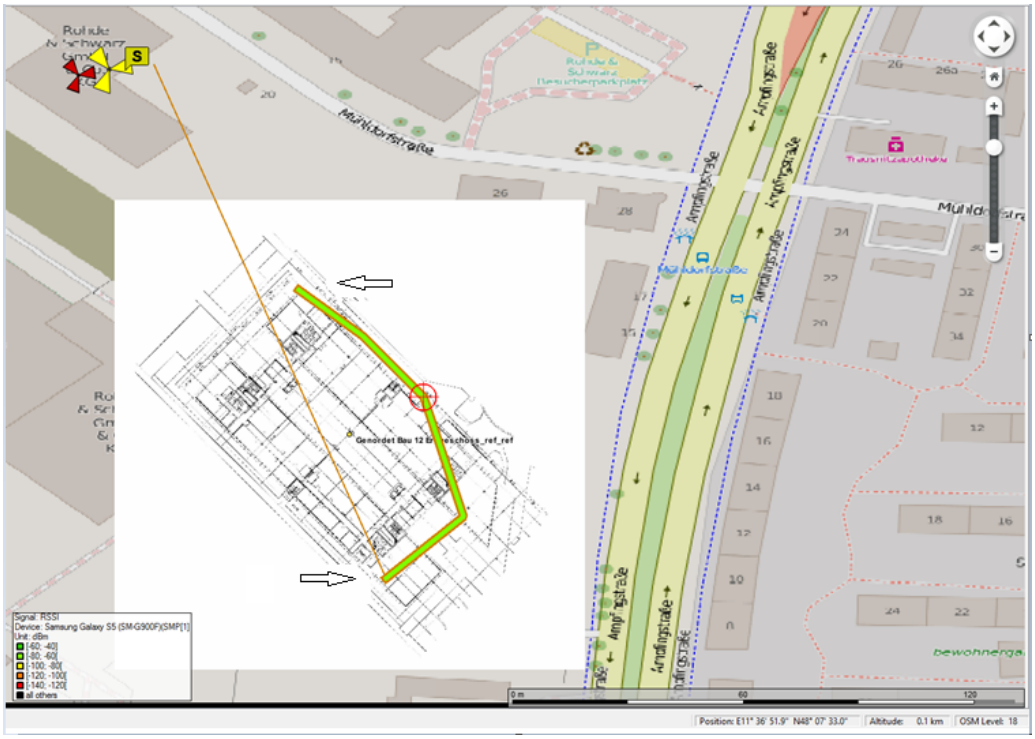


Figure 4-298: Hidden indoor waypoints

Fixed size waypoint

The waypoint size does not change while zoom in/out if the "Fixed size Waypoint" context sensitive menu is checked-in in previously mentioned pop-up menu.

If "Fixed size Waypoint" is unchecked, the waypoint size changes according to current zoom level.

The following TETRA report example shows the indoor plan layout dependent on activation/deactivation of the mentioned context menu.

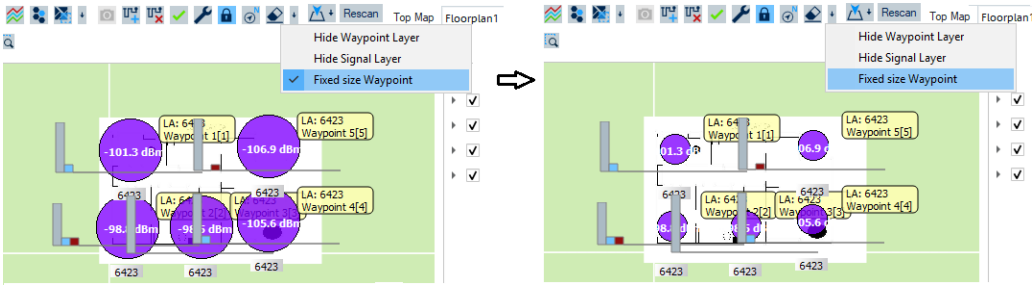


Figure 4-299: Waypoints size fixed or adaptive

Hide waypoint label

The indoor waypoint labels are displayed by default in the "ROMESMAP Route Track View".

To make the indoor waypoint labels invisible, select the "Hide Waypoint Label" entry of the "Indoor Layer menu". The menu's entries are visible if you click the arrow of the icon.

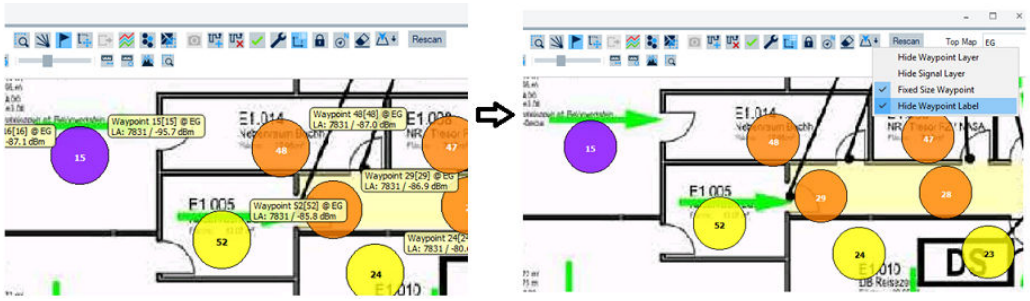


Figure 4-300: Hiding waypoints label

4.3.3.8 Screenshot wizard

The Screenshot Wizard allows an automated screenshot export of a content added in the "ROMESMAP Route Track View".

To open the wizard press located in the "ROMESMAP Route Track View" icon bar.

The icon is available in the icon bar if at least one signal has been added to the "ROMESMAP Route Track View".

The wizard allows the screenshots of the measurements to generate for each signal and floorplan.

"Export Underlay Layer" option is checked by default. To create an export without underlay layer, uncheck this box.

If you want to create screenshots only for the floorplans on which at least one waypoint has been set, check the "Export only Layers which ..." option.

The resolution of the map on the currently visible screen is displayed. With "Target Pixel Width", you can create a high resolution of the image on the screen. It defines the width of the resulting exported image. The width can be used as a target width by pressing the arrow button.

If this value is higher than the currently visible screen, the export tries to generate the high-resolution screenshot using the following steps.

1. Internally, the view is extended to meet the requested number of pixels for the target width.

   This extension leads to a greater geographic area that is covered by this internal view, as the zoom level still is the same.

2. In a second step the zoom level is adapted.

   In this way, the originally visible geographic area fits as good as possible into the significant internal view.

It is possible to suppress the color scale in the Legend during the export. Check the "Legend does not show Color Ranges" box to activate this option. The Legend of the screenshot displays also the floorname.

Further, specify the output folder and the output file name.

The output file name can be any combination of text and the following parameters:

- "%FILE%" File name of the measurement file
- "%FLOOR%" Name of the floorplan
- "%SIGNAL%" Name of the visible R&S ROMES4 signal
- "%DEVICE%" Name of the device which reported the R&S ROMES4 signal

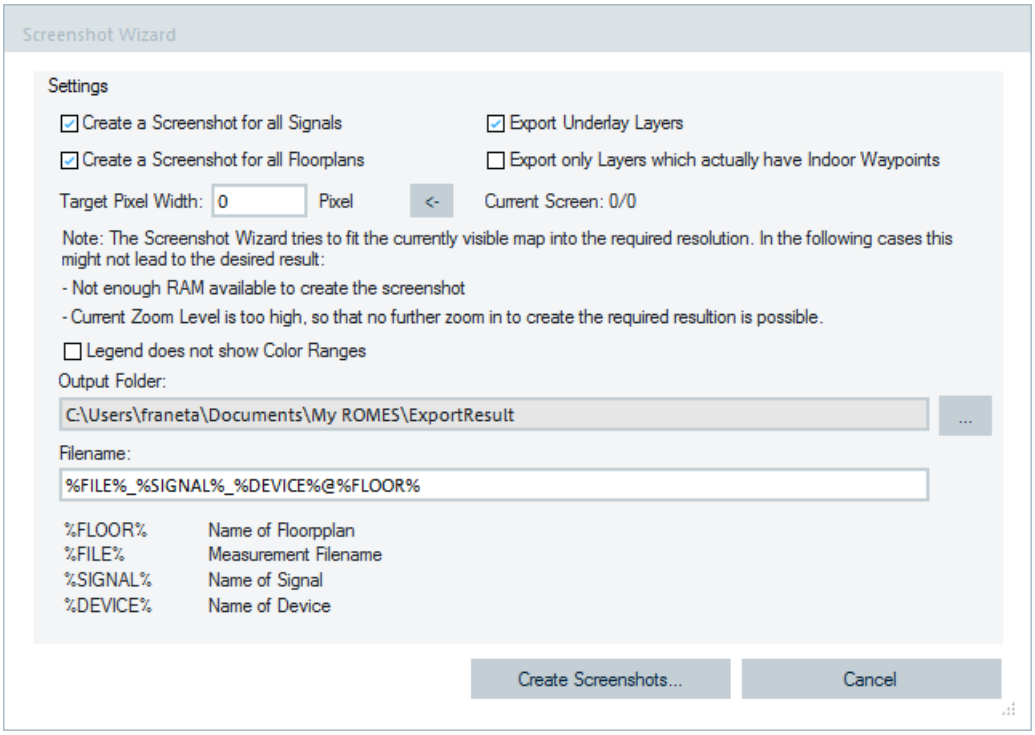


Figure 4-301: Configuration of screenshots for export

Errors that can occur due to creation of a high-resolution image

- If not enough RAM is available to extend the view to the requested size, the export tries to achieve half of the requested size.
- If the current zoom level is already at the maximum so that step 2. Cannot zoom in anymore, the output is an image with the requested resolution, but the covered geographic area is more than the visible one.

After finishing the export process, each occurred error is reported.

4.3.3.9 Map theme creation wizard

To create a map theme, select the "Create new map theme" command in the context sensitive menu which is opened when clicking the icon.

The "MapView Map Theme Creation Wizard" window opens guiding you through the steps needed for creating basemaps.

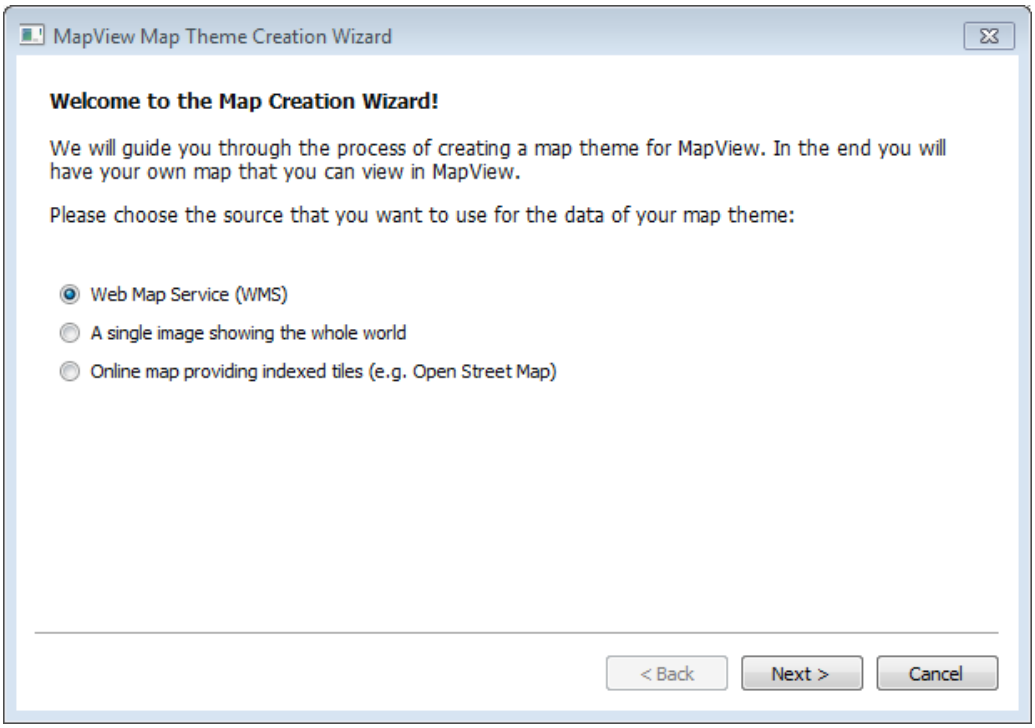


Figure 4-302: Welcome to the Map creation wizard window

Three different kinds of basemap creation are offered in this window.

- "Web Map Service (WMS)"
- "A single image showing the whole world"
- "Online map providing indexed tiles (e.g. Open Street Map)"

Creating WMS-based map theme

There are many free-to-use WMS servers available, offering different kind of maps. MapView is able to connect to any WMS server following the WMS specification described by the OGC, see `http://www.opengeospatial.org/standards/wms`.

The creation of a basemap connecting to a Landsat7 WSM server is explained here.

A list of free/commercial WMS servers can be found in `http://mapmatters.org/search/`.

1. Open this site in Internet Explorer.
2. Enter “Landsat7” into the search field to get a list of WMS servers offering satellite images collected by the Landsat7 program (`http://landsat.gsfc.nasa.gov/about/landsat7.html`).
3. Select one of the listed servers.

The “Overview” site opens, copy the WMS server Url listed on top of the overview site.

4. From the map menu, open the "MapView Map Theme Creation Wizard".

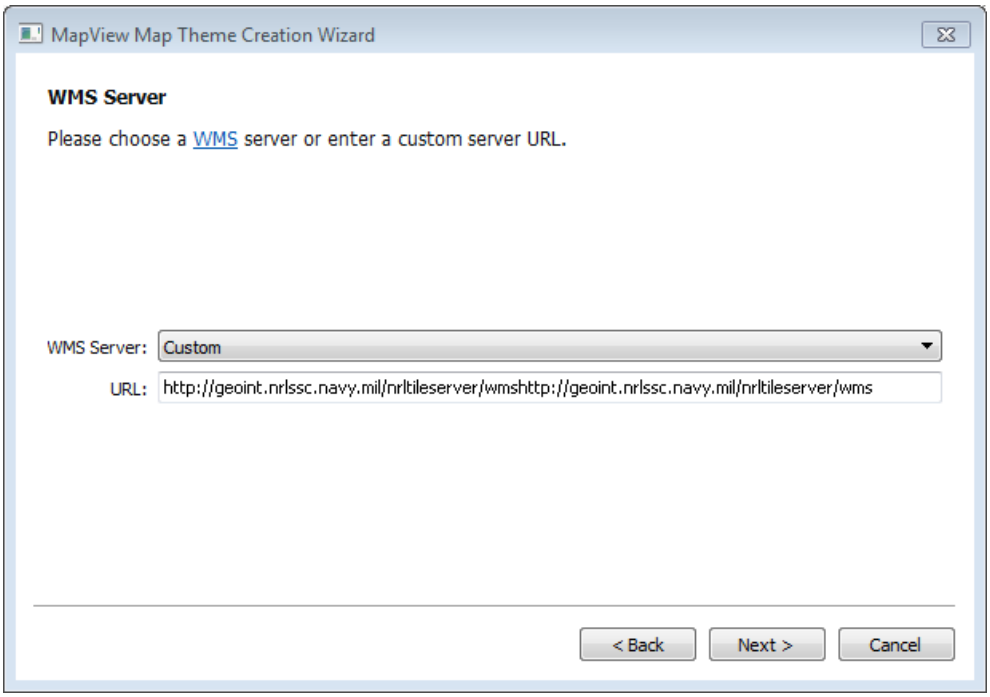


Figure 4-303: Inserting a custom server URL

The "Web Map Service (WMS)" basemap option is selected by default. Click the "Next" button and use CTRL-V to copy the WMS server Url into the Url field. Click the "Next" button.

5. The "Available Maps" window opens.

   The maps offered by this WMS server are displayed in a list.

6. Scroll down to select Landsat7 from the list.

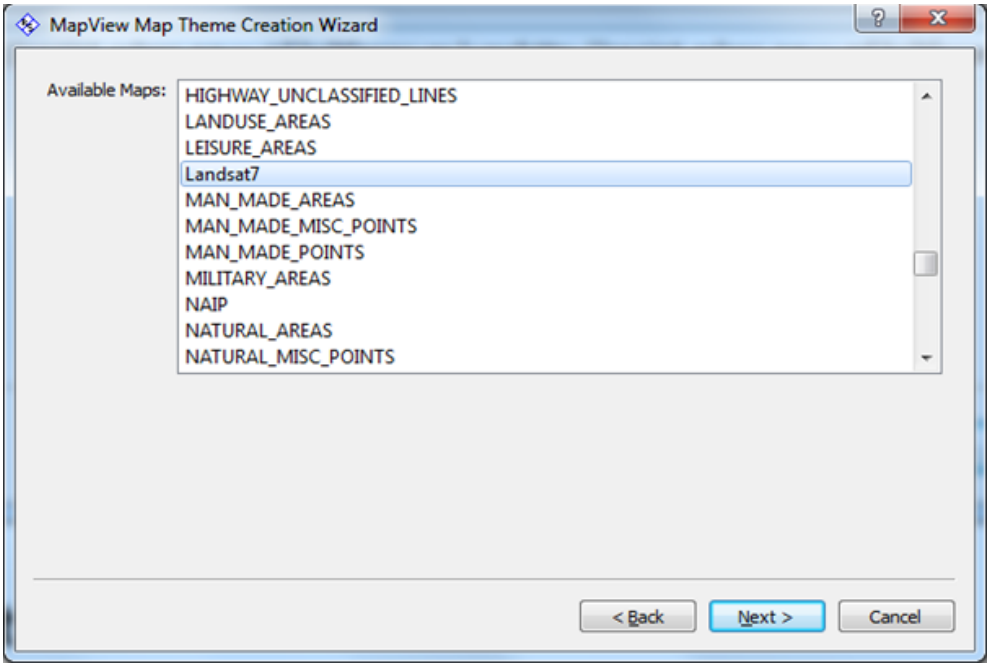


Figure 4-304: List of available maps

Click the "Next" button.

7. The "General Information" window displays the map title, map name and a preview image downloaded from the server.

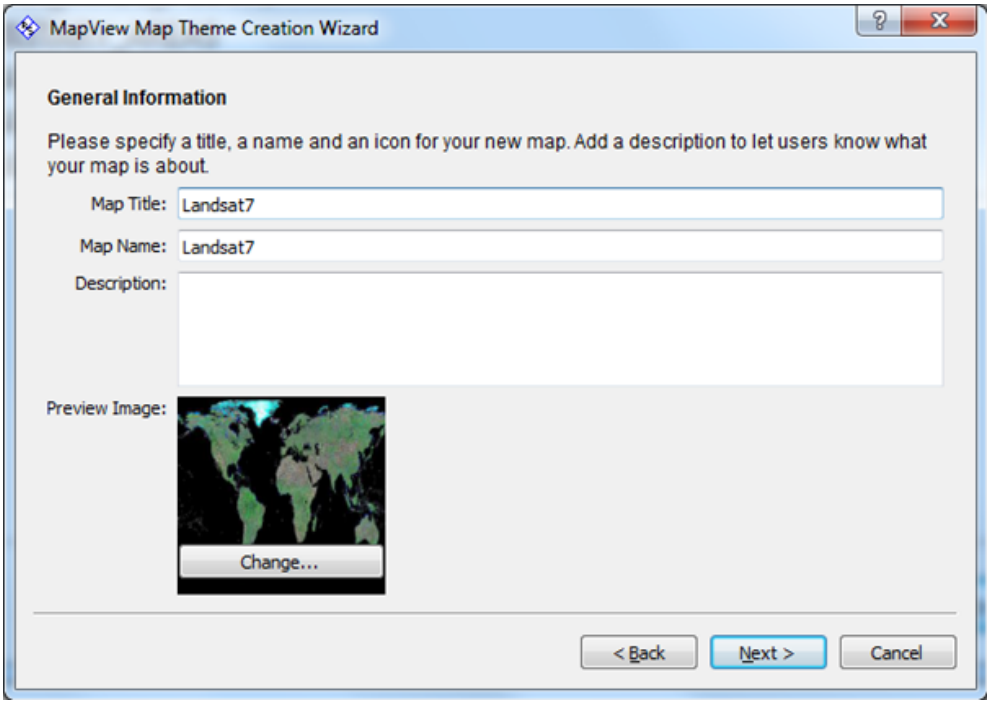


Figure 4-305: General Information window

Click the "Next" button.

8. Now, activate the coordinate grid layer for the new basemap. Select the "Coordinate Grid" check-box.

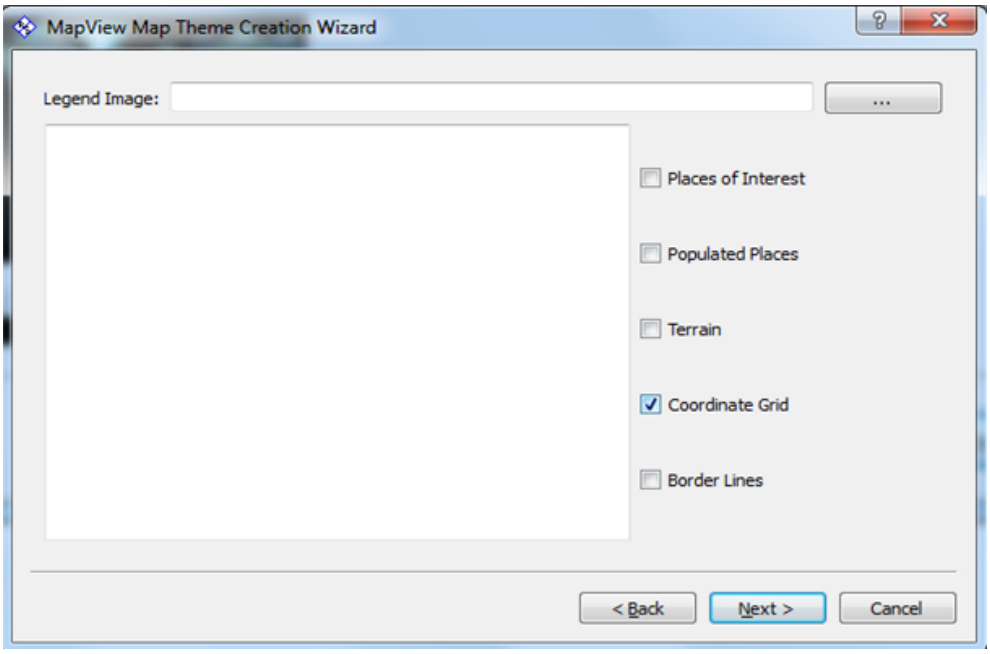


Figure 4-306: Coordinate grid setting

Click the "Next" button.

9. The "Summary" window displays all basemap information.

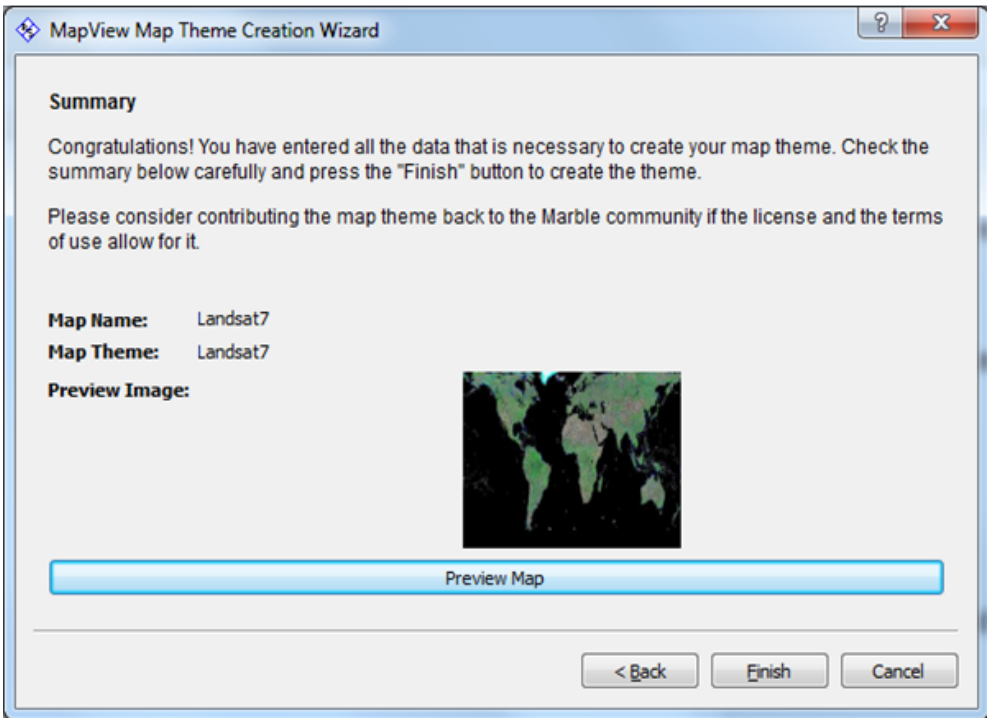


Figure 4-307: WMS creation finished

You can click the "Preview Map" to see a preview of the new basemap.
Click "Finish" to finalize map theme creation.

The new basemap will be listed in the basemap pop-up menu "Load Map" after the MapView restart.

4.3.3.10 GSM layer configuration

The submenu of the "GSM Layer" command in the "ROMESMAP Route Track View" context menu provides display settings for base stations and GSM signals.

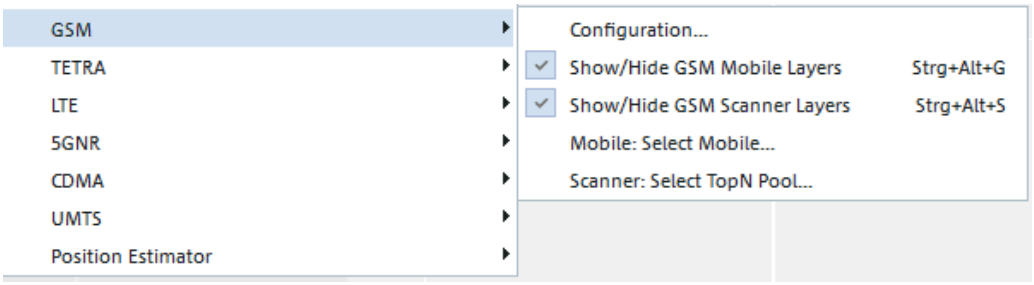


Figure 4-308: GSM layer submenu

- "Configuration"
  Opens the technology layer dialog to set the display options. It contains the following tabs:
  – "BTS Symbols"

The BTS size controls can be found within the "BTS Symbols" page, see "ROMESMAP route track view configuration: Bts symbols tab" on page 601.

– "Scanner Layers"
The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Scanner Layers" tab, see "LTE RTM Bts layer configuration: scanner layers" on page 669.
– "Mobile Layers"
The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Mobile Layers" tab, see "LTE RTM Bts layer configuration: mobile layers" on page 672.
– "C/I Analysis Layers"
The tab is the part of the "ROMESMAP GSM RTM BTS Layer" page, see Figure 4-310.
– **Info**
The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Info" tab, see "LTE RTM Bts layer information: info" on page 674.

- "Show/Hide..."
You can select specified layer to be displayed or hidden in the map view.
- "Mobile: Select Mobile"
Specifies of which mobile the route underlay is displayed.
The function has two options as shown in the following figure:
  – Automatic selection by selected signal
  – Change to automatic selection when a signal of a mobile from the list was selected

Figure 4-309: Selected mobile for display in map view

If no option is checked, one mobile is selected. The route underlay of that mobile is displayed all the time, no matter which signal/mobile is selected at the top of the Route Track view.
If "Automatic Selection by Selected Signal" is selected, it is not possible to select a mobile with that function. The route underlay is in this case specified by the

selected signal and the selected mobile on top of the Route Track view. It must be a GSM signal and a mobile that stays on GSM to show the belonging route underlay for GSM of that mobile.
If "Change to Automatic Selection when a Signal of a Mobile..." is selected, the route underlay of the selected mobile is displayed all the time up to that moment when another signal of the mobiles from the list is selected. Then the function switches back to automatic selection.

- "Scanner: Select TopN Pool"
  Lets select a scanner Top N pool from the list which route underlay is displayed.

ROMESMAP GSM RTM Bts layer: C/I analysis layers

The "C/I Analysis Layers" tab shows configuration settings for display setting of C/I analysis layers data and the order of the corresponding layers.

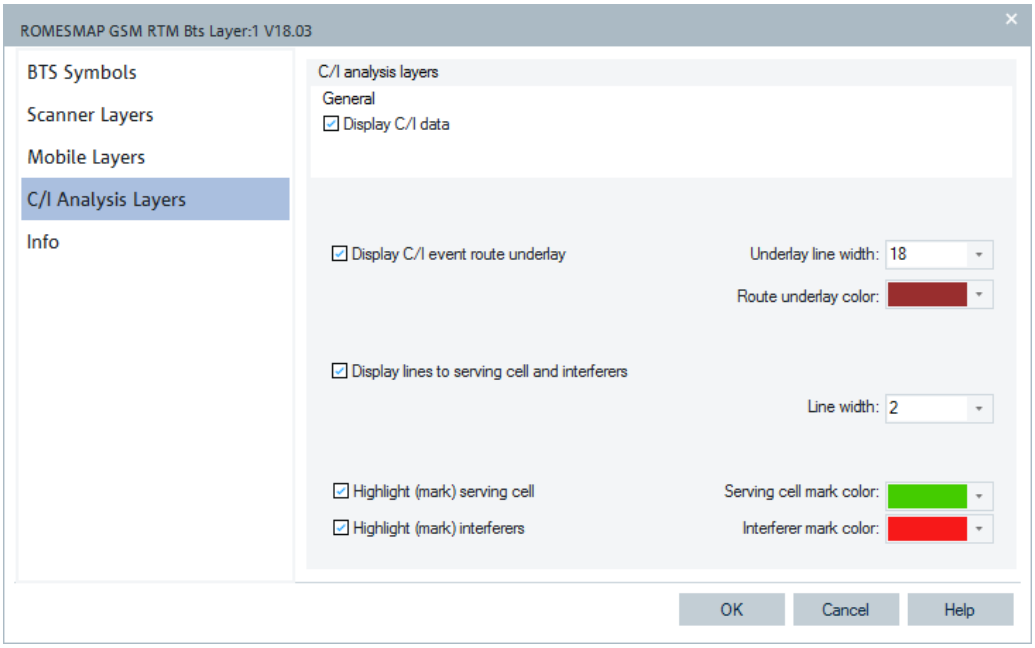


Figure 4-310: GSM RTM Bts Layer

- "General"
  Shows the C/I measured data if the "Display C/I Data" check box is ticked.
  For data display, the analysis layer uses the line width and the colors of serving cell and interferers selected below. Used are lines to serving cell and interferers, serving cell and interferers highlightings.
- "Display C/I event route underlay"
  Activate or deactivate the displaying of the C/I event route as underlay. If activated, define the C/I event route underlay line width and color via "Underlay line width" and "Route underlay color", respectively.
- "Display lines to serving cell and interferers"
  Draw line of selected width for measured serving cell signal and interferers via "Line width".
- Serving cell and interferers highlighting

Define the color to mark the serving cell signal and interferers.

Use only sorted Top N pools for the "ROMESMAP Route Track View".

4.3.3.11 TETRA layer configuration

The TETRA technology-specific extension of the "ROMESMAP Route Track View" shows following information:

- Transmitters of the currently loaded TETRA database
- Route underlay and lines to best server in the color of the carrier of the currently best server of the selected Top N pool
- For scanner Top N pools: best server symbols (Top1)
- Highlight serving cell and the neighbor cell

The submenu of the "TETRA Layer" command in the "ROMESMAP Route Track View" context menu provides display settings for base stations and TETRA signals. For the menu entries, refer to the LTE Layer Configuration chapter.

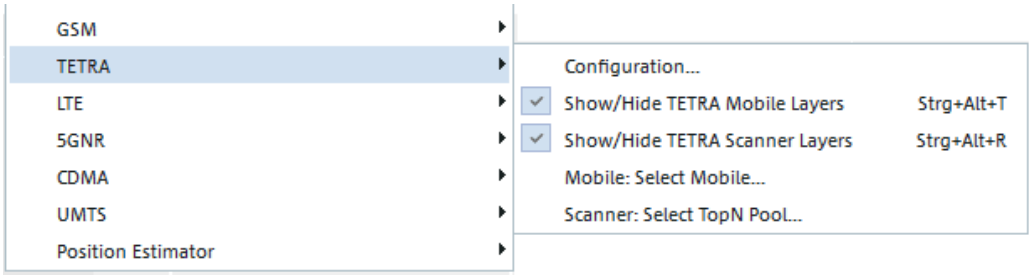


Figure 4-311: TETRA layer submenu

- "Configuration"
  Opens the technology layer dialog to set the display options. It contains following tabs:
  - "BTS Symbols"
    The BTS size controls can be found within the "BTS Symbols" page, see "ROMESMAP route track view configuration: Bts symbols tab" on page 601.
  - "Scanner Layers"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Scanner Layers" tab, see "LTE RTM Bts layer configuration: scanner layers" on page 669
  - "Mobile Layers"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Mobile Layers" tab, see "LTE RTM Bts layer configuration: mobile layers" on page 672.
  - "Info"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Info" tab, see "LTE RTM Bts layer information: info" on page 674.
- "Show/Hide..."
  You can select specified layer to be displayed or hidden in the map view.

- "Mobile: Select Mobile"
  Specifies of which mobile the route underlay is displayed, for more see Mobile: Select Mobile
- "Scanner: Select TopN Pool"
  Lets select a scanner Top N pool from the list which route underlay is displayed.

Use only sorted Top N pools for the "ROMESMAP Route Track View".

Correct server lines for TETRA route track

The recognition of the TETRA base station is based on decoding LA and MCC signals in the R&S ROMES4 version 18.0 and higher. This approach assures the correct server lines.

The former approach to use MCCH for this purpose is abandoned. The TETRA network can change MCCH dynamically so that after a while server lines partly miss.

4.3.3.12 LTE layer configuration

The LTE technology extension of the "ROMESMAP Route Track View" shows the following information:

- Symbols of LTE BTS
- Route underlay and lines to best server in the color of the cell ID
- For scanner Top N pools:
  - Scanner data
  - Best server symbols (Top1)
  - Next best server symbols (Top2 to Top6)
- For the LTE mobiles:
  - Mobile device data
  - Labels for a serving cell (for example, the cell name and ID)
  - Labels for the neighbor cells (for up to 12 cells, cell name and ID)

The submenu of the "LTE Layer" command in the "ROMESMAP Route Track View" context menu displays settings for base stations, LTE and LTE NB-IoT signals.

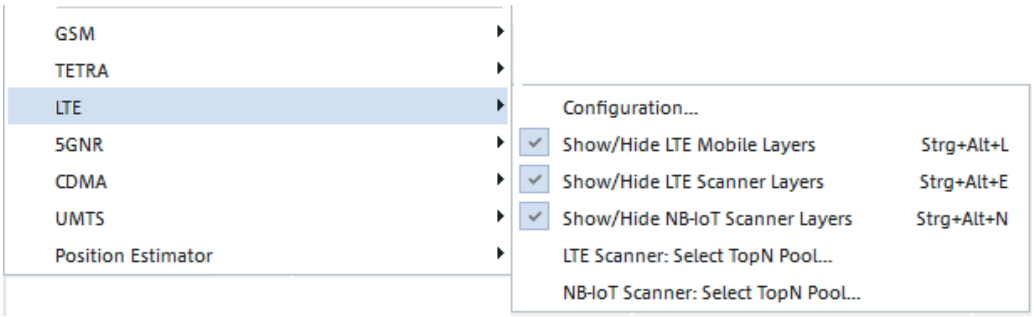
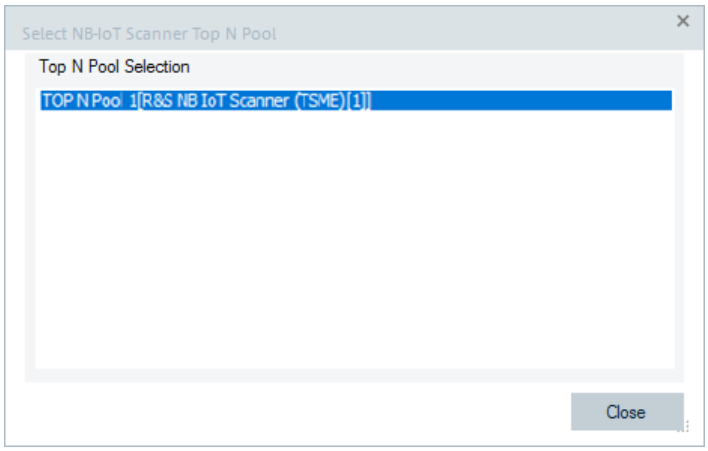


Figure 4-312: LTE layer submenu

A valid base station list must be imported and the BTS data base created before any configurations can be made. These actions are done in "Tools" > "Transmitter Database" > "Base station", see Chapter 3.8.5, "Transmitter database", on page 384.

- "Configuration"
  Opens the "ROMESMAP LTE RTM Bts Layer" dialog to set the following display options.
  - "BTS Symbols"
  - "LTE Scanner Layers"
  - "NB-IoT Scanner Layers"
  - "Mobile Layers"
  - "Info"
- "Hide /Show ..."
  You can select a layer to be displayed or hidden in the map view. This selection is valid for the following layers:
  - LTE mobile layers
  - LTE scanner layers
  - NB-IoT scanner layers
- "Scanner..."
  You can select the scanner Top N pool from the list of route underlay which is displayed. The scanners whose Top N pools that can be selected are:
  - LTE scanner
  - NB-IoT scanner
    Use the "NB-IoT Scanner: Select TopN Pool" entry to open the "Select NB-IoT Scanner Top N Pool" dialog.



Use only sorted Top N pools for the "ROMESMAP Route Track View".

LTE RTM Bts layer configuration: BTS symbols

The "BTS Symbols" tab dialog provides information on BTS size control and BTS color configuration.

The tab is analogous for all technologies.

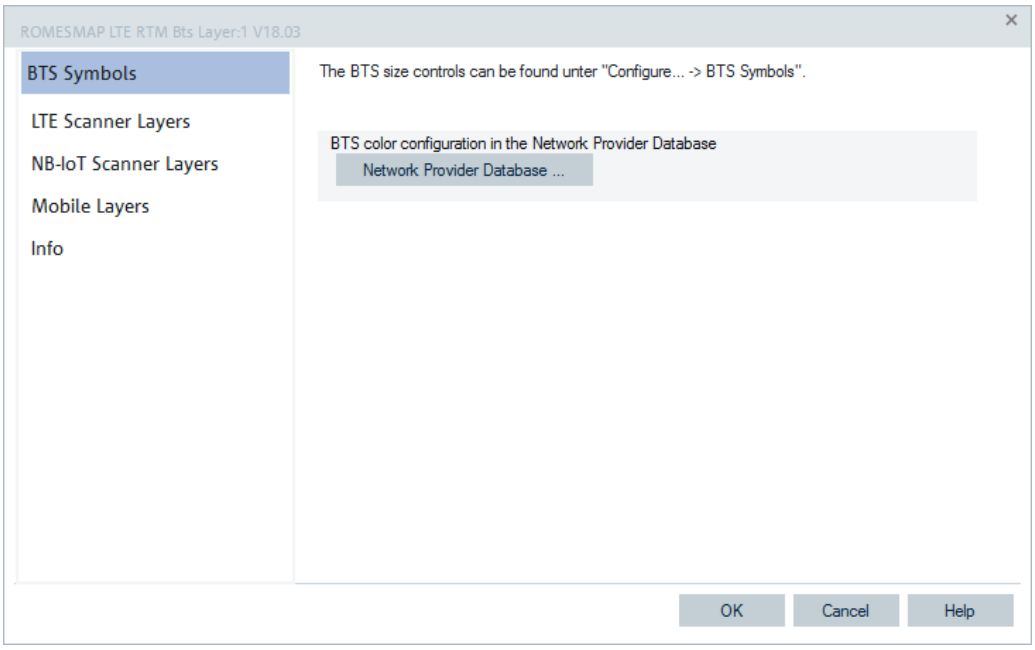


Figure 4-313: LTE RTM BTS Layer Configuration - BTS Symbols

The "BTS Symbol" page is technology independent:

- "The BTS size controls can be found ..."
  For information about the BTS size control, see "ROMESMAP route track view configuration: Bts symbols tab" on page 601.
- "BTS color configuration in the Network Provider Database"
  Defines which color to use. The coloring depends on the network provider database, see Chapter 3.8.6, "Network provider database", on page 403. The database is searched for MCC and MNC and the returned color is used.
  All base stations (BTS) from other networks get the default color.

LTE RTM Bts layer configuration: scanner layers

The "LTE Scanner Layers" dialog lets you set the parameters of LTE scanner data display and the order of the corresponding layers. The dialog layout and the meaning of the dialog's parameters is common for all supported RATs.

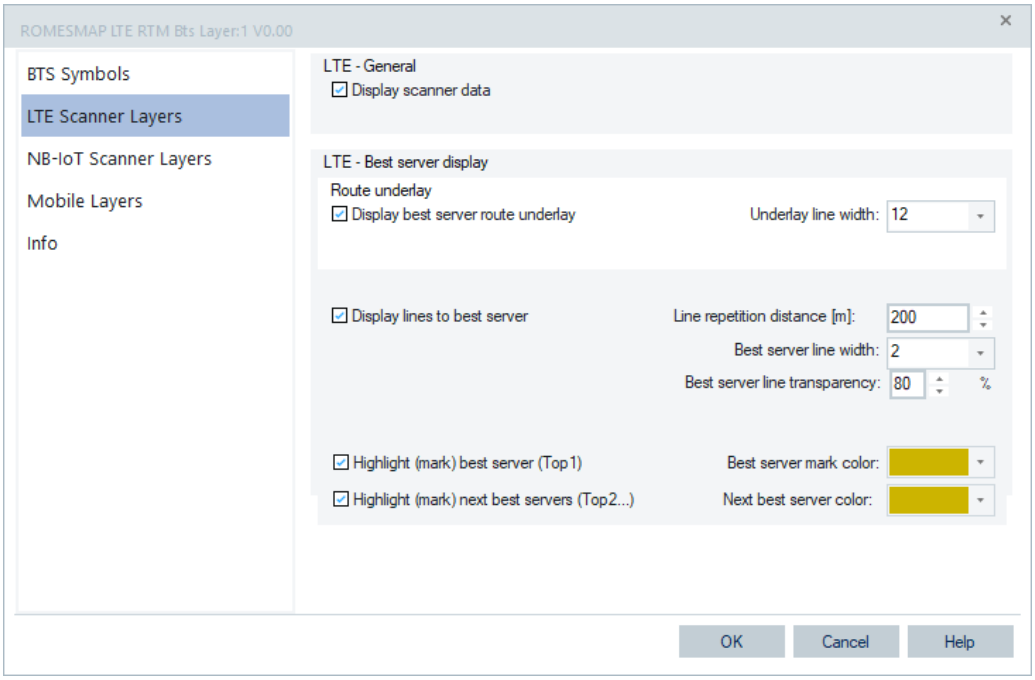


Figure 4-314: LTE RTM BTS Layer Configuration - Scanner Layers

- "LTE - General"
  If "Display scanner data" is marked, the scanner data in the "LTE - Best server display" pane is displayed.
- "LTE - Best server display"

  Defines the display option for the best server information.
  - "Route underlay"
    Activates/deactivates display of the best server route as underlay. If activated, you can select the width of the underlay line.
  - "Display lines to best server"
    Draws lines between the measurement position and the active sector (best server). Define the line repetition distance (in meters, default 200m), the line width and the best server line transparency (in %, default 80%). Here you can continuously change the values of the mentioned parameters.
  - "Highlight (mark) ..."
    Lets you select the color for the best server (1st Top N element) and the second best server (2nd Top N element) if the check-boxes are marked.

The following screenshot shows the best server lines display in the ROMESMAP dependent on the values set for the "Line repetition distance [m]" and "Best server line transparency" parameters. The sample signal is Top N EARFCN.

The first parameter determines the distance between server lines. More lines are drowned for smaller distance. A change is shown if you click the "OK" button in the dialog. The "Best server line transparency" allows the line transparency to change. The total transparency is 100%, while invisible and 0% transparency is opaque.

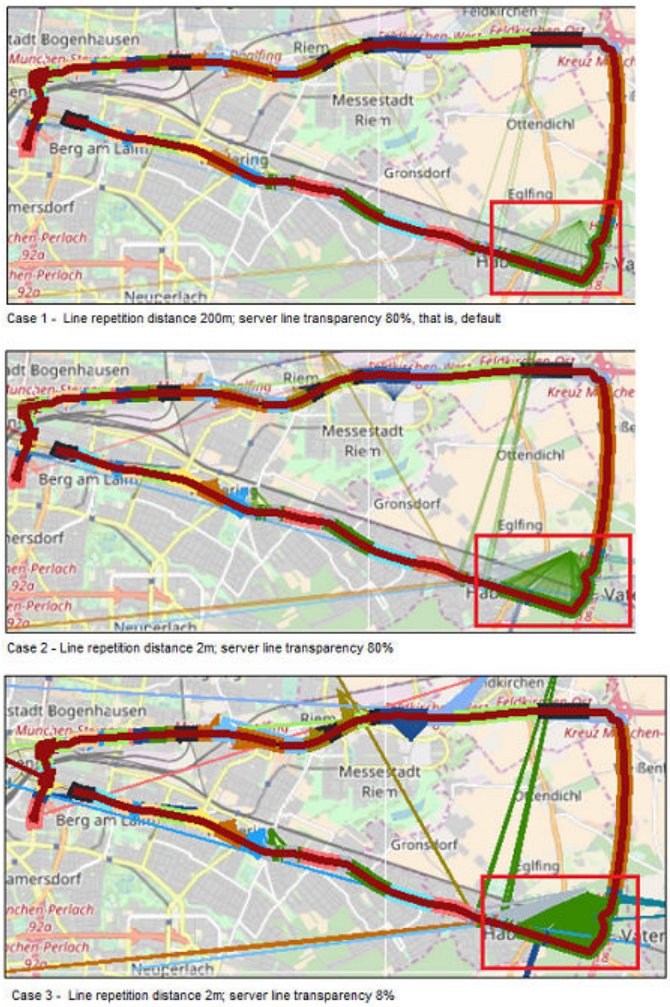


Figure 4-315: Three cases of the best server lines display - scanner layer

The "server lines Transparency" and "server lines Repetition Distance" buttons in the "ROMERSMAP Rroute Track View" icon bar let you quick change the values of these parameters. Possible values are displayed if clicked the left-mouse button.

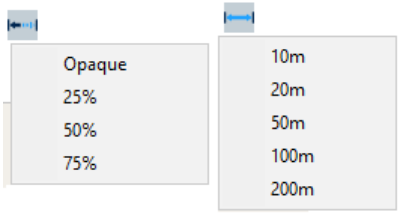


Figure 4-316: Server line transparency and distance repetition buttons

Display lines to best server during replay mode

To display lines to best server during replay of a measurement file, the BTS database has to be loaded together with the measurement file before file scan was performed.

Loading the BTS database afterwards is possible. However, the loading has no effect on drawing the lines to the best server for the currently open and scanned measurement file. Thus, reopen the measurement file together with the BTS database to see the lines to the best server during replay.

LTE RTM Bts layer configuration: NB-IoT scanner layers

For the description of the entries in this dialog, see the previous chapter.

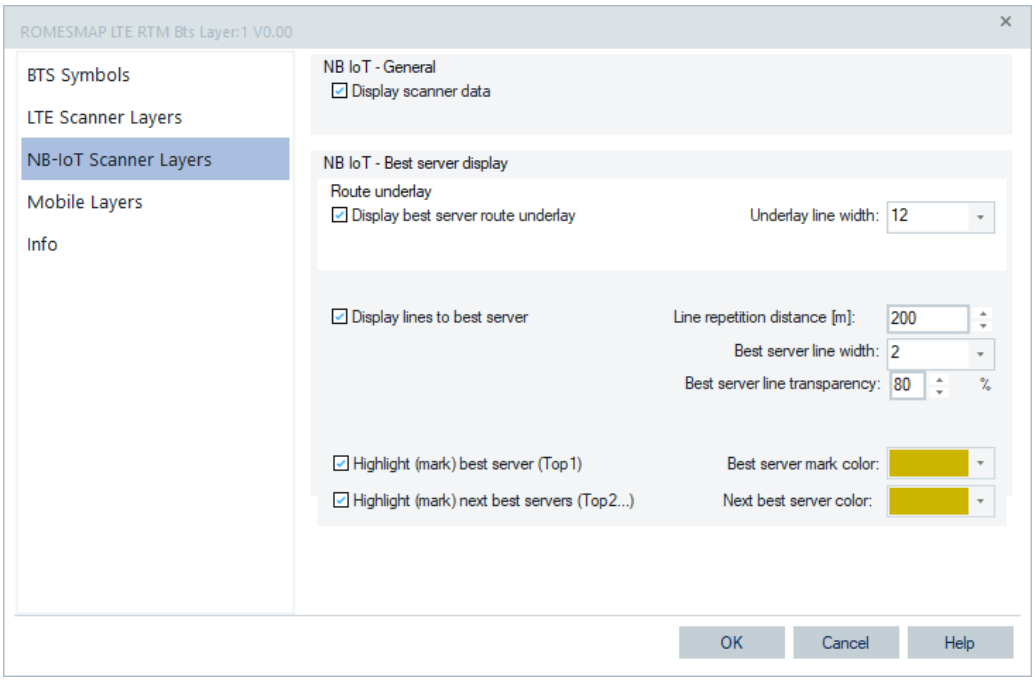


Figure 4-317: RTM BTS Layer Configuration - NB-IoT Scanner Layers

LTE RTM Bts layer configuration: mobile layers

The "Mobile Layers" dialog lets you set the parameters of a mobile device data display and the order of the corresponding layers.

If "General" > "Display mobile data" is marked, the mobile data selected in the "Best server display" pane is displayed.

For the further explanation of the dialog parameters, see "LTE RTM Bts layer configuration: scanner layers" on page 669.

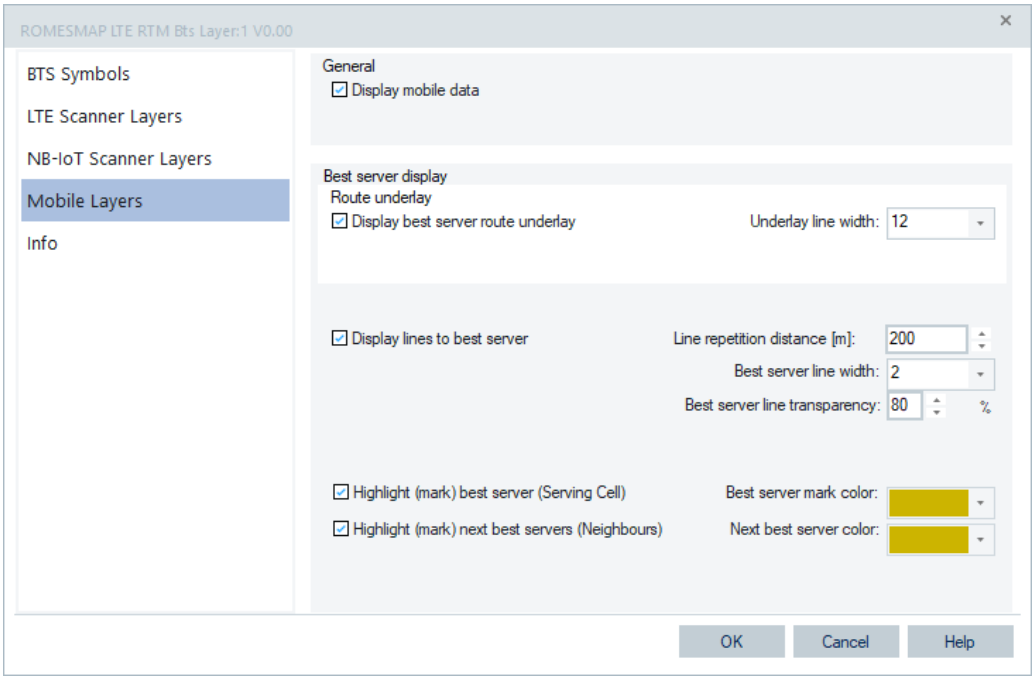


Figure 4-318: RTM BTS Layer Configuration - Mobile Layers

The following screenshot shows the best server lines display in the ROMESMAP dependent on the values set for the "Line repetition distance [m]" and "Best server line transparency" parameters for mobile data. The sample signal is RSRP.

Case 1 - Line repetition distance 200m; server line transparency 80%, that is, default

Case 2 - Line repetition distance 2m; server line transparency 80%

Case 3 - Line repetition distance 2m; server line transparency 8%

Figure 4-319: Three cases of the best server lines display - mobile layer

Display lines to best server during replay mode

See the Note in the "LTE RTM Bts layer configuration: scanner layers" on page 669.

LTE RTM Bts layer information: info

The "Info" page is divided into two parts.

The upper "Module Properties" part allows a user-defined name of the technology to set. The "Custom Name" field has no function in a view context. It is only useful in the devices context, where connected devices can be associated with different custom names. The field is assigned to separate mobiles in different networks or when simultaneously operated mobiles perform different tasks.

The lower "File Version" part shows the file information on the dynamic link library properties which are implemented in the selected technology.

4.3.3.13 5G NR layer configuration

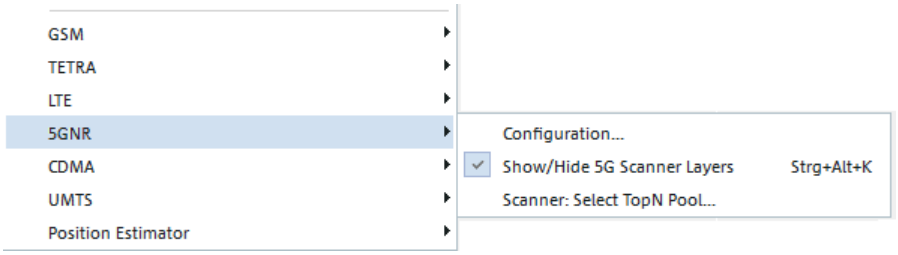


Figure 4-320: 5GNR layer submenu

The 5G NR technology extension of the "ROMESMAP Route Track View" shows the following information:

- Symbols of 5GNR BTS
- Scanner layers
- Mobile layers
- Info, which is common for all RATs

5G NR RTM Bts layer configuration: scanner layers

The following configuration options for display of the scanner Top N pools data and the order of the corresponding layers are available.

- Scanner data display
- Best server display configuration:
  - Separate best server PCI and best server SSB route underlays
  - Color server lines to best server PCI or to best server SSB index
  - Symbols of best server and the next best server (Top1 and Top2)

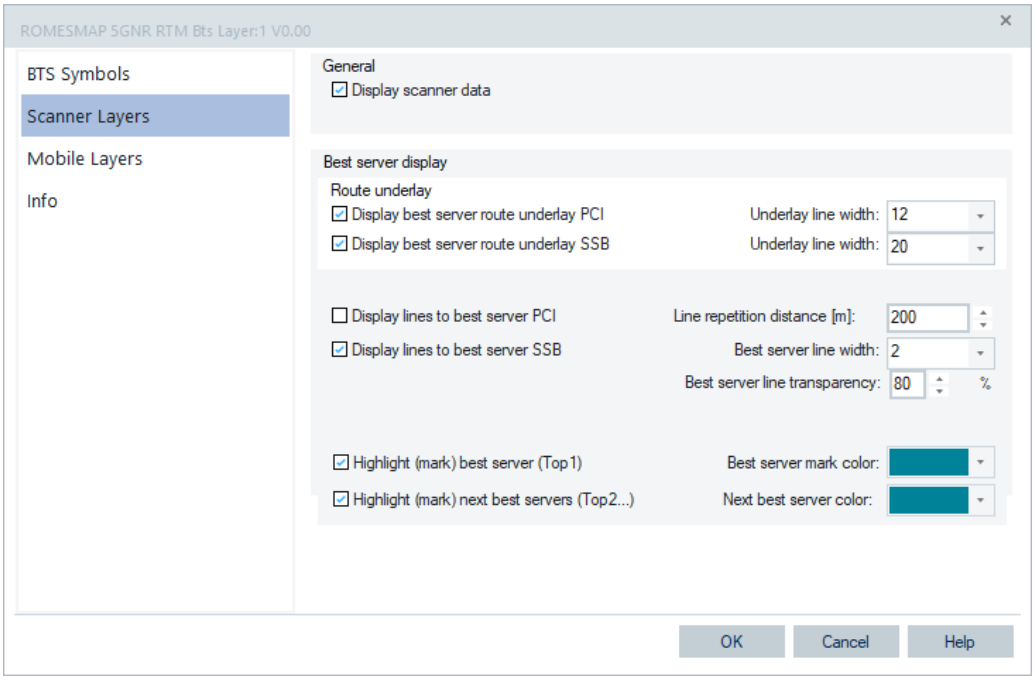


Figure 4-321: 5GNR layers configuration - scanner layers

The result of the configuration gives a "ROMESMAP Route Track View" like the following one.

Figure 4-322: ROMESMAP route track view - 5G NR scanner

5G NR RTM Bts layer configuration: mobile layers

The following configuration options for display of a 5G NR mobile device data and the order of the corresponding layers are available:

- Mobile data display
- Best server display configuration:
  - Separate best server PCI and best server SSB route underlays
  - Color server lines to best server PCI or to best server SSB index
  - Symbols of best server and the next best server (serving cell and neighbors)

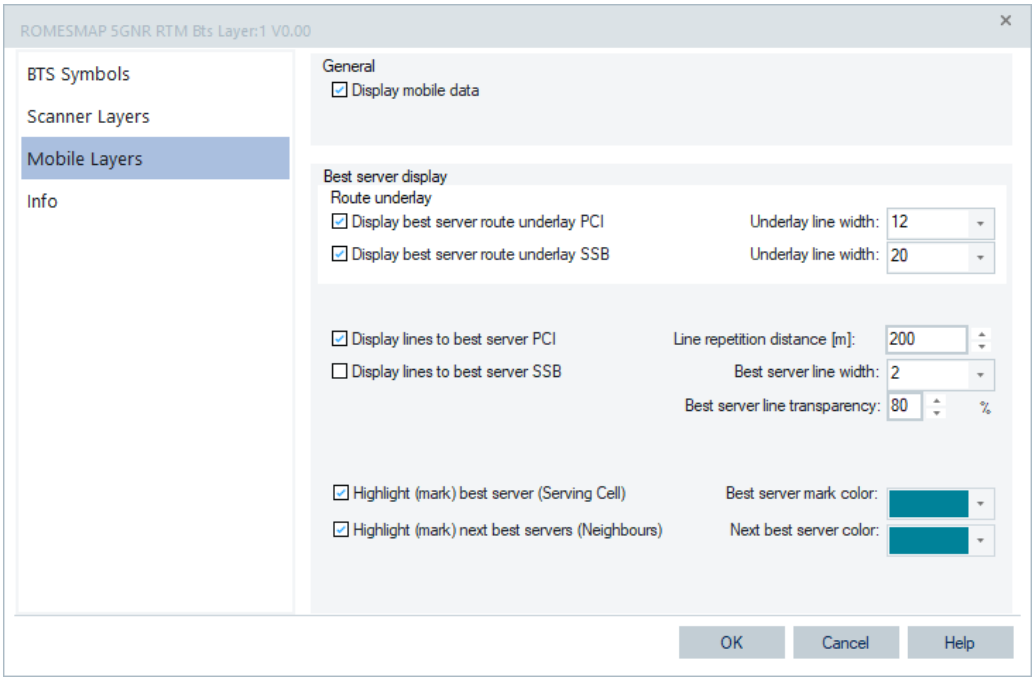


Figure 4-323: 5GNR layers configuration - mobile layers

4.3.3.14 CDMA2000 1xEV-DO layer configuration

The CDMA technology-specific extension of the "ROMESMAP Route Track View" shows following information:

- Symbols for CDMA BTS,
- Route underlay and lines to best server in the color of the PN offset
- For the scanner TopN pools:
  - Best server symbols (Top1)
  - Next best server symbols (Top2 to Top6)
- For the Mobiles CDMA2000 or EVDO
  - Best server symbols (Active Set A1 to A6)
  - Next best server symbols (Candidate Set C1 to C6 and Neighbour Set N1 to N9)

The submenu of the "CDMA Layer" command in the "ROMESMAP Route Track View" context menu provides display settings for base stations and CDMA2000 & 1xEV-DO signals.

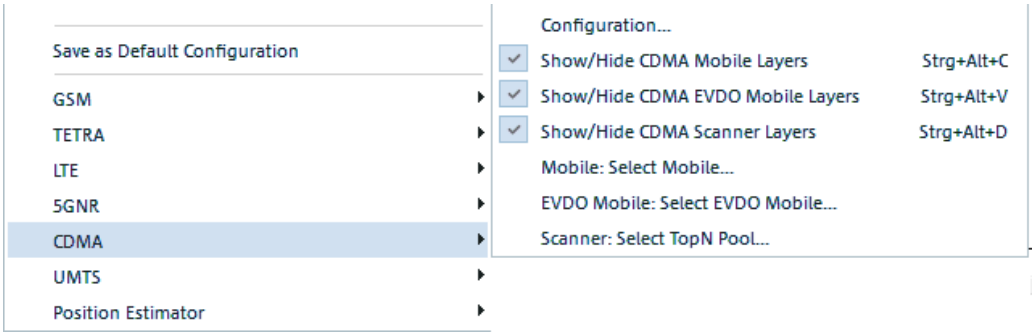


Figure 4-324: CDMA2000 1xEV-DO layer submenu

- "Configuration"
  Opens the technology layer dialog to set the display options. It contains following tabs:
  - "BTS Symbols"
    The BTS size controls can be found within the "BTS Symbols" page, see "ROMESMAP route track view configuration: Bts symbols tab" on page 601.
  - "Scanner Layers"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Scanner Layers" tab, see "LTE RTM Bts layer configuration: scanner layers" on page 669
  - "Mobile Layers"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Mobile Layers" tab, see "LTE RTM Bts layer configuration: mobile layers" on page 672.
  - "Info"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Info" tab, see "LTE RTM Bts layer information: info" on page 674.
- "Show/Hide..."
  You can select specified layer to be displayed or hidden in the map view.
- "Mobile: Select Mobile"
  Specifies of which mobile the route underlay is displayed, for more see Mobile: Select Mobile
- "Scanner: Select TopN Pool"
  Lets select a scanner Top N pool from the list which route underlay is displayed.

Use only sorted Top N pools for the "ROMESMAP Route Track View".

4.3.3.15 UMTS layer configuration

The submenu of the "UMTS Layer" command in the "ROMESMAP Route Track View" context menu provides display settings for base stations, UMTS signals and UMTS scanner Top N data, see the following figure.

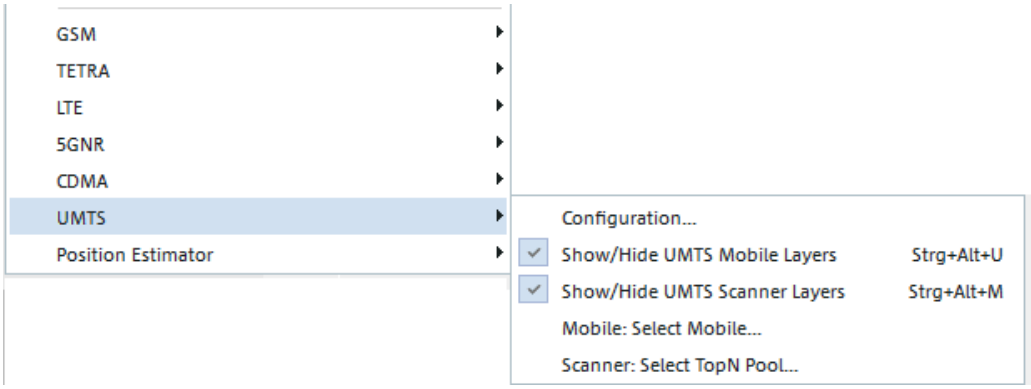


Figure 4-325: UMTS layer submenu

- "Configuration"
  Opens the technology layer dialog to set the display options. It contains following tabs:
  - "BTS Symbols"
    The BTS size controls can be found within the "BTS Symbols" page, see "ROMESMAP route track view configuration: Bts symbols tab" on page 601.
  - "Scanner Layers"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Scanner Layers" tab, see "LTE RTM Bts layer configuration: scanner layers" on page 669
  - "Mobile Layers"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Mobile Layers" tab, see "LTE RTM Bts layer configuration: mobile layers" on page 672.
  - "Info"
    The tab is analogous to the "ROMESMAP LTE RTM BTS Layer" > "Info" tab, see "LTE RTM Bts layer information: info" on page 674.
- "Show/Hide..."
  You can select specified layer to be displayed or hidden in the map view.
- "Mobile: Select Mobile"
  Specifies of which mobile the route underlay is displayed, for more see Mobile: Select Mobile
- "Scanner: Select TopN Pool"
  Lets select a scanner Top N pool from the list which route underlay is displayed.

Use only sorted Top N pools for the "ROMESMAP Route Track View".

4.3.3.16 Position estimator layer configuration

Click the "Position Estimator > Configuration" command in the "ROMESMAP Route Track View" context menu to open the "BTS Symbol" page.

The "BTS Symbol" page is technology independent, see "LTE RTM Bts layer configuration: BTS symbols" on page 668. It provides the information about the BTS size control and the BTS color configuration.

If a measurement with estimated BTS positions and a matching BTS database are loaded in R&S ROMES4, many BTSs can be displayed twice, as:

- BTS symbol at the known position from the BTS database
- BTS symbol with estimated position (with error ellipsis)

If the position of the BTS is known from the database, the display of estimated BTS is suppressed by default. This suppression makes the display much clearer.

However, sometimes it can be useful to have both displays for comparison and evaluation. This option can be configured if selecting "BTS Symbol" > "Show estimated bts data even if the position is known from the bts database". The setting is stored in the registry as a user preference and needs a reload of the measurement file to show effects.

However, sometimes it can be useful to have both displays for comparison and evaluation. This option can be configured if selecting "Show estimated bts data even if the position is known from the bts database", see the following figure. The setting is stored in the registry as a user preference.

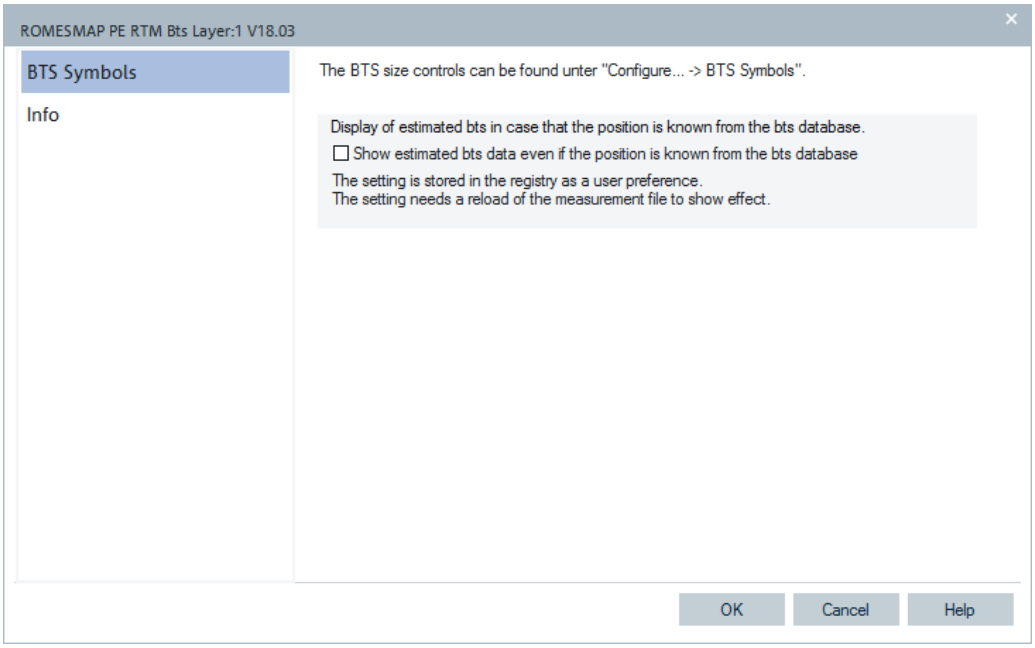


Figure 4-326: Display estimated BTS data...

The estimated BTS positions and their error ellipses are shown in the Position Estimator layer of the map online during the measurement. Later in replay, after loading the file, the final status at the end of the measurement is shown.

As the estimator cannot detect the direction of a BTS sector or if it is directed at all, all transmitters are visualized as omnidirectional.

Base stations and error ellipses can be hidden or shown per technology and / or estimation progress by configuring the "Tec Feature Switch", see Chapter 4.3.3.2, "View area", on page 566. There are three different progress states, visualized by different colors of the error ellipses, as shown in the following table:

Table 4-10: Position estimation progress states

Estimation	Error ellipse color
by Power	red
in Progress	yellow
Finished	green

By default, only yellow and green ellipses and the related BTS symbols are shown.

The threshold for the "Finished" state depends on the configuration of the minimum position error (estimation cutoff) in the PE settings, see Chapter 6.4.28.2, "Scanner settings for the BTS position estimator", on page 1872.

In the following, the examples for estimated BTS positions and their error ellipses are given.

Example: Estimated BTSs and their error ellipses "by power" only

In this case the PE feature in the "Tec Feature Switch" is configured as shown in the following figure.

PE Feature	All tec	GSM	CDMA	UMTS	LTE	TETRA
Main switch	☑	☐	☐	☐	☐	☐
by Power	☑	☑	☑	☑	☑	☑
in progress	☐	☐	☐	☐	☐	☐
finished	☐	☐	☐	☐	☐	☐
Ellipses	☑					

Figure 4-327: PE configuration for estimation "by power" only

This state represents the worst quality and therefore the largest ellipses, and all BTSs are displayed along the driven tour.

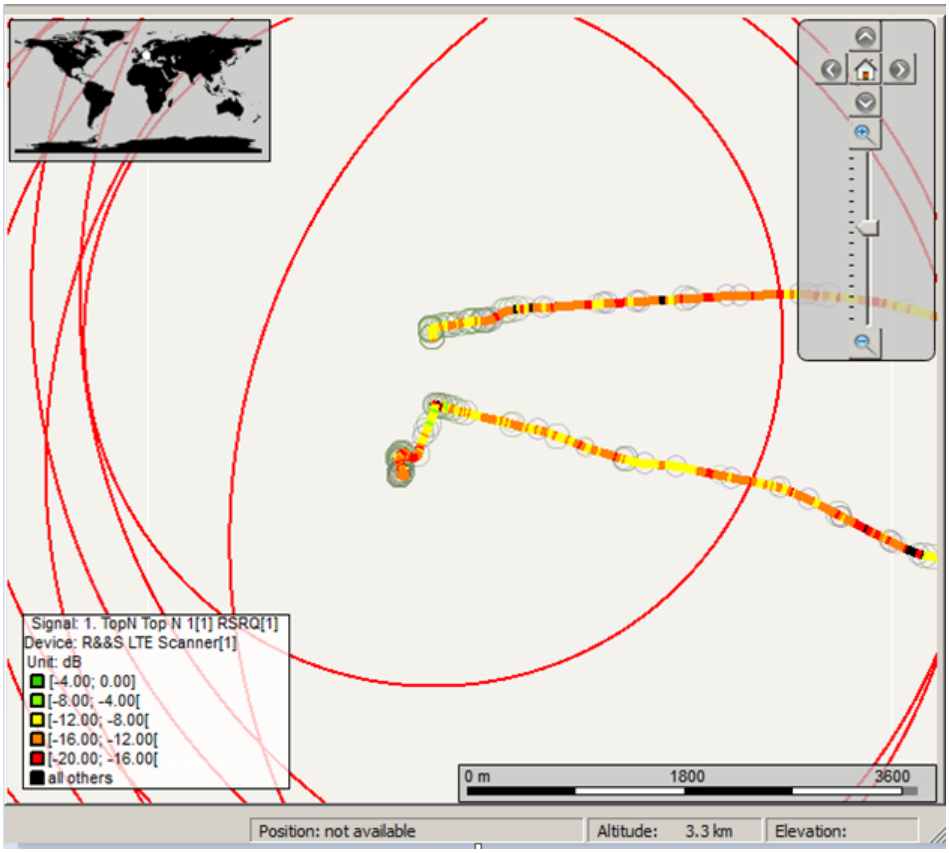


Figure 4-328: Estimated BTSs and their error ellipses "by power" only

Example: Estimated BTSs and their error ellipses "in progress" only

In this case the PE feature option in the "Tec Feature Switch" is configured as shown in the following figure.

PE Feature	All tec	GSM	CDMA	UMTS	LTE	TETRA
Main switch	☑	☐	☐	☐	☐	☐
by Power	☐	☐	☐	☐	☐	☐
in progress	☑	☑	☑	☑	☑	☑
finished	☐	☐	☐	☐	☐	☐
Ellipses	☑					

Figure 4-329: PE configuration for estimation "in progress" only

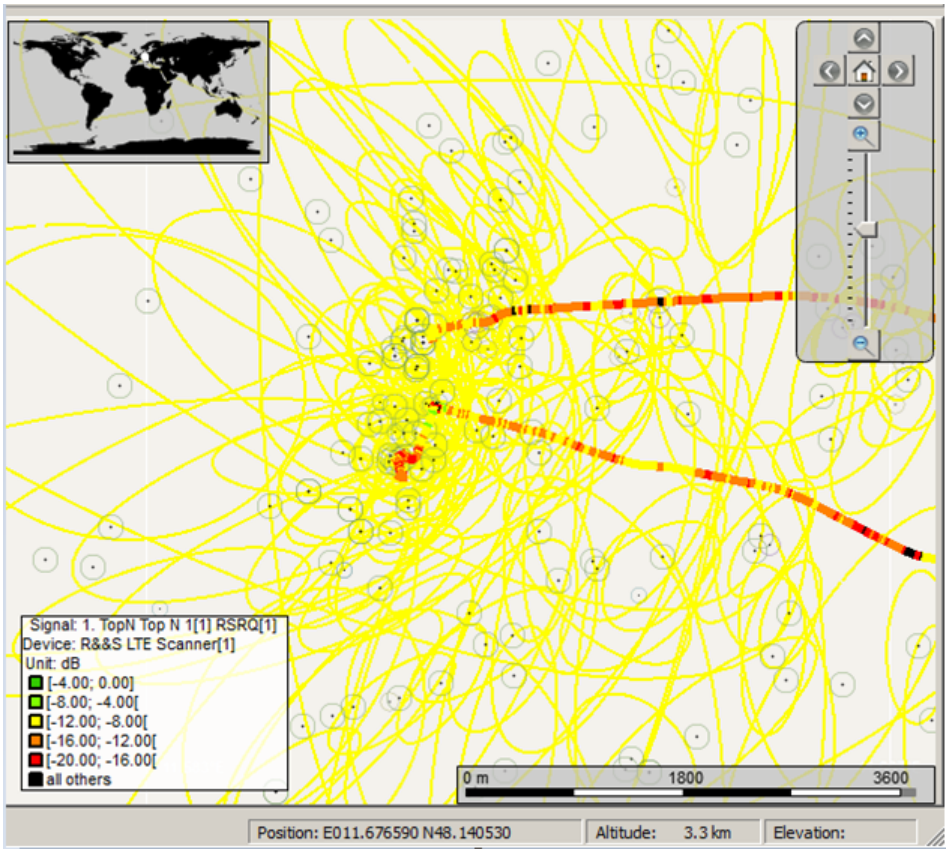


Figure 4-330: Estimated BTSs and their error ellipses "in progress" only

Example: Estimated BTSs and their error ellipses "finished" only

In this case the PE feature option in the "Tec Feature Switch" is configured as shown in the following figure.

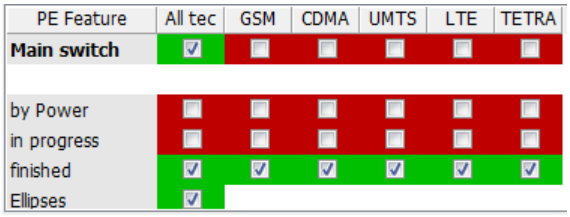


Figure 4-331: PE configuration for estimation "finished" only

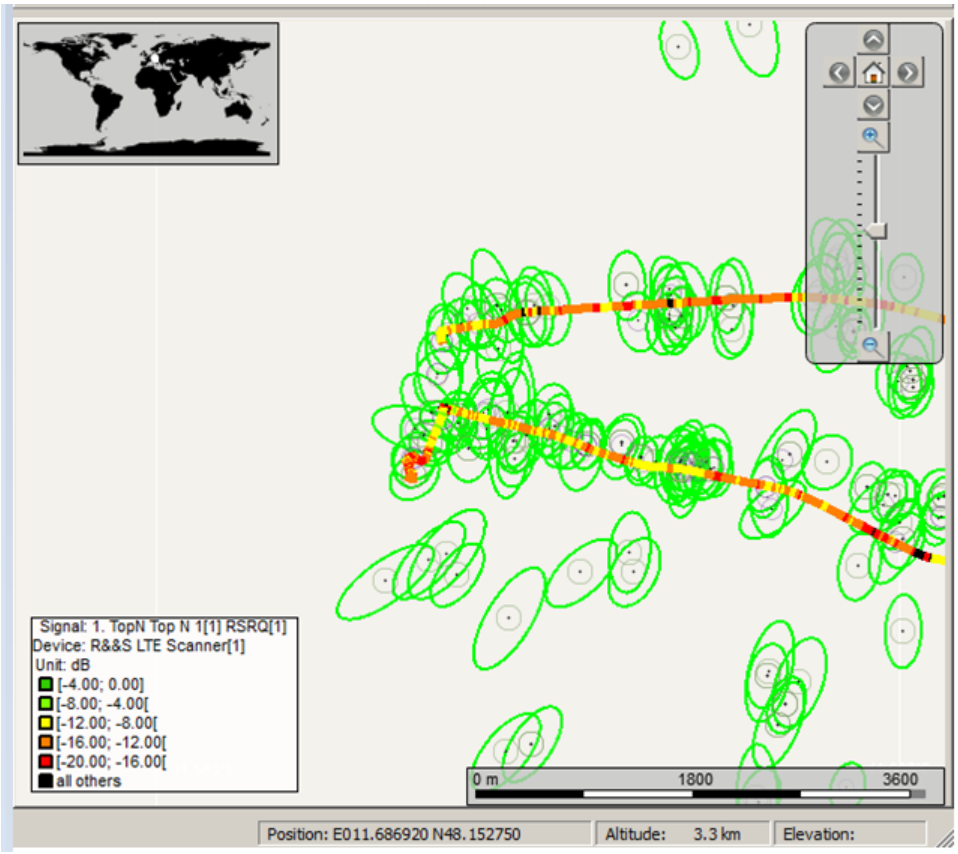


Figure 4-332: Estimated BTSs and their error ellipses "finished" only

4.3.3.17 User specified variable resolution for power, quality and UE

It is possible to specify the limits of the ellipses displayed in the map view according to the size of power, quality and equipment number.

A measurement value which is between its maximum and minimum value results in a circle or ellipse, the radius of which is an interpolation between the user-defined maximum and minimum. The max. and min. values of the UE-emulation parameters (power,

quality and count users) are set in the "Measurement Point Display Parameters" modal dialog.

Click the button in the scanner area to get the configuration dialog. This, so called "wrench" button, is found in the UE emulation menu bar for GSM, UMTS and LTE scanner.

The "Measurement Point Display Parameters" dialog is common for the mentioned UE-emulation technologies.

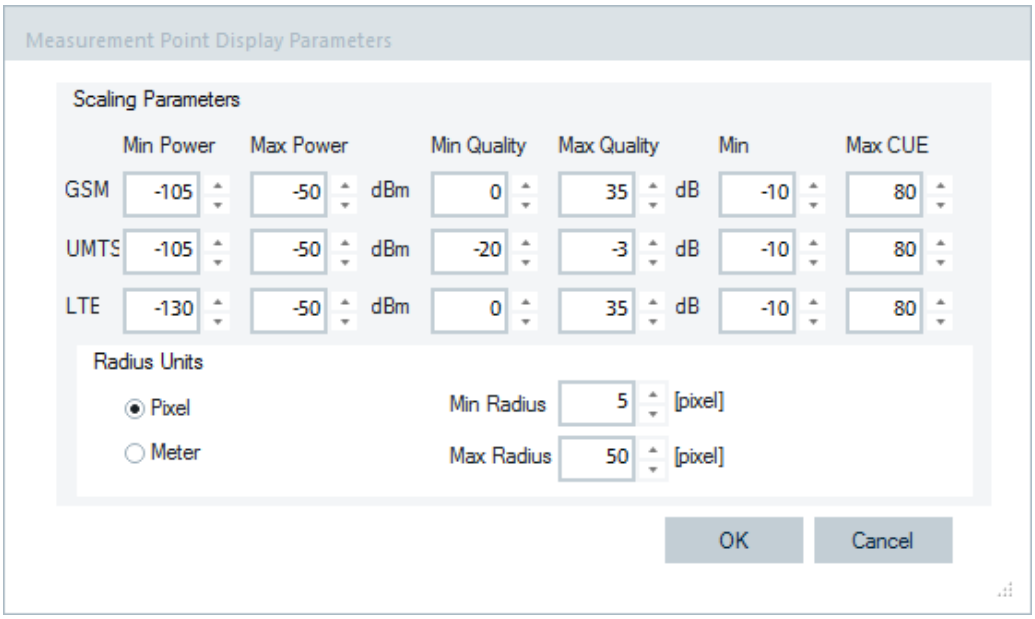


Figure 4-333: UE emulation modal dialog

Click "OK" to set the limits for the UE-emulation parameters and store in the registry.

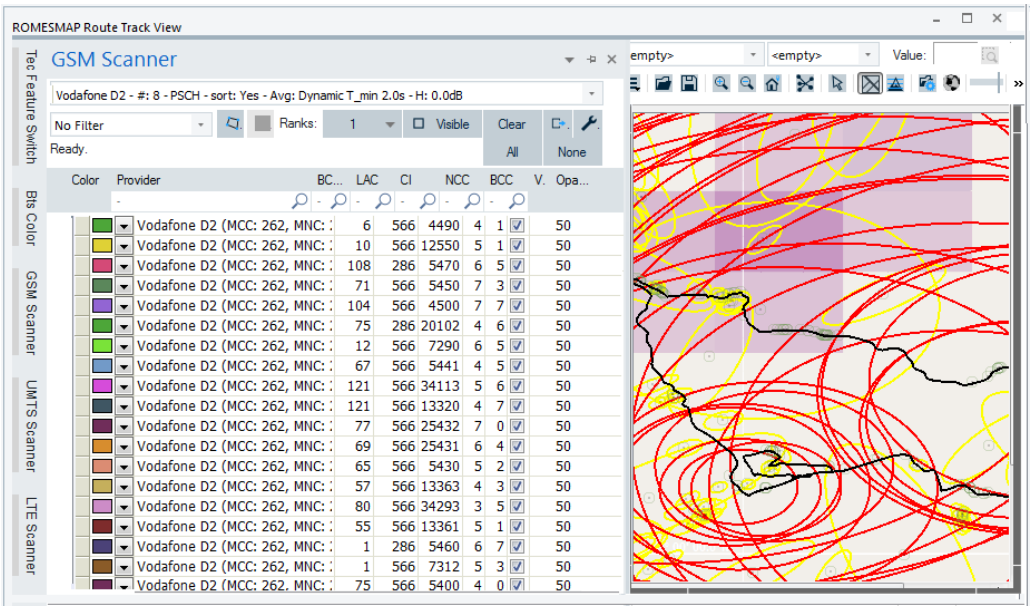


Figure 4-334: Wrench button and the map layout

4.4 Mobile views

"Mobile Views" can be used to view different technologies data. Some of the views evaluate processes that are independent of the technology, others show information that is exchanged between different technologies to ensure interoperability (e.g. the Layer 3 messages).

The views can be selected from a submenu displayed on the right-hand side of the "View" menu when the mouse pauses over the "Mobile Views" command.

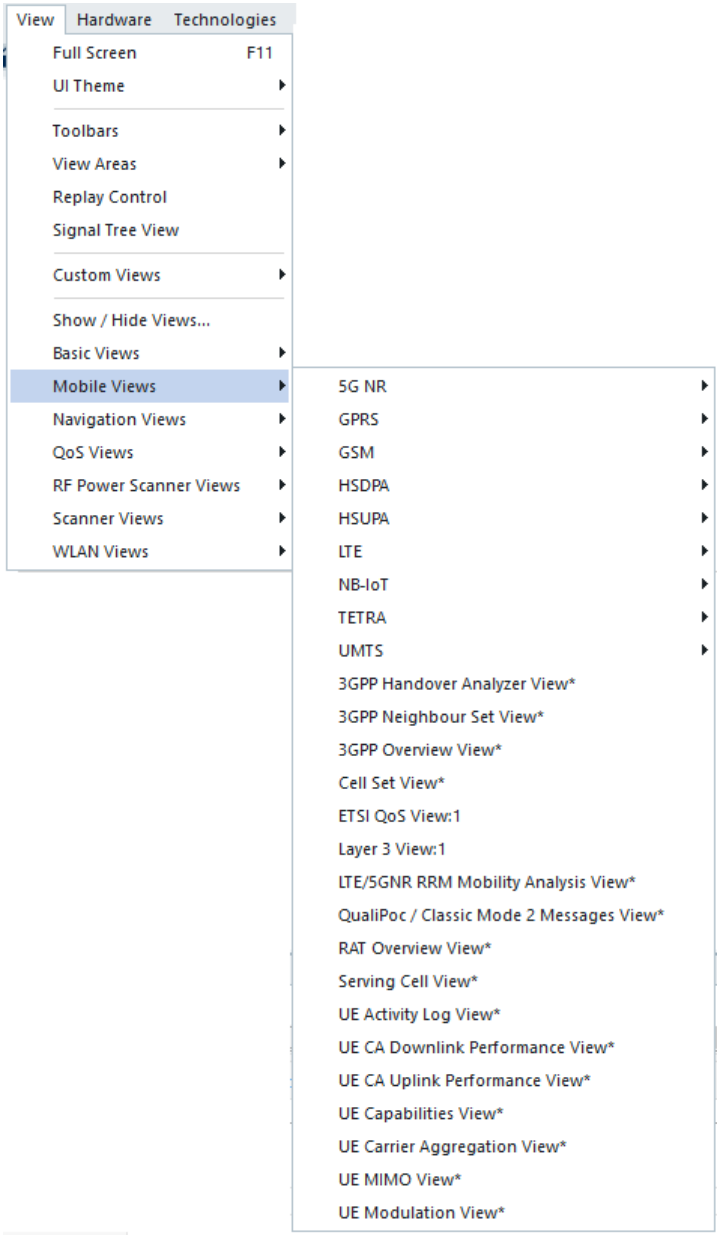


Figure 4-335: Mobile views

Graphics library used for mobile views

R&S ROMES4 makes use of the third party graphics library BCGDPro version 27.3 in order to support some 3GPP mobile views, for example, the LTE MIMO view, the LTE CA view, the LTE Modulation view, the LTE CA DL/UL Performance Views, the Mobile Serving Cell view.

Based on the BCGCPro version 27.3 the redrawn performances of the views during replay and scanning are improved. By opening multiple of these views simultaneously, the performance updates make R&S ROMES4 to perform better.

- UMTS HSUPA views....688
- UMTS HSDPA views....714
- UMTS views....742
- GPRS views....770
- GSM views....790
- LTE views....810
- NB-IoT views....854
- 5G NR views....859
- TETRA views....890
- 3GPP handover analyzer view....898
- 3GPP neighbour set view....910
- 3GPP overview view....923
- Cell set view....938
- ETSI QoS view....949
- Layer 3 view....958
- LTE/5GNR RRM mobility analysis view....990
- QualiPoc messages view....998
- Serving cell view....999
- UE activity log view....1007
- UE CA downlink performance view....1009
- UE CA uplink performance view....1022
- UE capabilities view....1023
- UE carrier aggregation view....1028
- UE MIMO view....1040
- UE modulation view....1052

4.4.1 UMTS HSUPA views

The "UMTS HSUPA Views" display High Speed Uplink Packet Access (HSUPA)-specific information acquired with UMTS test mobiles supporting HSUPA or data cards supporting HSUPA.

In general, recording of the different message types shown in the "UMTS Views" has to be explicitly activated in the device configuration menu:

1. Enable UMTS HSUPA in the "Configuration" tab.
2. Select the HSUPA node in the "Expert Mode" tab.

R&S ROMES4 supports HSUPA test mobiles based on Qualcomm 7200 chipset-based mobile or newer one.

The HSUPA views can be selected from a submenu displayed on the right side of the "View" menu hovering the mouse cursor over "HSUPA".

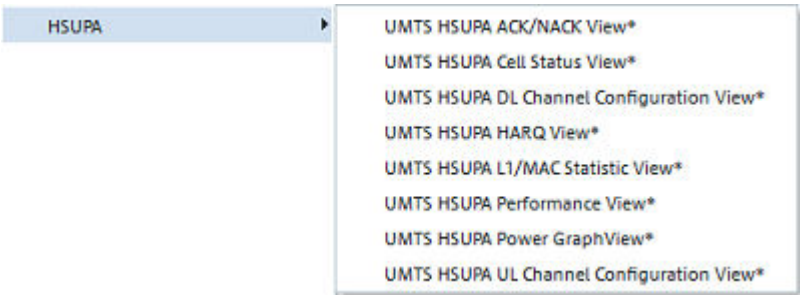


Figure 4-336: UMTS HSUPA views

The UMTS UE's view related to HSUPA ACK/NACK respects the general performance settings done in "Tools" >"Preferences" > "Performance" regarding the visual update rate. The individual view settings are avoided, see Chapter 4.4.1, "UMTS HSUPA views", on page 688.

- UMTS HSUPA ACK/NACK view 689
- UMTS HSUPA cell status view 690
- UMTS HSUPA DL channel configuration view 693
- UMTS HSUPA HARQ view 697
- UMTS HSUPA L1/MAC statistic view 699
- UMTS HSUPA performance view 705
- UMTS HSUPA power graph view 708
- UMTS HSUPA UL channel configuration view 710

4.4.1.1 UMTS HSUPA ACK/NACK view

The "UMTS HSUPA ACK/NACK View" shows the used transport block sizes per TTI. The Y-axis shows the TBS and the X-axis represents the TTIs.

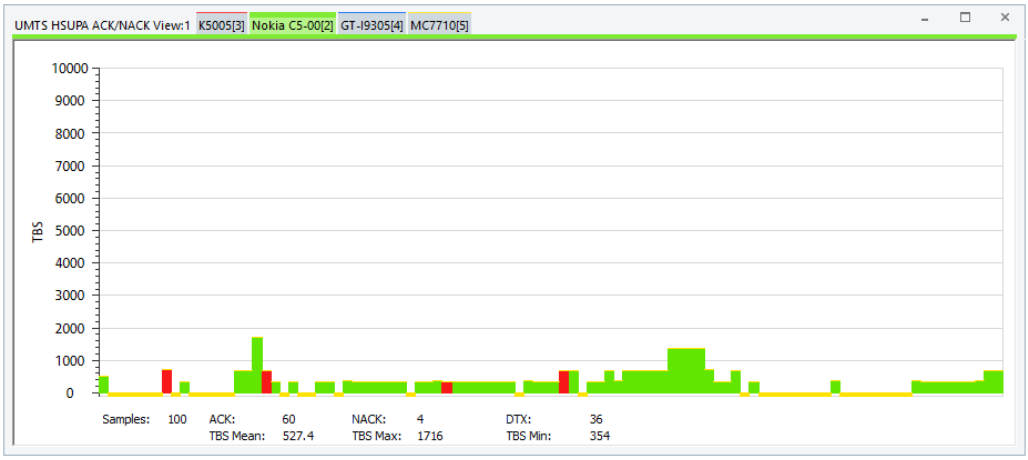


Figure 4-337: UMTS HSUPA ACK/NACK View

The chart of the view supports zooming using the mouse wheel, and panning using the left mouse button.

Diagram

The view shows a bar graph with fixed scale. Each bar corresponds to a TTI value reported by the mobile.

- A green bar denotes an acknowledged TTI
- A red bar denotes an unacknowledged TTI
- A yellow bar denotes a subframe that is not acknowledged but also not unacknowledged: no answer was received from the mobile

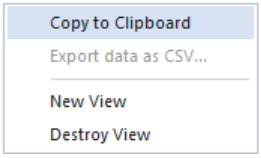
Use the Chapter 4.4.1.2, "UMTS HSUPA cell status view", on page 690 to analyze the cause for an unacknowledged or DTX frame.

Statistical results

Below the graph, the view shows the most important values per update cycle (Samples) in the diagram and the number of ACK, NACK, and DTX subframes. See the previous figure, ACK + NACK + DTX = Samples).

The arithmetic mean value of the displayed TBS values, the maximum, and the minimum TBS values are displayed below.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS HSUPA ACK/NACK View" has no context menu for configuration.

4.4.1.2 UMTS HSUPA cell status view

The Cell Status views show the events per TTI. Each column reflects one TTI. The background color corresponds to the Happy Bit (green = happy, red = unhappy, all other colors = DTX).

It is important, that the DialuUp connection is established during the R&S ROMES4 measurement session, as the mobile needs the information about the evolved cell set once. In the case, the DialUp connection is already established when the R&S ROMES4 measurement is started. The information about the Radio Link Set (RLS) is provided when the RLS changes and the mobile send a new trace due to changes.

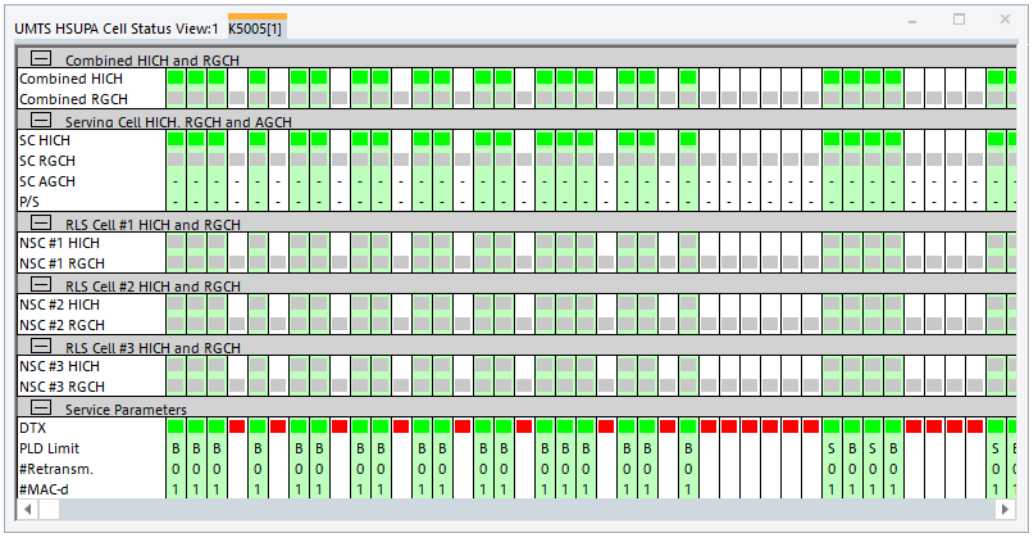


Figure 4-338: UMTS HSUPA Cell Status View

The first two rows show the result of the combination of the received HICH and RGCH.

- Combined HICH and RGCH 691
- Serving cell HICH, RGCH and AGCH 692
- RLS cell #<no.> HICH and RGCH 692
- Service parameters 692
- Context menu 693

Combined HICH and RGCH

Each row of the subdiagram shows one TTI. The chart contains the following results:

- **Combined HICH**
  The first row shows the result of the combination of the received Hybrid ARQ Indicator Channel (HICH).

  The color of a square in the TTI data row shows the type of TTI data:

  – Green → ACK
  – Red → NACK
  – Yellow → DTX

  The background color of the column represents the Happy Bit.

  – Light green Happy → Bit true
  – Pink → Happy Bit false
  – White → Happy Bit not set

  This parameter shows whether the mobile is "happy". The mobile is considered happy if it can transmit the currently available data within a certain time frame signaled by an RRC message.
- **Combined RGCH**

  The second row shows the result of the combination of the received Relative Grant Channel (RGCH), where the color of the square indicates:

  – Green → Up

– Red → Down
– Yellow → Hold
– Gray → no RGCH received

Serving cell HICH, RGCH and AGCH

The subdiagram shows the same values and colors described for the Combined HICH and RGCH on a cell basis, in this case for the serving cell (SC).

The chart contains the following results:

- "SC HICH"
  The background and square colors are identical to those colors described for Combined HICH.
- "SC RGCH"
  The background and square colors are identical to those colors described for Combined RGCH above.
- "SC AGCH"
  This additional row shows the Absolute Grant channel (AGCH) values which were transmitted in a certain TTI.

RLS cell #<no.> HICH and RGCH

The subdiagram shows the same values and colors described for the Combined HICH and RGCH on a cell basis, in this case for a non-serving cell (NSC), where #<nr.> could be #1, #2, or #3.

The chart contains the following results:

- "NSC #<nr.> HICH"
  The background and square colors are identical to those colors described for "Combined HICH".
- NSC #<nr.> RGCH
  The background and square colors are identical to those colors described for "Combined RGCH".

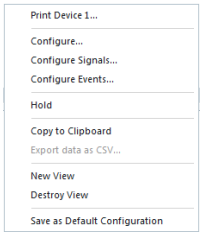
Service parameters

The last subdiagram shows additional parameters for the given TTIs.

The chart contains the following results:

- "DTX"
  Discontinuous transmission (green = true, red = false)
- "PLD Limit"
  Reason for the limitation of the throughput as described for the "Payload Limit" of the "UMTS HSUPA Performance View". (P = Power Rate, S = Serving Grant limit, B = Buffer Occupancy, M = MUX restricted, H = HARQ restricted).
- "# Retransmissions"
  The number of retransmissions.
- "# MAC-d"
  The number of Medium Access Control entities handling dedicated transport channels

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS HSUPA Cell Status View" has no context menu for configurations assigned.

4.4.1.3 UMTS HSUPA DL channel configuration view

The "UMTS HSUPA DL Channel Configuration View" shows the most important DL parameters of the active HSUPA connections, which were transmitted in the corresponding RRC messages. The power-offset table shows the basic information about what is the transmit power calculation of the mobile based on. For detailed information, refer to TS25.331 and TS25.212.

It is important, that the DialUp connection is established during the R&S ROMES4 measurement session, as the mobile needs the information about the evolved cell set once. In the case, the DialUp connection is already established, when the R&S ROMES4 measurement is started. The information about the Radio Link Set (RLS) is provided when the RLS changes and the mobile send a new trace due to these changes.

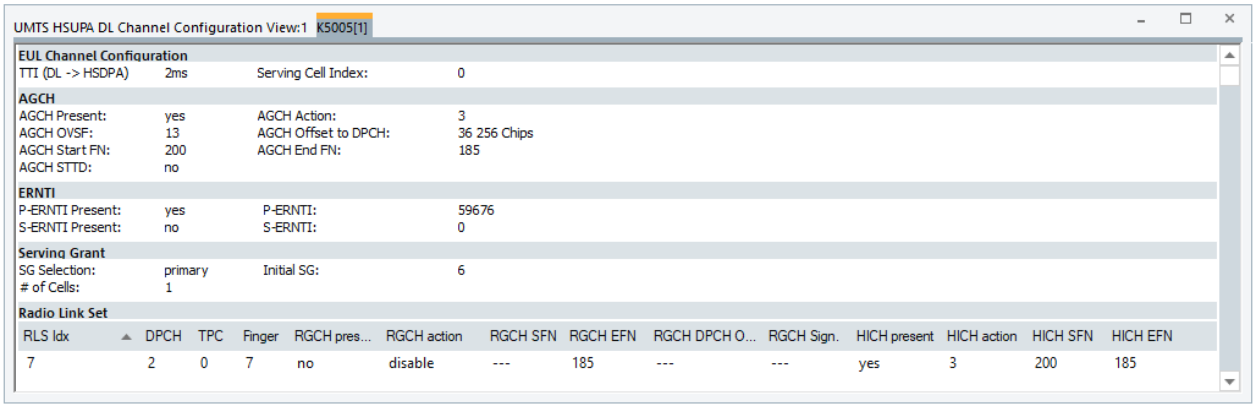


Figure 4-339: UMTS HSUPA DL Channel Configuration View

The channel configuration data is displayed in different panels.

EUL channel configuration

The following EUL (Enhanced Uplink) channel information is displayed in the view:

- "TTI (DL→HSDPA)"
  Transmission Time Interval for the E-DCH. The standard 3GPP TS 25.321 allows a TTI of, e.g, 2 ms.
- "Serving Cell Index"
  Serving cell index in the range 0 to 7.

AGCH

The following information is related to the Absolute Grant Channel (AGCH). This channel carries the absolute grants for uplink DCH scheduling.

- "AGCH Present"
  Indicates the presence of the Absolute Grant Channel
- "AGCH Action"
  Enabled or disabled
- "AGCH OVSF"
  Orthogonal Variable Spreading Factor of the Absolute Grant Channel
- "AGCH Offset to DPCH"
  The offset (in chips) between AGCH and the Dedicated Physical Channel
- "AGCH Start FN"
  Frame number of the AGCH start frame
- "AGCH End FN"
  Frame number of the AGCH end frame
- "AGCH STTD"
  Space/Time Transmit Diversity scheme used for the AGCH

ERNTI

The following information is related to the primary and secondary Enhanced Radio Network Temporary Identity (P-ERNTI and S-ERNTI).

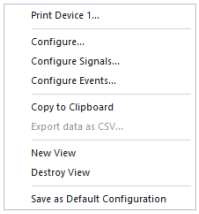
- "P-ERNTI Present"
  Indicates the presence of the primary ERNTI
- "P-ERNTI"
  Primary ERNTI number
- "S-ERNTI Present"
  Indicates the presence of the secondary ERNTI
- "S-ERNTI"
  Secondary ERNTI number
- "SG Selection"
  Indicates the use of the primary or secondary serving grant
- "Initial SG"
  Identifier of the initial service grant
- "# of Cells"
  Number of cells

Radio link set

The "Radio Link Set" panel contains a table with information related to RLS and the relative grant channel:

- "RLS Idx"
  Radio Link Set (RLS) index
- "DPCH"
  DPCH channel
- "TPC"
  TPC Index
- "Finger"
  Reference Finger
- "RGCH present"
  Relative Grant Channel (RGCH) is present (yes/no)
- "RGCH action"
  RGCH action is enabled or disabled
- "RGCH SFN"
  RGCH Start Frame Number (SFN)
- "RGCH EFN"
  RGCH End Frame Number (EFN)
- "RGCH DPCH Offset"
  Relative Grant Channel DPCH Offset
- "RGCH Sign."
  Relative Grant Channel Signature
- "HICH present"
  Hybrid Indicator Channel (HICH) is present (yes/no)
- "HICH action"
  Hybrid Indicator Channel action is enabled or disabled
- "HICH SFN"
  HICH Start Frame Number (SFN)
- "HICH EFN"
  HICH End Frame Number (EFN)
- "HICH OVSF"
  Orthogonal Variable Spreading Factor of the Hybrid Indicator Channel
- "HICH DPCH Offset"
  Hybrid Indicator Channel DPCH Offset
- "HICH Sign."
  Hybrid Indicator Channel signature
- "HICH STTD"
  Hybrid Indicator Channel Space/Time Transmit Diversity scheme

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSUPA DL channel configuration view configuration

The "UMTS HSUPA DL Channel Configuration View" configuration menu defines the list elements for the "Radio Link Set (RLS)" table and shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

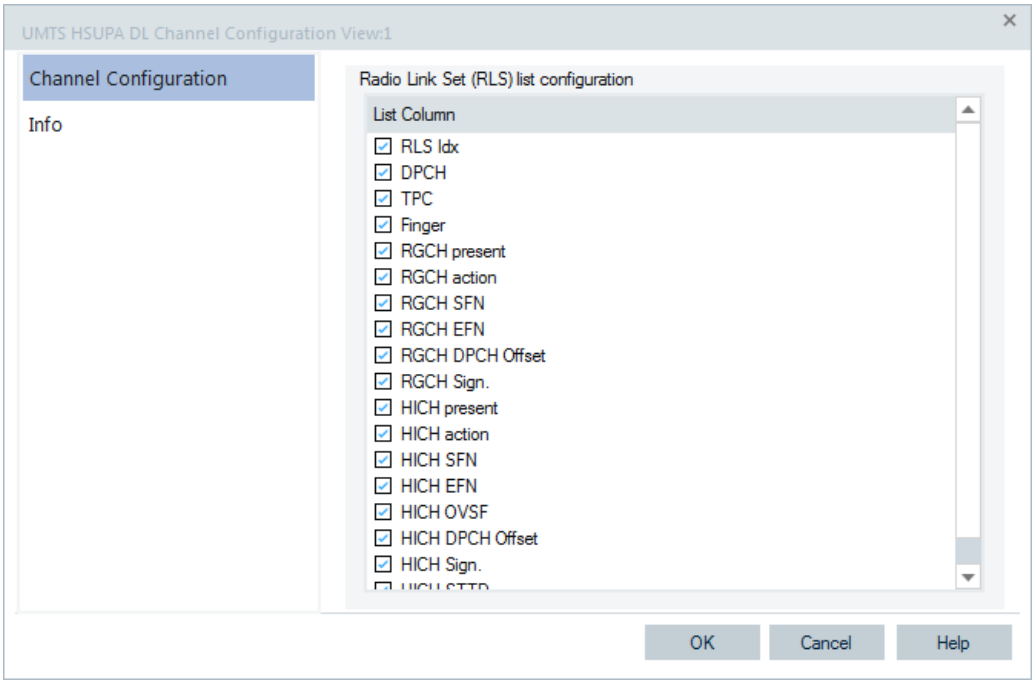
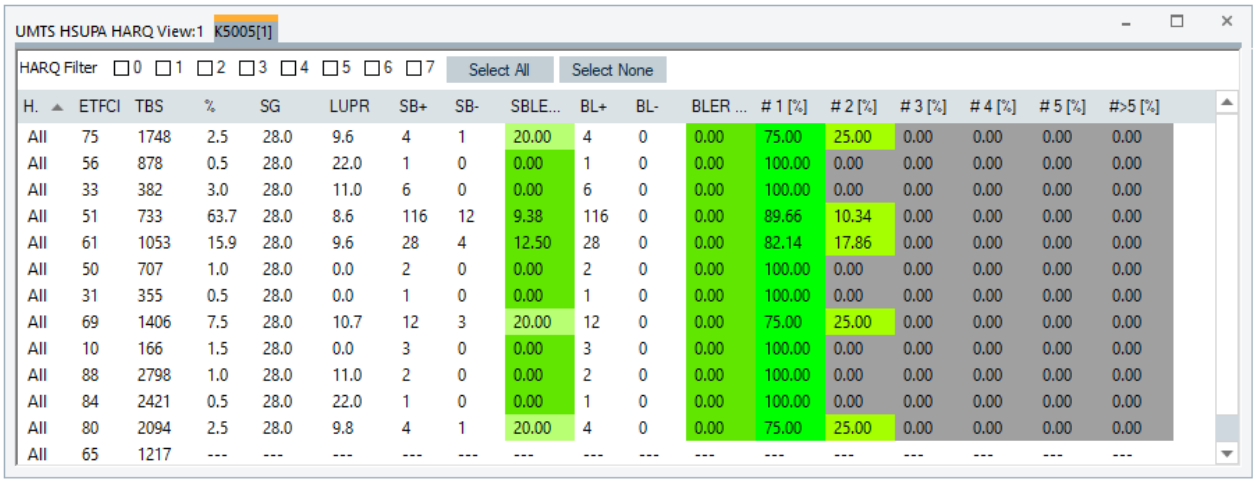


Figure 4-340: UMTS HSUPA DL Channel Configuration View - configuration

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.4.1.4 UMTS HSUPA HARQ view

The "UMTS HSDPA HARQ View" shows the characteristics of all HARQ processes of the test mobile. The view shows a statistical evaluation of the received UL E-DCH transport blocks, together with the block error rate and the number of retransmissions needed to decode successfully the blocks of each size. The transport block size depends on the allocated power for the mobile. Depending on TTI Duration up to 8 parallel HARQ processes can be active per mobile.



H.	ETFCI	TBS	%	SG	LUPR	SB+	SB-	SBLE...	BL+	BL-	BLER ...	# 1 [%]	# 2 [%]	# 3 [%]	# 4 [%]	# 5 [%]	#>5 [%]
All	75	1748	2.5	28.0	9.6	4	1	20.00	4	0	0.00	75.00	25.00	0.00	0.00	0.00	0.00
All	56	878	0.5	28.0	22.0	1	0	0.00	1	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	33	382	3.0	28.0	11.0	6	0	0.00	6	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	51	733	63.7	28.0	8.6	116	12	9.38	116	0	0.00	89.66	10.34	0.00	0.00	0.00	0.00
All	61	1053	15.9	28.0	9.6	28	4	12.50	28	0	0.00	82.14	17.86	0.00	0.00	0.00	0.00
All	50	707	1.0	28.0	0.0	2	0	0.00	2	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	31	355	0.5	28.0	0.0	1	0	0.00	1	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	69	1406	7.5	28.0	10.7	12	3	20.00	12	0	0.00	75.00	25.00	0.00	0.00	0.00	0.00
All	10	166	1.5	28.0	0.0	3	0	0.00	3	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	88	2798	1.0	28.0	11.0	2	0	0.00	2	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	84	2421	0.5	28.0	22.0	1	0	0.00	1	0	0.00	100.00	0.00	0.00	0.00	0.00	0.00
All	80	2094	2.5	28.0	9.8	4	1	20.00	4	0	0.00	75.00	25.00	0.00	0.00	0.00	0.00
All	65	1217	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Figure 4-341: UMTS HSUPA HARQ View

Table

The Header of the table defines which of the HARQ Processes are displayed.

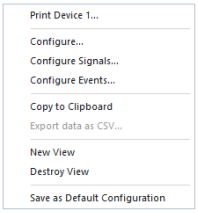
- **HARQ Filter**
  Each Flag represents one HARQ process. For a TTI of 2 ms, the maximum number is 8 and for a TTI of 10 ms the maximum number of HARQ processes is 4. Setting of this flag displays or hides the specific HARQ process. By default the filter is disabled and only the sum of all HARQ processes is displayed
- **Select All**
  Click this button to set the flags for all HARQ processes.
- **Select None**
  Click this button removes the flags for HARQ processes.

Each row reflects an E-TFCI and displays the following values:

- **HARQ ID**
  Identifier of the HARQ process is displayed
  "Sum" indicates the values, which are listed below, depending on the Transport Block Size

- **ETFCI**
  Transport Format Combination Identifier for E-DCH
- **TBS**
  Transport block size in bits
- **%**
  Percentage of usage of E-TFCI
- **SG**
  Average Serving Grant
- **LUPR**
  Average Last Used Power Ration
- **SB+**
  Number of successfully decoded subblocks. A subblock is a mobile specific unit comprising the HS-DSCH data of one subframe.
- **SB-**
  Number of subblocks which could not be decoded successfully has to be retransmitted. These blocks contribute to the SBLER but not necessarily to the BLER; see below.
- **SBLER [%]**
  Subblock error rate, SBLER = SB– / (SB+ SB–).
- **BL+**
  Number of successfully decoded blocks
- **BL–**
  Number of blocks which could not be decoded successfully until the maximum number of retransmissions was reached. Number of successfully decoded blocks
- **BLER [%]**
  Block error rate, BLER = BL– / (BL+ BL–). The BLER is usually smaller than the SBLER because it counts only the blocks that could not be decoded until the end of the HARQ process (until the maximum number of retransmissions was reached).
- **# [%]**
  Number of blocks successfully decoded without retransmission.
- **# n [%]**
  Number of blocks successfully decoded after one initial transmission and (n–1) retransmissions.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSUPA HARQ view configuration

The UMTS HSUPA HARQ View is configured via the "HSDPA Decode Statistic View" configuration tab. You can select the HSUPA HARQ signals to be displayed from the offered list.

The configuration tabs used to select signals to be displayed in the UMTS HSDPA Decode Statistic View and the UMTS HSPA L2 Statistic View have the same name. However, the offered signals in the "List Column" of these configuration tabs differ.

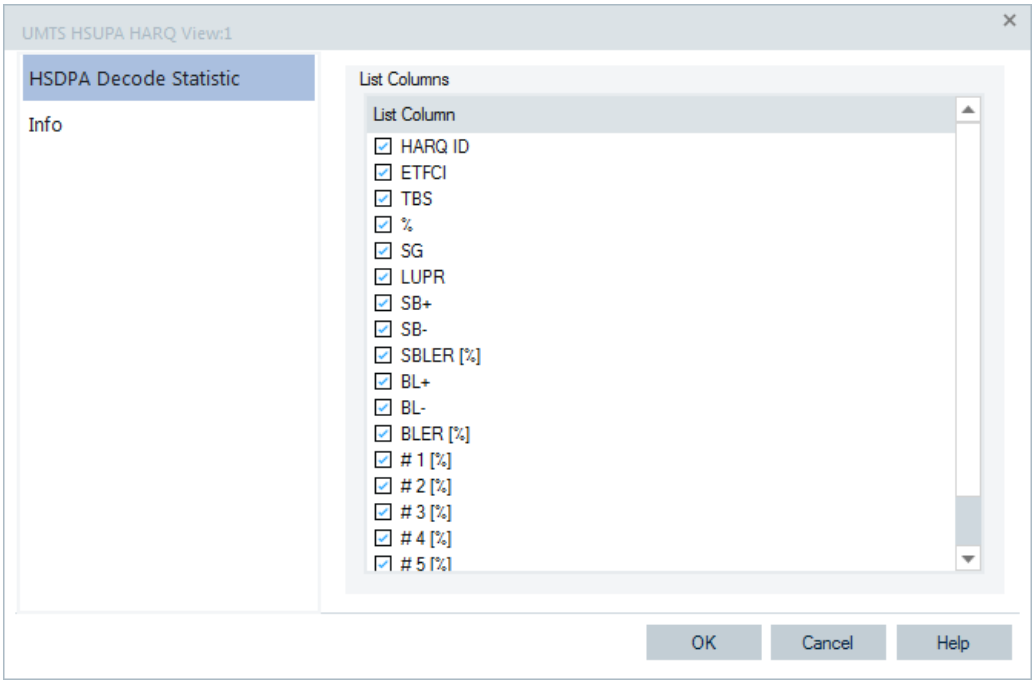
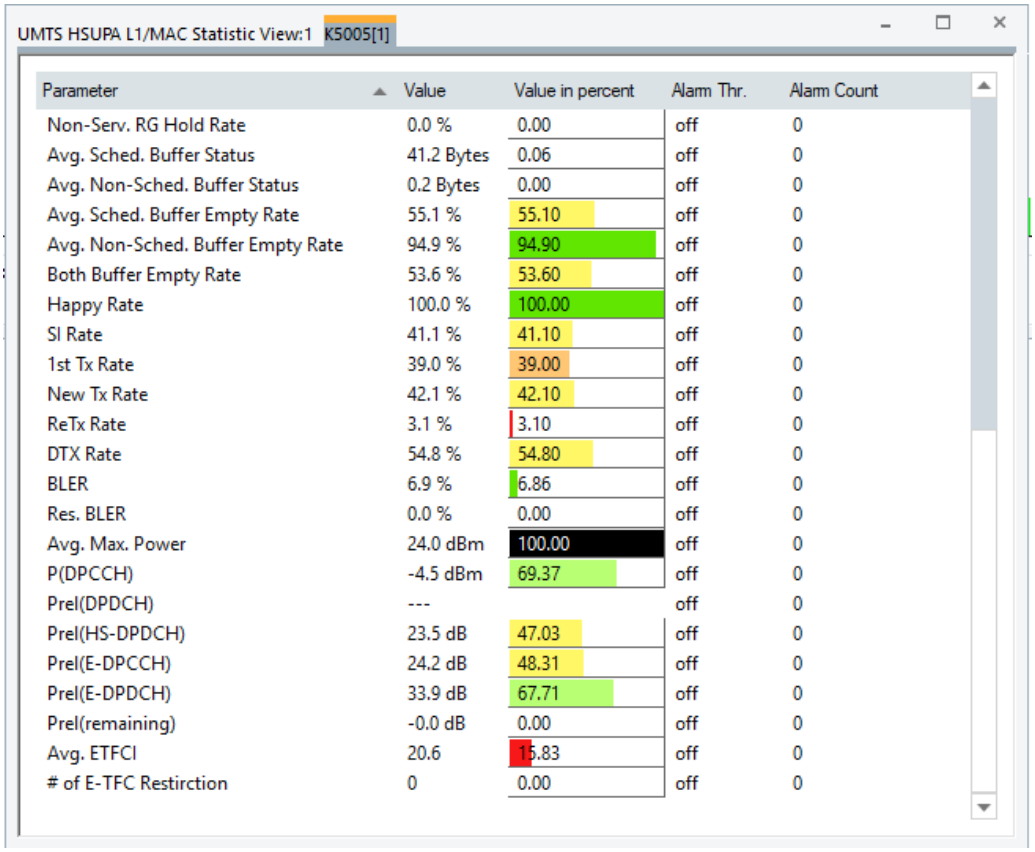


Figure 4-342: UMTS HSUPA HARQ View - configuration

4.4.1.5 UMTS HSUPA L1/MAC statistic view

The "UMTS HSUPA L1/MAC Statistic View" shows a configurable selection of the statistics parameters provided by the mobile itself.



Parameter	Value	Value in percent	Alarm Thr.	Alarm Count
Non-Serv. RG Hold Rate	0.0 %	0.00	off	0
Avg. Sched. Buffer Status	41.2 Bytes	0.06	off	0
Avg. Non-Sched. Buffer Status	0.2 Bytes	0.00	off	0
Avg. Sched. Buffer Empty Rate	55.1 %	55.10	off	0
Avg. Non-Sched. Buffer Empty Rate	94.9 %	94.90	off	0
Both Buffer Empty Rate	53.6 %	53.60	off	0
Happy Rate	100.0 %	100.00	off	0
SI Rate	41.1 %	41.10	off	0
1st Tx Rate	39.0 %	39.00	off	0
New Tx Rate	42.1 %	42.10	off	0
ReTx Rate	3.1 %	3.10	off	0
DTX Rate	54.8 %	54.80	off	0
BLER	6.9 %	6.86	off	0
Res. BLER	0.0 %	0.00	off	0
Avg. Max. Power	24.0 dBm	100.00	off	0
P(DPCCH)	-4.5 dBm	69.37	off	0
Prel(DPDCH)	---		off	0
Prel(HS-DPDCH)	23.5 dB	47.03	off	0
Prel(E-DPCCH)	24.2 dB	48.31	off	0
Prel(E-DPDCH)	33.9 dB	67.71	off	0
Prel(remaining)	-0.0 dB	0.00	off	0
Avg. ETFCI	20.6	15.83	off	0
# of E-TFC Restirction	0	0.00	off	0

Figure 4-343: UMTS HSUPA L1/MAC Statistic View

Diagram

Each parameter is shown in one row, and the alarm thresholds can be configured separately for each parameter. The following parameter properties are shown by default, the list columns can be configured using the "List format" tab of the configuration dialog as described in Chapter 4.4.1.5, "UMTS HSUPA L1/MAC statistic view", on page 699.

- **Parameter**
  Name of the HSUPA L1/MAC statistic parameter.
- **Value**
  Absolute value of the HSUPA L1/MAC statistic parameter.
- **Value in percent**
  The percent Value visualized as a bar diagram. The minimum and maximum of the value range are as defined in the definition of the signal. The color of the bar is defined as:
  - Green
  - Red
  - Orange
  - Yellow
- **Alarm Thr.**
  The value of the alarm threshold (or "Off").

- **Alarm Count**
  The count of processed values in alarm state "On".

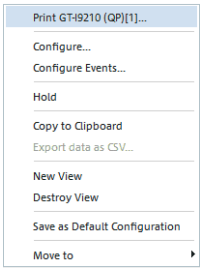
The L1/MAC statistic parameters comprise the following values, which can be configured using the "Parameters" tab of the configuration dialog as described in section "Parameters configuration" on page 703:

- **TTI**
  Transmission Time Interval for the E-DCH. The standard 3GPP TS 25.321 allows a TTI of 2 ms, which is one HSUPA subframe comprising 3 slots. The valid range is 0 to 1, alarm threshold default is 0.5.
- **Serv. RG Up Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Happy Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Avg. Number of E-DCH cells**
  The valid range is 0 to 254, alarm threshold default is 127.
- **Serv. RG Down Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Serv. RG Hold Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **AGCH Success Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Mean rec.AGCH Commands**
  The valid range is 0 to 65534, alarm threshold default is 32767.
- **Mean Serving Grant**
  The valid range is 0 to 37, alarm threshold default is 18.5.
- **New Transmission Rate**
  The valid range is 0 to 100%, alarm threshold default is 50.
- **Retransmission Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **DTX Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Residual BLER**
  The valid range is 0 to 100%, alarm threshold default is 50.
- **First Attempt BLER**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Power Limited Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **SG Limited Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Buffer Limited Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Mean scheduled transmitted bits**
  The valid range is 0 to 65534, alarm threshold default is 32767.
- **Mean non-scheduled transmitted bits**

The valid range is 0 to 65534, alarm threshold default is 32767.

- **Avg. Supported Bits**
  The valid range is 0 to 65534, alarm threshold default is 32767.
- **Avg. DPCCH Power**
  The valid range is –130 dBm to +30 dBm, the alarm threshold default is –50.
- **Max. Power allowed**
  The valid range is –130 dBm to +30 dBm, the alarm threshold default is –50.
- **Avg. Beta d/c**
  The valid range is –30 to +30, the alarm threshold default is 0.
- **Avg. Beta hs/c**
  The valid range is –30 to +30, the alarm threshold default is 0.
- **Avg. Beta ec/c**
  The valid range is –30 to +30, the alarm threshold default is 0.
- **Avg. Beta ed/c**
  The valid range is –30 to +30, the alarm threshold default is 0.
- **Scheduled Buffer Empty Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Non-Scheduled Buffer Empty Rate**
  The valid range is 0% to 100%, alarm threshold default is 50.
- **Mean scheduled buffer status**
  The valid range is 0 to 65534, alarm threshold default is 32767.5.
- **Mean non-scheduled buffer status**
  The valid range is 0 to 65534, alarm threshold default is 32767.5.
- **Avg. AGCH Qual.**
  The valid range is 0 to 65534, alarm threshold default is 32767.
- **Avg. RGCH Qual.**
  The valid range is 0 to 65534, alarm threshold default is 32767.
- **Avg. HICH Qual.**
  The valid range is 0 to 65534, alarm threshold default is 32767.
- **MAC Resets**
  The valid range is 0 to 254, alarm threshold default is 127.
- **Mean E-TFCI**
  "Transport Format Combination Indicator". The valid range is 0 to 254, alarm threshold default is 127

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSUPA L1/MAC statistic view configuration

Parameters configuration

The "Parameters" tab offers an editable list with the shown parameters. Therefore the "Parameters" panel offers check boxes to select the elements displayed in the "UMTS HSUPA L1/MAC Statistic View".

Also the alarm threshold settings can be configured.

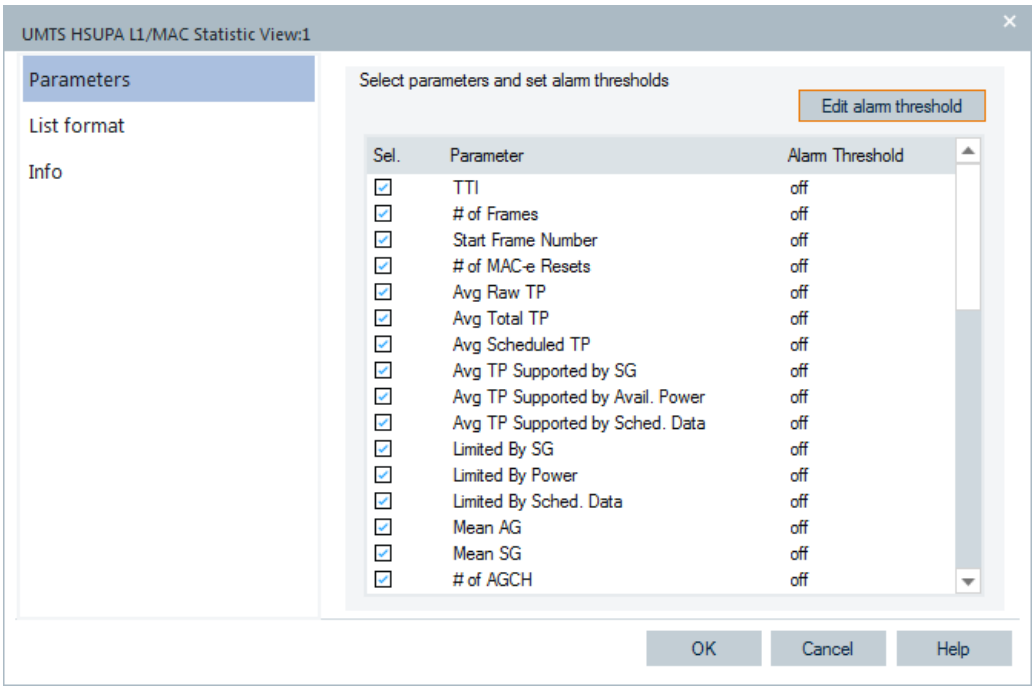


Figure 4-344: UMTS HSUPA L1/MAC Statistic View - parameters

Edit alarm threshold
The setting of an alarm can be defined for each selected parameter in the "Edit alarm threshold" panel when clicking the same named button.

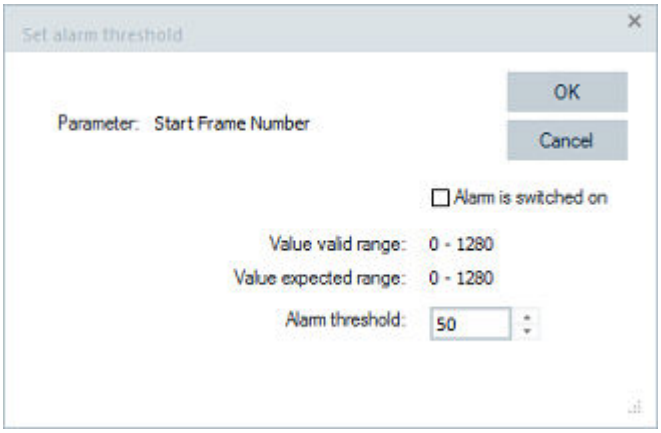


Figure 4-345: Setting alarm threshold

The valid and expected value ranges for each parameter of the mobile are shown on the dialog.

- **Alarm is switched on**
  This checkbox toggles the state of the alarm between "On" and "Off".
- **Alarm threshold**
  Defines the actual threshold value above / below which an alarm event is triggered. The valid value range of the threshold is shown above the entry field.
- **OK**
  Stores the alarm threshold setting and the alarm state.
- **Cancel**
  Aborts the current alarm threshold setting action and closes the dialog.

List format configuration

The "List format" tab of the "UMTS HSUPA L1/MAC Statistic View" configuration menu selects the information to be displayed.

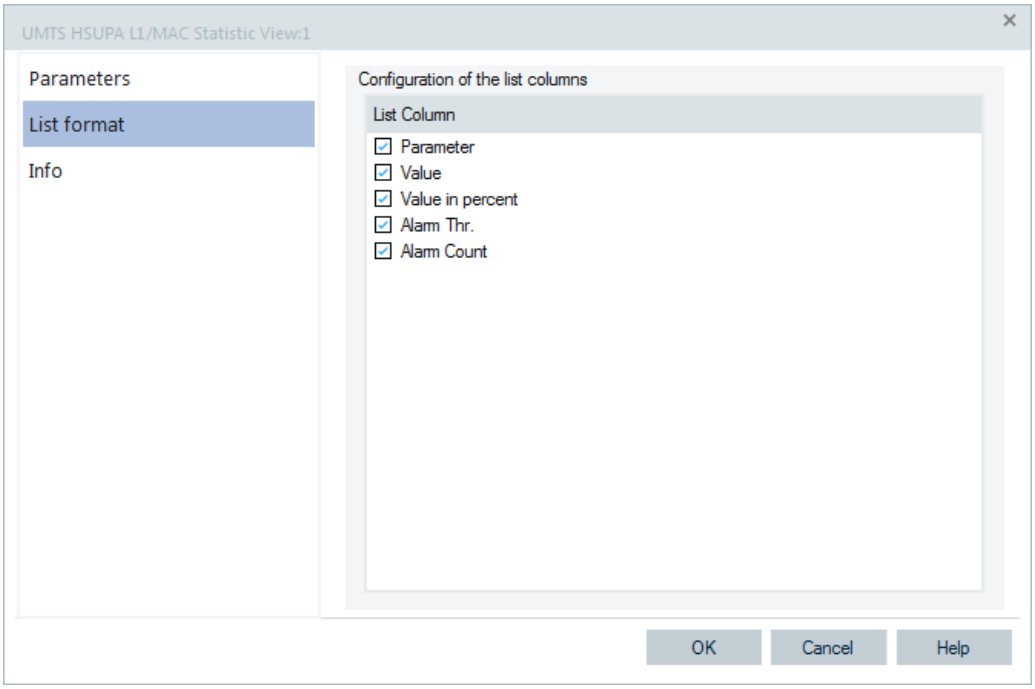


Figure 4-346: UMTS HSUPA L1/MAC Statistic View - list format

List Column
The "List Column" offers check boxes to select the columns displayed in the "UMTS HSUPA L1/MAC Statistic View".

4.4.1.6 UMTS HSUPA performance view

The "UMTS HSUPA Performance View" contains four preconfigured 2D charts. The signals in these charts are related to the transmission performance, given in terms of the requested and achieved data throughput.

Figure 4-347: UMTS HSUPA Performance View

A double-click the ☰ button ("Show / Hide Chart Group") opens or closes a chart in the performance view. The functionality of the charts in the view is analogous to the Chapter 4.2.1, "2D chart view", on page 448.

For the meaning of the configuration entries in the "UMTS HSUPA Performance View: <variable> Properties", see Chapter 4.2.1, "2D chart view", on page 448.

Chart 1

The "Chart 1" shows the most important, general parameters regarding throughput.

The chart contains the following results:

- "Happy Rate"
  This parameter shows whether the mobile is "happy". The mobile is considered happy if it can transmit the currently available data within a certain time frame signaled by an RRC message.
- "Comb. ACK Rate"
  The rate of acknowledged TTIs. A TTI is counted as acknowledged when the corresponding combination of the different HICH of the radio link-set results in an ACK.
- "NS (Non-scheduled) ACK Rate"
  The rate of TTIs which were acknowledged by "other cell", which are not belonging to the radio link set.
- "Comb. NACK Rate"
  The combined NACK rate is calculated as "100% - Comb. ACK Rate".
- "DTX Rate"
  Rate of TTIs in which no data was transmitted.
- "Comb. ACK'd Throughput"
  Data throughputs based on the transport block sizes of the acknowledged TTIs.

- "Scheduled Throughput"
  Data throughputs based on the transport block sizes of sent TTIs.

Chart 2

The "Chart 2" shows information about the Hybrid ARQ Indicator Channel (HICH) of the related cells in the radio link set.

The chart contains the following results:

- "Comb. HICH Success Rate"
  Rate of the successful reception of HICH information of one of the cells, which belong to the radio link set.
- "Srv. Cell HICH Success Rate"
  Rate of the successful reception of HICH information of the serving cell.
- "Srv. Cell ACK Rate"
  Rate of the successful reception of acknowledged TTIs of the serving cell.
- "1. Non-serv. Cell HICH Success Rate"
  Rate of the successful reception of HICH information of the first non-serving cell.
- "1. Non-serv. Cell ACK Rate"
  Rate of the successful reception of acknowledged TTIs of the first non-serving cell.
- "2. Non-serv. Cell HICH Success Rate"
  Rate of the successful reception of HICH information of the second non-serving cell.
- "2. Non-serv. Cell Rate"
  Rate of the successful reception of acknowledged TTIs of the second non-serving cell.

Chart 3

The "Chart 3" is related to retransmissions. It shows the minimum, average, and maximum number of retransmissions within the update rate.

The chart contains the following results:

- "Min. Retransmission Count"
  Counter for the minimum number of retransmissions.
- "Max. Retransmission Count"
  Counter for the maximum number of retransmissions.
- "Avg. Retransmission Count"
  Calculated average number of retransmissions.

Chart 4

The "Chart 4" is related to payload limit (only available for Qualcomm chipset). This chart shows information on the throughput limitation. Qualcomm specified the values 0, 1, 2, 3 and 4.

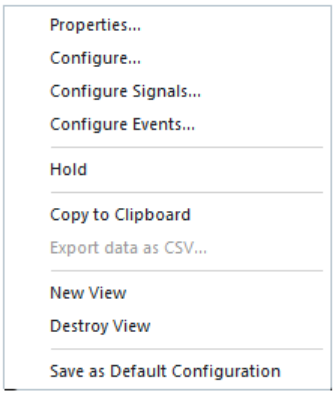
The chart contains the following results:

- "Ltd. by Power Rate"
  The max. allowed transmit power limits the throughput.
- "Ltd. by SG Rate"

The current serving grant limits the throughput.

- "Ltd. by Buffer Occ. Rate"
  The data buffer in the mobile is empty. There is no more data to transmit.
- "Ltd. by MUX"
  The current multiplexer limits the throughput.
- "Ltd. by HARQ"
  The current HARQ process limits the throughput.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS HSUPA Performance View" configuration is done in the "UMTS HSUPA Performance View: <variable> Properties" pane. Selecting the "Configure" command in the context-sensitive menu of the view opens only the "Info" page.

4.4.1.7 UMTS HSUPA power graph view

This View displays the most important power values for the HSUPA session in a 2D Chart. The upper chart displays the "Max. Allowed Tx Power" and the currently used power for the DPCCH. The second graph displays all relative power, calculated by the mobiles using the given Beta Factors. The third graph displays the SG and the last graph the UE Power Headroom.

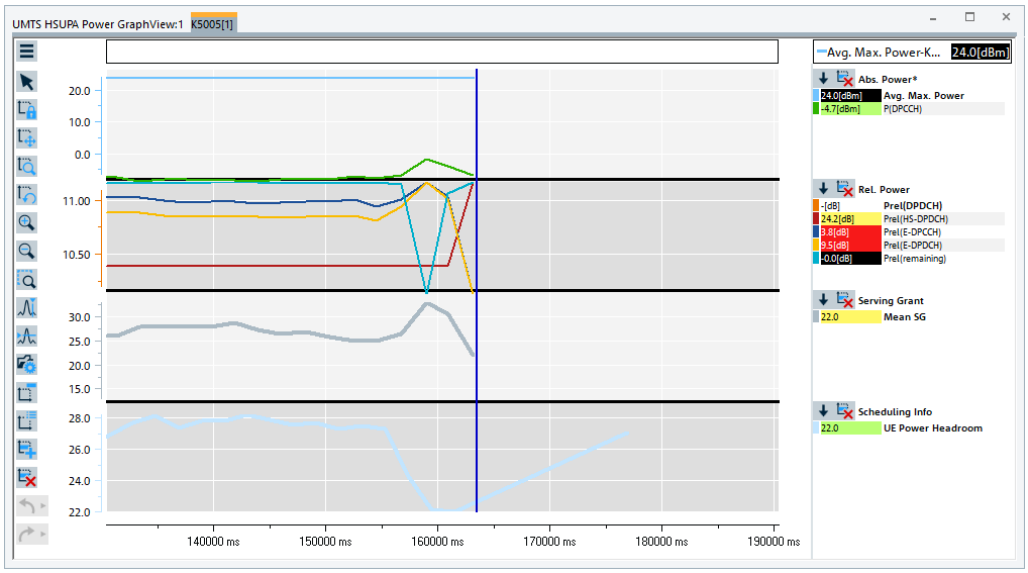


Figure 4-348: UMTS HSUPA Power Graph View

A double-click the title bars of the subdiagrams opens or closes them in the power graph view. The functionality of all sub-diagrams is analogous to the Chapter 4.2.1, "2D chart view", on page 448.

Absolute power

The "Absolute Power" subdiagram shows the average of the "Maximum Allowed Transmission Power" in Uplink and the power of the associated "Dedicated Physical Control Channel" in absolute values.

Relative power

This subdiagram shows the Power of certain Physical Channels relative to the DPCCH.

The chart contains the following results:

- **Prel(DPDCH)**
  Rel. Power of the “Dedicated Physical Data Channel” (R.99 Channel).
- **Prel(HS-DPCCH)**
  Rel. Power of the “High-Speed Dedicated Physical Control Channel” (HSDPA Channel).
- **Prel(E-DPCCH)**
  Rel. Power of the “Enhanced Dedicated Physical Control Channel” (HSUPA Channel).
- **Prel(E-DPDCH)**
  Rel. Power of the “Enhanced Dedicated Physical Data Channel” (HSUPA Channel).
- **Prel(remaining)**
  Remaining Power in UL.

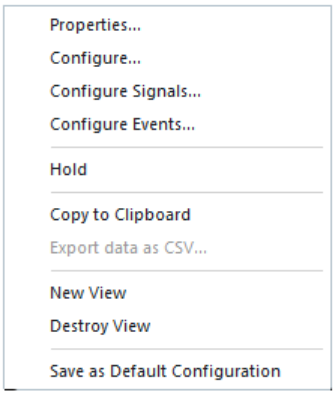
Serving grant

- **Mean SG**
  Average Value of the Serving Grant.

Scheduling info

- **UE Power Headroom**
  Indicates the Power Status of the UE, means how much the UE is able to power up.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.1.8 UMTS HSUPA UL channel configuration view

The "UMTS HSUPA UL Channel Configuration View" shows the most important UL parameters of the active HSUPA connections, which were transmitted in the corresponding RRC messages. Configuration of MAC-e and MAC flows is included in the view. The power-offset table shows the basic information about what is the transmit power calculation of the mobile based on. For detailed information, refer to TS25.331 and TS25.212.

It is important, that the DialUp connection is established during the R&S ROMES4 measurement session, as the mobile needs the information about the evolved cell set once. In the case, the DialUp connection is already established, when the R&S ROMES4 measurement is started. The information about the Radio Link Set (RLS) is provided when the RLS changes and the mobile send a new trace due to these changes.

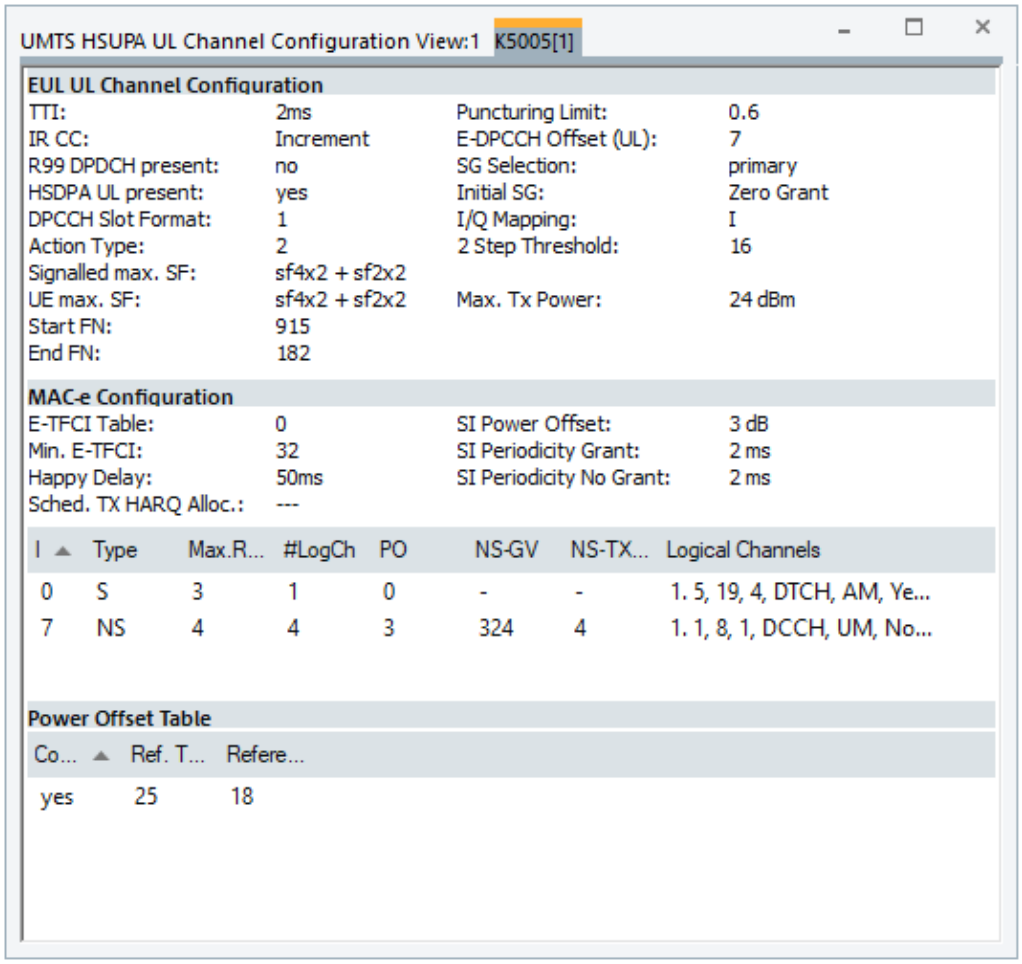


Figure 4-349: UMTS HSUPA UL Channel Configuration View

The channel configuration data is displayed in different panels.

EUL UL channel configuration

The following EUL (Enhanced Uplink) UL channel information is displayed in the view:

- **TTI**
  Transmission Time Interval for the E-DCH. The standard 3GPP TS 25.321 allows a TTI of, e.g., 2 ms, which is one HSUPA subframe comprising 3 slots
- **Puncturing Limit**
  Uplink puncturing limit limits the amount of puncturing that can be applied to minimize the number of physical channels.
- **IR CC**
  Incremental Redundancy (IR) or Chase Combining (CC) shows the HARQ combining scheme.
- **E-DPCCH Offset (DPCCH)**
  E-DPCCH power offset in dB.
- **R99 DPDCH present**
  Indicates the presence of Release 99 DPDCH.

- **SG Selection**
  Indicates a primary (or other) service grant.
- **HSDPA UL present**
  Indicates the presence of an HSDPA uplink channel
- **Initial SG**
  Identifier of the initial service grant
- **DPCCH slot format**
  Shows the DPCCH slot format (0 to 3)
- **I/Q Mapping**
  1 for I, 0 for Q
- **Action type**
  Shows whether the action type is enabled
- **2 Step Threshold**
  Value of 2-index-step threshold to set the serving grant.
- **Signaled max. SF**
  Max. spreading factor of the channel.
- **UE max. SF**
  Max. spreading factor of the UE
- **Max. Tx Power**
  Maximum transmission power in dBm
- **Start FN**
  Frame number of the start frame
- **End FN**
  Frame number of the AGCH end frame

MAC-e configuration

Following information is displayed in the MAC-e Configuration:

- **E-TFCI Table**
  Transport Format Combination Indicator Table for E-DCH.
- **Min. E-TFCI**
  Minimum E-TFCI
- **Happy Delay**
  Time until the UE sends a Happy Bit.
- **Sched. TX HARQ Alloc.**
  Scheduled TX HARQ Process Allocation
- **SI Power Offset**
  Power of Scheduling Information
- **SI Periodicity Grant**
  Scheduling Information periodicity if Grant is available
- **SI Periodicity No Grant**
  Scheduling Information periodicity if No Grant is available

The table in the MAC-e configuration displays following Logical Channel information.

- **ID**
  Mac Flow Id

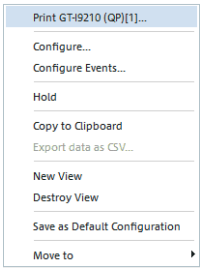
- **Type**
  Grant Type (S: Scheduled, NS: Non-scheduled)
- **Max.ReTx**
  Maximum number of retransmissions
- **#LogCh**
  Number of Logical Channels
- **PO**
  E-DCH MAC Power Offset
- **NS_GV (Non-scheduled_GV)**
  Non scheduled Grant Value (Value range: 0 -19982)
- **NS-TX-H-A (Non-scheduled-TX-H-A)**
  Non scheduled TX HARQ process allocation
- **Logical Channels**
  Radio Bearer ID, LogCh ID, Priority, Type, RLC Mode, Incl. in SI, # of PDU Sizes

Power offset table

The "Power offset table" contains the measured TCFI power-offset data for the available E-TCFIs.

- **Configured**
  Indicates whether the related Reference E-TFCI is configured.
- **Ref. TFCI**
  Reference E-TFCI number.
- **Reference Power Offset**
  Ref. Power Offset (in dBm).

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSUPA UL channel configuration view configuration

The "UMTS HSUPA UL Channel Configuration View" configuration menu defines the list elements of the Power Offset list and the MAC Flow list.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

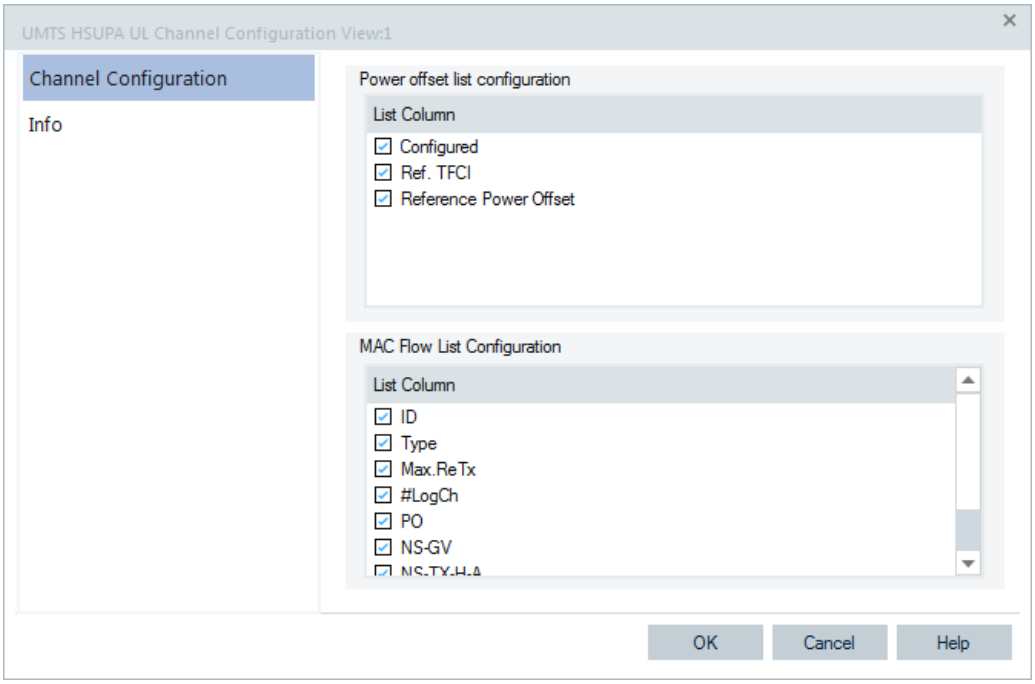


Figure 4-350: UMTS HSUPA UL Channel Configuration View - configuration

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.4.2 UMTS HSDPA views

The "UMTS HSDPA Views" display HSDPA-specific information acquired with an UMTS test mobile supporting HSDPA. In general, recording of the different message types shown in the "UMTS Views" must be explicitly activated in the mobile device configuration menu.

1. Enable UMTS HSDPA in the "Configuration" tab.
2. Select the HSDPA node in the"Expert Mode" tab.

R&S ROMES4 supports HSDPA test mobiles based on Qualcomm 6275 chipset or newer.

The HSDPA views can be selected from a submenu displayed on the right side of the "View" menu when the mouse cursor hovers over "HSDPA".

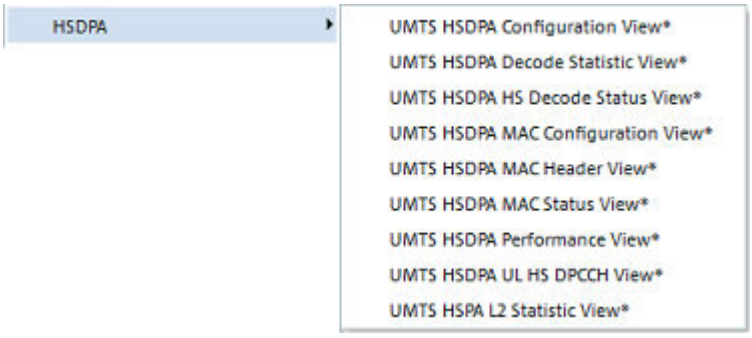


Figure 4-351: UMTS HSDPA views

Additional HSDPA views

In addition to the HSDPA views described in this section, the "Handover Analyzer View" and the "UMTS Finger Data View" can display HSDPA data. HSDPA-related information in these views is only available with HSDPA license.

The UMTS UE's view related to UMTS HSDPA UL HS-DPCCH respects the general performance settings done in "Tools" > "Preferences" > "Performance" regarding the visual update rate. The individual view settings are avoided.

4.4.2.1 HSDPA signals

In addition to the "HSDPA Views" described in this section, R&S ROMES4 provides an extensive selection of HSDPA signals. These signals appear below the "UMTS" node of the "Tools" > "Preferences" > "Available Signals" tree and can be analyzed in the appropriate Chapter 4.2, "Basic views", on page 445 and exported to ASCII files. Many signals are also displayed in the "HSDPA Views". For description, see the "R&S ROMES Description of Signals" manual.

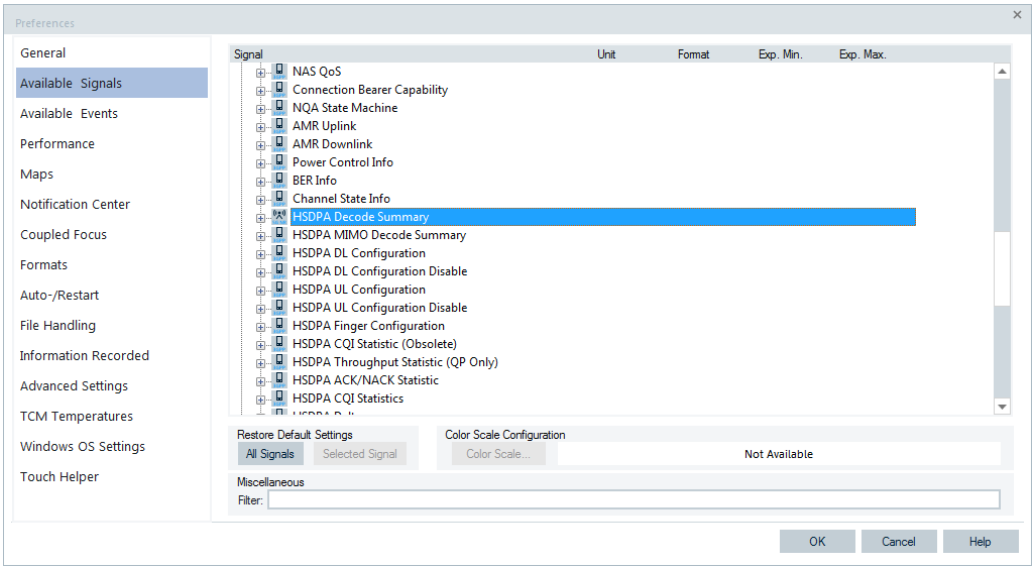


Figure 4-352: HSDPA signals

HSDPA throughput statistics (QP only)

There are parameters displayed in QualiPoc which are available as signals in R&S ROMES4. The following figure shows the signals of the HSDPA throughput statistics inserted in the Alphanumeric View.

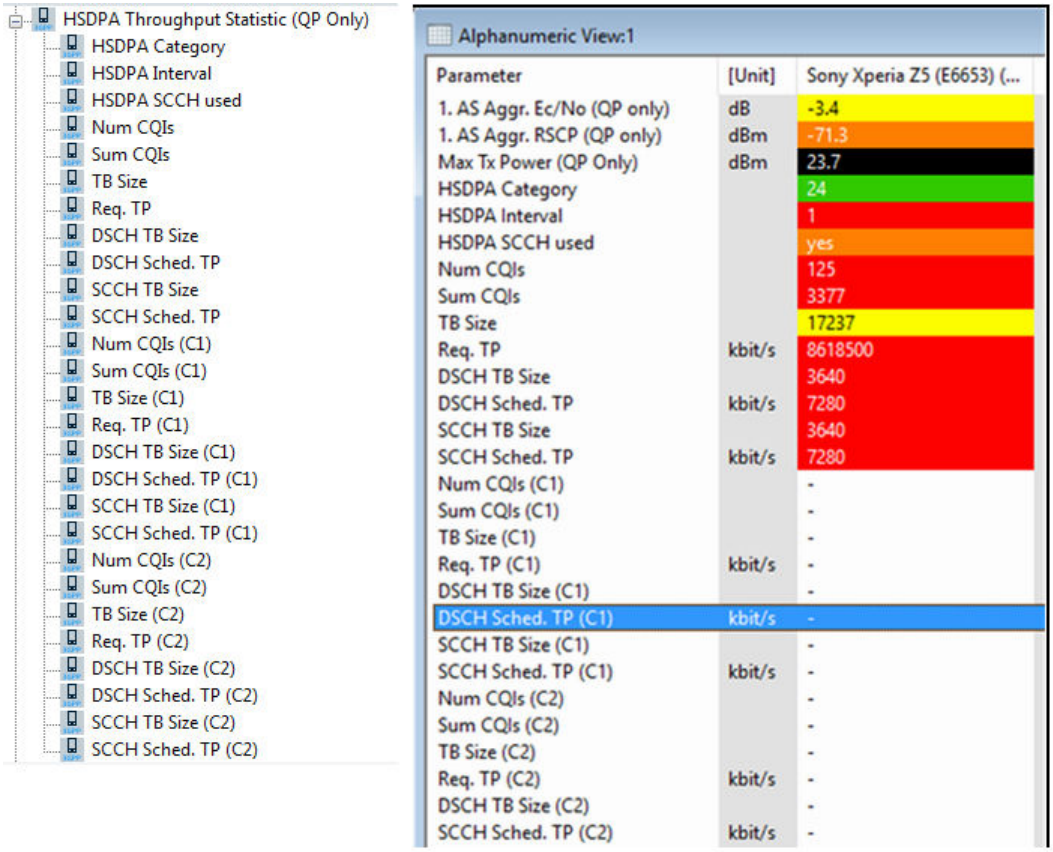
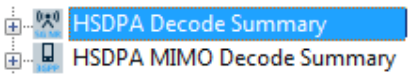


Figure 4-353: HSDPA throughput statistics signals

Results for MIMO and non-MIMO signals

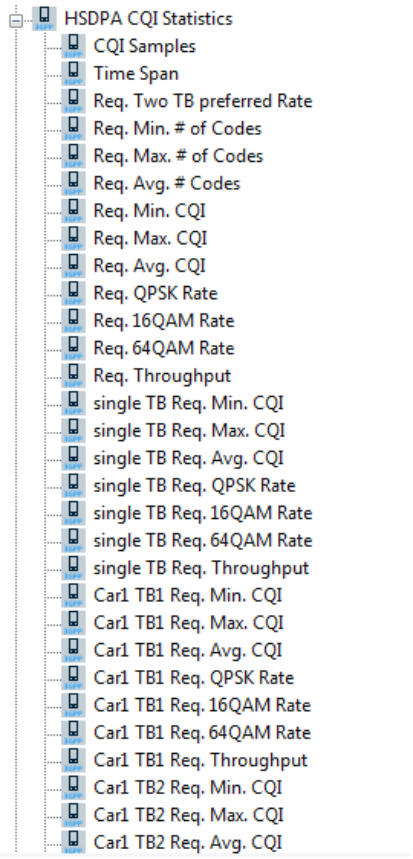
All signals below the HSDPA Decode Summary Branch refer to the sum of both transport blocks (TB1 and TB2) in MIMO case. To get the value for each MIMO path separately, use the HSDPA MIMO Decode Summary branch, which offers signals for the separated paths.

Branch HSDPA (MIMO) Decode Summary



All signals below the "HSDPA Decode Summary" branch refer to the sum of both transport blocks (TB1 and TB2) in MIMO case. To get the value for each MIMO path separately, use the "HSDPA MIMO Decode Summary" branch, which offers signals for the separated paths.

HSDPA CQI statistics



Below the branch "HSDPA CQI Statistic" signals are distinguished between MIMO and non-MIMO TTIs.

Also signals are available that reflect the statistic for the non-MIMO case and the two transport blocks in the MIMO case.

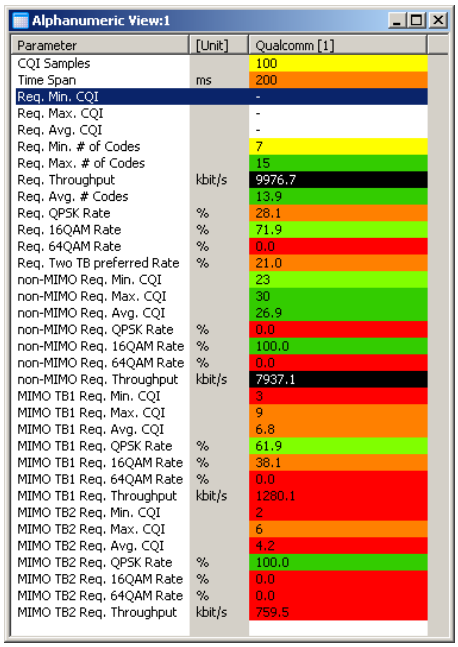
- 

Figure 4-354:

HSDPA CQI statistics values inserted to "Alphanumeric View"

HSDPA CQI statistics (obsolete)

The "HSDPA CQI Statistics (Obsolete)" set of signals made of only "CQI Min/Max/Avg" signals is only valid if no MIMO TTI was present during the reporting time period. If at least one MIMO TTI was found, those values are set to invalid, because the CQI value range differs between MIMO and non-MIMO case. Thus a statistic over all does not make a sense.

Note, that in the MIMO case, the "HSDPA Performance View" does not show any "Avg. CQI" value in the upper chart due to the same reason.

4.4.2.2 UMTS HSDPA UL HS-DPCCH view

The "UMTS HSDPA UL HS-DPCCH View" shows the CQI (Channel Quality Indicator) values reported by the test mobile in the last 100 HSDPA subframes. In the network, the CQI is transmitted on the UL High Speed Dedicated Physical Control Channel (HS-DPCCH), which is a fixed rate channel with a spreading factor of 256. The first slot of each UL HS-DPCCH subframe contains the ACK/NACK messages; the following two slots carry the CQI. The frame structure of the uplink HS-DPCCH is shown in the figure below.

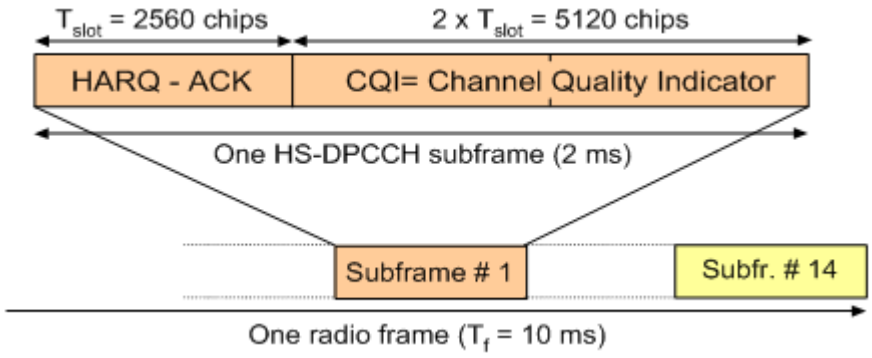


Figure 4-355: HS-DPCCH frame structure

The CQI values are integer numbers between 0 and 30; see CQI-mapping tables in standard 3GPP TS 25.214. Large CQI numbers denote a good channel quality and a high potential DL data throughput.

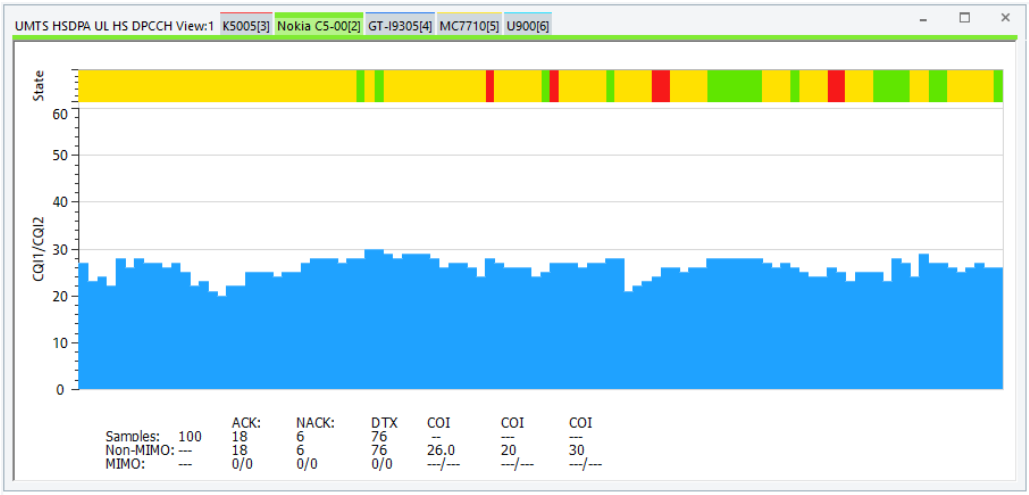


Figure 4-356: UMTS HSDPA UL HS DPCCH View

The charts of the view support zooming using the mouse wheel, and panning using the left mouse button.

MIMO refers to TTIs

In this section the wording “MIMO” refers to those TTIs for which two transport blocks are preferred by the UE.

Diagram

The view's diagram is split into two charts.

The upper chart shows the current state of the transmission, ACK, NACK or DTX. The lower chart is the main part of the view. It shows the CQI values which reflect the current state of the transmission channel for the point of view of the UE.

If there are two CQIs, the CQIs are drawn one above the other, so that the sum of both can be recognized easily.

The default colors are in accordance with the R&S adoptive colors.

Each bar corresponds to a CQI value reported by the mobile device.

The colors of the bars in the upper part of the view show the current state of the transmission. The transmission is related to the messages transmitted in the first (HARQ-ACK) slot of the HS-DPCCH subframe that carried the CQI value.

- Yellow background means DTX
  No transmission took place in this TTI. Denoted are subframes that were not acknowledged or not unacknowledged. No answer was received from the mobile device. This case is most likely because the mobile cannot correctly demodulate the downlink HS-SCCH. Note that the mobile can use DTX independently in the ACK/NACK and CQI slots.
- Green background visualizes an ACK
  It denotes an acknowledged subframe; the mobile sends an ACK message after a successful CRC check of a received HS-DSCH packet.
- Red background visualizes a NACK
  For the transmission which took place in the corresponding TTI it denotes an unacknowledged subframe. The mobile sends a NACK message after a failed CRC check.

The blue color of the frame of the CQI bar reflects the PCI (protocol capability indicator) value of the TTI. A PCI bit is an information element (a field) that indicates which protocol the device has or can use.

Analyze the cause for an unacknowledged or DTX frame

Use the Chapter 4.4.2.9, "UMTS HSDPA decode statistic view", on page 737 to analyze the cause for an unacknowledged or DTX frame.

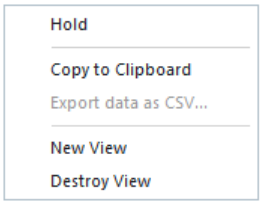
Statistical results

The view shows the total number of CQI bars ("Samples") in the diagram below the charts and the number of ACK, NACK and DTX subframes (ACK + NACK + DTX = Samples).

The arithmetic mean value of the displayed CQI values, the maximum, and the minimum CQI values are displayed.

The statistical report is separated into a non-MIMO and a MIMO part.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS HSDPA UL HS-DPCCH View" has no context menu for configurations.

4.4.2.3 UMTS HSDPA HS decode status view

The "UMTS HSDPA HS Decode Status View" shows the status of the HS-SCCH demodulation and the decoded HS-SCCH information. The view contains a table with up to 100 of the newest samples (sets of results) provided by the test mobile.

The view is split in two parts with three sections each. In MIMO case, the parts of the view are:

- Upper part reflects the state of the first MIMO path (first carrier).
- Lower part reflects the state of the second MIMO path (secondary carrier).

The HS-SCCH is a downlink physical channel used to carry downlink signaling information related to HS-DSCH transmission. This information includes the channelization code set, the modulation scheme, the transport block size and HARQ-related information (see standard 3GPP TS 25.212).

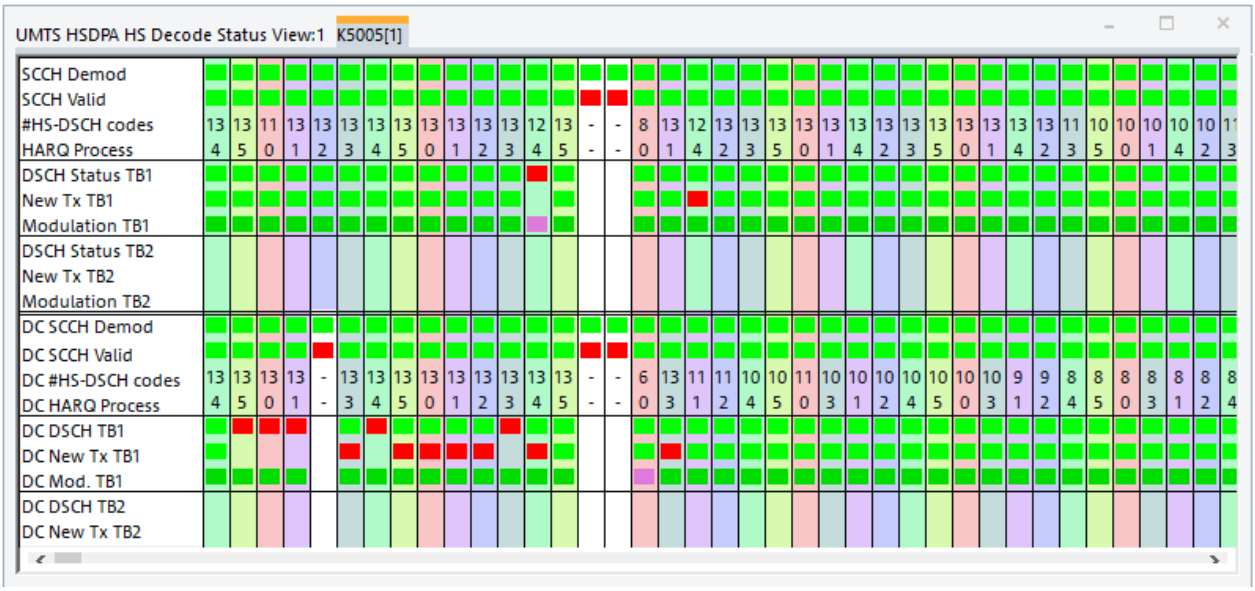


Figure 4-357: UMTS HSDPA HS Decode Status View

Diagram

The view shows tables with fixed scale. Each column corresponds to an HS-SCCH sample comprising the following information:

- "SCCH Demod"/"DC SCCH Demod"
  Indicates whether the mobile attempted to demodulate the HS-SCCH.
  If a dual cell is activated, "DC SCCH Demod" carries the information for the second MIMO path.

- "SCCH Valid"/"DC SCCH Valid"
  Indicates whether the mobile was able to decode consistent signaling information from the demodulated HS-SCCH
  If a dual cell is activated, "DC SCCH Valid" carries the information for the second MIMO path.
- "#HS-DSCH Codes"/"DC #HSDSCH Codes"
  Number of HS-(P)DSCH channelization codes in the range between 1 and 15. The HS-PDSCH is a fixed rate (SF = 16) physical channel with channelization code numbers ranging from 1 to 15. The channelization code C16,0 is barred because the channelization codes C256,0 and C256,1 are reserved for the P-CPICH and P-CCPCH, respectively. The HS-PDSCH channelization codes are allocated contiguously starting from the first code.
  If a dual cell is activated, "DC #HSDSCH Codes" carry the information for the second MIMO path.
- "HARQ Process"/"DC HARQ Process"
  HARQ Process ID, number of the HARQ process that the transmission belongs to (range 0 to 7). The HARQ process ID defines the background color of the column. The ID always corresponds to the first transport block (TB 1). A maximum of 16 HARQ processes is supported.

The information contained in the transport blocks ("DSCH Status", "New TX" and "Modulation") is shown for each MIMO path separately. In the non-MIMO case, only the section of the first transport block (TB1) is filled.

If a dual cell is activated, "DC HARQ Process" carry the information for the second MIMO path.

- "DSCH Status TB1/TB2"/"DC DSCH Status TB1/TB"2
  Shoes the status of the CRC check for the transmitted and decoded HS-DSCH packet. CRC pass (successful transmission) causes an ACK message in the UL HS-DPCCH. CRC fail causes a NACK message. No CRC check (because no valid HS-SCCH information could be obtained) causes DTX. See also Chapter 4.4.2.2, "UMTS HSDPA UL HS-DPCCH view", on page 718.
  If a dual cell is activated, "DC DSCH Status TB1/TB2" carry the information for the second MIMO path.
- "New TX TB1/TB2"/"DC New TX TB1/TB2"
  Transmission of a new HS-DSCH packet or retransmission of a packet transmitted earlier.
  If a dual cell is activated, "DC New TX TB1/TB2" carry the information for the second MIMO path.
- "Modulation TB1/TB2"/"DC Modulation TB1/TB2"
  Modulation scheme for (QPSK, 16QAM or 64QAM)
  If a dual cell is activated, "DC Modulation TB1/TB2" carries the information for the second MIMO path.

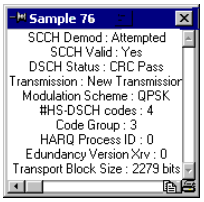
The meaning of the colors in the diagram is listed in the table below.

Note that a red square often causes red or white squares in the cells below the red marked cell. For example, a failed SCCH demodulation means that the mobile cannot start receiving the HS-DSCH and all the following cells are white.

Table 4-11: Color codes in the UMTS HSDPA HS Decode Status View

Decoding Stage	Green	Blue	Violet	Red	White
SCCH Demod	Attempted	-/-	-/-	Not attempted (because the SCCH did not carry the proper UE ID)	n/a
SCCH Valid	Yes	-/-	-/-	No	n/a
DSCH Status	CRC Pass	-/-	-/-	CRC Fail	n/a
New Trans-mission	New Trans-mission	-/-	-/-	Retransmis-sion	n/a
Modulation	64QAM	16QAM	QPSK	-/-	n/a

Details window

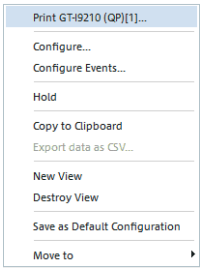


A double-click any of the table columns opens a details window for the corresponding sample.

The window repeats the information in the table and contains the following additional entries:

- "HARQ Process ID"
  Value of the HARQ process identifier (0 to 7)
- "Redundancy Version"
  Value X_{rv} in the range 0 to 7. X_{rv} jointly codes the redundancy version (RV) parameters r, s and the constellation version parameter b.
- "Transport Block Size"
  Size of the HS-DSCH transport blocks in bit, calculated from the 6-bit transport block size index; see 3GPP TS 25.321.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS HSDPA HS Decode Status View" configuration menu contains the "Info" tab; seeChapter 4.1.4, "Configuration menu", on page 430.

4.4.2.4 UMTS HSDPA configuration view

The "UMTS HSDPA Configuration View" shows the configuration of the DL HSDPA channels received by the test mobile, the UL HS-DPCCH, and information related to the finger configuration command, the DL HS-SCCHs, and the active HARQ processes. This configuration data is generated whenever there is a L1 reconfiguration related to HSDPA.

Most of the displayed information is mobile-specific and primarily intended for monitoring the status of the test mobile.

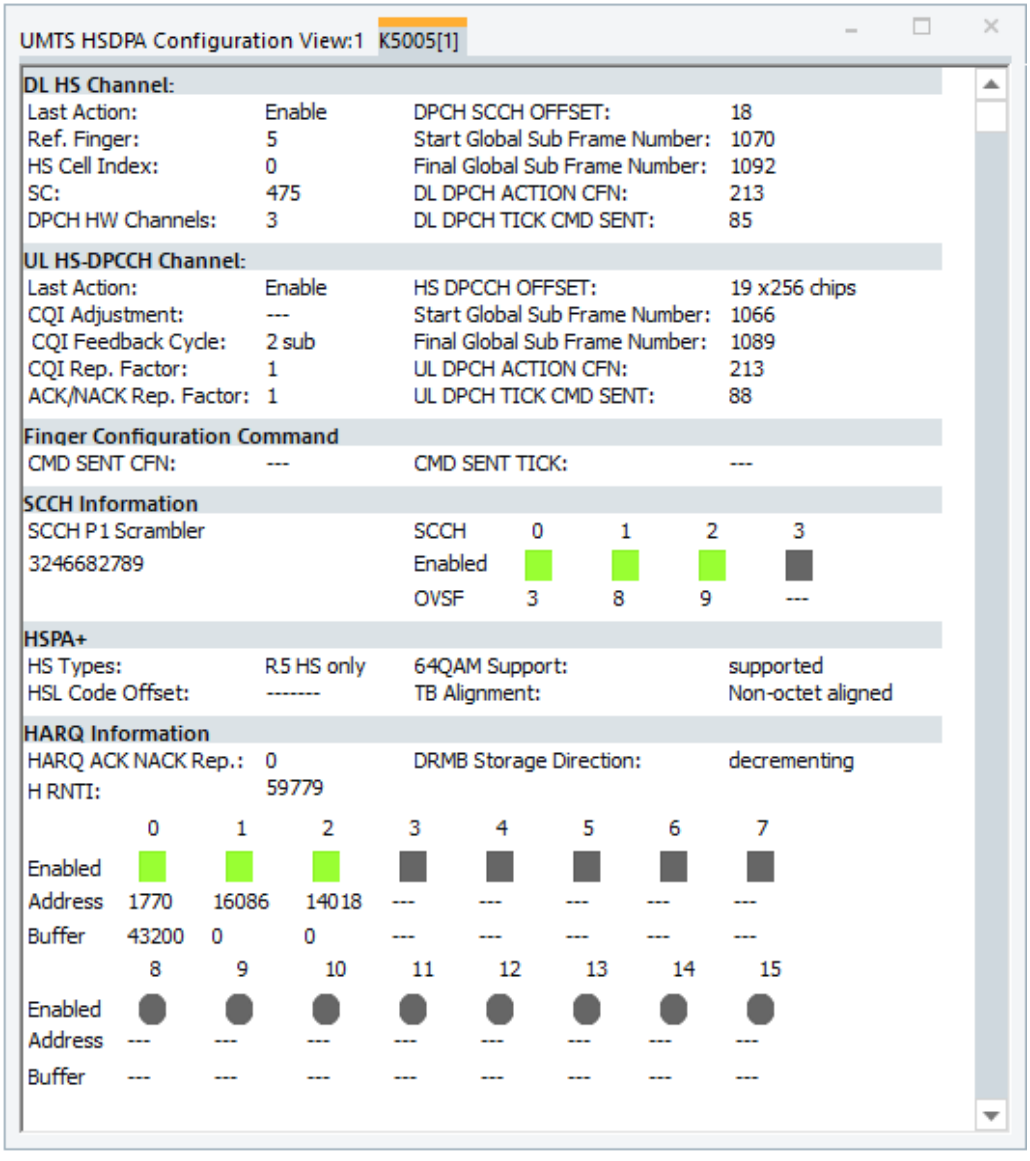


Figure 4-358: UMTS HSDPA Configuration View

The configuration data is displayed in different panels:

DL HS channel

The following information is related the DL High-Speed Channels (HS-DPCH and HS-SCCH):

- "Last Action"
  Status of the DL transmission. Enable, Disable, or Reslam
- "Ref. Finger"
  Reference finger (values 0 to 11)
- "HS Cell Index"
  High-speed cell index in the range 0 to 7
- "SC"
  Common scrambling code for all DL HSDPA channels

Use the Chapter 4.4.3.1, "UMTS finger data view", on page 743 to view the preceding parameters together with the time offset and Ec/Io of all signals captured by the different fingers of the mobile receiver.

- "DPCH HW Channels"
  Values 0 to 3.
- "DPCH SCCH Offset"
  Corresponds to starting global subframe number, values 0 to 149 (256 chip periods).
- "Start Global subframe Number"
  Mobile-specific subframe no. in the range 0 to 1279.
- "Final Global subframe Number"
  Mobile-specific subframe no. in the range 0 to 1279, only relevant for Last Action: Reslam.
- "DL DPCH ACTION CFN"
  Mobile-specific parameter, 0 to 255.
- "DL DPCH TICK CMD SENT"
  Mobile-specific parameter, 0 to 149.

UL HS-DPCCH channel

The following information is related the UL HS-DPCCH. This channel carries the ACK/NACK and CQI messages that the mobile reports to the network; see Chapter 4.4.2.2, "UMTS HSDPA UL HS-DPCCH view", on page 718.

- "Last Action"
  Status of the UL transmission: Enable, Disable, or Reslam
- "CQI Adjustment"
  Adjustment applied to SIR measurement before quantization; CQI Adjustment = [12.04 + DSCH to CPICH offset (signaled to the mobile) + SNR to CQI offset (constant for a software build, e.g. 4.0].
- "CQI Feedback Cycle"
  Time (in multiples of HSDPA subframes with a length of 2 ms) after which the mobile repeats the transmission of CQI symbols on the HS-DPCCH. Possible values are 0, 1, 2, 4, 5, 10, 20, 40 and 80

- "CQI Rep. Factor"
  Number of repeated CQI transmissions (1 to 4)
- "ACK/NACK Rep."
  Factor Number of repeated ACK/NACK transmissions (1 to 4)
- "HS-DPCCH Offset"
  Corresponds to starting global subframe number, values 0 to 149 (256 chip periods)
- "Start Global subframe Number"
  Mobile-specific subframe no. in the range 0 to 1279
- "Final Global subframe Number"
  Mobile-specific subframe no. in the range 0 to 1279, only relevant for "Last Action: Reslam"
- "UL DPCH ACTION CFN"
  Mobile-specific parameter, 0 to 255
- "UL DPCH TICK CMD SENT"
  Mobile-specific parameter, 0 to 149

Finger configuration command

The following information is mobile-specific:

- "CMD SENT CFN"
  Counter in the range 0 to 255
- "CMD SENT TICK"
  Counter in the range 0 to 149

SCCH info

The "SCCH Info" field provides information about the channels in the HS-SCCH set which is allocated to the mobile. An HS-SCCH set is a set of 1 to 4 HS-SCCHs. The mobile continuously monitors all the HS-SCCHs in the allocated set.

The panel shows the number of enabled SCCHs together with their channelization codes (OSVF). The SCCHs are fixed rate channels (SF = 128) with code numbers ranging from 1 to 127.

The remaining information is mobile-specific.

HARQ info

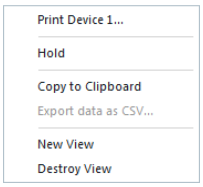
The "HARQ Info" field provides information about the active HARQ processes together with the internal address and the size of the physical buffer associated with each process.

In addition, the following information is displayed:

- "HARQ ACK/NACK Rep."
  Mobile-specific parameter
- "DRMB Storage Direction"
  Mobile-specific parameter
- "H-RNTI"

HS-DSCH RNTI, 16-bit identity, identifies the mobile for which data is transmitted in the corresponding HS-DSCH TTI

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.2.5 UMTS HSDPA MAC configuration view

The "UMTS HSDPA MAC Configuration View" shows the configuration of the MAC-hs that the test mobile receives from the network. The MAC-hs is the MAC entity that handles the high-speed downlink shared channel (HS-DSCH), see standard 3GPP TS 25.321. The view is updated every time the MAC-hs is reconfigured.

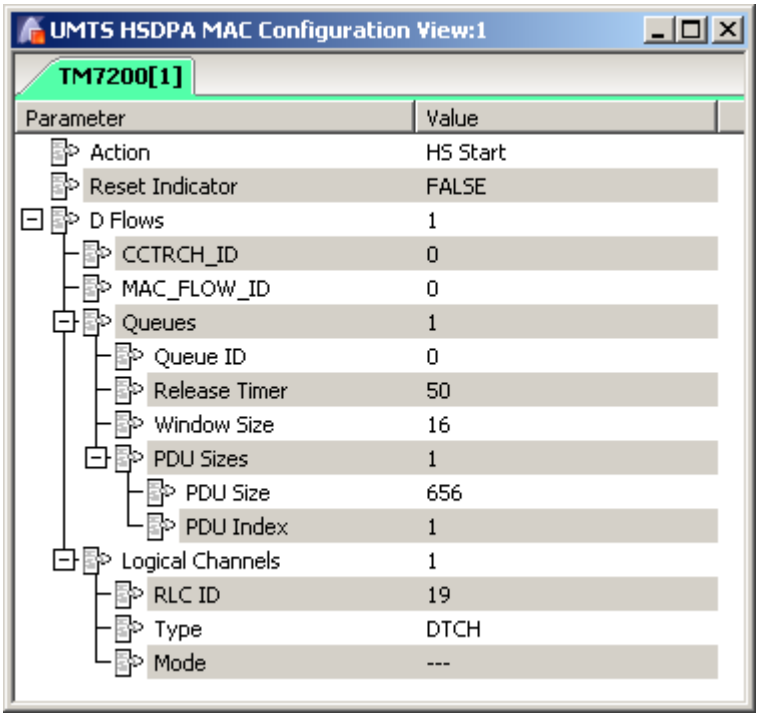


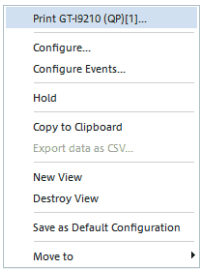
Figure 4-359: UMTS MAC Configuration View

Diagram

The view shows the following MAC-hs parameters with their values:

- "Action"
  Indicates the last action that the MAC-hs entity was requested to perform by upper layers: "Start", "Stop", or "Reconfigure".
- "Reset Indicator"
  TRUE indicates that a reset of the MAC-hs entity has been requested.
- "CCTRCH_ID"
  Unambiguous identifier for the Coded Composite Transport Channel (CCTrCH) inside the radio link (range 0 to 7).
- "MAC_FLOW_ID"
  Mobile-specific parameter, range 1 to 8
- "Queue"/"Queue ID"
  The "Queue ID" provides identification of the reordering queue in the receiver, to support independent buffer handling of data belonging to different reordering queues (range 1 to 8)
- "Release Timer"
  Value of the reordering release timer (T1). The release timer controls the stall avoidance in the mobile's reordering buffer; see 3GPP TS 25.321, section 11.6.2.3.2. Possible values are 10, 20, 30 … 100, 120, 140, 160, 200, 300 and 400
- "Window Size"
  Size of the receiver window, given in terms of a TSN range
- "PDU Size"
  Size of the Protocol Data Units (PDUs) that can be transferred to MAC within a transmission time interval in the range 0 to 5000 (bits)
- "PDU Index"
  MAC PDU Size Index in the range 0 to 7
- "Logical Channel"/"RLC ID"
  Mobile-specific parameter, range 0 to 17
- "Type"
  Channel type: BCCH, PCCH, CCCH, DCCH, CTCH, or DTCH
- "Mode"
  Channel Mode: Transparent mode (TM), Unacknowledged mode (UM), or Acknowledged mode (AM)

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

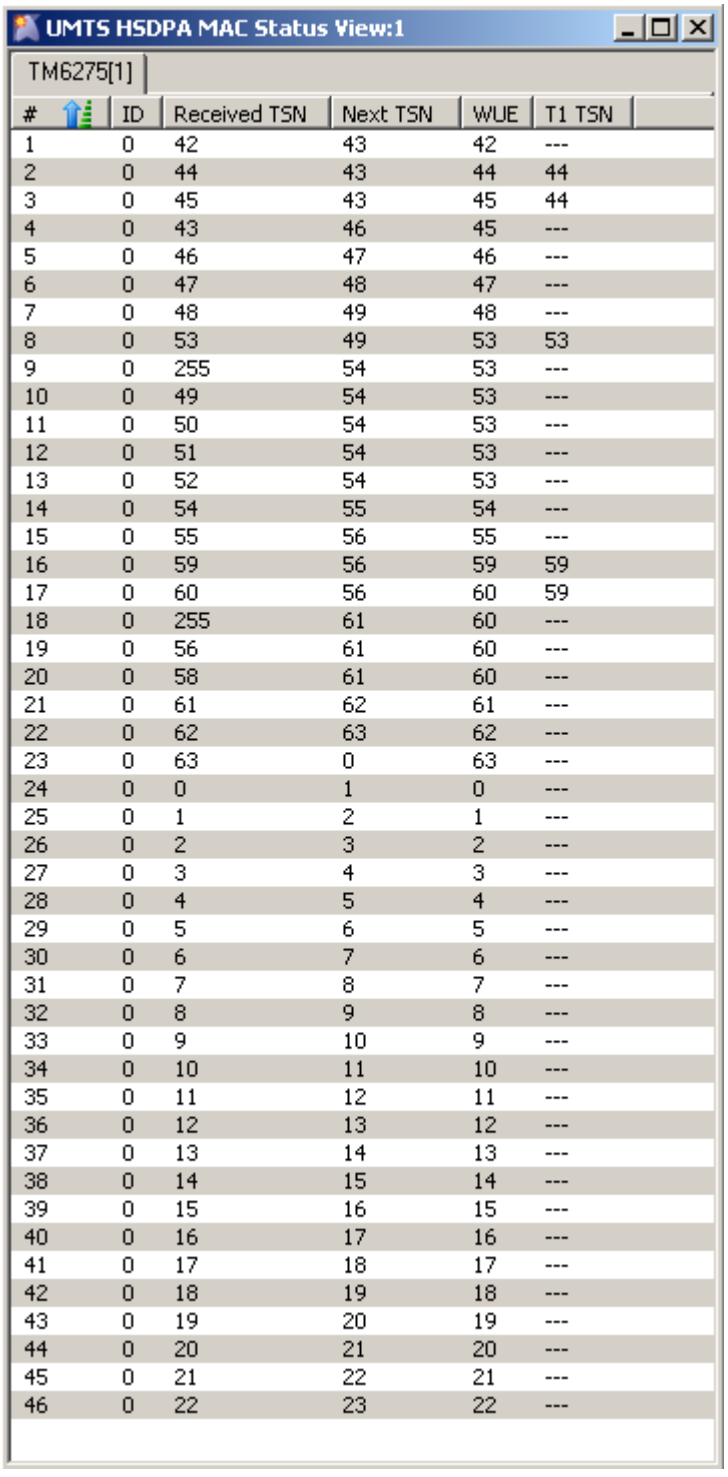
Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS MAC Configuration View" has no context menu for configurations.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.4.2.6 UMTS HSDPA MAC status view

The "UMTS HSDPA MAC Status View" gives an overview of the status of the reordering entity in the mobile receiver. The different state variables are described in standard 3GPP TS 25.321. The mobile collects this information in up to 100 consecutive samples which are displayed in a table.



#	ID	Received TSN	Next TSN	WUE	T1 TSN
1	0	42	43	42	---
2	0	44	43	44	44
3	0	45	43	45	44
4	0	43	46	45	---
5	0	46	47	46	---
6	0	47	48	47	---
7	0	48	49	48	---
8	0	53	49	53	53
9	0	255	54	53	---
10	0	49	54	53	---
11	0	50	54	53	---
12	0	51	54	53	---
13	0	52	54	53	---
14	0	54	55	54	---
15	0	55	56	55	---
16	0	59	56	59	59
17	0	60	56	60	59
18	0	255	61	60	---
19	0	56	61	60	---
20	0	58	61	60	---
21	0	61	62	61	---
22	0	62	63	62	---
23	0	63	0	63	---
24	0	0	1	0	---
25	0	1	2	1	---
26	0	2	3	2	---
27	0	3	4	3	---
28	0	4	5	4	---
29	0	5	6	5	---
30	0	6	7	6	---
31	0	7	8	7	---
32	0	8	9	8	---
33	0	9	10	9	---
34	0	10	11	10	---
35	0	11	12	11	---
36	0	12	13	12	---
37	0	13	14	13	---
38	0	14	15	14	---
39	0	15	16	15	---
40	0	16	17	16	---
41	0	17	18	17	---
42	0	18	19	18	---
43	0	19	20	19	---
44	0	20	21	20	---
45	0	21	22	21	---
46	0	22	23	22	---

Figure 4-360: UMTS HSDPA MAC Status View

Diagram

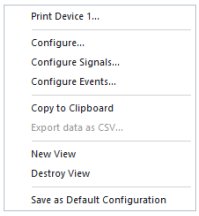
The view displays the following information elements:

- "#"

Current number of the sample, assigned in the range 1 to 100

- "ID Queue ID (0 to 7)"
  The Queue ID provides identification of the reordering queue in the receiver, to support independent buffer handling of data belonging to different reordering queues
- "Received TSN"
  Transmission Sequence Number (TSN, 0 to 63) of the last received (HS-DSCH) MAC-hs PDU
- "Next TSN"
  Next expected TSN. The TSN following the R&S TSME of the last in-sequence MAC PDU received
- "WUE"
  WUE (Window Upper Edge) represents the TSN at the upper edge of the receiver window. While timer T1 is active, the number is equal to the Received TSN. Otherwise it is invalid.
- "T1 TSN"
  TSN used in the reordering procedure. The TSN of the latest MAC-hs PDU that cannot be delivered to the disassembly entity, when the timer T1 is started.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSDPA MAC status view configuration

The "UMTS HSDPA MAC Status View" configuration menu selects the information to be displayed.

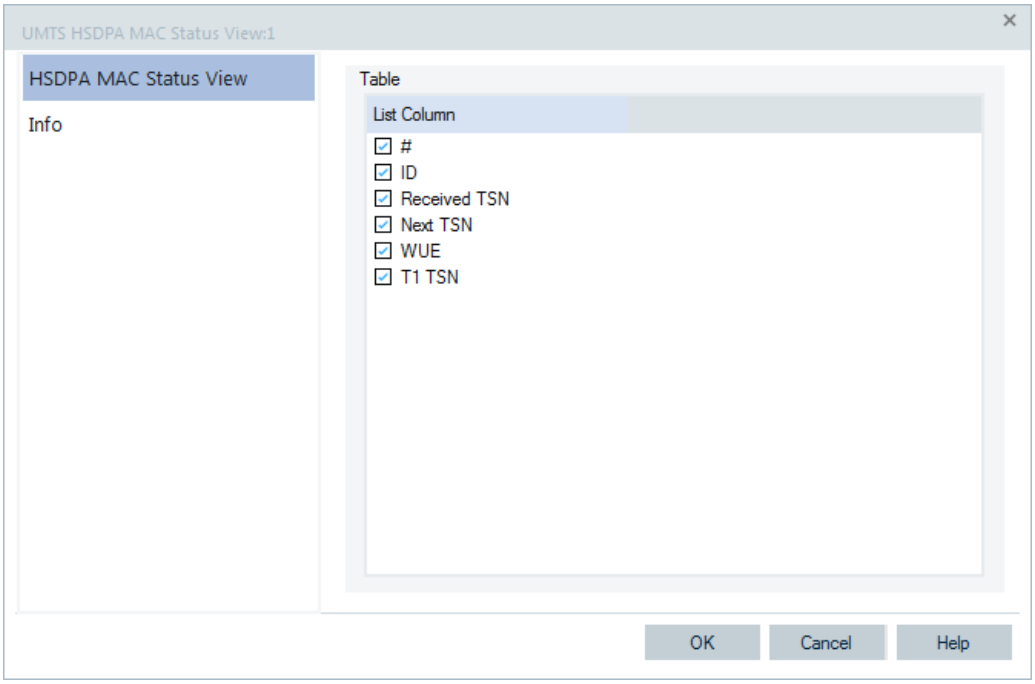


Figure 4-361: UMTS HSDPA Status View - configuration

4.4.2.7 UMTS HSDPA MAC header view

The "UMTS HSDPA MAC Header View" shows the mobile-specific subframe number and the corresponding (HS-DSCH) MAC-hs headers as defined in standard 2GPP TS 25.321, sections 9.1.4 and 9.2.2.

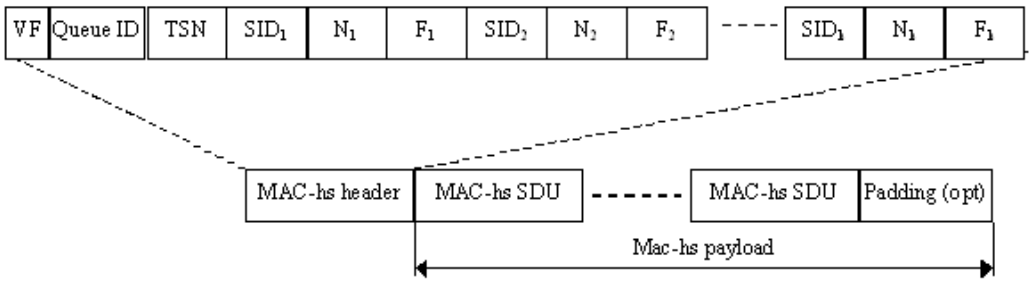
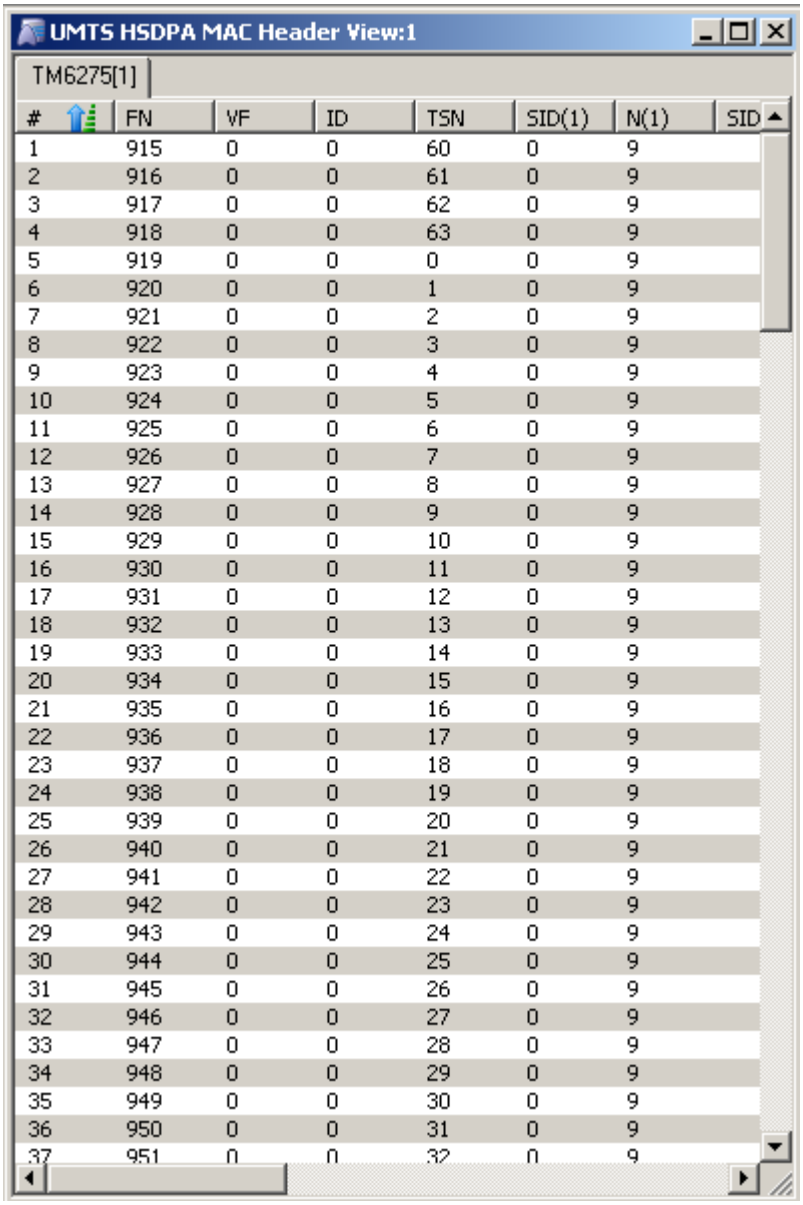


Figure 4-362: UMTS MAC-hs PDU

For an overview of the last 100 MAC-hs PDUs, use the Chapter 4.4.2.6, "UMTS HSDPA MAC status view", on page 729.



#	FN	VF	ID	TSN	SID(1)	N(1)	SID
1	915	0	0	60	0	9	
2	916	0	0	61	0	9	
3	917	0	0	62	0	9	
4	918	0	0	63	0	9	
5	919	0	0	0	0	9	
6	920	0	0	1	0	9	
7	921	0	0	2	0	9	
8	922	0	0	3	0	9	
9	923	0	0	4	0	9	
10	924	0	0	5	0	9	
11	925	0	0	6	0	9	
12	926	0	0	7	0	9	
13	927	0	0	8	0	9	
14	928	0	0	9	0	9	
15	929	0	0	10	0	9	
16	930	0	0	11	0	9	
17	931	0	0	12	0	9	
18	932	0	0	13	0	9	
19	933	0	0	14	0	9	
20	934	0	0	15	0	9	
21	935	0	0	16	0	9	
22	936	0	0	17	0	9	
23	937	0	0	18	0	9	
24	938	0	0	19	0	9	
25	939	0	0	20	0	9	
26	940	0	0	21	0	9	
27	941	0	0	22	0	9	
28	942	0	0	23	0	9	
29	943	0	0	24	0	9	
30	944	0	0	25	0	9	
31	945	0	0	26	0	9	
32	946	0	0	27	0	9	
33	947	0	0	28	0	9	
34	948	0	0	29	0	9	
35	949	0	0	30	0	9	
36	950	0	0	31	0	9	
37	951	0	0	32	0	9	

Figure 4-363: UMTS HSDPA MAC Header View

Diagram

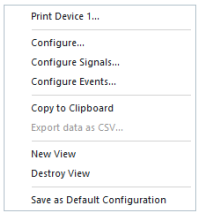
The MAC-hs header contains the following information elements:

- "FN"
  Internal subframe number, range 0 to 1279
- "VF"
  Version flag, now set to zero
- "ID"
  Queue ID (0 to 7; provides identification of the reordering queue in the receiver, to support independent buffer handling of data belonging to different reordering queues

- "TSN Transmission"
  Sequence Number (TSN, 0 to 63) on the HS-DSCH
  The TSN field is used for reordering purposes to support in-sequence delivery to higher layers.
- "SID(n)"
  Size Index Identifier (0 to 7), identifies the size of a set of consecutive MAC-d PDUs
  The MAC-d PDU size for a given SID is configured by higher layers and is independent for each Queue ID.
- "N(n)"
  Number of MAC-D PDUs (0 to 63), the number of consecutive MAC-d PDUs with equal size

The flag fields ("F") in the figure above indicate whether the MAC-hs header contains additional "SID" and "N" fields. They are not relevant for the "MAC Header View" because the number of columns in the table is selected in the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSDPA MAC header view configuration

The "UMTS HSDPA MAC Header View" configuration menu selects the information to be displayed.

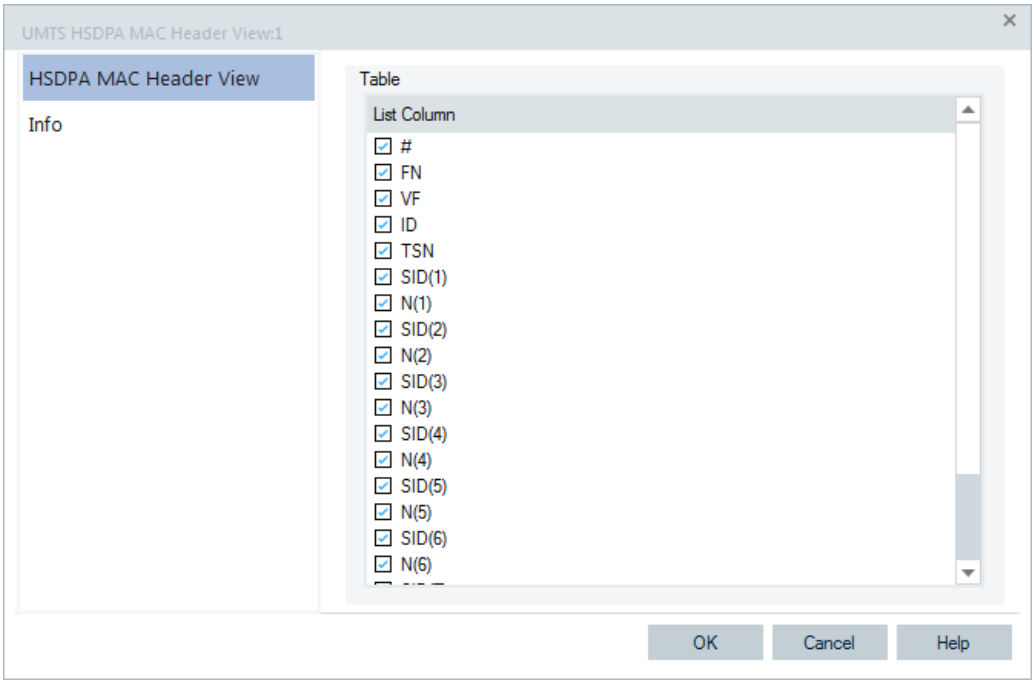


Figure 4-364: UMTS HSDPA Header View - configuration

4.4.2.8 UMTS HSDPA performance view

The "UMTS HSDPA Performance View" contains four preconfigured 2D charts. The signals in these charts are related to the transmission performance, given in terms of the requested and achieved data throughput.

Figure 4-365: UMTS HSDPA Performance View

A double-click the ≡ button ("Show / Hide Chart Group") opens or closes a chart in the performance view. The functionality of the charts in the view is analogous to the Chapter 4.2.1, "2D chart view", on page 448.

For the meaning of the configuration entries in the "UMTS HSDPA Performance View: <variable> Properties", see Chapter 4.2.1, "2D chart view", on page 448.

Chart 1

The "Chart 1" shows data throughput that the mobile requests according to the measured channel quality. The requested throughput is calculated from the CQI messages that the mobile transmits on the UL HS-DPCCH, see Chapter 4.4.2.2, "UMTS HSDPA UL HS-DPCCH view", on page 718. The results are averaged over the number of subframes (100) shown in the "UMTS HSDPA HS-DPCCH View".

The chart contains the following results:

- "Req. Throughput"
  Requested total throughput
- "Req. Avg. # Codes"
  Number of HS-(P)DSCH channelization codes in the range between 1 and 15, see Chapter 4.4.2.9, "UMTS HSDPA decode statistic view", on page 737
- "Req. QPSK Rate"
  Percentage of the requested throughput that can be transferred on QPSK-modulated data blocks
- "Req. 16QAM Rate"
  Percentage of the requested throughput that can be transferred on 16QAM-modulated data blocks
- "Req. Avg. CQI"
  Average CQI value received from the mobile

Conflict of MIMO and non-MIMO signals

In MIMO case, the "HSDPA Performance View" does not show any "Req. Avg. CQI" value. The reason is that the statistic is only valid, if no MIMO TTI was present during the reporting time period. If at least one MIMO TTI was found, those values are set to invalid. It is because the CQI value range differs between a MIMO and non-MIMO case, thus a statistic over all does not make any sense.

Chart 2

The "Chart 2" shows the scheduled throughput. It is the data throughput that the network uses according to the requests (CQI messages) from the mobile. The results are analogous to the "Requested Throughput" results.

Chart 3

The "Chart 3" shows the MAC layer throughput. It is the actual DL data throughput achieved. The MAC throughput depends on the scheduled throughput and the percentage of data blocks that the network has to retransmit ("HARQ Retransmission Rate"). The "MAC BLER" is the percentage of MAC blocks that the UE received with error. The

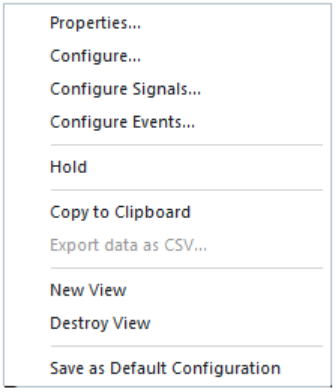
larger the Block Error Rate, the higher the number of retransmissions and the smaller the MAC throughput.

Chart 4

The "Chart 4" shows the RLC DL throughput. It is the data throughput of the RLC blocks that the mobile receives from the network. The "RLC DL BLER" is the percentage of RLC blocks that the UE received with error.

To measure "RLC DL Throughput" signal, it is required that the UMTS message type `WCDMA RLC DL AM Statistics` is selected in a test device menu. For details how to configure the test device, refer to "Extra settings UMTS" on page 1573.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

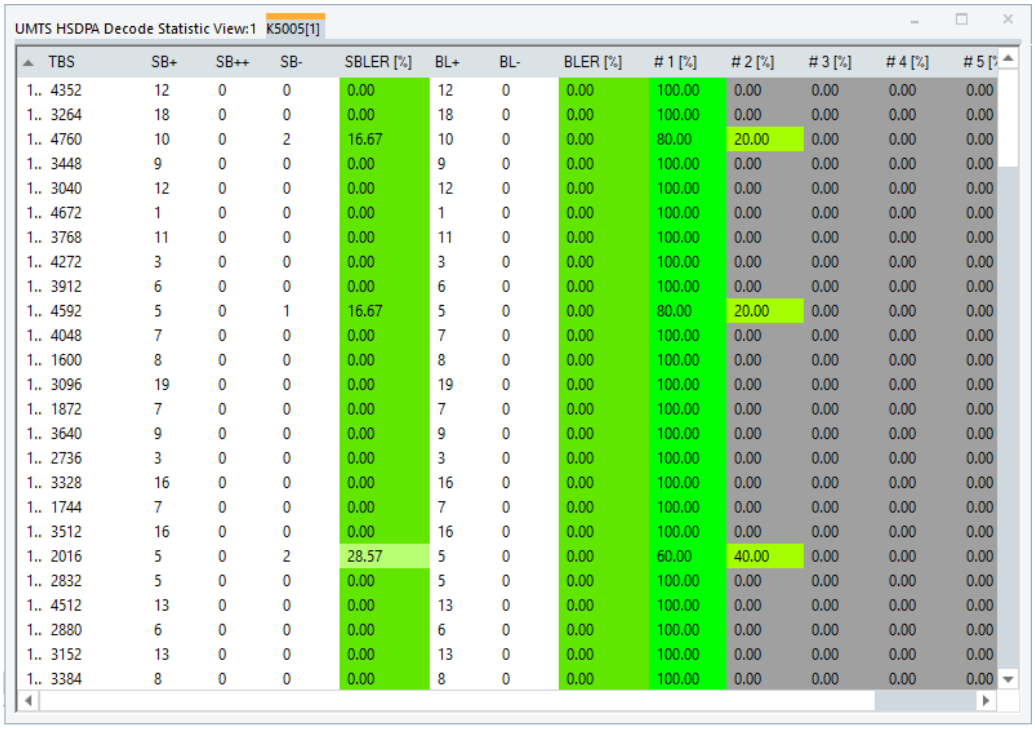
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS HSDPA Performance View" configuration is done in the "UMTS HSDPA Performance View: <variable> Properties" pane. Selecting the "Configure" command in the context-sensitive menu of the view opens only the "Info" page.

4.4.2.9 UMTS HSDPA decode statistic view

The "UMTS HSDPA Decode Statistic View" shows a statistical evaluation of the received DL HS-DSCH transport blocks. Also is shown the block error rate and the number of retransmissions needed to decode successfully the blocks of each size. The transport block size depends on the CQI values that the mobile reported to the network; see standard 2GPP TS 25.214 and Chapter 4.4.2.2, "UMTS HSDPA UL HS-DPCCH view", on page 718. The results are averaged over the number of subframes (100) shown in the "UMTS HSDPA HS-DPCCH view".



TBS	SB+	SB++	SB-	SBLER [%]	BL+	BL-	BLER [%]	# 1 [%]	# 2 [%]	# 3 [%]	# 4 [%]	# 5 [%
1.. 4352	12	0	0	0.00	12	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3264	18	0	0	0.00	18	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 4760	10	0	2	16.67	10	0	0.00	80.00	20.00	0.00	0.00	0.00
1.. 3448	9	0	0	0.00	9	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3040	12	0	0	0.00	12	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 4672	1	0	0	0.00	1	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3768	11	0	0	0.00	11	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 4272	3	0	0	0.00	3	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3912	6	0	0	0.00	6	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 4592	5	0	1	16.67	5	0	0.00	80.00	20.00	0.00	0.00	0.00
1.. 4048	7	0	0	0.00	7	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 1600	8	0	0	0.00	8	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3096	19	0	0	0.00	19	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 1872	7	0	0	0.00	7	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3640	9	0	0	0.00	9	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 2736	3	0	0	0.00	3	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3328	16	0	0	0.00	16	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 1744	7	0	0	0.00	7	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3512	16	0	0	0.00	16	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 2016	5	0	2	28.57	5	0	0.00	60.00	40.00	0.00	0.00	0.00
1.. 2832	5	0	0	0.00	5	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 4512	13	0	0	0.00	13	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 2880	6	0	0	0.00	6	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3152	13	0	0	0.00	13	0	0.00	100.00	0.00	0.00	0.00	0.00
1.. 3384	8	0	0	0.00	8	0	0.00	100.00	0.00	0.00	0.00	0.00

Figure 4-366: UMTS HSDPA Decode Statistic View

Diagram

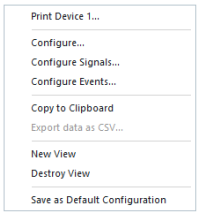
The table contains the following columns:

- "#"
  Number of the carrier and the MIMO path, e.g. 1 to 1 means primary carrier first MIMO path (or SISO)
- "TBS"
  Transport block size in bits, in ascending order
  The results in each row are relating to blocks of the same size.
- "SB+"
  Number of successfully decoded subblocks
  A subblock is a mobile-specific unit comprising the HS-DSCH data of one subframe.
- "SB++"
  Number of duplicate subblocks
  Duplicate subblocks are subblocks that the network retransmitted although they were received correctly (usually because no ACK message was received from the mobile).
- "SB–"
  Number of subblocks which could not be decoded successfully and had to be retransmitted
  These blocks contribute to the SBLER but not necessarily to the BLER, see the following parameters.
- "SBLER"

Subblock error rate, SBLER = SB–/(SB+SB–)

- "BL+"
  Number of successfully decoded blocks
- "BL–"
  Number of blocks which could not be decoded successfully until the maximum number of retransmissions was reached
- "BLER"
  Block error rate, BLER = BL–/(BL+BL–)
  The BLER is usually smaller than the SBLER because it counts only the blocks that could not be decoded until the end of the HARQ process (until the maximum number of retransmissions was reached).
- "# 1 [%]"
  Number of blocks successfully decoded without retransmission
- "# n [%]"
  Number of blocks successfully decoded after one initial transmission and (n–1) retransmissions

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSDPA decode statistic view configuration

The "UMTS HSDPA Decode Statistic View" configuration tab shows a list of signals that you can select to be displayed. The tab has the same name as the one used for the "UMTS HSUPA HARQ View" configuration, see UMTS HSUPA HARQ view configuration.

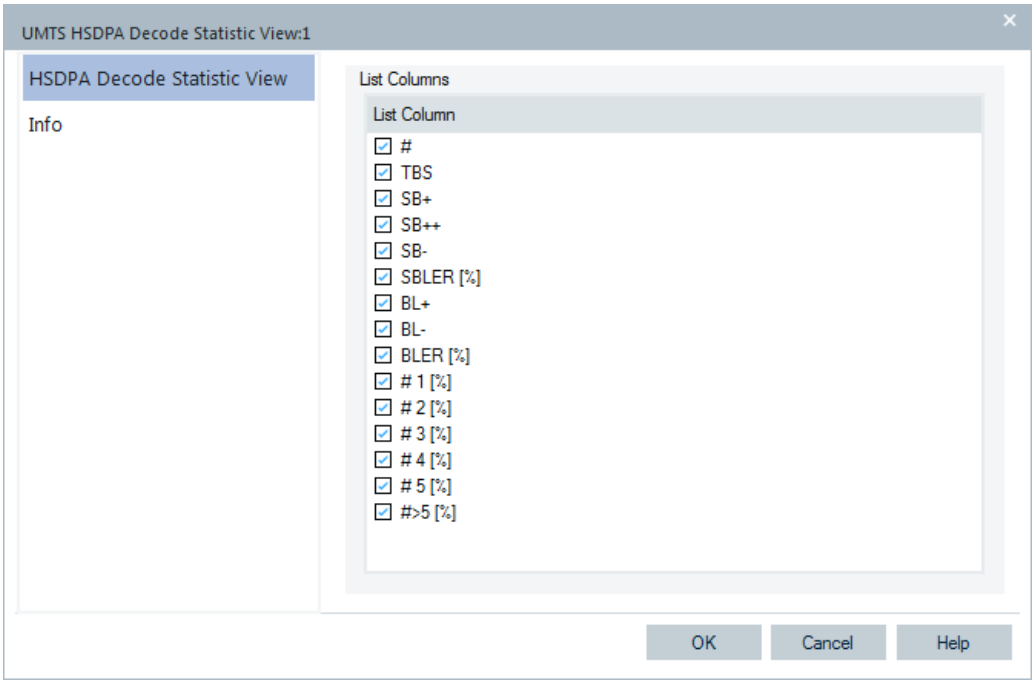


Figure 4-367: UMTS HSDPA Decode Statistic View - configuration

4.4.2.10 UMTS HSPA L2 statistic view

The "UMTS HSPA L2 Statistic View" shows information on used PDU size. The first column shows the size in octets, the second the absolute numbers of this size, the third the total numbers of PDUs and the fourth is the percentage of this size usage in the reporting period.

This information is only available if the "HSPA+ Flexible DL RLC AM PDU" size is activated.

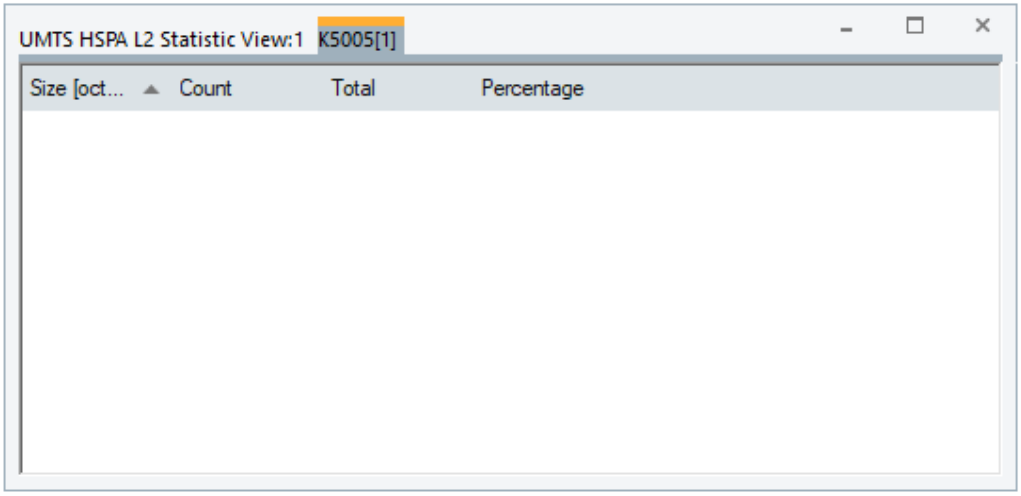
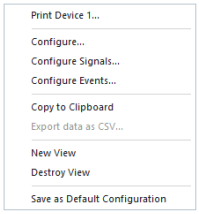


Figure 4-368: UMTS HSPA L2 Statistic View

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS HSPA L2 statistic view configuration

The "UMTS HSDPA L2 Statistic View" configuration tab shows a list of signals that you can select to be displayed. The tab has the same name as the one used for the "UMTS HSUPA HARQ View" configuration, see "UMTS HSUPA HARQ view configuration" on page 699.

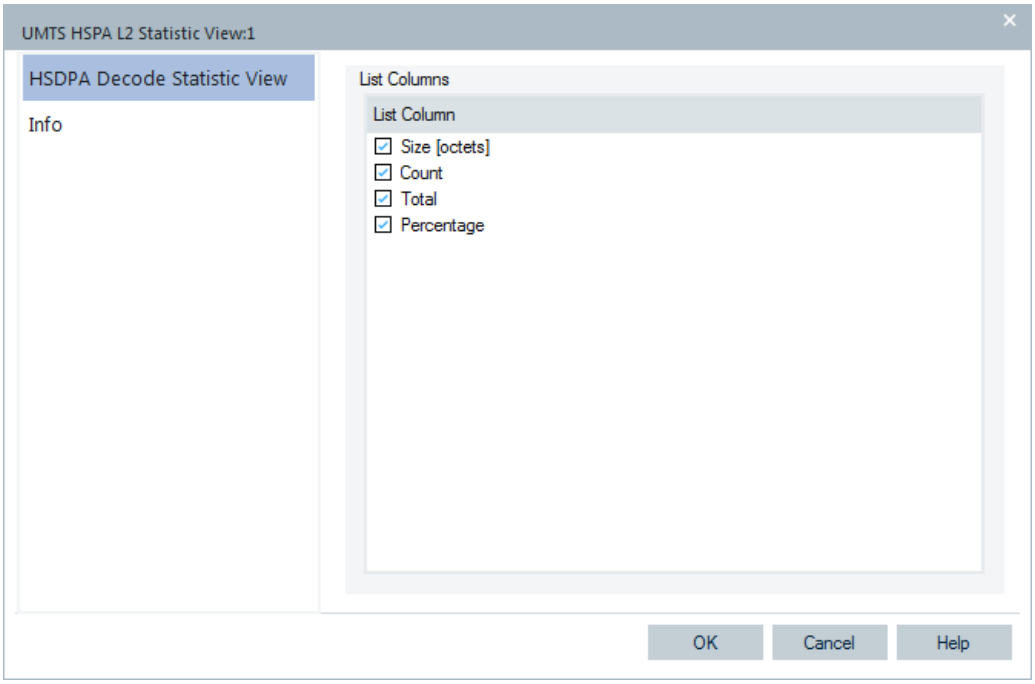


Figure 4-369: UMTS HSPA L2 Statistic View - configuration

4.4.3 UMTS views

The "UMTS Views" display UMTS-specific information acquired with an UMTS test mobile and using the UMTS device.

In general, recording of the different message types shown in the view must be explicitly activated in the "Configuration" and "Expert Mode" tabs of the device configuration menu, refer to "UMTS devices configuration" on page 1571.

The UMTS views can be selected from "View" > "Mobile Views" if the mouse pauses over "UMTS".

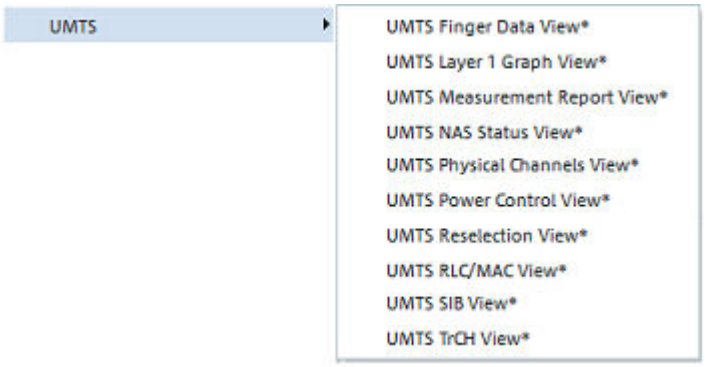


Figure 4-370: UMTS views

- UMTS finger data view 743
- UMTS NAS status view 746
- UMTS TrCH view 749
- UMTS physical channels view 753
- UMTS SIB view 758
- UMTS RLC/MAC view 760
- UMTS measurement report view 763
- UMTS power control view 765
- UMTS reselection view 766
- UMTS Layer 1 graph view 770

4.4.3.1 UMTS finger data view

The "UMTS Finger Data View" shows the most important layer 1 parameters characterizing the different downlink WCDMA signals received by the mobile, captured with the different branches (fingers) of the test mobile UMTS RAKE receiver. The value of the critical quantity Ec/Io for each signal is visualized in addition by horizontal bars. A mobile with a Qualcomm chipset must be used to record the data.

The view displays the fingers of the primary and the secondary carrier of a dual cell.

The view is empty unless the test mobile is configured to record the "WCDMA Finger Info"; see description of the "Extra settings" tab of the device configuration menu in "Extra settings UMTS" on page 1573.

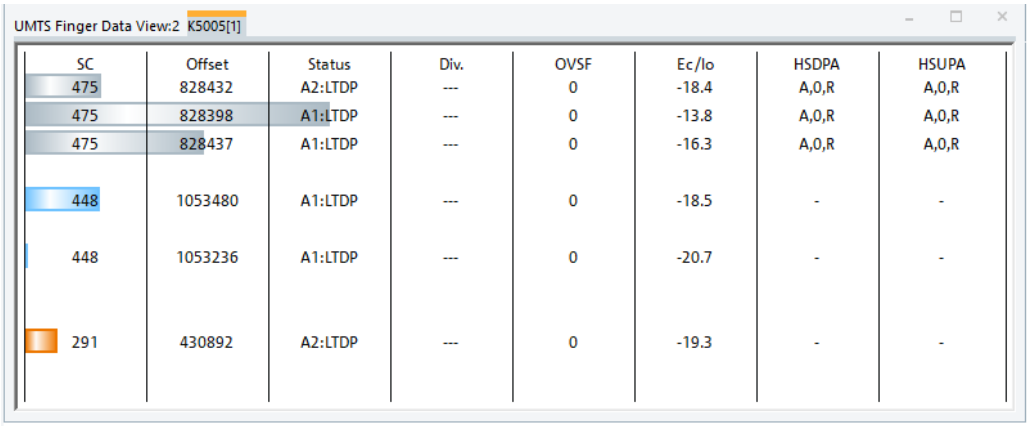


Figure 4-371: UMTS Finger Data View

The results for each mobile are arranged in a separate tab.

Results

Table of the most important layer 1 parameters of the captured downlink WCDMA signals. Each table row represents a signal. The maximum number of rows/signals can be set in the configuration menu. The signals are sorted according to the signal-to-noise ratio Ec/Io, the strongest signal appears on top of the list.

- **SC**
  Primary scrambling code of the signal used to identify a cell

The format is selected in the "TEC for UMTS Test Mobiles"; refer to section "Configuration Menu in chapter 3.

- **Offset**
  Time offset of the signal in 1/8-chip units relative to the system time (hardware-dependent)
  The difference between the offsets of different signals provides important information. Two signals with equal SC, Status, Div., and OVSF but different offset and Ec/Io originate from the same source but propagated along different paths.
- **Status**
  Status of the receiver fingers; one or several of the following characters:
  - A1/A2 (Antenna)
    Shows the used antenna of the device (A1, A2) for this finger
  - **L (Lock Detection State)**
    Shows whether the finger RSSI is > high threshold regardless of whether the given type of lock is enabled
  - **T (Time Tracking Lock)**
    Shows when time tracking lock is enabled, that the finger RSSI > upper lock threshold
  - **D (Data Combining Lock)**
    Shows when the data combining lock is enabled, that the finger RSSI > upper lock threshold
  - **P (Power Control Bit Lock)**
    Sows when the data combining lock is enabled, that the finger RSSI > power control bit threshold
- **Div.**
  Downlink transmit diversity scheme for the CPICH: STTD (Space Time Transmit Diversity), TSTD (Time Switched Transmit Diversity), SSDT (Site Selection Diversity Transmit Power Control), or No Diversity
- **OVSF**
  Orthogonal Variable Spreading Factor, code number of the signal
- **Ec/Io**
  Ratio of the received energy per PN chip for the signal to the total received power spectral density at the mobile antenna connector. Ec/Io is obtained in an unbiased measurement, i.e. the contribution of the noise floor to the powers is subtracted.

The "SC", "Offset" and "Ec/Io" values for each finger generate signals in the "UMTS – <Device> – Finger Info" branch of the data tree.

HSDPA results

The HSDPA-related results are closely related to the "Last Action", "Ref. Finger", and "HS Cell Index" parameters in the Chapter 4.4.2.4, "UMTS HSDPA configuration view", on page 724. Note that signals from the same source (equal SC) have the same "HSDPA" status and "HS Cell Index", but only a single signal can be the reference signal.

The results are comma delimited in the following order:

- **A (or –)**
  Active (or not)

- **1 .. n**
  Cell index in the range 0 to 7
- **R**
  Reference finger

HSUPA results

Note that signals from the same source (equal SC) have the same `HSUPA` status and "Cell Index", but only a single signal can be the reference signal.

The results are comma delimited in the following order:

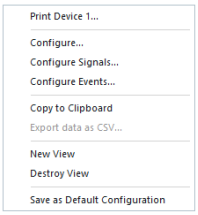
- **A (or –)**
  Active (or not)
- **1 .. 7**
  Radio link set in the range 0 to 7
- **R**
  Reference finger
- **SC**
  Serving Cell

Ec/Io bars

A colored bar overlaid to each table row shows the signal strength, expressed by its Ec/Io. The scale of the Ec/Io bars is defined in the configuration menu, the colors denote the SCs of the different signals; they can be customized in the "Colors" tabs of the UMTS view configuration menus, for example, the one linked to the UMTS Cell Set View. If the signal strength falls below the selected minimum, the bar is replaced by a narrow line at the left edge of the diagram.

The SC color codes are also shown in the "ROMESMAP Route Track" menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS finger data view configuration

The "UMTS Finger Data View" configuration menu defines the maximum number of table rows in the "UMTS Finger Data View" and the scale the Ec/Io bars and displays information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

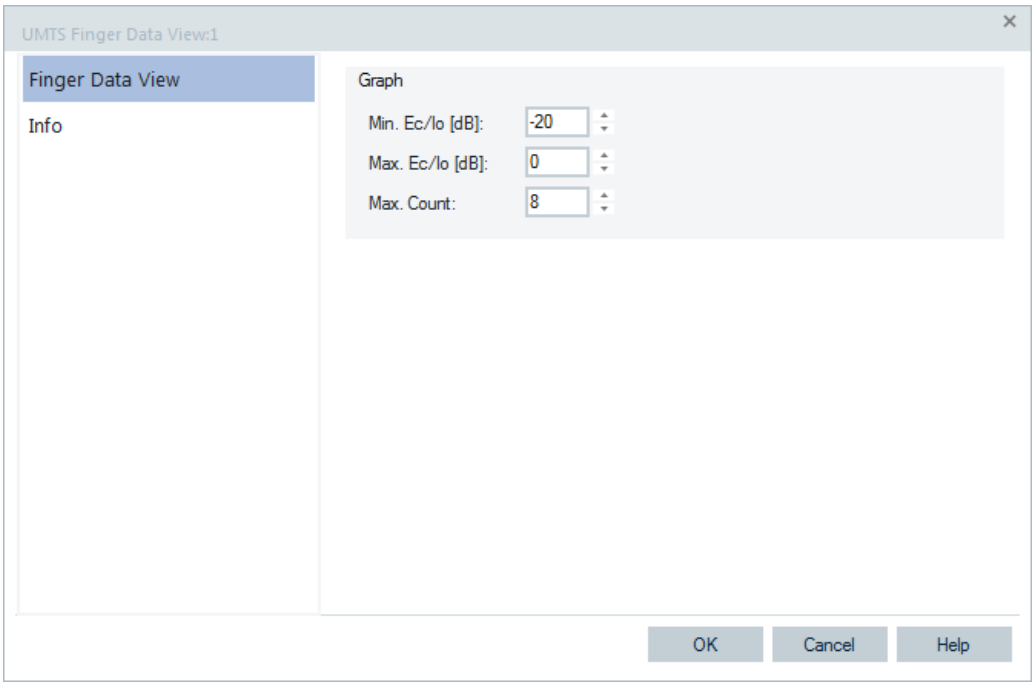


Figure 4-372: UMTS Finger Data View: Finger Data View - configuration

Graph
The "Graph" panel in the "Finger Data View Configuration" tab contains three input fields:

- **Min. Ec/Io [dB]**
  Value of Ec/Io at the left edge of the diagram. The length L of the bars increases with the value of Ec/Io, it is given by the linear formula:

$$L = L_{max} \cdot \frac{E_c / I_0 - \min(E_c / I_0)}{\max(E_c / I_0) - \min(E_c / I_0)}; \quad 0 \le L \le L_{max}$$

  where Lmax denotes the diagram width.
- **Max. Ec/Io [dB]**
  Value of Ec/Io at the right edge of the diagram; see above.
- **Max. Count**
  Maximum number of signals displayed in the view (= maximum number of table rows). The signals are sorted according to their Ec/Io, so a small number eliminates weak signals that can be of minor interest.

4.4.3.2 UMTS NAS status view

The "UMTS NAS Status View" shows an overview of higher-layer (Non-Access Stratum, NAS) parameters of the serving cell and the connection. A Qualcomm mobile must be used to record the data.

The view is empty unless the test mobile is configured to record the "UMTS NAS GMM State", "UMTS NAS MM State", "UMTS NAS REG State", or "UMTS NAS MM Characteristics" data, see description of the "Expert Mode" tab of the device configuration menu.

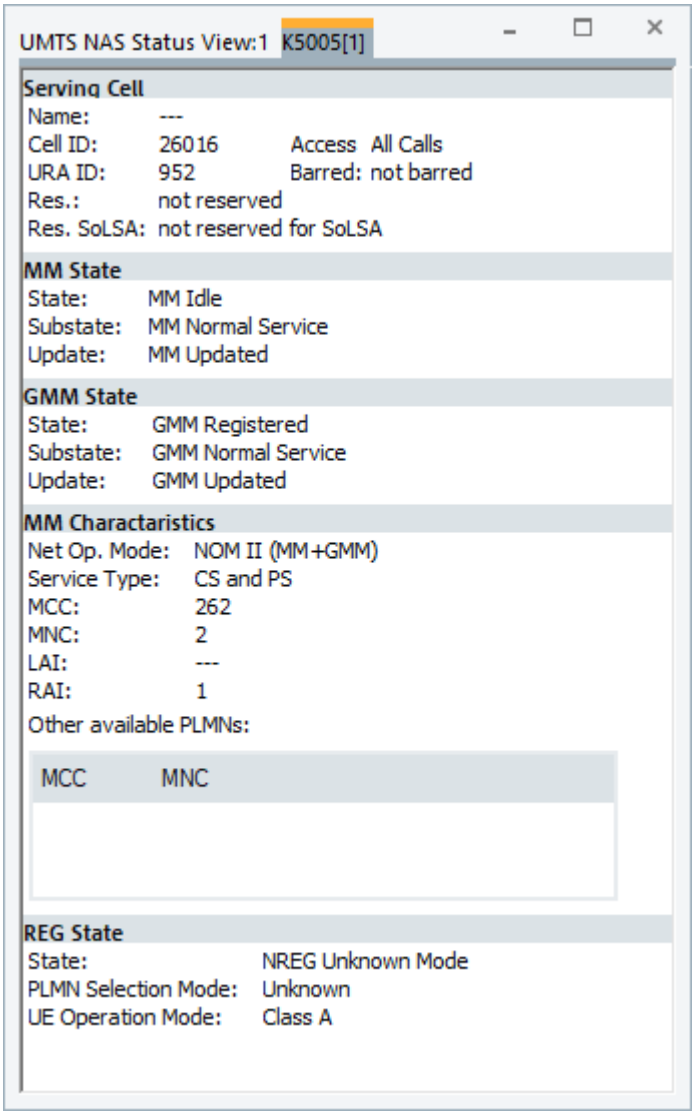


Figure 4-373: UMTS NAS Status View

The results for each mobile are arranged in a separate tab. Each tab consists of several panels.

Serving cell

Table of the most important higher layer (NAS) parameters of the serving cell.

- **Name**
  Name of the serving cell NodeB, taken from the UMTS NodeB database (if available)
- **Cell ID**

Cell Identity of the serving cell

- **URA ID**
  UTRAN Registration Area
- **Res**.
  Cell reserved or not reserved
- **Res. SoLSA**
  Cell reserved for Support of Localized Service Area
- **Access**
  Indication of possible cell access restrictions: Access for "All Calls" or "Emergency Calls Only"
- **Barred**
  Indication whether the cell is barred (for all calls, including emergency calls) or not barred

MM / GMM state

Overview of the current Mobility Management (MM) and GPRS Mobility Management (GMM) states, substates and updates of the mobile. The GMM results are available for test mobiles supporting GPRS functionality (which is true for most test mobiles). MM and GMM are described in standard 3GPP TS 24.008.

MM characteristics

Table of additional MM parameters:

- **Net Op. Mode**
  Network operation mode Class I, II or III, see standard 3GPP TS 123 060. The operation mode is indicated as system information to the mobile.
- **Service type**
  Circuit switched service ("CS"), packet switched service ("PS") or both ("CS and PS") or "Limited Service"
- **MCC**
  Mobile Country Code
- **MNC**
  Mobile Network Code
- **LAI**
  Location Area Identity
- **RAI**
  Routing Area Identity

Other available

- **PLMNs**
  MCC and MNC of other networks detected by the mobile

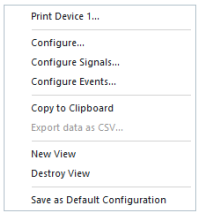
The "NAS" values generate signals in the "UMTS – <Device> – NAS State" branch of the data tree.

REG state

Table of registration information in the network

- **State**
  Identifies the state of the UE:
  – Not registered and the UE is not currently searching a new operator to register to.
  – Registered in home network.
  – Not registered, but UE is searching a new operator to register to.
  – Registration denied.
  – Unknown
  – Registered under roaming conditions.
- **PLMN Selection Mode**
  Identifies how the UE selects the network:
  – Automatic
  – Manual
  – Deregister from network.
  – Manual/automatic; if manual selection fails, automatic mode is entered.
- **UE Operation Mode**
  An UE in class-A mode of operation involved in a CS connection makes only RA updates and no combined RA/LA updates to the SGSN.
  An UE in class-B mode of operation involved in a CS connection does not make any updates during the CS connection.
  An UE in class-C mode of operation never makes combined RA/LA updates.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The configuration menu displays information about the view version only in the mobile/ technology common "Info" page.

4.4.3.3 UMTS TrCH view

The "UMTS TrCH View" shows an overview of the channel coding parameters in the downlink and uplink Transport Channels (TrCHs). A Qualcomm mobile must be used to record the data.

The view is empty unless the test mobile is configured to record the WCDMA TrCH Downlink or the "WCDMA TrCH Uplink" parameters; see description of the "Expert Mode" tab of the device configuration menu.

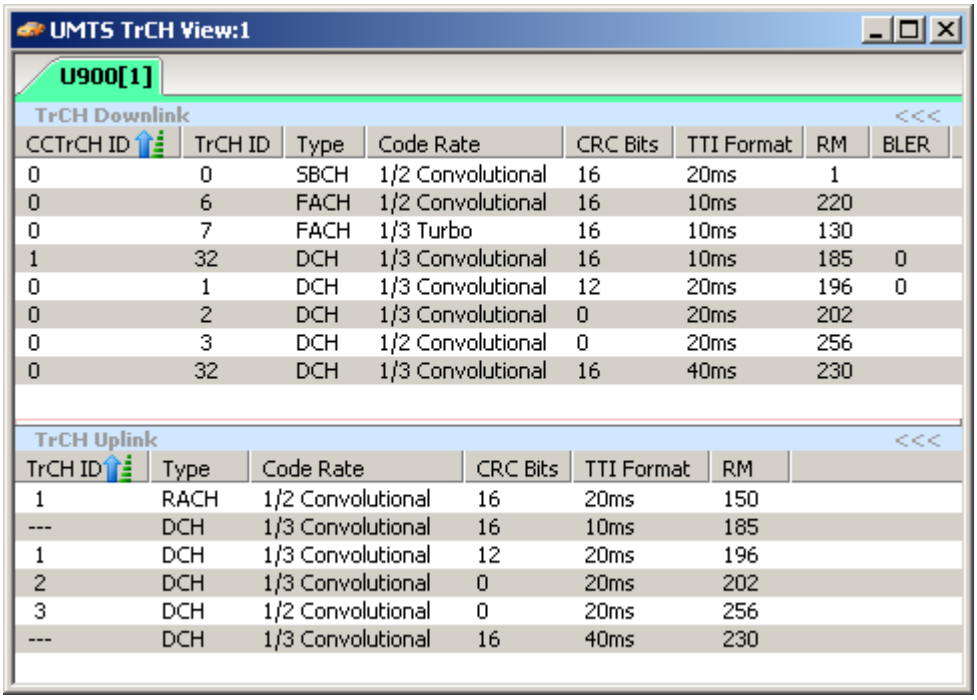


Figure 4-374: UMTS TrCH View

The results for each mobile are arranged in a separate tab.

View area

The entire view area is horizontally split to accommodate two different tables for the "TrCH Downlink" and the "TrCH Uplink".

A click the "TrCH Downlink" or "TrCH Uplink" title bars compresses and expands the corresponding table. A compressed table leaves more space for the other table. A compressed table is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

The contents of both tables can be selected in the configuration menu.

TrCH downlink

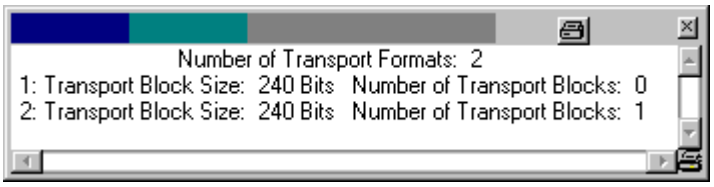
Table of the channel coding parameters of the downlink TrCHs received by the test mobile.

Each table row represents a single transport channel that has been added during the measurement (and possibly removed). A new table row is created each time that a new transport channel is added. However, a table row for a removed transport channel is deleted after the "Time Window for DL/UL" set in the configuration menu.

Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **CCTrCH ID**
  Composite Coded Transport Channel ID in the range 0 to 15, identifies unambiguously a CCTrCH inside a Radio Link.
- **TrCH ID**
  Transport channel number assigned to L1 by L2. Transport channels are multiplexed to the CCTrCH in the ascending order of these IDs.
- **Type**
  Transport channel type, e.g. Paging Channel (PCH), Slow Broadcast Channel (SBCH), Random Access Channel (RACH), Dedicated Channel (DCH), Downlink Shared Channel (DSCH), Forward Access Channel (FACH)
- **Code Rate**
  Coding rate and type of error protection/channel coding (Convolutional coding, turbo coding)
- **CRC Bits**
  Number of CRC bits per transport block.
- **TTI Format**
  Length of the Transmission Time Interval in ms.
- **RM**
  Rate matching attribute, assigned by higher layers and used when the number of bits to be repeated or punctured is calculated.
- **BLER**
  Estimation of the transport channel block error rate (BLER) based on evaluating the CRC on each transport block.

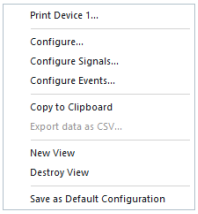
A double-click a table row opens a popup window with detailed information about the transport block format:



TrCH uplink

Table of the most important parameters of the uplink WCDMA TrCHs transmitted by the test mobile. The parameters are a subset of the TrCH Downlink parameters. Uplink transport channel types are Dedicated Channel (DCH), Random Access Channel (RACH), and Common Packet Channel (CPCH).

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS TrCH view configuration

The "UMTS TrCH View" configuration menu selects the columns in the view tables, defines the time window and displays information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "UMTS Transport Channel View" window lists the complete set of DL/UL transport channel parameters that is displayed (default), see "TrCH uplink" on page 751 and "TrCH downlink" on page 750). Clearing a parameter hides the column in the table.

Restricting viewed results

Restricting the viewed results makes it easier to read the tables if only a subset of available parameters are needed. To restrict the number of measured parameters and enhance the system performance, use the settings in the device configuration menu.

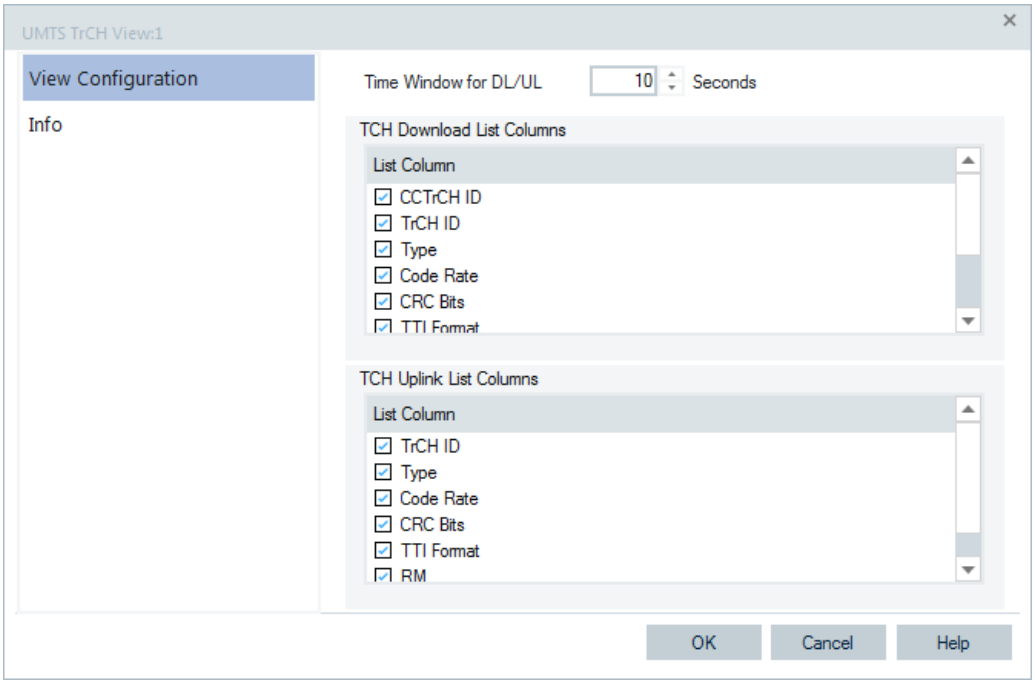


Figure 4-375: UMTS TrCH View - configuration

Time Window for DL/UL
Time after which a table row for a removed TrCH channel is cleared in the UMTS TrCH view DL and UL tables. Cleared table rows leave room for new entries.

4.4.3.4 UMTS physical channels view

The "UMTS Physical Channels View" shows an overview of the physical channel parameters in the downlink and uplink WCDMA signals. A Qualcomm mobile must be used to record the data.

The view is empty unless the test mobile is configured to record the "WCDMA Common Physical Channels Downlink", "WCDMA Dedicated Physical Channels Downlink", "WCDMA Physical Channels Uplink", or "WCDMA PRACH" parameters; see description of the Expert Mode tab of the device configuration menu.

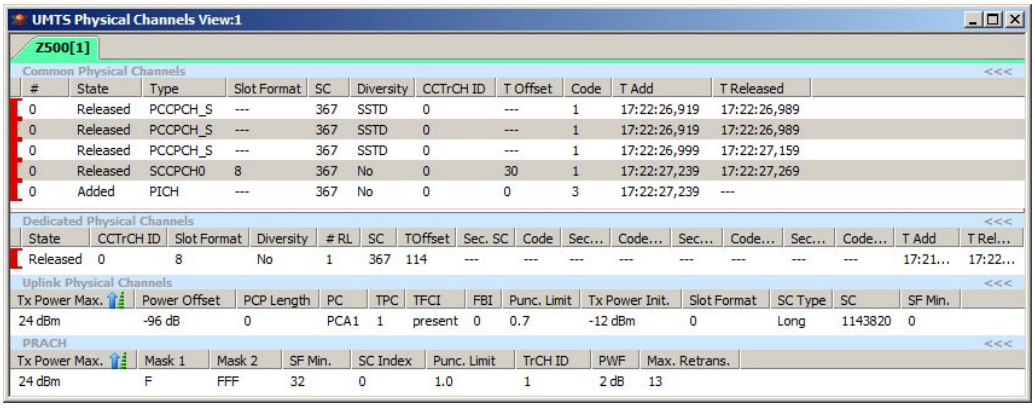


Figure 4-376: UMTS Physical Channels View

The results for each mobile are arranged in a separate tab.

View area

The entire view area is horizontally split to accommodate four different tables for the "Common Physical Channels" (downlink), "Dedicated Physical Channels" (downlink), "Uplink Physical Channels", or "PRACH".

A click one of the title bars compresses and expands the corresponding table. A compressed table leaves more space for the other tables. A compressed table is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

The contents of both tables can be selected in the configuration menu.

Common physical channels

Parameters of the downlink common physical channels.

Each table row represents a single physical channel that has been added during the measurement (and possibly removed). A new table row is created each time that a new physical channel is added. On the other hand, a table row for a removed physical channel is deleted after the "Time Window for DL/UL" set in the configuration menu.

Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **#**
  Color scheme to distinguish channels with different scrambling codes and sequence number
- **State**
  Physical channel state: Added (allocated) or "Released"
- **Type**
  Physical channel type: PICH, AICH, DPCH, PDSCH, SCCPCH0, SCCPCH1 (on FACH), AICH, PCCPCH_S(serving), PCCPCH_N(eighbor),
- **Slot Format**
  Slot format of the SCCPCH in the range 0 to 16

- **SC**
  Primary scrambling code of the signal in the format selected in the TEC for UMTS Test Mobiles tab of the Configuration of Software Modules menu; refer to chapter Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279. The primary SC is used to identify the cell.
- **Diversity**
  Downlink transmit diversity scheme for the CPICH: STTD (Space Time Transmit Diversity), TSTD (Time Switched Transmit Diversity), SSDT (Site Selection Diversity Transmit Power Control), or "No Diversity"
- **CCTrCH ID**
  Composite Coded Transport Channel ID in the range 0 to 15, identifies unambiguously a CCTrCH inside a Radio Link.
- **T Offset**
  Time offset of the channel relative to the frame boundary, in 156-chip units (corresponding to 1/10 slot or 1/150 frame).
- **Code**
  Channelization code number assigned to the channel
- **T Add**
  Time when the physical channel was added
- **T Released**
  Time when the channel was removed/released

Dedicated physical channels

Parameters of the downlink dedicated physical channels (DPCHs). In addition of the parameters for the Common Physical Channels, the table contains the following entries:

- **#RL**
  Sequence number for the radio links that the test mobile establishes to the network
- **2nd SC**
  Secondary Scrambling code number. “---” or “0” is displayed if a primary scrambling code is used.

Uplink physical channels

Parameters of the uplink physical channels (DPCCH/DPDCH). The table contains the following entries:

- **Tx Power Max**
  Maximum transmit power of the test mobile (+33 dBm, +27 dBm, +24 dBm or +21 dBm for power class 1, 2, 3, or 4 mobiles)
- **Power Offset**
  DPCCH power offset in dB. The DPCCH power offset is a reference value for the initial DPCCH power:
  PDPCCH = Power Offset – CPICH_RSCP
- **PCP Length**
  Length of the Power Control Preamble in slots
- **PC**
  Power control algorithm (PCA1 or PCA2)

- **TPC**
  Transmit Power Control step size in dB
- **TFCI**
  Presence of the optional Transport Format Combination Indicator
- **FBI**
  Number of Feedback Information bits (0 to 2)
- **Punc. Limit**
  Uplink puncturing limit limits the amount of puncturing that can be applied to minimize the number of physical channels.
- **TX Power Init.**
  Initial TX power of the test mobile
- **Slot Format**
  UL DPCCH slot format
- **SC Type**
  Scrambling code type (Long or Short)
- **SC**
  UL scrambling code number
- **SF Min.**
  Minimum allowed spreading factor

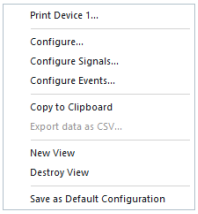
PRACH

Parameters of the uplink Physical Random Access Channel (PRACH), relevant for the physical random access procedure of the test mobile (3GPP TS 25.214). Some of the parameters are analogous to the Uplink Physical Channel parameters.

Besides the table contains the following entries:

- **Mask 1**
  PRACH preamble signature in the range 0 to 15
- **Mask 2**
  PRACH subchannel in the range 0 to 11; see 3GPP TS 25.216.
- **SC Index**
  PRACH scrambling code index
- **TrCH ID**
  Transport channel number assigned to L1 by L2. Transport channels are multiplexed to the CCTrCH in the ascending order of these IDs
- **PWF**
  PRACH preamble power step size, transmit power difference between two consecutive PRACH preambles
- **Max. Retrans.**
  Maximum number of preambles to be transmitted before a single preamble cycle is terminated.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS physical channels view configuration

The "UMTS Physical Channels View" configuration menu selects the columns in the view tables, defines the time window and displays information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "Physical Channel View" tab displays the complete parameter set to be displayed in the view tables (see description in chapter "Dedicated physical channels" on page 755). Clearing a parameter hides the column in the table.

Restricting viewed results

Restricting the viewed results makes it easier to read the tables if only a subset of available parameters are needed. To restrict the number of measured parameters and enhance the system performance, use the settings in the device configuration menu.

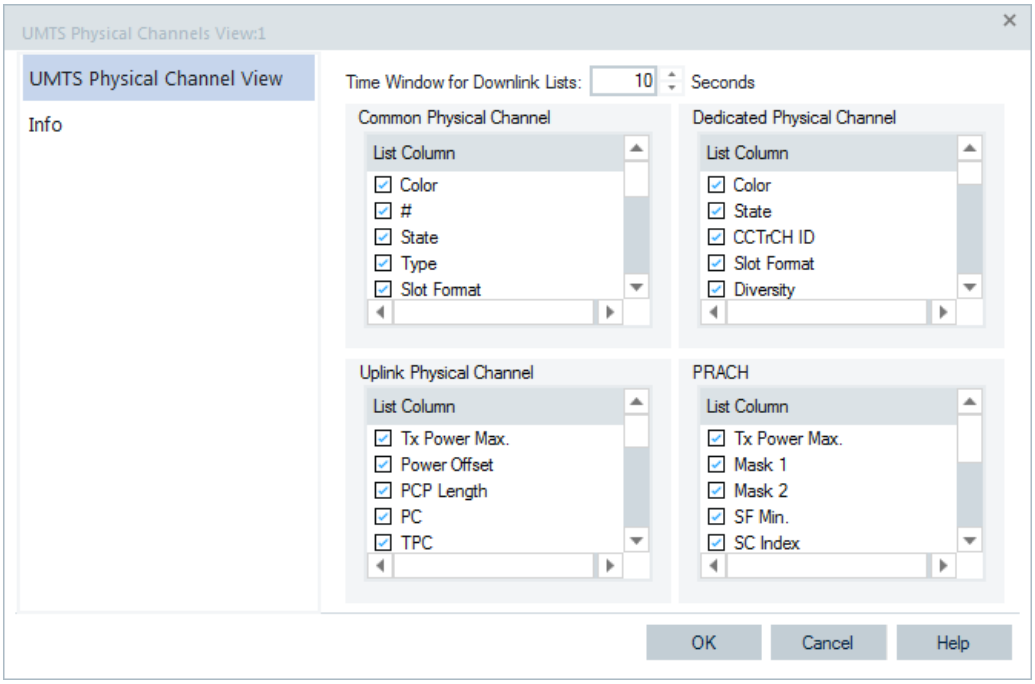


Figure 4-377: UMTS Physical Channels View

Time Window for Downlink Lists
Time after which a table row for a removed physical channel is cleared in the "Common Physical Channel" and "Dedicated Physical Channel" tables. Cleared table rows leave room for new entries.

4.4.3.5 UMTS SIB view

The "UMTS SIB View" shows a tree view of the exchanged System Information Blocks. The block type ("Master Information Block", "Scheduling Block 1 and 2", "System Information Block type 1 to 18") can be selected from a pull-down list. The SIB types and their information elements are described in standard 3GPP TS 25.331.

The view is empty unless the test mobile is configured to record the "Layer 3 – WCDMA RRC Signaling Messages"; see description of the "Expert Mode" tab of the device configuration menu in chapter 6.

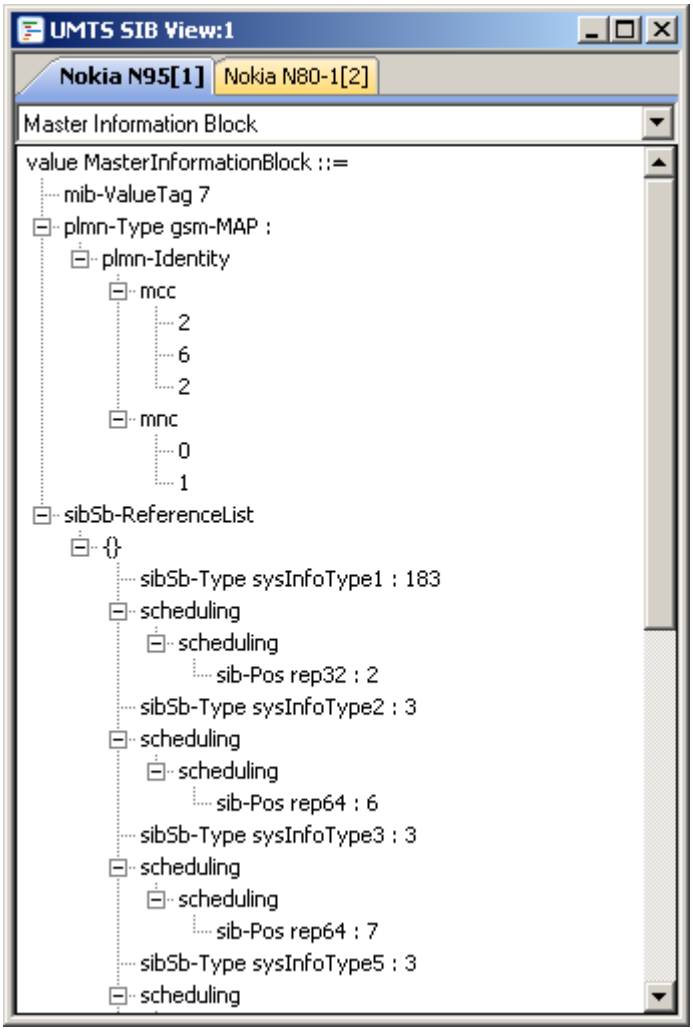
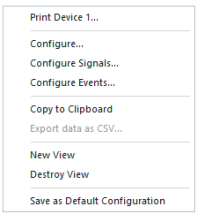


Figure 4-378: UMTS SIB View

The results for each mobile are arranged in a separate tab.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The configuration menu displays information about the view version in the mobile/technology common "Info" page.

4.4.3.6 UMTS RLC/MAC view

The "UMTS RLC/MAC View" displays important Radio Link Control/Medium Access Control parameters of UMTS mobile phones. To record the RLC/MAC parameters, a Qualcomm test mobile must be used and recording of all layer 2 RLC and MAC messages must be enabled in the device configuration menu.

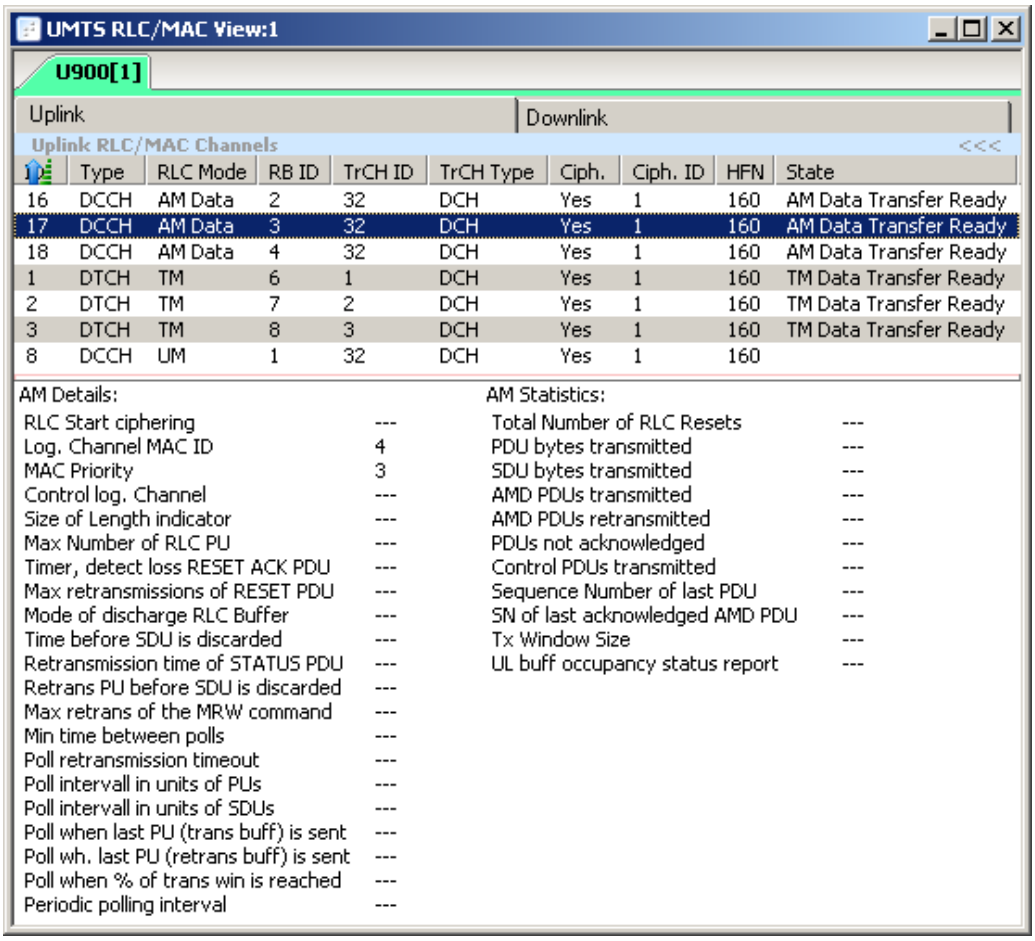


Figure 4-379: UMTS RLC/MAC View

View

The RLC/MAC parameters for each mobile and for the uplink and downlink are arranged in separate tabs. Each tab is divided into a RLC/MAC channel list in the upper part plus a detailed message section in the lower part.

A click the "Uplink (Downlink) RLC/MAC Channels" title bar shows or hides the RLC/MAC channel list. A hidden list leaves more space for the detailed message section. A hidden list is characterized by the symbol >>> (instead of <<<) in the title bar. On pausing on the title bar, the cursor displays a compress symbol.

The contents of the RLC/MAC channel list can be selected in the configuration menu.

RLC/MAC channels

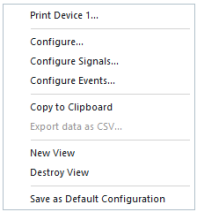
The channel lists monitor the RLC/MAC channels in uplink (mobile station towards base station) and downlink (base station towards mobile station) direction, respectively. The MAC and RLC protocols are specified in standards 3GPP TS 25.321 / TS 25.322 and related standards.

- **ID**
  Logical channel identifier.
- **Type**
  Logical channel type: "CCCH", "SHCCH", "DCCH" or "DTCH" in uplink direction, "BCCH", "PCCH", "SHCCH", "CCCH", "DCCH", "DTCH", "CTCH" in downlink direction. The logical channels depend on the "RLC" Mode.
- **RLC Mode**
  Type of service that the RLC provides to higher layers: "AM Data" ("Acknowledged Mode Data transfer"), "TM" ("Transparent Mode data transfer"), "UM" ("Unacknowledged Mode data transfer").
- **RB ID**
  Radio Bearer identity, required by RLC for ciphering.
- **TrCH ID**
  Transport Channel identity of the TrCH on which the MAC operates.
- **TrCH Type**
  Transport Channel type: "DCH", "DSCH", "FACH", "RACH", "PCH", "BCH", (in "FDD": "CPCH", "USCH").
- **Ciphering**
  Ciphering mode: Information whether ciphering is used in RLC.
- **Ciph. ID**
  Ciphering key
- **HFN RLC**
  Hyper Frame Number ("RLC AM HFN" or "RLC UM HFN")
- **State**
  RLC state, protocol state for RLC modes AM Data and TM (AM/TM Data Transfer Ready, Null State)

Detailed messages

The detailed message section is filled when a RLC/MAC channel is selected in the list. The detailed messages depend on the RLC Mode and the signal direction (uplink/ downlink). An example is shown in figure 4-379 "UMTS RLC/MAC View" above.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS RLC/MAC view configuration

The "UMTS RLC/MAC View" configuration menu selects the columns in the view tables and displays information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "RLC/MAC View" tab displays the complete parameter set to be displayed in the RLC/MAC channel lists (see chapter "RLC/MAC channels" on page 761). Clearing a parameter hides the column in the table.

Restricting viewed results

Restricting the viewed results makes it easier to read the tables if only a subset of available parameters are needed. To restrict the number of measured parameters and enhance the system performance, use the settings in the device configuration menu.

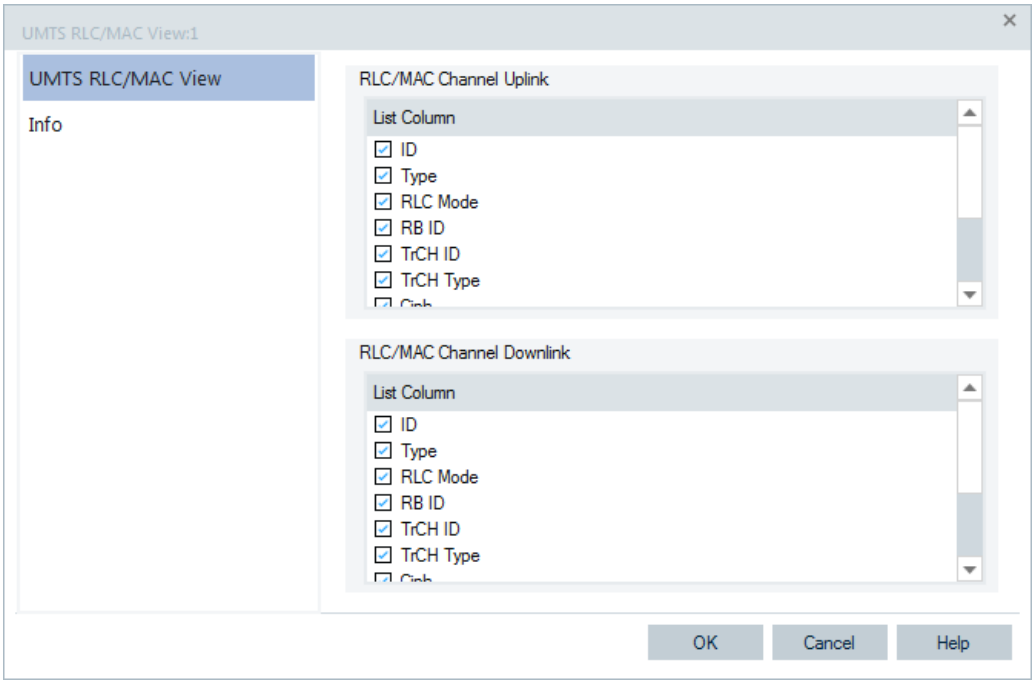
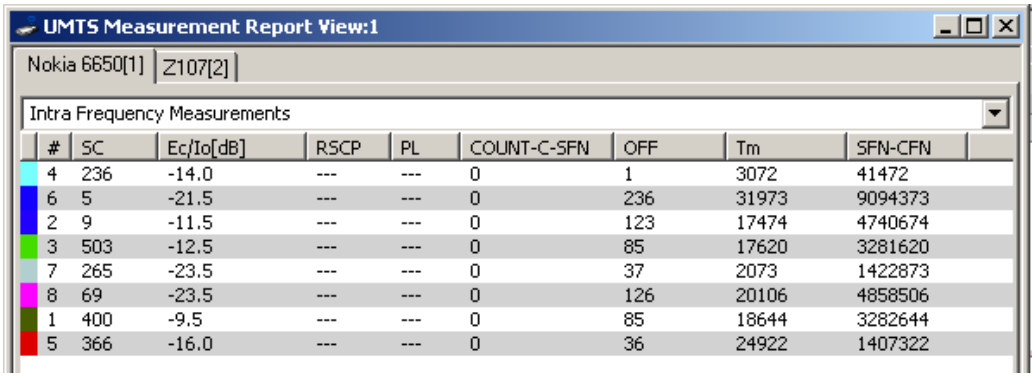


Figure 4-380: UMTS RLC/MAC View - configuration

4.4.3.7 UMTS measurement report view

The "UMTS Measurement Report View" shows the intra-frequency measurement results that the test mobile sends to the network in a "Measurement Report" RRC message. The message contents are described in standard 3GPP TS 34.108.

The view is empty unless the test mobile is configured to record the "Layer 3 – WCDMA RRC Signaling Messages"; see description of the "Expert Mode" tab of the device configuration menu.



#	SC	Ec/Io[dB]	RSCP	PL	COUNT-C-SFN	OFF	Tm	SFN-CFN
4	236	-14.0	---	---	0	1	3072	41472
6	5	-21.5	---	---	0	236	31973	9094373
2	9	-11.5	---	---	0	123	17474	4740674
3	503	-12.5	---	---	0	85	17620	3281620
7	265	-23.5	---	---	0	37	2073	1422873
8	69	-23.5	---	---	0	126	20106	4858506
1	400	-9.5	---	---	0	85	18644	3282644
5	366	-16.0	---	---	0	36	24922	1407322

Figure 4-381: UMTS Measurement Report View

The results for each mobile are arranged in a separate tab.

Intra frequency measurements

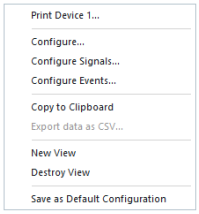
Parameters of the downlink common physical channels.

Each table row represents a physical channel of a definite channel type that has been allocated without interruption. Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **#**
  Color scheme to distinguish channels with different scrambling codes and sequence number
- **SC**
  Primary scrambling code of the signal in the format selected in the "TEC for UMTS Test Mobiles" tab of the "Configuration of Software Modules" menu; refer to chapter Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279. The primary SC is used to identify the cell.
- **E_c/I_o [dB]**
  Ratio of the received energy per PN chip for the signal to the total received power spectral density at the mobile antenna connector."E_c/I_o" is obtained in an unbiased measurement, i.e. the contribution of the noise floor to the powers is subtracted off.
- **RSCP**
  CPICH Received Signal Code Power in dBm; the received power on one code, measured on the Primary CPICH.
- **PL**
  Downlink path loss: P-CPICH power reported by the NodeB minus RSCP.
- **COUNT-C-SFN**
  Value of the "COUNT-C-SFN" high parameter transmitted in the cell synchronization information; see standard 3GPP TS 25.331, section 10.3.7.6. The value is an integer number of frames between 0 and 3840.
- **OFF**
  Value of the "OFF" parameter transmitted in the cell synchronization information; see standard 3GPP TS 25.331, section 10.3.7.6. The value is an integer number of frames between 0 and 255.
- **Tm**
  Value of the "Tm" parameter transmitted in the cell synchronization information; see standard 3GPP TS 25.331, section 10.3.7.6. The value is an integer number of frames between 0 and 38399.
- **SFN-CFN**
  "System Frame Number (SFN) – Connection Frame Number (CFN)"
  Observed time difference in chips, given by
  "SFN-CFN = OFF*38400 + Tm"

See standard 3GPP TS 25.215, section 5.1.8.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The configuration menu displays information about the view version in the mobile/technology common "Info" page.

4.4.3.8 UMTS power control view

The "UMTS Power Control View" shows the transmitter output power of a UMTS mobile and the parameter that the network uses for closed loop power control.

The results for each mobile are arranged in a separate tab. Each tab consists of two panels.

Tx power

Series of bar graphs showing the transmitter output power parameters of the UMTS mobile during its last random access procedure. The parameters are updated after each random access procedure.

- **Current Tx Power**
  Current Tx power of the mobile in dBm.
- **Init. Tx Power**
  1st PRACH preamble power
- **Message Tx Power**
  Tx power after the end of the preamble sequence, used for transmission of the RACH message part.
- **P0 Parameter**
  Optional downlink power control parameter. If P0 is not present, then downlink power control is not used.
- **Preamble Count**
  Number of PRACH preambles transmitted by the test mobile

Power control

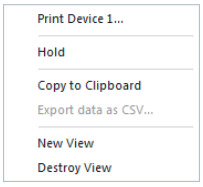
Table of closed loop power control parameters. The parameters are updated while a connection is maintained.

- **Algorithm**

Power control algorithm used to control the uplink power. Algorithm 1 means that the mobile power changes after each slot by the Step Size. Algorithm 2 means that the mobile power only changes if the same Transmit Power Control (TPC) command is received in a group of 5 consecutive slots.

- **Step Size**
  Power step that the mobile transmitter performs according to the received TPC pattern and the power control algorithm.
- **Close Loop Div.**
  Information whether the mobile uses closed loop mode transmit diversity.
- **Compressed Mode**
  Information whether the mobile operates in compressed mode. In compressed mode the mobile transmitter is switched off in periodic gaps so that the mobile can monitor UMTS and GSM neighbor cells.
- **UL/DL Power Control Commands**
  Total number of power-down (decrease) and power-up (increase) commands among the last 1500 transmit power control (TPC) commands. If power control algorithm 1 is active, the difference between both DL numbers indicates the net power change of the mobile.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "UMTS Power Control View" has no configuration menu assigned.

View further signals

To view the further available signals, use the basic "Alphanumeric View" and select the signals from the corresponding Figure 4-47.

For Qualcomm chip-set based mobiles, additional UMTS power control signals are available in the signal tree below "RACH Parameters".

- # of Transmitted Preambles
- Last Power Setting

4.4.3.9 UMTS reselection view

The "UMTS Reselection View" shows parameters that are used for cell reselection of UMTS mobile phones. The reselection process and the parameters are described in

standard 3GPP TS 25.304. To record the parameters, "Cell Reselection" must be enabled in the "Extra settings" tab of the UMTS mobile device configuration menu, see chapter 6.

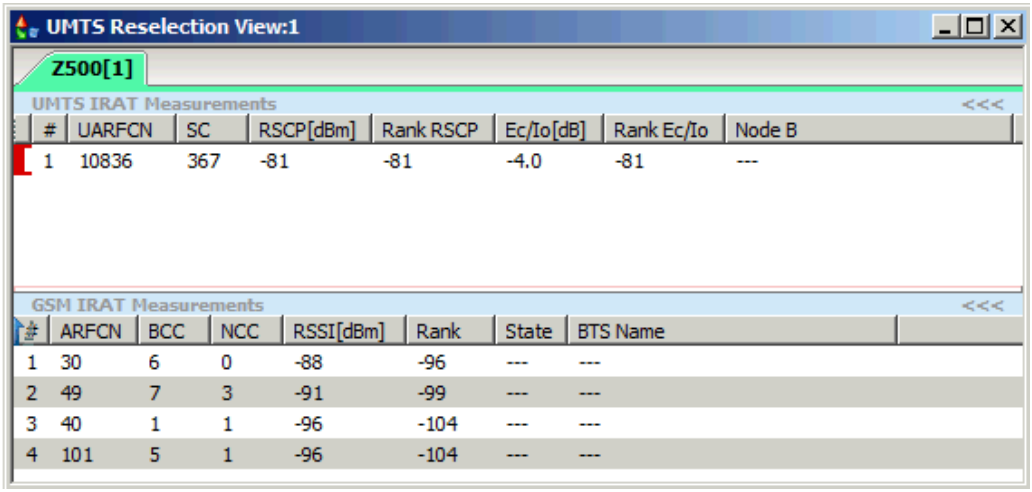


Figure 4-382: UMTS Reselection View

View

The view is divided into a UMTS cell list in the upper part and a GSM neighbor cell list in the lower part.

A click the "UMTS (GSM) Reselection Channels" title bar shows or hides the corresponding cell list. A hidden list leaves more space for the other list. A hidden list is characterized by the symbol >>> (instead of <<<) in the title bar. On pausing on the title bar, the cursor displays a compress symbol.

The contents of the cell lists can be selected in the configuration menu.

UMTS IRAT measurements

The UMTS cell list shows the IRAT measurement parameters of the UMTS cells, listed in the order they are detected and reported by the mobile.

- **Color Symbol**
  Color code for the Primary SC as defined in the "Colors" tab of the configuration menu.
  The SC color codes are also shown in the "ROMESMAP Route Track" view.
- **#**
  Sequence number for the cell, assigned in chronological order and always starting with 1.
- **UARFCN**
  UTRAN Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal. The carrier frequency is equal to "f = 0.2 MHz * UARFCN".
- **SC**
  Primary scrambling code of the signal used to identify a cell.
  The format is selected in the "TEC for UMTS Test Mobiles" tab; refer to section "Configuration Menu" in chapter 3.

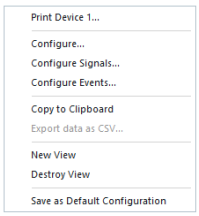
- **RSCP**
  CPICH Received Signal Code Power in dBm; the received power on one code, measured on the Primary CPICH.
- **Rank RSCP**
  Cell reselection criterion (cell ranking) Rs or Rn for serving cell or neighbor cell, computed as per 3GPP TS 25.304. Range 0 to 200 or '---' if ranking is not done.
- **Ec/Io**
  Ratio of the received energy per PN chip for the signal to the total received power spectral density at the mobile antenna connector. Ec/Io is obtained in an unbiased measurement, i.e. the contribution of the noise floor to the powers is subtracted off.
- **Rank Ec/Io**
  Cell reselection criterion (cell ranking) Rs or Rn for serving cell or neighbor cell, computed as per 3GPP TS 25.304. Range 0 to 200 or '---' if ranking is not done.
- **NodeB**
  Name of the NodeB, taken from the UMTS NodeB database (if available).

GSM IRAT measurements

The GSM cell list shows the IRAT measurement parameters of the GSM neighbor cells, listed in the order they are detected and reported by the mobile.

- **#**
  Sequence number for the cell, assigned in chronological order and always starting with 1
- **ARFCN**
  Absolute Radio Frequency Channel Number of the received GSM neighbor cell signal
- **BCC**
  BTS Color Code
- **NCC**
  Network Color Code
- **RSSI**
  Received Signal Strength Indicator of the received GSM channel power in dBm
- **Rank**
  Determines how much is the neighbor cell better, relative to the serving cell (range 0 to 200)
- **State**
  The state of a GSM cell: verified (V) or not verified (NV)
- **BTS Name**
  Name of the BTS, taken from the GSM BTS database (if available)

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS reselection view configuration

The "Reselection View" tab displays the complete parameter set to be displayed in the reselection parameter lists (see description in chapter "UMTS IRAT measurements" on page 767). Clearing a parameter hides the column in the table.

Restricting viewed results

Restricting the viewed results makes it easier to read the tables if only a subset of available parameters are needed. To restrict the number of measured parameters and enhance the system performance, use the settings in the device configuration menu.

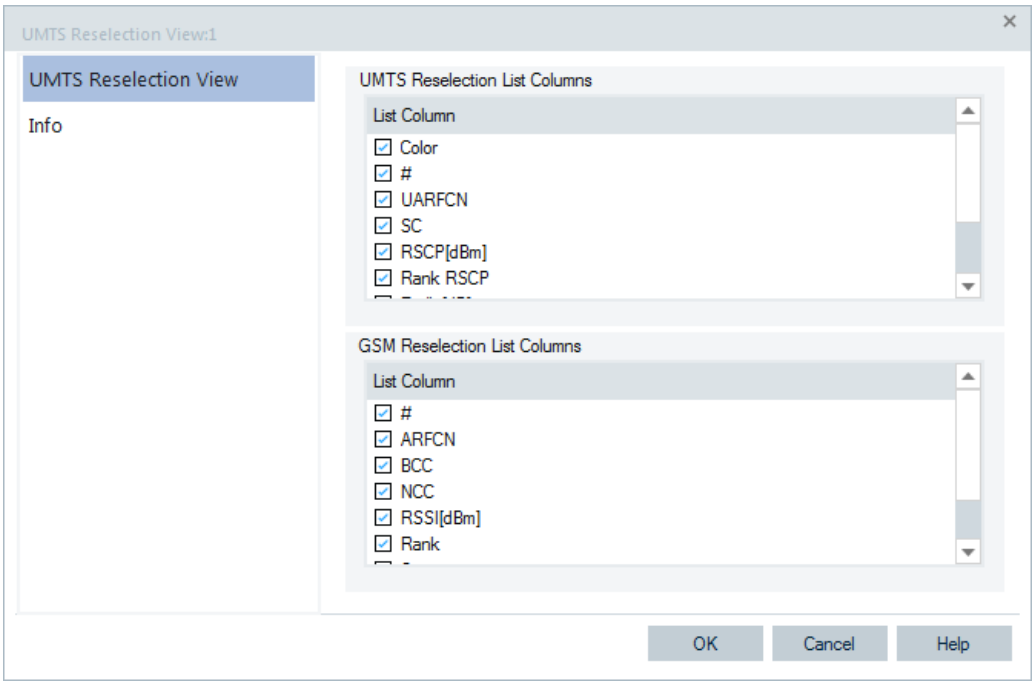


Figure 4-383: UMTS Reselection View - configuration

4.4.3.10 UMTS Layer 1 graph view

The "UMTS Layer 1 Graph View" contains a Cartesian diagram to display UMTS or GSM layer 1 parameters as a function of time. It corresponds to the Figure 4-19) with a special selection of signals in the configuration menu. The controls in the view, in the context menu, and in the configuration menu are identical with the "2D Chart View".

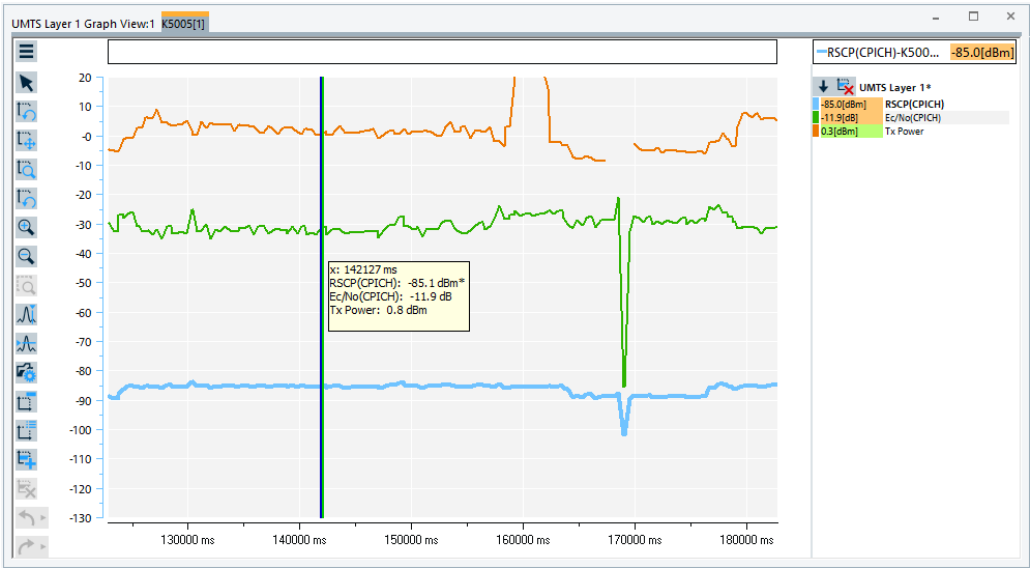


Figure 4-384: UMTS Layer 1 Graph View

4.4.4 GPRS views

The "GPRS Views" display parameters of the operating state of GPRS-supporting mobile phones, related parameters contained in the layer messages, Packet Data Protocol (PDP) parameters, Radio Link Control/Medium Access Control parameters, a statistical evaluation of the number of timeslots (TS) that are active in the connection, exchanged RLC/MAC block header information, control and physical parameters of a GPRS/EGPRS connection, and the RLC or MAC Release indicators,

The GPRS views can be selected from a submenu displayed on the right side of the View menu when the mouse pauses over "GPRS Views".

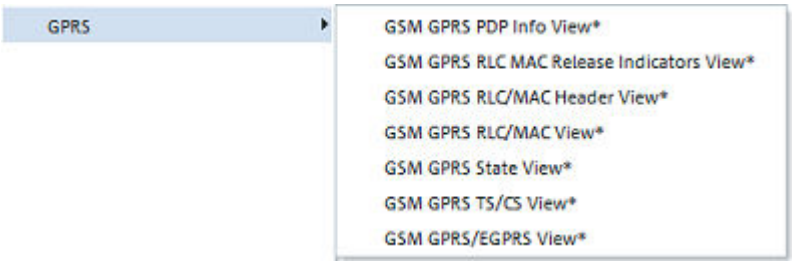


Figure 4-385: GPRS views

- Mobiles to provide GPRS parameters....771
- GSM GPRS state view....771
- GSM GPRS PDP info view....772
- GSM GPRS RLC/MAC view....774
- GSM GPRS TS/CS view....780
- GSM GPRS RLC/MAC header view....782
- GSM GPRS/EGPRS view....785
- GSM GPRS RLC MAC release indicators view....788

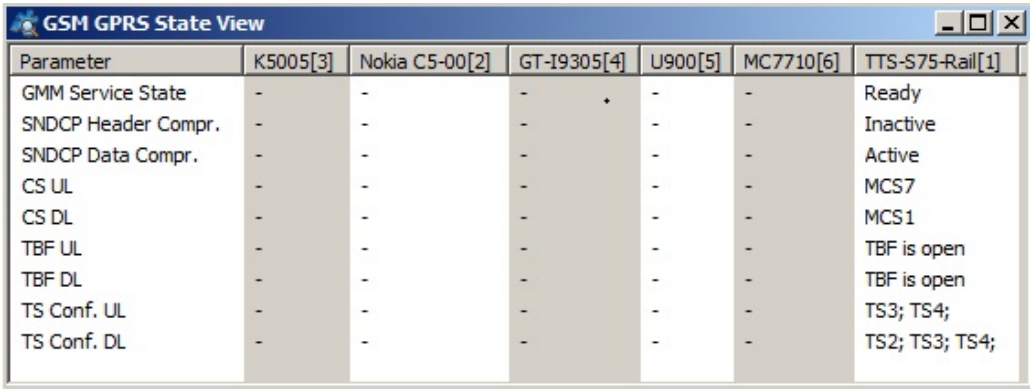
4.4.4.1 Mobiles to provide GPRS parameters

The GPRS views described in this section require corresponding mobiles. The following test mobiles are known which provide GPRS parameters:

- Siemens (S55, S55-R) mobiles
  They have to be used in Data/Trace mode and the splitter box must be connected to provide two COM ports, see Chapter 6.1.3.2, "Splitter box (mobiles supporting GPRS)", on page 1456.
- Qualcomm test mobiles and Qualcomm-compatible test mobiles such as Samsung
  They are connected via USB interface.

4.4.4.2 GSM GPRS state view

The "GSM GPRS State View" displays parameters characterizing the operating state of mobile phones supporting GPRS. The parameters are shown for all mobiles that are used in the current measurement or recorded in the replayed measurement file.



Parameter	K5005[3]	Nokia C5-00[2]	GT-I9305[4]	U900[5]	MC7710[6]	TTS-S75-Rail[1]
GMM Service State	-	-	-	-	-	Ready
SNDCP Header Compr.	-	-	-	-	-	Inactive
SNDCP Data Compr.	-	-	-	-	-	Active
CS UL	-	-	-	-	-	MCS7
CS DL	-	-	-	-	-	MCS1
TBF UL	-	-	-	-	-	TBF is open
TBF DL	-	-	-	-	-	TBF is open
TS Conf. UL	-	-	-	-	-	TS3; TS4;
TS Conf. DL	-	-	-	-	-	TS2; TS3; TS4;

Figure 4-386: GSM GPRS State View

The operating state parameters are arranged with separate columns for each mobile in the table. The width of the columns can be varied with a drag-and-drop mechanism in the header of the table. Part of the information is also displayed in chapter Chapter 4.4.4.4, "GSM GPRS RLC/MAC view", on page 774.

The "GSM GPRS State" view has no context menu for configurations assigned.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

- **GMM Service State**
  GPRS Mobility Management service state: Ready, Idle or Stand-by.
- **SNDCP Header Compr.**
  Compression information from the Subnetwork Dependent Convergence Protocol: Header compression "Used" or "Not used".
- **SNDCP Data Compr.**
  Compression information from the Subnetwork Dependent Convergence Protocol. Data compression Used or Not used.
- **CS UL / CS DL**
  Channel coding scheme (CS1 to CS4) used in uplink (UL) and downlink (DL) direction.
- **TBF UL / TBF DL**
  Status of the Temporary Block Flow (TBF) in uplink (UL) and downlink (DL) direction: open (during data transfer) or closed.
- **TS Conf. UL / DL**
  Timeslot configuration in uplink (UL) and downlink (DL) direction.

4.4.4.3 GSM GPRS PDP info view

The "GSM GPRS PDP Info View" displays important Packet Data Protocol (PDP) parameters of mobile phones supporting GPRS. The parameters are shown for all mobiles that are used in the current measurement or recorded in the replayed measurement file.

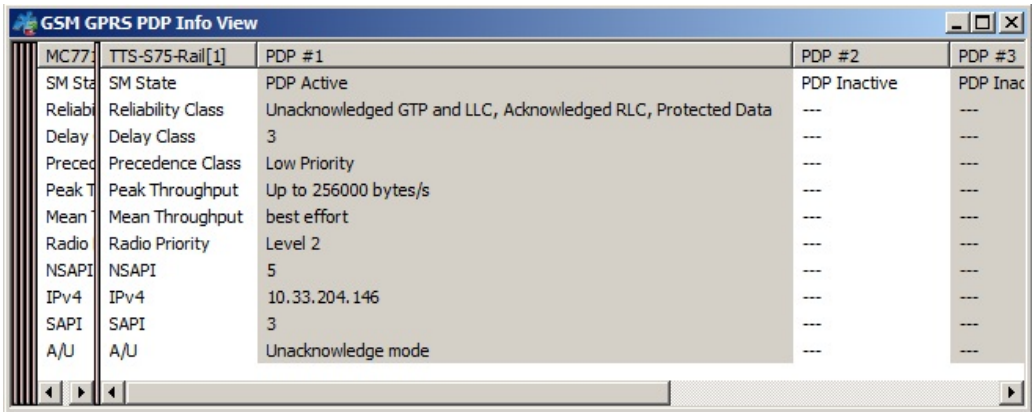


Figure 4-387: GSM GPRS PDP Info View

The PDP parameters are arranged in the separate tables for each mobile. The number of columns per mobile depends on the mobile itself. The width of the columns can be varied with a drag-and-drop mechanism in the header of the table.

The "GSM GPRS PDP Info" view has no context menu for configurations assigned.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

- **SM State**
  One of the four values PDP Active, PDP Active Pending, PDP Inactive, PDP Inactive Pending. If SM State = PDP Inactive or PDP Active Pending, then some of the other parameters of the view are invalid.

The following five parameters indicate the Quality of Service (QoS) of the PDP:

- **Reliability Class**
  The reliability class indicates the probability of loss, duplication, mis-sequencing or corruption of Service Data Units (SDU). This translates into the transmission characteristics that are required by an application. :

  The reliability classes are as specified in GSM 04.08

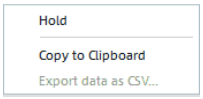
  – Acknowledged GTP, LLC, and RLC, Protected data
  – Unacknowledged GTP, Acknowledged LLC and RLC, Protected data
  – Unacknowledged GTP and LLC, Acknowledged RLC, Protected data
  – Unacknowledged GTP, LLC and RLC, Protected data
  – Unacknowledged GTP, LLC and RLC, Unprotected data
- **Delay Class**
  Defines the maximum delay to be incurred by the transfer of data through the GPRS network. Four delay classes 1 (smallest delay) to 4 (largest delay; maximum delay not specified) are defined.
- **Precedence Class**

  Indicates the relative priority of maintaining the service. The following three precedence classes are defined:

  – **High Priority**
    Service commitments will be maintained ahead of all other priority levels.
  – **Normal Priority**
    Service commitments will be maintained ahead of low priority users.
  – **Low Priority**
    Service commitments will be maintained after the high and normal priority commitment has been fulfilled.
- **Peak Throughput**
  Maximum user data throughput (bit rate) requested by the user.
- **Mean Throughput**
  Mean user data throughput (bit rate) requested by the user, including periods in which no data is transmitted.
- **Radio Priority**
  Radio priority of the requested TBF; one of the levels between Level 1 (highest priority) and Level 4 (lowest priority, corresponding to the highest throughput).
- **NSAPI**
  Network layer Service Access Point Identifier; integer number that, together with the Temporary Logical Link Identity (TLLI), is used for network layer routing.

- **IPv4**
  Internet Protocol address according to the IETF convention.
- **SAPI**
  Network Service Access Point Identifier. An integer value in the range [0; 15], identifying a PDP context belonging to a specific MM Context ID.
- **A/U**
  Acknowledge mode or Unacknowledge mode.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.4.4 GSM GPRS RLC/MAC view

The "GSM GPRS RLC/MAC View" displays important Radio Link Control/Medium Access Control parameters of mobile phones supporting GPRS and EDGE. The parameters are shown for all mobiles that are used in the current measurement or recorded in the replayed measurement file.

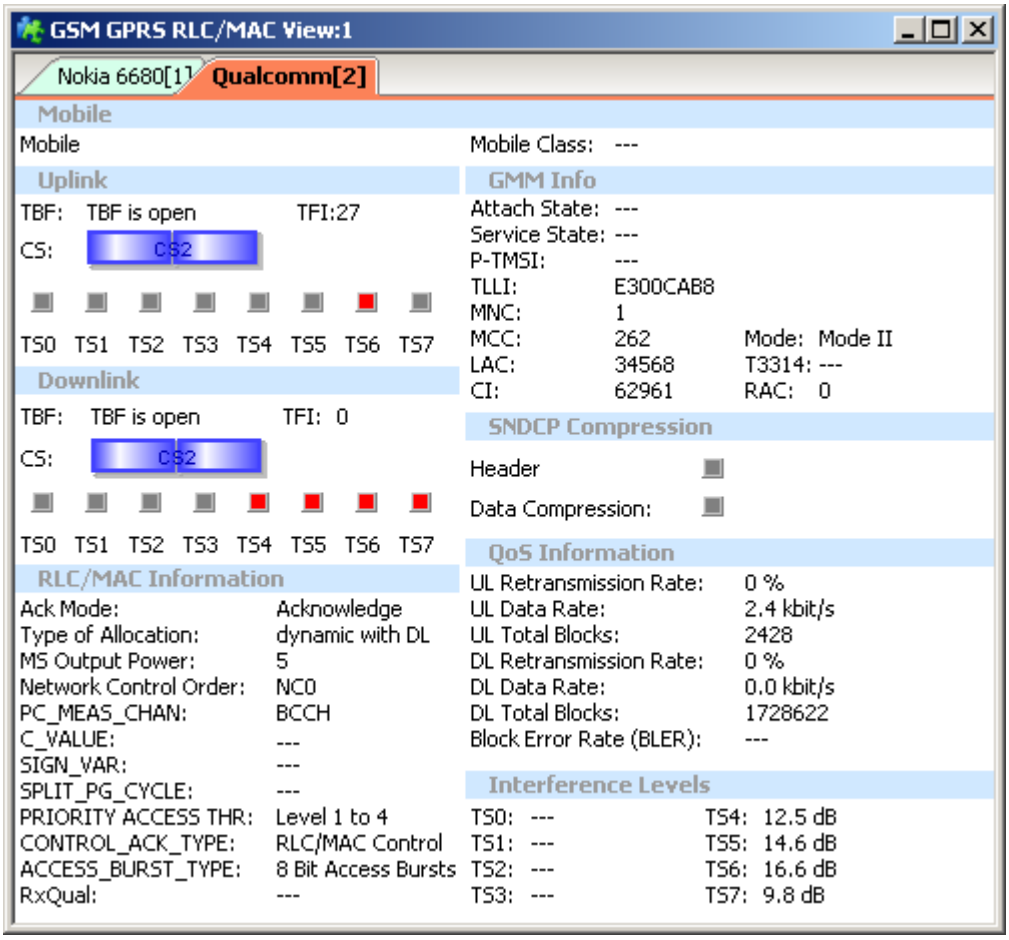


Figure 4-388: GSM GPRS RLC/MAC View – GPRS view

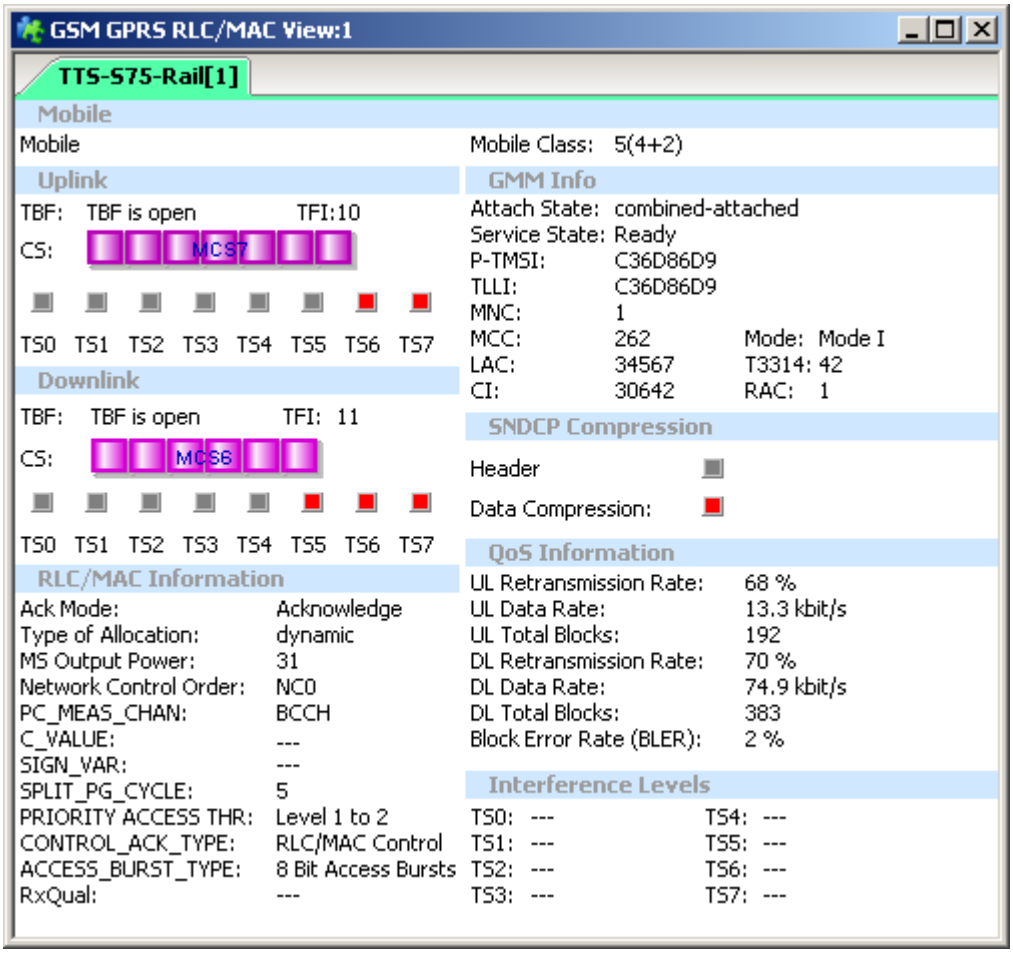


Figure 4-389: GSM GPRS RLC/MAC View – EDGE view

For each mobile, the RLC/MAC parameters are arranged in six panels. The mobile type and its power class are indicated above the Uplink panel.

The "GSM GPRS RLC/MAC" view has no context menu for configurations assigned.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

Uplink / downlink

The "Uplink and Downlink" panels monitor the Temporary Block Flow (TBF) in uplink (mobile station towards base station) and downlink (base station towards mobile station) direction, respectively. The TBF is a temporary physical connection between the mobile and the base station that is maintained only for the duration of the data transfer.

- **TBF**
  Status of the TBF: open (during data transfer) or closed.
- **TFI**

Temporary Flow Identity. Together with the direction (uplink or downlink), the TFI uniquely identifies a RLC data block.

- CS
  GPRS channel coding scheme (CS1 to CS4) or EDGE modulation and coding scheme (MCS1 to MCS9). A diagram makes it easy to notice changes of the coding scheme.
  - The EDGE diagram consists of 9 bars, corresponding to the modulation and coding schemes MCS1 to MCS9.

  - The GPRS diagram consists of 4 bars, corresponding to the coding schemes CS1 to CS4.

- **TS**
  Timeslot used for the TBF. The LED symbols light while the TBF occupies one or several of the timeslots 0 to 7.

RLC/MAC information

The RLC/MAC Information panel displays the following information:

- **Ack Mode**
  RLC mode: Acknowledge mode or Unacknowledge mode.
- **Type of Allocation**
  MAC mode; medium access method to be used during the TBF: Dynamic allocation, Fixed allocation or No allocation
- **MS Output Power**
  Output power of the mobile station in dBm.
- **Netw. Control Order**
  Current value of the NETWORK_CONTROL_ORDER parameter defined in GSM 05.08. This parameter controls the measurement reports provided by the mobile and its cell re-selection. Possible values are:
  - **NC0**
    Normal MS control: MS performs autonomous cell re-selection
  - **NC1**
    Normal MS control with measurement reports
  - **NC2**
    Network control. MS sends measurement reports but does not perform autonomous cell re-selection
- **RESET**
  The MS returns to the broadcast parameters. Only sent on PCCCH or PACCH
- **PC_MEAS_CHAN**
  Channel where the measurements for power control are made: BCCH or PDCH.
- **C_VALUE**
  Value of the C parameter calculated by the mobile station; relevant for the channel quality report.
- **SIGN_VAR**

Value of the signal variance parameter calculated by the mobile station; relevant for the channel quality report.

- **SPLIT_PG_CYCLE**
  Optional parameter specified in GSM 05.08 controlling the occurrence of paging blocks on CCCH or PCCCH belonging to the mobile station in DRX (Discontinuous Reception) mode.
- **PRIORITY_ACCESS_THR**
  Control parameter indicating whether packet access is allowed and for which priority level it is allowed.
- **CONTROL_ACK_TYPE**
  Default format of the PACKET CONTROL ACKNOWLEDGMENT message: either 4 Access Bursts or RLC/MAC Control Block.
- **ACCESS_BURST_TYPE**
  Access burst format: 8 Bit Access Bursts or 11 Bit Access Bursts.
- **RxQual**
  Received signal quality reported by the mobile.

GMM info

The GMM Info panel displays the following GPRS Mobility Management information:

- **Attach State**
  GPRS operating mode of the mobile: – (not available), Attached, IMSI Attached, Combined Attached, Not Attached
- **Service State**
  GPRS operating mode of the mobile: – (idle/not available), Stand By or Ready.
- **P-TMSI**
  Packet TMSI of the mobile, transferred to the network during a GPRS attaches.
- **TLLI**
  Temporary Logical Link Identity, code number to identify the mobile at the RLC/MAC layer.
- **MNC**
  Mobile Network Code
- **MCC**
  Mobile Country Code
- **LAC**
  Location Area Code
- **CI**
  Cell Identity
- **Mode**
  Network mode of operation 1, 2, or 3.
- **T3314**
  Ready timer used in the MS and in the network for each assigned P-TMSI to control the cell updating and paging process.
- **RAC**
  Routing Area Code; fixed length code (of 1 octets) identifying a routing area within a location

SNDCP compression

The "SNDCP Compression" panel indicates whether or not the mobile uses compression of the Subnetwork Dependent Convergence Protocol (SNDCP) information (GSM 04.65). Protocol control information compression is an optional SNDCP feature that helps to improve channel efficiency.

The TCP/IP Header and Data Compression are indicated in separate boxes. A red box indicates that compression is enabled.

QoS information

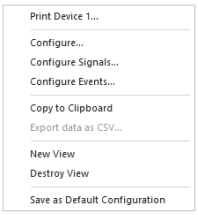
The QoS Information panel indicates parameters describing the user data throughput and reliability of the GPRS connection. The parameters characterize the quality of service (QoS); see GSM 02.60.

- **UL Retransmission Rate**
  Number of unacknowledged uplink (UL) frames that the mobile had to retransmit for error recovery
- **UL Data Rate**
  UL data rate in bytes/s
- **UL Total Blocks**
  Total number of UL data blocks transferred
- **DL Retransmission**
  Rate Number of unacknowledged downlink (DL) frames that the base station had to retransmit for error recovery
- **DL Data Rate**
  DL data rate in bytes/s
- **DL Total Blocks**
  Total number of DL data blocks transferred
- **Block Error Rate**
  Ratio of blocks received with error at the mobile to total number of received blocks (GSM 11.10).

Interference levels

The Qualcomm based mobiles report the SNR values per ARFCN / timeslot pair (see chapter Chapter 4.4.4.7, "GSM GPRS/EGPRS view", on page 785). The value, which is displayed in the field is the average of the reported values for the corresponding timeslot over all ARFCNs.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.4.5 GSM GPRS TS/CS view

The "GSM GPRS TS/CS View" provides a statistical evaluation of the number of timeslots ("TS") that are active in the connection and of the Coding Scheme ("CS") that is used for the transmission of radio blocks. EDGE MCS statistics are also supported. All parameters are shown for the uplink and downlink.

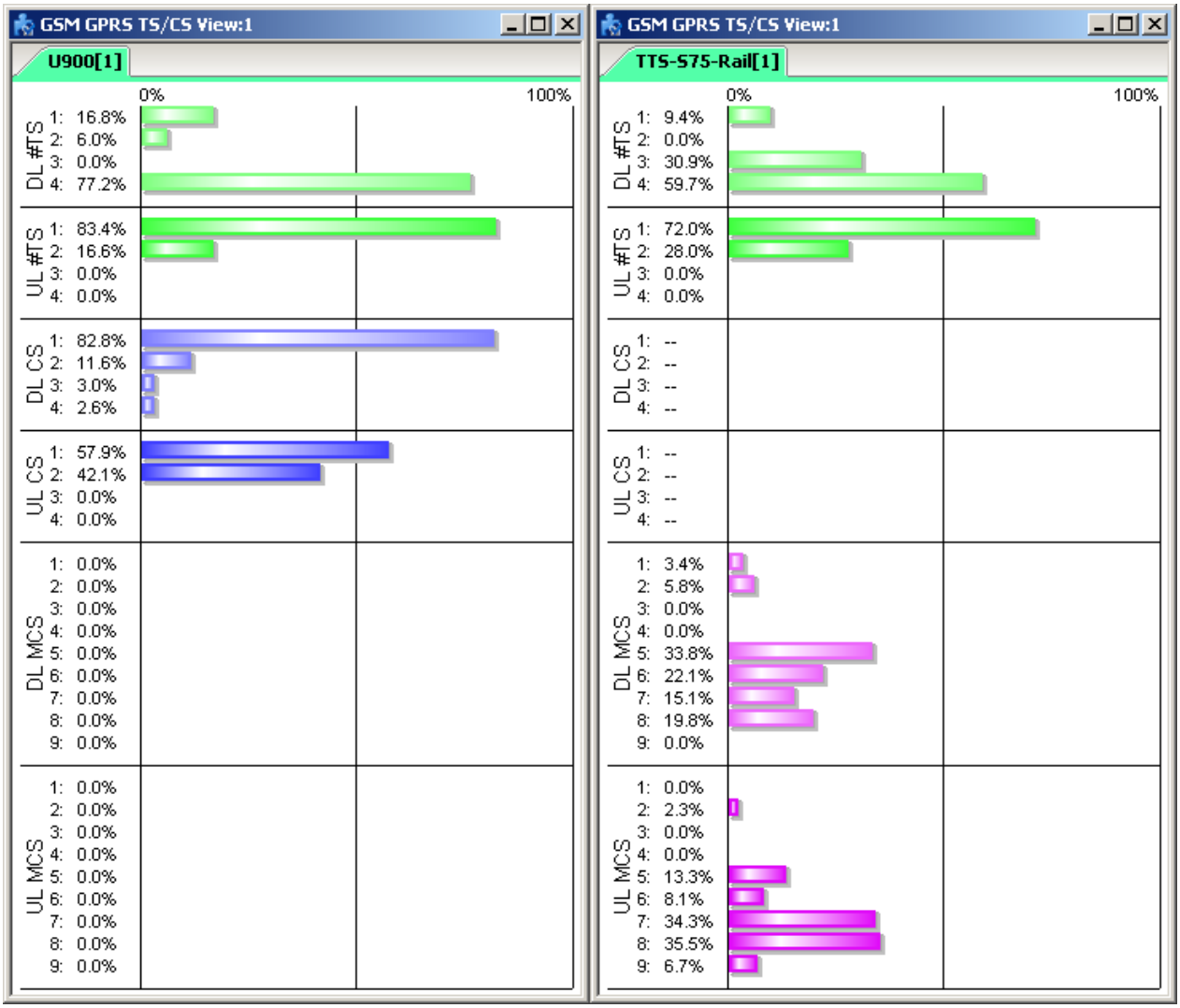


Figure 4-390: GSM GPRS TS/CS Views (for GPRS and EDGE)

UL TS / DL TS

Distribution in time of the number of timeslots used in the connection: Ratio of the time during which each number of timeslots is active to the total connection time. The ratios

are expressed as percentages and visualized with colored bars. The length of the bars is proportional to the percentages; the sum of all percentages adds up to 100 %.

The maximum number of timeslots displayed can be selected in the configuration menu.

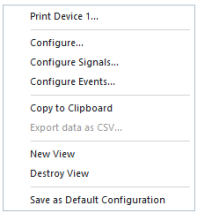
UL CS / DL CS

Distribution in time of the coding scheme used in the connection: Ratio of the time during which each coding scheme is used to the total connection time. The ratios are expressed as percentages and visualized with colored bars. The length of the bars is proportional to the percentages; the sum of all percentages adds up to 100 %.

The maximum CS number displayed can be selected in the configuration menu.

The display of the fields UL MCS / DL MCS can be selected in the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM GPRS TS/CS view configuration

The "GPRS QoS View" configuration dialog lets the user define the contents of the view.

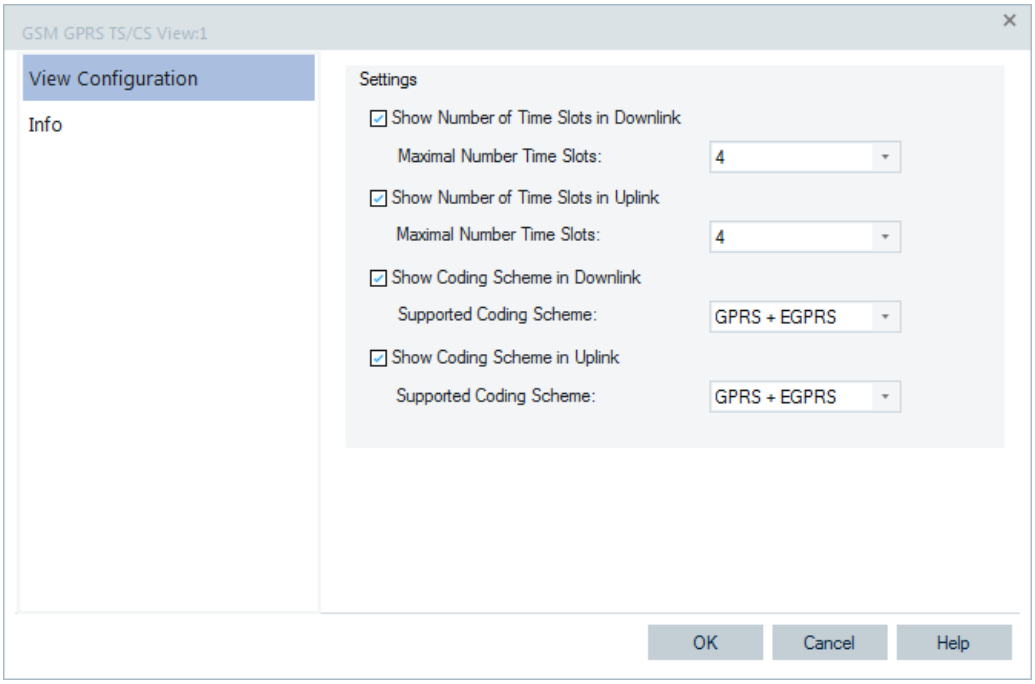


Figure 4-391: GSM GPRS TS/CS View - configuration

Settings

Clearing the "Show Number of Time Slots…" or "Show Coding Scheme…" check box entirely hides the corresponding diagram in the view.

In addition, it is possible to simplify the diagrams by restricting the maximum number of time slots to less than 8 or the number of coding scheme to less than 4. This makes it easier to read the diagram, especially if the maximum number of TS and maximum CS is known.

The "Supported Coding Scheme" drop-down boxes offer the options for GPRS or GPRS + EGPRS coding scheme statistic graphs. If GPRS + EGPRS is selected, the "DL MCS" and "UL MCS" fields are shown in the view. Otherwise (GPRS is selected) they are hidden.

4.4.4.6 GSM GPRS RLC/MAC header view

The "GSM GPRS RLC/MAC Header View" shows the exchanged RLC/MAC block header information. The RLC/MAC header contents depend on the transmission direction (UL/DL); they are described in standard 3GPP TS 44.060.

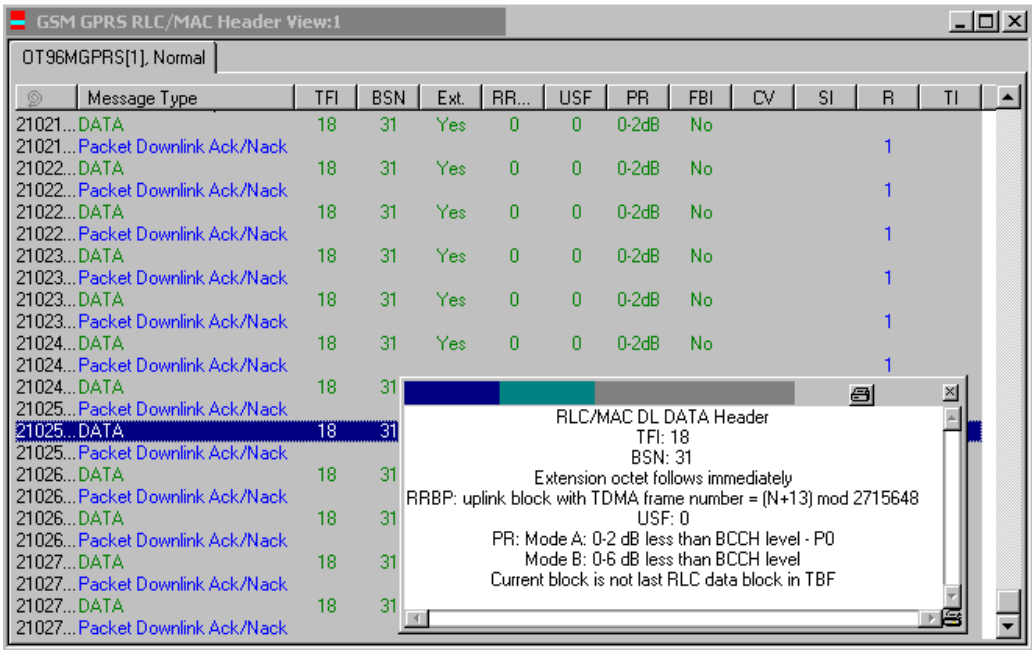


Figure 4-392: GSM GPRS RLC/MAC Header View

For each mobile, the RLC/MAC header information is arranged in a table. The width of the columns can be varied with a drag-and-drop mechanism in the header of the table.

The "GSM GPRS RLC/MAC Header" view has no context menu for configurations assigned.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

List of entries

Each RLC/MAC header forms a list with the entries described below. Some of the values are only available for a particular direction (uplink or downlink).

- **@**
  Timestamp assigned to the header
- **Message Type**
  Data block or message type transmitted in the RLC/MAC block
- **TFI 5-bit**
  Temporary Flow Identity identifies the Temporary Block Flow (TBF) to which the RLC data block belongs.
- **BSN**
  Block Sequence Number, carries the sequence absolute Block Sequence Number (BSN) modulo Sequence Number Space (SNS) (128 in GPRS and 2 048 in EGPRS) of each RLC data block within the TBF.
- **Ext.**

Extension bit indicates the presence of an optional octet in the RLC data block header (0: Extension octet follows immediately; 1: No extension octet follows).

- **RRBP**
  Relative Reserved Block Period specifies a single uplink block in which the mobile station shall transmit either a PACKET CONTROL ACKNOWLEDGEMENT message or a PACCH block to the network.
- **USF**
  Uplink State Flag, sent in all downlink RLC/MAC blocks, indicates the owner or use of the next uplink radio block on the same timeslot.
- **PR**
  Power Reduction field, indicates the power level reduction of the current RLC block.
- **FBI**
  Final Block Indicator indicates whether the downlink RLC data block is the last RLC data block of the downlink TBF.
- **CV**
  4-bit Countdown Value, sent by the mobile station to allow the network to calculate the number of RLC data blocks remaining for the current uplink TBF.
- **SI**
  Stall Indicator bit, indicates whether the mobile's RLC transmit window can advance (i.e. is not stalled, value 0) or can not advance (i.e. is stalled, value 1).
- **R**
  Retry bit, indicates whether the mobile station transmitted the CHANNEL REQUEST message, PACKET CHANNEL REQUEST message, or EGPRS PACKET CHANNEL REQUEST message one time or more than one time during its most recent channel access.
- **TI**
  TLLI Indicator bit indicates the presence of an optional TLLI field within the RLC data block.

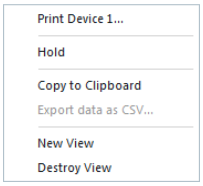
Detailed information

An upper case D appears to the right of the cursor arrow when it is placed in the active (gray) zone of the view. This symbol indicates that there is detailed information to be retrieved for the current RLC/MAC header. A double-click opens the detailed information window; see Chapter 4.4.4.4, "GSM GPRS RLC/MAC view", on page 774.

Detailed information window

The detailed information window is totally independent of the GSM, GPRS RLC/MAC Header View, so you can move, resize and scroll it as you like. Click the printer symbol in the lower right corner to generate a hard copy of the detailed in-formation. Alternatively, you can write the detailed information into the table (e.g. if you wish to create a hard copy), see the "Messages" tabs of the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.4.7 GSM GPRS/EGPRS view

The "GSM GPRS/EGPRS View" displays the control and physical parameters of a GPRS and EGPRS connection.

If this view is used with an EDGE-enabled test mobile, it also displays EDGE-parameters.

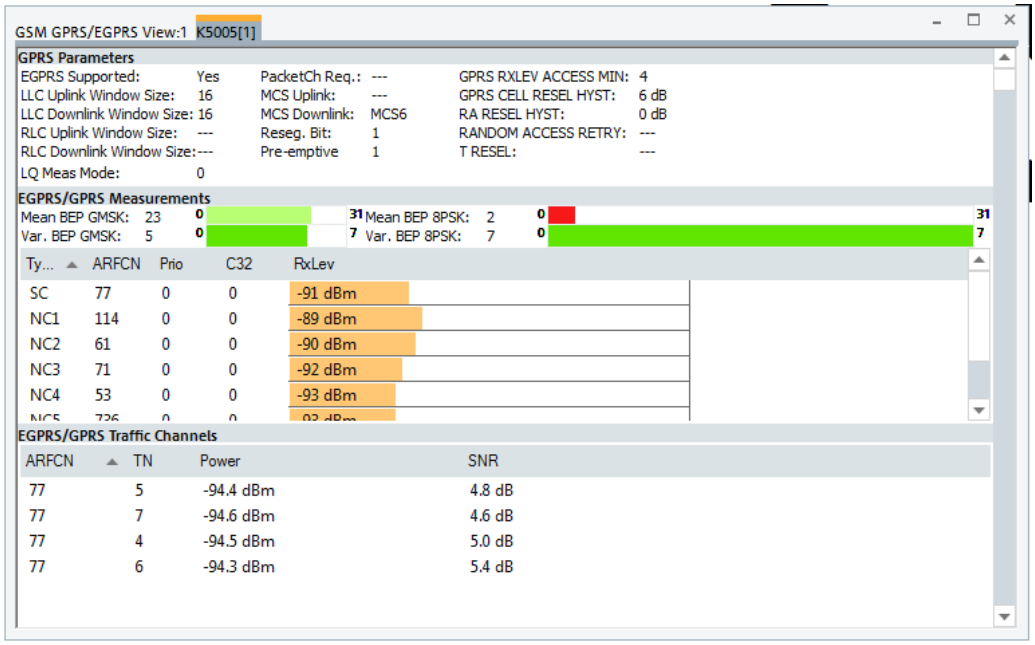


Figure 4-393: GSM GPRS/EGPRS View

For each mobile, the GPRS and EGPRS parameters are arranged in two panels and two tables below.

EGPRS parameters

The upper left panel shows the following EGPRS-related control parameters:

- **EGPRS Supp.**
  EGPRS capability of the mobile phone ("Yes" or "No"). Most of the following parameters are only available if EGPRS is supported.
- **LLC Uplink/Downlink Window Size**
  LLC window size, i.e. the maximum number of sequentially-numbered uplink/downlink I frames that may be outstanding at any time. The window size is in the range 1 through 255 (see standard 3GPP TS 04.64).
- **RLC Uplink/Downlink Window Size**
  RLC window size (no. of RLC data blocks) that the network selects for the uplink/downlink, depending on the number of timeslots allocated (see standard 3GPP TS 44.060). For GPRS, a fixed window size of 64 is used.
- **LQ Meas. Mode**
  Link Quality Measurement Mode (0 to 3), see standard GPP TS 04.60, sub clause 11.2.7.2.
- **PacketCh Req.**
  EGPRS packet channel request supported in serving cell (Yes/No).
- **MCS Uplink/Downlink**
  GPRS channel coding scheme (CS1 to CS4) or EGPRS modulation and coding scheme (MCS1 to MCS9) used in the uplink and downlink.
- **Reseg. Bit**
  Value of the resegment bit sent in the PACKET UPLINK ACH/NACK message, indicating whether or not the transmitted RLC blocks shall be resegmented (see standard 3GPP TS 51.010).
- **Pre-emptive Bit**
  Value of the pre-emptive transmission bit sent in the PACKET UPLINK ACH/NACK message, indicating whether or not pre-emptive transmission shall be used.

The upper right panel shows a list of GPRS-related control parameters relevant for cell reselection and described in standard 3GPP TS 04.60 and related standards.

- **GPRS RXLEV ACCESS MIN**
  Minimum received signal level at the MS required for access to the system (value range: 0 to 63).
- **GPRS CELL RESEL HYST**
  Additional hysteresis applied in Ready state for cells in the same Routing Area (value range: 0 dB, 2 dB,..., 14 dB).
- **RA RESEL HYST**
  Additional hysteresis applied for cells in different Routing Areas (value range: 0 dB, 2 dB,..., 14 dB).
- **RANDOM ACCESS RETRY**
  1-bit value, if set to 1, it indicates that the mobile station is allowed to try to access another cell if available.
- **T RESEL**

Delay time before a mobile is allowed to reselect a cell after an abnormal release of the connection to this cell. T RESEL can be set to 8 discrete values between 5 seconds and 300 seconds.

GPRS/EGPRS measurements

Below the parameter panels of the "GSM GPRS/EGPRS View" presents an evaluation of physical parameters of the GPRS/EGPRS connection that the mobile reports to the network (see standard 3GPP TS 04.60 and related standards).

- **Mean BEP**
  Mean value of the Bit Error Probability of the channel averaged over all timeslots in the TBF. Two different values are calculated – one for GSMK (CS1-CS4, MCS1-MCS4) and one for 8PSK (MDC5-MCS9). Range is 0 to 31; see 3GPP TS 04.60 and 3GPP TS 05.08.
- **Var BEP**
  Variation coefficient for the Bit Error Probability averaged over all time slots of the TBF. Two different values are calculated – one for GSMK (CS1-CS4, MCS1-MCS4) and one for 8PSK (MDC5-MCS9). Range is 0 to 7; see 3GPP TS 05.08.
- **Type**
  The table shows results from the serving cell ("SC") and up to six neighbor cells (NC1, …, NC6), if available.
- **ARFCN**
  Absolute Radio Frequency Channel Number used in the serving cell and the neighbor cells.
- **Prio**
  GPRS priority class, 3-bit value to indicate the HCS priority for the call.
- **C32**
  Flag indicating an exception rule for GPRS_RESELECT_OFFSET according to 3GPP TS 05.08.
- **RxLev**
  RxLev of the serving cell and the neighbor cells

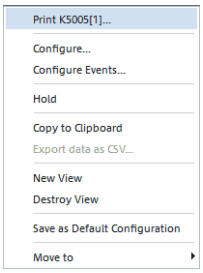
GPRS/EGPRS traffic channels

The last part of the "GSM GPRS/EGPRS View" presents traffic channel related information (for Qualcomm only):

- **ARFCN**
  Absolute Radio Frequency Channel Number used in the serving cell and the neighbor cells.
- **TN**
  Time Slot Number
- **Power**
  Received Power (in dBm)
- **SNR**
  Signal-to-Noise ratio (in dB)

The mobile reports an "SNR" value and a "Power" value per ARFCN/timeslot pair.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.4.8 GSM GPRS RLC MAC release indicators view

The "GSM GPRS RLC MAC Release Indicators View" shows control and physical parameters of the connection release information, such as the cause of the release, statistical parameters and the release indicator description, if supplied.

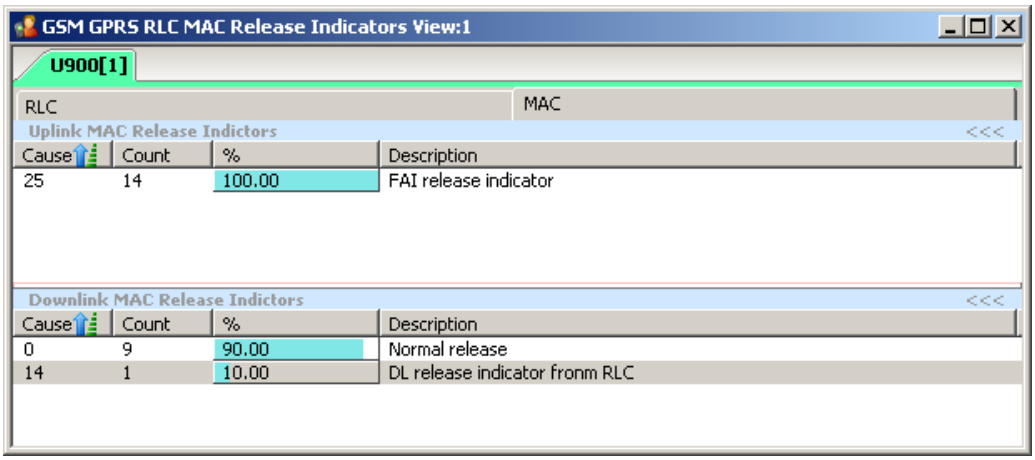


Figure 4-394: GSM GPRS RLC MAC Release Indicators View

For each mobile, the RLC or MAC Release indicators are arranged in two lists. The width of the columns can be varied with a drag-and-drop mechanism in the header of the table.

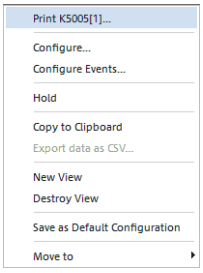
Uplink / downlink table

Each RLC or MAC release indicator forms a table row with the entries described below.

- **Cause**
  The cause of the RLC/MAC release
- **Count**
  The number of measured release indicators of the current session
- **%**
  Percentage of the related cause

- **Description**
  Release indicator description

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM GPRS RLC MAC release indicators view configuration

The configuration page let you select the contents of the view defines the contents of the view.

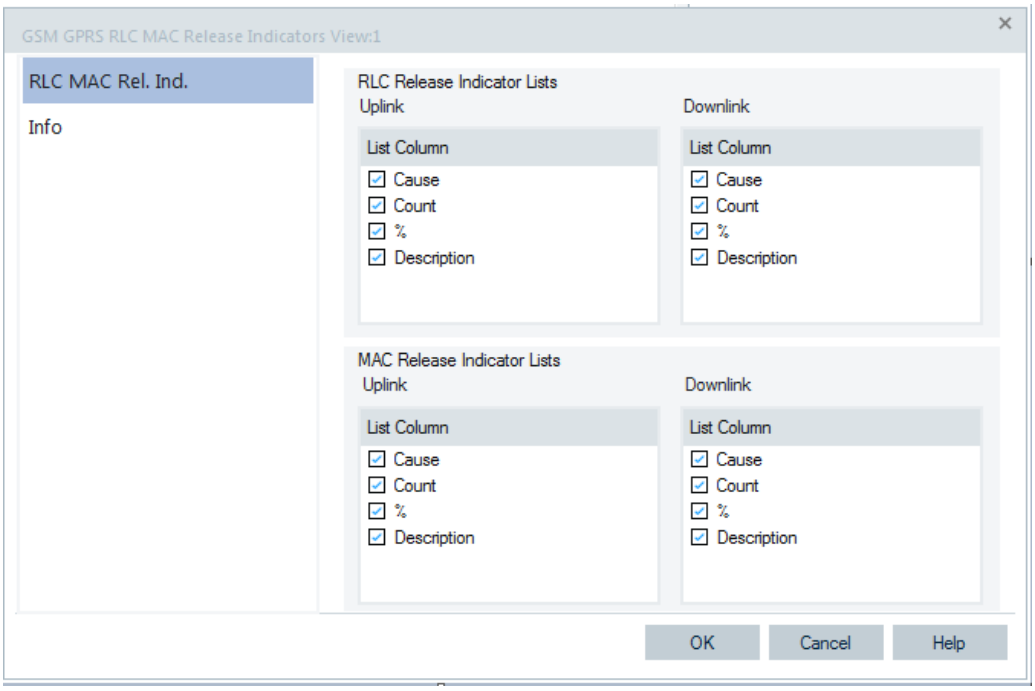


Figure 4-395: GSM GPRS RLC MAC Release Indicators View - configuration

RLC/MAC Release Indicator Lists
In the "RLC Release Indicators Lists"/"MAC Release Indicators Lists" you can select via the available check boxes the elements to be displayed in the uplink and downlink RLC/MAC release indicator view tables.

4.4.5 GSM views

The "GSM Views" display GSM-specific information included in the measurement data. GSM data can be acquired using the supported GSM mobile devices. The devices are attached to R&S ROMES4 by selecting the "Generic Mobiles GSM / WCDMA" option in the "Available Devices" > "Mobile Devices" branch of the "Hardware" > "Hardware Configuration" window.

Some of the views require a particular measurement mode or a GSM mobile supporting special features (for example, GPRS).

The GSM views can be selected from a submenu displayed on the right side of the "View" menu when the mouse hovers over "GSM".

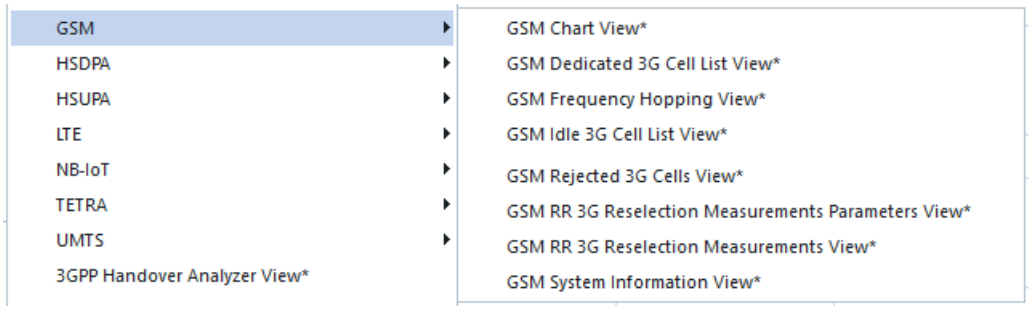


Figure 4-396: GSM views

The GSM mobile signals BCCH, CI, LAC, MCC, MNC, BSIC and C2 have been assigned the same relation IDs like for the GSM NWS Top N signals. This helps the operations with signals, for example, grouping in the GSM 2D chart view.

- GSM chart view....790
- GSM dedicated 3G cell list view....792
- GSM frequency hopping view....794
- GSM idle 3G cell list view....796
- GSM RR 3G reselection measurements parameters view....799
- GSM RR 3G reselection measurements view....803
- GSM rejected 3G cells view....805
- GSM system information view....808

4.4.5.1 GSM chart view

The "GSM Chart View" displays "RxLev" and "RxQual" and "Frame Erasure Rate" of the serving cell. Also is displayed "RxLev" of up to 6 neighbor cells, N1 to N6. The values are taken from the "Measurement Report". For detailed description of the parameters, refer to Chapter 4.4.13.4, "GSM grid layout", on page 946.

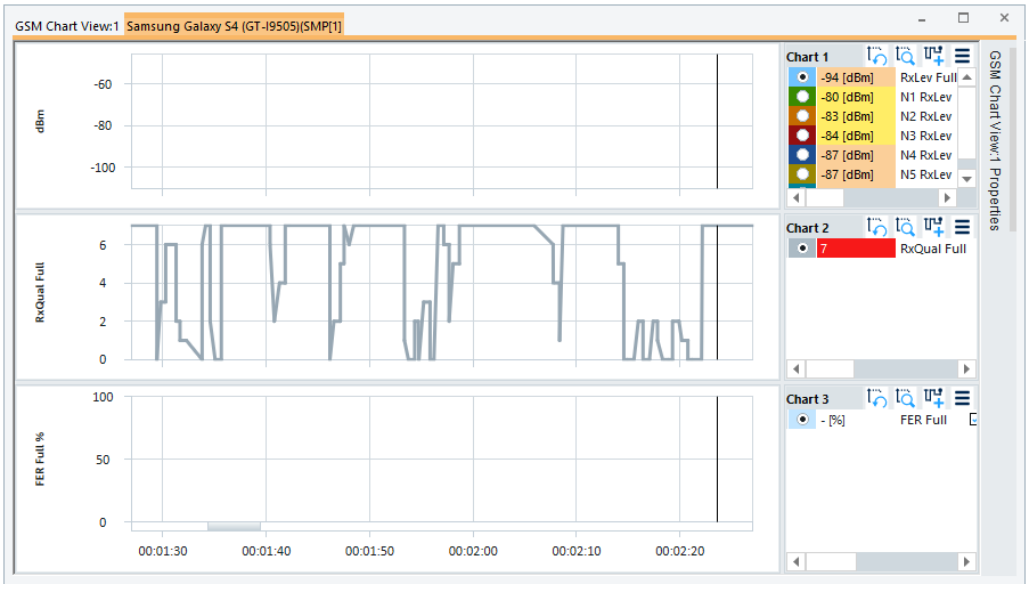


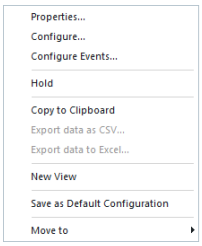
Figure 4-397: GSM Chart View

For the meaning of the panes and entires in the view, see Chapter 4.2.1, "2D chart view", on page 448.

The view shows following GSM signal properties:

- "RxLev"
  - "RxLev Full"
    Received Signal Level assessed over the full range of TDMA frames within a SACCH block.
  - N1-N6 RxLev
    Received Signal Level of the neighbour cells.
- "RxQual"
  - "RxQual Full"
    Received Quality assessed over the full range of TDMA frames within a SACCH block.
- "FER"
  - FER Full""
    "Frame Erasure Rate" assessed over the full range of TDMA frames within a SACCH block.
  - "C1"
    UE estimation parameter C1.
  - "C2"
    UE estimation parameter C2.

Context menu

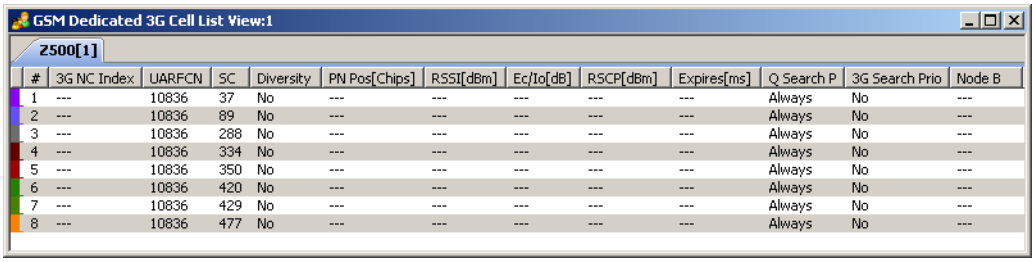


The "GSM Chart View" configuration is done in the "GSM Chart View: <variable> Properties" pane. Selecting the "Configure" command in the context sensitive menu of the view opens only the "Info" page.

4.4.5.2 GSM dedicated 3G cell list view

The "GSM Dedicated 3G Cell List View" shows an overview of the measured 3G cell parameters.

The view is empty unless the test mobile is configured to record the GSM 3G cell-related messages.



#	3G NC Index	UARFCN	SC	Diversity	PN Pos[Chips]	RSSI[dBm]	Ec/Io[dB]	RSCP[dBm]	Expires[ms]	Q Search P	3G Search Prio	Node B
1	---	10836	37	No	---	---	---	---	---	Always	No	---
2	---	10836	89	No	---	---	---	---	---	Always	No	---
3	---	10836	288	No	---	---	---	---	---	Always	No	---
4	---	10836	334	No	---	---	---	---	---	Always	No	---
5	---	10836	350	No	---	---	---	---	---	Always	No	---
6	---	10836	420	No	---	---	---	---	---	Always	No	---
7	---	10836	429	No	---	---	---	---	---	Always	No	---
8	---	10836	477	No	---	---	---	---	---	Always	No	---

Figure 4-398: GSM Dedicated 3G Cell List View

The results for each mobile are arranged in a separate tab.

Cell list

The cell list comprises the most important parameters of the serving cell and all other cells that are currently used for the connection; its members are permanently monitored and updated by the network.

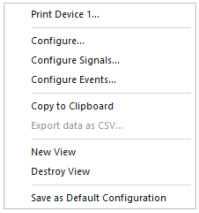
Each table row represents a cell. Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **Color Symbol**
  Color code for the Primary SC as defined in the Colors tab of the configuration menu.
- **#**
  Sequence number for the cell, assigned in chronological order and always starting with 1.
- **3G NC Index**
  Index of the cell in the 3G neighbourhood Cell List.
- **UARFCN**
  UTRAN Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal.
  The carrier frequency is equal to f = 0.2 MHz * UARFCN

- **SC**
  Primary scrambling code of the signal in the format selected in the TEC for UMTS Test Mobiles tab of the Configuration of Software Modules menu; refer to section Configuration Menu in chapter 3. The primary SC is used to identify the cell.
- **Diversity**
  Downlink transmit diversity scheme for the CPICH: STTD (Space Time Transmit Diversity), TSTD (Time Switched Transmit Diversity), SSDT (Site Selection Diversity Transmit Power Control), or No Diversity
- **PN Pos. [Chips]**
  PN position in Chips, ranging from 0 to 38399.
- **RSSI [dBm]**
  The received signal strength indicator of the cell on the forward traffic channel, ranging from –109 to –21 dBm.
- **E_c/I_o [dB]**
  Ratio of the received energy per PN chip for the signal to the total received power spectral density on the PCPICH. E_c/I_o is obtained in an unbiased measurement, i.e. the contribution of the noise floor to the powers is subtracted.
- **RSCP**
  CPICH Received Signal Code Power in dBm; the received power on one code, measured on the Primary CPICH.
- **Expires [ms]**
  Time until this cell loses its known status.
- **Q Search P**
  Quality threshold for reselection. L1 searches for 3G cells if the signal level is below or above the threshold value.
- **3G Search Prio**
  Flag indicating if the idle frames in dedicated or packet transfer mode can be used with priority for 3G measurements, when BSIC decoding is required.
- **Node B**
  Name of the node B, taken from the UMTS Node B database (if available).

The "SC" value for each active set element generates signals in the "UMTS – <Device> – Active Set" branch of the data tree.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM dedicated 3G cell list view configuration

In the "GSM Dedicated 3G Cell List View" page you can select/deselect the parameters to be viewed in the tables and see the information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The complete parameter set to be displayed in the cell list is by default selected in the "3G cells in dedicated mode" field. If you deselect a parameter, the associated column in the table is hidden.

Restricting the viewed results makes it easier to read the tables if only a subset of the available parameters is needed. To restrict the number of parameters measured and enhance the system performance, use the settings in the device configuration menu.

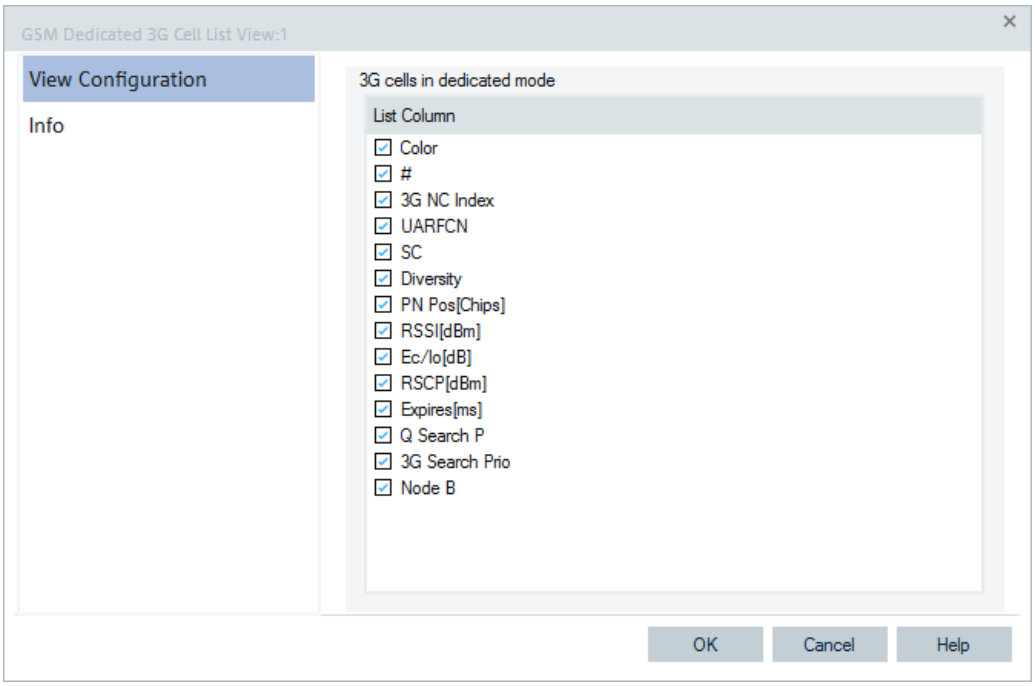


Figure 4-399: GSM dedicated 3G Cell List View - configuration

4.4.5.3 GSM frequency hopping view

The "GSM Frequency Hopping View" shows the channel information of a GSM (or GPRS) connection that may or may not be operated in frequency hopping mode. The parameters are shown for all mobiles that are used in the current measurement or recorded in the replayed measurement file.

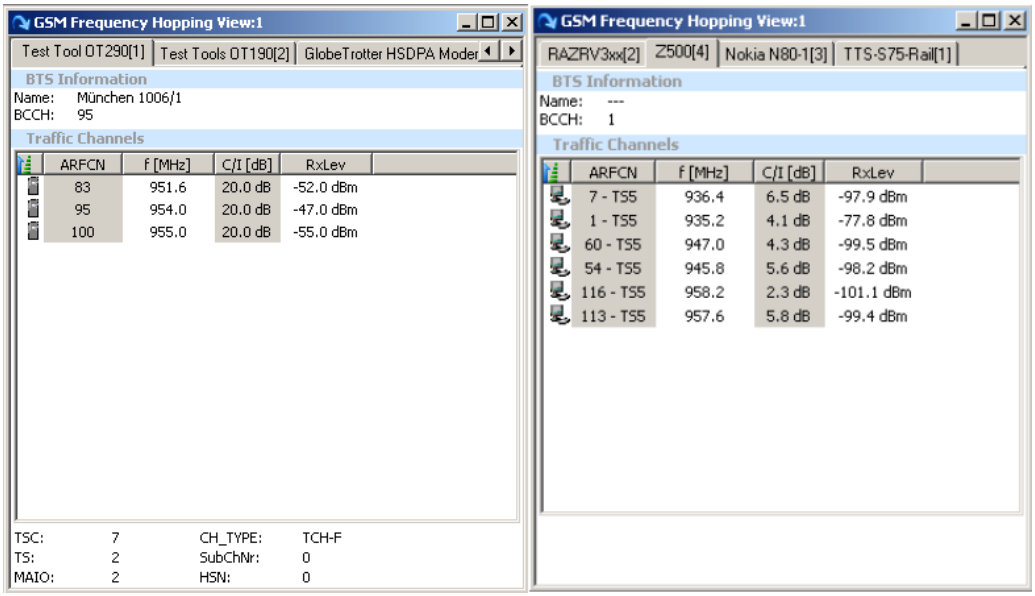


Figure 4-400: GSM Frequency Hopping View

The hopping information provided by each mobile is displayed in a separate tab. Each tab is divided into two panels showing the properties of the BTS and the channel parameters of the RF connection, respectively.

BTS information

The upper panel indicates the channel number of the Broadcast Control Channel BCCH) plus the base station name, if a BTS list is available.

Traffic channels

The panel below "BTS Info" shows the parameters of the RF connection.

Channel list

The channel list shows the sequence of GSM channel numbers ("ARFCN") and frequencies used, together with the carrier-to-interference ratio ("C/I") and RxLev value for each hopping frequency. Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A blue arrow in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

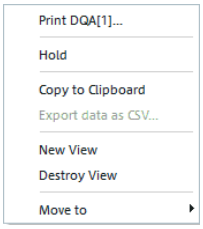
Some of the parameters may not be provided by all test mobiles. The "C/I" is provided by various test mobiles. The icons and denote what kind of service is used - CS Circuit Switched (mobile) and Packet Switched (PS). In case of a PS connection additionally the timeslot is provided. If frequency hopping is off, the list shows only one traffic channel. The list is empty if the mobile is in idle mode.

Parameter list

The parameter list below the hopping channel list shows the properties of the dedicated connection. It is not shown while the connection is "Idle". Some of the parameters may not be provided by all test mobiles.

- **TSC**
  Training sequence code of the RF channel.
- **TS**
  Traffic channel timeslot number of the connection.
- **MAIO**
  Mobile Allocation Index Offset in the range 0 to 63. The MAIO is only displayed if frequency hopping is on.
- **CH_Type**
  Channel type allocated for the connection: "TCH-F" (full-rate traffic channel), "TCH-H" (half-rate traffic channel), "SDCCH/4" or "SDCCH/8".
- **SubChNr**
  SDCCH sub-channel number as defined in section 7, tables 3 and 4 of standard 3GPP TS 05.02.
- **HSN**
  Hopping Sequence Number in the range 0 to 63. The HSN is only displayed if frequency hopping is on.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.5.4 GSM idle 3G cell list view

The "GSM Idle 3G Cell List View" shows an overview of the 3G cell parameters for measured idle cells.

The view is empty unless the test mobile is configured to record the GSM 3G idle cell-related messages.

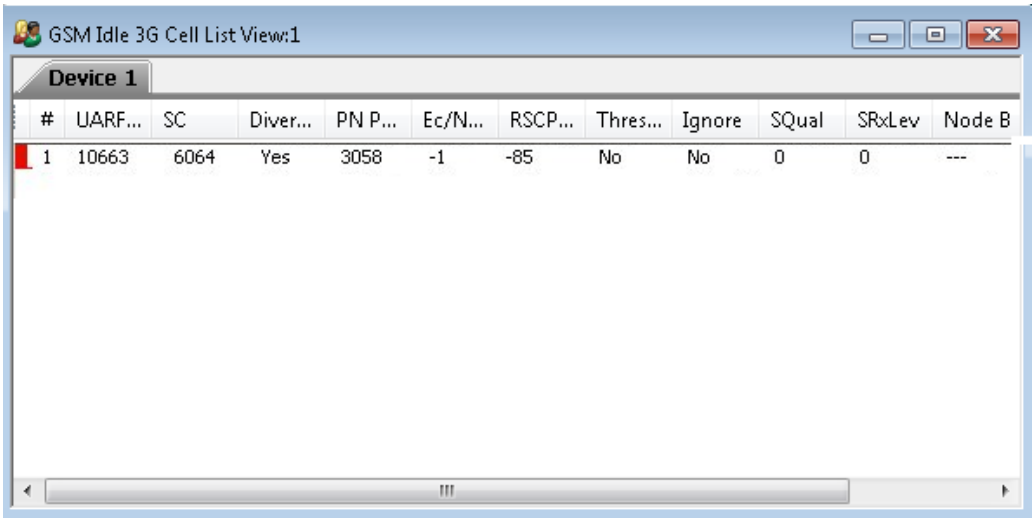


Figure 4-401: GSM Idle 3G Cell List View

The results for each mobile are arranged in a separate tab.

Cell list

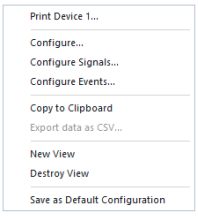
The cell list comprises the most important parameters of the 3G cells that are currently available for the connection; its members are permanently monitored and updated by the network.

Each table row represents a cell. Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **Color Symbol**
  Color code for the Primary SC as defined in the "Colors" tab of the configuration menu.
- **#**
  Sequence number for the cell, assigned in chronological order and always starting with 1.
- **UARFCN**
  UTRAN Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal.
  The carrier frequency is equal to "f = 0.2 MHz * UARFCN"
- **SC**
  Primary scrambling code of the signal in the format selected in the "TEC for UMTS Test Mobiles" tab of the "Configuration of Software Modules" menu. The primary SC is used to identify the cell.
- **Diversity**
  Downlink transmit diversity scheme for the CPICH: "STTD" (Space Time Transmit Diversity), "TSTD" (Time Switched Transmit Diversity), "SSDT" (Site Selection Diversity Transmit Power Control), or "No" Diversity
- **PN Pos. [Chips]**
  PN position in Chips, ranging from 0 to 38399.

- **E_c/I_o [dB]**
  Ratio of the received energy per chip to the total received power density in the band.
- **RSCP [dBm]**
  Unbiased Integral Received Signal Code Power for all measured peaks in dBm.
- **Thresholds valid**
  Indicates if GSM L1 should apply cell reselection criterion S to be reported to the RR layer (see standard 3GPP TS 25.304).
- **Ignore**
  Indicates if GSM L1 is not supposed to report this cell to the RR layer.
- **SQual**
  Signal quality value used as a criterion for cell reselection.
- **SRxLev**
  RxLevel value used as a criterion for cell reselection.
- **Node B**
  Name of the closest node B with the corresponding SC and ARFCN.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM idle 3G cell list view configuration

In the "GSM Idle 3G Cell List View" page you can select/deselect the parameters to be viewed in the tables and see the information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The complete parameter set to be displayed in the cell list is by default selected in the "3G cells in idle mode" field. If you deselect a parameter, the associated column in the table is hidden.

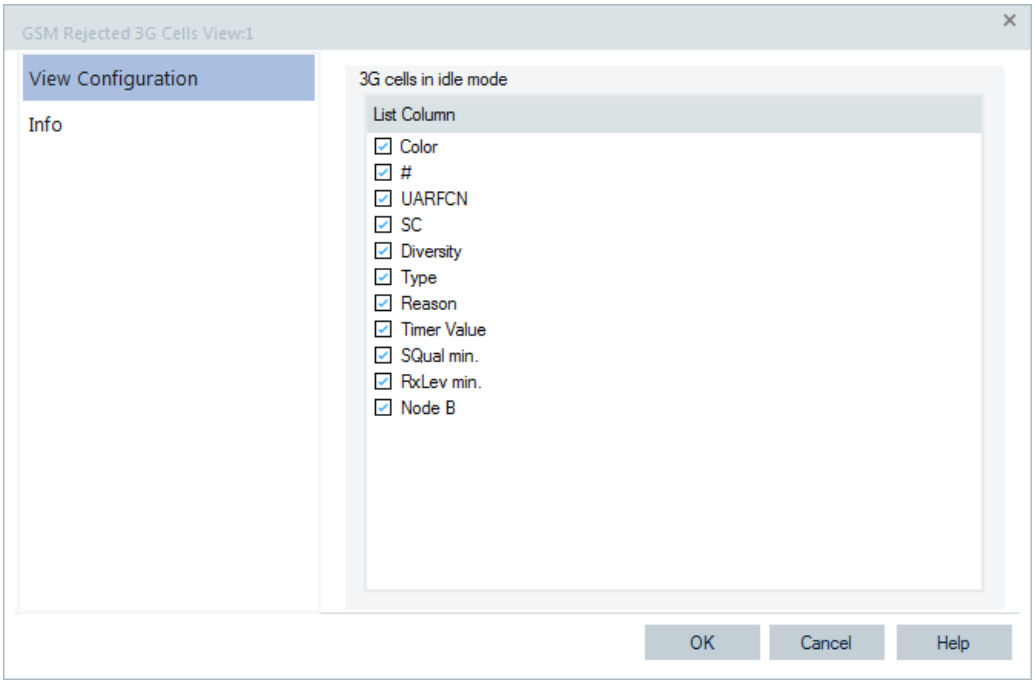


Figure 4-402: GSM Idle 3G Cell List View - configuration

4.4.5.5 GSM RR 3G reselection measurements parameters view

The "GSM RR 3G Reselection Measurements Parameters View" shows the parameters used for the Radio Resource 3G reselection measurements described in the previous sections.

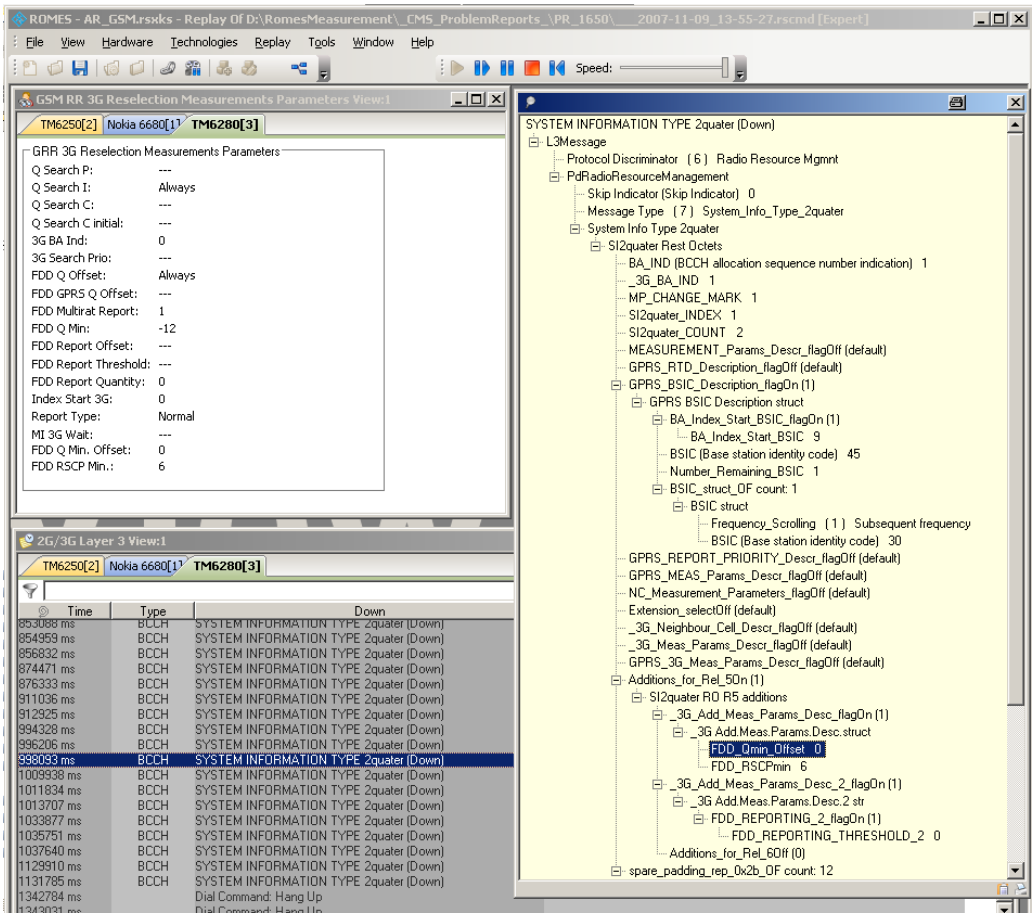


Figure 4-403: GSM RR 3G Reselection Measurements Parameters View

Parameters

The "GSM RR 3G Reselection Measurements Parameters View" displays the parameters used for the Radio Resource 3G Reselection measurements, described in the following. Additional information on these parameters is available in standard 3GPP TS 51.010.

- **Q Search P**
  Q Search P defines a threshold and also indicates whether these measurements shall be performed when RLA_P of the serving cell is below or above the threshold.
- **Q Search I**
  For a multi-RAT MS, cells or frequencies with other radio access technologies may be included in 3G Cell Reselection list (see 3GPP TS 04.18). The network controls the measurements for reselection of idle cells by the parameter Qsearch_I broadcast on BCCH. Qsearch_I defines a threshold and also indicates whether these measurements shall be performed when RLA_C of the serving cell is below or above the threshold. The value of 7 indicates to always search for neighbouring 3G cells, a value of 15 disables the search.
  Search for 3G cells if signal level is below (0-7) or above (8-15) threshold
  0 = - 98 dBm, 1 = - 94 dBm to 6 = - 74 dBm,

7 = ∞ (always), 8 = - 78 dBm, 9 = - 74 dBm, and so on
14 = - 54 dBm, 15 = ∞ (never).
Default value = ∞ (never).

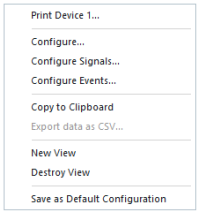
- **Q Search C**
  As defined in 3GPP TS 45.008, the Q Search C parameter defines a threshold and also indicates whether the mobile measures 3G cells when the average signal level (RxLevel) of the BCCH carrier is below (0-7) or above the threshold (8-15). The value of 7 indicates to always search for neighbouring 3G cells, a value of 15 disables the search.
  Search for 3G cells if signal level below threshold (0-7):
  - 98, - 94 to - 74 dBm, ∞ (always)
  or above threshold (8-15):
  - 78, - 74 to - 54 dBm, ∞ (never)
- **Q Search C initial**
  Indicates the Q Search C value to be used in connected mode before the configured Q Search C is received,
  0 = use Q Search I, 1 = ∞ (always).
  Default value = use Q Search I.
- **3G BA Ind.**
  The 3G_BA_IND message type parameter is needed to identify set of 3G Neighbor Cell information used for reporting in dedicated mode. The value received is reflected in the Measurement Report and Enhanced Measurement Report messages as described in standard 3GPP TS 04.18.
- **3G Search Prio**
  This parameter indicates if 3G cells may be searched when BSIC decoding is required. With 3G Search Prio set to On, the MS attempts to demodulate the SCH on the BCCH carrier of as many surrounding cells as possible, and to decode the BSIC as often as possible, as a minimum at least once every 10 seconds. A multi-RAT MS is allowed to extend this period to 13 seconds if the neighbor cell list contains cells from other RATs. With 3G Search Prio set to Off, the BSIC is also decoded, but only 2G neighbor cells are monitored.
- **FDD Q Offset**
  "FDD Q min", "FDD Q Offset" and optionally "FDD RSCP min" and "FDD Qmin Offset" are broadcast on BCCH of the serving cell.
  "FDD Q Offset" applies an offset to "FDD Q min" value:
  0 = 0 dB, 1 = 2 dB, 2 = 4 dB, 3 = 6 dB,
  4 = 8 dB, 5 = 10 dB, 6 = 12 dB, 7 = 14 dB.
  Default value = 0 dB
- **FDD GPRS Q Offset**
  Applies an offset to RLA_P for cell re-selection to access technology/mode: default is –12 dB.
- **FDD MultiRAT Report**
  The parameter "FDD MultiRAT Report" indicates a number of cells to be reported in a measurement, e.g. "1" (one cell) report message and does not include the number of places taken by RSSI reporting in the measurement report message. If no measurements have been performed on a cell since last report, the cell shall not be included in the report.

The "FDD MultiRAT Report" parameter is broadcast on BCCH and PBCCH. An MS attached to GPRS uses the parameter broadcast on PBCCH if it exists. In all other cases, the MS uses the parameters broadcast on BCCH.

- **FDD Q Min.**
  "FDD Q min" is defined as the minimum threshold for Ec/No for UTRAN FDD cell reselection, its default value is 12 dB.
- **FDD Report Offset**
  The "FDD Report Offset" parameter applies an offset to the reported value when prioritizing the cells for reporting for GSM frequency band or access technology/ mode FDD.
  Possible values are: 0 (0 dB), 1 (6 db), to 7 (42 dB). The default value is 0 dB.
- **FDD Report Threshold**
  The "FDD Report Threshold" parameter applies priority reporting if the reported value is above the thus defined threshold for GSM frequency band or access technology/mode FDD. The default value is "always"
- **FDD Report Quantity**
  The parameter "FDD Report Quantity" is used to specify whether the MS reports the results of the P-CPICH level measurement of the neighbouring 3G cells as RSCP or as Ec/No, e.g. 0 = RSCP, 1 = Ec/No
- **Index Start 3G**
  Each 3G neighbour Cell Description received is added to the 3G neighbor cell list, starting with the index equal to the parameter "Index Start 3G". If this parameter is not present then the value 0 is used.
  For each 3G neighbour Cell Description, the cells are indexed in the following order:
  1) UTRAN FDD cell ARFCNs are indexed in the order of occurrence in the 3G neighbor cell description. Then, for each FDD ARFCN, the cells are indexed in the order of increasing values of the decoded FDD_CELL_INFORMATION parameters.
  2) UTRAN TDD cell ARFCNs are indexed in the order of occurrence in the 3G neighbor cell description. Then, for each TDD ARFCN, the cells are indexed in the order of increasing values of the decoded TDD_CELL_INFORMATION parameters.
  3) CDMA 2000 cells are indexed in the order of occurrence in the 3G neighbor cell description.
- **Report Type**
  The condition for sending the Packet Enhanced Measurement Report message instead of the Packet Measurement Report message is based on the "Report Type" parameter and if the MS has received BSIC information for all cells.
- **MI 3G Wait**
  The "3G Neighbour Cell" list (either from SI2quater or from PSI3quater) is used for reporting when the MS enters dedicated mode, until the MS has received a given number of instances of Measurement Information (MI) messages that contain 3G neighbor cell description. This number of instances is defined by the "MI 3G-Wait" parameter.
- **FDD Q Min. Offset**
  FDD Q Min. Offset is extracted from the Layer 3 message SI2quater. The parameter applies an offset to the minimum threshold for Ec/No for UTRAN FDD cell reselection.
- **FDD RSCP Min.**

"FDD RSCP Min." is extracted from the Layer 3 message SI2quater. The parameter defines the minimum value for Received Signal Code Power (RSCP) for FDD.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "GSM RR 3G Reselection Measurements Parameters View" has no specific configuration menu.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.4.5.6 GSM RR 3G reselection measurements view

The "GSM RR 3G Reselection Measurements View" is an overview of the measured Radio Resource 3G reselection parameters.

The view is empty unless the test mobile is configured to record the GSM RR-related messages. See the description of a device's "Expert Mode" configuration menu.

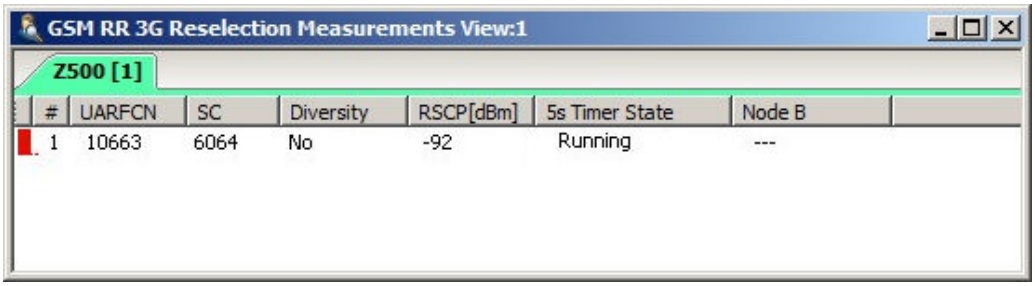


Figure 4-404: GSM RR 3G Reselection Measurements View

The results for each mobile are arranged in a separate tab.

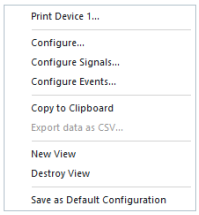
Cell list

The cell list comprises the most important parameters of the 3G cells that are involved in Layer3 RR reselection measurements.

Each table row represents a cell. Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **Color Symbol**
  Color code for the Primary SC as defined in the "Colors" tab of the configuration menu.
- **#**
  Sequence number for the cell, assigned in chronological order and always starting with 1.
- **UARFCN**
  UTRAN Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal.
  The carrier frequency is equal to "f = 0.2 MHz * UARFCN"
- **SC**
  Primary scrambling code of the signal in the format selected in the "TEC for UMTS Test Mobiles" tab of the configuration of software modules; refer to section Configuration Menu in chapter 3. The primary SC is used to identify the cell.
- **Diversity**
  Downlink transmit diversity scheme for the CPICH: "STTD" (Space Time Transmit Diversity), "TSTD" (Time Switched Transmit Diversity), "SSDT" (Site Selection Diversity Transmit Power Control), or "No" Diversity
- **RSCP [dBm]**
  Unbiased Integral Received Signal Code Power for all measured peaks in dBm.
- **5s Timer State**
  State of the 5s Timer (Stopped/Running/Expired)
- **NodeB**
  Name of the closest NodeB with the corresponding SC and ARFCN.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM RR 3G reselection measurements view configuration

In the "View Configuration" page you can select/deselect the parameters to be viewed in the tables and see the information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The complete set of the 3G cells parameters to be displayed in the list of 3G cells for a GSM mobile in idle mode is by default selected in the "3G cells in idle mode" pane. If you deselect a parameter, the associated column in the table is hidden.

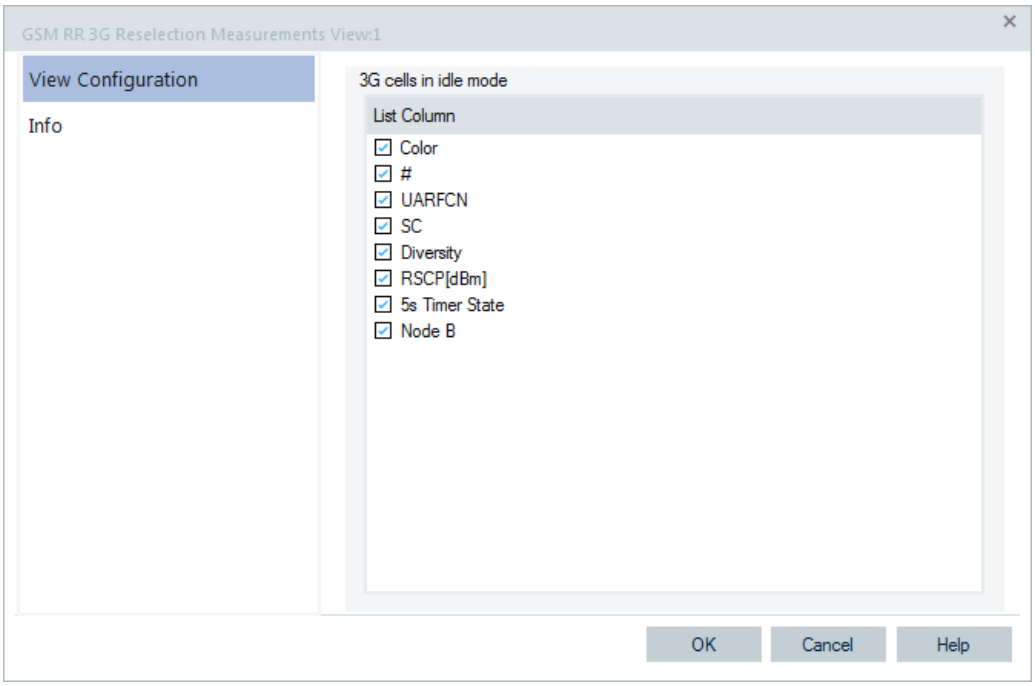


Figure 4-405: GSM RR 3G Reselection Measurements View - configuration

4.4.5.7 GSM rejected 3G cells view

The "GSM Rejected 3G Cells View" shows an overview of the determined 3G cell parameters for rejected cells.

The view is empty unless the test mobile is configured to record the GSM L3 RR 3G rejected cell-related messages.

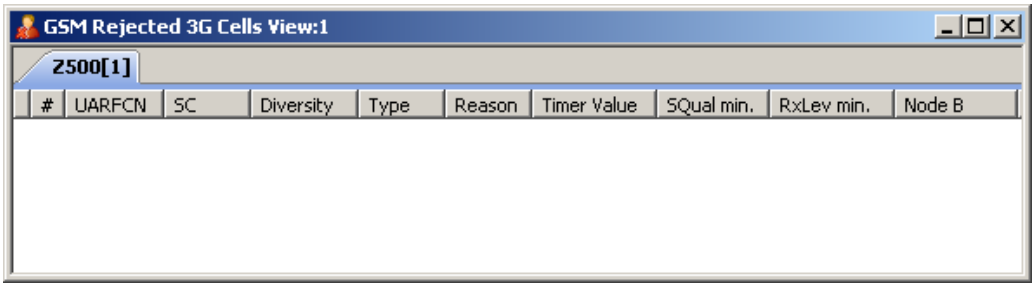


Figure 4-406: GSM Rejected 3G Cells View

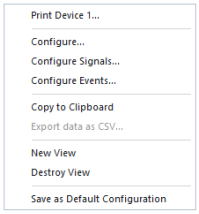
Cell list

The cell list comprises the most important parameters of the 3G cells that have a registration result of "rejected"; its members are permanently monitored and updated by the network.

Each table row represents a cell. Clicking an entry in the table heading sorts the cells according to the corresponding parameter. A gray triangle in the heading pointing upward (downward) indicates that the table is sorted in ascending (descending) order.

- **Color Symbol**
  Color code for the Primary SC as defined in the "Colors" tab of the configuration menu.
- **#**
  Sequence number for the cell, assigned in chronological order and always starting with 1.
- **UARFCN**
  UTRAN Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal.
  The carrier frequency is equal to "f = 0.2 MHz * UARFCN"
- **SC**
  Primary scrambling code of the signal in the format selected in the "TEC for UMTS Test Mobiles" tab of the "Configuration of Software Modules" menu. The primary SC is used to identify the cell.
- **Diversity**
  Downlink transmit diversity scheme for the CPICH: "STTD" (Space Time Transmit Diversity), "TSTD" (Time Switched Transmit Diversity), "SSDT" (Site Selection Diversity Transmit Power Control), or "No" Diversity
- **Type**
  Reject type as defined by Radio Resource Control (RRC): Threshold (RRC delivered a threshold) or Timer (RRC delivered a timer value)
- **Reason**
  Reason for the rejection. Possible reasons include:
  NONE, INVALID_STATE, CELL_BARED, PLMN_MISMATCH, LOW_S_VALUE, AQUISITION_FAIL, SIBS_FAILED_LOWER_LAYERs, INVALID_SIBS, SIBS_TIMEOUT, SIBS_FAILED_OTHER, FORBIDDEN_LA, CELL_QUAL_FAILURE, CELL_NOT_SUITABLE, CELL_NOT_EVALUATED, or CELL_CHANGE_FAILURE
- **Timer Value**
  Time (in seconds) when the same cell should be reconsidered.
- **SQual min.**
  Minimum Cell Selection Quality value [dB], the parameter is used in the cell reselection criterion S for FDD cells.
- **RxLev min.**
  Threshold value [dBm] to be applied to Ec/No measurements
- **NodeB**
  Name of the closest NodeB with the corresponding SC and ARFCN.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM rejected 3G cells view configuration

The "View Configuration" tab lets you select/deselect the parameters of the 3G cells in idle mode to be displayed in the "GSM Rejected 3G Cells View". The view configuration provides in addition the information about the view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The complete set of the 3G cells parameters to be displayed in the list of rejected 3G cells for a GSM mobile in idle mode is by default selected in the "3G cells in idle mode" field. If you deselect a parameter, the associated column in the table is hidden.

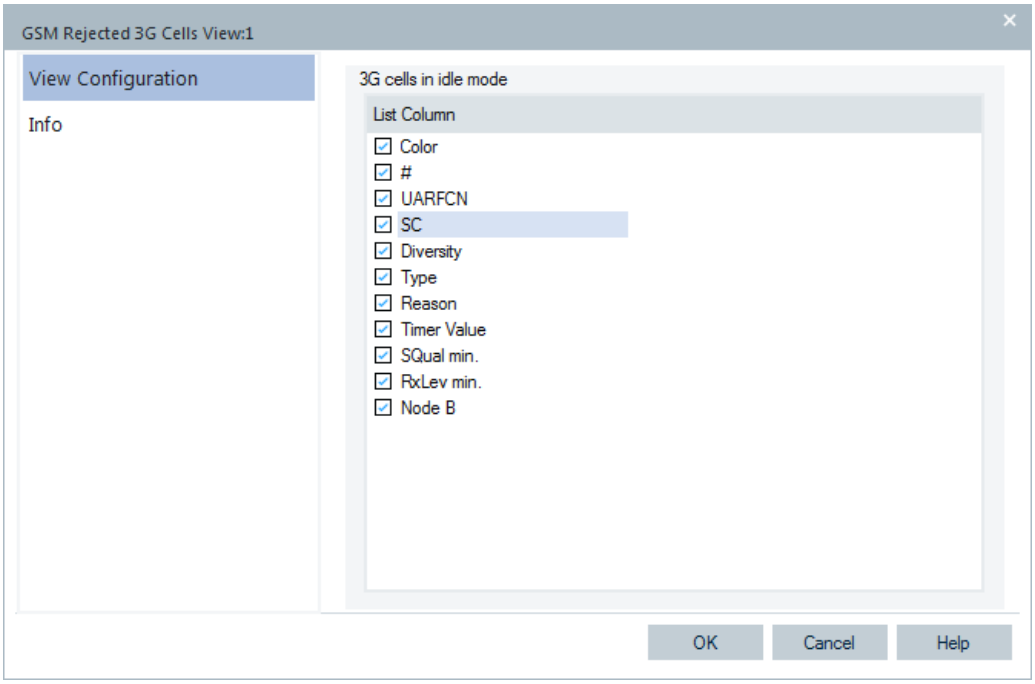
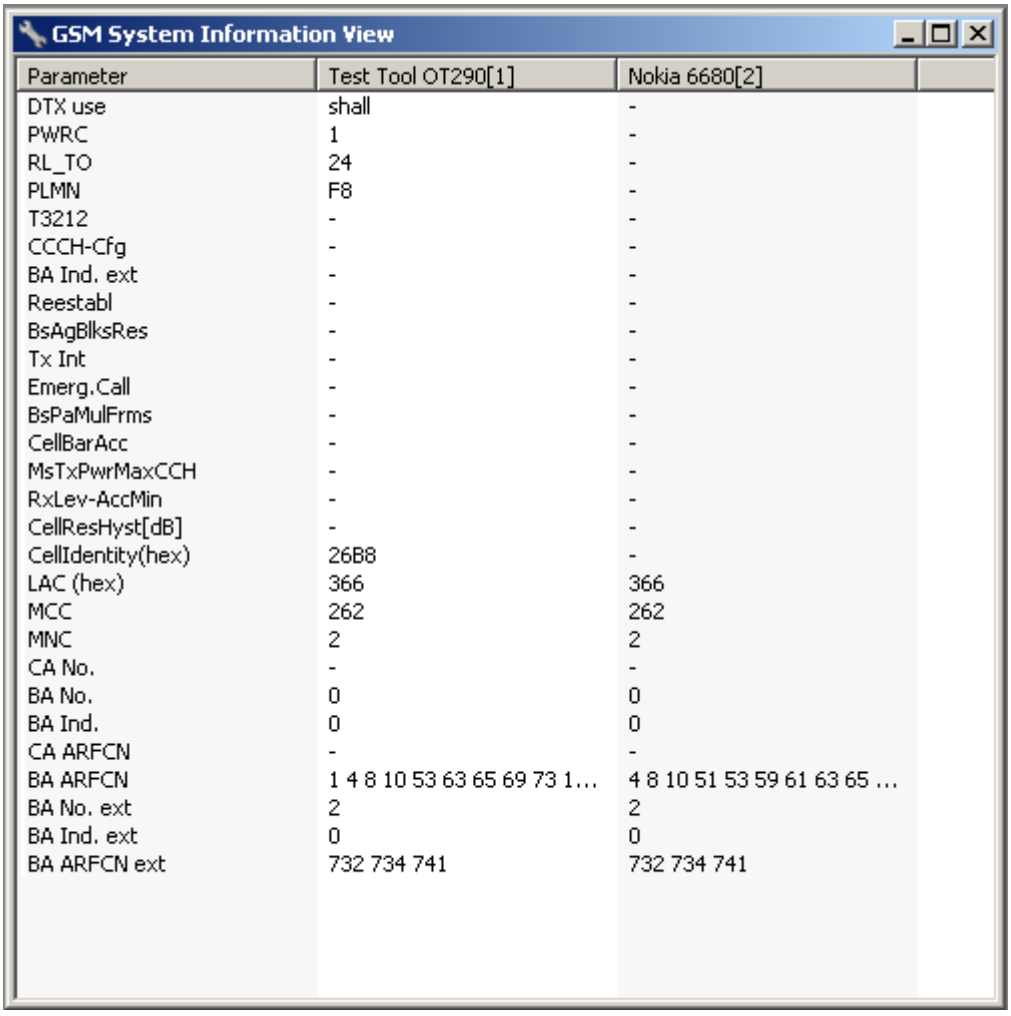


Figure 4-407: GSM Rejected 3G Cells View - configuration

4.4.5.8 GSM system information view

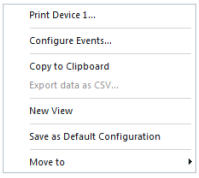
The "GSM System Information View" displays a selection of GSM parameters contained in the layer 3 messages System Information Type 1 to 6 sent by the BTS, according to GSM recommendation 04.08. The values are shown for all mobiles used.



Parameter	Test Tool OT290[1]	Nokia 6680[2]
DTX use	shall	-
PWRC	1	-
RL_TO	24	-
PLMN	F8	-
T3212	-	-
CCCH-Cfg	-	-
BA Ind. ext	-	-
Reestabl	-	-
BsAgBlksRes	-	-
Tx Int	-	-
Emerg.Call	-	-
BsPaMulFrms	-	-
CellBarAcc	-	-
MsTxPwrMaxCCH	-	-
RxLev-AccMin	-	-
CellResHyst[dB]	-	-
CellIdentity(hex)	26B8	-
LAC (hex)	366	366
MCC	262	262
MNC	2	2
CA No.	-	-
BA No.	0	0
BA Ind.	0	0
CA ARFCN	-	-
BA ARFCN	1 4 8 10 53 63 65 69 73 1...	4 8 10 51 53 59 61 63 65 ...
BA No. ext	2	2
BA Ind. ext	0	0
BA ARFCN ext	732 734 741	732 734 741

Figure 4-408: GSM System Information View

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM system information view configuration

The "GSM System Information View" configuration menu defines the parameters to be viewed and shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

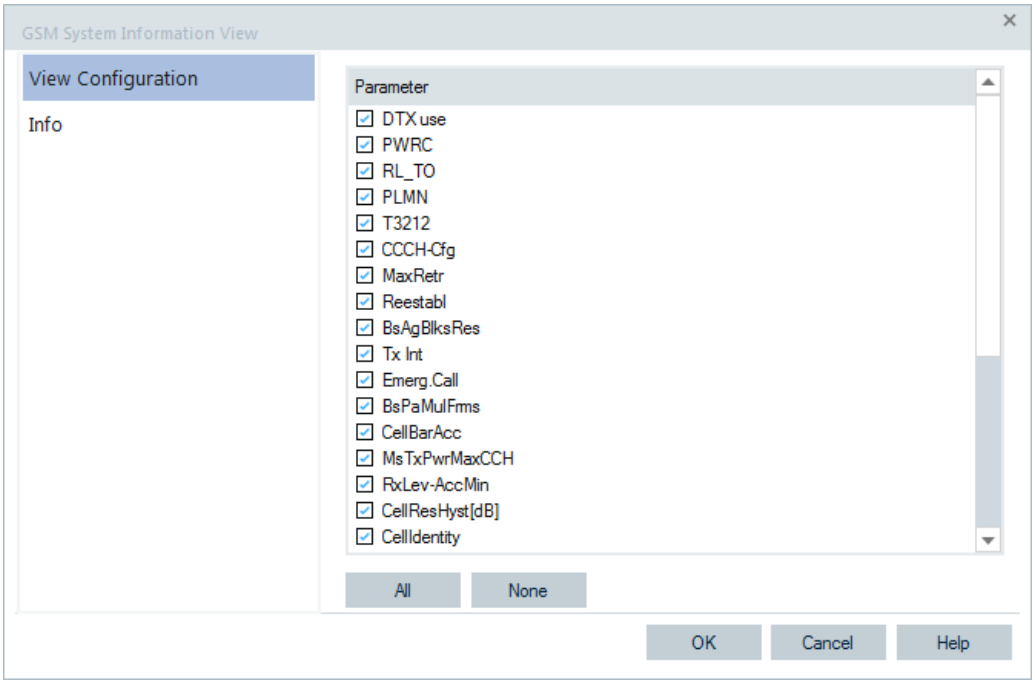


Figure 4-409: GSM System Information View - configuration

The parameters of different System Information types (SI type 1 to 6) conveyed via the Layer3 messages are shown in the view if selected in "Parameter". The parameters' short explanation is given in the following table.

Table 4-12: GSM System Information Type 1 to 6 parameters

DTX use	Discontinuous Transmission	**RxLev-AccMin**	Min. received signal level at a MS for access to a cell
PWRC	Power Control Indicator	**CellResHyst [dB]**	RxLev hysteresis required for Cell Reselection
RL_TO	Radio Link Timeout	**CellIdentity [hex]**	Cell Identity code
PLMN	Public Land Mobile Network	**LAC [hex]**	Location Area Code
T3212	Timeout Value	**MCC**	Mobile Country Code
CCCH-Config	Common Control Channel Configuration	**MNC**	Mobile Network Code

MaxRetr	Max. allowed RACH retrasmissions	**CA No.**	RF channel number in a particular cell (Numbering in a Cell Allocation)
Reestabl	Reestablishment Indicator	**BA No.**	BCCH Allocation Number
BsAgBlksRes	No. of blocks on each CCCH reserved for access grant messages	**BA Ind.**	BCCH Allocation sequence number indication
Tx Int	Number of slot to spread transm.	**CA ARFCN**	Cell Allocation ARFCN
Emerg.Call	Emergency call permission	**BA ARFCN**	BCCH Allocation ARFCN
BsPaMulFrms	Transmisson of the same paging messages to MSs of the same paging group	**BA No. ext**	Extended BCCH Allocation Number
CellBarAcc	Cell Access Barred	**BA Ind. ext**	Extended BCCH Allocation sequence number indication
MsTxPwrMaxCCH	Max. allowed transmitted RF power	**BA ARFCN ext**	Extended BCCH Allocation ARFCN

The extended BA parameters are relevant for the network operators who work with two GSM bands (GSM900 and GSM1800) identified by two parameter sets.

4.4.6 LTE views

The "LTE Views" display the LTE-specific information acquired with an LTE test mobile and the installed LTE device.

Activate explicitly recording of different messages which you wan04_0408_LTE Views, 38, en_USt to visualize in the LTE views. For activation, use the "Configuration" and "Expert Mode" pages of the device's configuration menu, see Chapter 6.4.7, "LTE mobile devices", on page 1633.

The LTE views can be seen and a view selected from the submenu displayed when the mouse pauses over "View" > "Mobile Views" > "LTE".

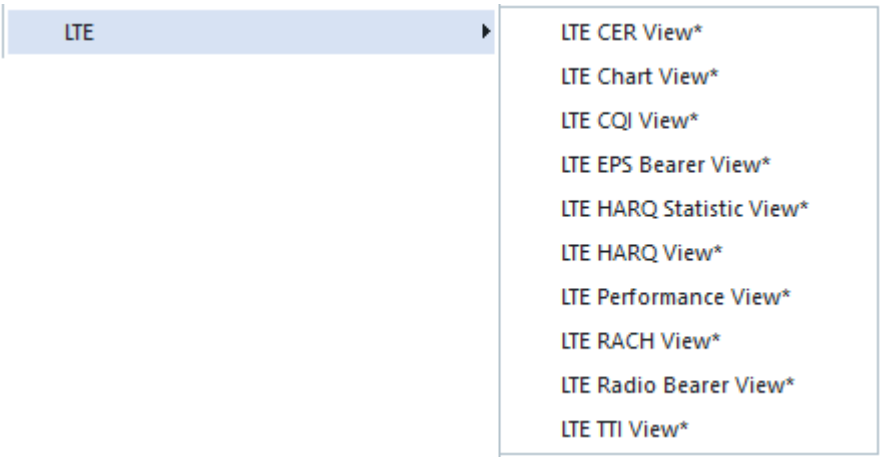


Figure 4-410: LTE views

Some of the views visualize the measurements and messages collected during the eMBMS sessions.

With the addition of 5G NR support, the "LTE CA Downlink Performance View", "LTE CA Uplink Performance View", "LTE Carrier Aggregation View", "LTE MIMO View" and "LTE Modulation View" are replaced by "UE CA Downlink Performance View", "UE CA Uplink Performance View", "UE Carrier Aggregation View", "UE MIMO View" and "UE Modulation View", respectively.

- LTE CER view 811
- LTE CQI view 812
- LTE chart view 814
- LTE EPS bearer view 818
- LTE HARQ statistic view 819
- LTE HARQ view 822
- LTE performance view 827
- LTE RACH view 828
- LTE radio bearer view 841
- LTE TTI view 843
- LTE UE signals 845

4.4.6.1 LTE CER view

The Channel Energy Response (CER) view shows the responses of both antennas.

The view is useful to check inter-symbol interferences.

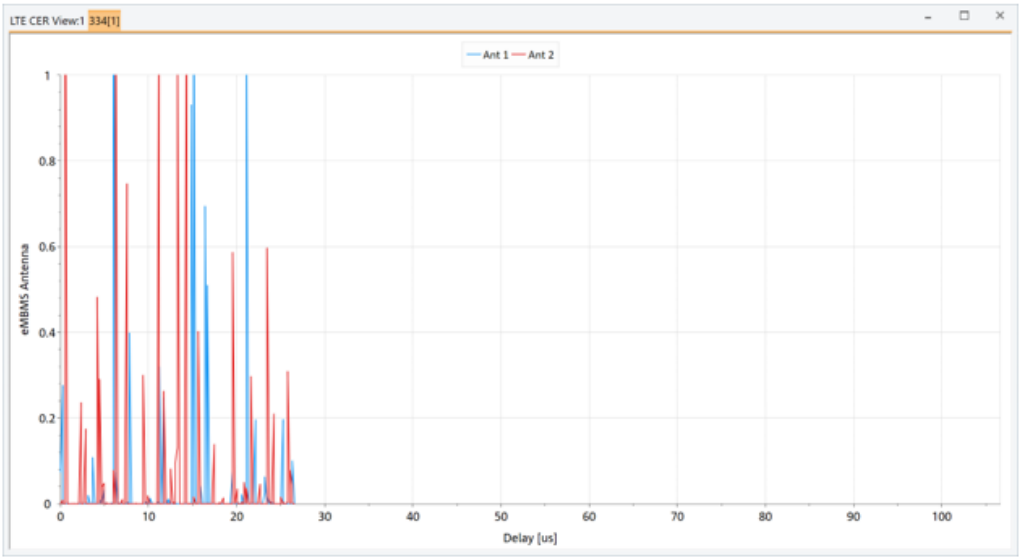


Figure 4-411: LTE CER View

4.4.6.2 LTE CQI view

The view gives a quick overview of the reported CQI values to the network. The upper part shows some basic information about modes (e.g. P0→primary carrier, Reporting Mode 1-0, and so on) and the channel (PUSCH or PUCCH) the CQI was reported on. The Rank Indicator (RI) is visualized as a number only. Two last rows in the upper part of the view display the wideband CQI value, coded in color from red (0) via yellow to green (15).

The lower part shows the first CQI for the configured subbands (SB 0 to 8) as color coded. If transmitted, a second CQI value is also color coded.

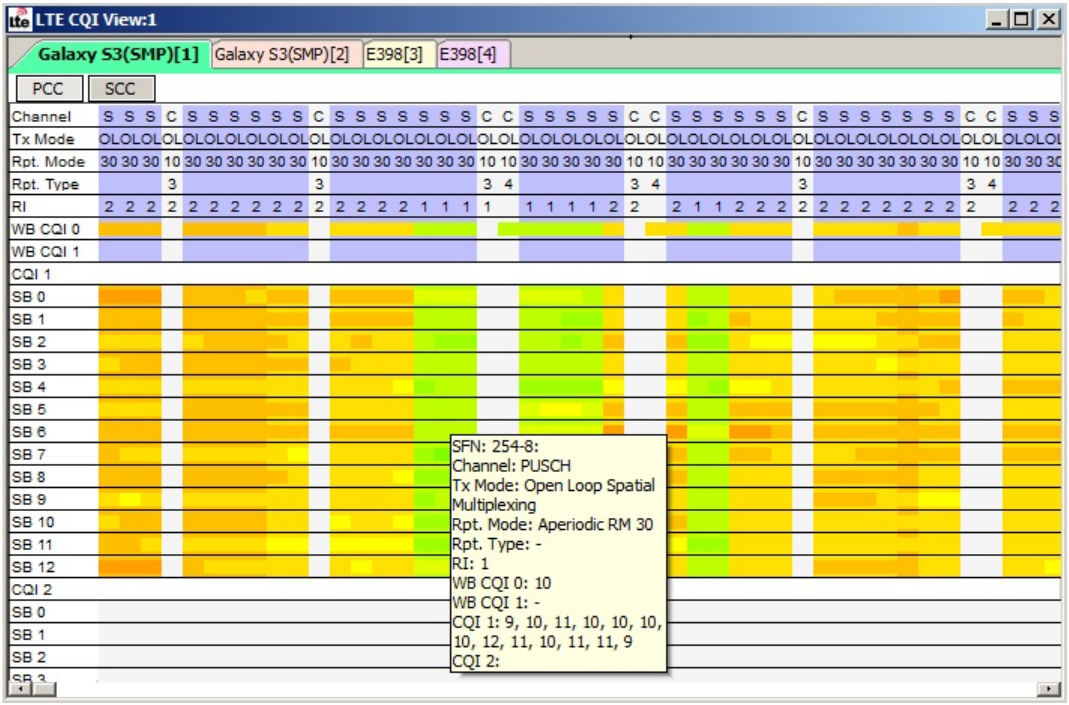


Figure 4-412: LTE CQI View

Compact visualization

For compact visualization only TTIs are represented, in which a CQI value is reported (in contrast to the Chapter 4.4.6.6, "LTE HARQ view", on page 822).

The next two sections display the subband CQIs. The display provides a quick overview over the CQI situation and if there is a specific problem for a certain subband.

Tooltips and details window can be used as usual.

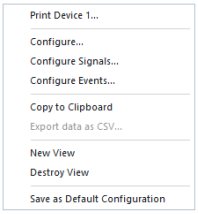
The chart contains the following results:

- **Channel**
- **Tx Mode**
- **Rpt. Mode**
- **Rpt Type**
- **RI**
- **WB CQI 0/WB CQI 1**
- **CQI 1/CQI 2**
- **SB 0 to SB 8**

The LTE-Advanced Carrier Aggregation feature is supported in "LTE CQI View" in a way that it shows the CQI processes for PCC and LCC or SCC. A desired view is displayed when selecting the "PCC" or "SCC" button.

To show both in parallel, the view has to be duplicated with the "New View" command of the context menu, see Context menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The view's configuration page has only the "Info" tab. The page can be accessed by selecting the "Configure" entry or via "Tools" > "Configuration Active View". See Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

If you select the "New View" command, the second LTE CQI view opens allowing monitoring another carrier component for LTE carrier aggregation.

4.4.6.3 LTE chart view

The "LTE Chart View" displays the measured data of a server cell and the best neighbor cells, the channel quality of the current server cell and Frame Error Rates (FER) in a predefined 2D Chart. For definition and explanation of the signals, refer to 3GPP TS 36.214 and TS 36.213.

Figure 4-413: LTE Chart View

The "LTE Chart View" configuration is done in the "LTE Chart View: <variable> Properties" pane. Selecting the "Configure" command in the context sensitive menu of the view opens only the "Info" page.

For the meaning of the entries in the properties of the "LTE Chart View", see Chapter 4.2.1, "2D chart view", on page 448.

In the following defined are the LTE parameters that are displayed in this view.

Server / best neighbor

- **RSSI**
  Received Signal Strength Indication
  The received power in a radio signal, i.e. all channels together.
  3GPP TS 36.214 definition: E-UTRA Carrier Received Signal Strength Indication (RSSI), comprises the linear average of the total received power (in [W]) observed only in OFDM symbols containing reference symbols for antenna port 0, in the measurement bandwidth, over N number of resource blocks by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.
- **RSRP**
  Reference-Signal-Received-Power
  Received Signal Strength on Reference Symbols
  3GPP TS 36.214 definition: Reference Signal Received Power (RSRP) is the linear average over the power contributions (in [W]) of the resource elements that carry cell-specific reference signals within the considered measurement frequency bandwidth.
  For RSRP determination, the cell-specific reference signals R0 is used, according to 3GPP TS 36.211. If the UE can reliably detect that R1 is available, it can use R1 in addition to determine RSRP.
- **SINR**
  Signal-to-Interference-plus-Noise Ratio
  Indicates the quality of the channel.
- **Tx Power**
  Transmission power of the uplink reference signal in dBm.
- **1. NC RSSI**
  RSSI signal of the first neighbor cell.
- **1. NC RSRP**
  RSRP signal of the first neighbor cell.

Channel quality

- **1st CINR**
  Ratio of carrier/interference plus noise of the first antenna.
  The received energy per chip divided by the power density in the band.
- **2nd CINR**
  Ratio of carrier/interference plus noise of the second antenna.
- **1st CQI Metric**
  The Channel Quality Indicator is an indication of the downlink mobile radio channel quality as experienced by this UE. Essentially, the UE is proposing to the eNodeB an optimum modulation scheme and coding rate to use for a given radio link quality. The resulting transport block error rate would not exceed 10% in this way. 16 combinations of modulation scheme and coding rate are specified as possible CQI values. The UE can report different types of CQI.

A so-called “wideband CQI” refers to the complete system bandwidth. Alternatively, the UE can evaluate a “subband CQI” value per subband of a certain number of resource blocks. The subband is configured by higher layers. The full set of sub-bands covers the entire system bandwidth.
A CQI per code word needs to be reported for spatial multiplexing. The CQI for the first antenna is shown in the table.

- **2nd CQI Metric**
  Channel Quality Indication for the second downlink radio channel.
- **1st DL MCS Level**
  Current used modulation coding scheme on the first downlink radio channel. The information is provided by the eNodeB, see table below.
- **2nd DL MCS Level**
  Current used modulation coding scheme on the downlink for the second antenna if used.

Table 4-13: Channel Quality Indicator for first antenna

CQI index	modulation	code rate x 1024	efficiency
0	out of range		
1	QPSK	78	0.1523
2	QPSK	120	0.2344
3	QPSK	193	0.3770
4	QPSK	308	0.6016
5	QPSK	449	0.8770
6	QPSK	602	1.1758
7	16QAM	378	1.4766
8	16QAM	490	1.9141
9	16QAM	616	2.4063
10	64QAM	466	2.7305
11	64QAM	567	3.3223
12	64QAM	666	3.9023
13	64QAM	772	4.5234
14	64QAM	873	5.1152
15	64QAM	948	5.5547

Table 4-14: Currently defined modulation coding schemes

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
0	2	0	0
1	2	1	0
2	2	2	0

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
3	2	3	0
4	2	4	0
5	2	5	0
6	2	6	0
7	2	7	0
8	2	8	0
9	2	9	0
10	2	10	0
11	4	10	0
12	4	11	0
13	4	12	0
14	4	13	0
15	4	14	0
16	4	15	0
17	4	16	0
18	4	17	0
19	4	18	0
20	4	19	0
21	6	19	0
22	6	20	0
23	6	21	0
24	6	22	0
25	6	23	0
26	6	24	0
27	6	25	0
28	6	26	0
29	reserved		1
30			2
31			3

FER

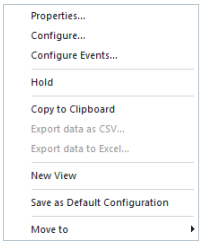
Frame erasure ratio detected by the UE.

- **PDSCH FER**

Frame erasure ratio for the Physical Downlink Shared Channel (PDSCH)

- **PUSCH FER**
  Frame erasure ratio for the Physical Uplink Shared Channel
- **DL FER**
  General frame erasure ratio for the downlink
- **UL FER**
  General frame erasure ratio for the uplink

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

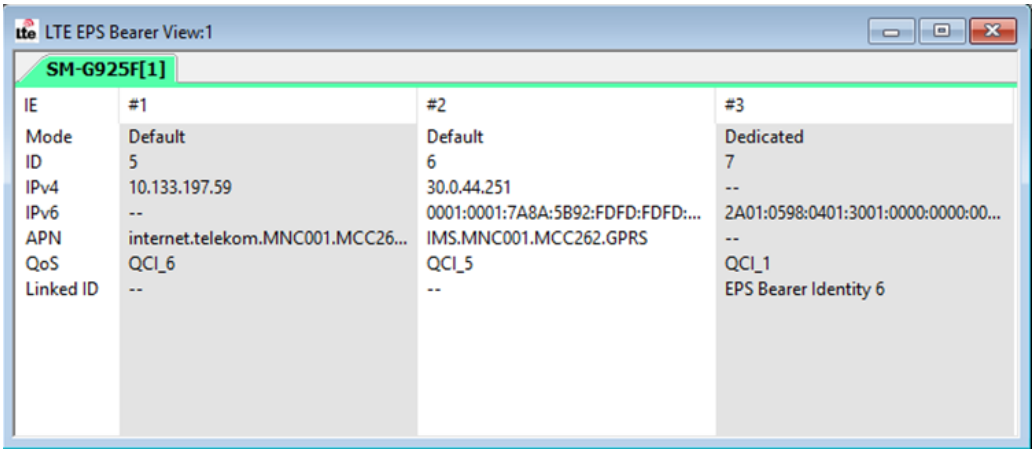
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "Configue" command opens the chart's read only "Info" page.

4.4.6.4 LTE EPS bearer view

The view displays the current active EPS bearers of the UE and their most important values.



IE	#1	#2	#3
Mode	Default	Default	Dedicated
ID	5	6	7
IPv4	10.133.197.59	30.0.44.251	--
IPv6	--	0001:0001:7A8A:5B92:FDFD:FDFD:...	2A01:0598:0401:3001:0000:0000:00...
APN	internet.telekom.MNC001.MCC26...	IMS.MNC001.MCC262.GPRS	--
QoS	QCI_6	QCI_5	QCI_1
Linked ID	--	--	EPS Bearer Identity 6

Figure 4-414: LTE EPS Bearer View

Only EPS bearers, which have been configured during the measurement are shown. The values of the view reflect directly the content of the logged Layer 3 messages.

4.4.6.5 LTE HARQ statistic view

The view displays statistics of the used transport block sizes and the necessary retransmission. The upper list shows the downlink statistics for one or two codewords. The bottom list stands for uplink.

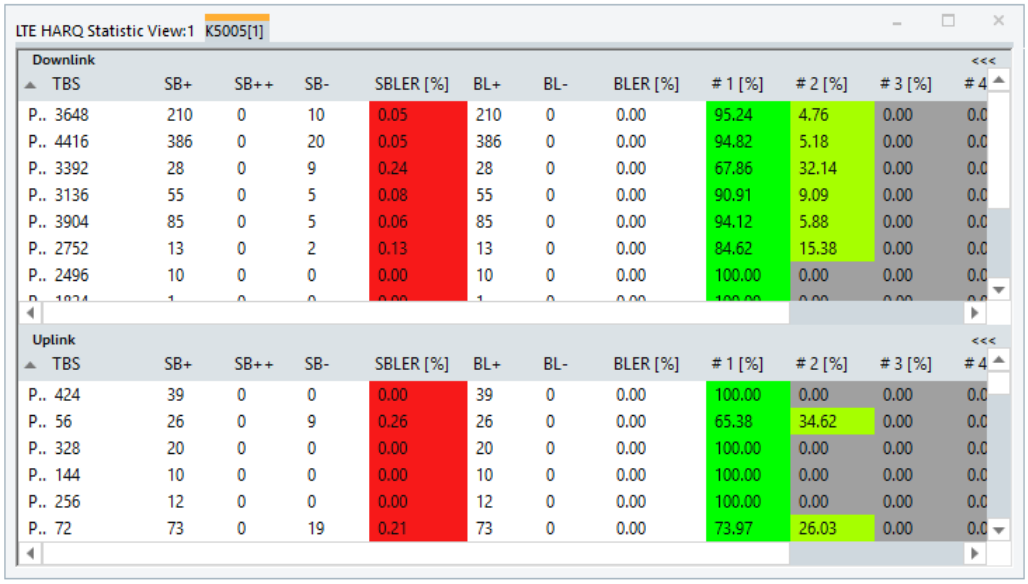


Figure 4-415: LTE HARQ Statistic View

The view supports also the LTE-Advanced Carrier Aggregation feature and displays the data of secondary component carriers. The secondary component carriers (SCC) data is shown in the first column. The SCC entries are marked with "Sn" for n-th SCC and the PCC with "P".

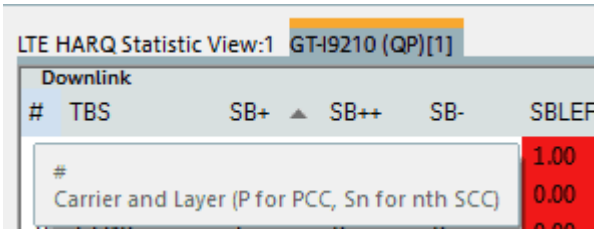


Figure 4-416: LTE-Advanced HARQ Statistic View

All HARQ statistics are also done for eMBMS HARQ. Using the corresponding R&S ROMES4 signals, the resulting values are visible. The "HARQ Statistic View" adds the prefix "e" to TBSs used for MBMS/eMBMS.

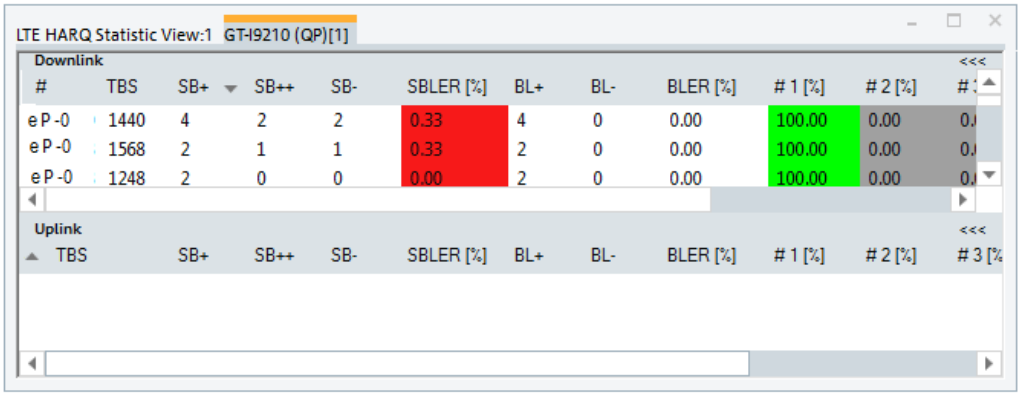


Figure 4-417: LTE HARQ Statistic View - eMBMS

In the LTE available signals tree you can see all the signals related to the eMBMS HARQ statistics.

The eMBMS available signals are described in the "Description of R&S ROMES Signals" manual.

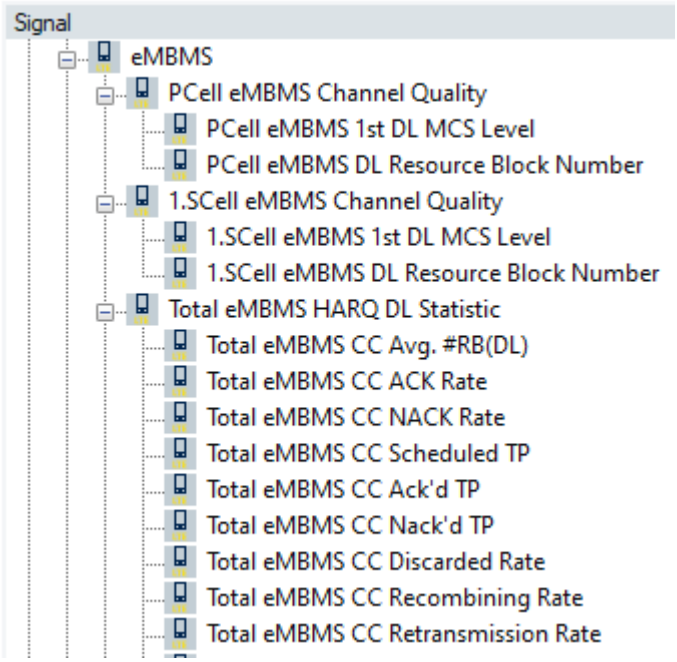


Figure 4-418: LTE HARQ Statistics View - available eMBMS signals

View area

The entire view area is horizontally split to accommodate two tables for the downlink and the uplink.

A click on the title bars compresses and expands the tables. A compressed table leaves more space for the other table A compressed table is characterized by the sym-

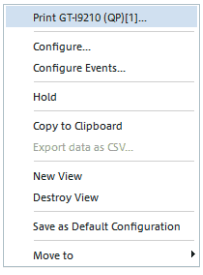
bol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Table

The following information is displayed for downlink and uplink:

- **#**
  Code word
- **TBS**
  Transport block size
- **SB+**
  Number of successful decoded sub-blocks. Number of successfully decoded sub-blocks. A sub-block is a mobile specific unit comprising the data of one subframe.
- **SB++**
  Number of duplicated Sub Block Number of duplicate sub-blocks. Duplicate sub-blocks are sub-blocks that the network retransmitted although they were received correctly (usually because no ACK message was received from the mobile).
- **SB-**
  Number of failed decoded sub blocks. Number of sub-blocks which could not be decoded successfully has to be retransmitted. These blocks contribute to the SBLER but not necessarily to the BLER
- **SBLER [%]**
  Sub-block error rate. SBLER = SB– / (SB+ SB–).
- **BL+**
  Number of successful decoded blocks.
- **BL-**
  Number of failed decoded blocks.
- **BLER [%]**
  Block error rate, BLER = BL– / (BL+ BL–). BLER is usually smaller than the SBLER because it counts only the blocks that could not be decoded until the end of the HARQ process (until the maximum number of retransmissions was reached).
- **#1[%] to # >5[%]**
  Percentage of blocks for which n (n=1 to 5) transmissions were needed for successful decoding.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

LTE HARQ statistic view configuration

The view configuration menu allows adapting the visualized columns in the "Downlink" and "Uplink" table of the view. Select or deselect the IE listed in the "Downlink List Column"/"Uplink List Column" according to your needs.

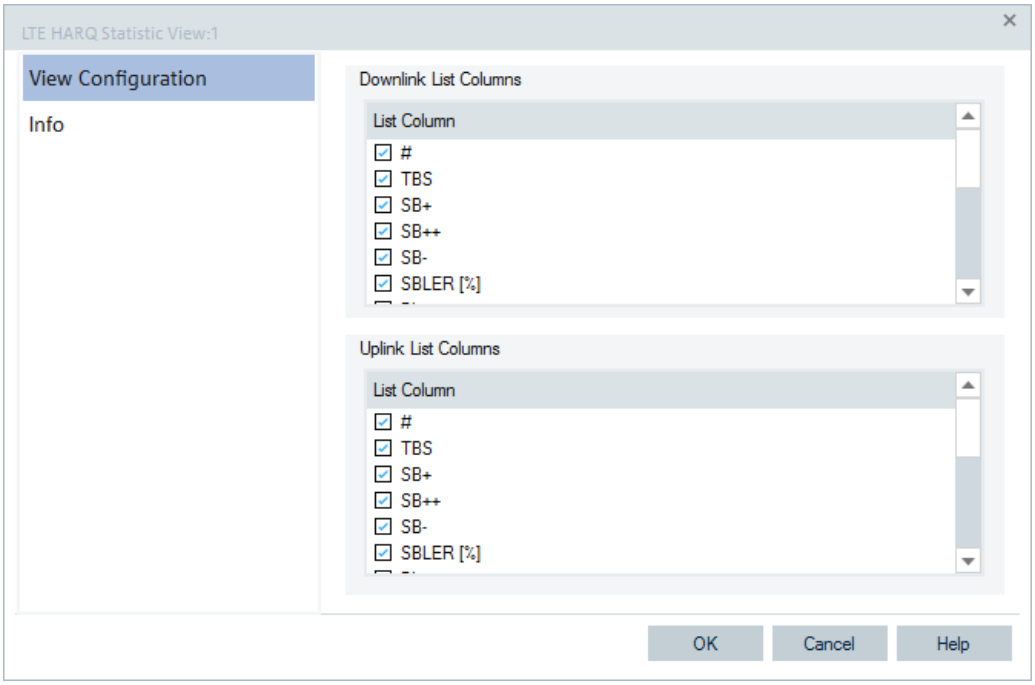


Figure 4-419: LTE HARQ Statistic View - configuration

4.4.6.6 LTE HARQ view

The view displays detailed information about the HARQ processes in downlink and uplink direction for FDD and TDD LTE.

The "LTE HARQ View" supports the LTE-Advanced Carrier Aggregation feature. The view shows the HARQ processes for PCC or SCC<n>.

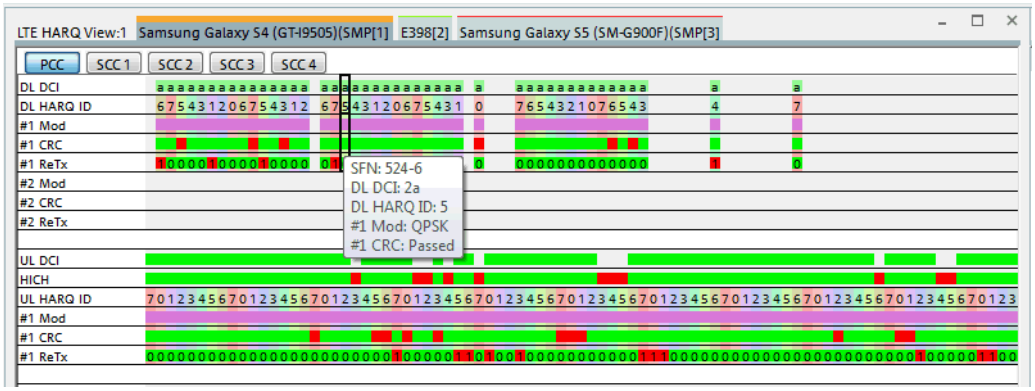


Figure 4-420: LTE HARQ View - FDD mode

The "LTE HARQ View" supports also eMBMS. The HARQ processes are evaluated separately for "normal" LTE and eMBMS.

The "LTE HARQ View" for eMBMS shows the eMBMS TTIs also, but the background color is always gray.

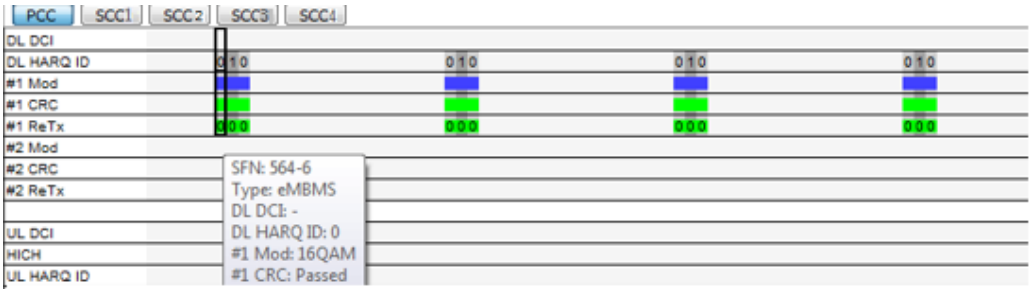


Figure 4-421: LTE HARQ View - eMBMS

The Qualcomm chipset-based LTE test UEs can trace the PDSCH Resource Block (RB) allocation and the PUSCH RB allocation, as shown in the following figure.

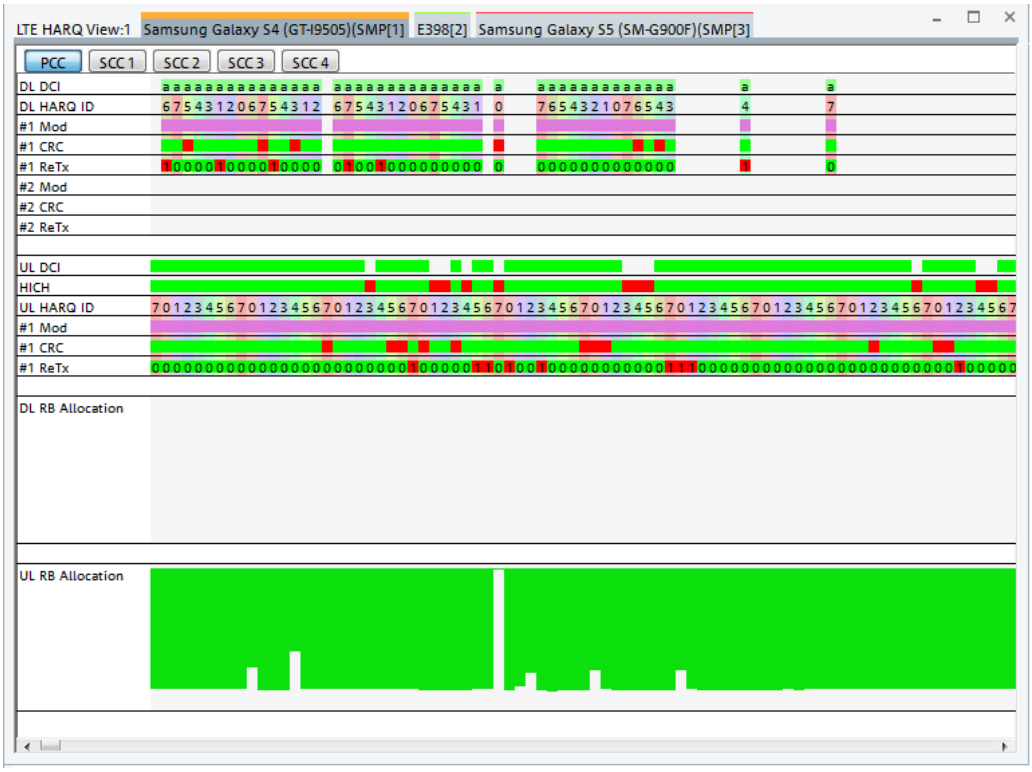


Figure 4-422: RB allocation for PUSCH

Enable the PDSCH/PUSCH de-mapper log for tracing the RB allocations. Due to the high update rate of this log, it is disabled by default, see "Extra settings LTE (Qualcomm)" on page 1639.

Each line of the RB allocation field represents a resource block, starting with RB 0 at the top. The field has always reserved 110 lines.

Visualizing the PCC and SCC processes

The view is identical for both component carriers.

A desired view is displayed when selecting the "PCC" or the "SCC<n>" button. The buttons are also present in the "LTE CQI View" to visualize the CQI processes for PCC or SCCs.

The upper part of the view, the "DL DCI" table, shows the DL layers. Hovering the mouse over a column marks the column and the other columns which are related to this TTI. A Tooltip displays the actual System Frame Number (SFN) and subframe number of the TTI, the HARQ ID and the used MCS. The view shows one column for each TTI, independently on if the TTI was used by the test device or not. This approach allows you to get a quick impression about the allocated time resources. The values are coded in colors.

The lower part, the "UL DCI" table, shows the UL DCI data transmission itself and the HICH. The corresponding retransmissions are not in the same TTI (column), but always shifted by 4 TTIs.

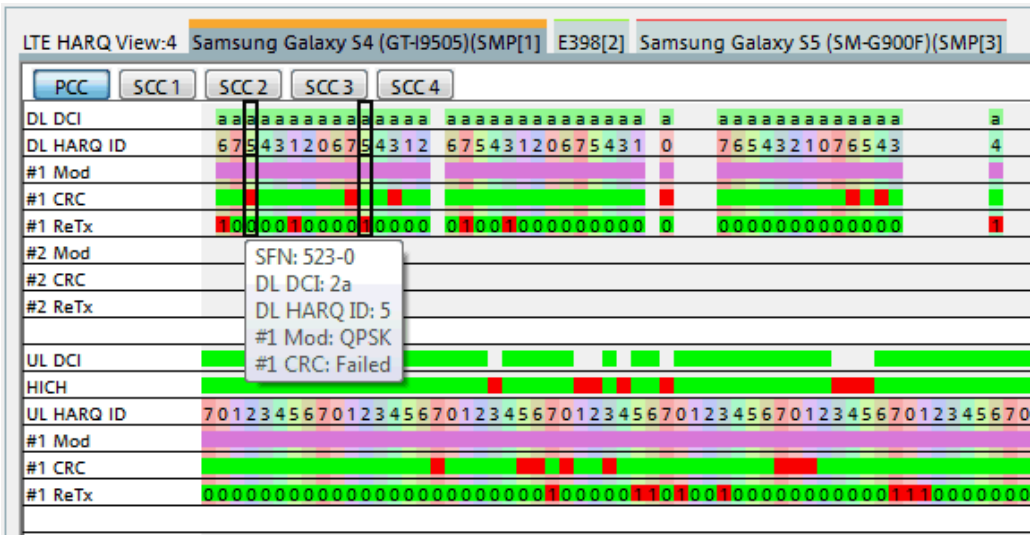


Figure 4-423: Move mouse pointer over column to view details

If double-click a column, the Tooltip shows information of the complete column.

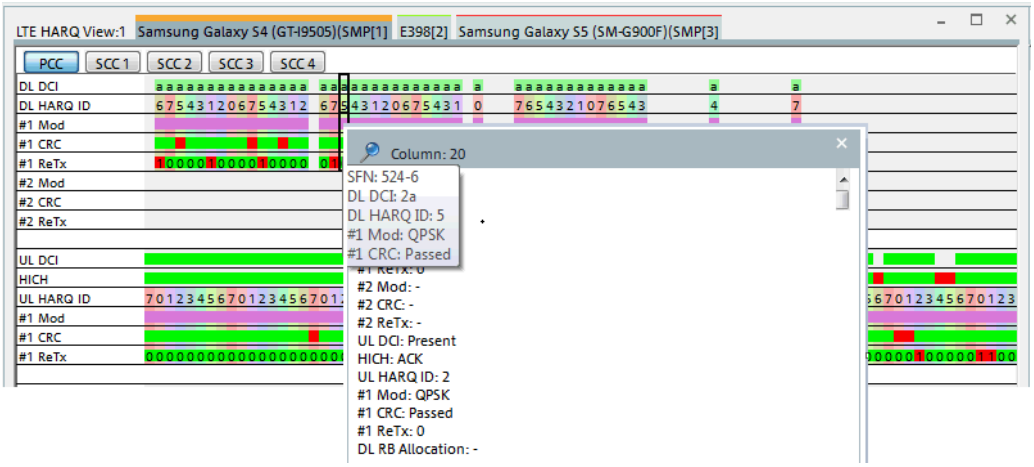


Figure 4-424: Double-click a column to view more details

Based on the HARQ, the R&S ROMES4 provides signals which can be used in the basic views, example given, in the "Alphanumeric View" or "2D Chart View". All signals are calculated on 1second basis.

Signal	Branch	Remark
Scheduled TP	HARQ DL	The scheduled throughput is calculated by the sum of transport blocks sizes of assigned TTIS divided by the number of assigned TTIs*1ms. This throughput takes into account only the TTIs which actually have been assigned to the UE.
Avg. DL RB	HARQ DL	Average number of assigned resource blocks in the time window.
Req. MIMO Imbalance	HARQ DL	This parameter compares the reported wideband CQIs for MIMO channel 1 and 2. The value is the difference of WB CQI1 minus WB CQI2
Scheduled MIMO Imbalance	HARQ DL	This parameter shows the differences of the throughput on the MIMO channels. It is calculated as the difference of the scheduled TP of TBS1 minus the scheduled TP of TBS2. This parameter reflects the balance of assigned throughput to both MIMO channels by the eNodeB.
Ack'd MIMO Imbalance	HARQ DL	This parameter compares the actual acknowledged throughput on both MIMO channels. The value is the difference between the Ack'd TP on channel 1 and channel 2. The acknowledged throughput is calculated taking into account all TTIs and not only the assigned TTIs as the scheduled throughput value does.
Avg. WB CQI 1 **Avg. WB CQI 2**	HARQ UL	The average WB CQI for the MIMO channel per time unit.
Avg. UL RB	HARQ UL	The average number of assigned resource blocks on the uplink.
Req. QPSK Rate **Req. 16QAM Rate** **Req. 64QAM Rate**	HARQ UL	The requested rate of the modulation schemes per time unit based on the CQIs.
Req. Throughput	HARQ UL	The requested throughput based on the CQIs. If only CQI1 is reported, the same value is assumed for CQI2. It is assumed, that 66 resources elements per resource block can be used in the case of normal prefix and 58 in the case of extended prefix. The second MIMO channel is taken into account accordingly to the reported rank index in the time window. E.g. if the average rank index is 1.5 it is assumed, that for 50% of the TTIs MIMO will be used.

Figure 4-425: LTE HARQ View signals

LTE HARQ view data exporter

The executable `ExportHARQ.exe` file is the command line-tool for exporting the LTE HARQ view data to an R&S ROMES4 measurement file in CSV format. You can export to separate files all view entries with the valid data of each device.

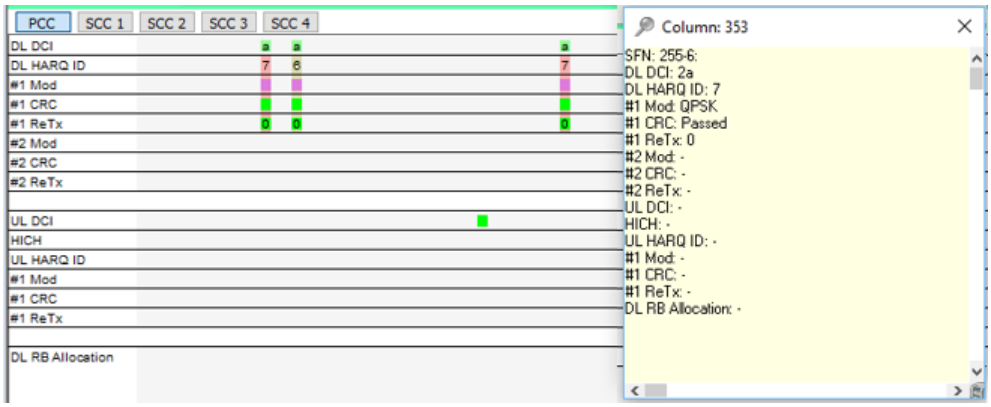


Figure 4-426: Successful data export

If the export was successful, the exporter returns the data value to 0.

Syntax of export command line

The command line is

```
[C:\Program Files (x86)\Rohde-Schwarz\ROMES<version>]HARQ.exe
-f <measurement file> [-d <destination dir>]
```

The exporter saves the output files in the measurement file directory if no destination directory is specified.

The output files are named like the input files with the appended device name.

In case there are blanks in paths and/or file names, it is mandatory to use quotation marks.

For example, `"C:\User\My ROMES\MeasData\Measurement File.rscmd"`

Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The view configuration menu has only the "Info" tab. Click the "Configure" entry of the context menu to open the "Info" page.

If you select "New View", the "LTE HARQ View" allows monitoring the available component carriers for LTE carrier aggregation.

4.4.6.7 LTE performance view

The "LTE Performance View" displays the throughput performances of the mobile during the measurement.

In the properties pane you can select the charts displaying the performances you are interested in:

- Requested throughput per MSC and wideband CQi
- Total scheduled throughput per MSC
- Total acknowledged throughput and DL PDCP and RLC throughput
- MIMO imbalance

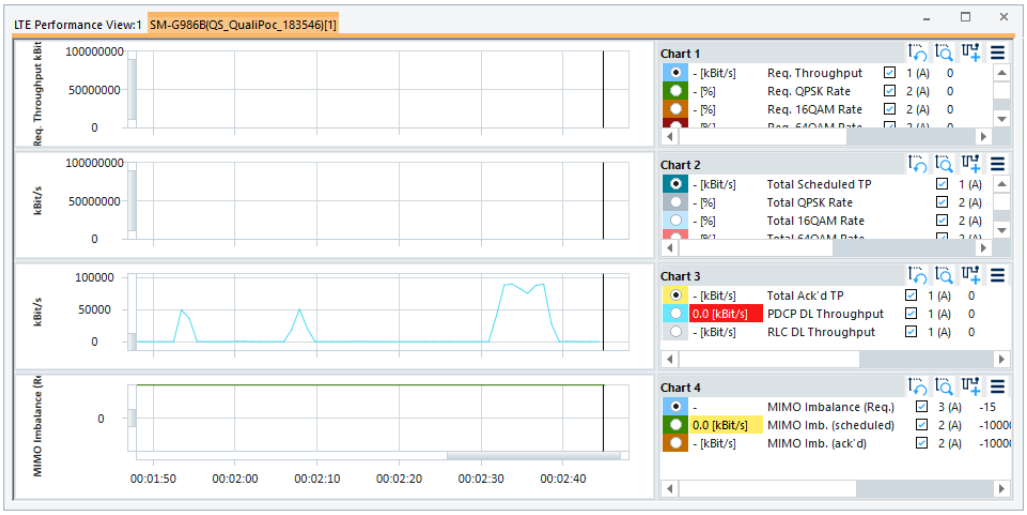


Figure 4-427: LTE Performance View

The "LTE Performance View" configuration is done in the "LTE Performance View: <variable> Properties" pane. Selecting the "Configure" command in the context sensitive menu of the view opens only the "Info" page.

For the meaning of the configuration entries in the properties of the "LTE Performance View", see Chapter 4.2.1, "2D chart view", on page 448.

4.4.6.8 LTE RACH view

The "LTE RACH View" summarizes all the information on the test-mobile's RACH procedures during the measurement.

There is a tab showing the connected device on the top of the screen. Multiple tabs are shown for multiple devices.

A switch bar control is located at the top of the tab view, see "Switch bar" on page 830.

The "RACH Summary" pane contains details on one RACH procedure attempt and success, see "RACH summary pane" on page 831.

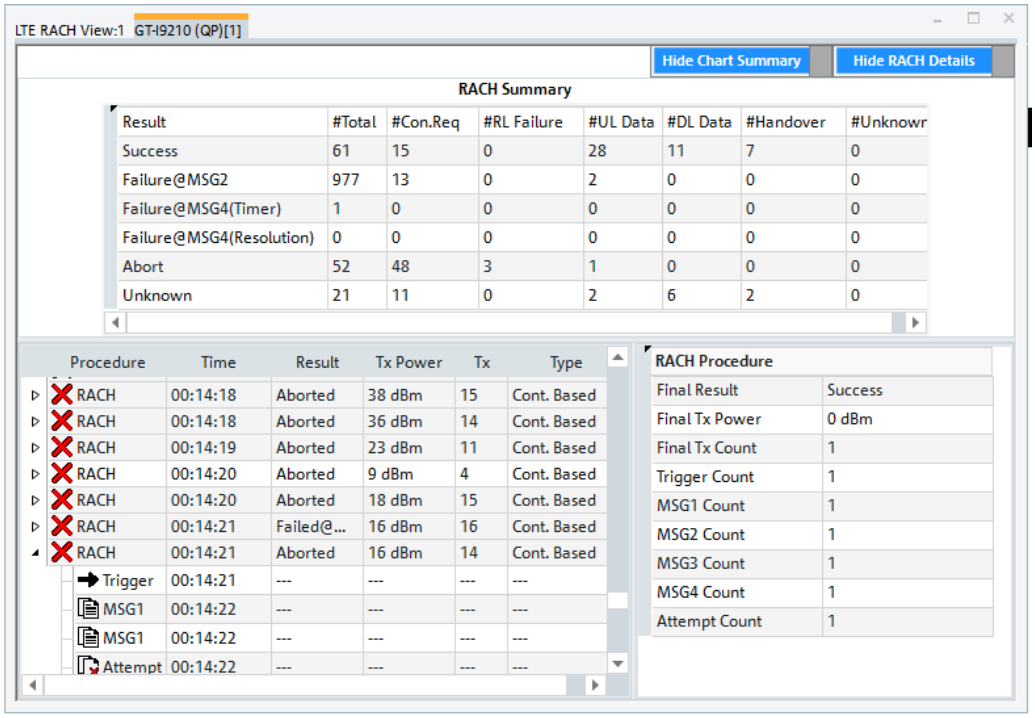


Figure 4-428: LTE RACH View

The view supports the R&S ROMES4 coupled focus, see Chapter 4.1.6, "Coupled focus", on page 432.

General description

The RACH procedure can be triggered/started for one of the following reasons:

- Connection Request
- Radio Link Failure
- UL Data Arrival, see Figure 4-428
- DL Data Arrival
- Handover

These reasons to start RACH procedure are counted separately by R&S ROMES4 in the "RACH Summary" table.

The RACH procedure is controlled by a set of parameters that is signaled in the SIB2-NB Layer 3 message. They tell the UE, for example, what channel resources, timings and transmit power to use. The RACH resource parameters also control the behavior in case the signaling procedure fails. For example, controlled is how many attempts the UE can use to finalize the RACH signaling before it must abort the procedure.

The result of a RACH attempt can be:

- Success
- Failure (with details at what stage it failed)

The result of one RACH procedure can be:

- Success

- Abort
- Unknown

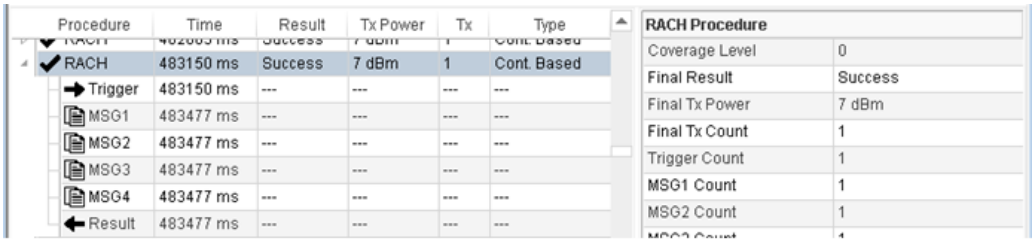


Figure 4-429: RACH procedure result

The reasons to trigger RACH procedure and the results of it are counted separately by R&S ROMES4 in the "RACH Summary" table.

Switch bar

The bar contains two switches used for hiding/showing chart summary (the top pane) and RACH procedure details (the bottom pane), respectively.

If a pane is visible, the corresponding switch shows "Hide …" and clicking the switch hides the pane.

The following figure shows the procedure details' pane only. The first switch is changed to grey color and shows "Show Chart Summary".

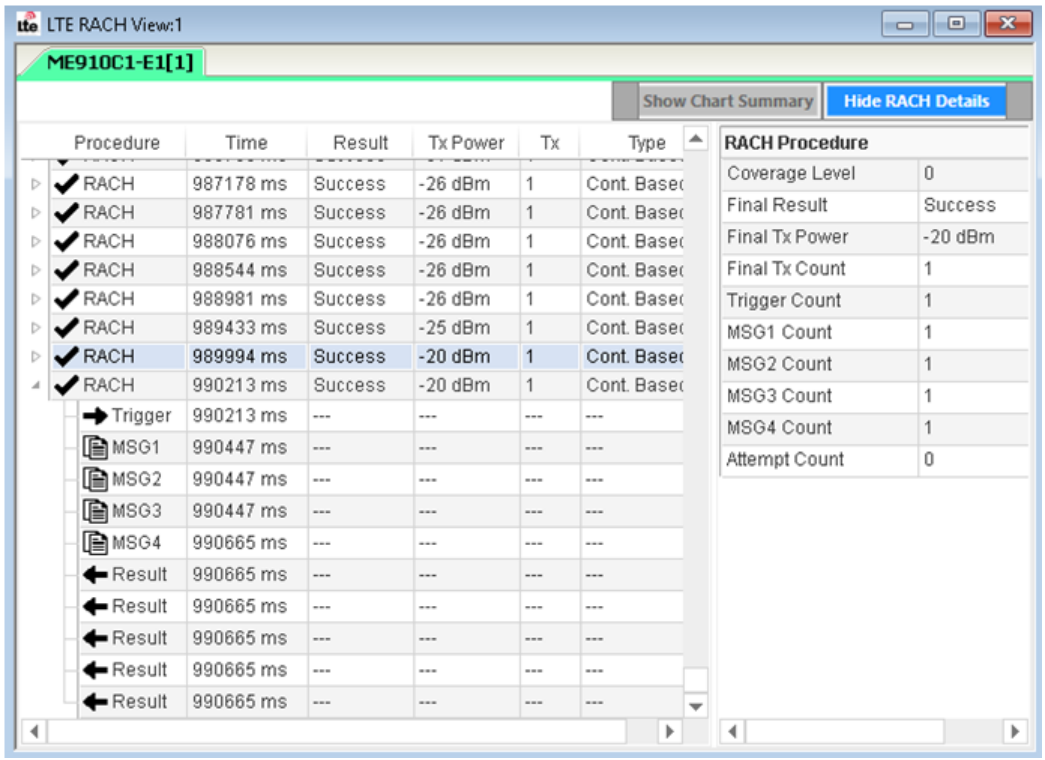


Figure 4-430: Hiding the view panes

Similarly, if a pane is invisible, the corresponding switch is in grey color and shows "Show …" and clicking the switch shows the pane. At least one pane is visible.

If resizing the view smaller, the switch cannot have enough space to show all the text. Ellipse is displayed at the end of the text.

Scroll bars can appear on the grids depending on the view size.

RACH summary pane

The "LTE RACH View" is horizontally divided into two panes.

- The top pane provides the statistics summary of all RACH procedures, that is, the number of started RACH procedures for any of the previously mentioned reasons.

RACH Summary

Result	#Total	#Con.Req	#RL Failure	#UL Data	#DL Data	#Handover	#Unknown
Success	289	5	0	284	0	0	0
Failure@MSG2	405	0	0	0	0	0	0
Failure@MSG4(Timer)	3	0	0	0	0	0	0
Failure@MSG4(Resolution)	0	0	0	0	0	0	0
Abort	98	31	0	67	0	0	0
Unknown	0	0	0	0	0	0	0

Figure 4-431: Top pane - RACH Summary

  The number of rows and columns of this table is fixed. The table always stays in the middle horizontally.
- The bottom part of the view is vertically divided into two panes.
  – The left bottom pane displays the list of RACH procedures and the messages summary.
  – The right bottom pane displays detailed information on the selected item in the list, see Figure 4-429.
  Double click an item of the procedure list to toggle expanded/collapsed status of the node.
  CTRL+double click an item of the procedure list to toggle expanded/collapsed status of all nodes.

Panes with loaded measurement file

1. Initially loading of the RACH view populates the view with empty panes.

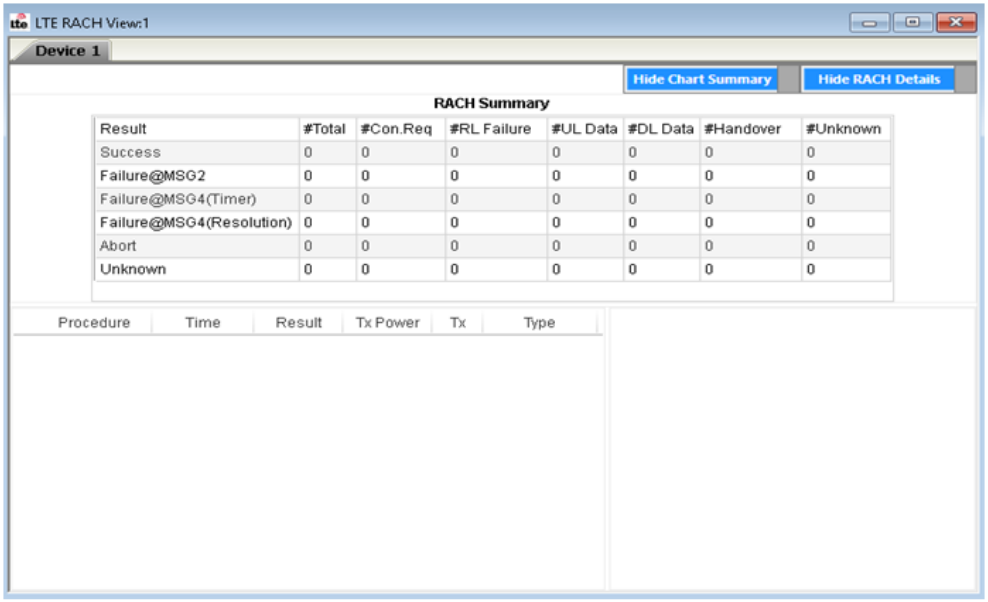


Figure 4-432: Initial loading of the view

2. After loading a measurement, the chart summary pane and the procedure pane are populated. The last entry of the procedure list ("Result") is selected and is visible.

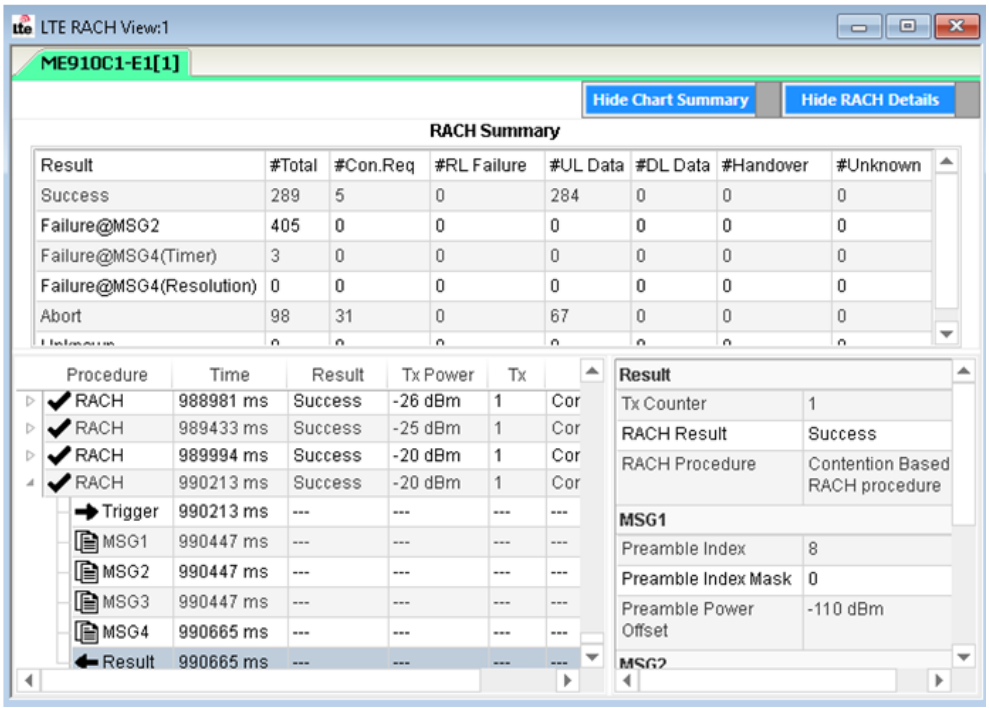


Figure 4-433: Procedure result

The "Procedure" table contains the procedure nodes and the message nodes. The detail pane is populated with the selected procedure or message node.

The following figure shows the success and abort procedure on the left-hand side and the attempt message on the right-hand side.

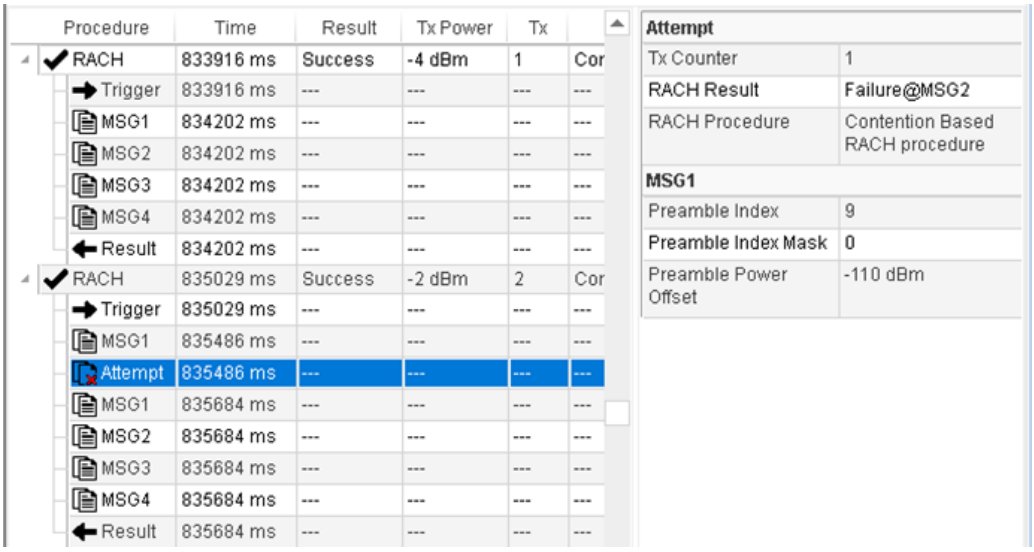


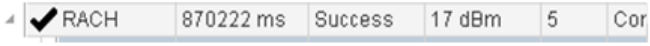
Figure 4-434: RACH attempt procedure and message

Root procedure nodes

The root nodes labeled with RACH are:

- Success final procedure without failed attempt (one attempt)

- Success final procedure with failed attempts (five attempts)

- Aborted procedure

Message nodes

The nodes under the procedure nodes are message nodes.

There are six types of message nodes.

Trigger

"Trigger" indicates the reason to start RACH procedure. The message node contains the information given in the next table.

Table 4-15: Message node - Trigger

RACH Reason	Connec-tion	Matching ID	Preamble	Preamble mask	MSG3 size	Group	Pathloss	CRNTI

MSG1

MSG1 is the request sent to base station. The message node contains the information given in the next table.

Table 4-16: Message node - MSG1

EARFCN	EARFCN offset	Coverage level	CP length	PRACH TX power	Sub carrier index	Sub carrier index offset	Number of repetitions	RA-RNTI	Scheduled SFN-SubFN	PRACH Tx SFN-SubFN	Window start SFN-SubFN	Window end SFN-SubFN

MSG2

MSG2 is the response from base station. The message node contains the information given in the next table.

Table 4-17: Message node - MSG2

SFN-SubFN	Timing Advance	Timing Advance included	RACH procedure mode	RNTI type	RNTI value

MSG3

MSG3 is the request sent to base station. The message node contains the information given in the next table.

Table 4-18: Message node - MSG3

Subcarrier spacing	I_SC	I_Delay	I_Rep	I_MCS	Number of subcarriers	Subcarrier index	Scheduled SFN-SubFN	MSG3 Tx SFN-SubFN

MSG4

MSG4 is the response from base station. The message node contains the information given in the next table.

Table 4-19: Message node - MSG4

Contention Result	MSG4 RX SFN-SubFN	UL ACK SFN-SubFN

Attempt

"Attempt" indicates a failed connection attempt. The message node contains the information given in the next table.

Table 4-20: Message node - Attempt

Tx counter	RACH result	RACH procedure

The "RACH Result" field of the message detail shows why the attempted connection failed.

The Figure 4-434 shows the Attempt message details in case the MSG2 failed.

Result

"Result" indicates the final result of RACH procedure. The message node contains the same information as the attempt node.

The possible results are:

- Success result without failed attempts, see Figure 4-433.
- Success result with failed attempts
- Aborted result, see the following figure.

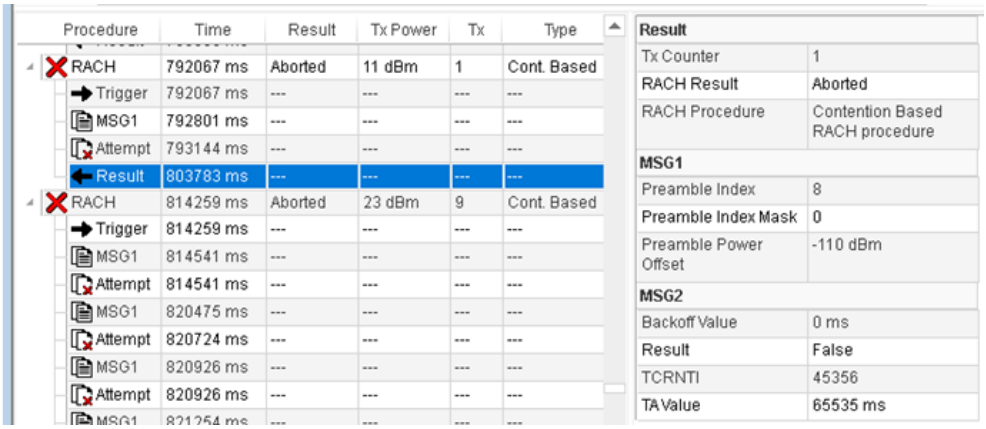


Figure 4-435: RACH procedure result - Aborted

Focus coupled synchronization

The RACH view participates RACH synchronization in "Replay" > "Pause" mode.

RACH synchronization is a process where a data provider notifies all its data observers to synchronize to a given timestamp. The process is called Focus Coupled Synchronization.

The following is valid for the process:

1. While Replay is in progress, there is no focus coupled view synchronization
2. While Replay reaches the end, there is no focus coupled view synchronization
3. Click the "Pause" button.

   Replay is in Paused mode and focus coupled view synchronization is available. The synchronization is timestamp-based.
4. Changing selection in one of focus coupled views, triggers synchronization to RACH views
5. The synchronized RACH nodes are RACH procedure nodes, not message nodes.

During the RACH synchronization

1. Clicking an entry of, for example, Layer 3 view, causes RACH view to show the corresponding procedure node whose timestamp is related to the selected Layer 3 view record.

2. Clicking an entry of RACH view procedure list, notifies all its subscribers to synchronize, including other RACH views.

Replaying or measuring in progress

If R&S ROMES4 is configured to work with a phone or UE during measuring, new nodes for the phone connect procedures is added to RACH view procedure pane. The pane automatically grows and scrolls to the bottom. The last message of the last procedure is selected as visible.

Count of failed MSG2, MSG4 and attempts

MSG2 failure

During connection procedure, after UE sends MSG1, a MSG2 is expected.

1. If MSG2 is not received correctly, an Attempt message is generated. The associated "MSG1" and the "RACH Result" field of the Attempt message show Failure@MSG2 in the details pane.
2. The total count of failed MSG2 is displayed in the cell of the "Failure@MSG2" row and in the "#Total" column of the "RACH Summary" pane.
3. The #Total count is the sum of failed MSG2's from all connection procedure nodes, including the nodes whose final result is success.

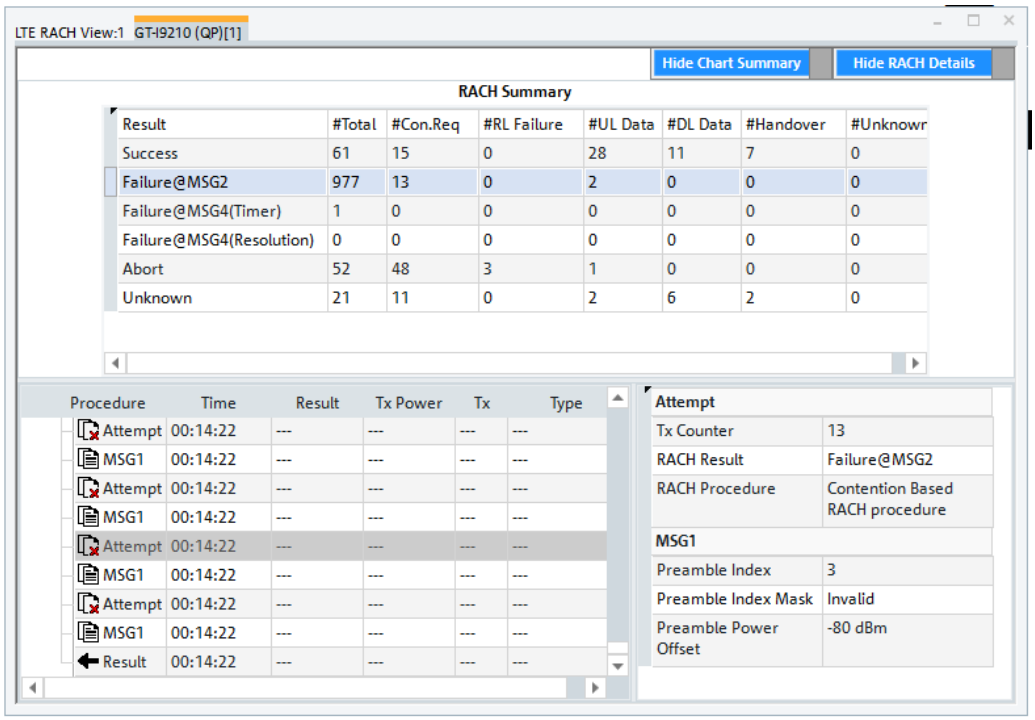


Figure 4-436: Total number of MSG2 failures

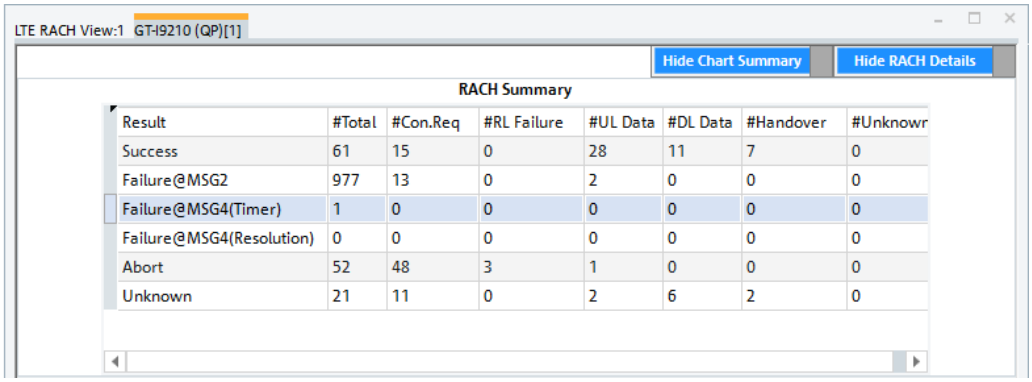
MSG4 failure

During connection procedure, after UE sends MSG3, a MSG4 is expected. MSG4 can fail.

There are two types of MSG4 failure:

- MSG4 timeout
- MSG4 resolution not passed

If the MSG4 fails, the "Contention Result" field of MSG4 node's detailed pane shows the message "failed".

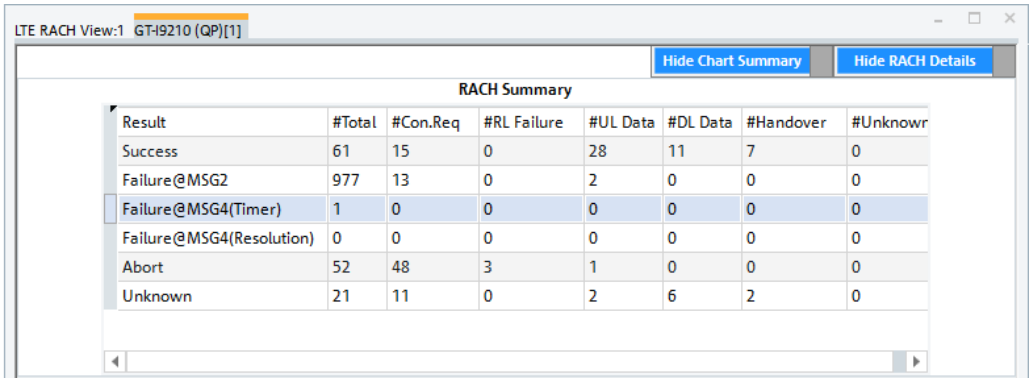


Result	#Total	#Con.Req	#RL Failure	#UL Data	#DL Data	#Handover	#Unknowr
Success	61	15	0	28	11	7	0
Failure@MSG2	977	13	0	2	0	0	0
Failure@MSG4(Timer)	1	0	0	0	0	0	0
Failure@MSG4(Resolution)	0	0	0	0	0	0	0
Abort	52	48	3	1	0	0	0
Unknown	21	11	0	2	6	2	0

Figure 4-437: Total number of MSG4 failures (timer)

In addition, an RACH Attempt message is generated following the failed MSG4.

The "RACH Result" field of the RACH Attempt message shows the failure reason in the detailed pane. The shown message is "Failure@MSG4 due to CT timer expired" or "Failure@MSG4 due to CT resolution is not passed".



Result	#Total	#Con.Req	#RL Failure	#UL Data	#DL Data	#Handover	#Unknowr
Success	61	15	0	28	11	7	0
Failure@MSG2	977	13	0	2	0	0	0
Failure@MSG4(Timer)	1	0	0	0	0	0	0
Failure@MSG4(Resolution)	0	0	0	0	0	0	0
Abort	52	48	3	1	0	0	0
Unknown	21	11	0	2	6	2	0

Figure 4-438: Failure@MSG4 due to CT timer expired

Signals and events for LTE RACH procedures

RACH procedures signals

There are two types of RACH signals:

- RACH single signal

The signal occurs between trigger and final result in one connection procedure. The signal values are only valid inside the procedure time frame. A line chart for those values shows the gap between procedures.

- RACH final signals
  The signal is the result for each connection procedure. The values stay continuously until new value comes in. In a line chart, it shows continuous line.

For the description of the signals related to RACH procedures, see the "Description of R&S ROMES4 Signals" document, the "LTE" > "Device n" > "RACH Procedures" chapter.

RACH procedures events

1. Add a RACH signal to "Alphanumeric View".
2. Right click the added RACH signal.
3. Choose the "Configure Events" menu item.

   The "Configure Events" dialog shows the new RACH procedures events.

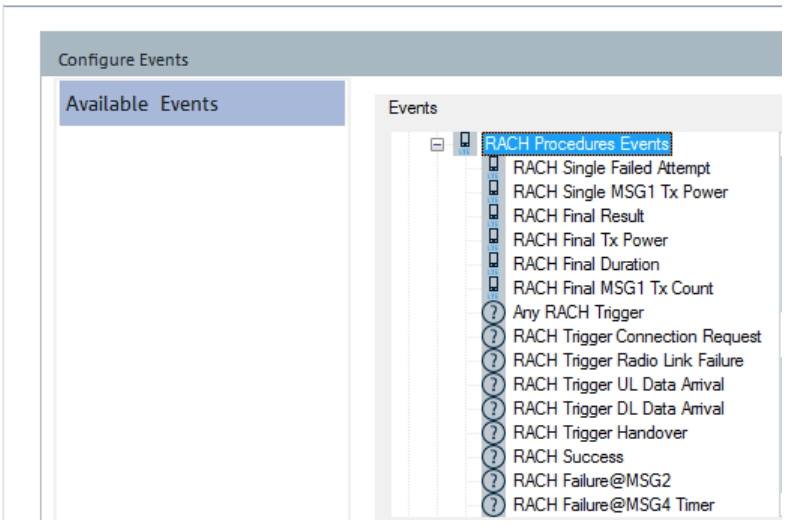


Figure 4-439: RACH procedure events configuration

RACH signals views

RACH signals in alphanumeric view

The figure shows all the RACH procedure signals in Alphanumeric View.

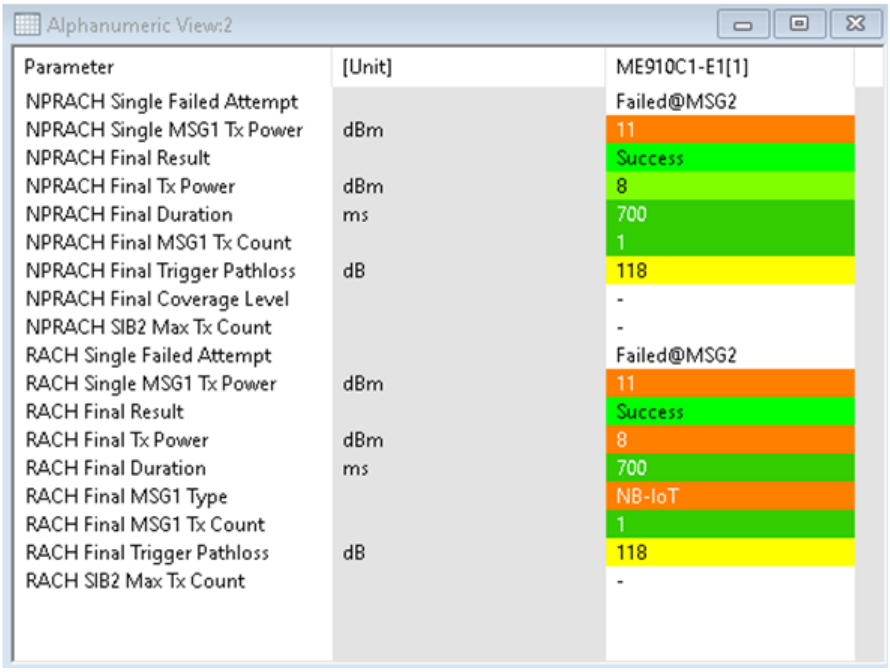


Figure 4-440: RACH procedure signals in Alphanumeric View

RACH single signals in 2D chart view

The figure shows the RACH procedure single signals in 2D Chart View.

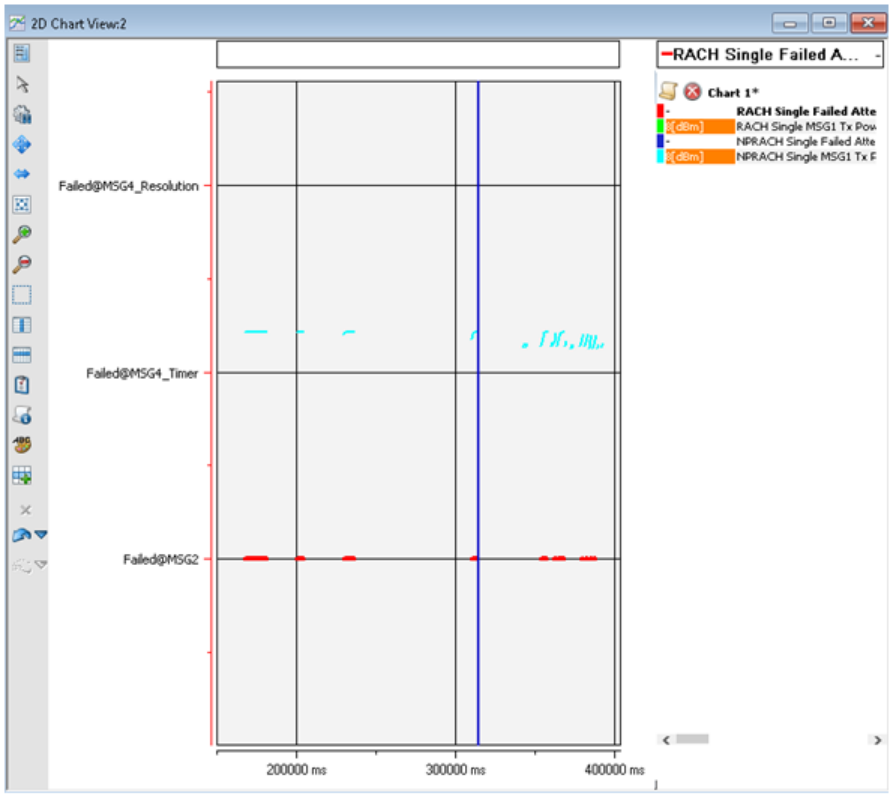


Figure 4-441: RACH procedure single signals in 2D Chart View

RACH final signals in 2D chart view

The figure shows the final RACH procedure signals in 2D Chart View.

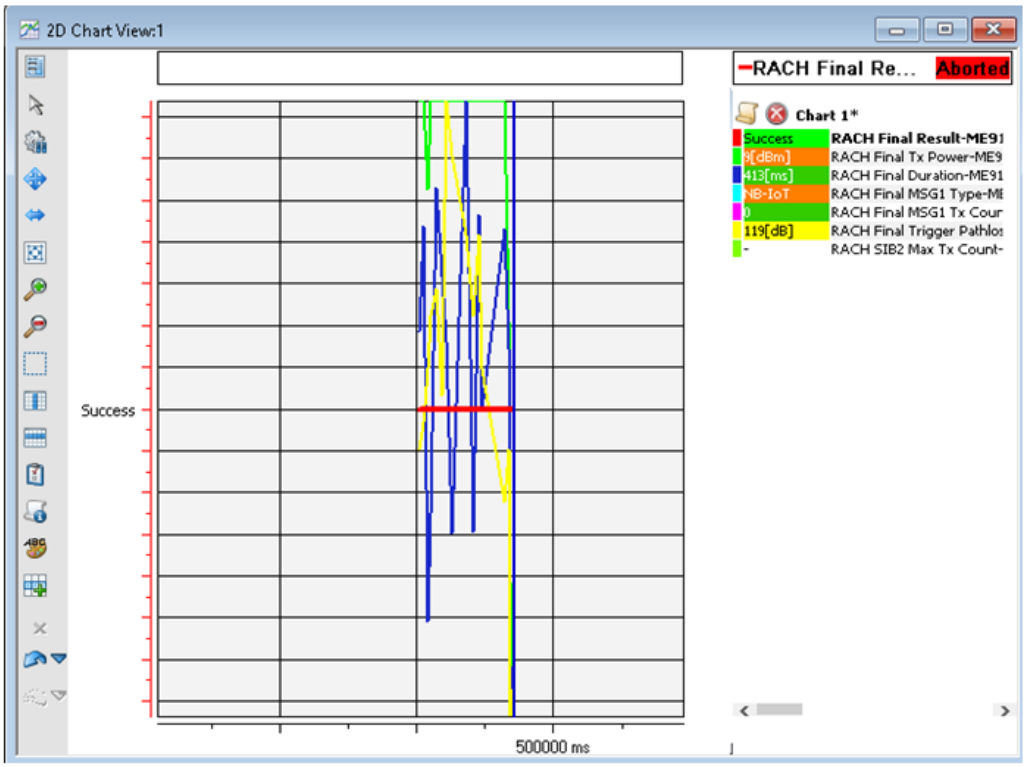


Figure 4-442: RACH procedure final signals in 2D Chart View

4.4.6.9 LTE radio bearer view

"LTE Radio Bearer View" shows the currently active downlink and uplink bearers, based on the RLC parameters configuration. The bearer type includes also the eMBMS bearer if present.

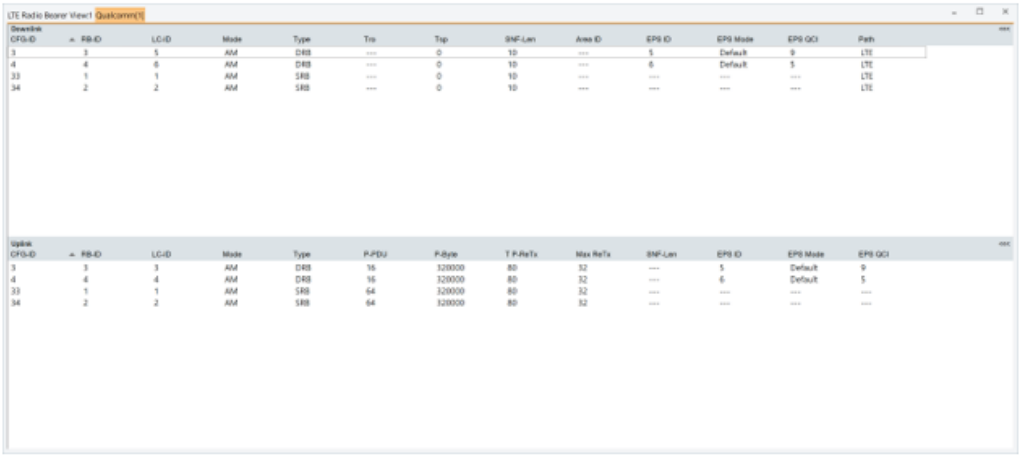


Figure 4-443: LTE Radio Bearer View

The following table shows the available information elements (IE) in the view. The Direction column indicates if an IE is present in DL, UL or in both directions.

Table 4-21: Available information in LTE Radio Bearer View

IE	Meaning	Direction	Remark
CFG	CFG_IDX of the radio bearer	Both	Unique index of the radio bearers
RB-ID	Radio Bearer ID	Both	Radio Bearer ID
LC-ID	Logical Channel ID	Both	Logical Channel ID
Mode	Radio Bearer Mode	Both	AM or UM
Type	Radio Bearer Type	Both	Signaling Radio Bearer (SRB) or Data Radio Bearer (DRB)
Tro	T_reordering	Downlink	T_reodrering timer in milliseconds
Tsp	T_status_prohibit	Downlink	T_status_prohibit timer in milliseconds, AM only
SNF-Len	Sequence Length	Both	Sequence length in bits: 5 bits SN or 10 bits SN, UM only
P-PDU	Poll PDU	Uplink	poll_PDU constant, AM only
P-Byte	Poll Byte	Uplink	poll_byte constant, AM only
TP-ReTx	T_poll_retransmit	Uplink	T_poll_retransmit timer in milliseconds, AM only
Max ReTx	Maximum retransmission	Uplink	Maximum number of retransmissions, AM only
EPS ID	EPS bearer Id	Both	Identity of EPS bearer
EPS mode	EPS mode	Both	EPS mode (default)
EPS CQI	EPS channel quality identifier	Both	A value from 0 to 15 indicting the channel quality
Path	PDCP path	Downlink	Visualizes which RAT is used by the bearer

LTE radio bearer view configuration

The "HARQ Decode Statistic View Configuration" menu lets you adapt the visualized columns in the "Downlink" and "Uplink" table. Select/deselect the RB parameters listed in the "Downlink List Column" and "Uplink List Column" panels of the view according to your actual needs.

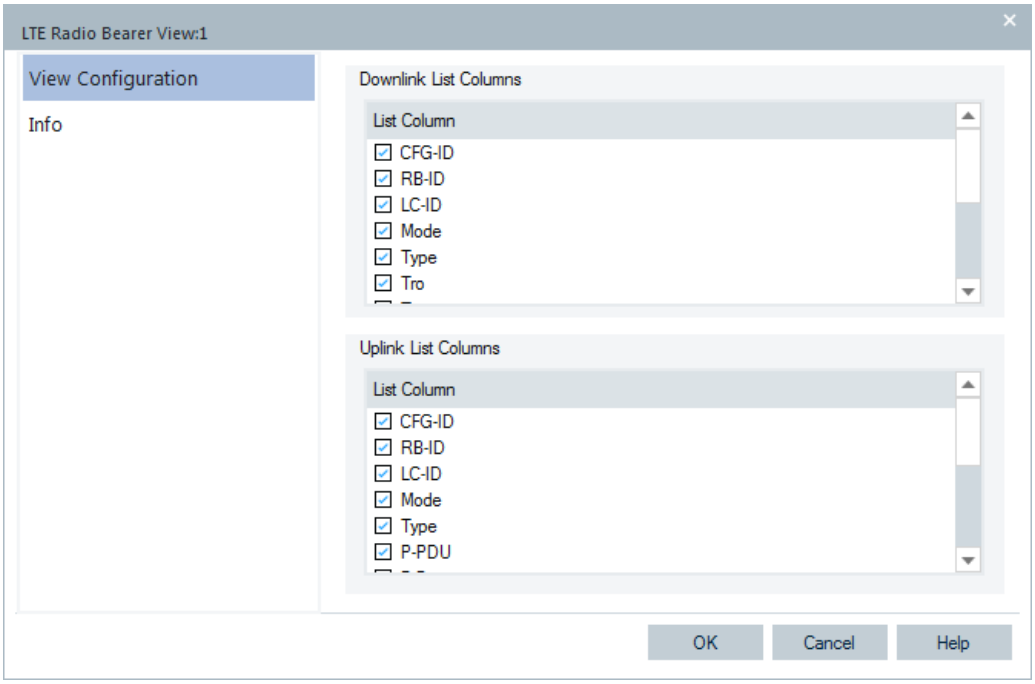


Figure 4-444: LTE RB View - configuration

4.4.6.10 LTE TTI view

The "LTE TTI View" lets you follow the data stream over the air for each used TTI and therefore to perform a detailed analysis of a test device performances per TTI. The view displays per TTI recorded values of component carriers and their states, frequency, SFN, number of used RBs and layers, modulation and so on.

To open the view, select the "Mobile Views" > "LTE Views" > "LTE TTI View".

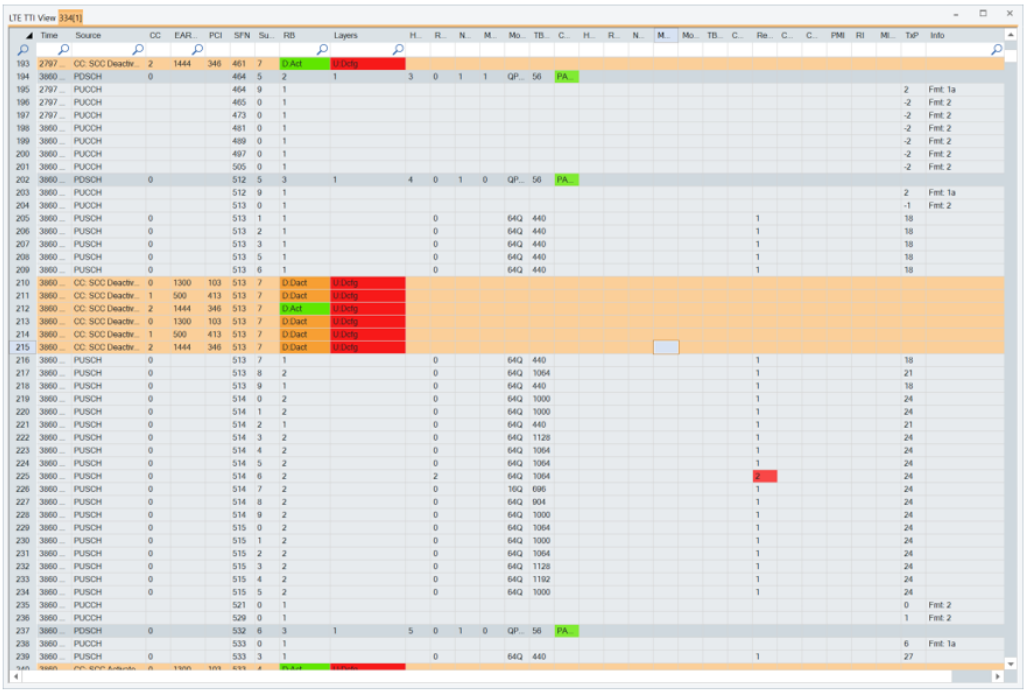


Figure 4-445: LTE TTI view

The previous figure highlights the option to display the PDSCH or PUSCH component carriers' states in the view. The state is reported as "Deconfigured", "Deactivated" or "Activated". The "Serving Cell View" however does not display the states of DL/UL component carriers.

The component carrier state signals are included in the "PDSCH Carrier" and "PUSCH Carrier" nodes of "Signal Tree" > "LTE UE". The signals are visualized in the "3GPP Overview View".

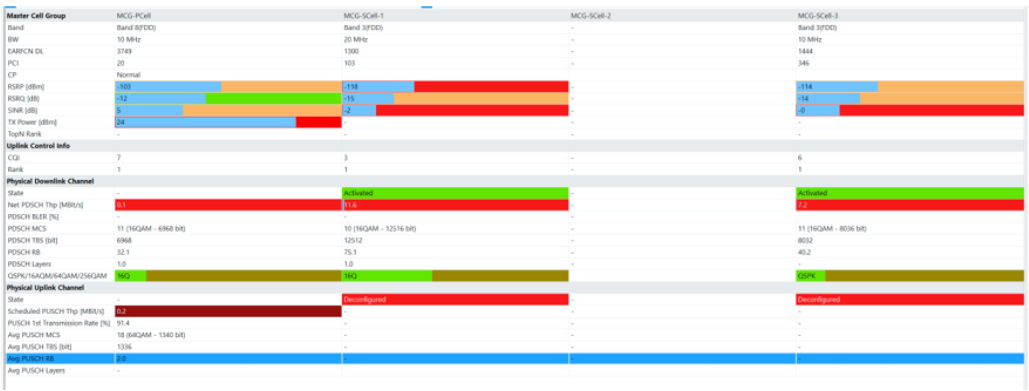


Figure 4-446: Extract from 3GPP Overview View

The "LTE TTI View" is filled by the values obtained only by Qualcomm chipset based devices.

Due to a huge amount of data, the required data logging is disabled by default. To get filled view, enable the TTI logging on the Qualcomm device's configuration page.

4.4.6.11 LTE UE signals

The following chapter is dedicated to the LTE UE signals supported by R&S ROMES4. The all LTE UE signals are configurable via "Preferences" > "Available Signals" > "LTE UE".

Figure 4-447: LTE UE available signals

The signals you want to display in a particular R&S ROMES4 supported LTE UE view can be also selected via the view's context menu.The LTE UE signals are grouped in nodes (branches) each one related to certain procedure, layer or function (e.g. support of VoLTE, eMBMS).

The previous screenshot shows the nodes of the "Signal Tree" > "LTE UE" signals. The UE cell signals are not distinguished in nodes whether they belong to PCell (Primary Cell) or SCell (Secondary Cell). The dedicated PCell and SCell UE signal nodes are

not supported in the R&S ROMES4 signal tree for LTE UE by default. For signal nodes that indicate performances of PCC and SCCs introduced are LTE UE nodes template signals. For example, the template signals are those signals contained in the "LTE UE Carriers" node.

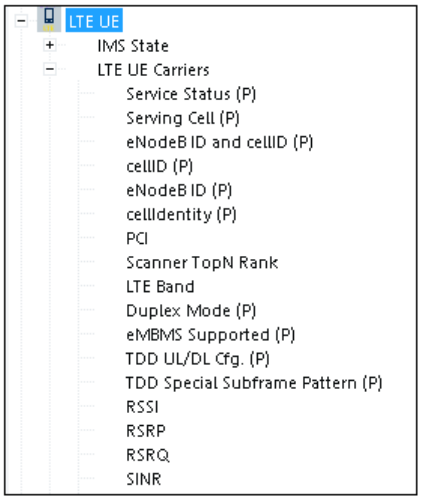


Figure 4-448: Template signals in LTE UE Carriers node

If a signal is only available in PCell carrier, "(P)" is suffixed in the signal name. If multiple signals are selected and the selected signals contain both PCell and SCell carriers, the filter dialog asks twice for both types of signals, once for each type.

For the following LTE UE nodes, related to carrieir aggregation, supported are template signals:

- "LTE UE Carriers"
- "Channel Quality Carrier"
- "PDSCH Carrier"
- "PUSCH Carrier"
- "HARQ DL Statistic Carrier"
- "HARQ UL Statistic Carrier"

Some signals of the previously listed signal nodes have the suffix (P) or (S) to mark clearly, that these signals are related to PCC or SCCs only, respectively.

Therefore, the mentioned nodes simplify the presentation of signals related to CA.

The list of supported LTE UE signals is long, as covered under the corresponding subnodes (branches). In the "Selection of LTE UE signals" on page 850 mentioned are only some of the supported signals. For the all LTE UE signals and their description, see "Description of R&S ROMES4 Signals" document.

Template signals filter dialog

When signal(s) are dragged into a view or for export, filter dialog pops up. LTE filter dialogs show different number of carriers in pulldown list.

Signals available for both PCell and SCell

If both PCell and SCell signals are available for the selected signal, following pulldown list displays LTE filter dialog.

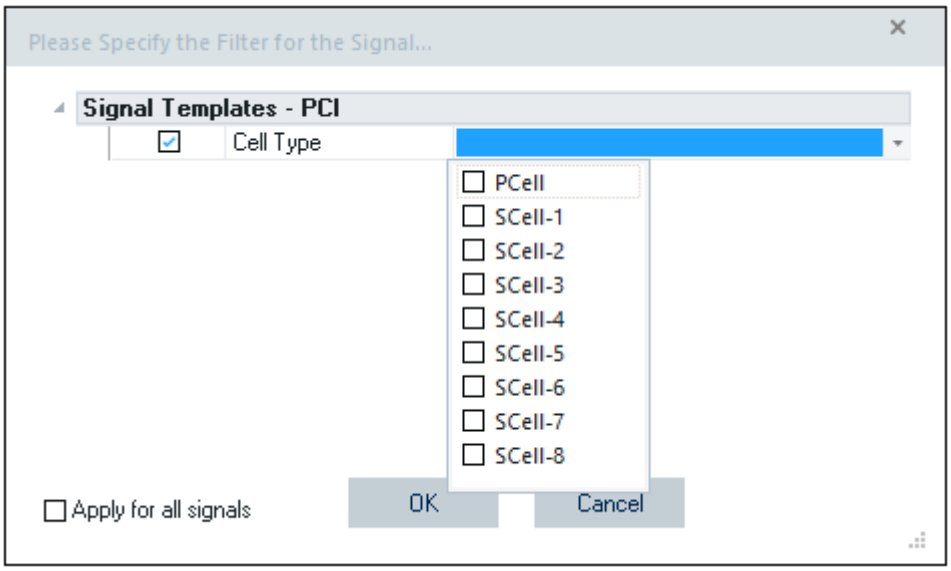


Figure 4-449: LTE filter dialog

There are 9 LTE UE mobile template signals, a PCell signal and SCell signals 1 to 8.

PCell only signals

If only PCell signal is available for the selected signal, the pulldown list is auto filled with the only choice - PCells.

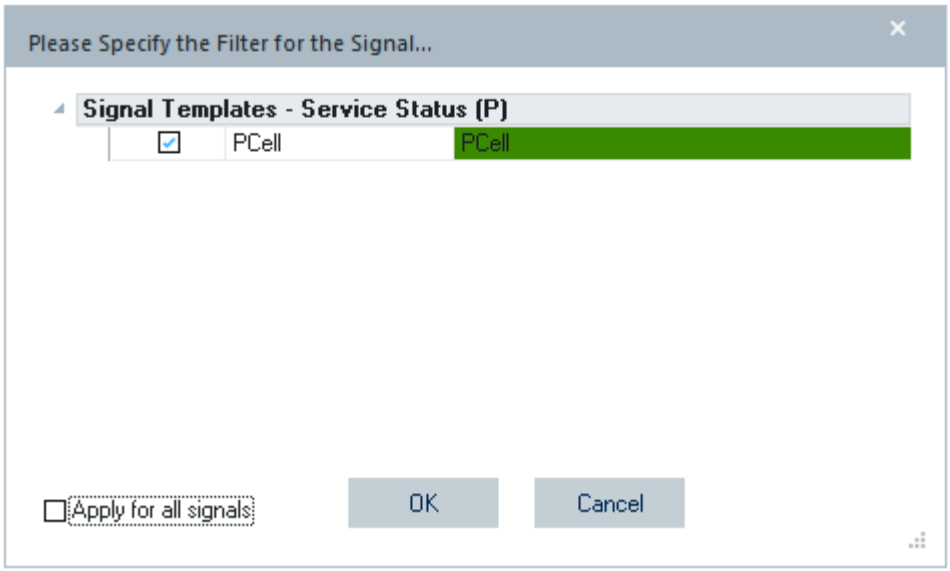


Figure 4-450: Filtering PCells only

Optionally, check the "Apply for all signals" check box to apply the choice to all signals.

Multiple signals for PCell only and for both PCell and SCell

It is possible to select multiple signals, some of them are PCells only and some are for both PCell and SCell. In this situation, the filter dialog asks twice for both types of signals, once for each type.

Prior filter

The "Prior Selection" template option is available in the filter dialog for both PCell and SCell.

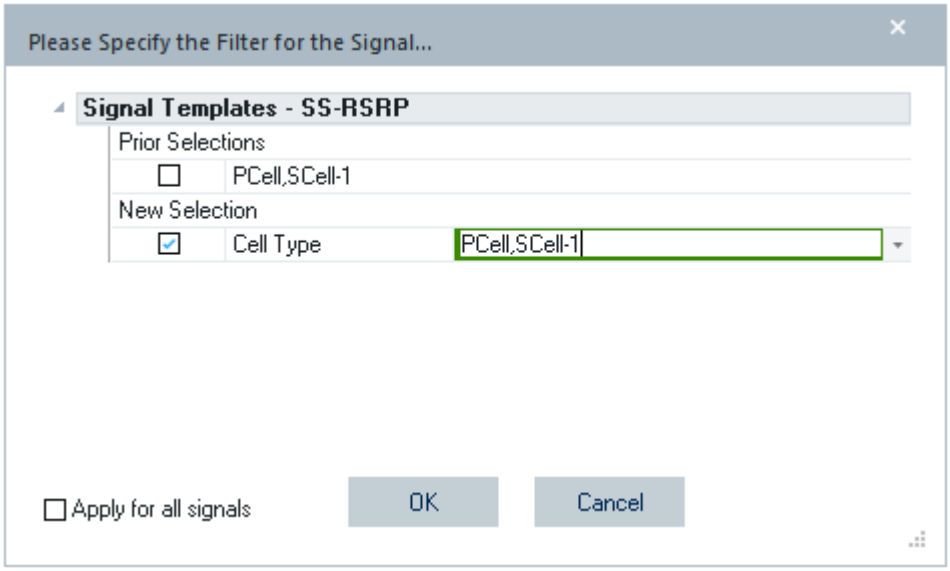


Figure 4-451: Prior selection both PCell and SCell

The LTE UE and 5G NR UE template signals are contained in the UE mobile views that involve carrier signals, e.g., "UE CA DL Performance View"/"UE CA DL Performance View", "Serving Cell View". The views are updated to show the signals correctly.

As the number of carrier increases, it can happen that there is no enough space to show all carriers at top of the view. Because of that reason, the carriers are not presented at the top of the views. If only one carrier is selected at a time, the carriers are displayed for selection in a pulldown menu. If multiple carriers are chosen for display at the same time, they have to be selected from the property bar on the left side of the view.

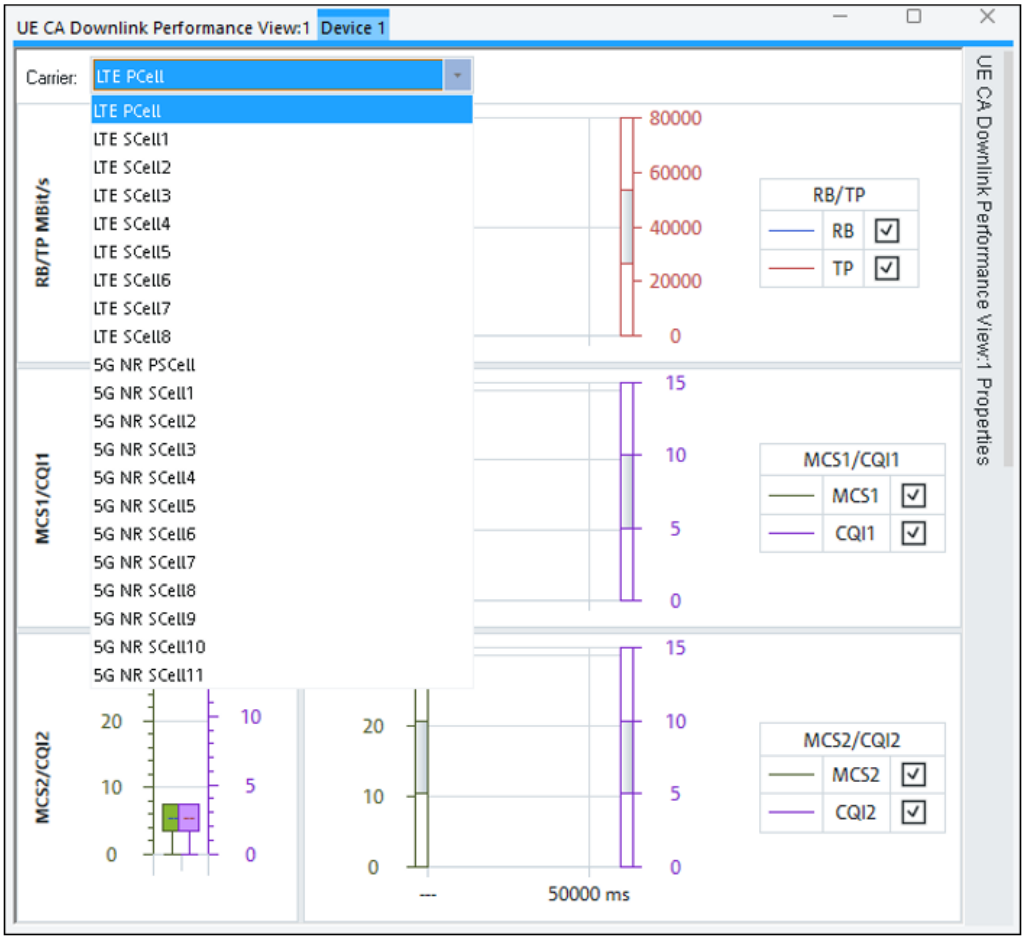


Figure 4-452: Single carrier selection from carrier selector

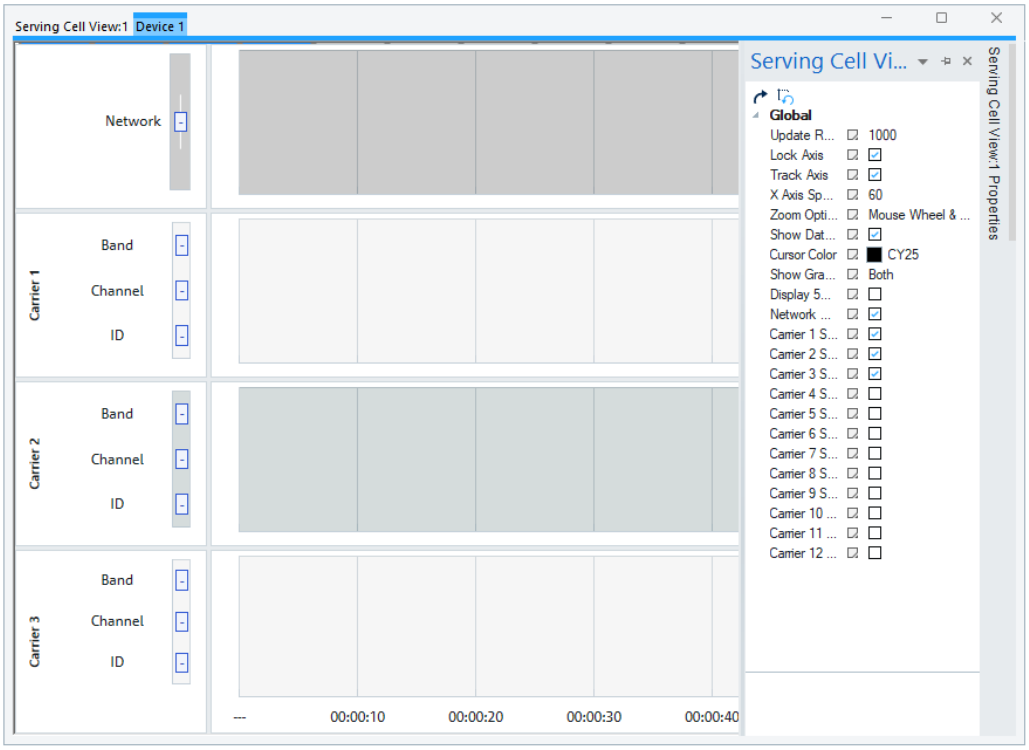


Figure 4-453: Multiple carriers selection from property bar

Selection of LTE UE signals

The list of supported LTE UE signals is long, as covered under the corresponding sub-nodes (branches). Here are mentioned only some of the supported signals. For the all LTE UE signals and their description, see "Description of R&S ROMES4 Signals" document.

Scanner Top N rank

The "LTE UE Carriers" branch of the "LTE UE" signal tree contains the "Scanner Top N Rank" signal. The signal displays the current rank of the carrier in the corresponding LTE TopN pool. Only LTE auto-EARFCN Top N pools are supported by this feature.

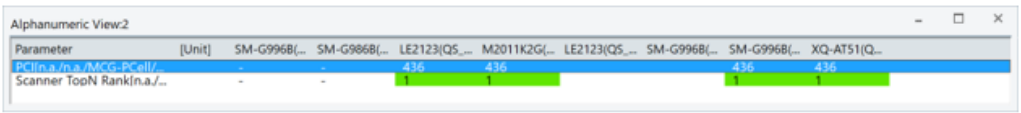


Figure 4-454: Alphanumeric view shows the scanner Top N rank

The screenshot shows that PCI 436 is detected by the scanner and ranked as the best cell.

The "3GPP Overview View" shows the Top N rank of the carrier for LTE and 5G NR within the MCG and SCG columns, respectively.

Figure 4-455: 3GPP Overview view shows MCG and SCG values

EPS QoS

The signals which provide access to the content of the PDU session configuration are available in the "EPS QoS" branch. The content is taken from the corresponding Layer 3 messages.

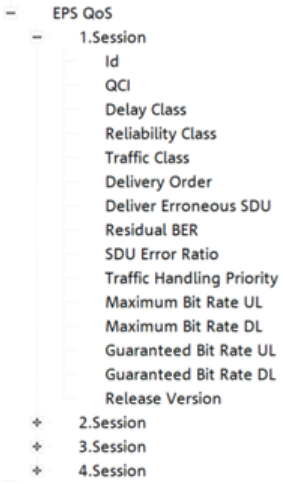


Figure 4-456: EPS QoS signals

The Session Activation has to take place while the measurement is active to get access to the data.

IRAT neighbor cells signals

R&S ROMES4 supports for LTE mobiles measurements and reporting of IRAT neighbor cells.

The IRAT neighbor cell signals are filled at the point in time when the UE starts reporting the measurement results to the network. The "measurementReports" messages and the corresponding "measConfiguration" command itself can be observed in the Layer 3 view.

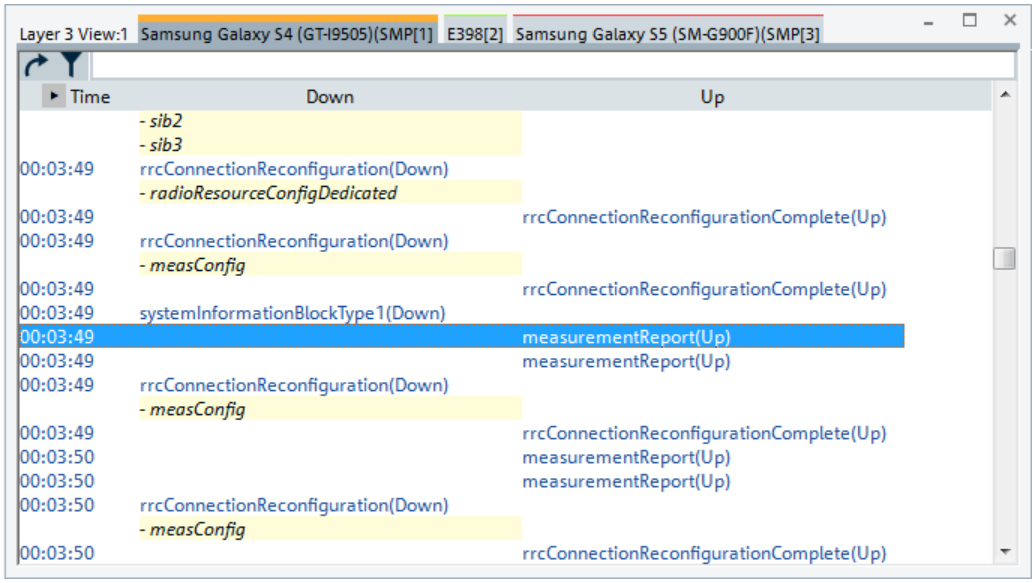


Figure 4-457: Time between measConfig and measurementReport

The IRAT neighbor cell details can be observed in the "Alphanumeric View".

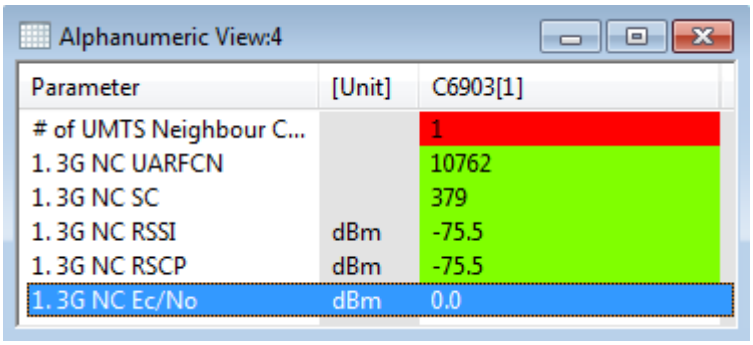


Figure 4-458: Reported 3G neighbor cell details

Voice call signals

R&S ROMES4 supports for LTE mobiles measurements and reporting of voice calls.

A voice call interruption is observed in the "Alphanumeric View". The signal to display the "Voice Interruption Time" between the RTP and the AMR stream, if configured, is measured and displayed in the view.

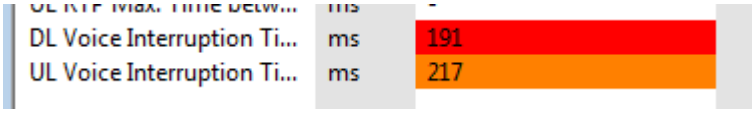


Figure 4-459: Voice call interruption time in both directions

The voice interruption time is measured from the last received RTP packet to the point in time when the first AMR packet has been received. The time is calculated separately for the downlink and uplink stream. This calculated performance indicator is not neces-

sarily the exact duration of the audio-interruption during the SRVCC, but is an indication of the performance.

The calculation of this duration is based on the UEs internal timestamps.

VoLTE RTP statistics signals

VoLTE statistics signals provided by the implemented RTP analyzer are available for viewing. Supported VoLTE RTP statistics signals are displayed for configuration in the "Preferences" page.

The values of the signals are updated in average every second.

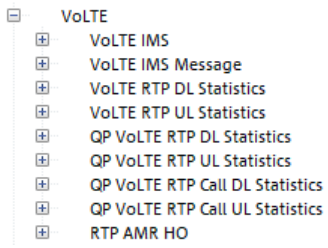


Figure 4-460: VoLTE RTP statistics available signals

The VoLTE RTP statistic signals are defined for both directions.

VoLTE IMS signals

Voice over LTE over IMS monitoring and reporting is supported by the R&S ROMES4, as far as concerning the security procedure.

Support of Cat M1

R&S ROMES4 supports the Cat M1 devices. They behave basically as normal LTE devices from a R&S ROMES4 perspective. The LTE available signal tree includes "Applied Coding Rate on the PUSCH" and "Last RACH MSG1 Type (LTE, NB-IoT or LTE-CatM)" signals. These signals give additional information on Cat M1 devices.

Support of LAA

Qualcomm and Exynos chipsets-based devices provide signals which indicate the current LTE CA state. One signal shows the number of aggregated carriers (LTE CA), the other one indicates if unlicensed band 46 is a part of the carrier aggregation set (LTE CA Type). The LTE CA signal type LAA is shown in several views if a LAA carrier is configured, for example in the "UE CA Downlink Performance View".

The Qualcomm chipset based devices support signals in the "PDSCH LAA Total" branch, analog to the "PDSCH Total" branch. These signals show the corresponding values, aggregated over all currently active carriers in a configured LAA band.

ESM throughput signals

The ESM throughput values obtained from UE can be displayed as R&S ROMES4 signals. The signals are available in the "ESM Throughput" branch.

These signals are the throughput values assigned by the network in EPS Mobility Management message, which is sent from a network to the UE during network connection.

Qualcomm only LTE MIMO-related signals

The R&S ROMES4 provides the signals of PCC and SCC<n>, n=1 to 8, obtained by the Qualcomm chipset based mobiles. These signals help better to understand the MIMO state. In addition to the Channel Quality RI, added is the distribution RI rate. The rate is calculated based on all reported RI during one cycle.

The RI reflects the UE reports of the current RF conditions regarding the usage of MIMO mode. It is the eNB that decides how many MIMO layers have to be used. The min., max. and average number of user layers and its distribution can be visualized by using the signals PCC/SCCn MIMO Layers Min., Max., Avg. and the corresponding rate signals. The signals report the value for all TTI in one cycle.

4.4.7 NB-IoT views

Select the "View" > "Mobile Views" > "NB-IoT" to get currently available NB-Iot views.

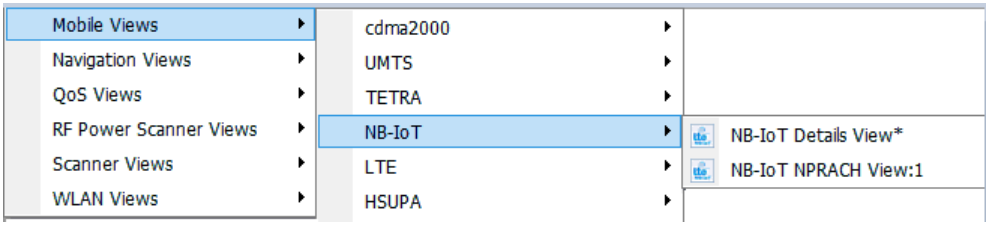


Figure 4-461: NB-IoT mobile views

To get an in-depth view of what is going on during a NB-IoT session, detailed measurement data is required.

On the other hand, the setup of the actual test requires some knowledge of AT commands and the general behavior of such a module. To fulfill both requirements, R&S ROMES4 offers solutions which help you getting data in more convenient way.

4.4.7.1 NB-IoT details view

The "NB-IoT Details View" offers an in-depth view of the NB-IoT procedures. It offers all available data per TTI from the sources of NPRACH, NPDSCH, NPUSCH and DCI information.

To get a better overview, all uplink related messages are colored blue, while all downlink related messages are colored green. The view synchronizes to other views by timestamps, so that the related TTIs for problems spots can be identified easily. The cells of the table which indicate errors are marked red.

The left most columns are the same for all source. They describe the source, the timing (HSFN, SFN, SubSFN), NPRACH messages, RNTI type and the direction.

The content of the right columns depend on the source. Thus the actual name of the parameter is part of the cell.

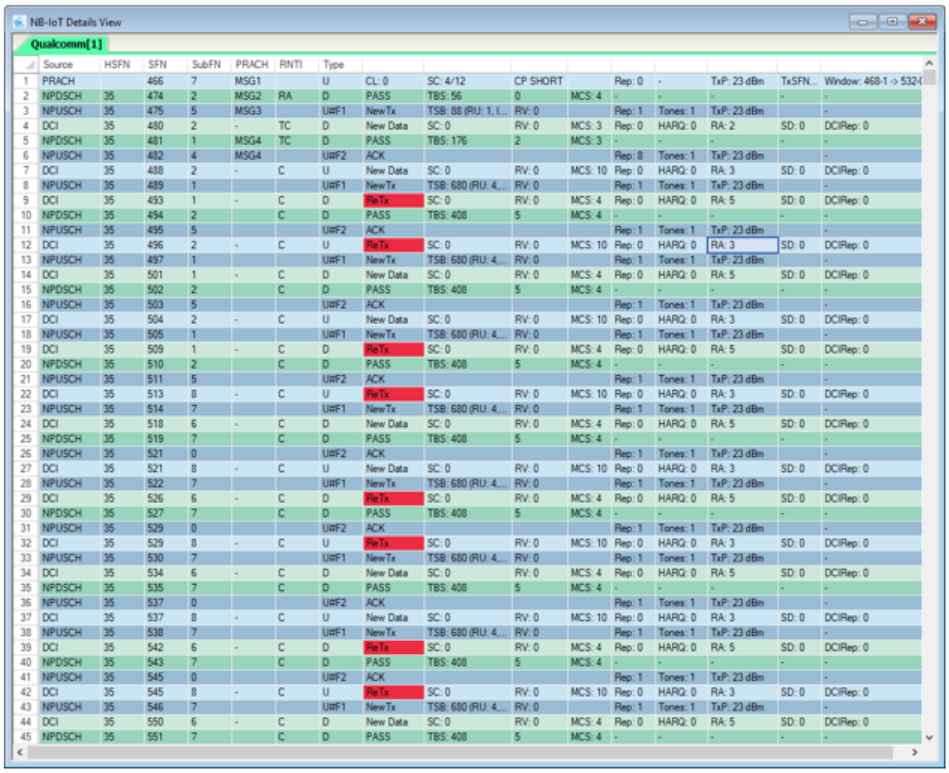


Figure 4-462: NB-IoT Details view

Detailed measurement data

NB-IoT signals have their own branch in the "Available Signals" tree, refer to "Description of R&S ROMES4 Signals".

The branch is just a different view of the data in the measurement files. The measurement data itself is still stored in the LTE mobile container.

Depending on the firmware of the NB-IoT module, R&S ROMES4 can provide more detailed measurement data via the NB-IoT available signals branches related to:

- **Layer 1**
  Layer 1 parameters which are essential for coverage measurement. These parameters are NRSRP, NRSSI, NRSRQ, NSINR, for example.

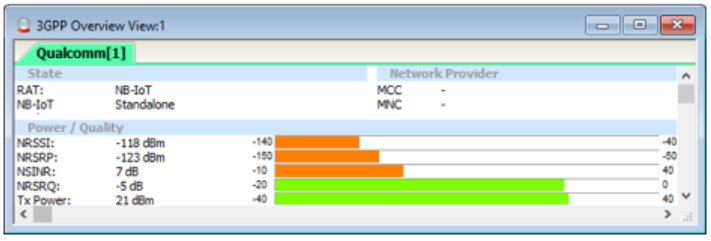


Figure 4-463: 3GPP Overview view of NB-IoT

Additionally to the server parameters, the cell reselection list is populated via R&S ROMES4 signals. This list contains all eNodeBs, which are currently seen by the UE and their ranking regarding cell reselection.

- **Layer 2**
  The NPUSCH signal branch provides signals, which indicate collisions on the NPRACH. For all format 1 TTIs the number of collisions are counted and reported as percentage related to the total number of format 1 TTIs .
- **Service Status of UE**
  The actual service status of the UE is available as R&S ROMES4 signal (the branch "NB-IoT" > "Device" > "Serving Cell"). This signal indicates, if the UE is in service or, for example, in power save mode.

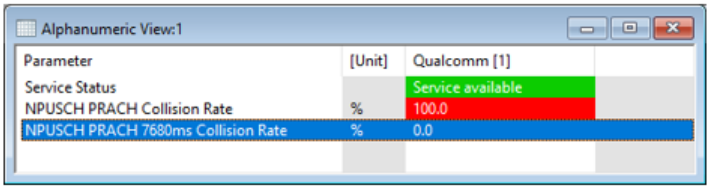


Figure 4-464: Alphanumeric view - reported collision

- **Data Transport**
  NB-IoT supports two different ways for transporting the user data to its destination. The data can be sent over the user plane, as normal LTE does, or sent piggy-backed on control plane messages. Which of these possibilities is actually supported, can be figured out by checking the 3GPP Overview View.

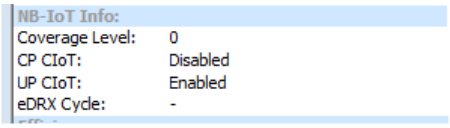


Figure 4-465: NB-IoT information within 3GPP overview view

- **MIB Decoding**
  Before the UE tries to attach to the network it has to decode its Master Information Block. R&S ROMES4 offers the possibility to track UE's attempts of MIB decoding. Every time the UE attempts to decode the MIB, the according R&S ROMES4 signals are filled, and a line is added to the Layer 3 View. This helps to see what is going actually before the UE decides to attach to the network.

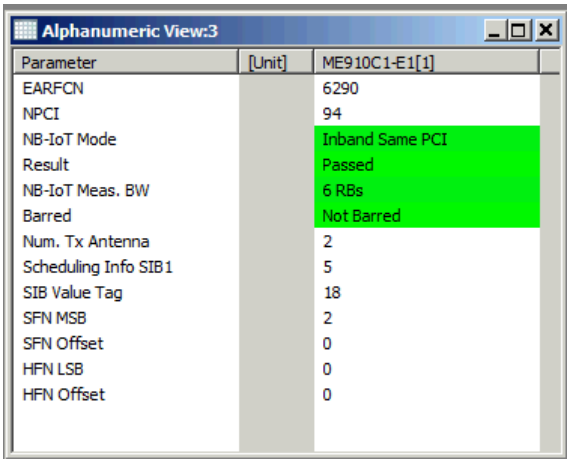


Figure 4-466: Alphanumeric view - NB-IoT operation mode

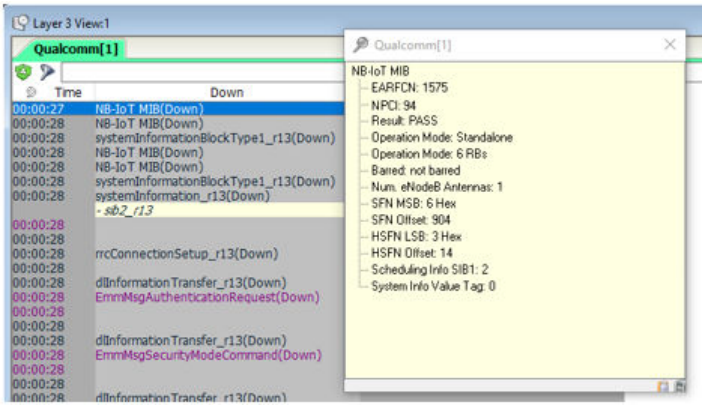


Figure 4-467: Layer 3 view - details

4.4.7.2 NB-IoT NPRACH view

The "NB-IoT NPRACH View" shows the NPRACH information. The views for LTE and NB-IoT are the same, the only difference is the title.

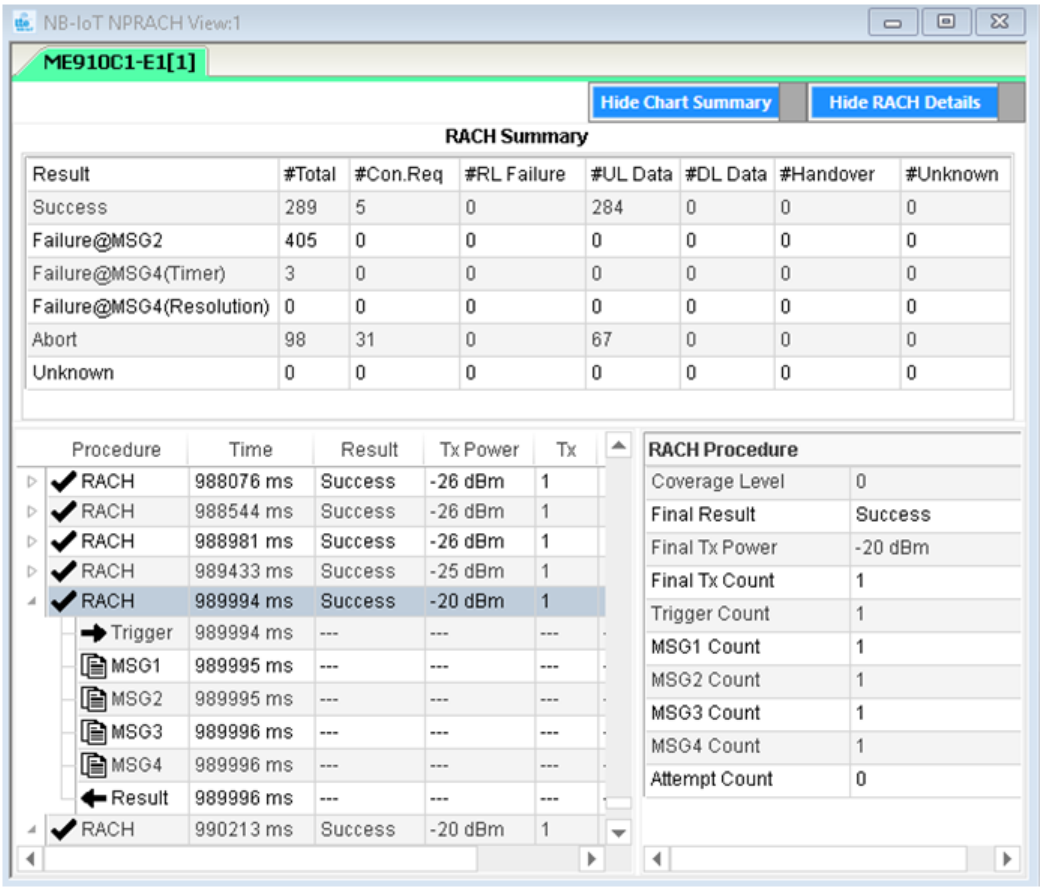


Figure 4-468: NB-IoT NPRACH view

For the view description, see Chapter 4.4.6.8, "LTE RACH view", on page 828.

Signals and events for NB-IoT NPRACH procedures

NB-IoT NPRACH procedures signals

There are two type of NB-IoT NPRACH signals:

- NB-IoT NPRACH single signal
  The signal occurs between trigger and final result in one connection procedure. The signal values are only valid inside the procedure time frame. A line chart for those values show gap between procedures.
- NB-IoT NPRACH final signals
  The signal is the result for each connection procedure. The values stay continuously until new value comes in. In a line chart, it shows continuous line.

For the description of the signals related to NB-IoT NPRACH procedures, see the "Description of R&S ROMES4 Signals" document, the "NB-IoT" > "Device n" > "NPRACH Procedures" chapter.

NB-IoT NPRACH procedures events

1. Add a NB-IoT NPRACH signal to "Alphanumeric View".
2. Right click the added NB-IoT NPRACH signal and choose the "Configure Events" menu item.

   The "Configure Events" dialog shows the new NB-IoT NPRACH procedures events.

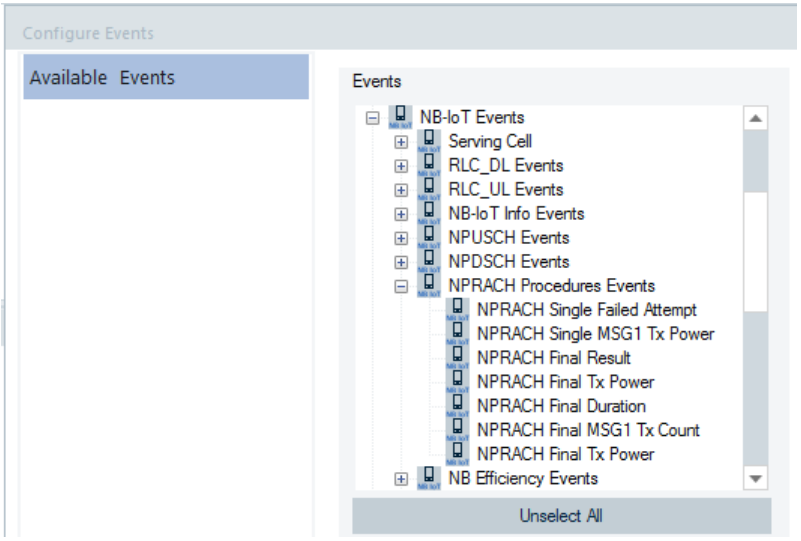


Figure 4-469: NB-IoT NPRACH procedures events configuration

4.4.8 5G NR views

The highlights are several views which support 5G NR UE signals testing with Qualcomm MTP.

A set of dedicated views helps in analysis and optimization of LTE-5G NR Dual Connectivity performance.

The following figure shows the available 5G NR UE views, accessible via "View" > "Mobile Views".

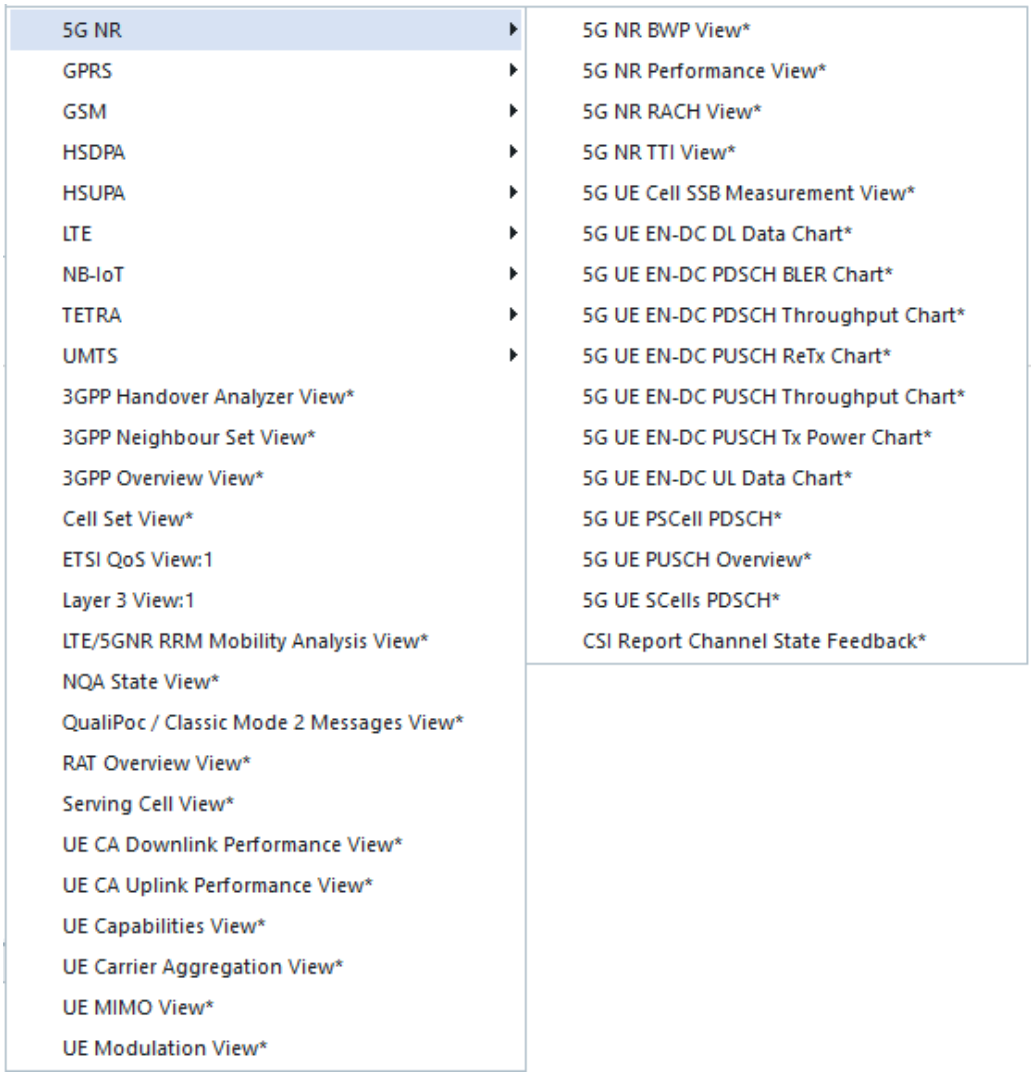


Figure 4-470: 5G NR UE views

The "Mobile Views" > "Serving Cell View" visualizes the NR/EN-DC cells history when a SA/NSA measurement file is run.

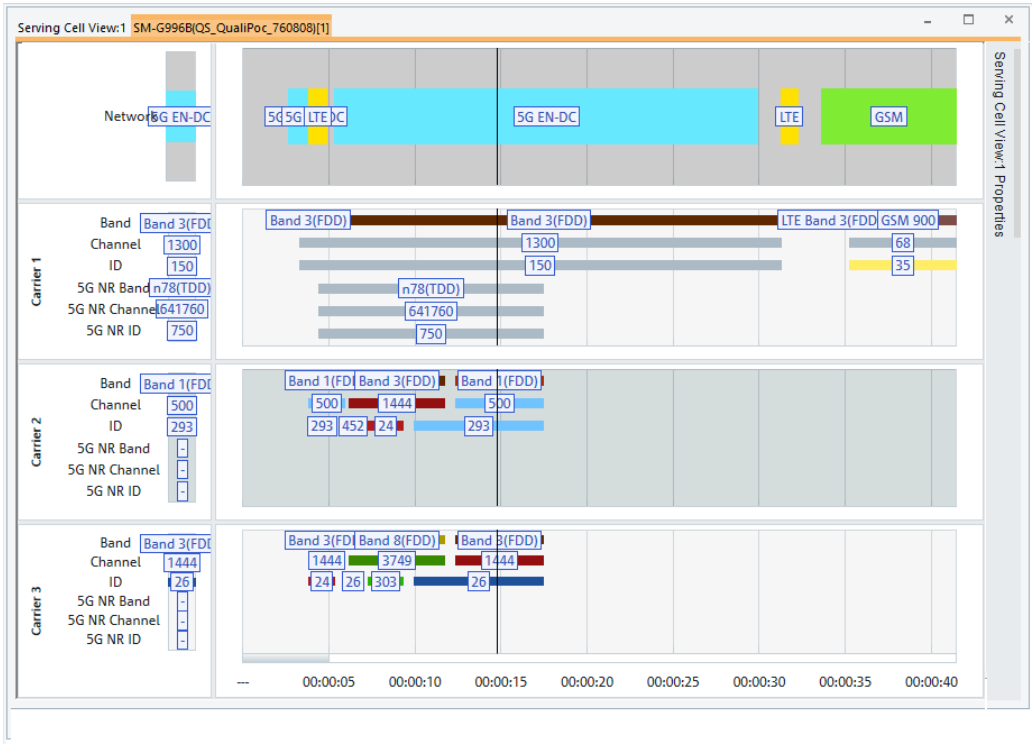


Figure 4-471: Serving cell view

The view shows the history of applied RAN in the first chart. The lower chart shows used bands, configured carriers and cell IDs of the measured and reported cells.

Some 5G NR UE views are based on the concept implemented in the "2D Chart View". These views are: "5G NR Performance View", "5G UE EN-DC DL Data Chart", "5G UE EN-DC PDSC BLER Chart", "5G UE EN-DC PUSCH Tx Power Chart", "5G UE EN-DC PDSCH Throughput Chart", "5G UE EN-DC PUSCH Throughput Chart", "5G UE EN DC PUSCH ReTX Chart" and "5G UE EN-DC UL Data Chart".

For the meaning of the panes and entires in the previously listed views and charts, see Chapter 4.2.1, "2D chart view", on page 448.

An introduction to some available 5G NR UE views which provide quick and easy creation of workspaces for 5G NR UE testing is presented in the following chapters.

Support of DSS capability of 5G NR UE

A 5G NR UE DSS capability is visualized with the signals available in the "Signal Tree" > "5G NR UE" branch of R&S ROMES4. The signals are also visible in some Basic Views, for example, in the "Alphanumeric View".

The names of relevant 5G and 4G R&S ROMES4 signals get an appendix, which represents the current role of a carrier. This appendix consists of the MCG or SCG and the Carrier Index (PCell, SCell1,..., SCelln). Signals assigned to a DSS carrier get the "-D" appendix.

PCI[MCG-PCell]		315
Band[MCG-PCell]		77
SSB NR-ARFCN[MCG-PCell]		640032
CC Index[MCG-PCell]		0
Serving SSB Index[MCG-PCell]		0
Num SSB Beams[MCG-PCell]		1
SSB Periodicity[MCG-PCell]	ms	-
SS-RSRP[MCG-PCell]	dBm	-78.7
SS-RSRQ[MCG-PCell]	dB	-10.4
SS-SINR[MCG-PCell]	dB	24.1
DM-RS SINR[MCG-PCell]	dB	-
Cell-RSRP[MCG-PCell]	dBm	-78.8
Cell-RSRQ[MCG-PCell]	dB	-10.5
Tx Power[MCG-PCell]	dBm	4.0
Timing Advance[MCG-PCell]	ns	1042.4

Figure 4-472: MCG appendix to 4G signals

To append the "-D" appendix to the carrier, the following conditions apply:

- 5G NR UE signals - 5G carrier has to have a valid DSS LTE frequency.
- 4G UE signals - 4G carrier has to have a valid EARFCN DL and band value. Any of the current 5G carrier's DSS LTE frequency matches the band and the 4G LTE carrier frequency calculated from EARFCN DL.

The smart events allow the DSS setup and release to follow in the "Layer 3 View", as highlighted in the following figure.

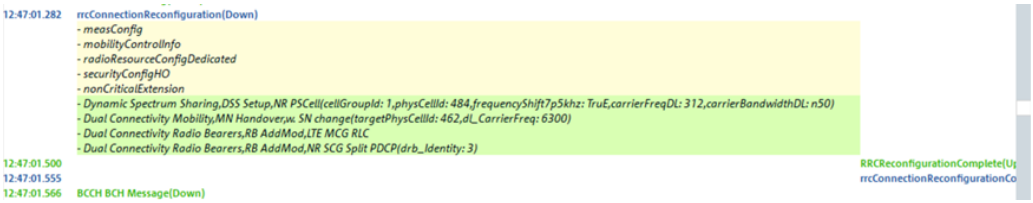


Figure 4-473: Extract from Layer 3 View

4.4.8.1 5G NR BWP view

The "5G NR BWP View" shows in a simple way the assigned Bandwidth Parts to 5G NR UE. Assigned are the initial ("iDBWP") and dedicated downlink bandwidths (up to 4 DBWP per UE can be defined). Since this assignment can be dynamic and user specific, a visual representation helps to understand the UE behavior in terms of assigned frequency resources over time.

The "5G NR BWP View" shows the actual BWPs assigned to 5G NR UE and the DL carriers allocation for SA and NSA networking.

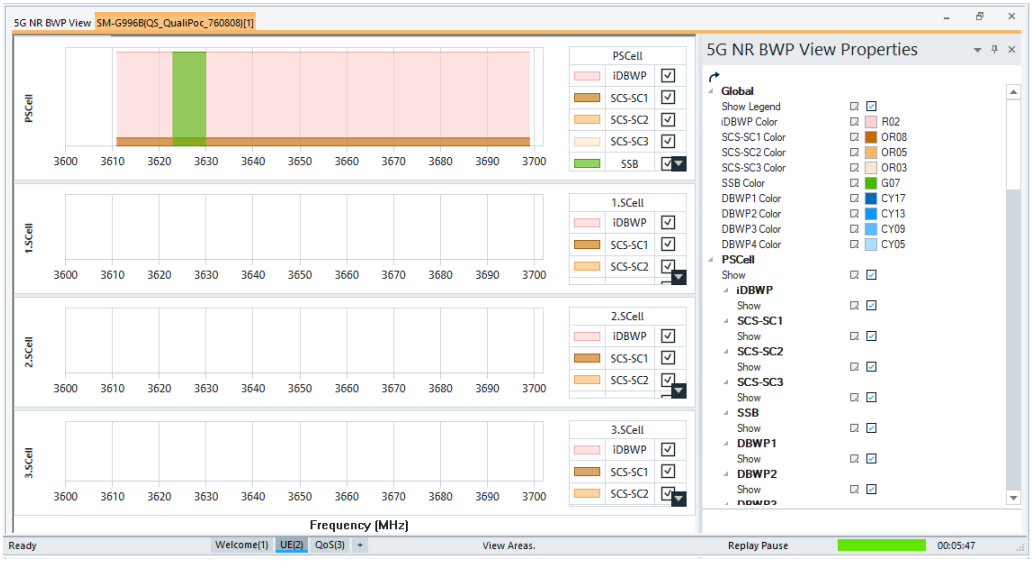


Figure 4-474: 5G NR BWP view

BWPs are shown only for measurements files recorded with R&S ROMES4 20.2 or higher.

To launch the view, click "5G NR" > "5G NR BWP View" in the "View" > "Mobile Views" menu. The opened view has no data.

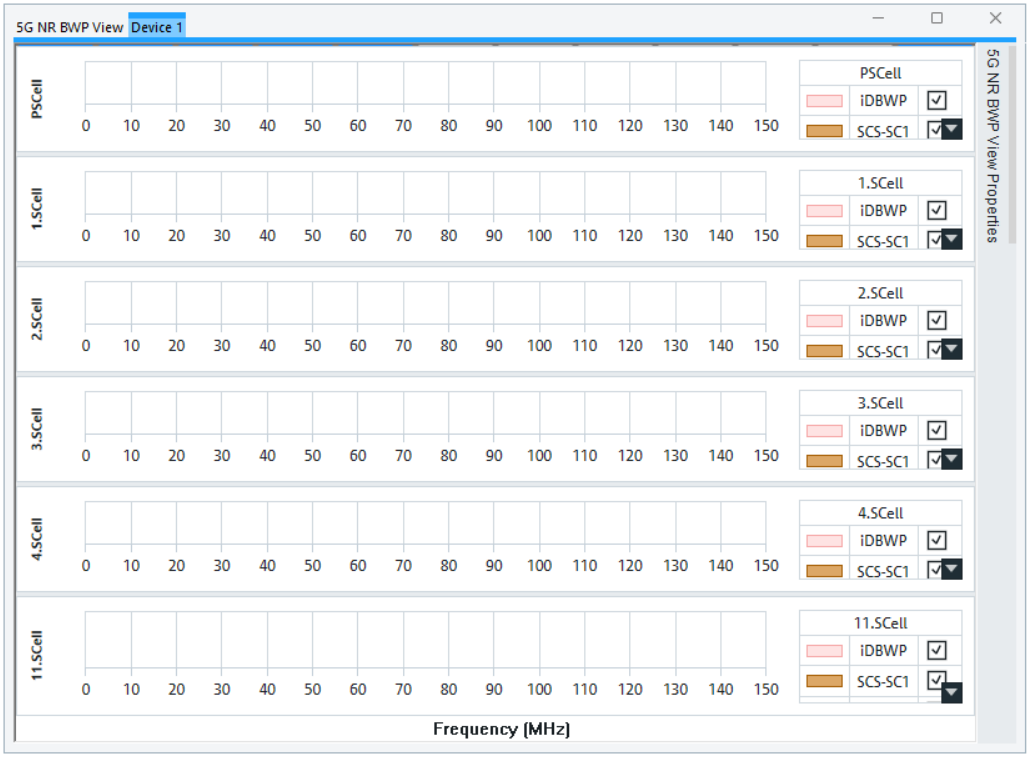


Figure 4-475: Empty 5G NR BWP view

The "5G NR BWP View" is designed as a tab view for different devices and therefore supports the BWP view of multiple devices. If more devices included in a measurement, more tabs are added in the title bar (each one for different UE connected to R&S ROMES4).

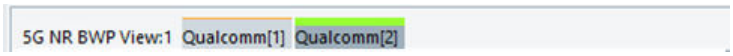


Figure 4-476: Title bar and tabs of loaded devices

You can activate or deactivate cells for which BWPs you want to be displayed. For connected UE, BWPs of up to 12 cells can be activated for display.

The selection of cells and signals to be displayed in the view and the view's layout configuration is done in the "5G NR BWP View Properties" pane. The parameters of a cell which can be activate or deactivate for display are iDBWP, SCS-SC1, SCS-SC2, SCS-SC3, SSB (SSB index) and downlink dedicated BWPs.

The pane opens when mouse hovers over the "5G NR BWP View Properties" bar. If the bar is invisible, as closed in previous action, click right-mouse button any point of the view to get the context-sensitive menu and select the "Properties" option.

For each subcarrier (SC), x-axis represents a frequency in [MHz].

5G NR BWP view description

The title bar of the view contains the tabs for loaded mobile devices.

The view area is divided into sections which are assigned to activated 5G NR cells. Activated can be primary (PSCell) and up to 11 secondary cells ("n.SCell", n=1..11).

Section

Each section is considered as a 5G NR cell and contains bandwidth data series (IDBWPx, SCS-SCx) for that cell. It is possible to have up to five cell's bandwidth data in the section area.

The figure shows primary 5G NR cell section that contains four bandwidth data distinguished by four colors.

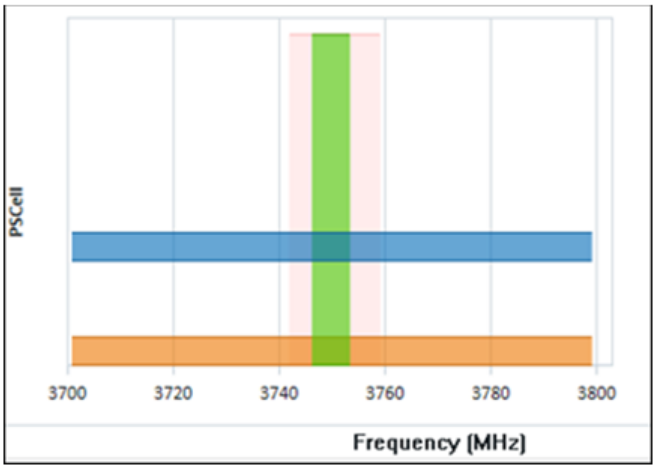


Figure 4-477: Section corresponding to PSCell

A section can contain up to nine cell's bandwidth data series (IDBWP, SCS-SC1, SCS-SC2, SCS-SC3, SSB, DBWP1, DBWP2, DBWP3 and DBWP4). The previous figure shows for that PSCell has measured data iDBWP, SSB and DBWP.

Data series rectangular

The cell data series are displayed as colored rectangles on the left-hand side in a section. The similar cells' series types are grouped with the similar colors.

Figure 4-478: Selected section - details

The cell series rectangles can be overlapped. The rectangles of SCS-SCn and DBWPx do not overlap. Each of them occupies a separate line.

Each section of the view has a separate x-axis. The x-axis shows the frequency range in MHz. Each x-axis can contain different value range. The x-axis title and unit are displayed at the bottom of the view area and shared by all rows ("Frequency [MHz]").

Section legend

Each section row contains a legend box that shows the color of bandwidth data.

A bandwidth data series can be shown or hidden by checking or clearing the corresponding check box in the legend area. The following figure shows the legend for PSCell.

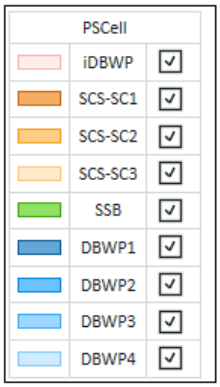


Figure 4-479: Legend of a PSCell

The cell series can also be controlled by the "5G NR BWP View Properties" bar. For the bar details, see Figure 4-481.

If a section row does not have enough height to show all the legend entries, arrows are displayed at the sides where more entries are available. Click the arrow to show more choices.

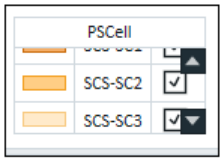


Figure 4-480: Arrow in the legend

Properties bar

The "5G NR BWP View Properties" bar is at the right-hand side of the "5G NR BWP View".

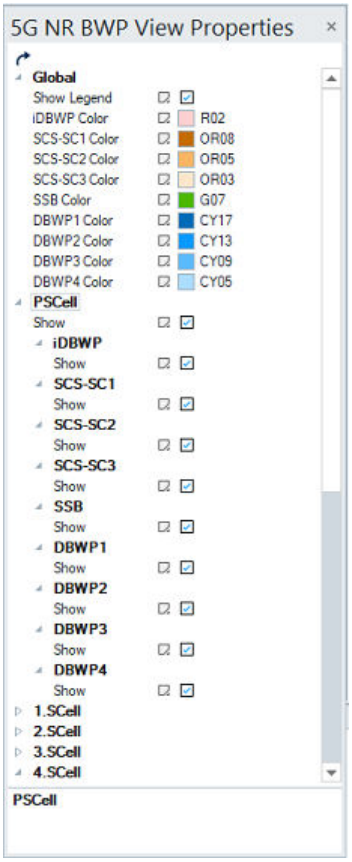


Figure 4-481: Properties bar of the view

The following entries are available in the bar:

- "Restore All Values" button on top of the property view is used to restore the default properties.
- "General" shows the general properties which include:
  - "Show Legend" check box to show or hide the legend. By default, the box is checked and the legend is displayed.
  - "iDBWP Color" check box to select a color from the color drop-down palette and change the corresponding iDBWP color.
  - "SCS-SCn" check box to select a color from color drop-down palette and change the corresponding SCS-SCn color, n=1, 2, 3.
  - "SSB" check box to select a color from color drop-down palette to change the corresponding SSB.
  - "DBWPx Color" check box to select a color from color drop-down palette to change the corresponding DBWPx color, x=1, 2, 3, 4.
- "PSCell" shows the primary 5G NR cell properties included in the following entries which are checked by default:
  - "Show" shows or hides the PSCell row.
  - "IDBWP" > "Show" shows or hides the iDBWP series data rectangle.

  - "SCS-SCn" > "Show" shows or hides the SCS-SCn series data rectangle, n=1, 2, 3.
  - "SBS" > "Show" shows or hides the SBS series data rectangle.
  - "DBWPx" > "Show" shows or hides the DBWPx series data rectangle, x=1, 2, 3, 4.
- "n.SCell" shows a secondary 5G NR cell property, n= 1 to 11. The following entries which are checked by default describe the cell properties:
  - "Show" shows or hides the n.SCell row.
  - "IDBWP" > "Show" shows or hides the iDBWP series data rectangle.
  - "SCS-SCn" > "Show" shows or hides the SCS-SCn series data rectangle, n=1, 2, 3.
  - "SBS" > "Show" shows or hides the SBS series data rectangle.
  - "DBWPx" > "Show" shows or hides the DBWPx series data rectangle, x=1, 2, 3, 4.

Exporting data as CSV

1. With the right-hand mouse button click any point on the view area to get the context-sensitive menu and choose the "Export Data as CSV" option.
2. Browse a folder.
3. Enter a name to save the generated CSV file.

   The exported format is `Cell,Series,F-Offset,F-BW,PointA(arfcn).`

The meaning of the format is as following:

- Cell: cell name
- Series: series name
- F-Offset: frequency offset starting from PointA in MHz
- F-BW: frequency bandwidth in MHz
- PointA(arfcn): PointA in ARFCN format, is the point where the chart starts

The PointA appears only once for each cell and at the end of the first series of each cell.

Exported CSV samples

An example of the data exported from a sample of one CSV file is listed here.

Cell,Series,F-Offset,F-BW,PointA(arfcn)

PSCell,iDBWP, 27702-27798,PointA(2074207)

PSCell,SCS-SC1, 27702-27798

PSCell,SSB, 27736-27764

1.SCell,iDBWP, 27802-27897,PointA(2075873)

1.SCell,SCS-SC1, 27802-27897

1.SCell,SSB, 27836-27864

2.SCell,iDBWP, 27902-27997,PointA(2077539)

2.SCell,SCS-SC1, 27902-27997

2.SCell,SSB, 27936-27964

3.SCell,iDBWP, 28002-28097,PointA(2079205)

3.SCell,SCS-SC1, 28002-28097

3.SCell,SSB, 28035-28064

In this example, there are four cells and each cell has three series bandwidth data (iDBWP, SCS-SC1 and SSB). The PointA is displayed at the end of the first line of the cell series.

4.4.8.2 5G NR performance view

The "5G NR Performance view" shows in three charts the signal level (RSRP), signal quality (RSRQ) and the signal to noise and interference ratio (SINR) of the SSB and user signal. The group charts can be added and named in the view's properties pane if you click the ☰ button and select "Add Chart Group" in the menu.

Figure 4-482: 5G NR performance view

In the "5GNR Performance View: 1Properties" pane you can select signals to be shown in a configured signal set group (RSS<variable>) via the "Add Signal/Signal Set" button. For more details related to the properties pane, see Chapter 4.2.1, "2D chart view", on page 448.

The performance view provides the EN-DC cells quality history details.

4.4.8.3 5G NR RACH view

R&S ROMES4 provides the "5G NR RACH View" for 5G NR. The view shows a summary of all collected RACH procedures and allows each procedure individually to investigate.

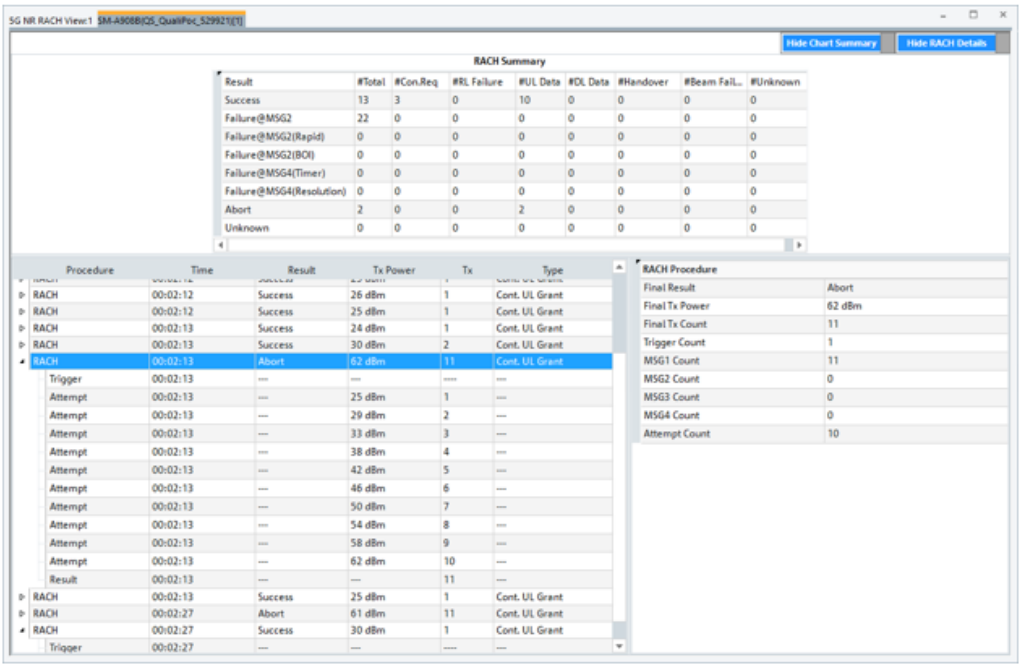


Figure 4-483: 5G NR RACH view

To open the view, click "Mobile Views" > "5G NR Views" > "5G NR RACH View".

The upper table summarizes the complete set of recorded RACH procedures. The list on left bottom shows all individual RACH procedures including their subprocedures. To get even more details of such a subprocedure, click it to get the details on the right of the details table.

Results of random access procedure

The workspace's second page of the "5G NR View" shown in the following figure gives the details and results of 5G NR Random Access (RA) procedure.

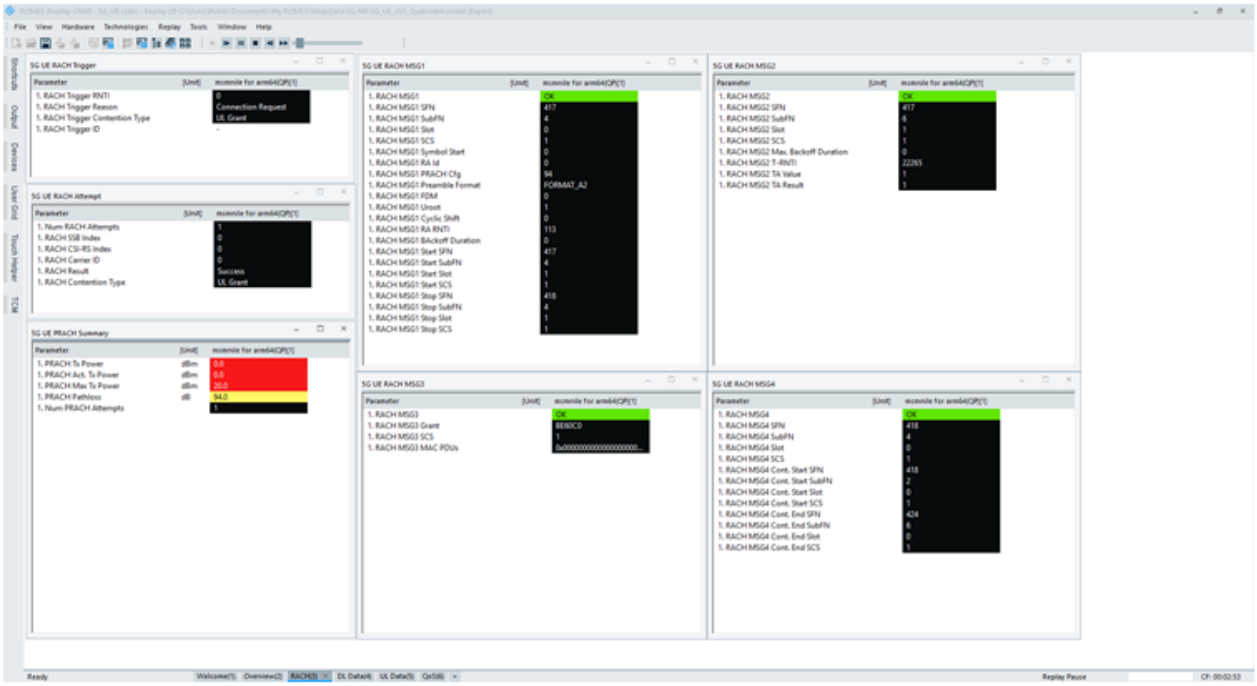


Figure 4-484: Displayed results of RA procedure steps

The following information on 5G NR random access procedure is included in this page:

- Identity, reason and contention type of triggered RACH
  The information is contained in the "5G UE RACH Trigger" 5G NR mobile view.
- Attempt summary including counts, final result and beam identity
  The information is contained in the "5G UE RACH Attempt" 5G NR mobile view.
- Physical transmission summary including Tx Power and path loss
  The information is contained in the "5G UE PRACH Summary" 5G NR mobile view.
- Details of each RACH message; msg1, msg2, msg3 and msg4
  The information is contained in the "5G UE MSG1", "5G UE MSG2", "5G UE MSG3" and "5G UE MSG4" 5G NR mobile view.

4.4.8.4 5G NR TTI view

The "5G NR TTI View" lets you follow the data stream over the air interface for each used TTI and perform a detailed analysis of performances of a test device per TTI. The view displays per TTI the recorded values such as component carriers and their states, 5G NR frequency, numerology, SFN, slot number, used MCS and modulation type and more. The view can also display the PDCP downlink logs per TTI. The PDCP logs allow you to verify how much data has been transferred via LTE and 5G NR.

The 5G NR cell component carriers states in downlink and uplink are included in the view's grid. A state is reported as "Deconfigured", "Deactivated" or "Activated". The "Serving Cell View" however does not display the states of DL/UL component carriers. The component carrier state signals are included in the "Signal Tree" >"5G NR UE" branch, and visualized in the "3GPP Overview View", see Figure 4-446.

To open the view, select the "Mobile Views" > "5G NR Views" > "5G NR TTI View".

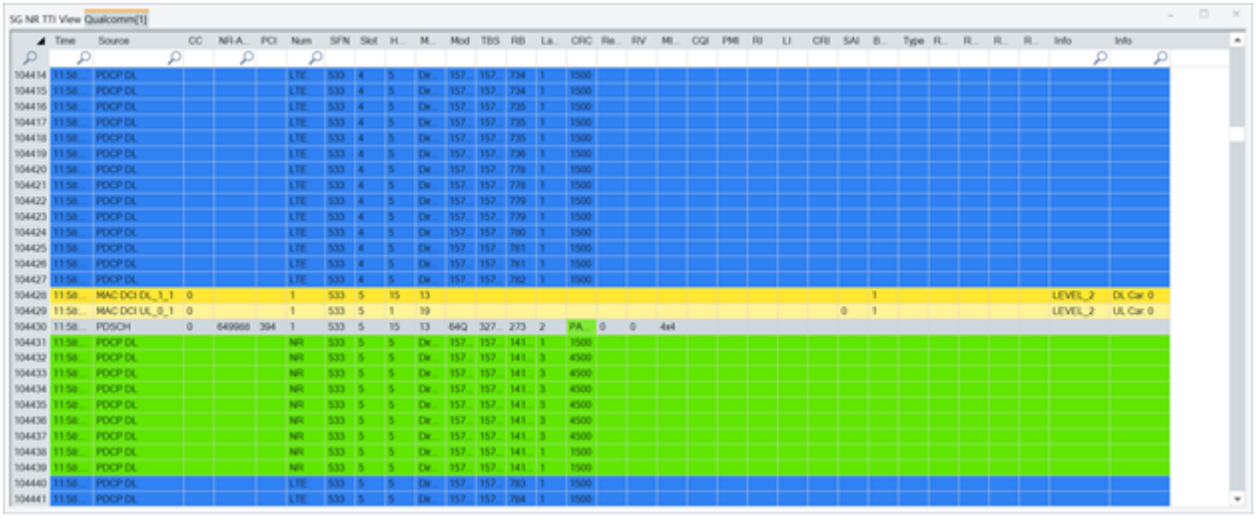


Figure 4-485: 5G NR TTI view

The Tooltips of the column header give more information about the content of the column. The column filters offer a possibility to shrink the size of information to the one which is under the investigation.

Activate the option "Store 5G NR TTI information". The size of the measurement file increases when using this option.

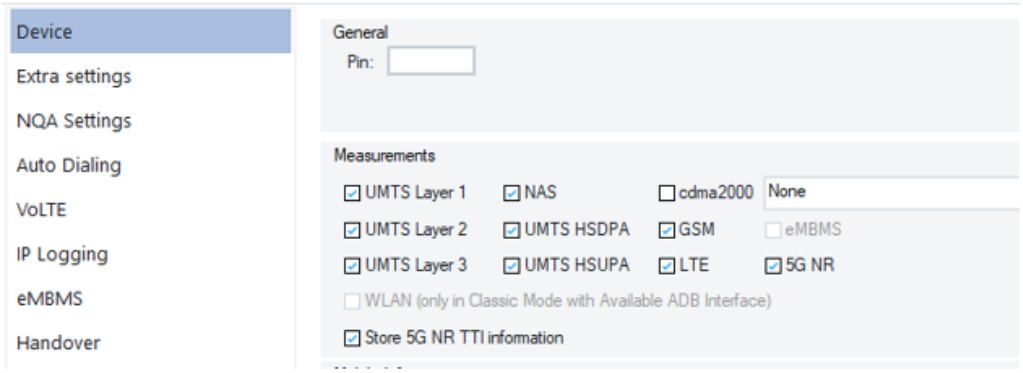


Figure 4-486: Enabled needed option

Although the "5G NR TTI View" can be opened during the measurement, it is meant to be used for in-depth analysis during the post-processing/analyses phase of a measurement. The view can be time synchronized with other views to ease the access of critical point of times in the measurement file.

The view requires a Qualcomm chipset-based test UE.

Evaluated PMI displayed in the view

For the Qualcomm chipset-based mobile devices, R&S ROMES4 derives the reported PMI values for Type I Single Panel codebook (i11, i12, i13 and i2) and implements

them. The values are visible in the "5G NR TTI View" and are available as R&S ROMES4 signals.

The "CRI" ("CSI Resource Indication") report lines of the "5G NR TTI View" show the I values and the source of the values (carrier Id and report Id) and the current configuration of the antenna panel of the source.

The columns PMI-I contain the actual information values. Depending on the configuration, not always all I values are reported.

The first info column contains the current configuration given by the panel dimension in N1, N2, O1 and O2 and the currently active code book mode (CBM).

The second info column contains the source of the values as there are carrier Id, report Id and the report mode (a periodical: A or periodical: P). The Bits values inform about the bit size which was necessary to report the I values to the gNodeB.

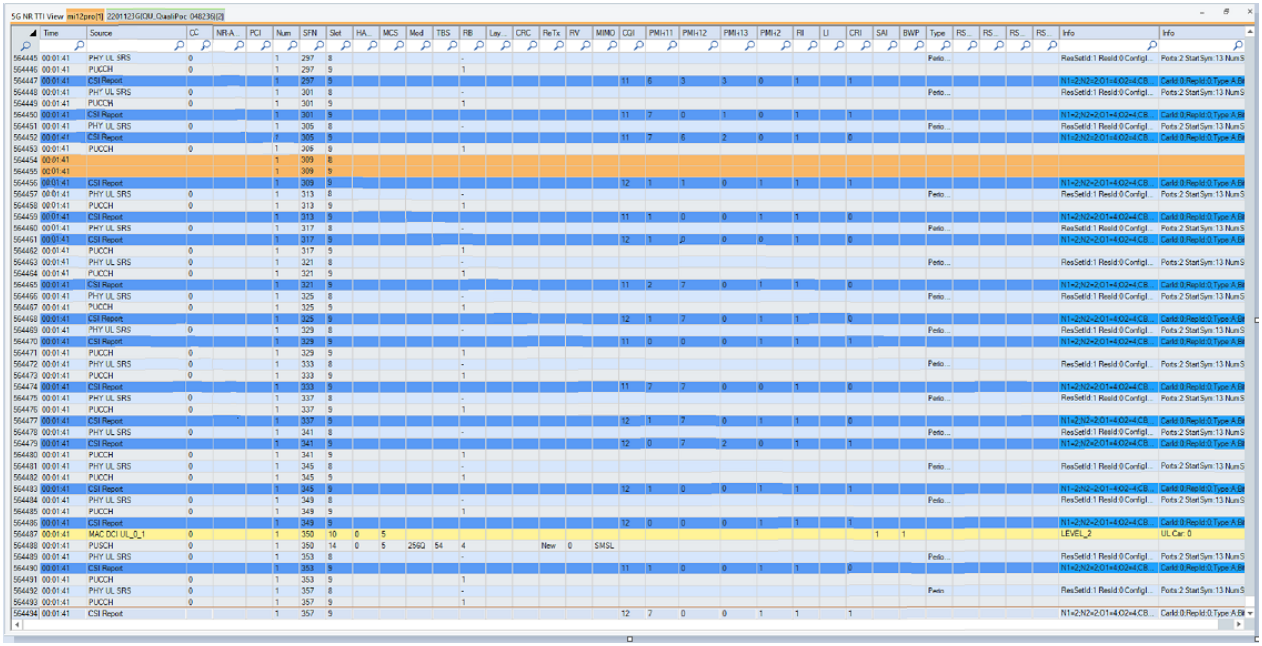


Figure 4-487: PMI information columns - on the right side of the view

The R&S ROMES4 capability to offer signal templates allows the used PMI information values to visualize as signals. An ixy value can be compared only for a certain combination of cell group, carrier Id, report Id and rank indicator. Therefore you have to select these properties to specify the signals content.

Two signals are provided for each I value.

- ixy: This signal is a numeric signal, which can be used on the map, the "2D Chart view" or any other basic view. It reports the ixy value which occurred the most during the R&S ROMES4 data-reporting period (approx. 500ms).

- i Distribution: This signal is a text signal and can be used only in the "Alphanumeric View" or in the ASCII export. It prints all I values with its number of occurrences during the reporting period.

For the signals definition, see the "5G NR UE" > "CSI Templates" branch of the "Signal Tree" or the same named chapter in the "Description of the R&S ROMES signals" document.

When you add the signals to a view, a signal filter "Signal Templates - ixy" pops up. Fill the corresponding filter values in the filter.

Example:

Figure 4-488: Added i11 signal

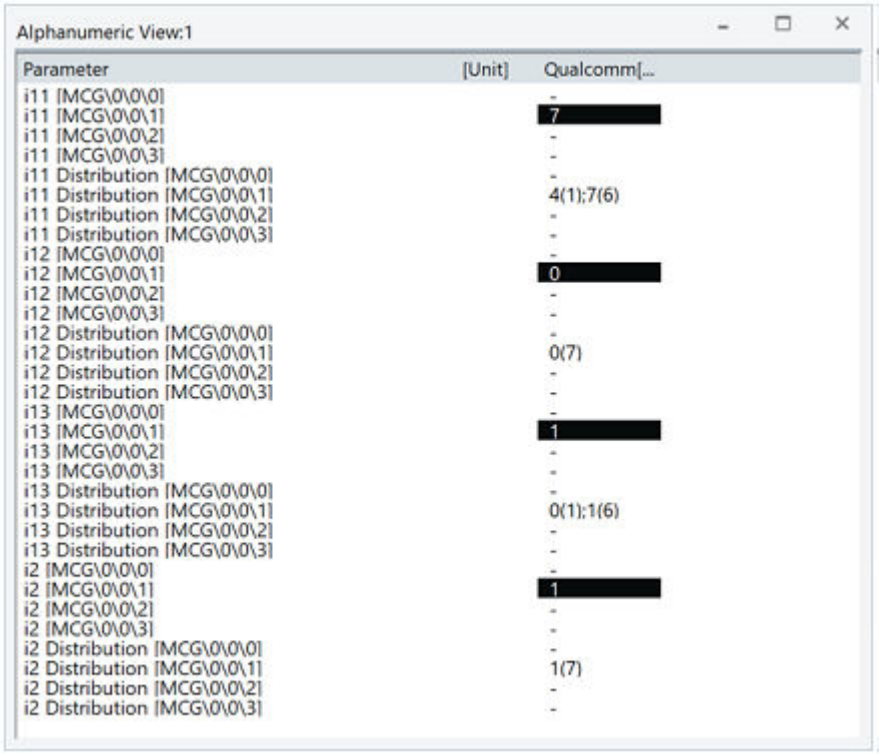


Figure 4-489: Alphanumeric View of the PMI-i11

Read the distribution signals as this example shows: 4(1);7(6): i11 had one time the value 4 and 6 times the value 7. The i11 signal's value is 7 as seven has the most occurrences.

The former PMI signals in the "5G NR UE" >"5G NR Carriers" signal branch have been removed.

TTI occupancy signals

The TTI Occupancy signals let you better understand the TTIs number granted and scheduled for transmission.

The information is available as a set of signals per carrier and is available only on Qualcomm based chipsets mobiles. Those signals are available per carrier for downlink (e.g. on PSCell, "PSCell PDSCH TTI Occupancy") and for uplink (e.g. on PSCell, "PSCell PUSCH TTI Occupancy"). The value is calculated as several reported TBSs per time in TTI/second.

4.4.8.5 CSI report channel state feedback

The "CSI report channel state feedback" view is a default-configured grid view. It is not configurable by the user. It shows channel state indication (CSI - CQI, RI and PMI) measurement reports in tabular form. The report includes the report of the primary cell in NSA and SA operation mode, MCG cells and added SCG cells.

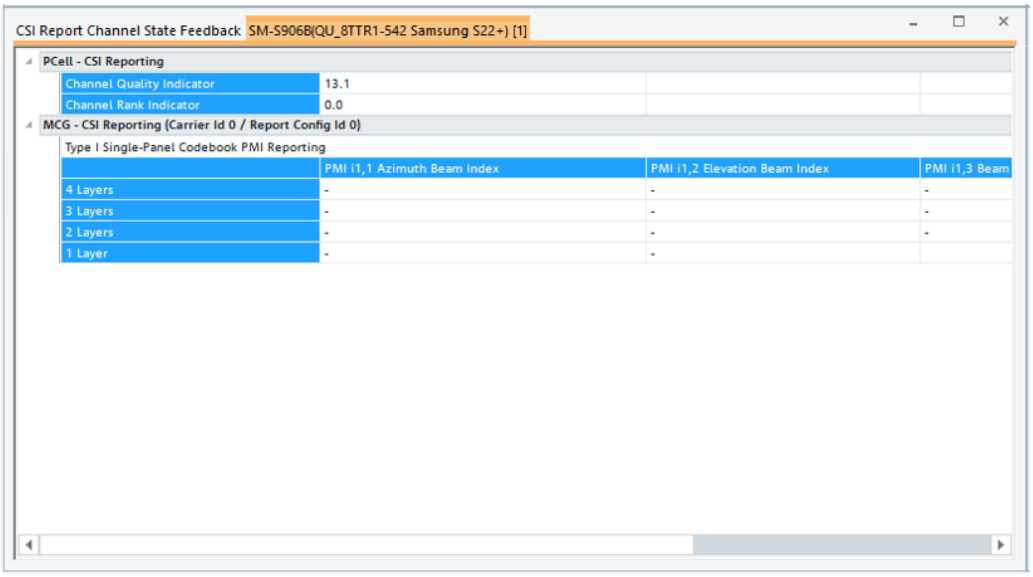


Figure 4-490: CSI report - channel state feedback

4.4.8.6 5G NR UE views

There are three widget templates installed in the R&S ROMES4 software which can be used as a starting point for setting up a 5G NR UE grid view. One widget is a part of the "Device Grid View" (`5GUE.pwidget`) and two are parts of the "Grid View" (`5G UE Cell Quality.gwidget` and `5G UE History.gwidget`).

1. Open the "Device Grid View" or "Grid View" page.

2. Double-click any point in the view to get the context-sensitive menu.
3. Select "Configure" in the pop-up menu.
4. In the opened page, under the "Template", click the drop-down button for loading the existing template file.
5. Select the mentioned files.

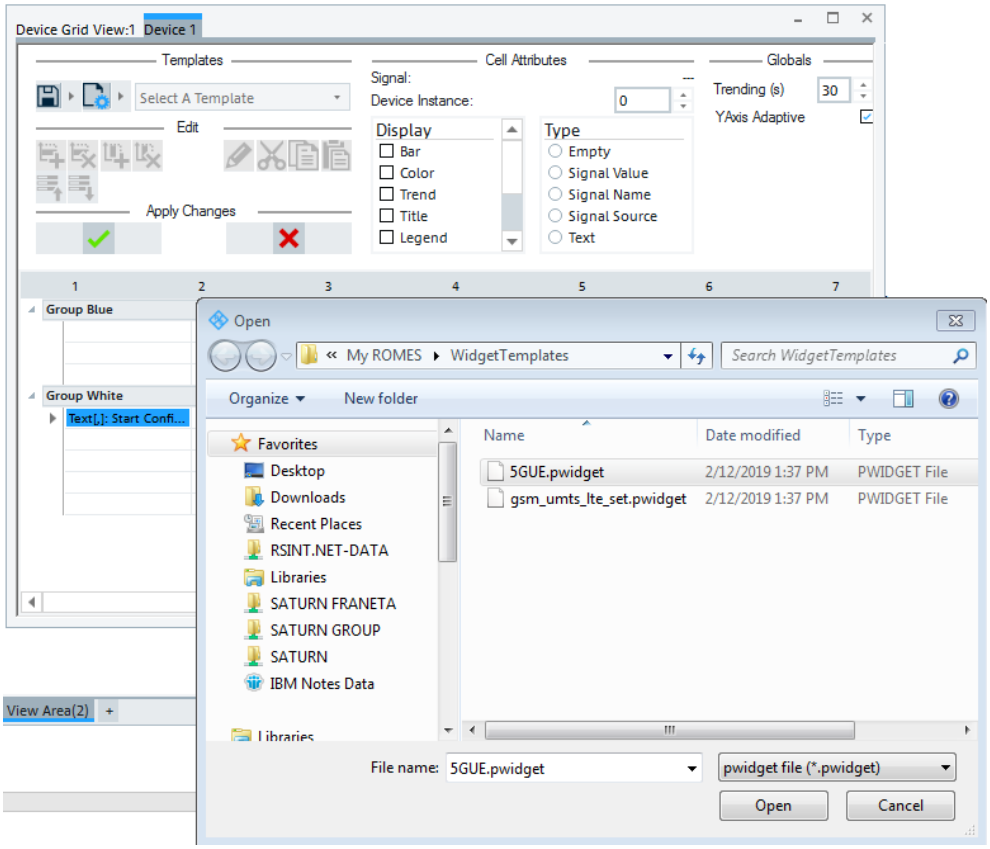


Figure 4-491: Loading the 5G UE widget template file

The 5G NR UE grid views open.

4.4.8.7 5G EN-DC capable UE

The R&S ROMES4 5G EN-DC capable mobile device views are partly dedicated. Some are included in the general 5G NR views.

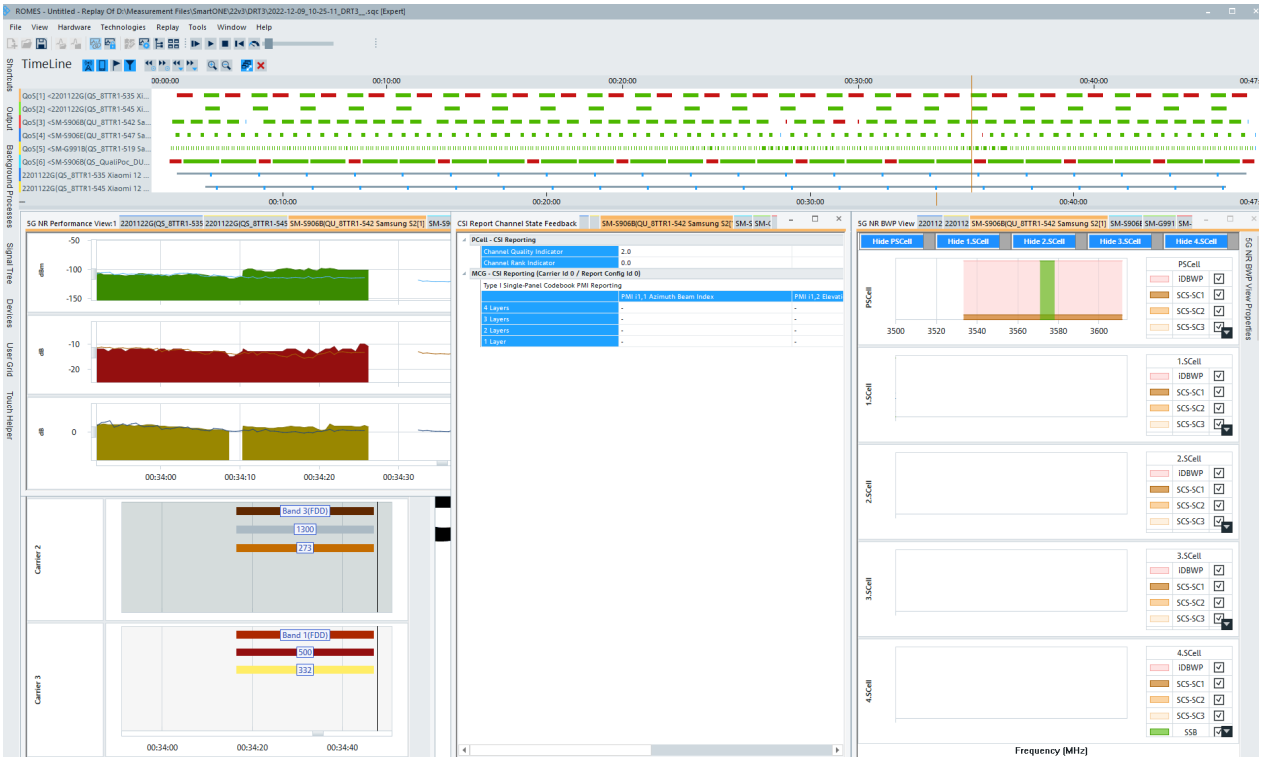


Figure 4-492: Some 5G UE EN-DC views

The following views provide the information on UE Master Node (LTE) and Secondary Node (5G NR) for EN-DC capable UEs.

- Actual serving cell parameters such as ARFCN, PCI, SSB index and the history of serving cell changes are visualized in the "Serving Cell View".
- DL carrier allocation is included in the "5G NR BWP View".
- Actual cell quality measurement results including RSRP, RSRQ and SINR are visualized in the "5G NR Performance View".
- The CSI measurements are visualized in the "CSI Report Channel State Feedback" table.
- UL and DL data channel performance including physical layer throughput, RB allocation and modulation and coding schemes are visualized in the dedicated views.

DL dual connectivity data

The EN-DC DL data pages display the data transport performance of the downlink physical layer.

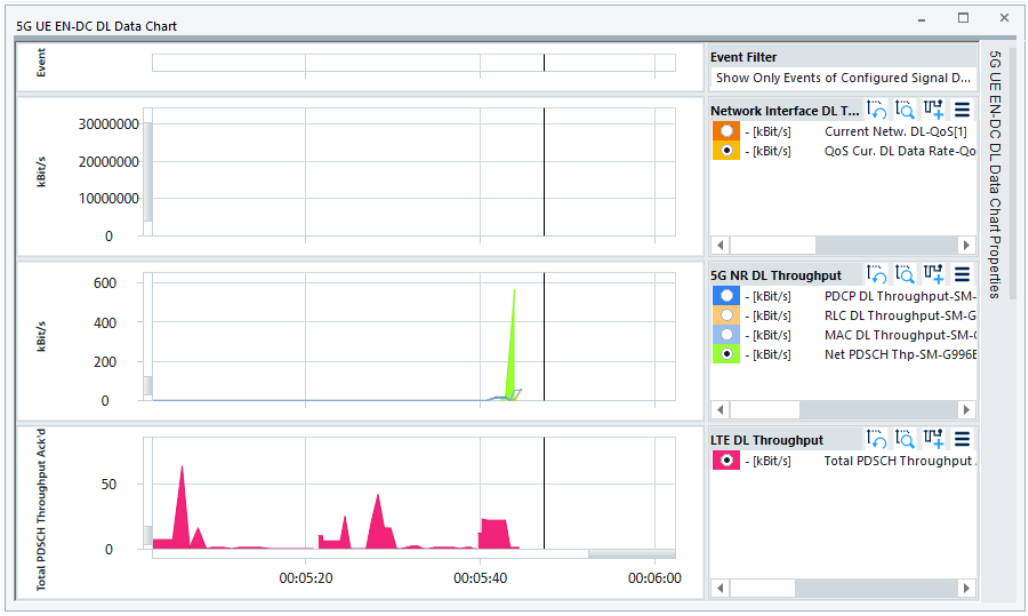


Figure 4-493: DL data chart of an EN-DC capable UE

The metrics related to EN-DC DL Transport Block transmission which can be assumed as the performance of reception of MAC PDUs over the physical layer are shown in the PDSCH BLER and Throughput pages. The later page gives the EN-DC throughput and BLER comparison of LTE and 5G NR downlinks.

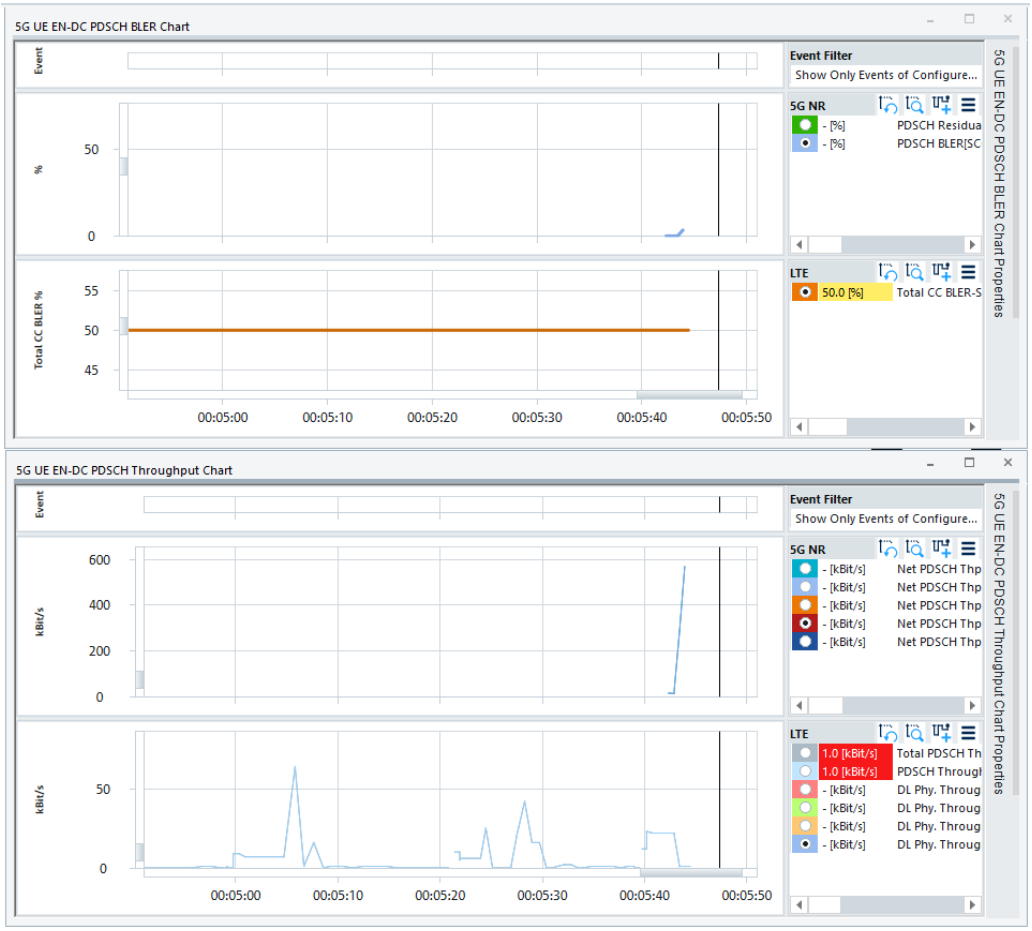


Figure 4-494: PDSCH BLER and throughput chart of an EN-DC capable UE

The EN-DC cell quality measurement history of included RSRP, RSRQ and SINR are included in the "5G NR Performance View".

The resource allocation including frequency domain allocation of resource blocks is included in the "5G NR BWP View".

UL dual connectivity data

The UL EN-DC data page displays the data transport performance of the uplink direction of all 5G RAN layers.

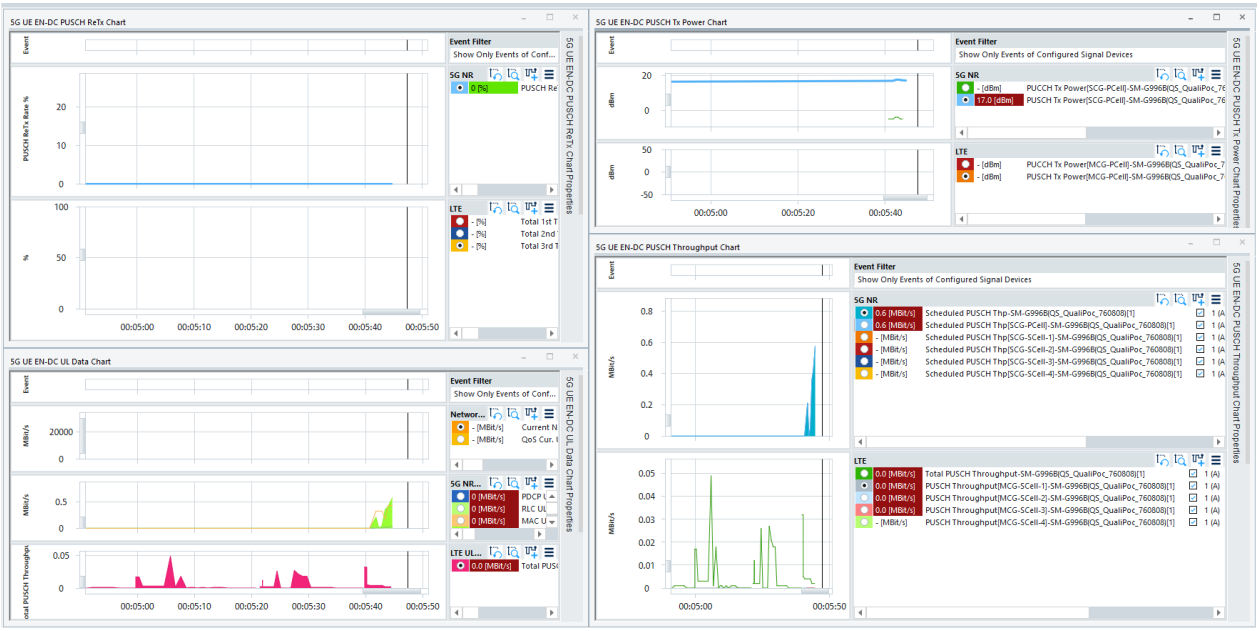


Figure 4-495: UL charts of an EN-DC capable UE

The metrics related to UL Transport Block transmission which can be assumed as the performance of reception of MAC PDUs over the physical layer are included in the following charts:

The following metrics related to UL Transport Block transmission which can be assumed as the performance of reception of MAC PDUs over the physical layer are shown:

- EN-DC UL transmission power comparison of LTE and 5G NR control channels (PUCCH) and shared data channels (PUSCH) is provided in the "5G UE EN-DC PUSCH Tx Power Chart".
- UE received power on PUSCH is provided in the "5G UE EN-DC PUSCH ReTx Chart".
- EN-DC throughput and retransmission comparison of LTE and 5G NR uplinks provided in the "5G UE EN-DC PDSCH Throughput Chart".

4.4.8.8 5G NR quality of service

The following page is an example of the workspace which provides the results of the application to physical layer comparison.

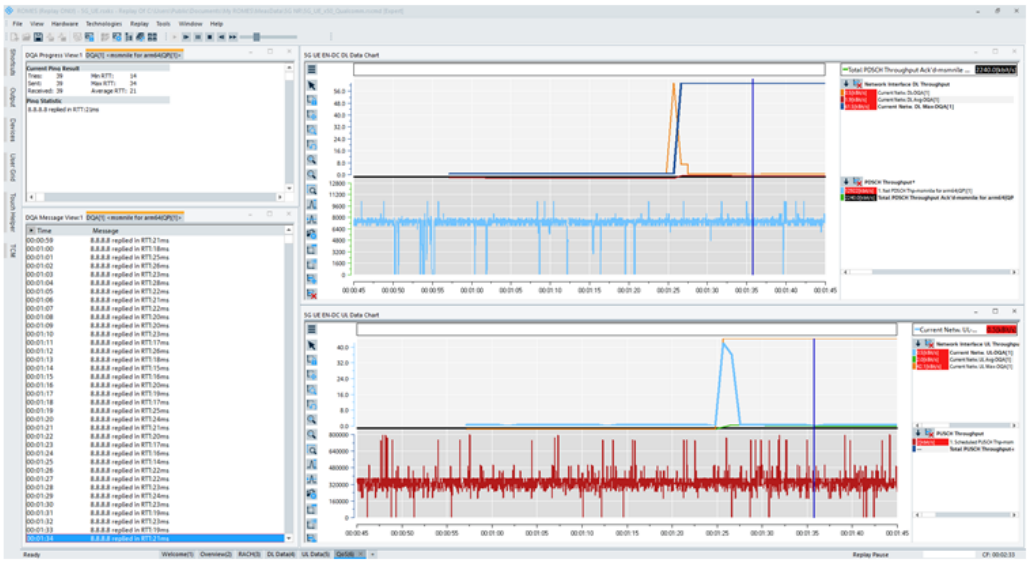


Figure 4-496: 5G UE QoS views

The workspace page related to 5G UE QoS displays the application layer measurement results and the output. Also are compared the TCP/IP network interface data performances with the DL and UL physical layer.

The following information is included:

- Application layer test results and statistics
- Application layer testing progress
- Downlink throughput side-by-side comparison of IP network interface with LTE and 5G NR downlink physical layer
- Uplink throughput side-by-side comparison of IP network interface with LTE and 5G NR uplink physical layer

This information is given by the existing QoS DQA views and the "5G EN-DC DL Data Chart" and "5G EN-DC UL Data Chart" 5G NR mobile views.

4.4.8.9 5G NR UE signals and templates

The following chapter is dedicated to the 5G NR UE signals supported by R&S ROMES4. The signals are configurable via "Preferences" > "Available Signals" > "5G NR UE"

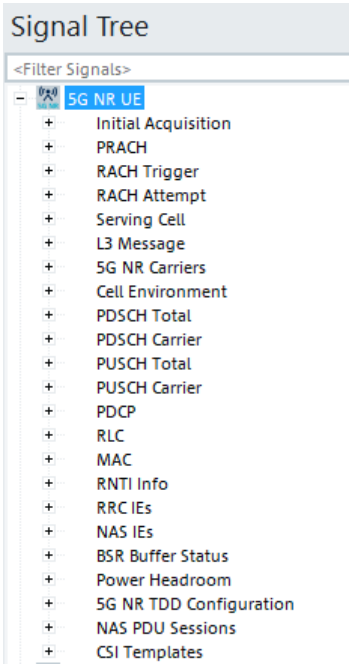


Figure 4-497: 5G NR UE supported signals

The signals you want to display in a particular R&S ROMES4 supported 5G NR UE view can be also selected via the view's context menu. The 5G NR UE signals are grouped in nodes (branches) each one related to certain procedure or layer.

The previous screenshot shows the nodes of the "Signal Tree" > "5G NR UE" signals. The UE cell signals are not distinguished in nodes whether they belong to PCell (Primary Cell) or SCell (Secondary Cell). The dedicated PCell and SCell UE signals nodes are not supported in R&S ROMES4 signal tree for 5G NR UE signals as default. For signal nodes that indicate performances of PCC and SCCs introduced are 5G NR UE nodes template signals. For example, the template signals are those signals contained in the "5G NR UE Carriers" node.

Figure 4-498: Template signals in 5G NR Carriers node

If a signal is only available in PCell carrier, "(P)" is suffixed in the signal name. If multiple signals are selected and the selected signals contain both PCell and SCell carriers, the filter dialog asks twice for both types of signals, once for each type.

For the following 5G NR UE nodes are supported template signals:

- "5G NR Carriers"
- "Channel Quality Carrier"
- "PDSCH Carrier"
- "PUSCH Carrier"
- "RRC IEs"
- "BSR Buffer Status"
- "5G NR TDD Configuration"

Template signals filter dialog

When signals are dragged into a view or for export, filter dialog pops up. 5G NR filter dialogs show different number of carriers in pulldown list.

Signals available for both PCell and SCell

If both PCell and SCell signals are available for the selected signal, following pulldown list displays 5G NR filter dialog.

There are 12 5G NR UE mobile template signals, a PCell signal and SCell signals 1 to 11.

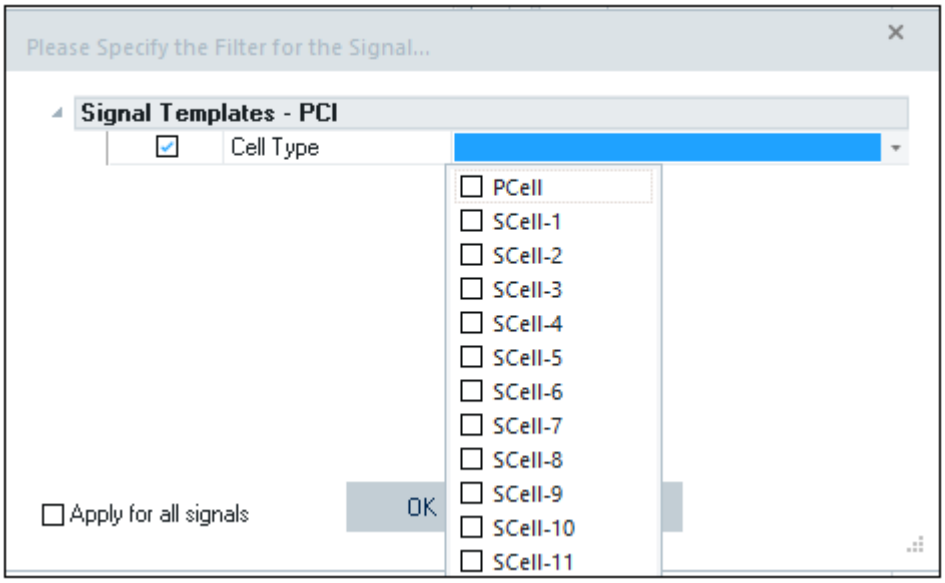


Figure 4-499: 5G NR filter dialog

PCell only signals

If only PCell signal is available for the selected signal, the pulldown list is auto filled with the only choice - PCells.

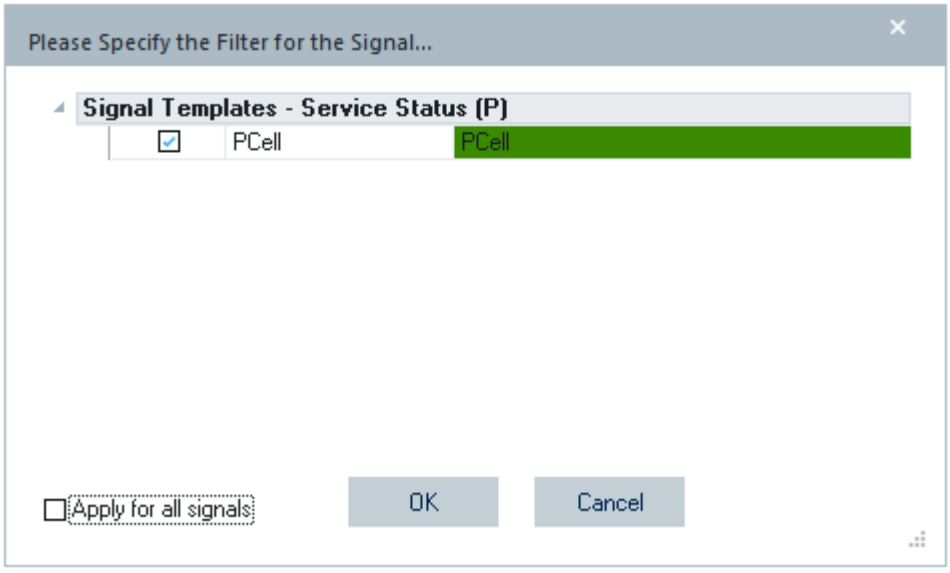


Figure 4-500: Filtering PCells only

Optionally, check the "Apply for all signals" check box to apply the choice to all signals.

Multiple signals for PCell only and for both PCell and SCell

It is possible to select multiple signals and some of them are PCells only and some are for both PCell and SCell. In this situation, the filter dialog asks twice for both types of signals, once for each type.

Prior filter

The "Prior Selection" template option is available in the filter dialog for both PCell and SCell.

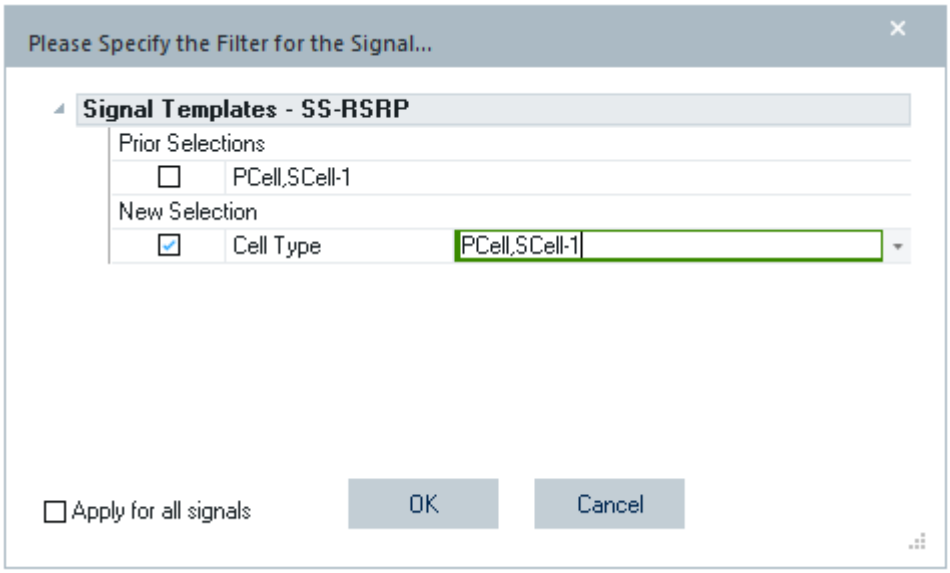


Figure 4-501: Prior selection both PCell and SCell

The LTE UE and 5G NR UE template signals are contained in the UE mobile views that involve carrier signals, e.g., "UE CA DL Performance View"/"UE CA DL Performance View", "Serving Cell View". The views are updated to show the signals correctly.

As the number of carrier increases, it can happen that there is no enough space to show all carriers at top of the view. Because of that reason, the carriers are not presented at the top of the views. If only one carrier is selected at a time, the carriers are displayed for selection in a pulldown menu. If multiple carriers are chosen for display at the same time, they have to be selected from the property bar on the left side of the view.

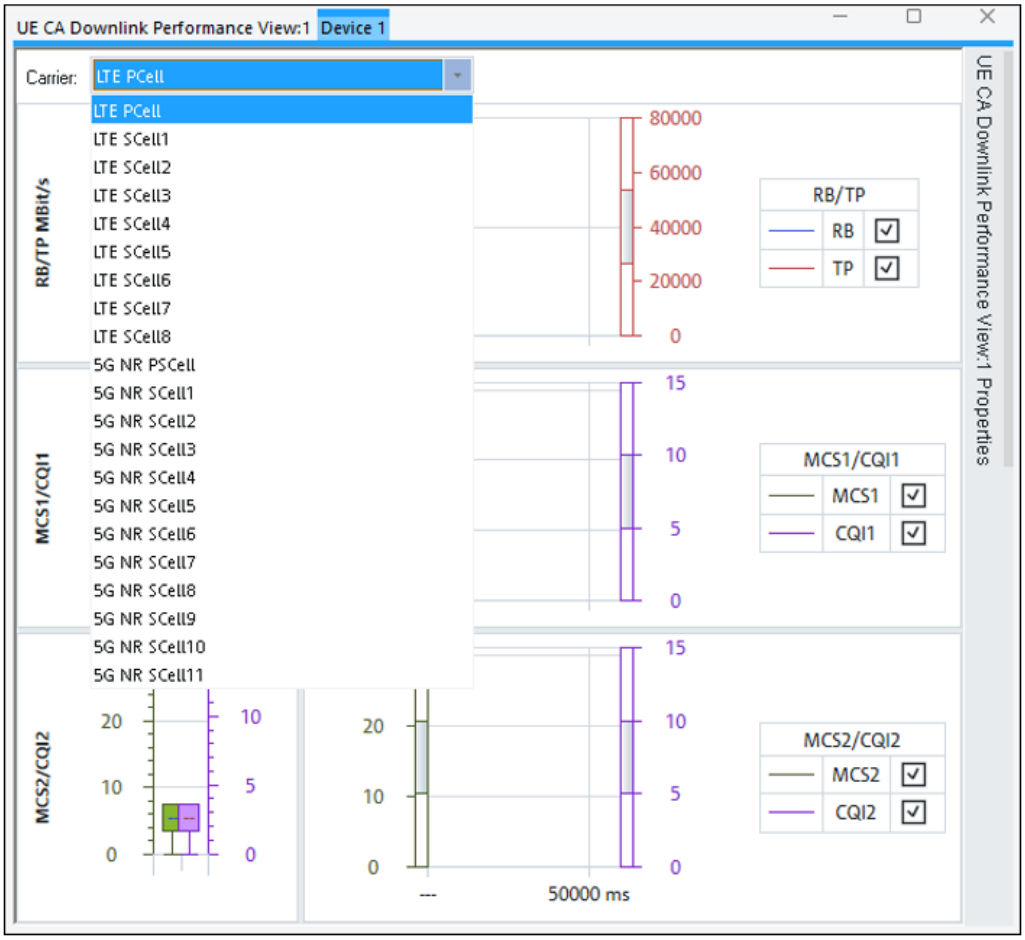


Figure 4-502: Single carrier selection from carrier selector

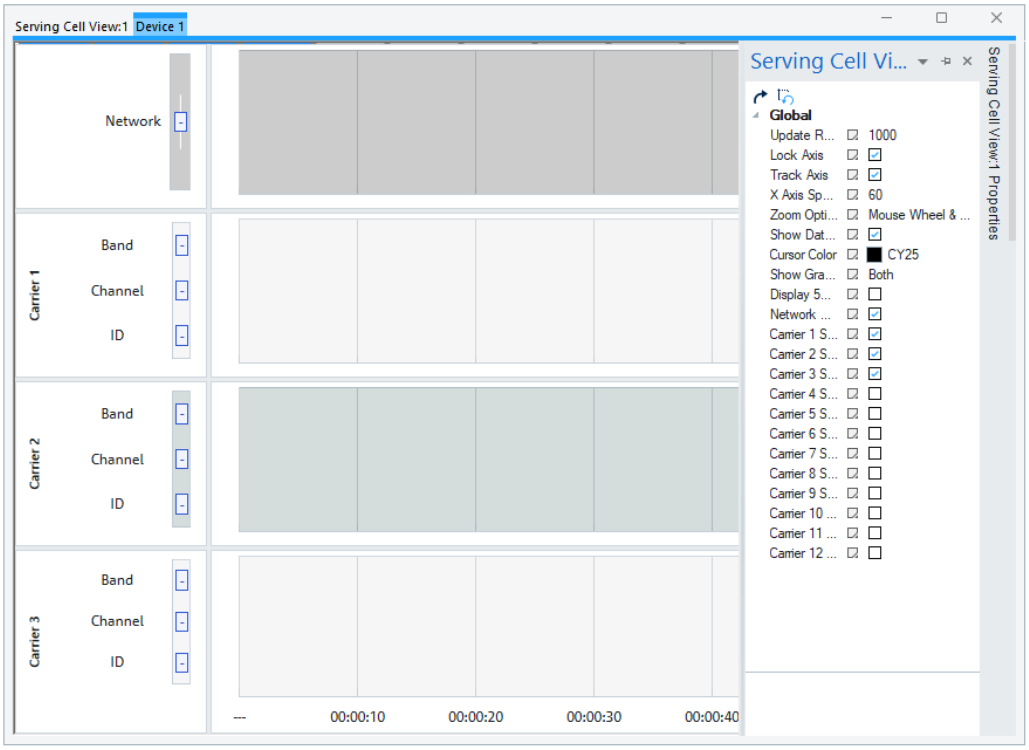


Figure 4-503: Multiple carriers selection from property bar

5G NR UE signals

The list of supported 5G NR UE signals is long, as covered under the corresponding subnodes. Here are mentioned only some of the supported signals. For the all 5G NR UE signals and their description, see "Description of R&S ROMES4 Signals" document.

The Qualcomm and Exynos chipset based mobile devices measure and report RSRP per antenna ports. The signals are visible in the "5G NR UE" > "5G NR Carriers" node of the "Signal Tree". However, their availability in the node depends on used firmware.

VoNR support

A 5G NR UE capability to support VoNR is indicated in the "UE Capabilities View", see Figure 4-645. The important 5G NAS MM IEs shown in the following screenshot are included in the "5G NR UE" > "NAS IEs" branch.

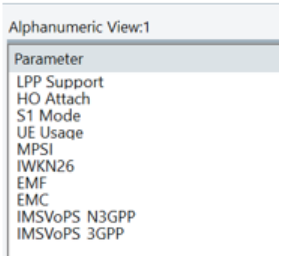


Figure 4-504: VoNR signals

5G NR TDD

For the TDD configuration, 5G NR UE branch "5G NR TDD Configuration" displays the TDD slot pattern for UL and DL allocation in a radio frame. To see the signals displaying the TDD configuration only, type filtering criterion "tdd".

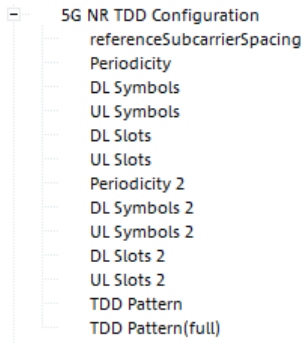


Figure 4-505: Filtered 5G NR TDD configured signals

The configured TDD slot patterns of a cell are shown as strings of letters "D", "U", "F" indicating downlink, uplink and flexible configured slot, respectively. The following "Alphanumeric View" screenshot displays the configured pattern.

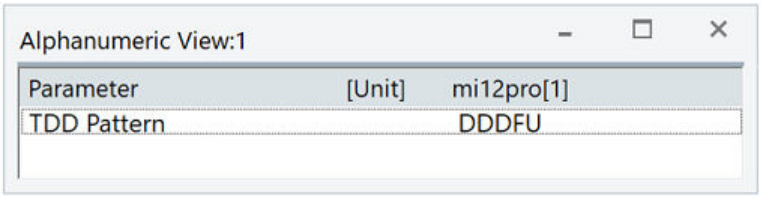


Figure 4-506: Example of the configured TTD slot pattern

The "TDD Pattern(full)" signal provides the slot number added to the slot letter and the info on slot's symbols configuration. A symbol is marked as "d" for DL, "u" for UL and "f" for flexible symbol. The Tooltip explains the information of TDD Pattern(full) when mouse hovers over the signal.

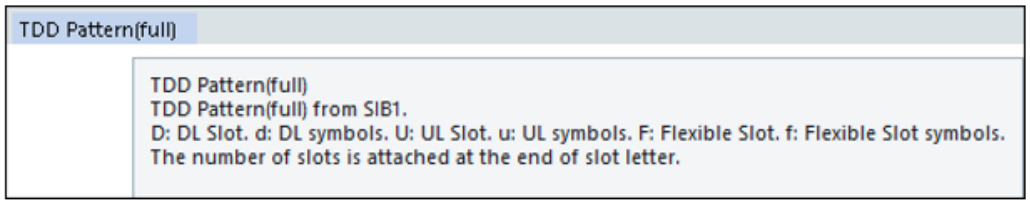


Figure 4-507: Tooltip for TDD Pattern (Full) signal

NAS PDUI sessions signals support

The signals which provide access to the content of the PDU session configuration are available in the "NAS PDU Sessions" branch of the "Signal Tree" > "5G NR UE". The content is taken from the corresponding Layer 3 messages.

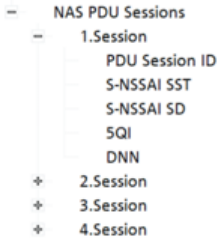


Figure 4-508: Supported NAS signals

PDSCH/PUSCH carrier signals support

The "PDSCH Carrier" and "PUSCH Carrier" branches contain signals that indicate the states of a primary component carrier and secondary component carriers. The consecutive "PDSCH Total" and "PUSCH Total" branches indicate the CC states in total. Added are the corresponding signals that indicate a time elapsed for PDSCH and PUSCH component carriers being in "Deactivated" and "Activated" state. For the signals, refer to the "Description of R&S ROMES4 signals" document.

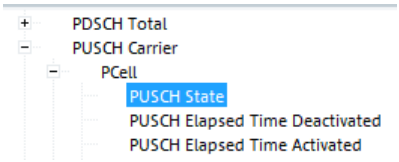


Figure 4-509: Supported PCC and SCC state signals

The "5G NR Carriers" > "PCell" branch of the "5G NR UE" signal tree contains the "Scanner Top N Rank" which displays the current rank of the carrier in the corresponding 5G NR TopN pool. Only 5G NR auto NR-ARFCN TopN pools are supported by this feature.

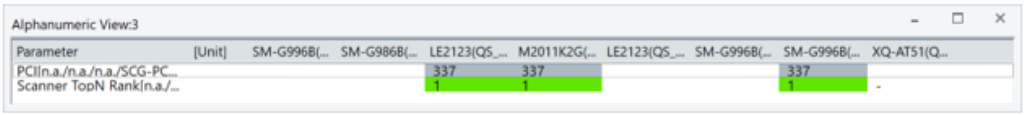


Figure 4-510: Alphanumeric view shows the scanner Top N rank

The screenshot shows, that PCI 337 has been detected by the scanner and ranked as the best cell.

The "3GPP Overview View" shows the TopN rank of the carrier for LTE and 5G NR within the MCG and SCG columns, respectively.

Figure 4-511: 3GPP Overview view shows MCG and SCG values

4.4.8.10 Network - 5G NR UE negotiated throughput

EPS Mobility Management Message "ESM Throughput Information" is responsible for informing the UE on assigned throughputs negotiated between 5G NR UE and network. This information is an important message for understanding the difference between promised/negotiated and achieved throughputs on the radio-link. The information is included in R&S ROMES4 application in a form of several signals like "Delay Class", "Reliability Class", "Maximum Bit Rate UL/DL" and "Guaranteed Bit Rate UL/DL".

4.4.9 TETRA views

The "TETRA Views" display TETRA-specific information acquired with a TETRA test mobile and installed TETRA device.

Recording of the different message types shown in the "TETRA Views" must be explicitly activated by the TETRA device configuration tabs "Configuration" and "Expert Mode".

R&S ROMES4 available TETRA views are displayed in the context sensitive menu on the "View" > "Mobile Views", when the mouse pauses over "TETRA".

Figure 4-512: TETRA views

Measurement files recorded with R&S ROMES4 4.50 SP1 or earlier

Due to an update of the supported TETRA data format, measurement files recorded with R&S ROMES 4.50 SP1 or earlier are not fully supported anymore by R&S ROMES4 4.50 SP2 or later. The files can still be replayed but the "Layer 3 View" and "ETSI QoS View" remain empty.

TETRA group calls

Group calls within separated groups are highly recommended as the test cases with four mobiles in two cars. In addition, other users of the same group in the same network should not interfere with the measurement.

Explanation: If this is ignored, the Call KPIs cannot be calculated according to ETSI or other in R&S ROMES4 implemented standards and will be rendered invalid. R&S ROMES4 will not inform the user about such configuration errors. As a consequence the QoS view will most likely contain invalid setup-times and other wrong messages related to KPI.

However, R&S ROMES4 NPA indicates detection of the invalid message sequences, which is particularly important when analyzing many files. The R&S ROMES4 NPA informs then the user which files contain the non-standard setup. In order to get valid KPIs, these files have to be removed from the evaluated files list.

4.4.9.1 TETRA graph view

The "TETRA Graph View" displays the TETRA power and the CI of the current server and the TETRA power and the C2 of the best neighbor.

Figure 4-513: TETRA Graph View

The "TETRA Graph View" configuration is done in the "TETRA Graph View: <variable> Properties" pane.

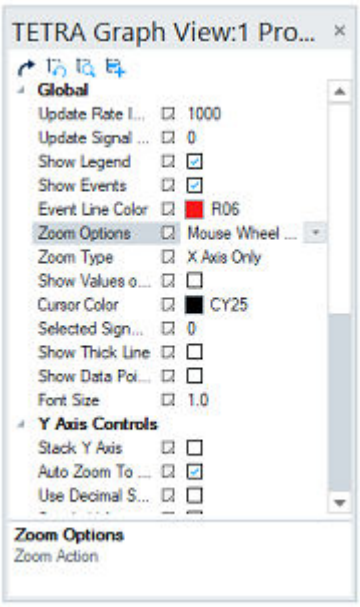


Figure 4-514: Properties of TETRA graph view

For the meaning of the configuration entries in the properties of the "TETRA Graph View", see Chapter 4.2.1, "2D chart view", on page 448.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Selecting the "Configure" command in the context sensitive menu of the view opens only the "Info" page.

TETRA power

Indicates the received TETRA power of the server expressed in dBm.

C1

Path loss C1 of the server expressed in dB. The calculation is based on the values of the broadcast channel and the configured maximum MS transmit power.

Best NC TETRA power

Indicates the received TETRA power of the best neighbor cell expressed in dBm.

Best NC C2

Path loss parameter C2 expressed in dB.

```
C2(n) =
TETRA Power(n) - RXLEV_ACCESS_MIN_MCELL(n) - Max ( 0, MS_TXPWR_MAX_MCELL(n) - PMS(n) )
```

- **TETRA Power(n)**

Averaged TETRA signal level at MS or equivalent signal quality measurement on the monitored carrier.

- **RXLEV_ACCESS_MIN_MCELL(n)**
  Minimum permissible received level at MS on the monitored carrier.
- **MS_TXPWR_MAX_MCELL(n)**
  Maximum MS transmit power allowed on the monitored carrier.
- **PMS(n)**
  Maximum transmit power of the MS for the modulation mode on the monitored carrier.

4.4.9.2 TETRA overview view

The "TETRA Overview View" displays the most important parameters. In the upper section shows the registration state of the MS. The next section shows the most important parameters concerning the current serving cell. The parameters of best neighbor cell can be seen below, followed by the "Call State Info" and the "Top N" list of the TETRA scanner, if available.

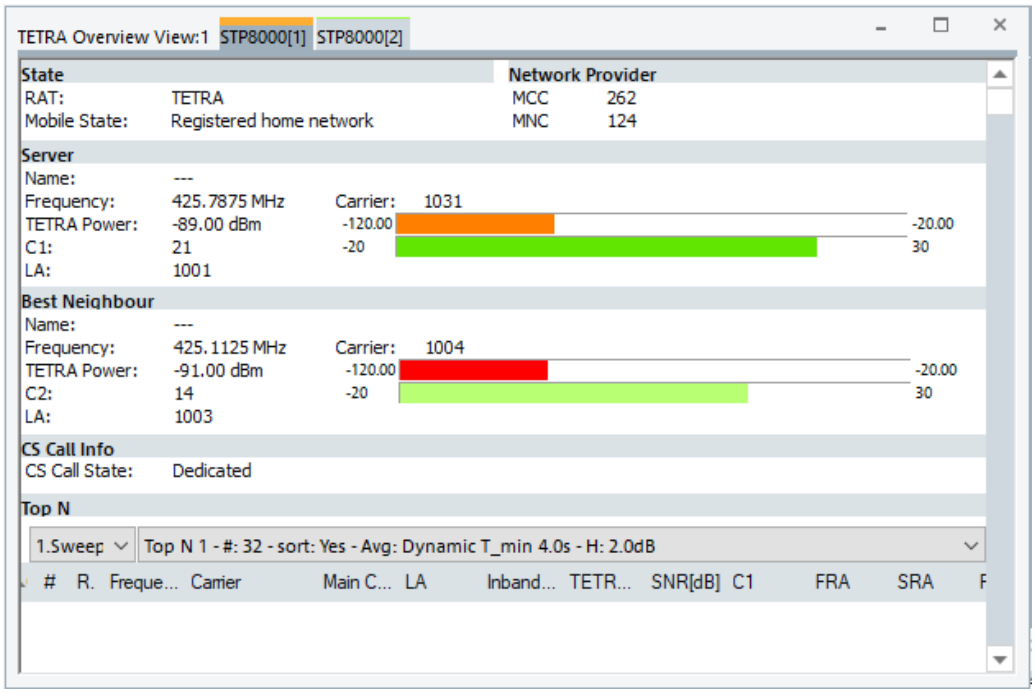


Figure 4-515: TETRA Overview View

The "TETRA Overview View" configuration menu customizes the color of the carrier and the contents of the table.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

State

- **RAT**
  Current Radio Access Technology.
- **Mobile State**
  Possible states of the radio are:
  - **Unknown**
    No network available
  - **Idle**
    Registered in standby mode (no active call)
  - **Access**
    Call is set up
  - **Dedicated**
    Call in TETRA network
  - **Unconnected**
    Radio is not connected
  - **Scan**
    Radio is in scan mode
  - **Registered home network**
    Radio is registered in home network

Network provider

- **MCC**
  Mobile Country Code identifies a country the operator belongs to.
- **MNC**
  Mobile Network Code identifies the operator.

Server

The "Server" panel displays several parameters describing the signal power and quality reported by the test mobile of the current serving cell.

- **Name**
  Name of the serving cell.
  There is a "+" behind the name when there are more than one cell of a provider within the same LA and the filtering by carrier is not enabled, see TEC for TETRA.
- **Frequency**
  Centre frequency of the TETRA channel.
- **TETRA Power**
  Indicates the received wideband power in dBm.
- **BER**
  Block Error Rate
- **C1**
  Server path loss parameter C1 calculated using the values of the broadcast channel and the configured maximum UE transmit power.
- **LA**
  Location Area a geographical area including one or more cells.

Best neighbor

- **Name**
  Name of the best neighbor cell.
  There is a "+" behind the name when there are more than one cell of a provider within the same LA and the filtering by carrier is not enabled, see TEC for TETRA.
- **TETRA Power**
  Received wideband power in dBm.
- **C1**
  Path loss parameter C1 calculated for a neighbor cell using broadcast channel information and the configured maximum UE transmit power.
- **LA**
  Location Area a geographical area including one or more cells.

CS call info

The "CS Call Info" panel displays the circuit switched call state.

Top N

The "Top N" panel displays TETRA scanner data recorded by the TETRA scanner device. It shows the properties of the signals from the BTS that are elements of the current Top N Pools. The data is also displayed in Chapter 4.8.10.7, "TETRA scanner Top N view", on page 1363.

The drop down menu on top of the "Top N" panel contains all Top N pools defined in the "Top N" tab of the TETRA technology configuration. Up to 3 differently named pools can be configured in the default setup. Each pool has several configurable parameters. The Top N list gives an overview of the received signals in the current Top N pool together with their measured power parameters, frequency and timing information. In the view configuration menu, it is possible to show or hide each individual table column.

On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

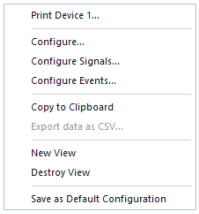
The Top N list contains the following columns:

- **#**
  Number of measured cells within the Top N pool
- **Rank**
  Current rank within the Top N pool
- **Carrier**
  TETRA Carrier Index (0 to 3999)
- **Main Carrier**
  Frequency of the MCCH extracted from SYSINFO PDU
- **LA**
  Location Area a geographical area including of one or more cells
- **Inband Power**
  Inband power of the TETRA channel in dBm
- **TETRA Power**

Received TETRA power in dBm

- **SNR**
  Signal-to-Noise-and-interference-ratio in dB
- **C1**
  Path loss parameter C1 calculated using the values of the broadcast channel and the configured maximum MS transmit power
- **FRA**
  State of the Fast Reselection
  Calculation uses the values of the broadcast channel.
- **SRA**
  State of the Slow Reselection
  Calculation uses the values of the broadcast channel.
- **BLER Pre-Vit.**
  Ratio of estimated number of channel errors in block 1 and block 2 to the number of analyzed bits in block 1 and block 2 (comparison of received data and re-encoded data after error correction (Convolutional Code with Viterbi-Detector)) expressed in %.
- **BLER AACH**
  Block Error Rate of Access Assign Channel
  Ratio of estimated number of channel errors in the broadcast block to number of analyzed bits in the broadcast block (comparison of received data and re-encoded data after error correction (Reed-Muller-Code)) expressed in %.
- **Freq-Error**
  Frequency error in Hz
- **Phase-Error**
  RMS (Root-mean-square) phase error on the information symbols expressed in degree [°]
- **Delay Spread**
  Delay spread of arriving paths expressed in µs
- **Timeslot**
  Timeslot number extracted from SYNC PDU
- **FN**
  Frame number extracted from SYNC PDU
- **MFN**
  Multiframe number extracted from SYNC PDU
- **Burst Mod ER**
  Modulation Error Ratio over all symbols in the burst in dB
- **Pilot Mod ER**
  Modulation Error Ratio over the pilot and sync symbols in dB
- **Header Mod ER**
  Modulation Error Ratio over the header symbols in dB
- **Data MER**
  Modulation Error Ratio over the data symbols in dB
  MER = Modulation Error Ratio (Mod ER in dB)

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

TETRA overview view configuration

Top N view configuration

The "Top N View" tab defines the contents of the "Top N" table.

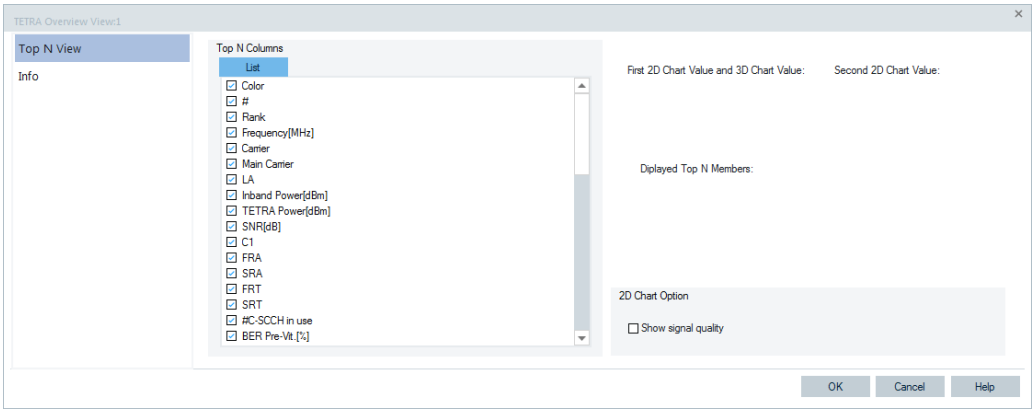


Figure 4-516: TETRA Overview View - configuration

2D Chart Option
The option to display the signal quality is active if "Show signal quality" is checked. The function is the possibility to switch "on" or "off" the second y-axis on the chart and quality signal bars.

If the option is selected, you will see the result of the switching only on the next frame. The chart must redraw at least once for it.

Color settings

The color scale for the TETRA Power signal values obtained both from mobiles and scanners is unified with the scale used in R&S ROMES4 NPA.

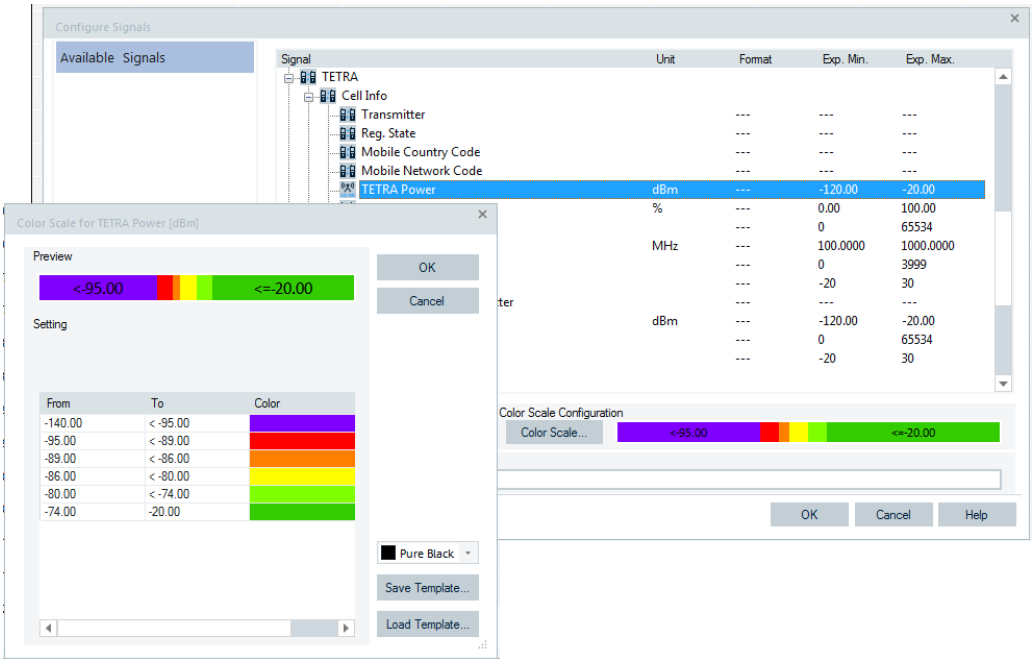


Figure 4-517: Color scale setting - common for TETRA mobiles and scanners

4.4.10 3GPP handover analyzer view

The "3GPP Handover Analyzer View" shows a list of the GSM (2G → 2G), UMTS (3G → 3G), LTE (4G -> 4G) and inter-RAT (3G → 2G, 4G → 2G and 4G → 3G) handover procedures attempted by UMTS, GMS and LTE mobile devices and provides a statistical evaluation. The list and the statistics are displayed in two alternative views. It is possible to open several "3GPP Handover Analyzer Views" simultaneously in order to observe the list and the statistical views in parallel.

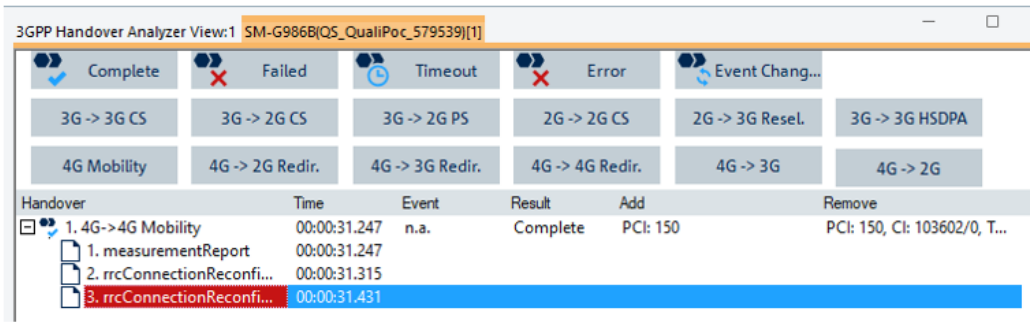


Figure 4-518: 3GPP Handover Analyzer View

The Handover analyzer generates nodes for each UMTS event. It may happen that the actual ActiveSetUpdate (renamed to UMTS Handover analyzis due to support of 3G -> 2G handover packet switched, see Chapter 4.4.10.1, "Handover list", on page 899) is not placed in the same branch as the triggered event if meanwhile the mobile has reported different event. In this case, the event can be found in one of the branches above.

The handover analysis requires the Handover Analyzer plugin option R&S ROMES4HOA. The view is empty unless the test mobile records the "Layer 3 Messages". For more, see the description of the "Handover" window in the mobile devices configuration menus in the chapter "Handover analyzer" on page 1584. The handover analysis must be activated in the "HOA" check box of the window.

The complete list of the recorded handovers is selected via "Show List" in the context menu.

4.4.10.1 Handover list

The handover list consists of the following columns:

- **Handover**
  Shows current handover number and handover type. The handover analyzer reports GSM,UMTS LTE intra-/inter-RAT handovers. CS and PS denote the circuit switched and packet switched domains, respectively.

  The following Layer 3 messages which are relevant for the handover processes related to 3G and 2G technologies are listed within a handover event:

  – **3G → 3G Handovers (CS):**
  Measurement report with one of the events (1a, 1b, …, uplink) described below
  ACTIVE SET UPDATE (downlink)
  ACTIVE SET UPDATE COMPLETE (uplink)

  – **3G → 2G Handovers (CS):**
  Measurement report with event 3a described below (uplink) or Cancel event
  HANDOVER FROM UTRAN COMMAND (to GSM, downlink)
  HANDOVER COMPLETE (uplink)

  – **3G → 2G Handovers (PS):**
  Due to support of 3G → 2G handover (PS), the page UMTS ActiveSet Analysis is renamed as UMTS Handover Analysis to show that more than some Active Set Updates are detected.

  – **2G → 2G Handovers (CS):**
  GSM HANDOVER COMMAND (downlink)
  HANDOVER COMPLETE (uplink)

  – **3G → 3G Handovers (PS):**
  CELL UPDATE (downlink)
  CELL UPDATE CONFIRM (uplink)

  – **3G → 3G Handovers (HSDPA):**
  TRANSPORT CHANNEL RECONFIGURATION REQUEST / ACCEPT

  It is possible to expand or collapse the messages for a single handover (click the + / – symbols or double-click the line) or all handovers (use the context menu).

Double-click for a detailed analysis of the Layer 3 messages. For a complete list of Layer 3 messages use Chapter 4.4.15, "Layer 3 view", on page 958.

- **Time**
  Handover start time, the time of the first Layer 3 message (see above) which initiated the handover report.
- **Event**
  Handover type or one of the measurement reporting events that the UMTS test mobile received from the network. The events are used to notify a UMTS UE in which instance it should transmit a measurement report.

  3GPP TS 25.331 describes the following events:

  – **Event 1a**
  For intra-frequency measurements: a primary CPICH enters the reporting range.
  – **Event 1b**
  A primary CPICH leaves the reporting range.
  – **Event 1c**
  A non-active primary CPICH becomes better than an active primary CPICH.
  – **Event 1e**
  Aa primary CPICH becomes better than an absolute threshold.
  – **Event 1f**
  A primary CPICH becomes worse than an absolute threshold.
  – **Event 2d**
  For inter-frequency measurements: The estimated quality of the currently used frequency is below a certain threshold.
  – **Event 2f**
  The estimated quality of the currently used frequency is above a certain threshold.
  – **Event 3a**
  For inter-RAT measurements: The estimated quality of the currently used UTRAN frequency is below a certain threshold and the estimated quality of the other system is above a certain threshold.
- **Result**
  Status of the handover attempt.

  Possible results are:

  – **Start**
  – **Pending**
  – **Complete** for successful handovers
  – **Timeout** for handover time exceeded the timeout specified in "HOA" tab of the UMTS mobile device configuration menu (see "Handover analyzer" on page 1584).
  – **Event Change** for the measurement reporting event changed by the network during the handover.
- **Add**
  GSM: BCCH and BSIC of the source base station.

UMTS: Name of an UTRAN cell added to the active set, taken from the Node B database (if available). To monitor the complete active set and neighbor set, see Chapter 4.4.18, "Serving cell view", on page 999.

- **Remove**
  GSM: BCCH, BSIC, CI, and LAC of the target BTS and cell.
  UMTS: Name of an UTRAN cell removed from the active set, taken from the Node B database (if available).

4.4.10.2 Filter options

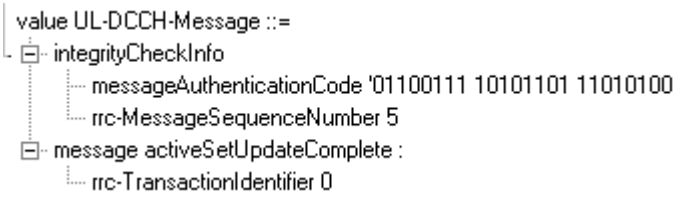
The buttons above the "Handover" list are used to select for display or hiding handovers/reselections of different types and with specific results. A dimmed button means that the handover events are not shown in the list, they are hidden.

- The buttons in the first row stand for the events outcomes.
- The buttons in the second row stand for mobility events in the 3G and 2G technologies.
- The buttons in the third row stand for the 4G mobility events.

Beside each line in the "Handover" list, the simple symbol indicates event and its state.

4.4.10.3 Further analysis

An upper case D appears to the right of the cursor arrow when it is placed on a layer 3 message. This symbol indicates that there is detailed information to be retrieved for the current Layer 3 message. The detailed information window is opened by double-clicking the message.



It is also instructive to monitor the measurement route and the NodeBs / Base Stations in the Chapter 4.3.3, "ROMESMAP route track view", on page 562 view. The cells in the "Add" and "Remove" columns can be displayed with different colors using the "Show NodeBs/BTSs" on map command in the context menu. The color code can be configured in the "3GPP Handover Analyzer View" configuration menu.

3G –> 3G handover

The statistical evaluation of the recorded handovers is selected via "Show Statistics" in the context menu. There are three versions of the statistics tab, corresponding to the three handover types "3G → 3G", "3G → 2G" (inter-RAT), "2G → 2G" The versions are selected in the drop-down list across the top of the view.

The 3G –> 3G Handover tab shows the following results.

Event table

The table lists the total number of detected handovers with their measurement reporting event class and the handover result.

- Handovers with the same active event appear in the same row. The last row ("All") shows the sum of all previous rows. "Event Change" handovers are classified according to the event at the start of the handover.
- Handovers with the same result appear in the same column. The following categories are defined: MR (Measurement Report; the sum of the "ASU", "ASU-F", and "ASU-X" columns), "ASU" (Active Set Update, handovers with an update of the active cell set), "ASU-C" (Active Set Update Complete, ASU handovers that could be completed without error), "ASU-F" (Active Set Update Failure, ASU handovers that failed before the timeout), "ASU-X" (all other handovers, e.g. the "Timeout" or "Event Change" handovers).

Overview of the GSM handovers and handovers between different Radio Access Technologies (inter-RAT handovers, 3G/UMTS → 2G (GSM) and 2G (GSM) → 3G/UMTS).

- **SR**
  Success Rate, ratio of the successful handover attempts (Result: "OK") to the total number of handover attempts for each handover type. A handover is classified successful if it could be achieved before the "Handover Timeout" defined in the configuration menu elapsed.
- **Attempts**
  Total number of handover attempts for each handover type.

The distribution of the duration of the handover procedures (i.e. the time between a HO command and a HO response) is shown in two bar graphs:

- **GSM Handover [s]**
  Time for GSM handovers.
- **Inter-RAT Handover [s]**
  Time for inter-RAT handovers including
  3G → 2G and 2G → 3G handovers.

The diagram scales and the number of classes (bars) are fixed.

Successful handover distribution

The upper bar graph shows the percentage of successful (completed) handover attempts for each event class, i.e. the number of "ASU-C" handovers divided by the number of "MR" handovers. In the example of the figure above, all "Event 1a" and "Event 1b" handovers but none of the "Event 2f" handovers were successful.

The diagram scales and the number of classes (bars) are fixed.

General handover distribution

The lower bar graph shows the percentage of (completed and failed) handover attempts for each event class. The red portion of each bar corresponds to the failed, the green portion to the successful attempts. The added length of all bars is 100%.

The "3G → 2G Handover" and "2G → 2G Handover" tabs are similar to the previous one.

The following properties of the network standard simplify the tables and diagrams:

- An inter-RAT handover can only occur while the measurement reporting event 3a is active, so the "3G → 2G Handover" view only shows the percentage of successful and failed handovers within the event class 3a.
- No reporting events are defined for GSM (2G) networks, so the "2G → 2G Handover" view only shows the percentage of successful and failed handovers.

IRAT HO testing using autodialing

The autodialing mechanism of the mobile devices was extended with a new feature in order to test IRAT handovers automatically.

4.4.10.4 Support of 4G mobility, redirection and handover

For the LTE technology the R&S ROMES4 HO analyzer supports the following events:

- **4G Mobility**
- **Redirection**
  - 4G → 4G
  - 4G → 3G
  - 4G → 2G
- **Handover**
  - 4G → 3G
  - 4G → 2G
  - 4G → 3G/2G during a voice call, named SRVCC

The analyzer results are reported automatically if the Handover Analyzer feature is switched on in the mobile devices configuration (default setting when the necessary option is available).

3GPP Release 8 Layer 3 messages are supported and given in the following chapters.

4G mobility

The 4G mobility info evaluats the **rrcConnectionReconfiguration** messages which contain a mobilityControlInfo structure. The analyzers result reports the foregoing **measurementReport**, the **rrcConnectionReconfiguration** and the **rrcConnectionReconfigurationComplete**.

The source and the target eNodeB are reported also, see the Figure 4-518.

4G → 2G redirection

The start trigger point of the 4G → 2G redirection is the **rrcConnectionRelease** with a **redirectedCarrierInfo** structure. The analyzer checks if the **Location Area Update** in 2G can be executed successfully. The corresponding message flow can be seen in the "Handover Analyzer View". The source eNodeB and the target ARFCNs are reported.

4G → 3G redirection

The start trigger point of the 4G → 3G redirection is the **rrcConnectionRelease** with the **redirectedCarrierInfo** structure. The analyzer checks if the **rrcConnectionSetup-Complete** in the 3G network succeeded. This message is a trigger point for successful 4G → 3G redirection. The corresponding message flow can be seen in the "Handover Analyzer View". The source eNodeB and the target UARFCN are reported.

4G → 4G redirection

The start trigger point of the 4G → 4G redirection is the **rrcConnectionRelease** with a **redirectedCarrierInfo** structure. The analyzer checks if the **rrcConnectionSetup** at the new EARFCN succeeded. The corresponding message flow can be seen in the "Handover Analyzer View". The source eNodeB and the target EARFCN are reported.

4G → 3G handover

The Handover Analyzer plugin supports detection of 4G→ 3G handover events among others, see Figure 4-519.

The corresponding trigger points are displayed in the "Handover Analyzer View":

- mobilityFromEUTRANCommand
- handoverToUTRANComplete
- LOCATION UPDATING REQUEST
- LOCATION UPDATING ACCEPT

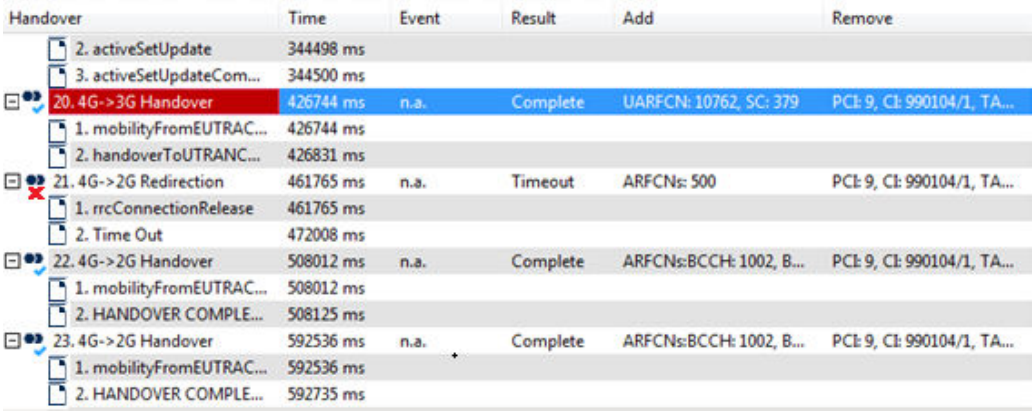


Figure 4-519: 4G -> 3G Handover

The message flow, the source eNodeB and the target UARFCNs are also reported.

SRVCC (4G→ 3G /2G handover)

The Layer 3 view displays the corresponding messages which are involved into the handover process, as shown in the following figure.

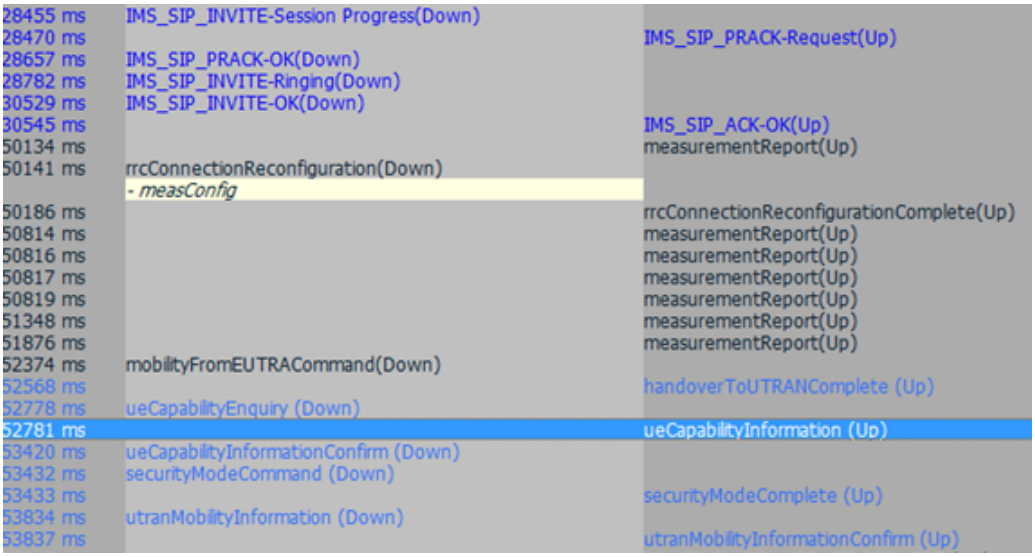


Figure 4-520: Layer 3 messages view

The Handover Analyzer generates nodes for each HO event.

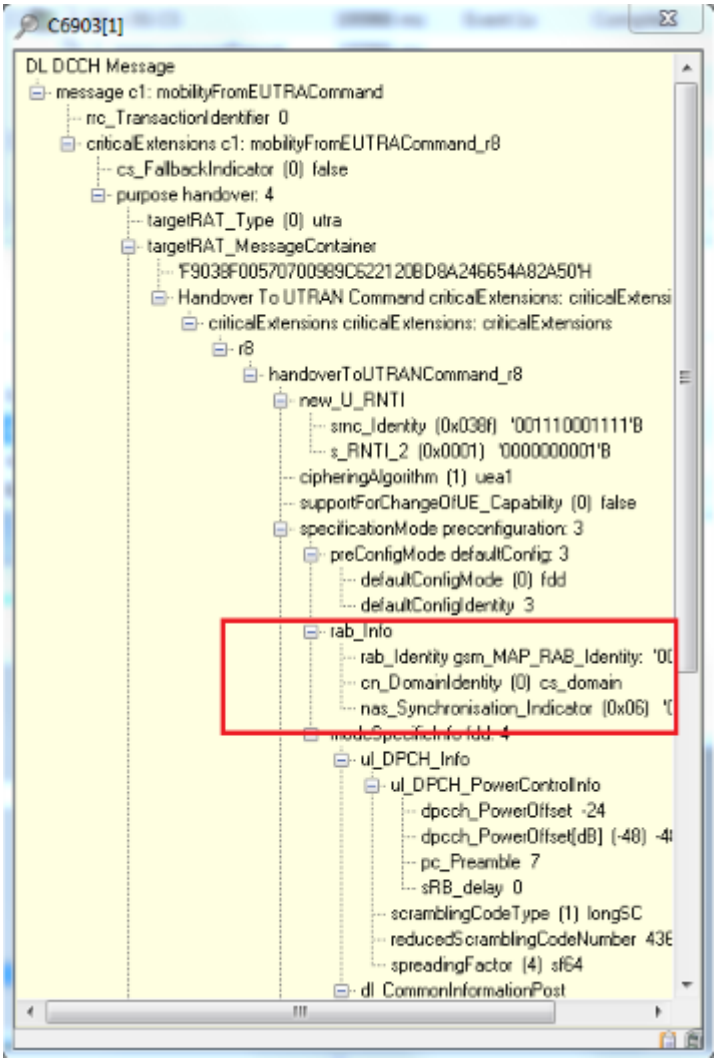
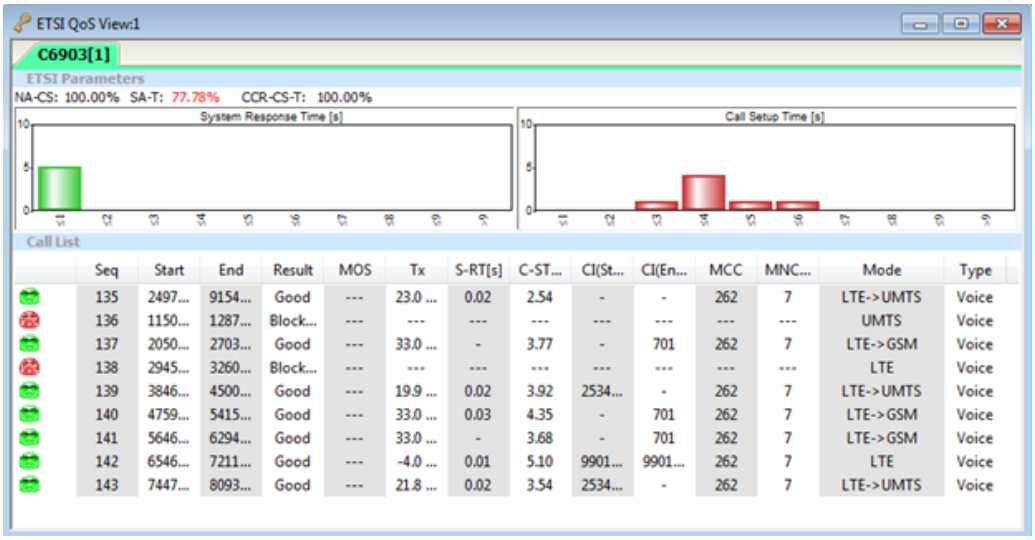


Figure 4-521: SRVCC tracer

The SRVCC is displayed in the "ETSI QoS View".

The "ETSI QoS View" reports the presence of an IRAT handover in the "Mode" column, see the following figure.



Seq	Start	End	Result	MOS	Tx	S-RT[s]	C-ST...	CI(St...	CI(En...	MCC	MNC...	Mode	Type
135	2497...	9154...	Good	---	23.0 ...	0.02	2.54	-	-	262	7	LTE->UMTS	Voice
136	1150...	1287...	Block...	---	---	---	---	---	---	---	---	UMTS	Voice
137	2050...	2703...	Good	---	33.0 ...	-	3.77	-	701	262	7	LTE->GSM	Voice
138	2945...	3260...	Block...	---	---	---	---	---	---	---	---	LTE	Voice
139	3846...	4500...	Good	---	19.9 ...	0.02	3.92	2534...	-	262	7	LTE->UMTS	Voice
140	4759...	5415...	Good	---	33.0 ...	0.03	4.35	-	701	262	7	LTE->GSM	Voice
141	5646...	6294...	Good	---	33.0 ...	-	3.68	-	701	262	7	LTE->GSM	Voice
142	6546...	7211...	Good	---	-4.0 ...	0.01	5.10	9901...	9901...	262	7	LTE	Voice
143	7447...	8093...	Good	---	21.8 ...	0.02	3.54	2534...	-	262	7	LTE->UMTS	Voice

Figure 4-522: Mode column shows IRAT HO type

Statistics

For both new analyzer results, the statistics are reported. To show the statistics display, change the views display by opening the context menu and selecting the "Show Statistics".

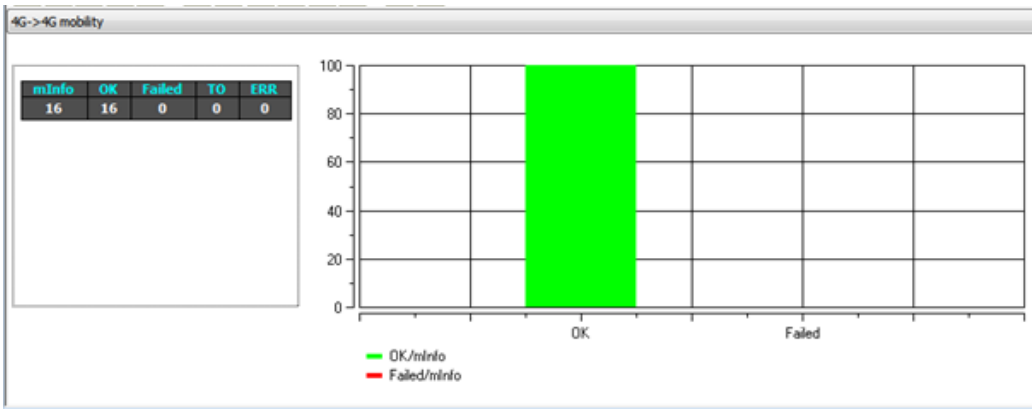


Figure 4-523: Show Statistics - the 4G → 4G mobility case

4G handover analyzer events

The 4G handover analyzer results provide the events can be used for visualizing the analyzers results, for example, in the map or 2D chart. The events have to be activated in the "Event Configuration" dialog. To access the dialog click "Tools > Preferences".

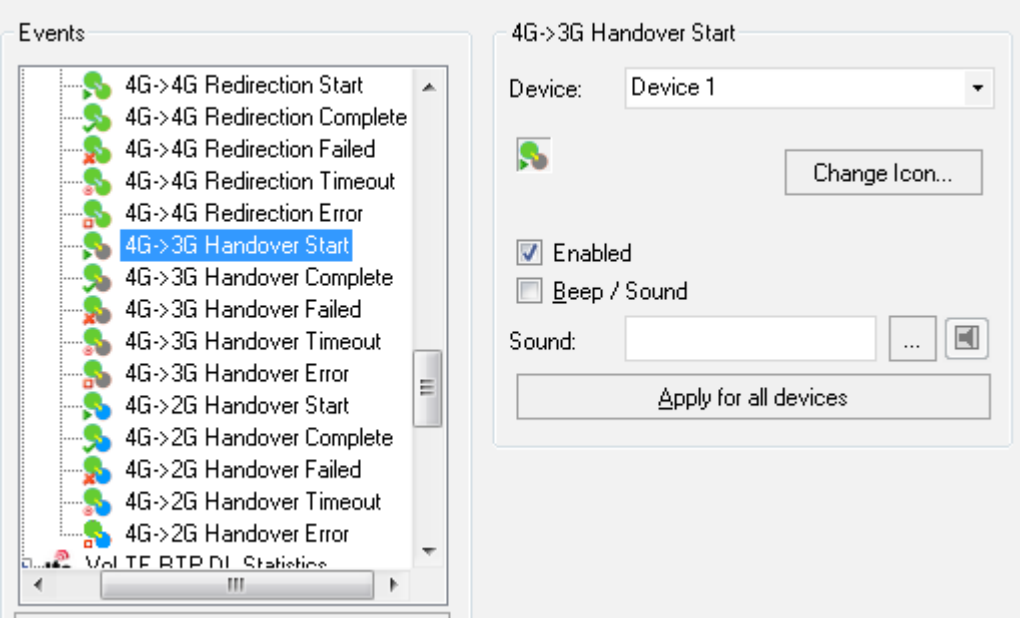
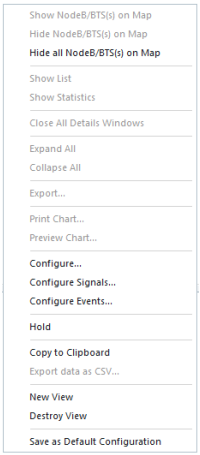


Figure 4-524: List of 4G events

4.4.10.5 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional, view-specific commands:

- **Show Node B…**
  Use the color code defined in the "3GPP Handover Analyzer View" configuration menu (see below) to mark the cell for the selected handover in the "ROMESMAP Route Track" view. This feature is only available if a handover process is selected in the handover list. The colored cells are the ones listed in the "Add" and "Remove" columns, respectively. The UMTS layer / GSM BTS layer in the "Route Track" view must be visible to use this feature.
- **Hide Node B**
  Reverse the previous action, display the selected cell symbol with standard colors.
- **Hide all Node B**
  Display all cell symbols with standard colors.
- **Show List/Statistics**

Toggle between the list of the recorded handovers and the statistical evaluation.

- **Close all Details**
  Remove all open details windows from the view. This action is convenient for removing several open windows pinned over the view; see Chapter 4.1, "Common properties of R&S ROMES4 views", on page 428.
- **Expand/Collapse All**
  Show or hide the layer 3 messages for each handover in the list.
- **Export**
- Export the handover analyzer data to a `*.csv` export file that can be opened and processed by Excel. The file contains the information in the statistics view.
- **Print/Preview Chart**
  Show a print preview or print the Show Statistic view.

4.4.10.6 3GPP handover analyzer view configuration

The "3GPP Handover Analyzer View" configuration menu defines the CMD file scanning behavior and the color scheme for the NodeB / BTS symbols in the "ROMESMAP Route Track View" .

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

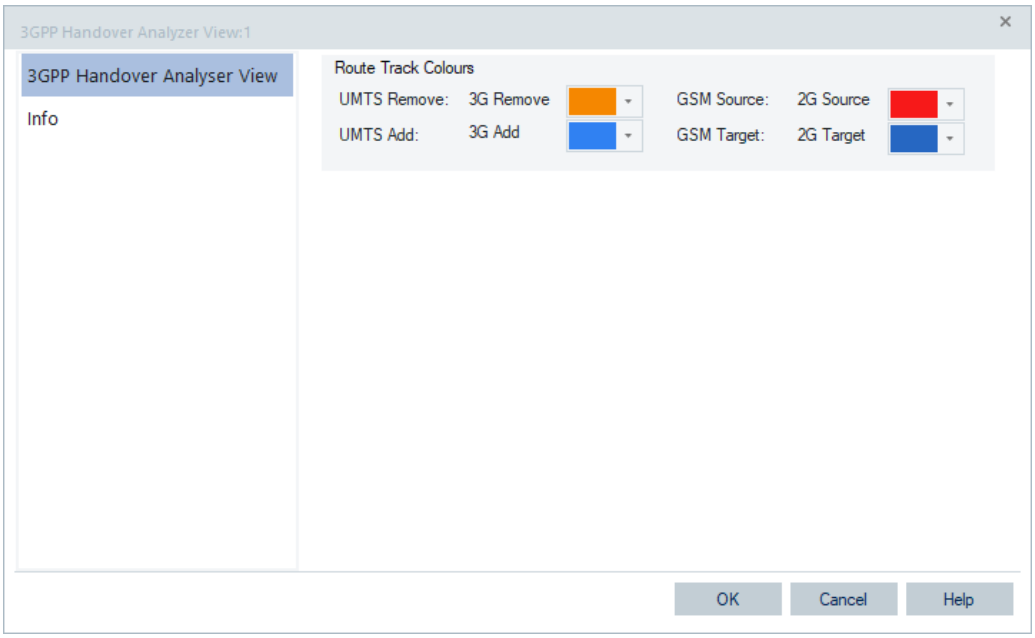


Figure 4-525: 3GPP Handover Analyzer View - configuration

General
The "Scan File" check box enables/disables the automatic scanning of 2G/3G-related handover data in the active measurement file.

Route Track Colors ← General

- The colors distinguish the following UMTS Node Bs and GSM base stations:
- "UMTS Remove"
  UTRAN source cell of the handover
- "UMTS Add"
  UTRAN target cell of the handover
- "GSM Source"
  GSM target cell of the handover
- "GSM Target"
  GSM target cell of the handover

4.4.11 3GPP neighbour set view

The "3GPP Neighbour Set View" is joining and enhancing the existing GSM, UMTS and LTE cell set views towards a single 3 technology view for all intra- and inter-RAT measurements commanded by the network and performed by the mobile station.

For a 3GPP specific technology, signaling info from the cell broadcast and/or measurement control messages are evaluated and displayed depending on the mobile state and current measurement situation.

4.4.11.1 Measurement data

Information about the neighbour set will be retrieved from the mobile trace data and from the Layer 3.

4.4.11.2 State/list

The "State" has an overview bar for displaying the current mobile state (idle, DCH, FACH, PCH, Dedicated, GPRS Active, LTE traffic, compressed mode) and the following technology specific information: HSDPA, HSUPA, Dual Cell, MIMO activation.

The "List" > "Set" table has the tree layout with the five fixed root items:

- Active
- Intra-Frequency Neighbor Cells
- Inter-Frequency Neighbor Cells (not available for GSM)
- Inter-RAT Neighbor Cells [Technology 1]
- Inter-RAT Neighbor Cells [Technology 2]

The technology of the Inter-RAT tree items is dependent on the current RAT and can be GSM, UMTS or LTE. Each tree item has a sub-set of eight columns. The content of each column depends on the current RAT.

Table 4-22: Inter-RAT tree items

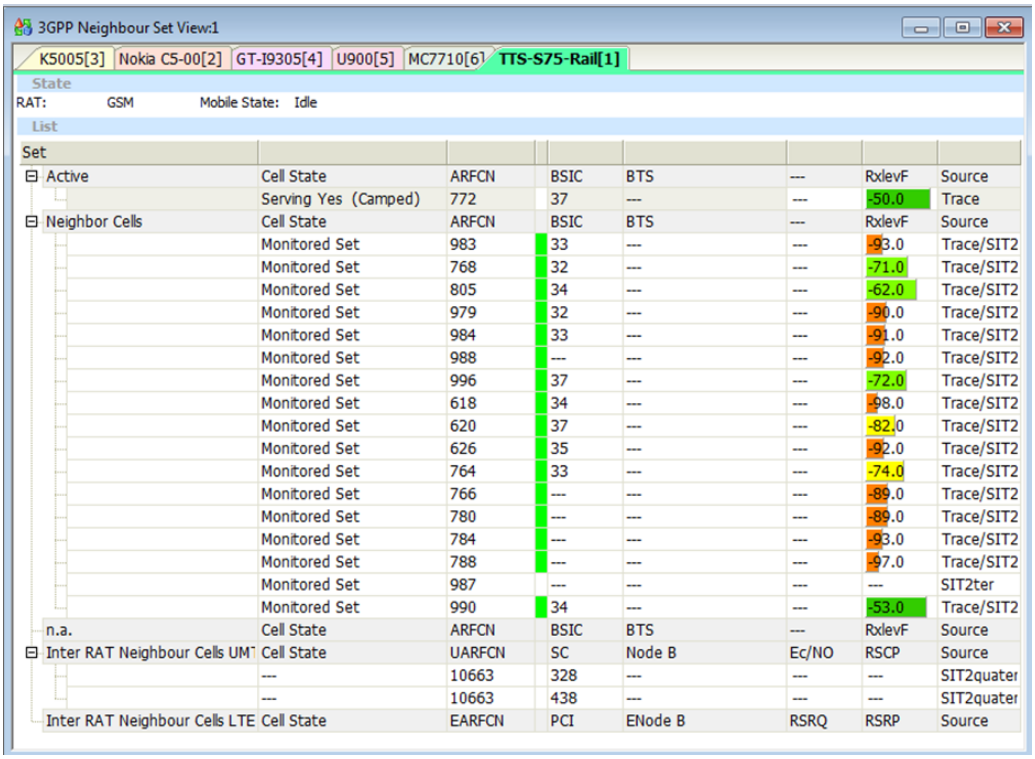
RAT	Cell State	Channel	Color	Cell Identifier	Name	Quality	Level	Source
GSM	Cell State	ARFCN	Color	BSIC	BTS	...	RxLevF or RSSI	Source
UMTS	Cell State	UARFCN	Color	SC	Node B	Ec/No	RSCP	Source
LTE	Cell State	EARFCN	Color	PCI	Enode B	RSRQ	RSRP	Source

If RAT changes, the tree is reset.

RAT dependent 3GPP neighbour set view

RAT GSM

2G intra- and inter-frequency and 3G inter-RAT neighbors are extracted from SIT 2 (detected mode) and SIT 5 (detected mode) of the current cell. The cell info list of UE trace will be modified by the reception of the SIT 2 and 5. The cells which are included in both lists are marked "Trace/SIT2" or "Trace/MC" (SIT5).



Set							
Active	Cell State	ARFCN	BSIC	BTS	---	RxlevF	Source
	Serving Yes (Camped)	772	37	---	---	-50.0	Trace
Neighbor Cells	Cell State	ARFCN	BSIC	BTS	---	RxlevF	Source
	Monitored Set	983	33	---	---	-93.0	Trace/SIT2
	Monitored Set	768	32	---	---	-71.0	Trace/SIT2
	Monitored Set	805	34	---	---	-62.0	Trace/SIT2
	Monitored Set	979	32	---	---	-90.0	Trace/SIT2
	Monitored Set	984	33	---	---	-91.0	Trace/SIT2
	Monitored Set	988	---	---	---	-92.0	Trace/SIT2
	Monitored Set	996	37	---	---	-72.0	Trace/SIT2
	Monitored Set	618	34	---	---	-98.0	Trace/SIT2
	Monitored Set	620	37	---	---	-82.0	Trace/SIT2
	Monitored Set	626	35	---	---	-92.0	Trace/SIT2
	Monitored Set	764	33	---	---	-74.0	Trace/SIT2
	Monitored Set	766	---	---	---	-89.0	Trace/SIT2
	Monitored Set	780	---	---	---	-89.0	Trace/SIT2
	Monitored Set	784	---	---	---	-93.0	Trace/SIT2
	Monitored Set	788	---	---	---	-97.0	Trace/SIT2
	Monitored Set	987	---	---	---	---	SIT2ter
	Monitored Set	990	34	---	---	-53.0	Trace/SIT2
n.a.	Cell State	ARFCN	BSIC	BTS	---	RxlevF	Source
Inter RAT Neighbour Cells UM	Cell State	UARFCN	SC	Node B	Ec/NO	RSCP	Source
	---	10663	328	---	---	---	SIT2quater
	---	10663	438	---	---	---	SIT2quater
Inter RAT Neighbour Cells LTE	Cell State	EARFCN	PCI	ENode B	RSRQ	RSRP	Source

Figure 4-526: RAT GSM

Cell State

- Active Set: Indication whether the cell is the serving cell or not (Yes/No).
- Intra-Frequency Neighbor Cells
  - Monitored Set: The cell is reported in the Layer 3 message SIT2 or SIT5.

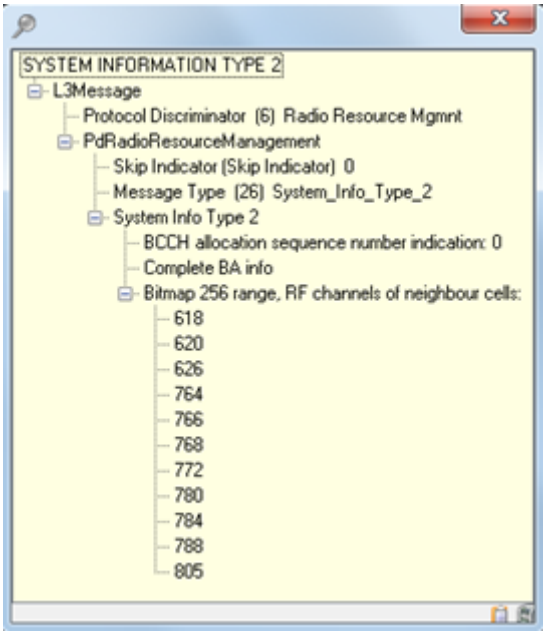


Figure 4-527: System Information Type 2

  - Detected Set: The cell is detected by the mobile trace and not reported in the Layer 3 SIT2 or SIT5.
- Inter-Frequency Neighbor Cells: Not available for GSM
- Inter-RAT Neighbor Cells LTE: Currently not implemented
- Inter-RAT Neighbor Cells UMTS: Cell State is not available

ARFCN

- Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal.

Color

- Active Set: No coloring
- Intra-Frequency Neighbor Cells
  - Green: The cell is monitored and measured (RxLevF value available)
  - No color for all other states
- Inter-Frequency Neighbor Cells: Not available for GSM
- Inter-RAT Neighbor Cells LTE: Not currently implemented for GSM
- Inter-RAT Neighbor Cells UMTS: No coloring

BSIC

- Base transceiver station (BTS) identity code; In this view, the BSIC is always octal (BSIC = ab where a is the NCC and b is the BCC), irrespective of the format (octal/ decimal / hex) selected in the "Preferences > Available Signals" menu.

BTS

- The BTS Name; Only available when a transmitter database corresponding to the measurement data is loaded.

RxLevF

- Minimum received signal level required for an interference situation. The value can be entered either as an RxLev value in steps from 0 to 63 (steps) or as an absolute level in dBm depending on the signal settings. The values will only be displayed when they are inside the expected range.
  In the Inter RAT Neighbor Cells UMTS this column displays the RSCP value.

Source

- Trace: The data source is a mobile trace
- MC: The data source is the Layer 3 SIT3, SIT5ter or SIT2bis
- SIT2: The data source is the Layer 3 SIT2
- SIT2ter: The data source is the Layer 3 SIT2ter
- SIT2quater: The data source is the Layer 3 SIT2quater
- SIT2n: The data source is the Layer 3 SIT2n
- SIT2bis: The data source is the Layer 3 SIT2bis

Multiple data sources are possible.

When the signal settings of the RxLevF value have been changed during replay, the measurement file must be reloaded to apply the changes in this view. This especially holds for the ranges of the appropriate signals. If not set correctly, the signal color will be black.

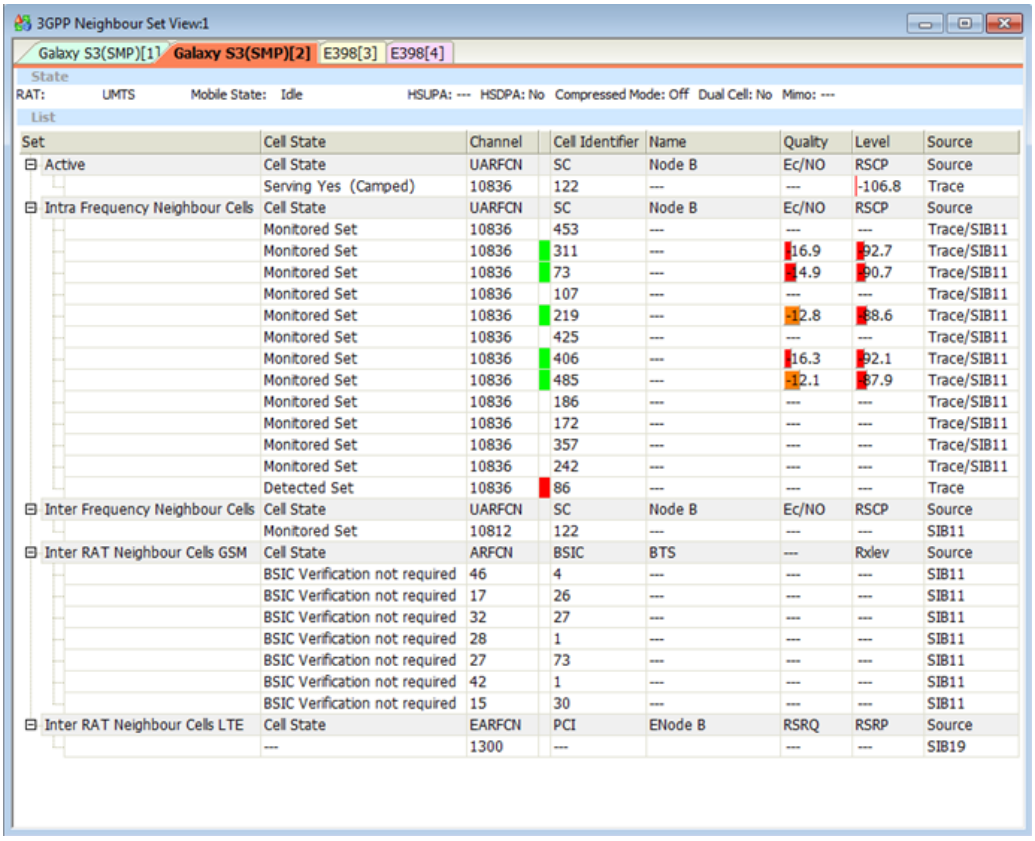
RAT UMTS

For idle mode, 3G intra- and inter-frequency and 2G and 4G inter -RAT neighbors are extracted from SIB 11 and SIB19 of the current cell the UE camps on.

SIB 12 modifies the settings from SIB 11 of the selected cell (formerly camped cell) in Cell FACH, Cell PCH and URA PCH.

If the UE changes from idle (PCH, FACH) to Cell DCH state, the SIB 11 (SIB12 if transmitted) is modified by IntraFreqCellInfoSI List on reception of the RRC Measurement Control. Cells which are included in the cell info list of the UE trace are marked as "Trace/MC", while all another are marked as MC.

If the UE changes from Cell DCH state to Idle (PCH, FACH), the Cell Info List of UE trace is modified on reception of the SIB11 (12, if available) by its IntraFreqCellInfoSI List. Cells which are included in both lists are marked as "Trace/SIB11" ("Trace/SIB12") or “SIB11” (SIB12).



Set	Cell State	Channel	Cell Identifier	Name	Quality	Level	Source
Active	Cell State	UARFCN	SC	Node B	Ec/NO	RSCP	Source
	Serving Yes (Camped)	10836	122	---	---	-106.8	Trace
Intra Frequency Neighbour Cells	Cell State	UARFCN	SC	Node B	Ec/NO	RSCP	Source
	Monitored Set	10836	453	---	---	---	Trace/SIB11
	Monitored Set	10836	311	---	-16.9	-92.7	Trace/SIB11
	Monitored Set	10836	73	---	-14.9	-90.7	Trace/SIB11
	Monitored Set	10836	107	---	---	---	Trace/SIB11
	Monitored Set	10836	219	---	-12.8	-88.6	Trace/SIB11
	Monitored Set	10836	425	---	---	---	Trace/SIB11
	Monitored Set	10836	406	---	-16.3	-92.1	Trace/SIB11
	Monitored Set	10836	485	---	-12.1	-87.9	Trace/SIB11
	Monitored Set	10836	186	---	---	---	Trace/SIB11
	Monitored Set	10836	172	---	---	---	Trace/SIB11
	Monitored Set	10836	357	---	---	---	Trace/SIB11
	Monitored Set	10836	242	---	---	---	Trace/SIB11
	Detected Set	10836	86	---	---	---	Trace
Inter Frequency Neighbour Cells	Cell State	UARFCN	SC	Node B	Ec/NO	RSCP	Source
	Monitored Set	10812	122	---	---	---	SIB11
Inter RAT Neighbour Cells GSM	Cell State	ARFCN	BSIC	BTS	---	Rxlev	Source
	BSIC Verification not required	46	4	---	---	---	SIB11
	BSIC Verification not required	17	26	---	---	---	SIB11
	BSIC Verification not required	32	27	---	---	---	SIB11
	BSIC Verification not required	28	1	---	---	---	SIB11
	BSIC Verification not required	27	73	---	---	---	SIB11
	BSIC Verification not required	42	1	---	---	---	SIB11
	BSIC Verification not required	15	30	---	---	---	SIB11
Inter RAT Neighbour Cells LTE	Cell State	EARFCN	PCI	ENode B	RSRQ	RSRP	Source
	---	1300	---		---	---	SIB19

Figure 4-528: RAT UMTS

Cell State

- Active Set: Indication whether the cell is the serving cell or not (Yes/No).
- Intra-Frequency Neighbor Cells
  - Monitored Set: The cell is reported in the Layer 3 message DL DCCH, SIB11 or SIB12.

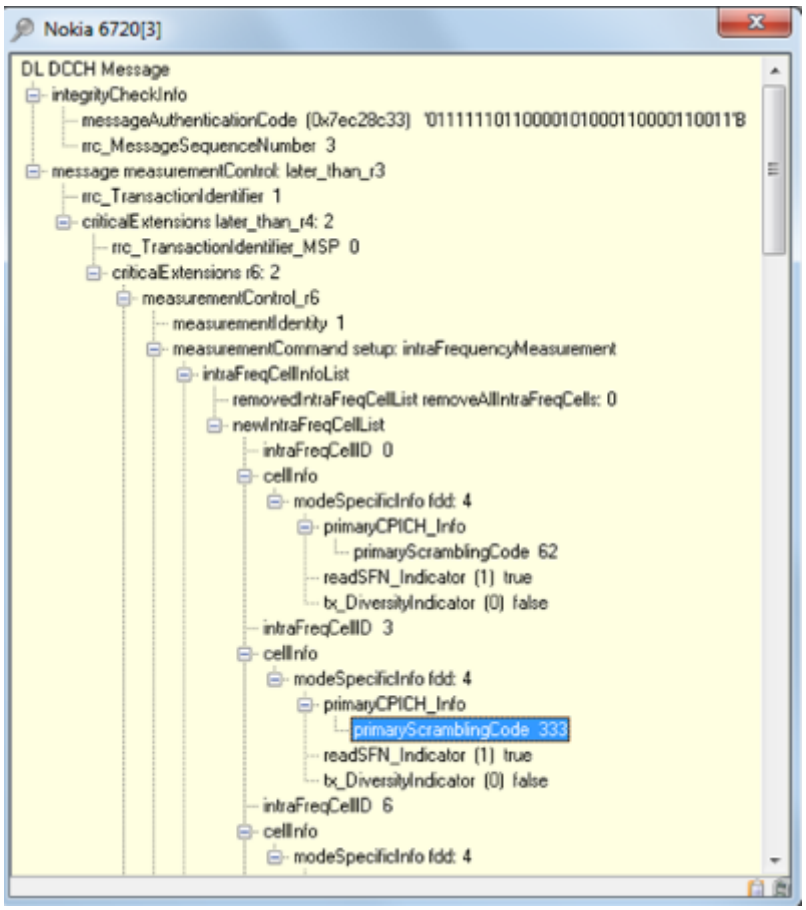


Figure 4-529: DL DCCH message

  - Detected Set: The cell is detected by the mobile trace and not reported in the Layer 3 message DL DCCH, SIB11 or SIB12.

- Inter-Frequency Neighbor Cells
  - Monitored Set: The cell is reported in the Layer 3 message DL DCCH, SIB11 or SIB12.

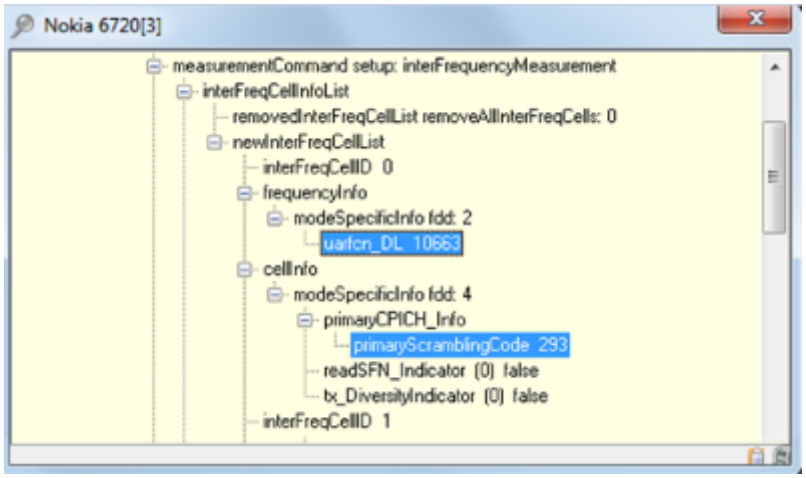


Figure 4-530: Inter-frequency measurement

– Detected Set: The cell is detected by the mobile trace and not reported in the Layer 3 message DL DCCH, SIB11 or SIB12.

- Inter-RAT Neighbor Cells GSM
  – BSIC verification is required: The bsic_VerificationRequired flag is set in the Layer3 DL DCCH message.

Figure 4-531: Verification required

– BSIC verification is not required: The bsic_VerificationRequired flag is not set in the Layer3 DL DCCH message

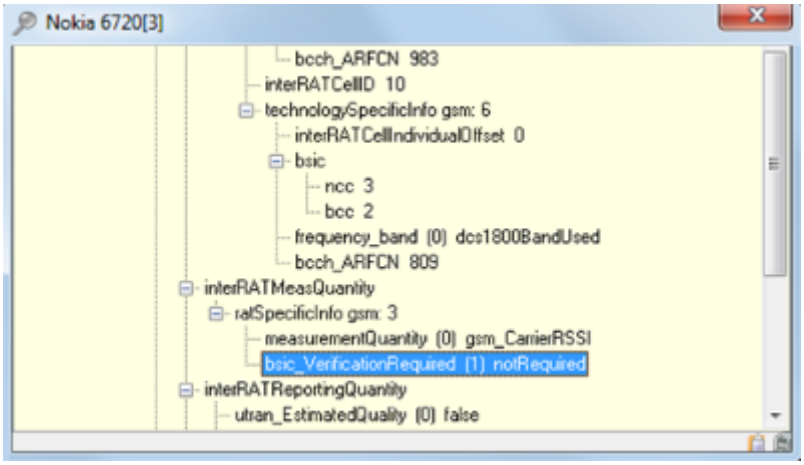


Figure 4-532: Verification not required

- Inter-RAT Neighbor Cells LTE: Cell state not available.

UARFCN

- UTRAN Absolute Radio Frequency Channel Number (ARFCN) of the received DL signal. The carrier frequency is equal to "f = 0.2 MHz * UARFCN".

Color

- Active Set: No coloring
- Intra-Frequency Neighbor Cells:
  - Green: The cell is monitored and measured (RSCP value available).
  - Red: The cell is detected and the triggering condition for the detected set is not included in the event criteria list of the Intra-Freq Reporting Criteria.

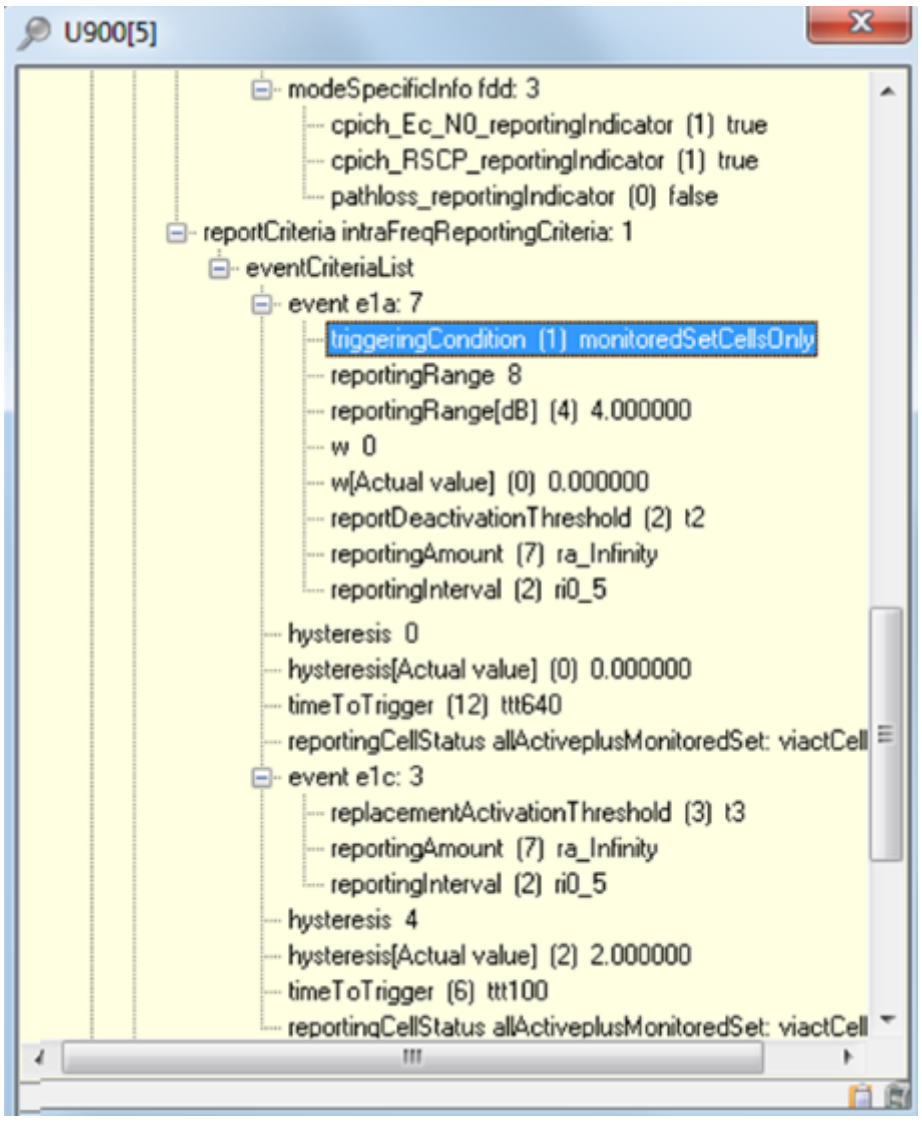


Figure 4-533: Red color - triggering condition not included

– Yellow: The cell is detected and the triggering condition for the detected set is included in the event criteria list of the Intra Freq Reporting Criteria.

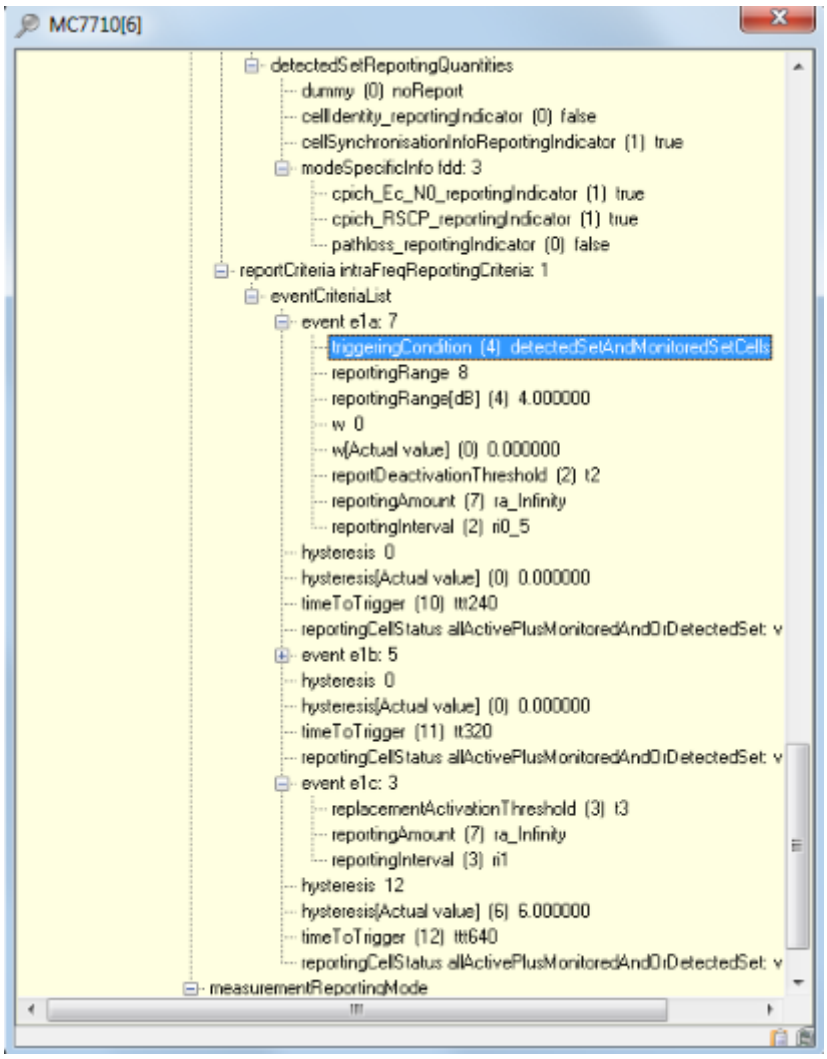


Figure 4-534: Red color - triggering condition included

  – No coloring: The cell is detected and the event criteria list of the Intra Freq Reporting Criteria is not available.

- Inter-Frequency Neighbor Cells: No coloring
- Inter-RAT Neighbor Cells GSM: Yellow if BSIC verification is required, otherwise no coloring.

SC

- The scrambling code of a cell.

Node B

- The Node B name. Only available when a transmitter database corresponding to the measurement data is loaded.

Ec/No

- Ratio of the received energy per PN chip for the signal to the total received power spectral density at the mobile antenna connector. The color depends on the value and is taken from the signal setting.

The values are only be displayed when they are inside the expected range. In the Inter RAT Neighbor Cells LTE this column displays the RSRQ value. In the Inter RAT Neighbor Cells GSM this column has now values.
In the Inter RAT Neighbor Cells UMTS this column displays the RSCP value.

RSCP

- CPICH Received Signal Code Power value; The color depends on the value and is taken from the signal setting.
  The values are only be displayed when they are inside the expected range. In the Inter RAT Neighbor Cells LTE this column displays the RSRP value. In the Inter RAT Neighbor Cells GSM this column displays the RxLevF value.

Source

- Trace: The data source is a mobile trace
- MC: The data source is the Layer 3 measurement control (DL DCCH)
- SIB11: The data source is the Layer 3 SIB11
- SIB12: The data source is the Layer 3 SIB12
- SIB19: The data source is the Layer 3 SIB19

Multiple data sources are possible.

When the signal settings of the Ec/No or RSCP values have been changed during replay, the measurement file must be reloaded to apply the changes in this view. This especially holds for the ranges of the appropriate signals. If not set correctly, the signal color will be black.

RAT LTE

4G intra- and inter-frequency and 2G and 3G inter-RAT neighbors are extracted from SIB 4,5,6 and 7 of the current cell the UE camps on.

When the UE changes from idle to connected, the SIB 4,5,6,7 is modified on reception of the RRCReconfiguration message (DL_DCCH) by the Cell Info List of the UE trace. The cells which are included in both (intra- and inter-frequency) lists are marked as Trace/SIB4, 5, 6, 7 or Trace/MC.

The"3GPP Neighbour Set View" for LTE RAT only shows the DL_DCCH message details on the right side of the Cell Info List. The Layer 3 DL_DCCH message contains the active set of objects, configurations and measurements of the serving LTE cell.

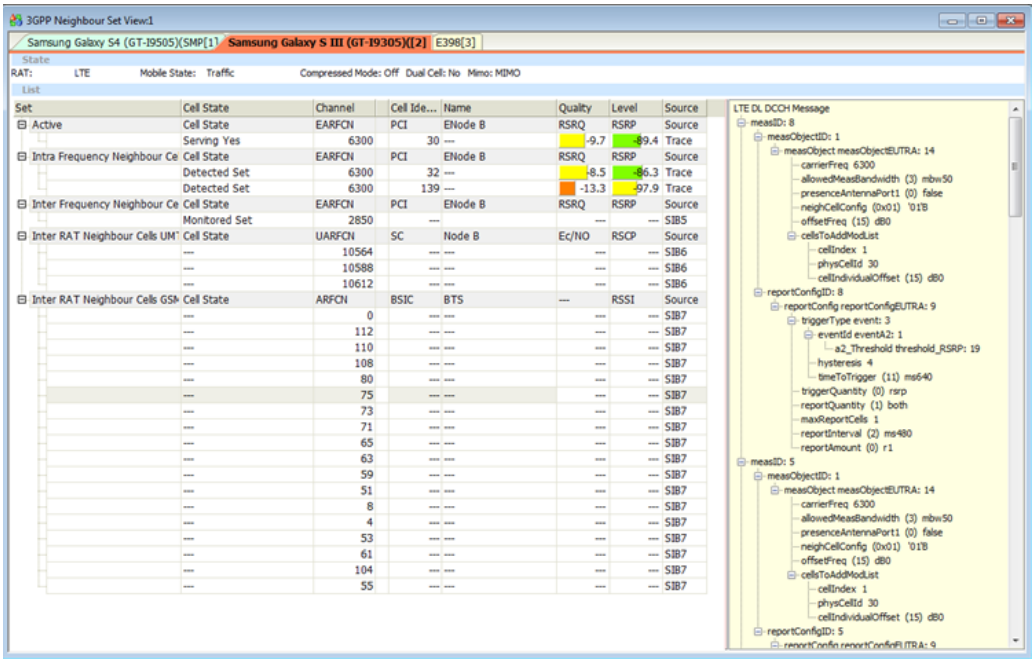


Figure 4-535: RAT LTE

Cell State

- Active Set: Indication whether the cell is the serving cell or not (Yes/No).
- Intra-Frequency Neighbor Cells:
  - Monitored Set: The cell is reported in the Layer 3 message DL DCCH or SIB4.
  - Detected Set: The cell is detected by the mobile trace and not reported in the Layer 3 message DL DCCH or SIB11.
    In the current LTE networks the SIB4 comes very rarely.
- Inter-Frequency Neighbor Cells:

  For the LTE serving cell the current active set of objects, measurements and configurations of the Layer 3 message DL DCCH are displayed in a detail window at the right side of the list.
  - Monitored Set: The cell is reported in the Layer 3 message DL DCCH or SIB5, see the previous figure.
  - Detected Set: The cell is detected by the mobile trace and not reported in the Layer 3 message DL DCCH and SIB5.
- Inter-RAT Neighbour Cells GSM: Cell state is not available.
- Inter-RAT Neighbour Cells UMTS: Cell State is not available.

EARFCN

- EUTRAN Absolute Radio Frequency Channel Number of the received DL signal.

Color

- Active Set: No coloring
- Intra-Frequency Neighbor Cells
  - Green: The cell is monitored and measured (RSRP value available).

  – No color for all other states.
- Inter-Frequency Neighbor Cells: No coloring
- Inter-RAT Neighbor Cells GSM: No coloring
- Inter-RAT Neighbor Cells UMTS: No coloring

PCI

- The physical cell ID of the cell.

ENode B

- The ENode B name; only available when a transmitter database corresponding to the measurement data is loaded.

RSRQ

- Reference Signal Received Quality; It is the ratio N×RSRP/(E-UTRA carrier RSSI), where N is the number of RB's of the E-UTRA carrier RSSI measurement bandwidth. The measurements in the numerator and denominator shall be made over the same set of resource blocks. E-UTRA Carrier Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in OFDM symbols containing reference symbols for antenna port 0, in the measurement bandwidth, over N number of resource blocks by the UE from all sources, including co-channel serving and nonserving cells, adjacent channel interference, thermal noise etc. (3GPP TS 36.214).
  The values are only be displayed when they are inside the expected range. In the Inter RAT Neighbor Cells UMTS this column displays the Ec/No value. In the Inter RAT Neighbor Cells GSM this column has now values.

RSRP

- Reference-Signal-Received-Power Received Signal Strength on Reference Symbols Definition TS 36.214; The signal is defined as the linear average over the power contributions (in [W]) of the resource elements that carry cell-specific reference signals within the considered measurement frequency bandwidth.
  For RSRP determination the cell-specific reference signals R0 according TS 36.211 shall be used. If the UE can reliably detect that R1 is available it may use R1 in addition to R0 to determine RSRP. The values are only be displayed when they are inside the expected range. In the Inter RAT Neighbor Cells UMTS this column displays the RSCP value. In the Inter RAT Neighbor Cells GSM this column displays the RxLevF value.

Source

- Trace: The data source is a mobile trace
- MC: The data source is the Layer 3 measurement control (DL DCCH)
- SIB4: The data source is the Layer 3 SIB4
- SIB5: The data source is the Layer 3 SIB5
- SIB6: The data source is the Layer 3 SIB6
- SIB7: The data source is the Layer 3 SIB7

Multiple data sources are possible.

When the signal settings of the RSRQ or RSRP values have been changed during replay, the measurement file must be reloaded to apply the changes in this view. This

especially holds for the ranges of the appropriate signals. If not set correctly, the signal color will be black.

4.4.11.3 Limitations

Certain chipsets may have restrictions concerning their trace output. Also various access network vendors and parameter settings can influence the results on the view.

4.4.11.4 Supported devices

All 2G, 3G, 4G Qualcomm and Samsung chipsets based devices and the QualiPoc converter files.

4.4.12 3GPP overview view

The R&S ROMES4 "3GPP Overview View" displays the most important parameter values of the 3GPP test mobile, like it's state, power/quality, system parameters and tests results performed by the mobile.

The view's layout is adjusted to fit all supported technologies (GSM, UMTS, LTE, NB-IoT, LTE EN-DC, 5G NR).

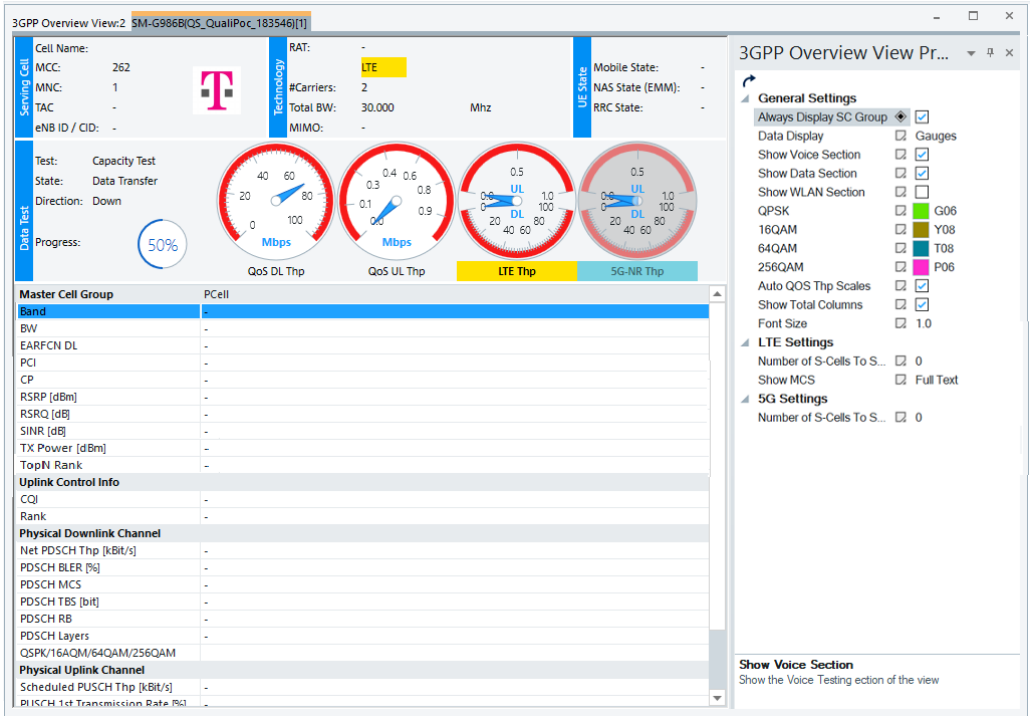


Figure 4-536: Default 3GPP Overview View page

The upper part of the view is common for the technologies. The common part includes the "Serving Cell", "Technology" and "UE State" sections. They show the serving cell

details like cell name, MCC, MNC and BTS ID, the RAT details and the UE states, respectively.

This part of the view shows also the results of the performed data, voice and/or WLAN tests in the "Data Test", "Voice Test" and "WLAN" sections.

The "Data Test" section has three ways of data test results display depending on settings done in the "3GPP Overview View Properties" pane. The data test results can be displayed as text, gauges and chart dependent on selection in "General Settings" > "Data Display".

The option to show data test results as text allows you to focus on the actual values.

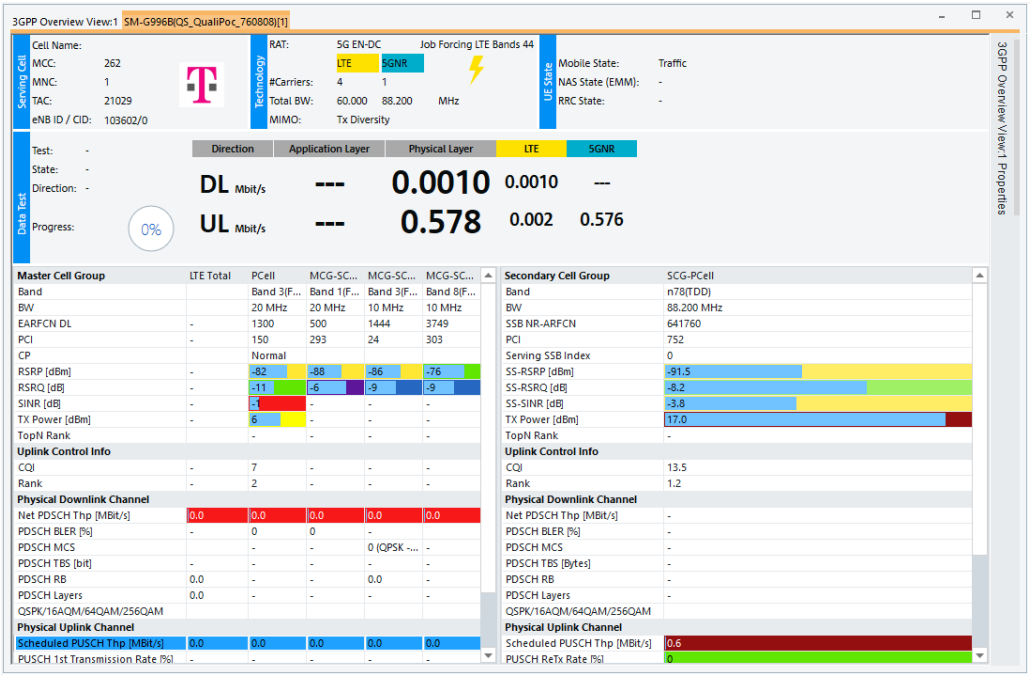


Figure 4-537: 3GPP Overview View - text display of data test results

In case of gauges display, the two gauges "QoS DLl Thp" and "QoS ULThp" on left show the data throughput on the application layer for all RATs. The two gauges on the right-hand side add additional information about the PDSCH/PUSCH throughput for LTE and 5G NR.

Therefore, the PDSCH/PUSCH throughput is shown by these right-hand gauges separately, as two parts (DL/UL) per LTE and 5G NR and also on the application layer gauges, on left-hand side.

The usage of the supported MSC during the measurement is displayed by the colored horizontal bar. The bar is made of colored blocks that represent the values in percentage of contribution of each used MSC in the total modulation. The selection of MCS colors is done in the "3GPP Overview View Properties" pane, see Figure 4-536.

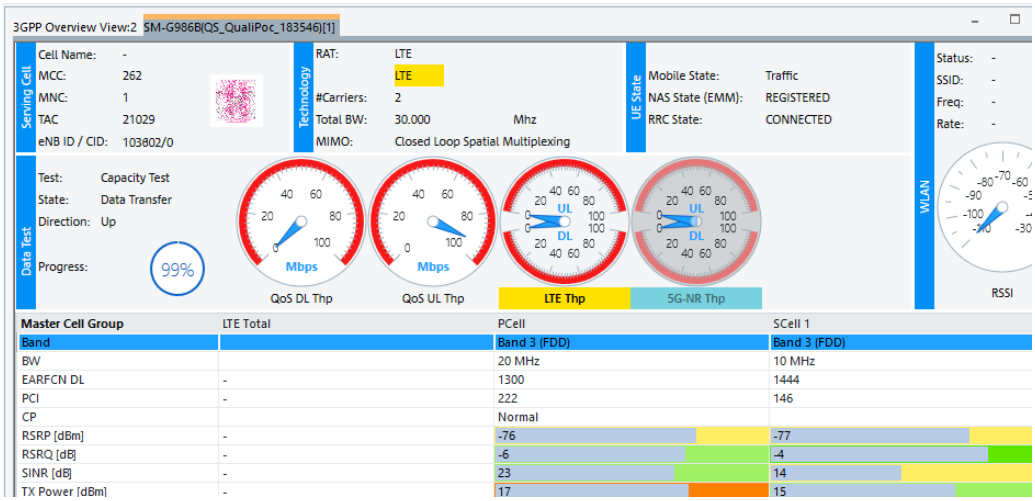


Figure 4-538: 3GPP Overview View - gauges display of test results

The following screenshot shows capacity test result as a chart.

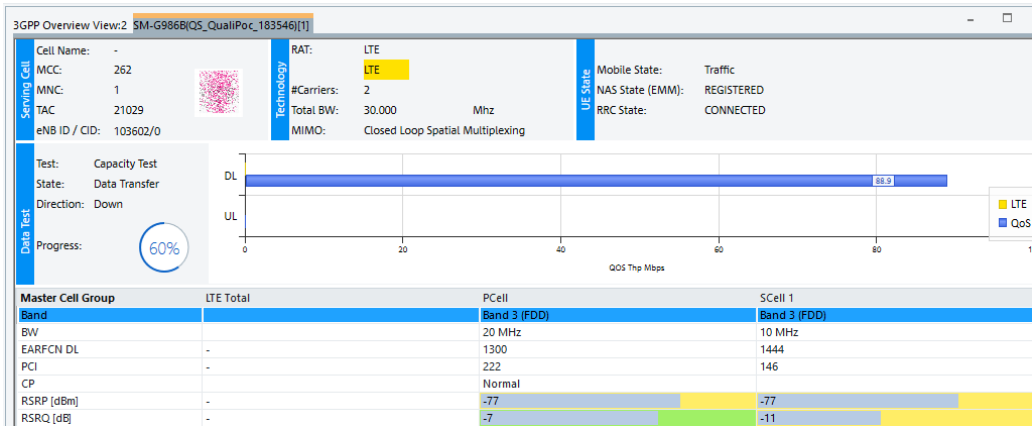


Figure 4-539: 3GPP Overview View - chart display of test results

The "Voice Test" section shows the last MOS value and the AMR values if a voice test is available (all phones do report AMR values). The section is hidden by default and is visible if a voice call is configured for a replay or measurement. The approach provides better use of screen space as voice calls are not the most commonly test items.

However, the "Voice Test" section can be forced to display even if no voice call is configured by checking the "Show Voice Call Section" check-box in the "3GPP Overview View Properties" > "General Settings" pane.

The data and WLAN test sections are optional. Similarly, the associated check-boxes in the "3GPP Overview View Properties" > "General Settings" pane are provided to select them for display.

The lower part of the "3GPP Overview View" is a grid displaying the Physical Layer parameters and measured values of the currently used RAT. The parameters shown here differ and depend on the RAT the mobile is working on.

The view offers to change the font size of the grid. To do so, either press CTRL and move the mouse wheel on the selected grid or change the font size in the configuration pane.

The "Total" column for LTE and 5G NR can be hidden. Bandwidths, carrier count and Top N rank are displayed per LTE and 5G NR.

Select the layout of the upper part of the view, that is, if to show and how the test results section, the coloring of displayed used MCSs and the QoS throughput scaling in "General Settings".

If the "General Settings" > "Auto QOS Thp Scales" option is selected, the throughput ranges of the gauges are adapted to the actual values. They can also be set to initial value.

If the "Auto QOS Thp Scales" is not selected, the gauges use the range value defined in "General Settings" > "QOS Thp Scale".

If the data of the gauge is outside the range of the selected scale, the gauge pointer changes from R&S blue to red. Any shaded area in the gauge changes to a combination of red and the normal color of the shaded area.

The amount of SCells for LTE and 5G can be set in the "Number of S-Cells To Show" option of the RAT dedicated parts of the "3GPP Overview View Properties" configuration pane. The only column that is shown if this number is left as default "0" is the "PCell" column. All SCells columns and the "Total" column are hidden in this case.

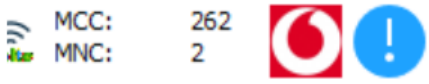
If the "Number of S-Cells To Show" is set to its max value, "PCell", "Total" and all "SCell n" are shown (n= number of Scell), as displayed the previous screenshots.

The following default screenshot shows minimum of columns (PCell only) as "Number of S-Cells To Show"=0.

If during the measurement more SCells are detected, the number of columns will be increased automatically.

Fixing the LTE and 5G EN-DC columns prevents toggling between them two in 3GPP overview view and the checked option "Always Display SC Group" makes that both columns are displayed.

The "3GPP Overview View" shows one additional icon besides the provider's one if the mobile is forced.



Display of visual elements sources

The "3GPP Overview View" has the ability to add the underlying data source of any visual element on the view to a R&S ROMES4 generic view. This ability allows for greater flexibility in data analysis of the 3GPP overview.

To add the underlying R&S ROMES4 signal to a generic view ("Alphanumeric View", "2D Chart view", "Grid View" or Map) drag the desired visual element (text field, gauge,

chart or grid element) to a generic view. The underlying signal is added than to the view, the same as if it had been added from the "Signal Tree".

Optional Tooltips

The "3GPP Overview View" can optionally display ToolTips for all visual elements in the view. The option is active if the "Show Tooltips" check-box in the properties menu is checked. If checked, the ToolTip shows the underlying R&S ROMES4 signal that is used as a data source for the visual element. You get a better understanding of the data and it's sources that are used in the view.

To view the Tooltip, hover the mouse over a visual element.

4.4.12.1 RAT specific areas in 3GPP overview view

5G NR PDSCH (Downlink)

- "Net PDSCH Thp [kbit/s]"
  Resulting PDSCH throughput of all acknowledged TBs, not including non-acknowledged TBs, ref. 3GPP TS 36.306.
- "PDSCH BLER [%]"
  PDSCH Block Error Rate, the rate of non-acknowledged TBs.
- "PDSCH MCS"
  Average Modulation and Coding Scheme on PDSCH in observation period.
- "PDSCH TBS [Bytes]"
  Average Transport Block Size on PDSCH in observation period.
- "PDSCH RB"
  Average number of PDSCH Resource Blocks for all TTIs in observation period.
- "PDSCH Layers"
  Average PDSCH transmission layers in observation period.
- "QPSK/16QAM/64QAM/256QAM"
  - QPSK: Rate of Transport Blocks using QPSK modulation on PDSCH in observation period.
  - 16QAM: Rrate of Transport Blocks using 16QAM modulation on PDSCH in observation period.
  - 64QAM: Rate of Transport Blocks using 64QAM modulation on PDSCH in observation period.
  - 256QAM: Rate of Transport Blocks using 256QAM modulation on PDSCH in Observation period.

5G NR PUSCH (Uplink)

- "Scheduled PUSCH Thp [kbit/s]"
  Resulting PUSCH throughput of all transmitted TBs aslo including non-acknowledged TBs, ref. 3GPP TS 36.306.
- "PUSCH ReTx Rate [%]"
  PUSCH Retransmission Rate, the rate of retransmitted TBs. Number of non-toggling NDI divided by the total number of observed TTIs

- "Avg PUSCH MCS"
  Average Modulation and Coding Scheme on PUSCH in observation period.
- "Avg PUSCH TBS"
  Average Transport Block Size on PUSCH in observation period.
- "Avg PUSCH RB"
  Average Number of PUSCH Resource Blocks in observation period.
- "Avg PUSCH Layers"
  Average PUSCH transmission layers in observation period.

LTE state

- EMM "State"
  - "Registered"
  - "Idle"
- RRC "State"
  - "Connected"
  - "Idle"
- "Modem State"
  Possible state is "Traffic".
- "MIMO"
  MIMO transmission mode refers to the use of multiple antennas at transmitter and receiver side. For LTE downlink, a 2x2 configuration for MIMO is assumed as baseline configuration, i.e. two transmit antennas at the base station and two receive antennas at the terminal side.
  - "SISO": Single Input-Single Output
  - "SIMO": Single Input-Multiple Output
  - "MISO": Multiple Input-Single Output
  - "MIMO": Multiple Input-Multiple Output

UMTS

- "Node B"
  Name of the NodeB, taken from the UMTS NodeB database (if available)
- "Cell ID"
  Serving cell Identity
- "Band"
  Frequency band the cell is operating
- "UARFCN DL"
  UTRAN ARFCN of the received DL signal; the carrier frequency is calculated as f = 0.2 MHz * UARFCN.
- "UARFCN UL"
  UTRAN ARFCN of the transmitted UL signal
- "SC"
  Primary scrambling code of a cell in the format selected in "TEC for UMTS Test Mobiles > Configuration of Software Modules"; the primary SC is used to identify the cell.

- "CPICH RSCP [dBm]"
  CPICH Received Signal Code Power in dBm is the received power on one code, measured on the Primary CPICH.
- "TrChannel BLER [%]"
  Estimation of the transport channel block error rate (BLER) based on evaluating the CRC on each transport block.
- "CPICH Ec/No [dB]"
  Received energy per chip divided by the power density in the band. The CPICH Ec/No is identical to CPICH RSCP divided by the RSSI UTRAN.
- "Transmit Power [dBm]"
  Total mobile transmitted power on one carrier in dBm.

GSM

the Master Cell Group section contains the following parameters:

- "BTS Name"
  Name of the Base Station; the parameter is displayed if a valid GSM BTS database is available
- Band
  Used GSM band, e.g, E-GSM, DCS, PCS
- "Timeslot"
  Shows the number of current occupied timeslot
- "Hopping"
- "BCCH (ChanNr)"
  Number of the broadcast control channel of the cell and mobile
- "BSCI"
  Base station identity code
- "RxQual (F/S)"
  Displays the received RXQual full (F) and sub (S) value. The bar is divided into two parts:
  – Upper part shows the full value
  – Lower part shows the sub value. If DTX is off, the color of the lower bar is gray.
- "RxLev (F/S) [dBm]"
  Displays the received RXLev full (F) and sub (S) value. The bar is divided into two parts:
  – Upper part shows the full value
  – Lower part shows the sub value. If DTX is off, the color of the lower bar is gray.
- "Timing Advance (Step)"
  The length of time the signal from the mobile takes to reach the Base Station. It is count in steps. The Timing Advance (TA) value is normally between 0 and 63. Each step representing an advance of one symbol period.
- "Transmit Power [dBm]"
  Total mobile transmitted power on one carrier in dBm.
- "TCHs"
  Shows the list of currently active traffic channels.
- "CA-List"

Cell Allocation (CA) list. The parameter shows the defined ARFCN within a cell.
Note: CA list is only shown in idle mode.

- "Ext. BA-List"
  Extended BCCH Allocation List is relevant for network operators who work with two GSM bands (GSM900 and GSM1800) identified by two parameter sets.
- "BA-List"
  BCCH Allocation List shows the supported frequencies on the neighboring cells; the parameter is broadcast on the BCCH (Broadcast Control Channel). It gives mobiles the frequencies of the BCCH carriers on neighboring cells.
- "P-TCHs"
  Shows the list of active traffic channels for GPRS (the Qualcomm device only).

PS call info (GSM/UMTS)

"PS Call Info" displays the following parameters reflecting the current state of the test UE regarding PS connections.

- "PS Call State"
  Phone mode concerning PS connections based on Layer 3 messages reported by the mobile; indicates if a PDP context is established or not
- "# of PDPs"
  Number of established PDP contexts

4.4.12.2 RAT common areas in 3GPP overview view

In the following sections listed are parameters that are common for different technologies. Some per RAT specific parameters are noted as such.

Serving cell

The "Serving Cell" pane displays the following parameters describing the serving cell:

- "Cell Name"
- "MCC"
  Mobile Country Code identifies the Country of the network.
- "MNC"
  Mobile Network Code identifies the operator.
- "TAC"
  Tracking Area Code
- "eNB ID / CiD"In genera, BTS identifier / servinfg cell identifier
- "LAC"
  Location Area Code
  At the end of this section there is the table containing the details on available LAC and RAC signals.

5G NR only

- "SSB NR-ARFCN"
  NR Absolute Radio Frequency Channel Number of the SSB for the NR cell. Ref 3GPP 38.331.
- "NR Cell"

Name of serving cell.

- "Band"
  Band of NR cell.
- "PCI"
  Physical cell ID of the NR cell.
- "Serving SSB Index"
  Serving NR cell beam SS/PBCH Block index.
- "Num SSB Beams"
  Number of detected SSB beams of the serving NR cell.
- "Avg CQI WB"
  Avg CQI WB CQI WB value.
- "Avg RI"
  Average RI value.

LTE only

- "Node B"
  Name of the eNodeB, taken from the LTE eNodeB database (if available)
- "Phys. Cell"
  Physical Cell ID (0..503)
- "EARFCN DL"
  Evolved ARFCN of the received DL signal
- "EARFCN UL"
  Evolved ARFCN of the transmitted UL signal
- 1st DL MCS
  Used modulation coding scheme in downlink
- "2nd DL MCS"
  Used modulation coding scheme in downlink
- "UL MCS"
  Used modulation coding scheme in uplink
- "RI"
  Rank Indication is the number of useful transmission layers when spatial multiplexing is used; in case of transmit diversity, the rank is equal to 1
- "TAC"
  Tracking Area Code is a part of the IMEI used to uniquely identify the UE
- "CP"
  Cyclic Prefix
- "BW"
  Bandwidth
  Note: E-UTRA operating band 25 for LTE FDD and 41, 42 and 43 for LTE TDD specified by 3GPP TS 36.101 are supported.
- "1st CQI"
  First channel quality indicator
- "2st CQI"
  Second channel quality indicator
- "RB DL"

Number of resource blocks used in downlink

- "RB UL"
  Number of resource blocks used in uplink

Table 4-23: LAC/RAC signals

Signal	Remark
LAC (3G)	The 3G Location Area Code which is reported by the trace messages of the Test UE.
LAC (3G, registered CS)	The 3G Location Area Code of the Circuit Switched Domain to which the UE is registered concerning the layer 3 message flow.
LAC (3G, registered PS)	The 3G Location Area Code of the Packet Switched Domain to which the UE is registered concerning the layer 3 message flow.
LAC (3G, last read on SIB)	The last 3G Location Area Code which was read out of a system information block.
RAC (3G)	The 3G Routing Area Code which is reported by the trace messages of the Test UE.
RAC (3G, registered)	The 3G Routing Area Code to which the UE is registered concerning the layer 3 message flow (Routing Area Updates).
RAC (3G, last read on SIB)	The last 3G Routing Area Code which was read out of a system information block.
LAC (2G)	The 2G Location Area Code which is reported by the trace messages of the Test UE.
LAC (2G, registered CS)	The 2G Location Area Code of the Circuit Switched Domain to which the UE is registered concerning the layer 3 message flow.
LAC (2G, registered PS)	The 2G Location Area Code of the Packet Switched Domain to which the UE is registered concerning the layer 3 message flow.
LAC (2G, last read on SIB)	The last 2G Location Area Code which was read out of a system information message.
RAC (2G)	The 2G Routing Area Code which is reported by the trace messages of the Test UE.
RAC (2G, registered)	The 2G Routing Area Code to which the UE is registered concerning the layer 3 message flow.
RAC (2G, last read on SIB)	The last 2G Routing Area Code which was read out of a system information block.

Technology

- "RAT"
  Radio access technology
- "Num CA"
  Number of Component Carriers (Carrier Aggregation)
- "Total BW"
  Total used bandwidth

- "MIMO"
  Type of the used MIMO

UE state

The UE state section relates to mobile state, NAS state related to mobility and RRC states.

- "Unknown"
  Network unavailable
- "Idle"
  Registered in standby mode (no active call)
- "Access"
  Call is set up
- "Dedicated"
  Call in GSM network
- "Unconnected"
  Mobile is not connected
- "Scan"
  Mobile is in scan mode
- "CELL FACH"
  UMTS mode
- "CELL DCH"
  Call in UMTS network
- "CELL PCH"
  UMTS mode
- "URA PCH"
  UMTS mode
- "Traffic"
  Data transfer in LTE network

Power / quality

The "Power/Quality" panel displays several parameters describing the signal power and quality reported by the test mobile (see 3GPP TS 25.225 recommendation).

- "Tx Power"
  Total mobile transmitted power on one carrier in dBm. the parameter is present in the 3GPP Overview View for LTE, UMTS and GSM.

5G NR only

- "SS-RSRP"
  Reference Signal Received Power value from layer 3 beam filtered measurement based on SS/PBCH blocks in [dBm], ref 3GPP 38.331, 38.215 and 38.133.
- "SS-RSRQ"
  Reference Signal Received Quality value from layer 3 beam filtered measurement based on SS/PBCH blocks in [dB, ref 3GPP 38.331, 38.215 and 38.133.
- "SS-SINR"

Signal to Interference and Noise Ratio value from layer 3 beam filtered measurement based on SS/PBCH blocks in [dB], ref 3GPP 38.331, 38.215 and 38.133.

- "TX-Power"
  Max. Transmit Power (PUCCH or PUSCH) of UE on the NR-ARFCN of this cell in [dBm].

LTE only

- "RSSI"
  Received wideband power in dBm
- "RSRP"
  Reference Signal Received Power in dBm is the received signal strength on reference symbols.
- "SINR"
  Received energy per chip divided by the power density in the band.
- "PDSCH BLER"
  Estimation of the transport channel block error rate (BLER) based on evaluating the CRC on each transport block.
- "Transmit Power"
  As previously defined

UMTS only

- "RSSI UTRAN"
- Received wideband power in dBm.
- "CPICH RSCP"
- CPICH Received Signal Code Power in dBm is the received power on one code, measured on the Primary CPICH.
- "CPICH E_c/I_o"
- Received energy per chip divided by the power density in the band. The CPICH Ec/No is identical to CPICH RSCP divided by the RSSI UTRAN.
- "TrChannel BLER"
- Estimation of the transport channel block error rate (BLER) based on evaluating the CRC on each transport block.
- "Transmit Power"
  As previously defined

GSM only

- R"xLev (F/S)"
  Displays the received RXLev full (F) and sub (S) value. The bar is divided into two parts:
  - Upper part: Shows the full value
  - Lower part: Shows the sub value. If DTX is off, the color of the lower bar is gray.
- "RxQual (F/S)"
  Displays the received RXQual full (F) and sub (S) value. The bar is divided into two parts:
  - Upper part: Shows the full value

  - Lower part: Shows the sub value. If DTX is off, the color of the lower bar is gray.
- "Timing Advance"
  The length of time the signal from the mobile takes to reach the Base Station. It is count in steps. The Timing Advance (TA) value is normally between 0 and 63. Each step representing an advance of one symbol period.
- "Transmit Power"
  As previously defined

Data test

"Data Test" displays the information on currently running DQA jobs.

- "Test": Name of the current DQA job
- "State": Current state of the DQA job
- "Direction": Current link direction
- "Progress": The current progress of the DQA job
- "Qos DL ThpL": Current downlink throughput on the application layer (socket)
- "QoS UL Thp": Current uplink throughput on the application layer (socket)
- "LTE Thp": Current PDSCH/PUSCH throughput for LTE
- "5G-NR Thp": Current PDSCH/PUSCH throughput for LTE

The ranges of the throughput values can be set using the "Configure Signals" command of the view's configuration manu. The Click the line to open the "Available Signals" window. Select "QoS Tester" > "DQA Current State". To change the range, click "Exp. Min." and "Exp. Max." of the "DQA Cur. DL Data Rate"/"DQA Cur. UL. Data Rate".

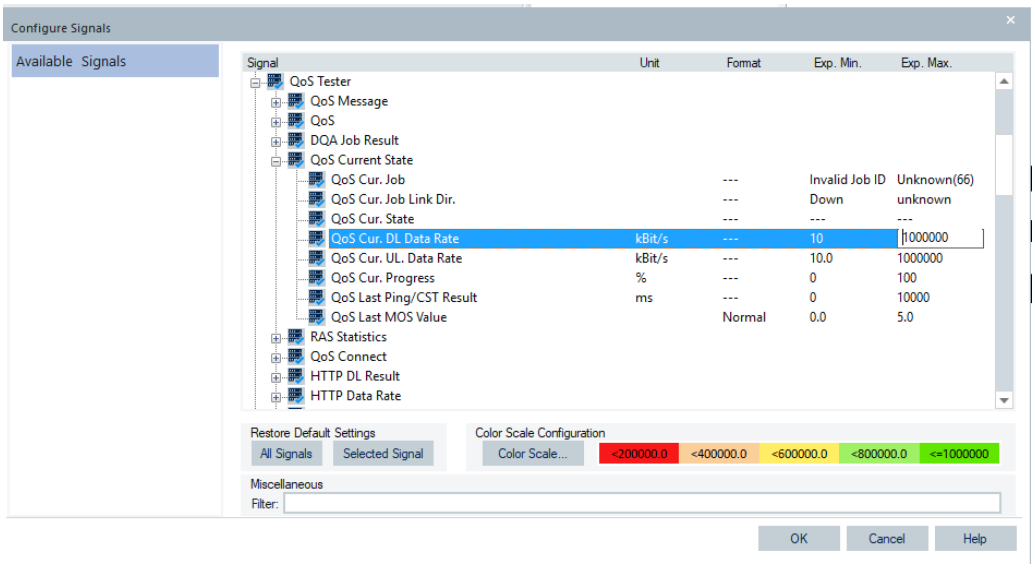


Figure 4-540: Setting the throughput range for data calls

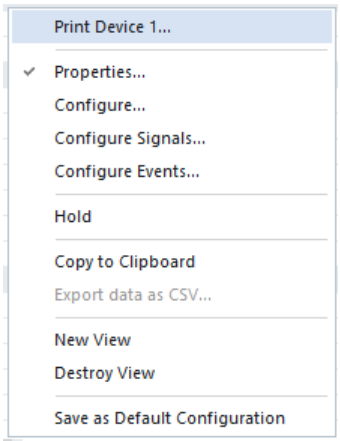
Alternatively you can set the thresholds via "Tools" >"Available Signals" > "QoS Tester" > "DQA Current State".

Voice test

The "Voice Test" section displays the following parameters describing the ongoing call:

- "WB"
- "CS Mode"
  - "Voice"
  - "Data call"
- Vocoder UL/DL, GSM only
  - "AMR codec mode"
  - "FR (Full Rate)"
  - "HR (Half Rate)"
  - "EFR (Enhanced Full Rate)"
- "Channel Type", GSM only
  Channel type allocated for the connection:
  - "TCH-F": Traffic Channel Full Rate
  - "TCH-H": Traffic Channel Half Rate
  - "SDCCH/4": Stand-alone Dedicated Control Channel/4
  - SDCCH/8: Stand-alone Dedicated Control Channel/8
- "AMR DL/UL Rate", UMTS and LTE
  Downlink/Uplink voice encoder is always NB/WB AMR. The current selected rate is shown.
- "Bearer Type (DL)", UMTS only
  Indicates the Spreading Factor (SF)

4.4.12.3 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.12.4 3GPP overview view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

View settings

In te "LTE CA" pane you can choose for display the MCS modulation type or MSC value if LTE carrier aggregation is active.

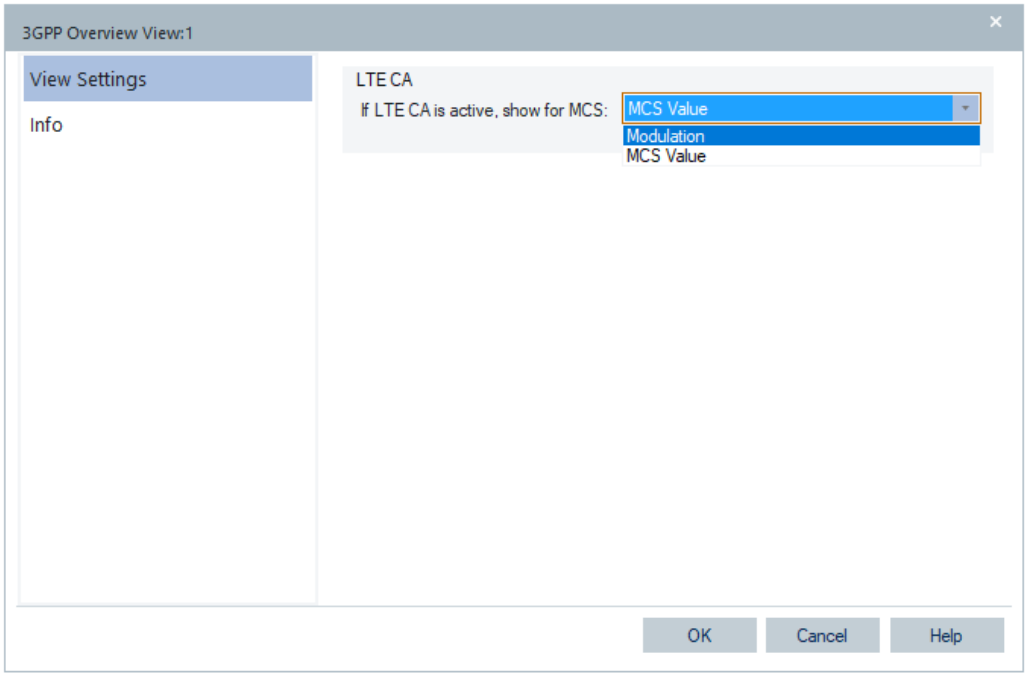


Figure 4-541: View Settings page

4.4.13 Cell set view

The "Cell Set View" combines the elements of the cell set views of different 3GPP specified RAT cells and the measurement report view to a single view. Such an view switches between data values of these technologies based on the current RAT mode.

To access the view, select the "View" > "Mobile Views" > "Cell Set View" command.

The default view is shown in the following figure.

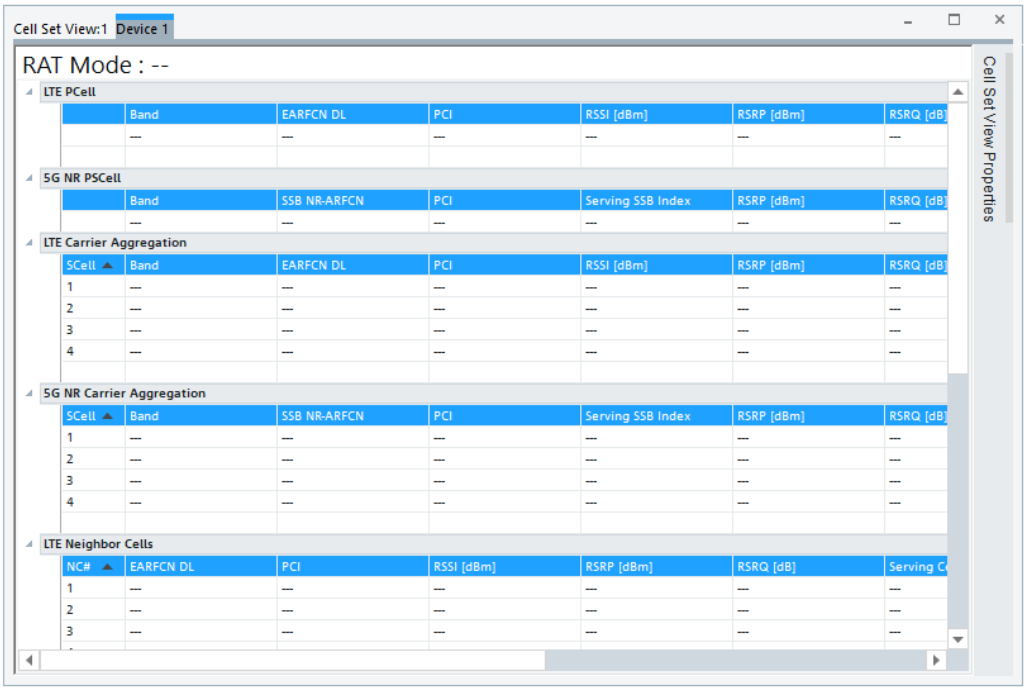


Figure 4-542: Default layout of the view

The Cell Set View supports 5G NR. If the current RAT is equal to 5G EN-DC, the view shows LTE and 5G NR carrier cells and LTE and 5G NR neighbor cells.

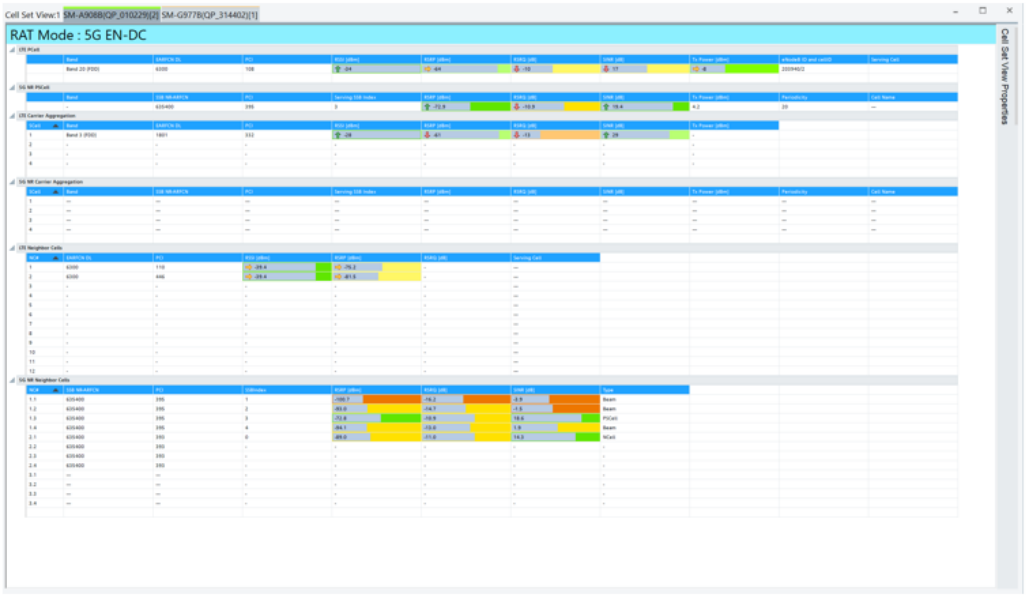


Figure 4-543: RAT mode 5G EN-DC

Table 4-24: LTE/5G cell details

Column	Value	
	LTE PCell	**5G PSCell**
1	Intentionally left blank	Intentionally left blank
2	Band	Band
3	EARFCN	NR-ARFCN
4	PCI	PCI
5	RSSI	Serving SSB Index
6	RSRP	RSRP
7	RSRQ	RSRQ
8	SINR	SINR
9	TX-Power	TX-Power
10	eNodeB and Cell ID	Periodicity
11	Cell name	Cell name

Table 4-25: LTE/5G carrier aggregation details

Column	Value	
	LTE Carrier Aggregation	**5G Carrier Aggregation**
1	SCell number (1 to 4)	SCell number (1 to 4)
2	Band	Band
3	EARFCN	NR-ARFCN

Column	Value	
	LTE Carrier Aggregation	5G Carrier Aggregation
4	PCI	PCI
5	RSSI	Serving SSB Index
6	RSRP	RSRP
7	RSRQ	RSRQ
8	SINR	SINR
9	TX-Power	TX-Power
10	-	Periodicity
11	-	Cell name

Table 4-26: LTE/5G neighbor cells details

Column	Value	
	LTE Neighbor Cell	5G Neighbor Cell
1	Neighbor cell #	Neighbor cell # (X, Y) X = Neighbor Cell # Y = Beam Index of Neighbor Cell
2	EARFCN	NR-ARFCN
3	PCI	PCI
4	RSSI	SSB index
5	RSRP	RSRP
6	RSRQ	RSRQ
7	SINR	SINR
8	Serving cell	-
9	-	Type PSCell – SSB Index = 5G PSCell Serving SSB Index Beam - Candidate SSB index of the 5G PSCell NCell - Neighbor Cell

4.4.13.1 Layout of the cell set view

Current RAT mode

Shows the current RAT mode for the Replay/Measurement.

The background color can be modified by going to the signal configuration screen and modifying the color ("Preferences" > "Available Signals"). The following figures show the cases RAT mode undefined and RAT mode defined as UMTS.

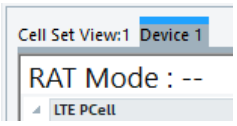


Figure 4-544: Undefined RAT Mode

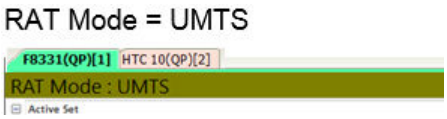


Figure 4-545: Defined RAT mode as UMTS

Grid layout

The grid of the Cell Set View shows the values specific to a RAT mode, see RAT specific grid layout chapters.

The following is generic and applies across all RAT specific grids.

Column resizing

The size of any column on the grid may be resized by holding the mouse over the column boarder, left clicking and dragging the mouse to the left or right to increase or decrease the size of the column, respectively.

Groups

Each grid layout has its values sorted into groups. Each individual group may be shown or hidden by clicking the group show/hide icon.

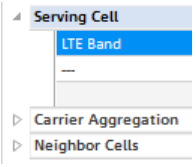


Figure 4-546: Show/hide groups

Column sorting

Column sorting is done by a group. The result of the sorting is the ability to have each group sorted by a different column. The current column sort order is indicated by the column sorting icon.

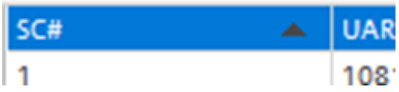


Figure 4-547: Sorting icon

Clicking the column header of the current column, the sorting values cycle though ascending (up arrow), descending (down arrow) and no sorting (no icon displayed).

The column that the group is sorted on can be changed if you click a different column header.

Cell contents

Cells that contain measurement values show the trend of the value by a data icon on the left side of the cell. If the value is increasing, an up arrow is displayed -2.1. If the value is decreasing a down arrow is displayed -95.8. If the value is unchanged, at side ways arrow is displayed -6.7. If no arrow is displayed it is because the current value is invalid or the previous value was invalid.

The cells also contain a displayed bar graph that shows where the current value is in relation to the minimum and maximum for the represented signal.

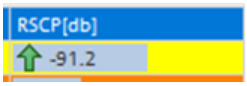


Figure 4-548: Current value relative to min/max values

The background color of the cell can be modified by going to the signal configuration menu and modifying the color of the signal in question.

4.4.13.2 LTE grid layout

The Cell Set View for the RAT mode LTE is shown in the following figure.

The "LTE PCell" section shows the current server cell (PCC). The "LTE Carrier Aggregation" section shows the secondary cells SCC1 – SCC4. The "LTE Neighbor Cells" section shows up to twelve measured neighbor cells.

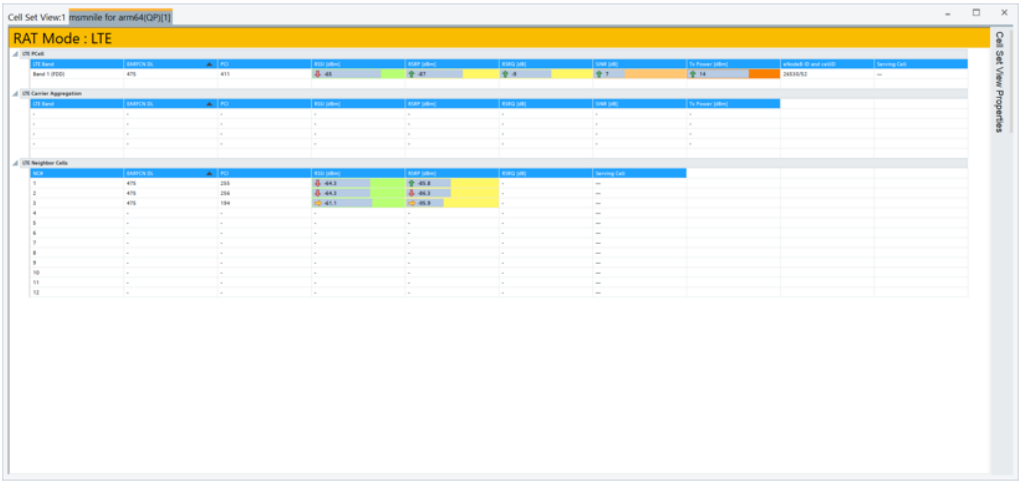


Figure 4-549: RAT mode LTE - Cell Set View

Each table row represents a cell.

The following columns are filled in the LTE grid:

- LTE Band
  Shows the LTE band for each cell.

- EARFCN
  Evolved Absolute Radio Frequency Channel Number
- PCI
  Physical Cell ID (0 to 503)
- RSSI [dBm]
  Received Signal Strength Indication - the total received power
  Definition TS 36.214: E-UTRA Carrier Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in OFDM symbols containing reference symbols for antenna port 0, in the measurement bandwidth, over N number of resource blocks by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise and so on.
- RSRP [dBm]
  Reference Signal Received Power
  Definition TS 36.214: Reference signal received power (RSRP), is defined as the linear average over the power contributions (in [W]) of the resource elements that carry cell-specific reference signals within the considered measurement frequency bandwidth.
  For RSRP determination the cell-specific reference signals R0 according TS 36.211 [3] shall be used. If the UE can reliably detect that R1 is available, it may use R1 in addition to R0 to determine RSRP.
- RSRQ [dB]
  Reference Signal Received Quality
  Definition TS 36.214: It is the ratio N×RSRP/(E-UTRA carrier RSSI), where N is the number of RB's of the E-UTRA carrier within the RSSI measurement bandwidth. The measurements in the numerator and denominator shall be made over the same set of resource blocks.
- SINR [dB]
  Signal-to-Interference-plus-Noise Ratio - Measure of the quality of the radio channel.
- TX Power [dBm]
  Transmitted power
- eNode ID and cellID
  eNodeB (20 bit as number) and Cell identity (8 bit as number).
- Serving Cell
  eNodeB name

4.4.13.3 UMTS grid layout

The UMTS grid layout is obtained in the "Cell Set View" if the current RAT mode is UMTS. The view is shown in the following figure.

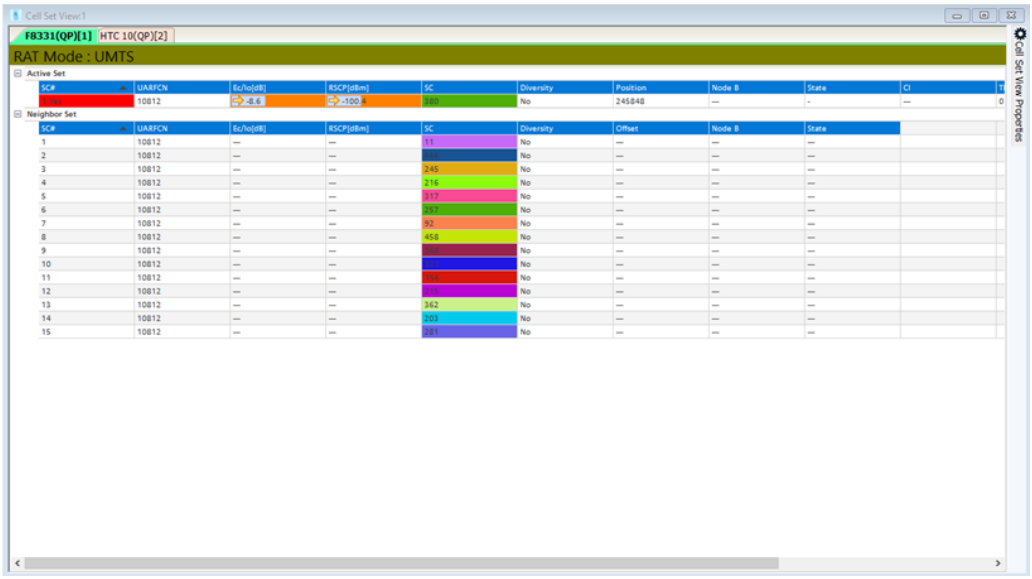


Figure 4-550: RAT mode UMTS - Cell Set View

The UMTS cell set grid shows an overview of the Layer1 parameters of the serving cell and the neighbor cells.

The results for each mobile are arranged in a separate tab. The HSPA+ dual cells are also shown. Therefore, the view shows the second carrier in the "Active Set" section.

The following columns are filled in the UMTS Cell Set View grid:

- "Color Symbol"
  Color code for the primary SC as defined in the "Colors" tab of the configuration menu. The SC color codes are also shown in the "ROMESMAP Route Track" view.
- "SC#"
  Sequence number for the cell, assigned in chronological order and always starting with 1.
- "UARFCN"
  UTRA Absolute Radio Frequency Channel Number
- "Ec/Io [dB]"
  Ratio of energy per modulating bit to the noise spectral density
- "RSCP [dBm]"
  Received Signal Code Power is the received power on one code, measured on the primary CPICH.
- "SC"
  Scrambling code of the signal used to identify a cell. The format is selected in the "TEC for UMTS Test Mobiles"
- "Diversity"
  Downlink transmit diversity scheme for the CPICH

  Possible schemes are:
  - STTD (Space Time Transmit Diversity)
  - TSTD (Time Switched Transmit Diversity)
  - SSDT (Site Selection Diversity Transmit Power Control)

  - No Diversity
- "Position"
  Indicates the active cell position.
- "Offset"
  Time offset of the signal in 1/8-chip units relative to the system time (hardware-dependent).
- "Node B"
- Name of the NodeB, taken from the UMTS NodeB database (if available)
- "State"
  Indication whether the neighbor cell is monitored, detected, undetected or not listed
- "CI"
  Cell ID of the cell in active set.
  R&S ROMES4 provides a signal for the active set cell ID. The following figure shows the active set cell ID among other parameters in the "Alphanumeric View".

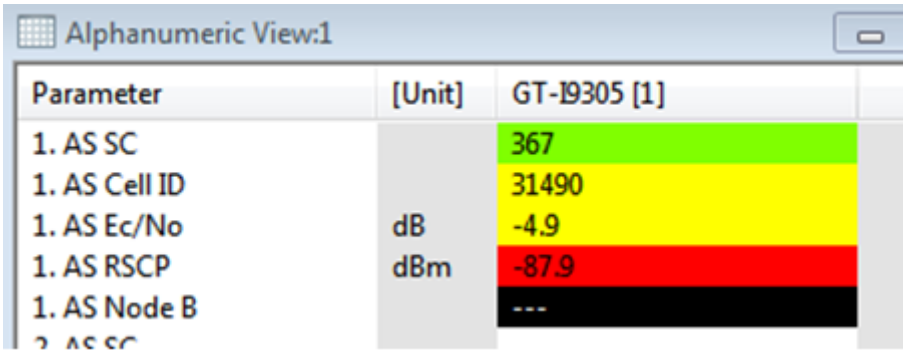


Figure 4-551: Active set parameters

- "TPC"
  Cell's transmission power control value ranging from 0 to 5
- "Sec. SC"
  Secondary Scrambling code number. “Not in use” is displayed if the cell uses only primary scrambling code.
- "OVSF"
  Orthogonal Variable Spreading Factor, code number of the signal
- "HSUPA"
  If HSUPA is activated, the column shows which EUL set the NodeB belongs to:
  - "SC"
    "Serving Cell"
  - "RLS"
    Radio Link Set
  - "Other"
    Other cells
- "Serving"
  Indication whether a cell is the serving cell (Yes/No)

The "Active Set" table comprises the most important parameters of the downlink signals from the UTRAN serving cell and all other cells that are currently used for the connection. The members are permanently monitored and updated by the network.

The "Neighbor Set" table comprises the most important parameters of the downlink signals from all UTRAN cells that are in the neighbor set and not currently used for the connection. The members of the neighbor set are permanently monitored and updated by the network.

The SC and Ec/Io values for each active set element generate signals in the "UMTS" > "Device n" > "Active Set" branch of the "Signal Tree".

A Qualcomm chipset based mobile must be used to record the neighbor cell data.

4.4.13.4 GSM grid layout

The "Serving Cell" section shows the current server cell. The "Neighbor Cells" section shows up to 32 measured neighbor cells.

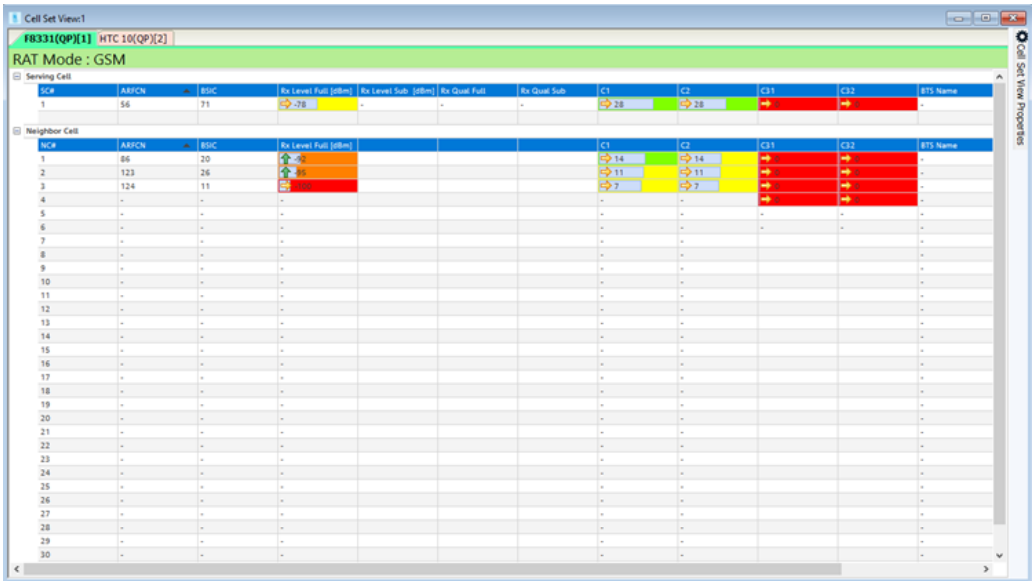


Figure 4-552: RAT mode GSM - cell set view

The following columns are filled:

- "SC#"
  Serving cell number
- "ARFCN"
  Absolute Radio Frequency Channel Number; GSM channel number of the measured SCH.
- "BSIC"
  Base transceiver station identity code. BSIC is always octal (so that BSIC = ab, where a is the NCC and b is the BCC), irrespective of the format (octal/decimal/hex) selected in the "Preferences" > "Available Signals" tab.
- "Rx Level Full [dBm]"

RxLev assessed over the full range of TDMA frames within a SACCH block. Mobile reports the signal value for the serving cell and the neighbor cells.

- "Rx Level Sub [dBm]"
  RxLev assessed over a subset of 12 TDMA frames. Mobile reports the signal value for the serving cell and the neighbor cells.
- "Rx Qual Full"
  Received signal quality assessed over the full range of TDMA frames within a SACCH block. Mobile reports the signal value for the serving cell and the neighbor cells.
- "Rx Qual Sub"
  Received signal quality assessed over a subset of 12 TDMA frames. Mobile reports the signal value for the serving cell and the neighbor cells.
- "C1"
  Parameter relevant for cell selection
- "C2"
  Reselect parameter, relevant for cell selection (GSM phase II)
- "C31"
  C31 cell reselection criteria
- "C32"
  Flag indicating an exception rule for GPRS_RESELECT_OFFSET according to 3GPP TS 05.08.
- "CI"
  Cell Identity (16 bit)
- "TA"
  Timing Advance
- "BTS Name"
  Name of the base station. This parameter is displayed if a valid BTS list is available. Detailed information can be obtained by double-clicking the BTS name.

DL /UL DTX mode

A large difference between the Rx Qual Full and Rx Qual Sub values indicates that the downlink signal shows strong variations in time. One possible reason is that the BTS uses discontinuous transmission (DTX).

In the DTX mode, the BTS transmitter is switched off during time periods where no information needs to be transferred. The relevant received signal quality is given by Rx Qual Sub. The averaged parameter Rx Qual Full is generally larger (in extreme cases, Rx Qual Full can be equal to 7, while Rx Qual Sub is equal to 0!) and the Rx Qual Sub reported value underestimates the signal quality.

The current DTX mode of a GSM mobile, that is, whether DTX is used, can be seen in the "Alphanumeric View". The "GSM System Information View" and the "Layer 3 View" show the DTX mode that the network commands the mobile station to use ("shall use DTX", "shall not use DTX" or "may use DTX").

4.4.13.5 Cell set view properties

Configuration of the Cell Set View is done through the use of a properties grid window that is attached to view. By default the properties window is attached to the upper right corner of the view.

Figure 4-553: Cell Set View Properties tab

Click the properties tab to open the properties window.

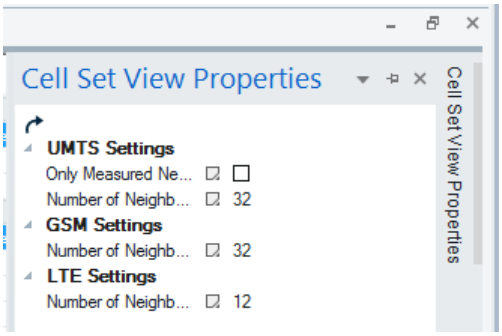


Figure 4-554: Cell Set View Properties window

You can access the same window via the "Properties" entry of the context menu which pops-up if right click any point in the "Cell Set View".

The "Cell Set View Property" window can be pinned to the view so that it is always available. For that, click the icon in the window.

To restore the property values to their saved workspace values, click the "Restore All Values" button within the dialog.

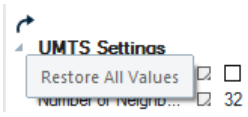
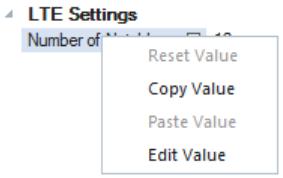


Figure 4-555: Restore button

To restore an individual property's value, right mouse button click a property and choose "Reset Value".



LTE properties

The only configurable property for the LTE grid layout is the number of neighbor cells to display.

The property defines the maximum number of neighbor cells to be displayed in the grid.

UMTS properties

The configurable properties for the UMTS grid layout are:

- Only measured neighbors
  The property limits the neighbor cell display to those neighbors which have valid Ec/Io and RSCP values.
- Number of neighbor cells to display
  The property defines the maximum number of neighbor cells to be displayed in the grid.

GSM properties

The only configurable property for the GSM grid layout is the number of neighbor cells to display.

The property defines the maximum number of neighbor cells to be displayed in the grid.

4.4.14 ETSI QoS view

The "ETSI QoS View" shows the NQA calls classified as "Good", "Blocked", "Dropped" or "No service" for LTE, LTE CSFB to 2G or 3G, VoLTE, UMTS, UMTS, GSM or TETRA mobile originating or terminating calls.

If a B-Party hangs up during a call, the NQA recognizes that and counts the call as dropped which is displayed in the "ETSI QoS View".

In addition to the information concerning the call classification, the "ETSI QoS View" displays a set of QoS parameters defined in the ETSI/IREG specifications.

The IREG is an ETSI committee developing specifications for the QoS evaluation.

QoS is a general notion, defined as “the collective effect of a service performance which determines the degree of satisfaction of a user”. A critical technical aspect related to QoS is a network performance (NP), i.e. “the ability of a network portion to provide the functions related to communication between users”.

The parameters to assess the QoS of various services are defined in ETSI TS 102.250-2 and related documents.

Requirements for displaying data in this view:

- Autodialing is enabled for the test mobile
- "Constant Call Pattern" ("ETSI Specification") is enabled
- The option "Use NQA" is enabled in the test mobile device "NQA Settings" menu

All device settings and call classes are explained in chapter Chapter 6, "Hardware Components", on page 1447.

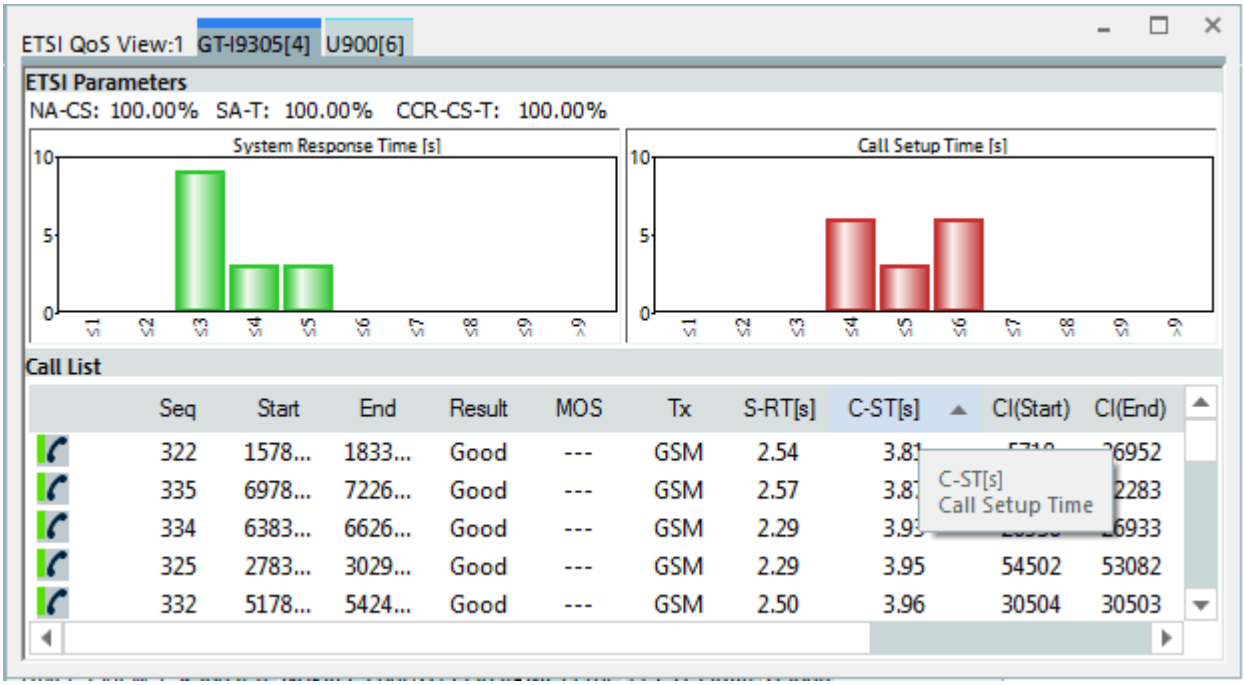


Figure 4-556: ETSI QoS View

The measurement results for each mobile are arranged in a separate tabs. The view contains two panels, independently on selected tab. The "ETSI Parameters" pane provides a statistical evaluation of the whole measurement. The lower "Call List" pane is a list with the results of each individual. The list can be replaced by the "Call Statistics" for a selected call.

Information about BLER, Ec/Io or handover durations are not shown in this view.

While executing a TETRA test be aware of the note TETRA Group Calls. If it is ignored, the obtained ETSI QoS measurement results will, for example, contain multiple calls per call sequence as shown in the following figure.

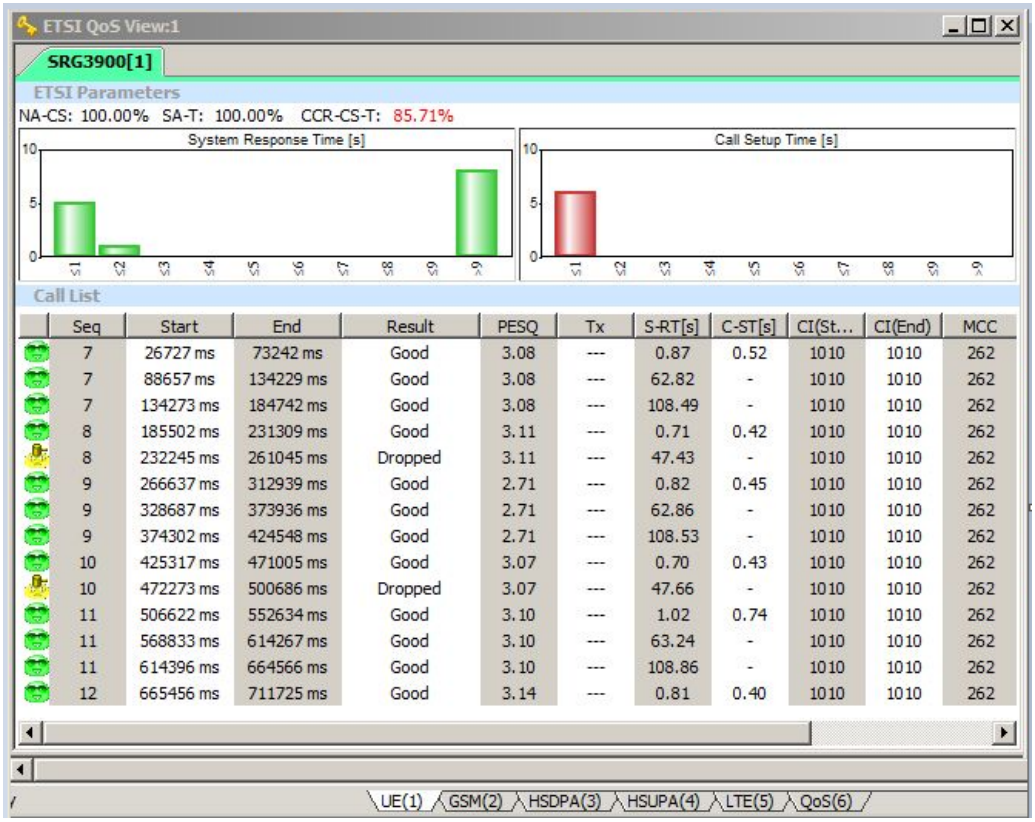


Figure 4-557: Disturbed TETRA call - ETSI QoS View

4.4.14.1 IREG IR.42 parameters

An overview of QoS service-independent and telephony-related parameters defined in TS 102.250-2 (formerly: PRD IR.42) and statistical evaluation of the timing parameters are defined this section.

The following values are displayed in percent:

- **NA-CS**
  Network Accessibility-Circuit Switched, ratio of the number of successful GSM network access attempts to the total number of network access attempts. The criterion for successful network access is that the path loss criterion parameter C1 is larger than 0 (see standard 3GPP TS 05.08).
- **NA-PS**
  Network Accessibility-Packet Switched, ratio of the number of successful GPRS network access attempts (with GPRS enabled for cell) to the total number of network access attempts. The criterion for successful network access is that the path loss criterion parameter C1 is larger than 0.
- **SA-T**
  Service Accessibility-Telephony, ratio of the number of successful call attempts (after successful network access) to the total number of call attempts.
- **CCR-CS-T**

Call Completion Rate Circuit Switched Telephony, ratio of the number of intentionally terminated telephony calls to the number of successful telephony calls.

The larger the four values, the better the QoS. The values in the "ETSI Parameters" pane turn to red if they fall below the limits defined in the configuration menu.

Support of VoLTE

The R&S ROMES4 Voice Call Analyzer supports VoLTE calls by generating the well-known result classes of voice calls and calculates the System Response Time S-RT and Call Setup Time C-ST.

The analyzer results are based on IMS messages, see Chapter 4.4.15, "Layer 3 view", on page 958. The messages are currently available for test-UEs with a Qualcomm chipset with the running Qualcomm IMS Stack (the Qualcomm chipset does not mean necessarily that the implemented IMS stack is also provided by Qualcomm). The R&S ROMES4 Qualcomm device checks for these UEs the possible problems during a VoLTE call, see Possible Problems Check During VoLTE Call

The distribution of the following timing parameters is shown in two-bar graphs:

- **System Response Time S-RT**
  Time between the start of a call attempt and indication of successful network access.
- **Call Setup Time C-ST**
  Time between the start of a call setup attempt (after successful network access) and indication of call setup success.

Short times indicate a good QoS. The diagram scales and the number of classes are defined in the configuration menu.

Calculation of these times is based on Layer 3 trigger points. Depending on RAT and call direction (MOC / MTC), the calculation is made as shown in the following list.

- **LTE -** CSFB
  - MOC
    S-RT: T(LTErrcConnectionSetupComplete) - T(EmmExtendedServiceRequest)
    C-ST: T(ALERTING) - T(EmmExtendedServiceRequest)
  - MTC
    S-RT: T(ALERTING) - T(EmmExtendedServiceRequest)
    C-ST: T(CONNECT_ACK) - T(EmmExtendedServiceRequest)
- **VoLTE**
  - S-RT = tINVITE-Trying – tINVITE-Request
  - C-ST= tACK-Ok – tINVITE-Request
- **UMTS**
  - MOC
    S-RT: T(rrcConnectionSetupComplete) - T(rrcConnectionRequest)
    C-ST: T(ALERTING) - T(rrcConnectionRequest)
  - MTC
    S-RT: T(ALERTING) - T(PAGING_RESPONSE)
    C-ST: T(CONNECT_ACK) - T(PAGING_RESPONSE)

- **GSM**
  - MOC/MTC
  - MOC
    S-RT: T(rrAssigmentCommand) - T(cmServiceRequest)
    C-ST: T(ALERTING) - T(cmServiceRequest)
  - MTC
    S-RT: T(ALERTING) - T(PAGING_RESPONSE)
    C-ST: T(CONNECT_ACK) - T(PAGING_RESPONSE)
- **GSM-R**
  - MOC/MTC
    - Mobile terminated VBS/VGCS setup time

  NOTE: Only the files recorded with the R&S ROMES4 version 17.00 or higher hold this determined KPI.
- **TETRA**
  - MOC
    - S-RT: T(NQA: Start of Call) - T(NQA: Start of Dial)
    - C-ST: T(NQA: Call active or D-CONNECT) - T(NQA: Start of Call or U-SETUP)
  - MTC
    - S-RT: no calculation
    - C-ST: no calculation

  NOTE: TETRA mobile PEI device provides the timestamps based on AT commands and AT responses. L3 commands / responses are not available.
  NOTE: TETRA Sepura device provides the timestamps based on arrival of certain internal data times.

4.4.14.2 Call list

The "Call List" shows all calls with their characteristics and QoS parameters. The table contains the following rows:

-

  Colored symbols to distinguish the Good, Dropped, Blocked/Cancelled calls and No Service case.
- **Start/End**
  Start and end time of the call.
- **Result**
  Call class: Good, Dropped, Blocked and No Service call; see description of NQA tab of the device configuration menu in chapter 6.
- **MOS**
  Mean Opinion Score value according to PESQ SQA measurement.
- **Tx**
  Maximum transmits power of the mobile during the call (not for GSM).
  Note:
  This parameter's values are not reported for TETRA.

- **S-RT, C-ST**
  System response time and call setup time, see previous chapter.
- **CI(Start)/ CI(End)**
  Cell Identity (decimal) at start and end of call.
- **MCC, MNC/NID**
  Mobile Country Code and Mobile Network Code/Network Identification Code.
- **Mode**
  Call mode: for example GSM, UMTS, LTE, CDMA, TETRA call or CSFB (3G)/ CSFB (2G) (LTE network is not available to make or receive voice call so that the device "falls back" to a more accessible 3G or 2G network to finish the call), LTE -> UMTS handover, LTE -> GSM network assisted cell change (NACC).
- **Type**
  Type of connection: Voice, Data or Group (TETRA only)

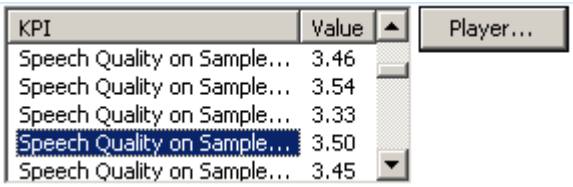
4.4.14.3 Call details

A double-click on a row in the "Call List" table opens the call details providing the entries of the"Call List" table plus three bar graphs to assess the distribution of the following parameter values:

- **RxQual/BLER**
  Indication of the Bit Error Rate (GSM) or Block Error Rate (UMTS).
- **RxLev/E_c/I_o**
  Indication of the downlink signal strength received by the mobile.
- **Handover Duration**
  Indication of the time needed for successful handover attempts.

The handover statistics (number of "Handover Attempts" and "Successful Intracell/ Intercell HOs)" is indicated in addition.

With SQA measurements, there is also a KPI window available, which allows the replay of speech quality files, if applicable:



Select a Speech Quality entry in the KPI window and click on the "Player" button to replay the file on the standard sound card. This function is also available during measurements with recording. The measurement must be set up with other soundcards to avoid a distortion.

Clicking ☒ closes the "Call Statistics" and displays the "Call List" table.

Example:

ETSI QoS view of speech quality measurement results made with Smartphone

The "ETSI QoS View" shows the average downlink MOS value of the call. The details of the call allow the user to listen to the degraded speech samples, if they were stored to the measurement file. To do so, just select one of the offered KPIs and press the button "Player".

Note: As the System Response Time parameter is not supported by Smartphone speech quality measurement, the corresponding parameter view is empty.

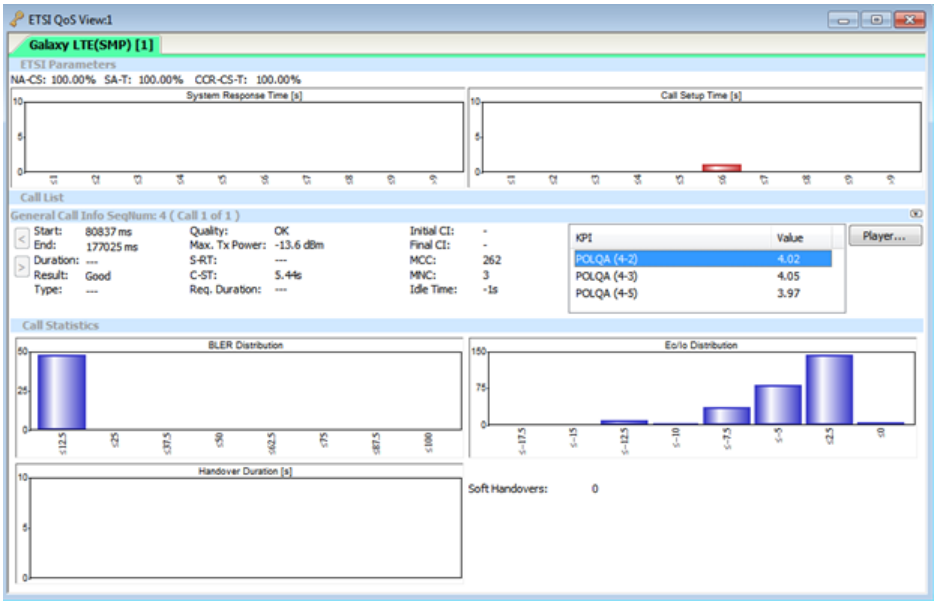


Figure 4-558: ETSI QoS view of Smartphone speech quality measurement results

4.4.14.4 Handling of incoming SMS

The MTC Analyzer is enhanced to handle incoming SMS during expected incoming calls, see Tracking of SMS.

The incoming SMSs are displayed with a separate icon. The "SMS" result is shown in the "Call List" and does not interfere with the call statistics. The call statistics are detected by the Layer 3 message CP-DATA.

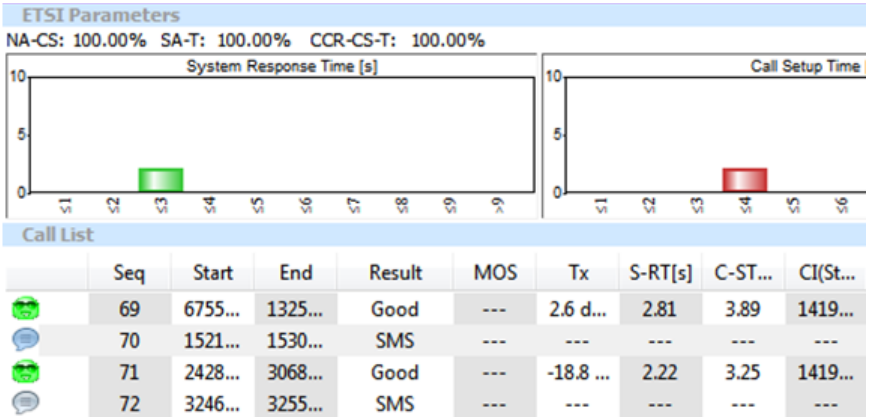
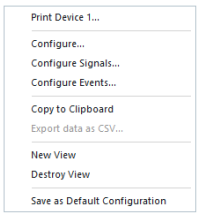


Figure 4-559: Handling the incoming SMS during incoming call

The feature is not intended to be an SMS analyzer for counting incoming SMS. The SMS entry is a result of the MTC analyses for incoming voice calls, which is more robust against the unexpected incoming messages, see Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891.

4.4.14.5 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.4.14.6 ETSI QoS view configuration

The "GSM ETSI View Configuration" configuration menu defines limits for the QoS parameters and configures the bar graphs.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

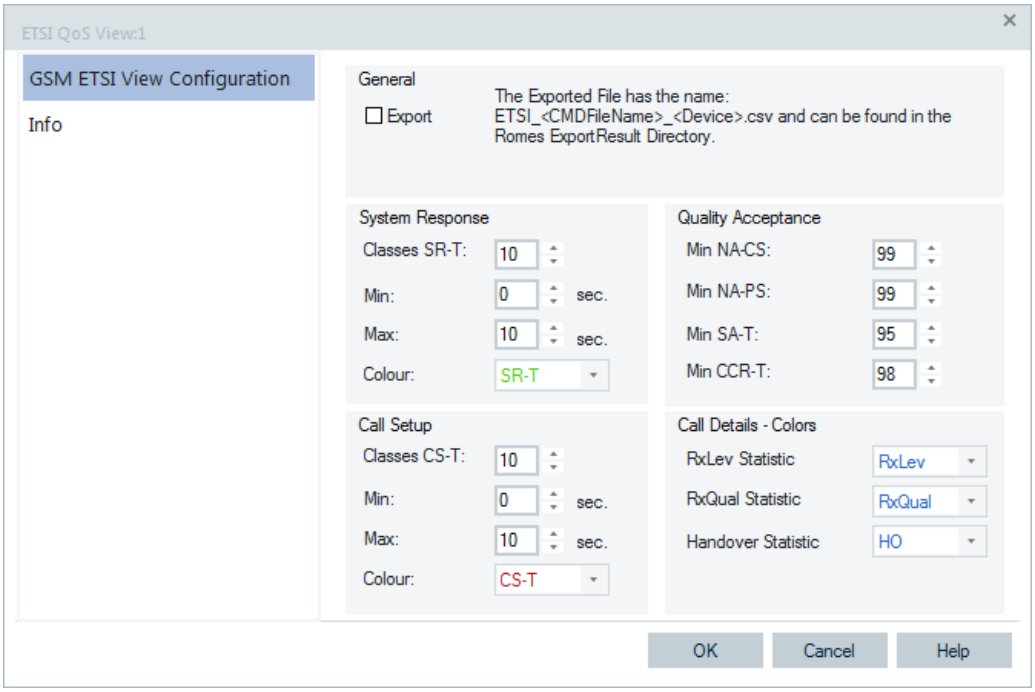


Figure 4-560: ETSI QoS View - configuration

General

Select the "Export" option to export the results of the "Generated Calls" table to a `*.csv` export file. This file can be then opened and processed by Excel, for example:

```
Start;End;Result;Quality;Tx;S-RT[s];C-ST[s];CI(Start);CI(End);MCC;MNC;Mode;Type
63813 ms;132000 ms;Good;OK;-6.0 dBm;0.44;6.55;-;-;262;1;UMTS;---
```

System Response / Call Setup

The "System Response / Call Setup" panel defines the number of classes (that is, the maximum number of bars) in the "System Response Time" and "Call Setup Time" diagrams, sets the scale of the y-axis and the colors of the bars.

With a number n of classes and a SR or CS time interval between "Min" and "Max" seconds, the classes correspond to the following sub-intervals:

Class 1	[0 s, (Max – Min) / n]
Class k	[(k – 1)*(Max – Min) / n, k*(Max – Min) / n] , 2 (k ((n – 1)
Class n	[(n – 1)*(Max – Min) / n, ∞ s]

Quality Acceptance

The four input fields in the "Quality Acceptance" panel contain lower limits for the QoS Parameters displayed in the "IREG IR.42 Parameters" panel. A measurement result turns red if it is below the limits.

Call Details - Colors
The "Call Details" panel sets the colors of the bars in the "RxQual/BLER Distribution", "RxLev/Ec/Io Distribution" and "Handover Duration" diagrams.

4.4.15 Layer 3 view

The "Layer 3 View" can display all Layer 3 messages recorded with mobile-related technologies and IP tracers, AT commands and the NQA state machine's messages.

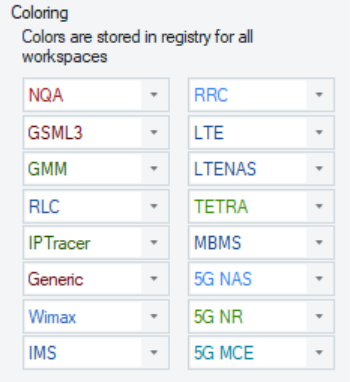


Figure 4-561: Layer 3 messages supporting RATs/layers

The Layer 3 messages are shown for all used mobiles. The tabs in the title bar of the view show the types of used/connected mobiles. The Layer 3 messages are arranged in a separate list for each mobile. Select the message types that you want to be displayed in the view for an individual mobile in the "Layer 3 View" configuration menu.

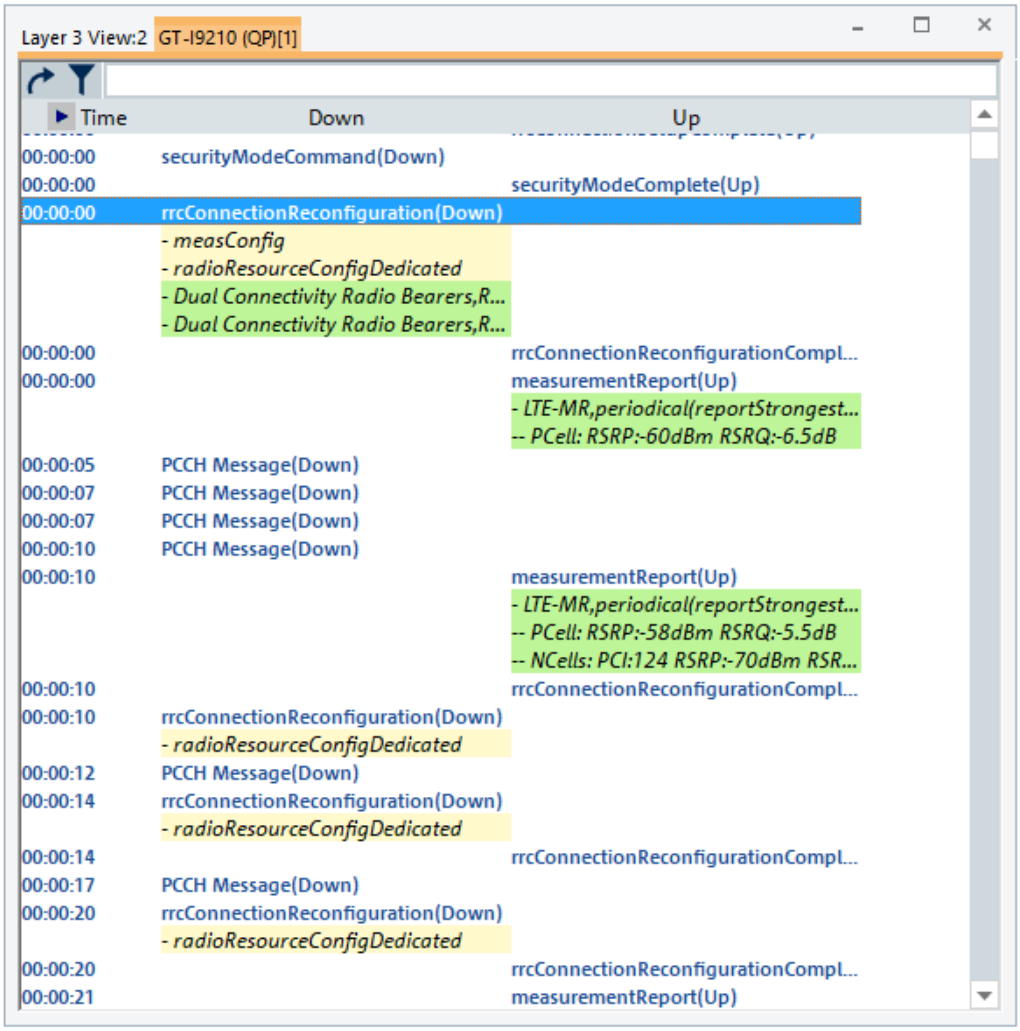


Figure 4-562: Layer 3 View - messages of the selected mobile device

The "Layer 3 View" automatically displays the second-level content of *rrcConnection-Reconfiguration* and *SystemInformation* message.

The uplink and downlink Layer 3 messages appear in separate columns, unless this feature is switched off. It can be switched in the configuration menu, see the "Separate Up/Downlink Columns" parameter in "Display" on page 968. The width of the individual lists can be varied with a drag&drop action in the header of the table.

The messages are not available in "Scan" mode. The mobile must be in "Normal", "Camp" or "Test Transmitter" mode.

The text filter on top of the "Layer 3 View" filters the content of the view immediately. Only the lines which contain the specified text are displayed after clicking the filter button.

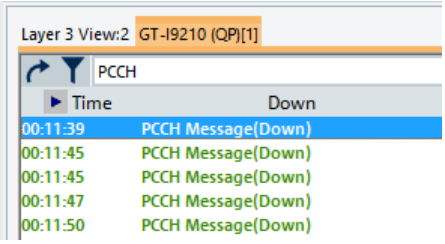


Figure 4-563: Filtered view

It can be necessary to refresh the view content after changing the filter. To refresh the content, click the button.

The QualiPoc IP traces are visible together with the other messages in the "Layer 3 View".

Decoding the QualiPoc IP traces' details requires a Wireshark installation. R&S ROMES4 uses the default Wireshark installation path by default. However, if the Wireshark default folder is not found, you have to run the `tshark.exe` manually the first time a decoding is attempted.

The AT commands and responses for mobiles configured with the generic mobile devices are supported in the "Layer 3 View".

The message details of the WiMAX MAC Management Payload decoding available for all MAC Management Messages (except UL-MAP and DL-MAP) are also supported.

Find dialog

The following keys are used directly in the "Layer 3 View":

- [Ctrl+F], which opens the "Find" dialog
- [F3], which continues a previous search, searching from top to bottom for the next occurrence of the search string
- [Shift+F3], which continues a previous search, searching from bottom to top for the next occurrence of the search string

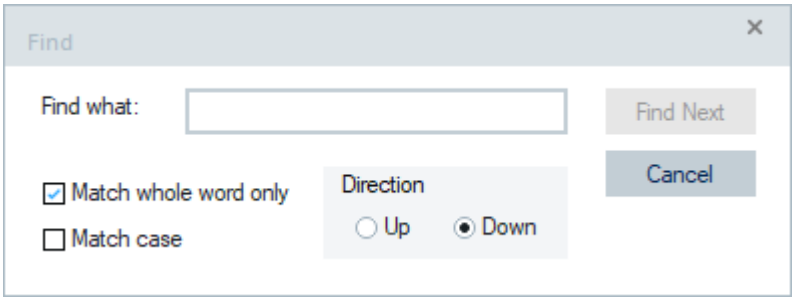


Figure 4-564: Find dialog

Detailed information

An upper case D appears to the right of the cursor arrow when it is placed on a Layer 3 message. This symbol indicates that there is detailed information to be retrieved for the

current Layer 3 message. The detailed information window is opened by double-clicking the selected message. The view automatically enables the detail filter and adds the corresponding filter, see "Detail Filter" on page 971.

It is possible also to move elements from the details window directly into the "Layer 3 View" by drag and drop.

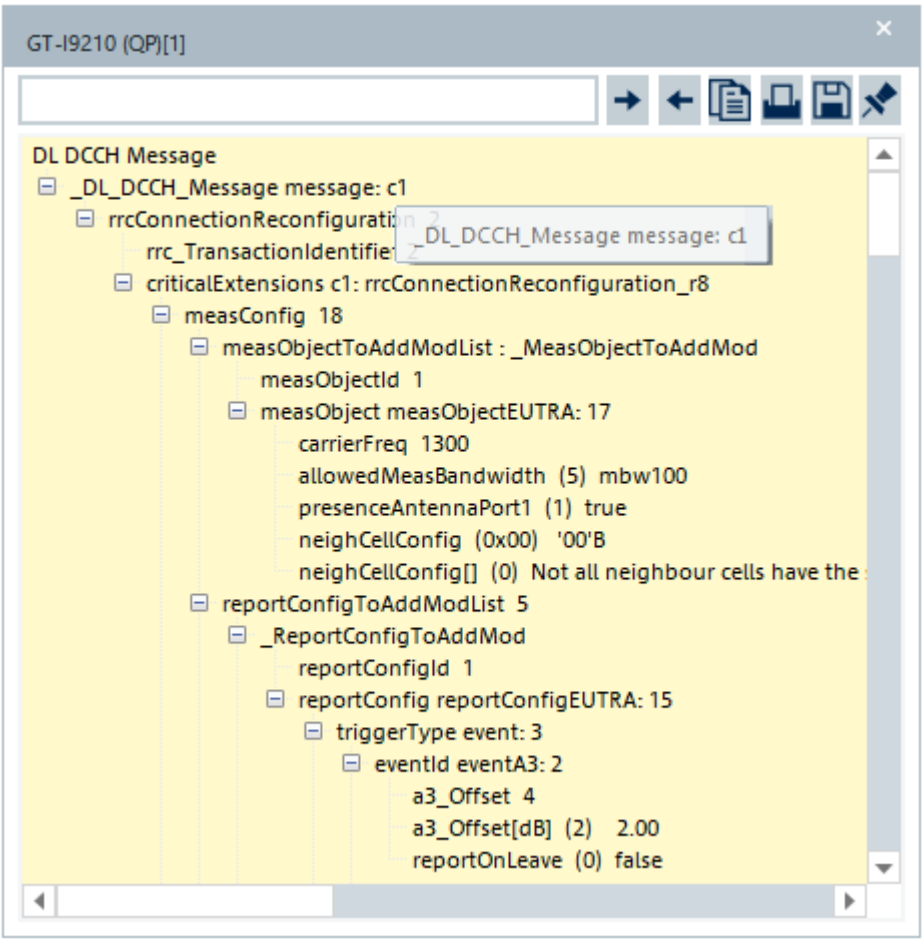


Figure 4-565: Details of the selected message in the Layer 3 View

Detailed messages are displayed during measurement/recording and replay session. Switching between different Layer 3 messages is also possible during a pause and even after stop.

Handling of the detailed information window

The detailed information window is independent of the Layer 3 view. You can move, resize and scroll it as you like.

Each individual list of Layer 3 messages can be stopped and released at any time by left mouse button clicking its title bar. A stopped list is indicated by a red "STOP" symbol left of the mobile type.

A search function was added to the details Layer 3 view page. While entering a text in the search field, the first occurrence of the text is highlighted in the tree view. Use the → and ← buttons to move the selection to the next / previous hit.

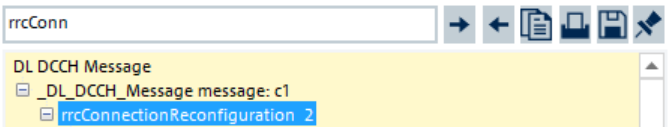


Figure 4-566: Search function

Click to generate a hardcopy of the detailed information or you can copy the content to the clipboard (the previous button). Alternatively, you can write the detailed information into the table (e.g. if you wish to create a hardcopy), see the "…Messages" tabs of the configuration menu.

The "Save to File" button offers the possibility to save the content of the Layer 3 detailed information directly to a text file.

4.4.15.1 IP tracer results

The IP tracer option enables capturing and decoding network traffic for the R&S ROMES4 software. This function is provided via a link layer network access and a comprehensive decoding engine, based on the Microsoft Network Monitor packet analyzer.

The protocol is shown in the "Type" column and the messages in the "Up" and "Down" columns. Source and destination IP address are shown in additional columns.

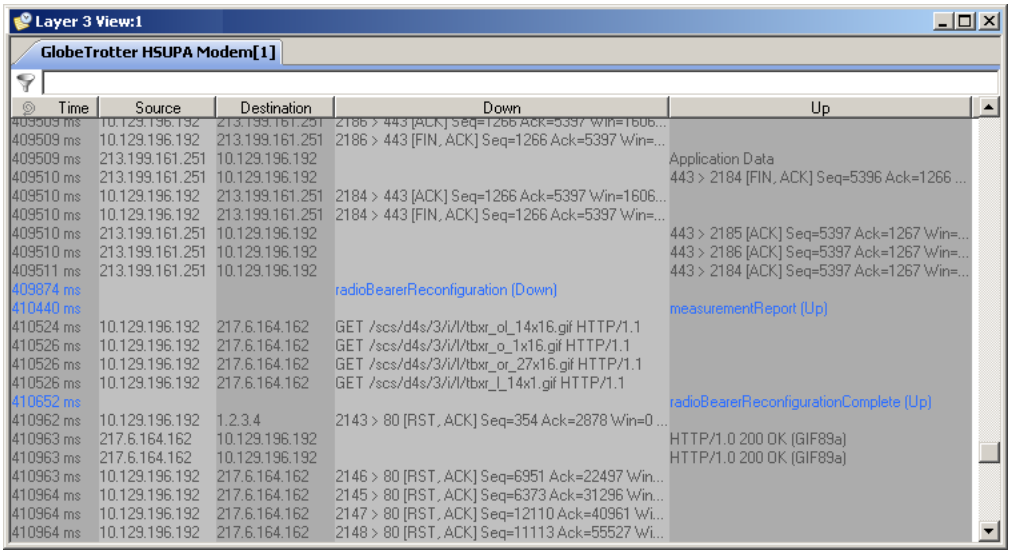


Figure 4-567: IP tracer results

IP tracer results are only visible if the IP tracer is configured in the DQA Connect to Network job, see "Connect to network" on page 1892.

R&S ROMES4 supports IP tracing only with network adapters and not with modems.

IP tracer TCP checksum

The TCP checksum cannot be calculated for TCP data packets, when the payload has been removed. In this case, the TCP checksum is marked as [n.a.] in the details window of the Layer 3 View.

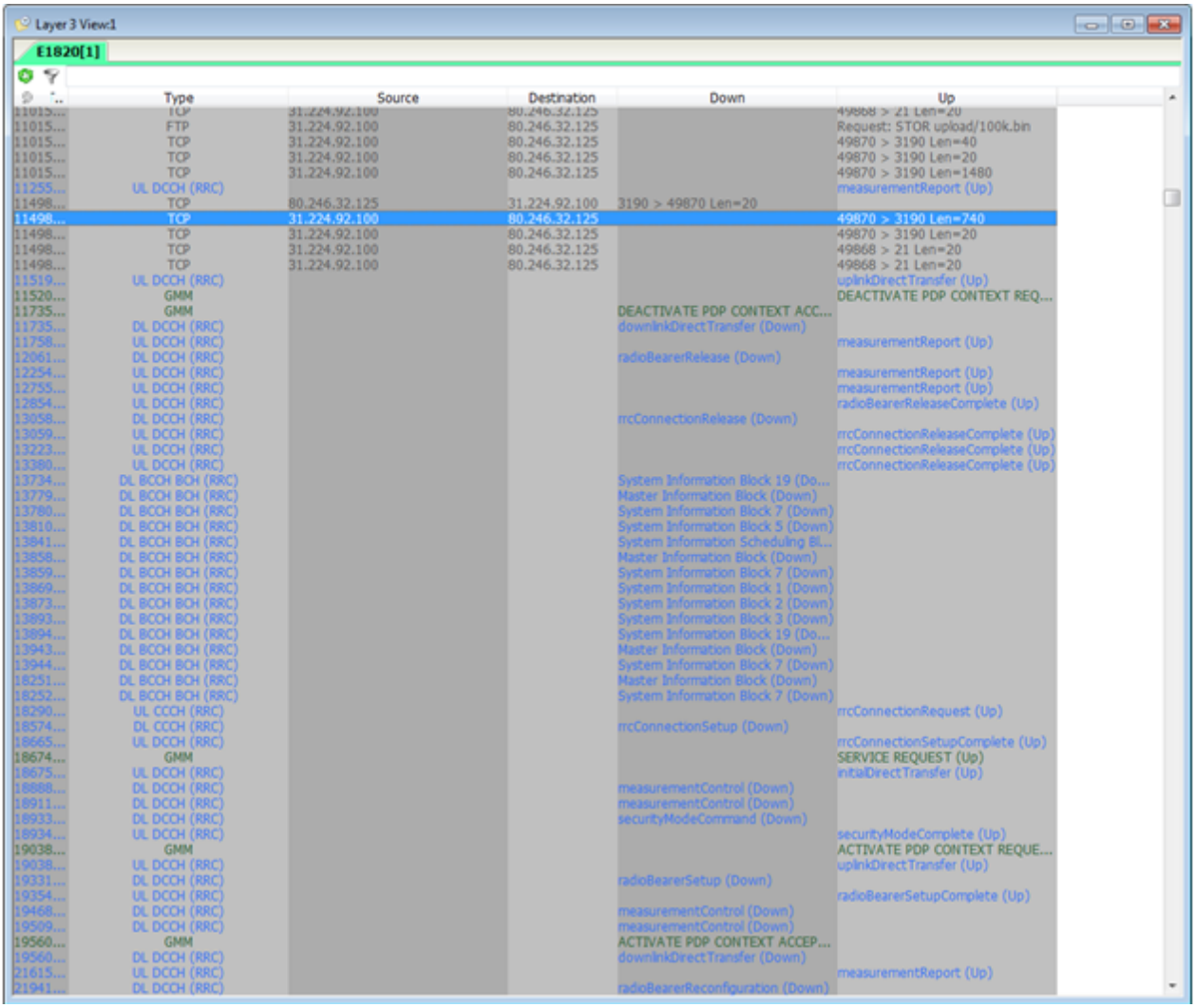
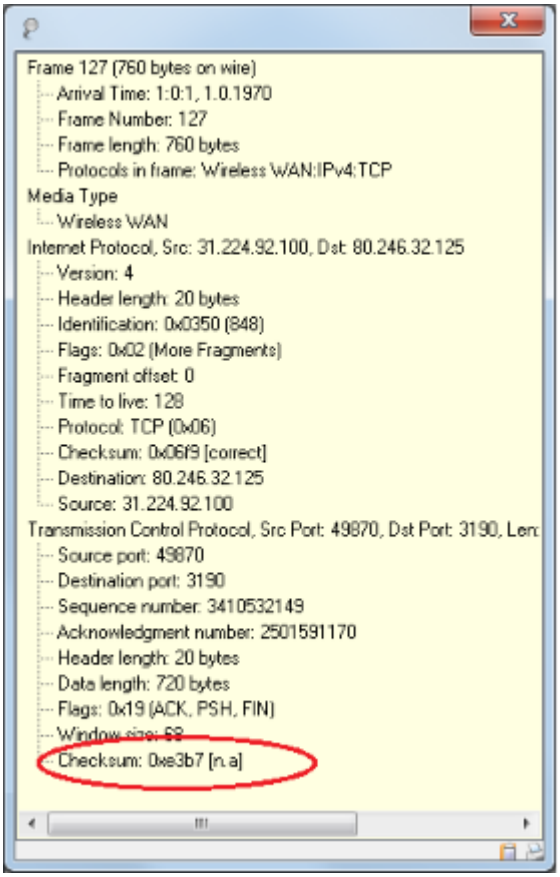


Figure 4-568: TCP checksum



4.4.15.2 MAC management messages

The MAC management messages can be analyzed in the "Layer 3 View". The view displays the messages together with the IP traces if measured. The details of the MAC messages are not available. The exceptions are the 5G NR MAC CE messages, which can be visualized in the view if so configured, see Figure 4-573 and 5G NR MAC CE and BWP Switch.

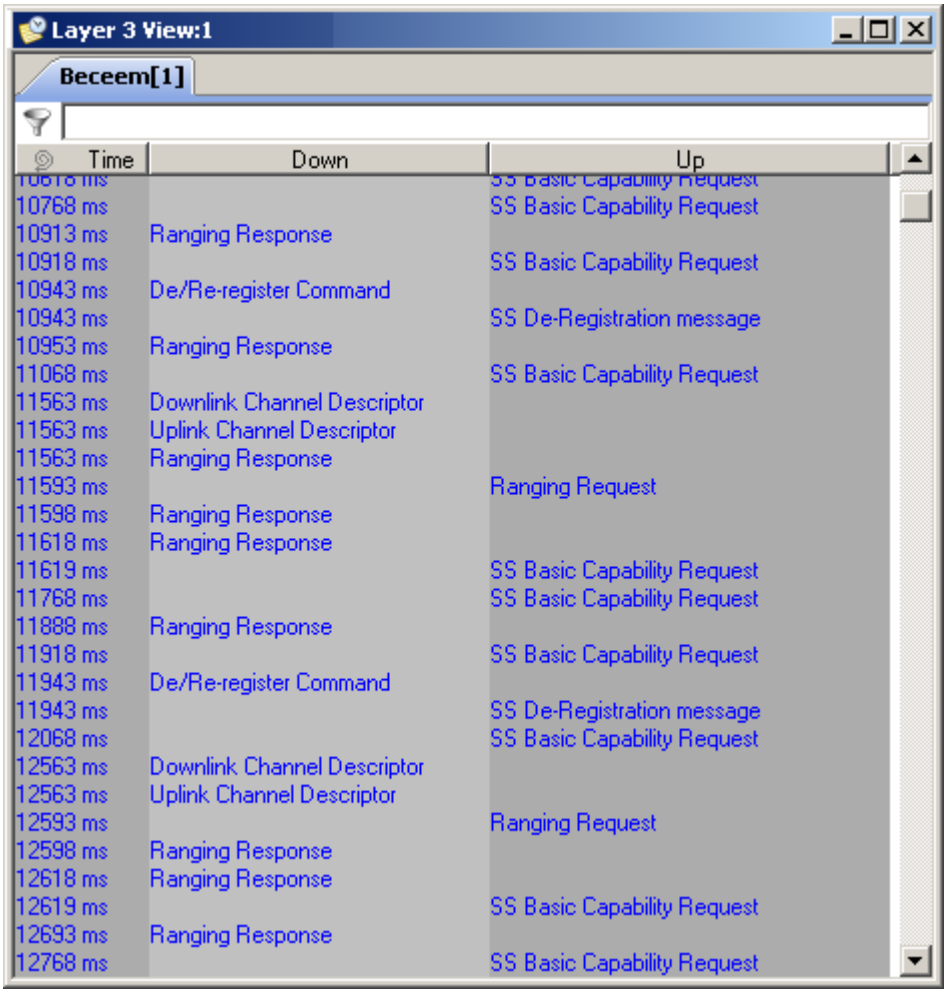


Figure 4-569: MAC management messages

4.4.15.3 Layer 3 filter

The "Layer 3 Filter" allows filtering dependent on a message type. Open it via context menu. After starting R&S ROMES4, the filter is empty. It is filling with the displayed messages during the measurement or replay.

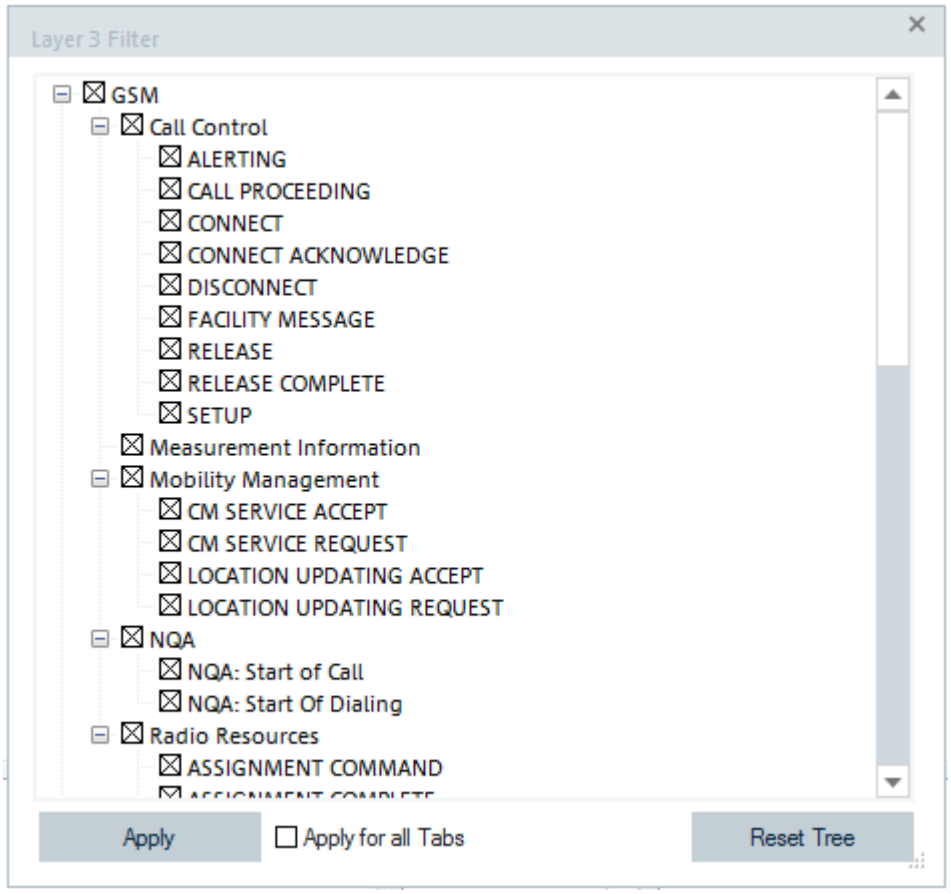
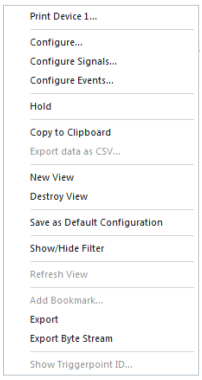


Figure 4-570: Filtering Layer 3 supported messages

Messages or groups of messages can be deselected.

- **Apply**
  Click "Apply" to update the view.
- **Apply for all Tabs**
  If checked, the filter is assigned to all tabs.
- **Reset Tree**
  Click "Reset tree" to blank the filter window again.

4.4.15.4 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

In addition, the context menu provides the following menu commands:

- "Show/Hide Filter"
  Opens the "Layer 3 Filter" dialog, see Chapter 4.4.15.3, "Layer 3 filter", on page 965.
- "Add Bookmark"
  Opens the "Edit Bookmark" dialog to define timestamp and a description for the bookmark of the selected message.

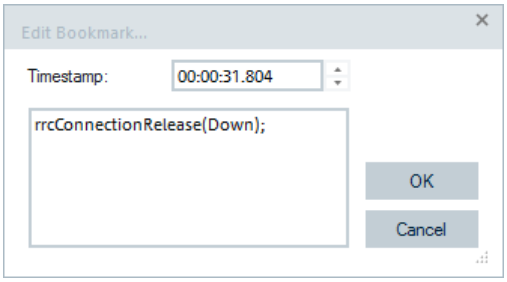


Figure 4-571: Edit bookmark for a Layer 3 message

- "Export"/"Export Byte Stream"
  Exports all visible information to a text file (`*.txt`). The file can be opened with a text editor or opened and processed, for example, by Excel. Using "Export Byte Stream", the corresponding Byte stream is visible beside the Layer 3 information.
- "Show Trigger Point ID"
  Opens a window with the trigger point ID. This ID is also copied to the clipboard.

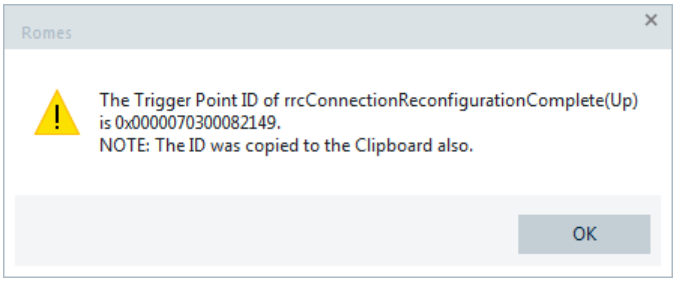


Figure 4-572: Trigger point of the selected Layer 3 message

4.4.15.5 Layer 3 view configuration

"Layer 3 View" lets you select messages you want to be shown or exported. The view also shows information on the current view version.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "Configure" entry triggers the execution of a measurement from the list and displays the messages obtained during the measurement. The large scale of possibilities to trigger and display Layer 3 messages is offered in this configuration page.

Apart from the configuration, there is the second option related to configuring Layer 3 views of signals, protocol-related signals of some 3GPP and non-3GGP technologies.

Display configuration

The "Display" page lets you select the display mode of the GSM/NAS, GPRS RLC/MAC, UMTS /LTE / 5G NR RRC, etc. messages, control the text markers and details filtering.

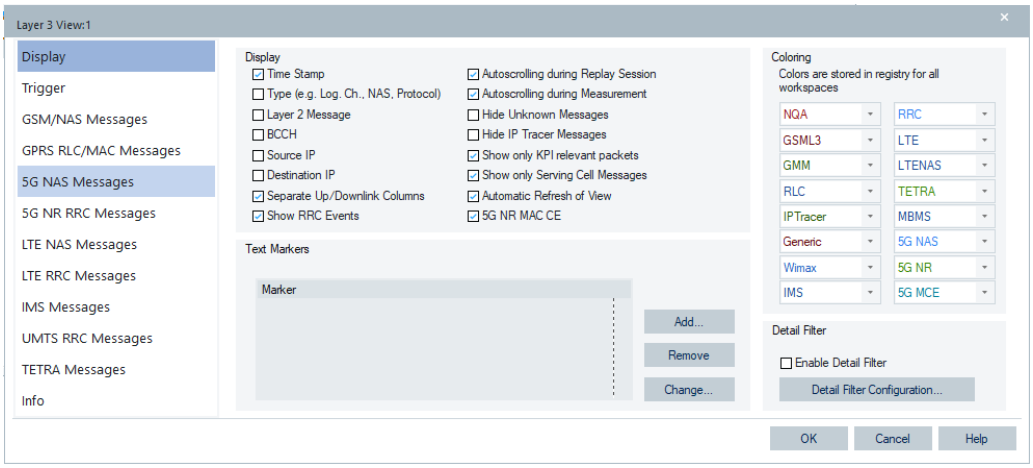


Figure 4-573: Layer 3 View - Display tab

Display

The controls "Display" let you select a type of information for display and the way of displaying in"Layer 3 View".

- "Time Stamp"
  If the box is checked, the time stamp associated with the message occupies the first column of the "Layer 3 View" tables.
- "Logical Channel"
  If the box is checked, the logical channel associated with the message occupies the second column of the "Layer 3 View" tables.
- "Layer 2 Message"
  If the box is checked, layer 2 messages associated with the layer 3 messages are displayed in an additional column of the "Layer 3 View" tables. There are test devi-

ces uncapable to record the layer 2 messages. However, those test devices, which support layer 2 messages have to be configured accordingly. For the concerned mobile device, see Chapter 6.4, "Test devices", on page 1511.

- "BCCH"
  Check the "BCCH" box to get the additional column in the "Layer 3 View". Usually, there are only messages from the serving cell. Some mobiles are able to receive information from one or more neighbor cells in the same time. In this case, the associated BCCH channel number is shown. Messages from the serving cell have no entry in the "BCCH" column.

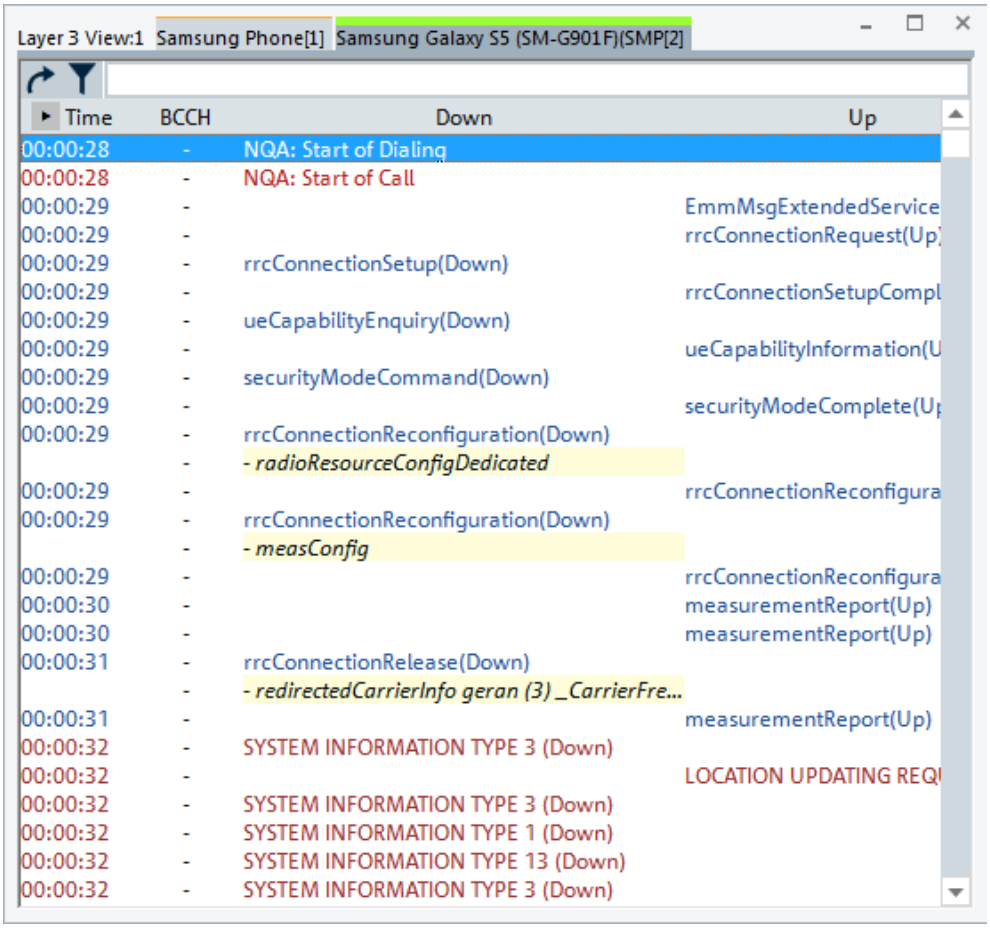


Figure 4-574: Additional column "BCCH"

The entry "BCCH" is used to distinguish between the messages from the own and the neighbor cells, concerning the mobiles with previously mentioned capability.
If you uncheck the "BCCH" box, it is not possible to distinguish between messages from the own and the neighbor cell. If you check the "Show only Serving Cell Messages" box, the view displays only the messages which belong to the serving cell.

- "Source/Destination IP"
  If the IP Tracer is enabled and this box is checked, the source and destination IP addresses are displayed in own columns.
- "Separate Up/Downlink Columns"
  If the box is checked, uplink and downlink messages appear in separate columns of the "Layer 3 View".

Otherwise, all messages from one mobile are written in a single column, in a chronological order. An (Up) or (Down) identifier after each message indicates the transmission direction of the messages.
Knowing the transmission direction is useful for display of the AT commands and the responses associated to a generic mobile device measurement setup, for example.

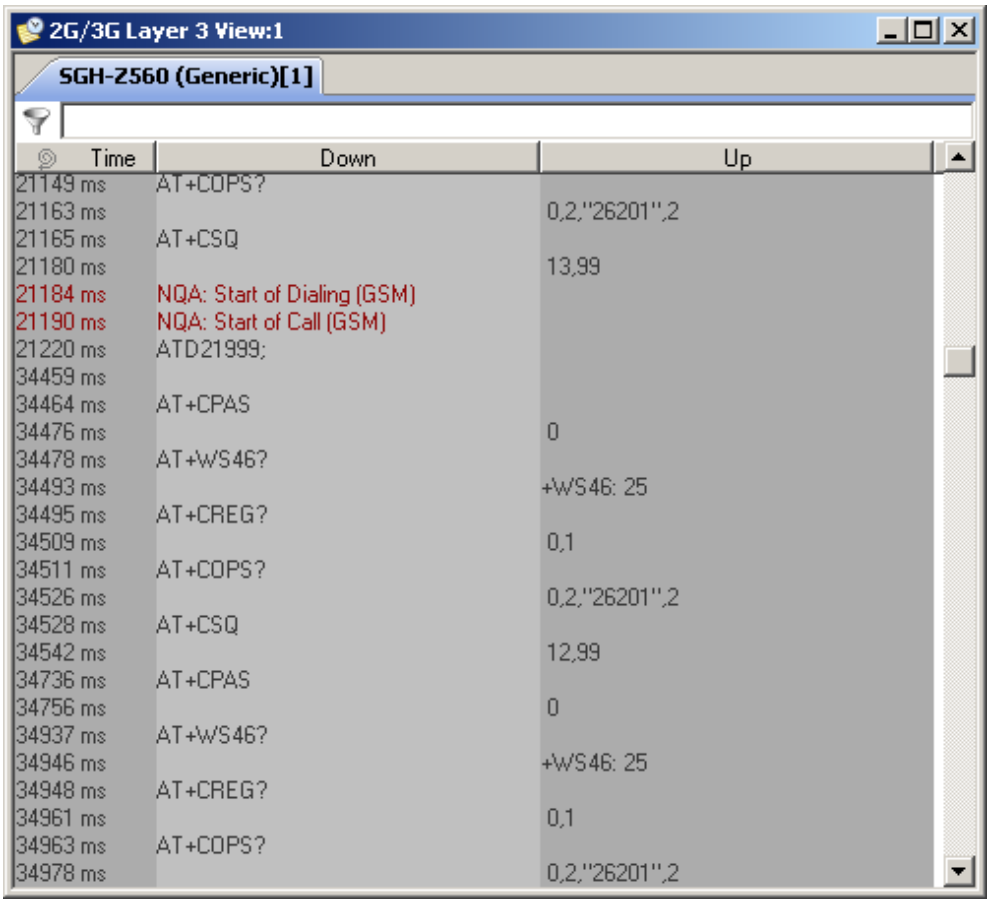


Figure 4-575: Separate columns for up and downlink

- "Show only Serving Cell Messages"
  If this option is checked, the layer 3 messages of the service cells only are exchanged for the display. Otherwise, the "Layer 3 View" shows all the layer 3 message records.
- "Autoscrolling during..."
  If the boxes are checked, the "Layer 3 View" tables are scrolled down automatically when the bottom of the view window is reached. Otherwise, the scrollbar can be used to move up and down in the table. Autoscrolling can be activated/deactivated separately for replay and measurement sessions.
- "Scan File"
  If the box is checked, the automatic scan for "Layer 3-related QoS" data in the active measurement file is activated.
- "Automatic Refresh of View"
  If the box is checked, the automatic view refreshment is activated whenever the configuration concerning filters or mark changes. It is also possible to trigger

refresh via the refresh button or "Refresh View" in context menu. Whenever it is necessary to initiate a refresh view process - the automatic refresh is disabled and a detail item was dropped onto the view - the icon gets an exclamation mark.

- "5G NR MAC CE" and BWP Switch
  If the box is checked, the 5G MAC CE (control element) messages are displayed in the "Layer 3 View". Although the messages display is an option, the option is by default switched on. The color of the message is customizable.
  The setting applies to the BWP Switch message as well. This message is shown whenever the assigned BWP by DCI has changed.
  Note: Both features are limited to Qualcomm chipset-based UEs and measurement files recorded with R&S ROMES4 23.2 or newer.

Color Scheme
Different message types can be displayed with different colors to be distinguished easier. Each of the pull-down combo boxes in "Coloring" lists a set of colors. Select a preferred color for the selected Layer 3 message here.

Text Marker
The controls in the "Text Markers" panel define markers that can be used to highlight keywords or expressions in the list of displayed messages. "Add" opens the "Configure Text Marker" dialog.

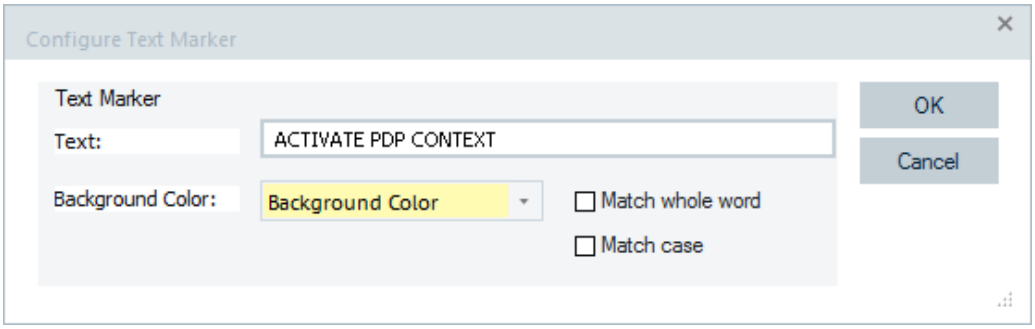


Figure 4-576: Dialog to configure text marker

The dialog can be opened from the context menu of the "Layer 3 View". A text marker highlights the search text entered in the "Text" line with selected "Background Color". The options "Match whole word" and "Match case" refine the text selection.

It is possible to define several text markers with different attributes,

Use "Remove"/"Change" buttons to delete/modify the search text in the "Text" field.

Detail Filter
Filters the detailed information displayed in the view. Filtering can be used to limit the amount of information displayed and search for particular information types. To activate the filter, proceed as follows:

1. Enable the details display for a particular message in one of the "Messages" tabs of the configuration menu (example given, for the "SETUP" in the "GSM NAS Messages" tab).

2. Click "OK".

3. Replay the ("Replay" or ▶) measurement file and pause the replay ("Pause Replay" or ⏸) when the message details are displayed for the first time.

4. Click the "Display" tab in the view's configuration page.

5. Click "Detail Filter Configuration" tab on the configuration page. The "Detail Filter" dialog opens.

6. In the box at the bottom of the "Detail Filter" dialog type the detailed information you wish to be displayed in the "Filter Strings" field. For example, type "BCD Number".

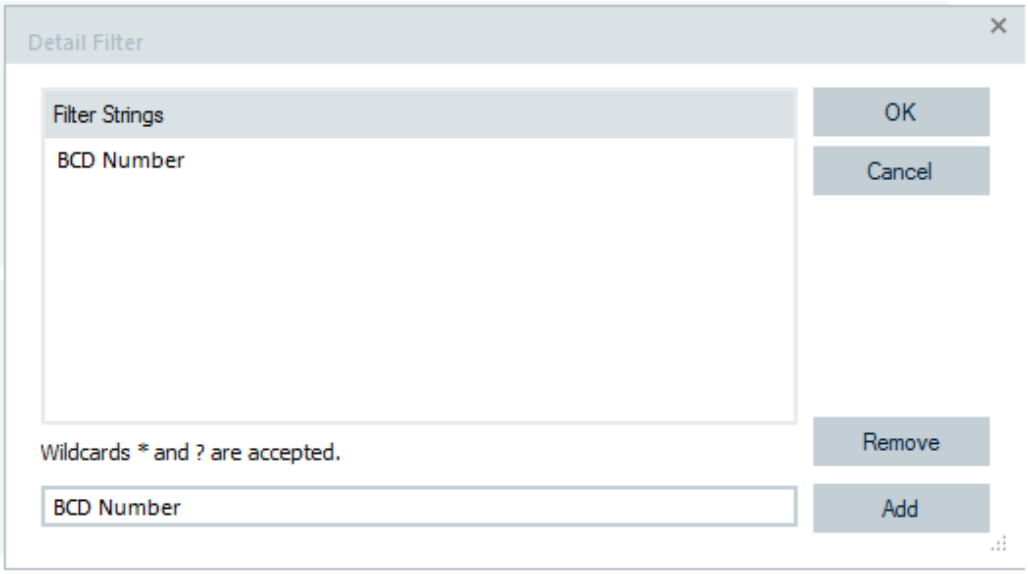


Figure 4-577: Detail filter dialog

7. Click "Add". The typed information is added.

8. Click "OK" to close the "Detail Filter" dialog.

9. Check the "Enable Detail Filter" box.

10. Click "OK" to close the configuration page.

11. Continue the replay. The next SETUP message is displayed with the "BCD Number" information only.

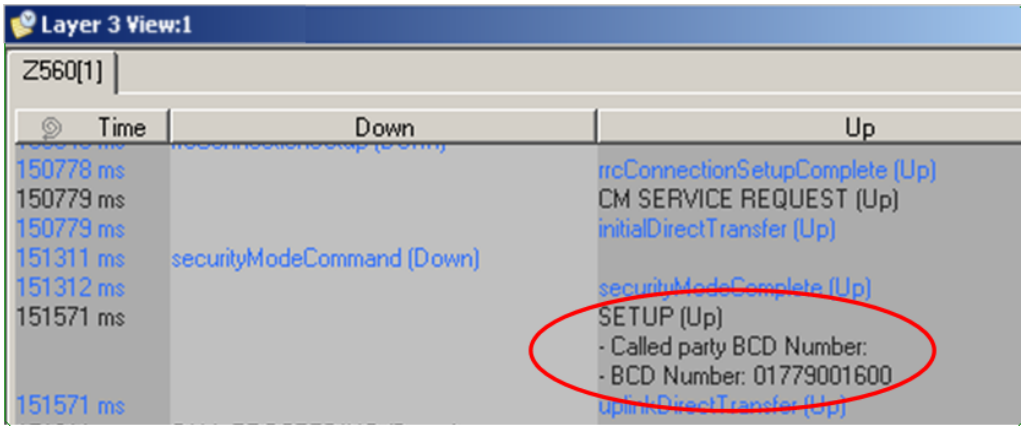


Figure 4-578: More details

It is possible to move elements from the "Detail Filter" directly into the "Layer 3 View" by drag and drop. The view automatically enables the detail filter and adds the filter. The filter is the selected item (in our example the BCD Number) in the details tree.

The "Details Filter" works per line. Only the line which contains the filter text is printed to the view. However, there are several layer 3 items, which hold the actual value in a lower hierarchy or the next line from the output's point of view. To add the following line to the filtered text, add a "+" to the filter text. The "+" is added automatically if the item is dragged and dropped from the "Details" window while the [Alt] key is pressed.

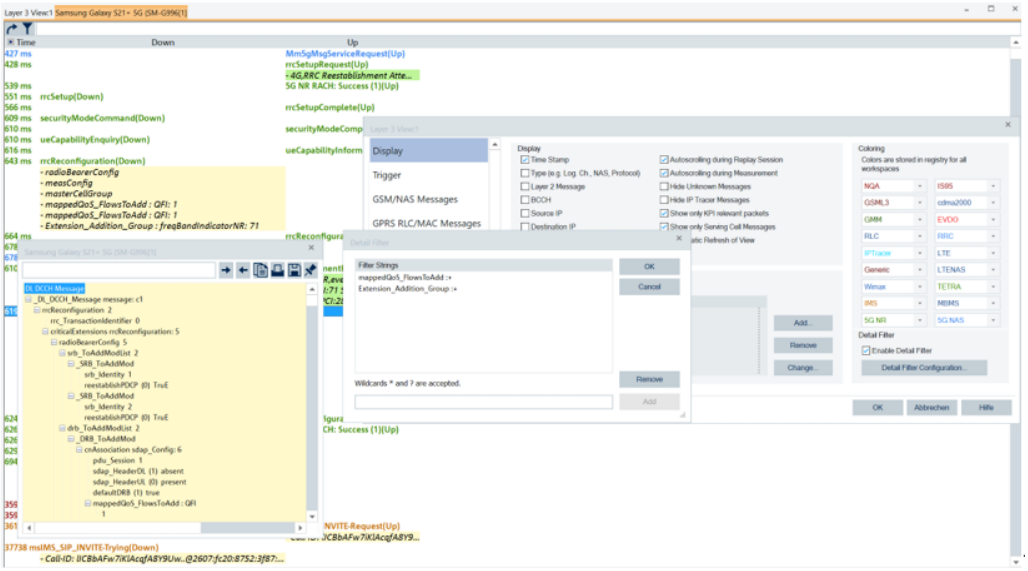
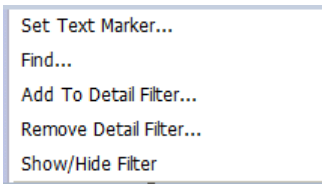


Figure 4-579: Adding lower hierarchy line

The previous screenshot shows the line "mappedQoS_FlowsToAdd" is followed by a "+" in the "Detail Filter". It is because the line in the "Details" window contains the QFI result 1 which is in the lower line.

The context menu of the "Layer 3 View" offers the command to remove the selected details.



The "Remove Detail Filter" entry of the menu only appears if the mouse cursor hovers over a detail item you want to remove and the detail filter is activated in the configuration.

If you select this option, R&S ROMES4 checks the currently active detail filters. If only one filter is matching the selected detail item, it is removed automatically. If more filters are matching the item, the "Details Filter" dialog opens. The matching detail item is preselected and you have to remove manually the item using the "Remove" button.

Trigger configuration

The "Trigger" tab controls the export of data during a replay session and defines the trigger for selecting a range of messages to be displayed.

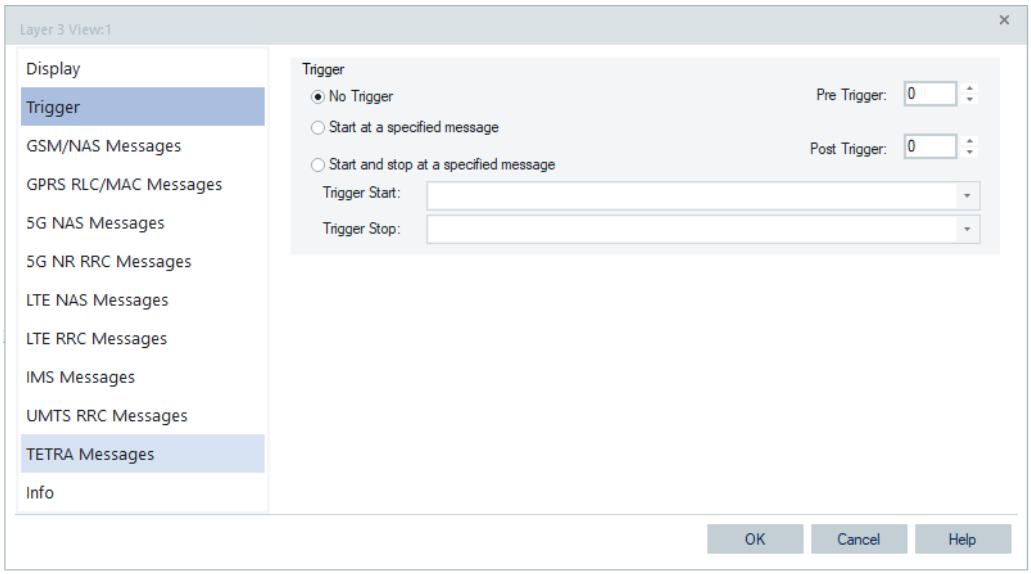


Figure 4-580: Layer 3 View - Trigger tab

Layer 3 Message Trigger

Instead of listing all messages of a given type recorded during the measurement, it is possible to select a range of messages:

- "No trigger"
  All messages recorded are displayed
- "Start at"
  Display starts when the first "Trigger Start" message is detected and continues until the end of the measurement
- "Start and stop"
  Display starts when the first "Trigger Start" message is detected and stops at the first Trigger Stop message
- "Trigger Start"
  Pull down list to select the message type triggering the start of the display
- "Trigger Stop"
  Pull down list to select the message type triggering the stop of the display
- "Pre Trigger"
  Number of messages displayed before the "Trigger Start" message
- "Post Trigger"
  Number of messages displayed after the "Trigger Stop" message

4.4.15.6 Layer 3 view messages

GSM/NAS messages

The "GSM/NAS Messages" tab selects the GSM/Non Access Stratum (NAS) layer 3 messages to be displayed.

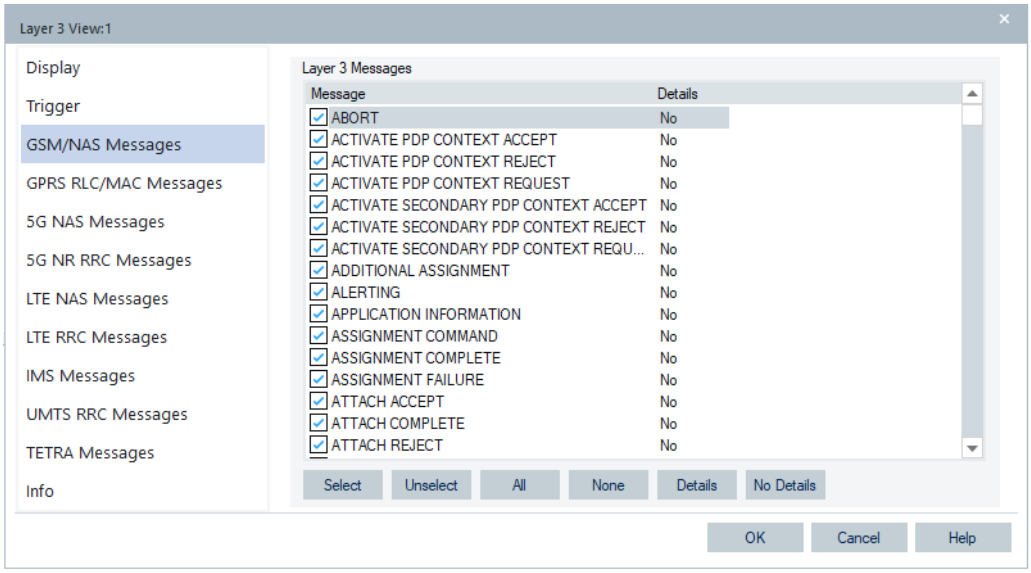


Figure 4-581: Layer 3 View - GSM/NAS messages

Message List
List of all Layer 3 message types defined in GSM/NAS. The second column of the table indicates whether the detailed information concerning a message type is displayed in the Layer 3 View.

- "Select"
  Displays the selected, highlighted message type (left-click) in the "Layer 3 View". As an alternative, the box on the left of the message type can be checked (left-click).
- "Unselect"
  Hides the selected, highlighted message type (left-click) in the "Layer 3 View". As an alternative, the box on the left of the message type can be cleared (left-click the checked box).
- "All"
  Display all layer 3 messages in the "Layer 3 View".
- "None"
  Display no layer 3 messages in the "Layer 3 View".
- "Details"
  Displays the detailed information concerning the selected message type in the "Layer 3 View" from where it can be printed.
- "No Details"
  Removes the detailed information from the "Layer 3 View" so that it cannot be printed. The detailed information can still be retrieved on screen by double-clicking an individual message.

Tip:

Details selected for display are included in an export file generated during a replay. See "Display configuration" on page 968.

Details selected for display are also included in an export file generated during a replay.

GPRS RLC/MAC messages

The "GPRS RLC/MAC Messages" tab selects the RLC/MAC control messages to be displayed.

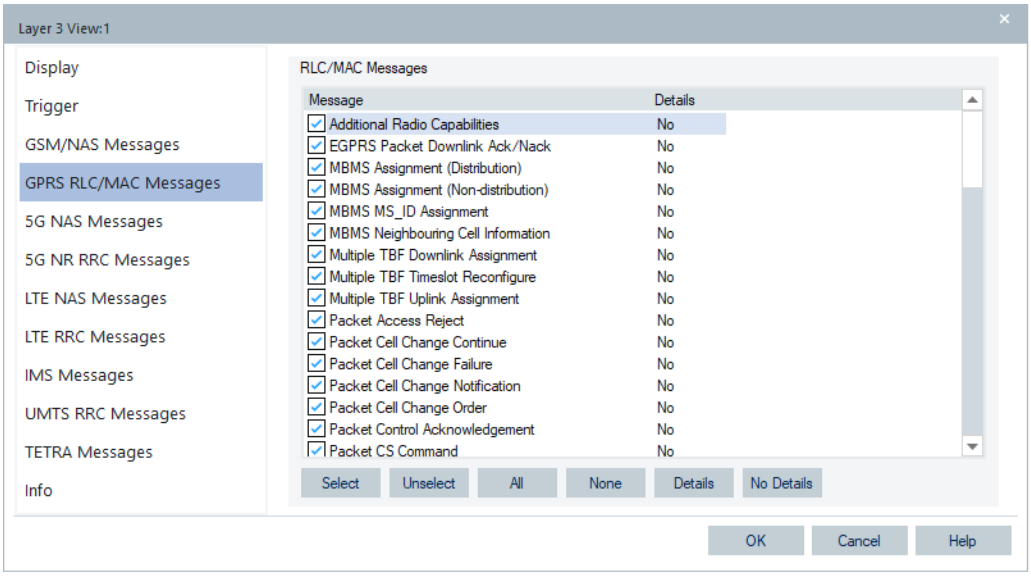


Figure 4-582: Layer 3 View - GPRS RLC/MAC messages

Message List
List of all RLC/MAC (Radio Link Protocol/Medium Access Control) control message types defined for GPRS. The second column of the table indicates whether the detailed information concerning a message type is displayed in the "Layer 3 View".

The buttons below the table are the same as in the "GSM/NAS Messages" tab.

5G NAS messages

The "5G NAS Messages" tab selects the 5G NR NAS control messages for display.

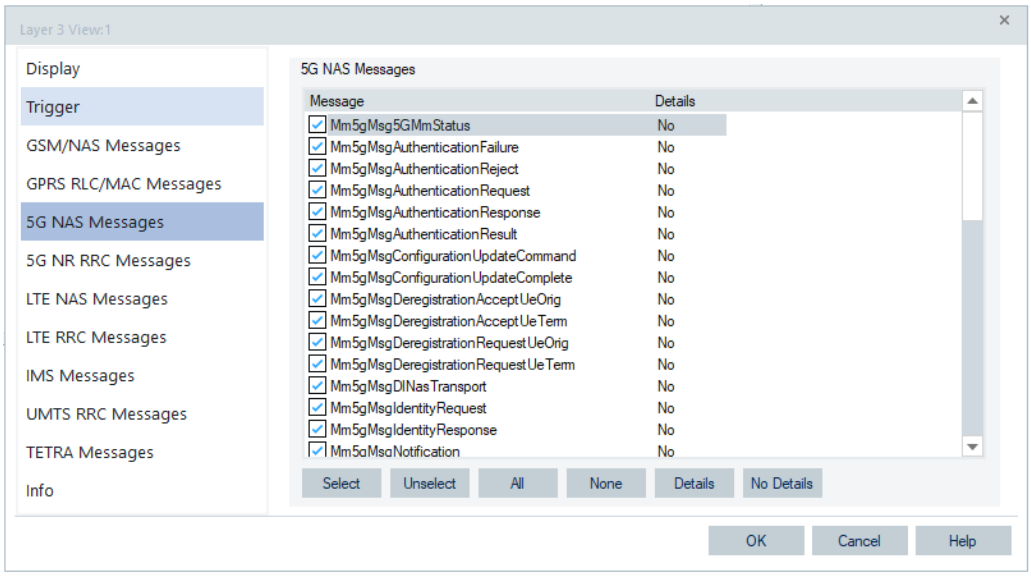


Figure 4-583: Layer 3 View - 5G NAS messages

The page is similar to all other message pages in the "Layer 3 View" configuration.

5G NR RRC messages

The "5G NR RRC Messages" page is similar to all other message pages in the "Layer 3 View" configuration.

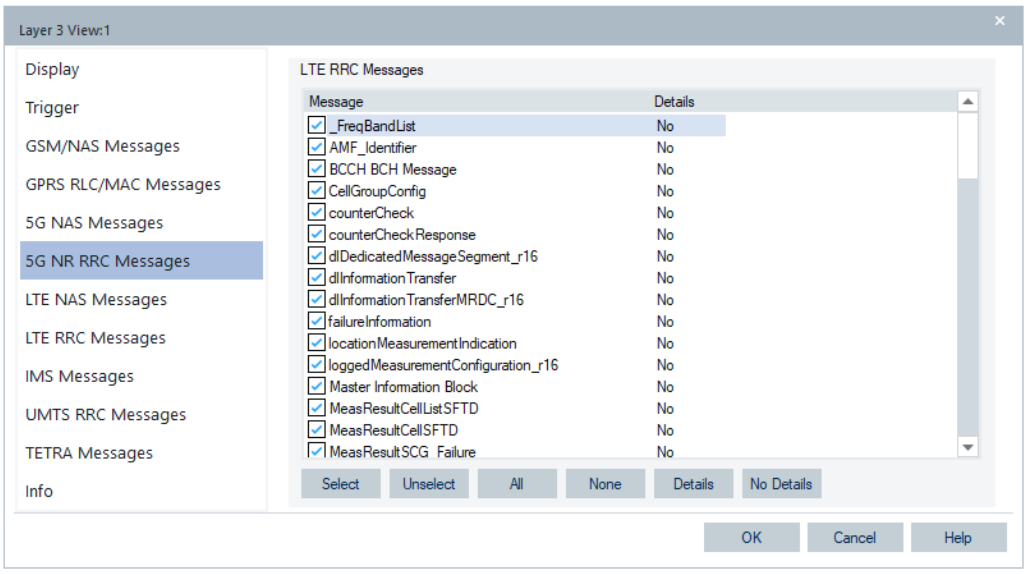


Figure 4-584: Layer 3 View - 5G NR RRC messages

The "rrcReconfiguration" message is followed by the first level of its content when 5G NR SA operation mode is used.

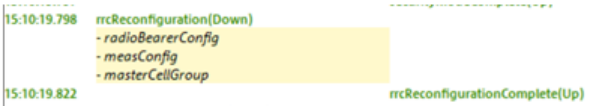


Figure 4-585: Available information in rrcReconfiguration message

The "systemInformation" message is followed by the contained SIBs in this mode.

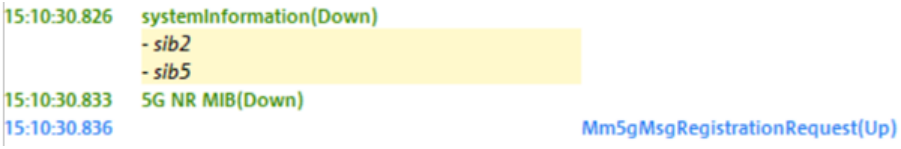


Figure 4-586: Available SIBs in systeminformation message

The message presentation complies with the presentation of the contents of the same Layer 3 message in LTE.

Layer 3 details of 5G scanner and 5G UE give an additional split interpretation to cell identity (0x1cfde00ac0) '000111001111110111100000000010101100'B. In SIB1 a cell identity is presented as [36Bit X/Y] (decimal) x/y. The default splitting is 28/8, but can be anything else, for example, 21/15 or 20/16.

LTE NAS messages

The "LTE NAS Messages" tab selects the LTE NAS control messages for display.

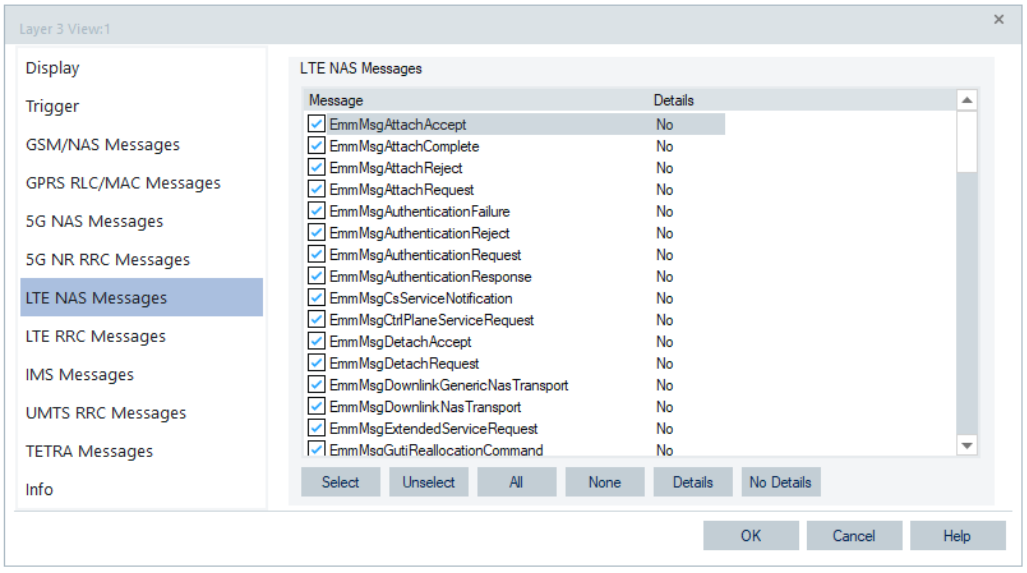


Figure 4-587: Layer 3 View - LTE NAS messages

The LTE NAS messages can be colored separately. Details of an LTE NAS message are displayed in a separate window if double-click the message.

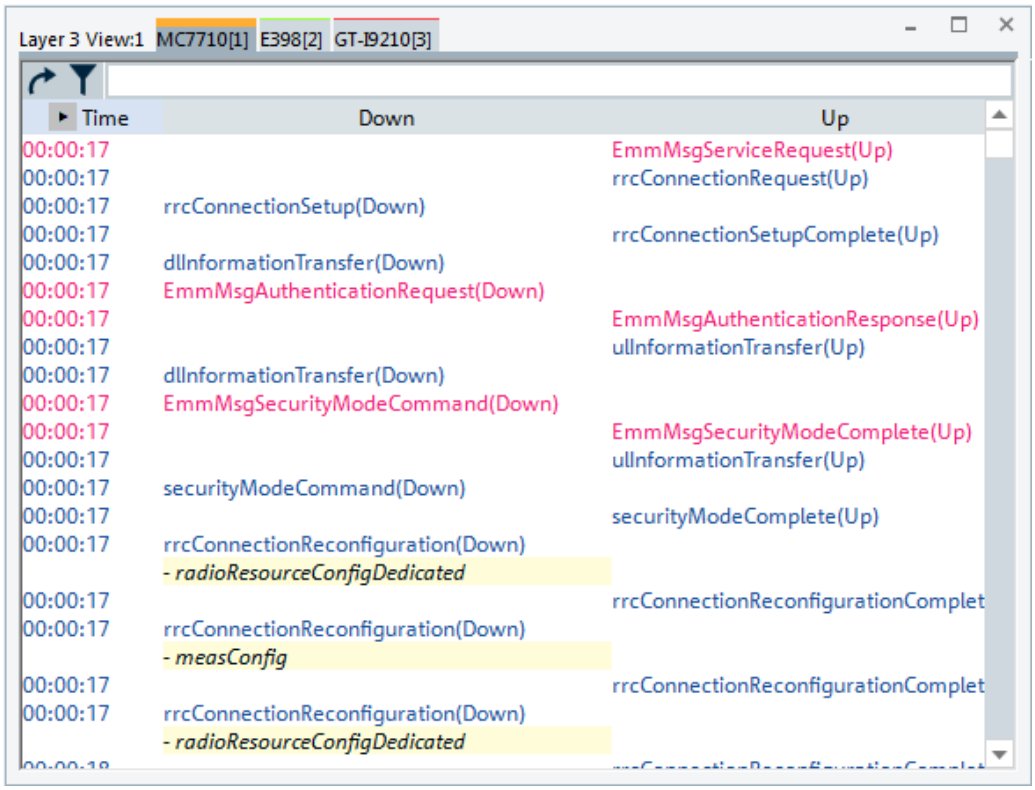


Figure 4-588: Layer 3 View - LTE NAS messages separately colored

Message List
List of all NAS control message types defined for LTE. The second column of the table indicates whether the detailed information concerning a message type is displayed in the "Layer 3 View".

The buttons below the table are the same as in the "GSM/NAS Messages" tab.

LTE RRC messages

The "LTE RRC Messages" tab selects the LTE RRC control messages to be displayed.

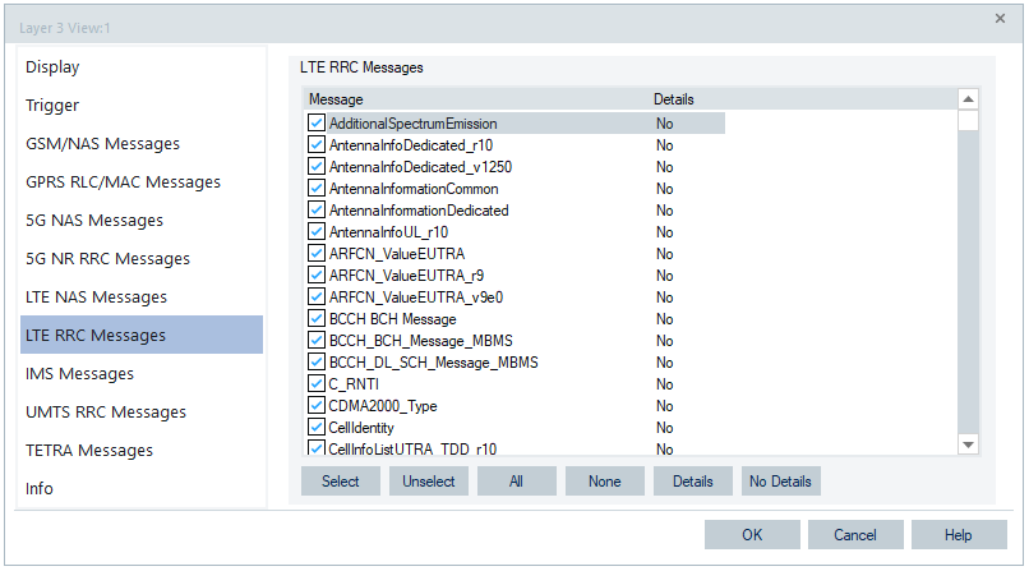


Figure 4-589: Layer 3 View - LTE RRC messages

Layer 3 details of LTE scanner and 4G UE give an additional split interpretation to cell identity (0x0142a920) '00010100001010101001000100000000'B. In SIB1 a cell identity is presented as [28Bit 20/8] (decimal) x/y. However, variable splitting is not supported in LTE. It is fix to 20/8.

Message List
List of all RRC (Radio Resource Control) message types defined for LTE. The second column of the list indicates whether the detailed information concerning a message type is displayed in the "Layer 3 View".

The buttons below the list are the same as in the "GSM/NAS Messages" tab.

IMS messages

The "IMS Messages" tab selects the IMS control messages to be displayed.

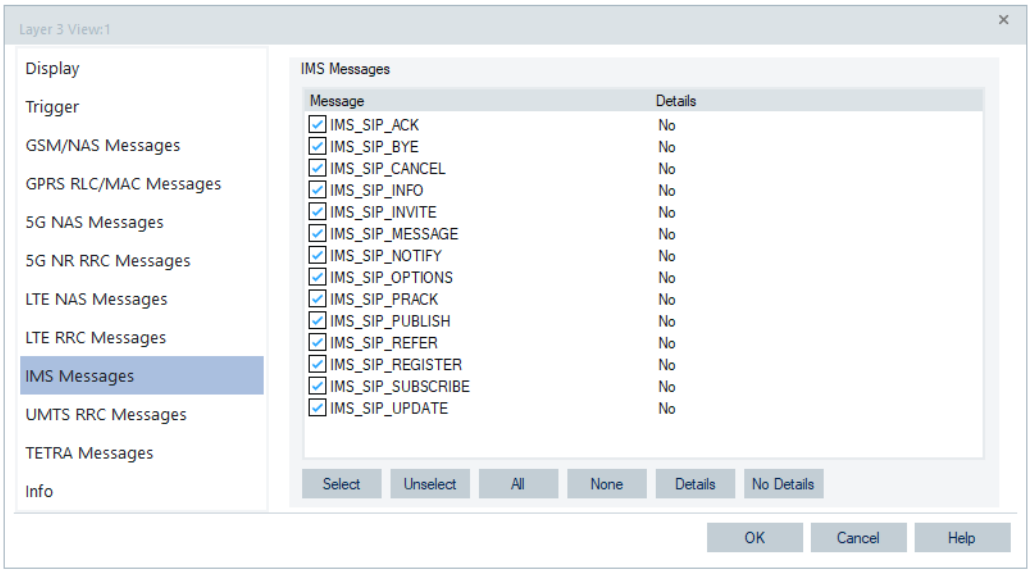


Figure 4-590: Layer 3 View - IMS messages

Details of an IMS message are displayed in a separate window if double-click the message.

Details of an IMS message are displayed in a separate window if double-click the message, see the following figure.

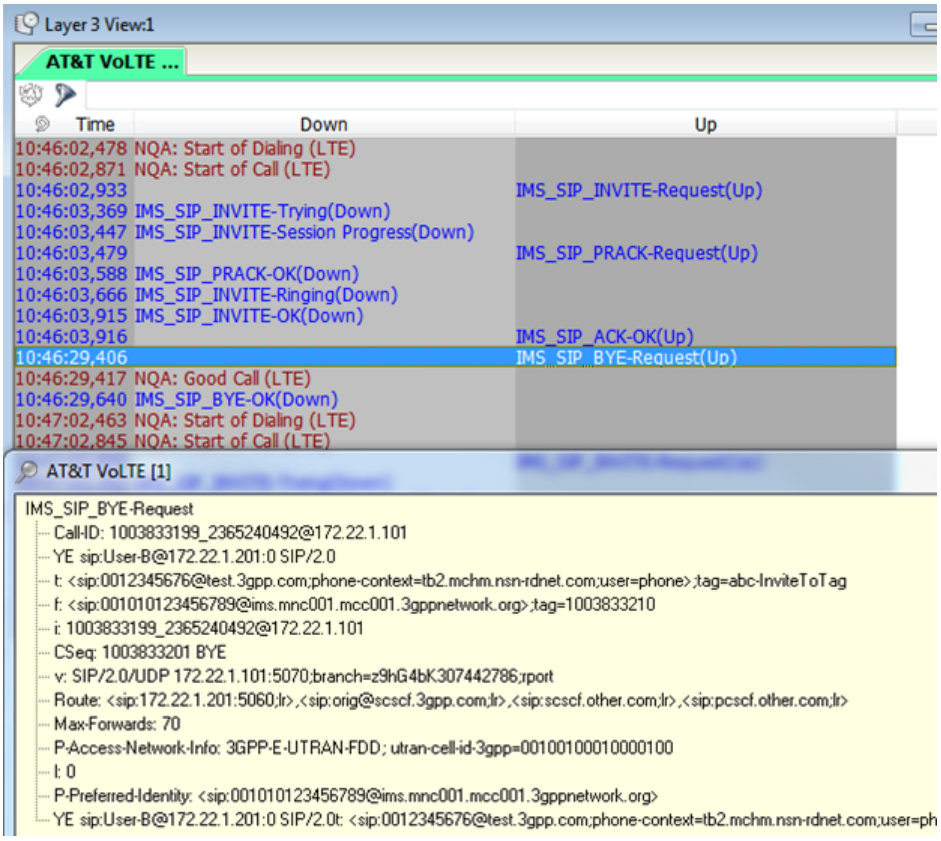


Figure 4-591: IMS message detail view

Message List
List of all IMS message types used for IP-based communication, like VoLTE. The second column of the list indicates whether the detailed information concerning a message type is displayed in the "Layer 3" view.

The buttons below the list are the same as in the "GSM/NAS Messages" tab.

UMTS RRC messages

The "UMTS RRC Messages" tab selects the UMTS RRC control messages to be displayed.

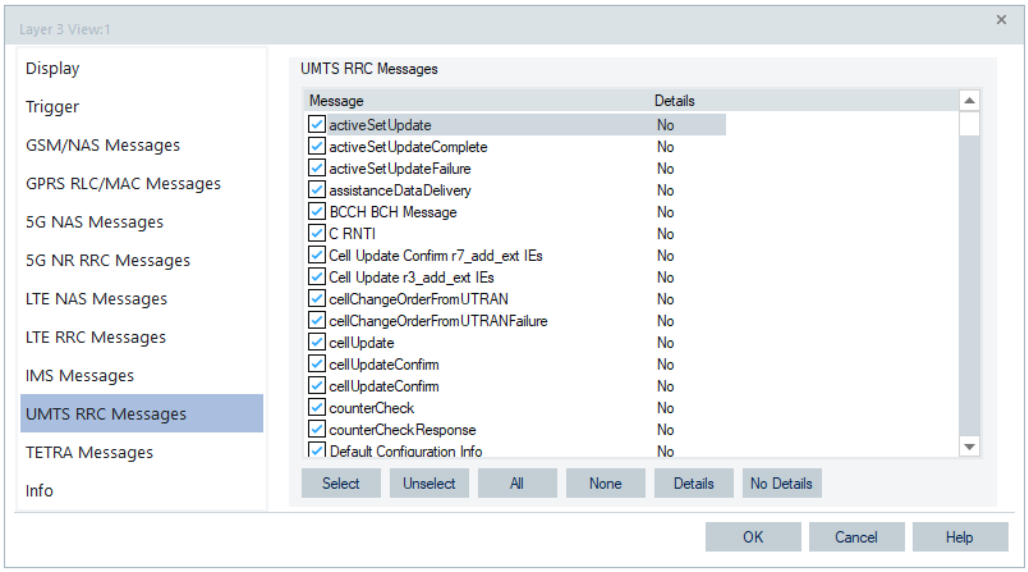


Figure 4-592: Layer 3 View - UMTS RRC messages

Message List
List of all RRC (Radio Resource Control) message types defined for UMTS. The second column of the list indicates whether the detailed information concerning a message type is displayed in the "Layer 3 View".

The buttons below the list are the same as in the "GSM/NAS Messages" tab.

TETRA messages

The "TETRA Messages" tab selects the TETRA messages to be displayed.

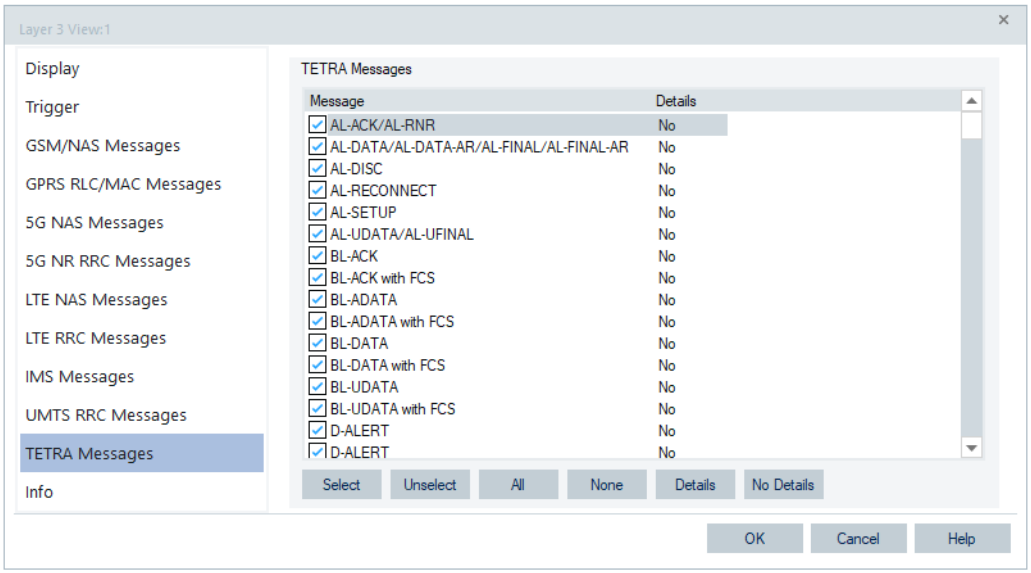


Figure 4-593: Layer 3 View - TETRA messages

Message List
List of all defined TETRA control message types. The second column of the table indicates whether the detailed information concerning a message type is displayed in the "Layer 3 View".

The buttons below the table are the same as in the "GSM/NAS Messages" tab, see "GSM/NAS messages" on page 975.

4.4.15.7 Layer 3 measurement reports

5G NR measurement reports

The "Layer 3 View" shows the 5G NR NAS messages beneath the 5G NR RRC messages. The messages are 5G Mobility Management and 5G Session Management messages.

The 5G NR NAS messages are colored according to the coloring configuration. Double-click a message to get the decoded Layer 3 details in a separate window.

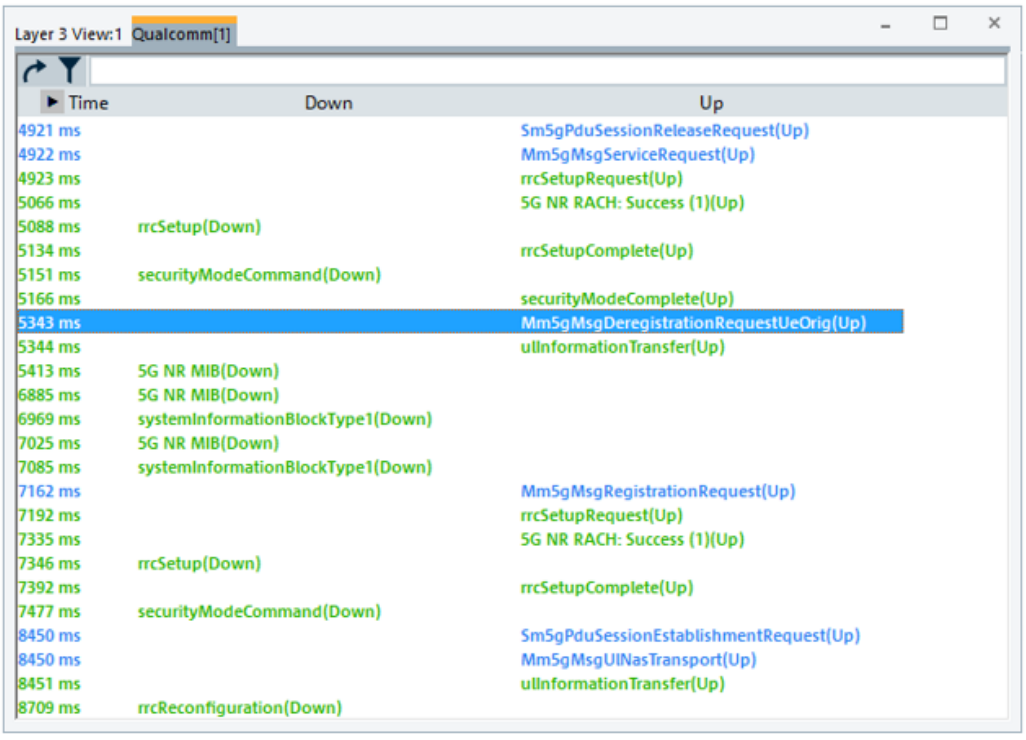


Figure 4-594: 5G NR Layer 3 messages

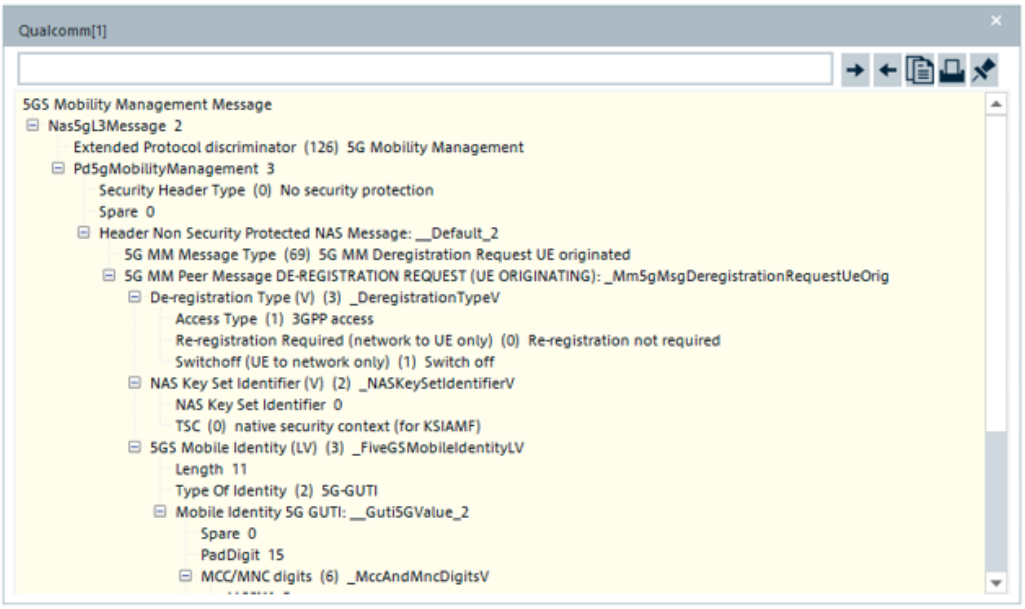


Figure 4-595: Details of selected message

The ciphered messages cannot be decoded. In this case, the ciphered data stream is printed.

5G NR measurement report events

The R&S ROMES4 5G NR UE events are available for reporting if triggered by the corresponding 3GGP events.

An 3GGP 5G NR event setup is done in the event branch "5G NR UE Events" > "RRC Measurement Events" within the "Available Events" dialog.

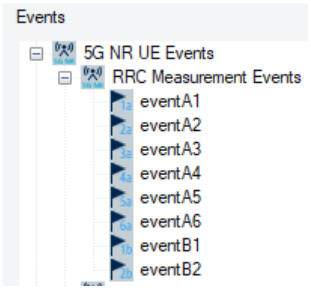


Figure 4-596: RRC measurement events

Activated the events before the start of the measurement, respectively before loading the measurement file for replay.

R&S ROMES4 decodes the Layer 3 message flow in such a way, that the result of 3GPP events is shown directly in the Layer 3 View, apart from being shown in the "Event View".

Figure 4-597: Example - measured event A3

The corresponding RRC reconfiguration message is contained in the measurement file.

LTE measurement reports

The LTE measurement report is referred to a specific measurement ID. To find out what is the actual measurement object and the report configuration responsible for the measurement report identified with an ID, R&S ROMES4 offers the Layer 3 View's detailed window.

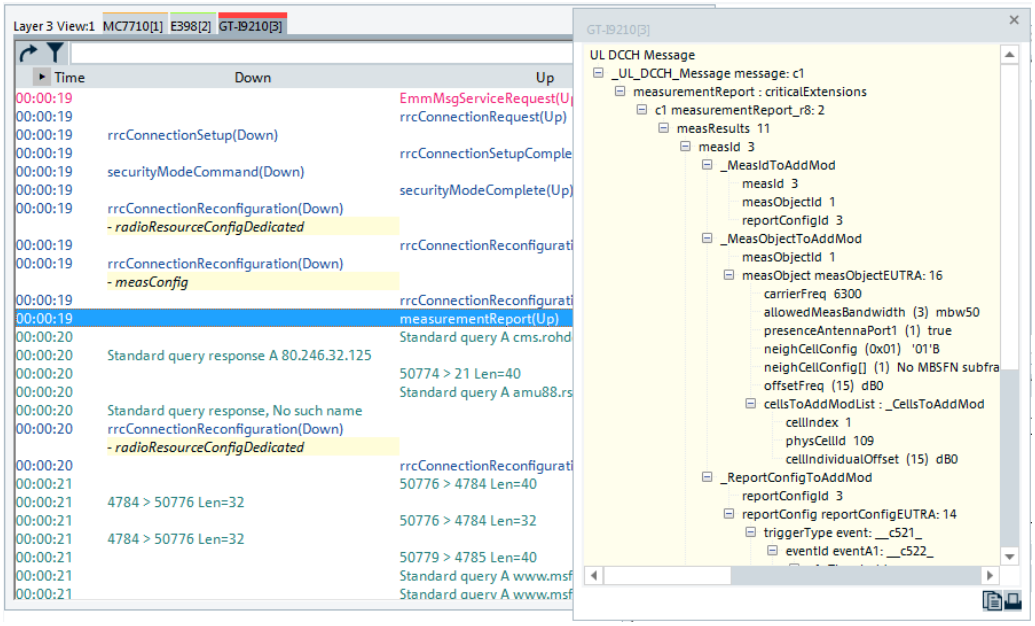


Figure 4-598: LTE Layer 3 detailed view

The "Layer 3 View" displays several eMBMS/Flute messages during the eMBMS session and also makes them visible in the mentioned details view.

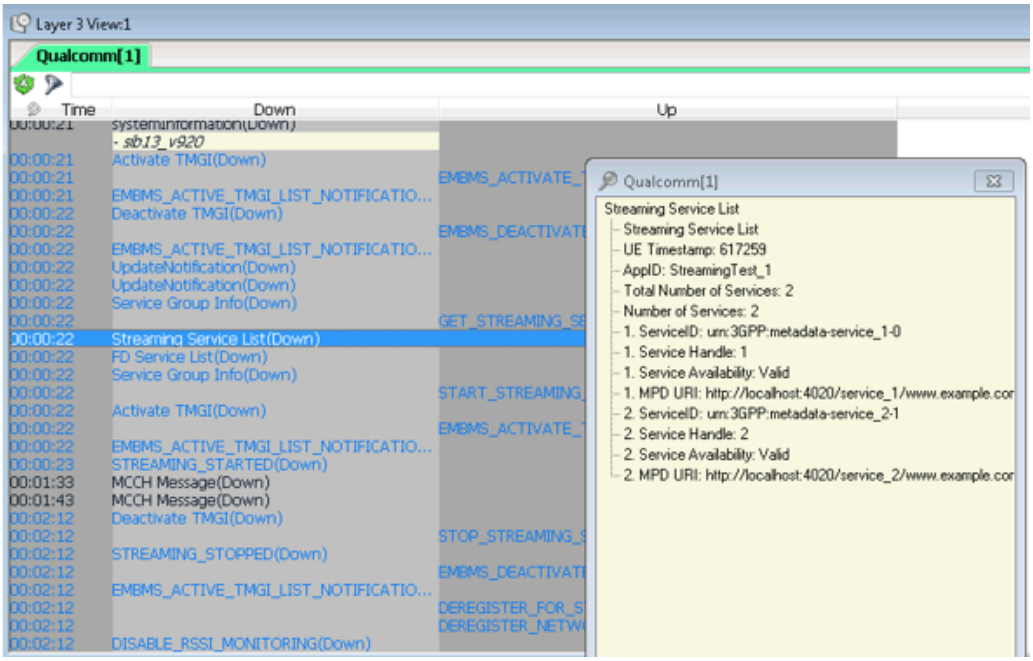


Figure 4-599: LTE Layer 3 detailed view - eMBMS session

It is also possible to add the event detail information to the "Layer 3 View" by using the Layer 3 detail filter. The filter can be configured by moving the corresponding detail element from the detail window to the "Layer 3 View" or by specifying the elements in the configurations dialog.

1. Click any point in the Layer 3 View to get the context-sensitive menu. Select the "Configuration" entry.

   The Layer 3 View "Display" window pops-up.

2. Click the "Detail Filter Configuration" button.

   The "Detail Filter" window pops-up.

3. Select the event from the detail window.

4. Click "OK" to move it to the Layer 3 View.

   The selected detail events are now inserted in the LTE Layer 3 View.

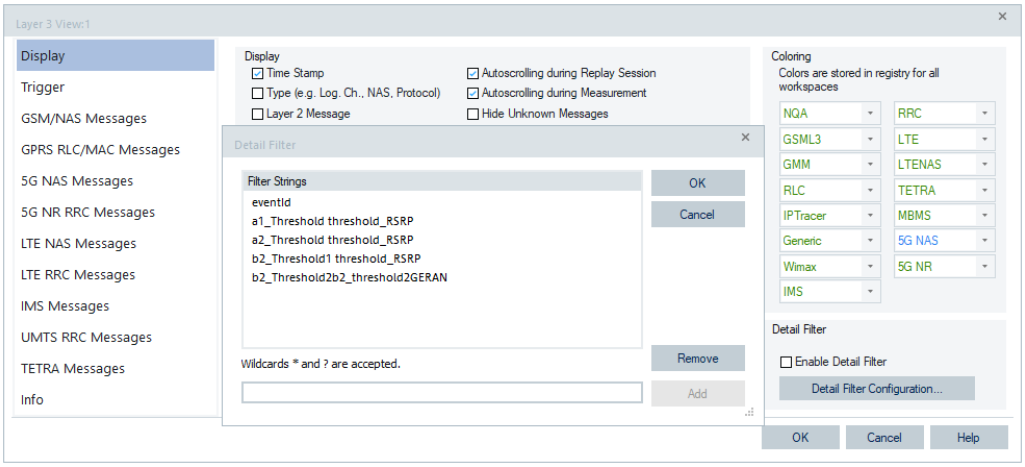


Figure 4-600: Inserting event details into the Layer 3 View

The event for measurement report has different icons for different events. The Tooltip includes the event-specific information which, as a kind of LTE event, has triggered the measurement report.

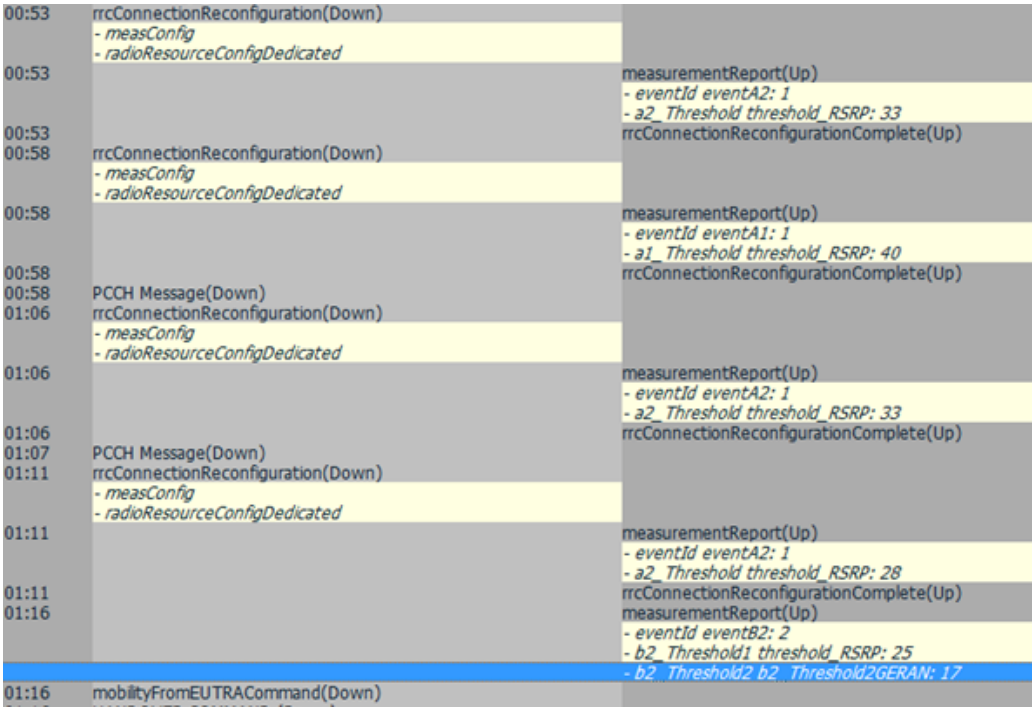


Figure 4-601: Inserted events

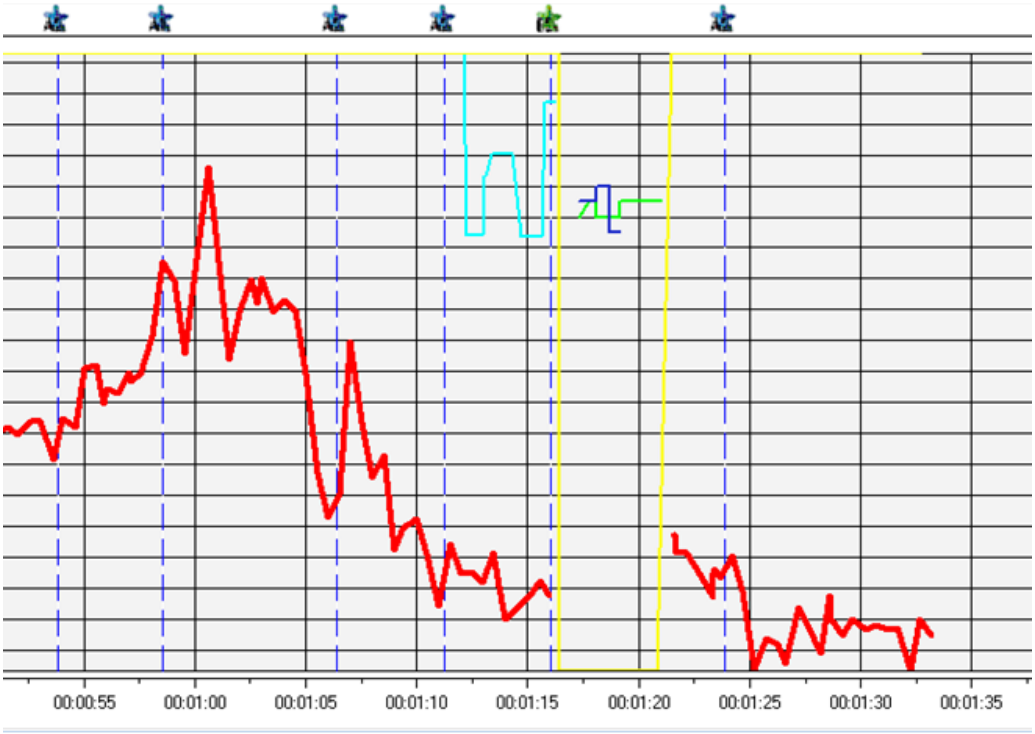


Figure 4-602: Diagram of inserted events

LTE measurement report events

The R&S ROMES4 LTE UE events are available for reporting if triggered by the corresponding 3GGP events.

An 3GGP LTE event setup is done in the event branch "LTE UE Events" > "RRC Measurement Events" within the "Available Events" dialog.

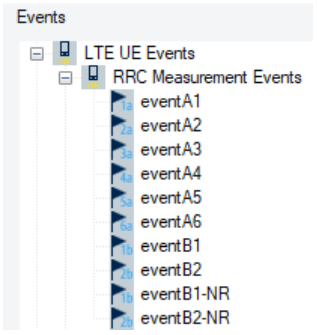


Figure 4-603: RRC measurement events

Activate the events before the start of the measurement, respectively before loading the measurement file for replay.

R&S ROMES4 decodes the Layer 3 message flow in such a way, that the 3GPP event results are shown directly in the Layer 3 View, apart from being shown in the "Event View".

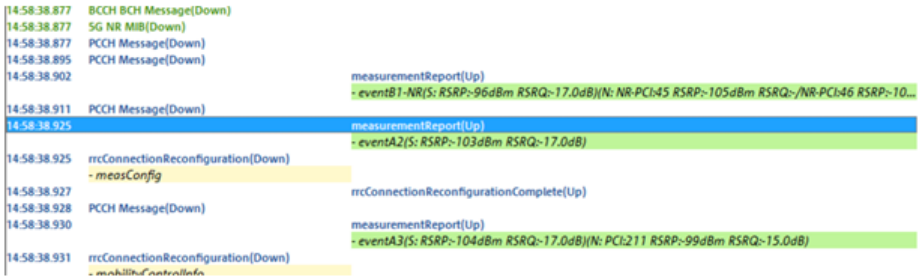


Figure 4-604: Example - measured event A2

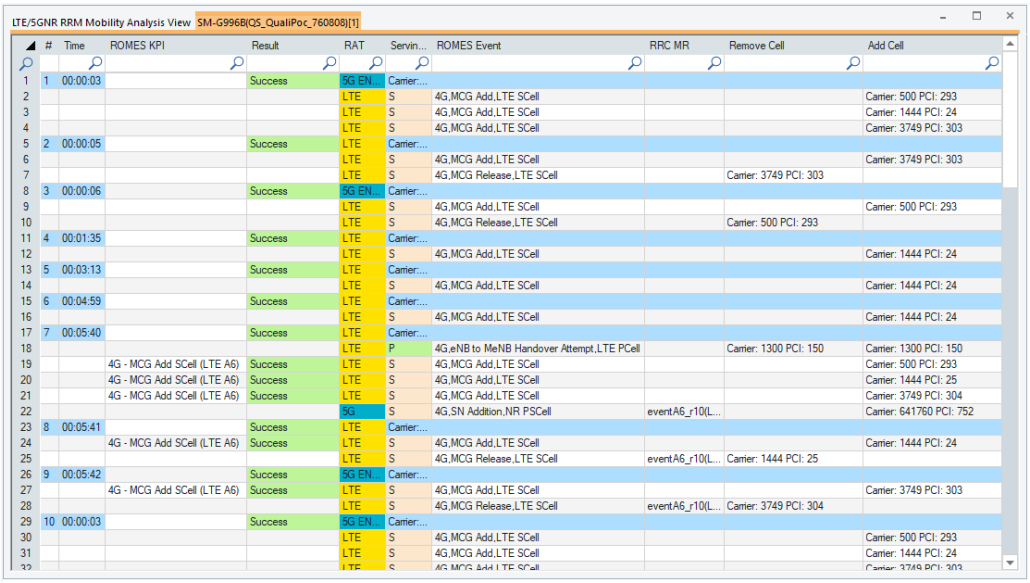
The corresponding RRC reconfiguration message is contained in the measurement file.

4.4.16 LTE/5GNR RRM mobility analysis view

R&S ROMES4 offers an analyzer which allows you to get insights into the LTE/5GNR mobility events quick and easy and helps to identify and improve LTE/5GNR mobility issues.

The "LTE/5GNR RRM Mobility Analysis View" has a grid layout and the grid cells information text can be marked and highlighted with colors. For the grid view handling, see Chapter 4.1.8, "Extended grid view", on page 432.

The view supports coupled focus. Triggered by a mobility event procedure of this view, the "Layer 3 View" synchronizes to the start timestamp of the event. It marks the timestamp column blue for the duration of the event in the view.



#	Time	ROMES KPI	Result	RAT	Servin...	ROMES Event	RRC MR	Remove Cell	Add Cell
1	00:00:03		Success	5G EN...	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 500 PCI: 293
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 24
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 3749 PCI: 303
2	00:00:05		Success	LTE	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 3749 PCI: 303
				LTE	S	4G,MCG Release,LTE SCell		Carrier: 3749 PCI: 303	
3	00:00:06		Success	5G EN...	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 500 PCI: 293
				LTE	S	4G,MCG Release,LTE SCell		Carrier: 500 PCI: 293	
4	00:01:35		Success	LTE	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 24
5	00:03:13		Success	LTE	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 24
6	00:04:59		Success	LTE	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 24
7	00:05:40		Success	LTE	Carrier:...				
				LTE	P	4G,eNB to MeNB Handover Attempt,LTE PCell		Carrier: 1300 PCI: 150	Carrier: 1300 PCI: 150
		4G - MCG Add SCell (LTE A6)	Success	LTE	S	4G,MCG Add,LTE SCell			Carrier: 500 PCI: 293
		4G - MCG Add SCell (LTE A6)	Success	LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 25
		4G - MCG Add SCell (LTE A6)	Success	LTE	S	4G,MCG Add,LTE SCell			Carrier: 3749 PCI: 304
				5G	S	4G,SN Addition,NR PSCell	eventA6_r10(L...		Carrier: 641760 PCI: 752
8	00:05:41		Success	LTE	Carrier:...				
		4G - MCG Add SCell (LTE A6)	Success	LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 24
				LTE	S	4G,MCG Release,LTE SCell	eventA6_r10(L...	Carrier: 1444 PCI: 25	
9	00:05:42		Success	5G EN...	Carrier:...				
		4G - MCG Add SCell (LTE A6)	Success	LTE	S	4G,MCG Add,LTE SCell			Carrier: 3749 PCI: 303
				LTE	S	4G,MCG Release,LTE SCell	eventA6_r10(L...	Carrier: 3749 PCI: 304	
10	00:00:03		Success	5G EN...	Carrier:...				
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 500 PCI: 293
				LTE	S	4G,MCG Add,LTE SCell			Carrier: 1444 PCI: 24

Figure 4-605: LTE/5GNR RRM Mobility Analysis View - example

The configuration file `5GEventConfig.xml` is not supported.

To navigate through the view perform the following:

- Select a cell in the grid.

- Use the arrow keys to move a line up or down.

- If you press the control key, the selection is the next/previous line with the same content in the column of the selected cell as the selected cell has.

- If you press the shift key, the selection is the next/previous line with a non empty cell in the column of the selected cell.

4.4.16.1 Approach to RRM procedures performance analysis

The support of combination of two RATs (LTE and 5G NR) and several different bands to achieve high capacity and wide area coverage requires state-of-the-art 5G-4G network solution. These assets together with a mobile operator's goal to offer a customer required quality experience, impose permanent RRM performance monitoring and optimization.

RRM performance must be in focus at the operations department and constantly optimized, and monitored for problems through the troubleshooting.

The R&S ROMES4 KPIs and Smart Event help that these tasks are done easier and quicker.

A KPI set and the events related to RRC connection control and mobility procedures of LTE, 5G EN-DC, NR are defined in accordance to some requirements. The require-

ments are to define KPIs which are considered as the important indicators of the high network performance quality.

The solution is relaying on setting the high network-wide goals for the KPI success rates and to analyze the cases and the situations where they are not met.

The following chapter gives the closer look to some problematic situations that are subjects of such analysis tasks.

4.4.16.2 RRM procedures problem analysis

Measurement reporting problem

In LTE and NR technologies there is no need to transmit the neighbor cell list to the UEs via RRC signaling. The UEs are able to detect cells on the measured frequencies. This detection capability is confirmed from the measurement in the life networks. The RRC measurement configuration rarely contains any cell identity information to force or prevent measurement on specific cells. However, such an option exists for LTE and NR and is used in some networks.

In the UE measurement report is visible if it reports cells with their PCI. From RAN perspective, it is required that neighbor cell relations are uniquely identified in each eNB/gNB cell. In that way only a source cell can address the correct target cell on the control signaling interface between the nodes within the RAN. Therefore, the CGI is needed in neighbor cell relation table of an eNB/gNB cell. The optimization principle is that an eNB/gNB cannot have too many cells in the table but also not too few.

The ANR feature is the common solution to automate the neighbor cell list management in LTE and NR. When the UE reports a neighbor cell PCI that is not defined as a neighbor, the eNB/gNB updates the measurement configuration. In the updated configuration it requests the UE to measure specifically this PCI, decode the broadcasted cell information from SIB1 and report back the CGI. The reported CGI is sufficient to add the cell into the neighbor cells table.

UEs need a larger idle gap in the channel frame structure to have time to decode the SIB1 compared to measurement gap for normal reference signal measurement. This type of measurements has not to be configured too often. Otherwise, it turns into a tradeoff between intensity of the ANR function to invoke RRC measurements with CGI requests and the throughput in a serving cell.

There are many EN-DC networks that do not broadcast SIB1 on the NR cells and then the UE cannot report the CGI to the ANR. Without support of ANR the EN-DC NR neighbor cell table optimization needs more manual work, just like in the past with 2G and 3G networks.

Missing neighbor problems are one of the most common root causes for dropped calls and bad connection quality. If the UE sends measurement reports to the primary cell, reporting a good neighbor cell and there is no response from the eNB/gNB, the UE most probably drops its connection. The cause of dropped connection is bad signal quality. The UE initiates then the RRC Reestablishment procedure.

The previous case is a sign that the cell relation to this neighbor cell is not defined in the primary cell. There are also other potential reasons, for example if the neighbor cell has too high traffic load currently.

R&S ROMES4 can easily detect the situations where there is no response to the UE measurement report. Searching for the KPI 'No MR Response' it quickly identifies if such problem occurs. This KPI is supported both for LTE and NR.

The following screenshot shows such a case for LTE.

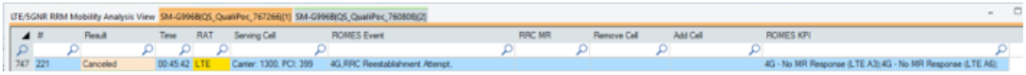


Figure 4-606: Problem - No MR response

KPI helps to find the problem. The decoded RRC MR events help to understand the problem. The following screenshot shows that a neighbor cell with PCI 400, which is reported by event A3, has much better cell quality than the serving one. Nevertheless, there is no handover triggered by the eNB.

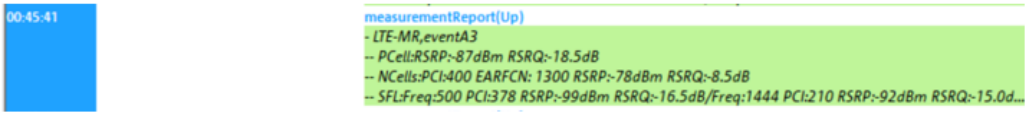


Figure 4-607: Measurement report of event A3

Connectivity problem

MR-DC operation has an advantage that the primary cells of master and secondary cell groups do not have to be collocated, that is, to be installed on the same antenna site.

However it is a challenge for the coverage. If the cell groups use different frequency bands, the resulting coverage layers do not always overlap. If the layers do not overlap, there are areas where the connection to the secondary cell group is bad. In that case there is no any advantage to utilize the cell groups in a DC connection.

In EN-DC networks various types of failures can happen at secondary node (SN) addition or SN change. The failures often indicate the problem areas for using DC. To find out if and where these problems occur, search for KPI results 'Failed'. Narrow down then the selection to SN addition or SN change.

The following screenshot shows an example of the SN change connectivity problem. The SN change from PCI 334 to 582 fails.

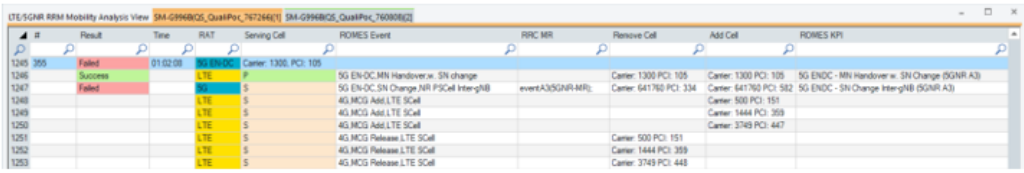


Figure 4-608: Problem - SN Change Inter-gNB

If UE cannot perform the RRC SCG configuration, it sends an SCG failure information message to inform the MCG PCell. There can be various failure causes and the UE indicates failure in the RRC message.

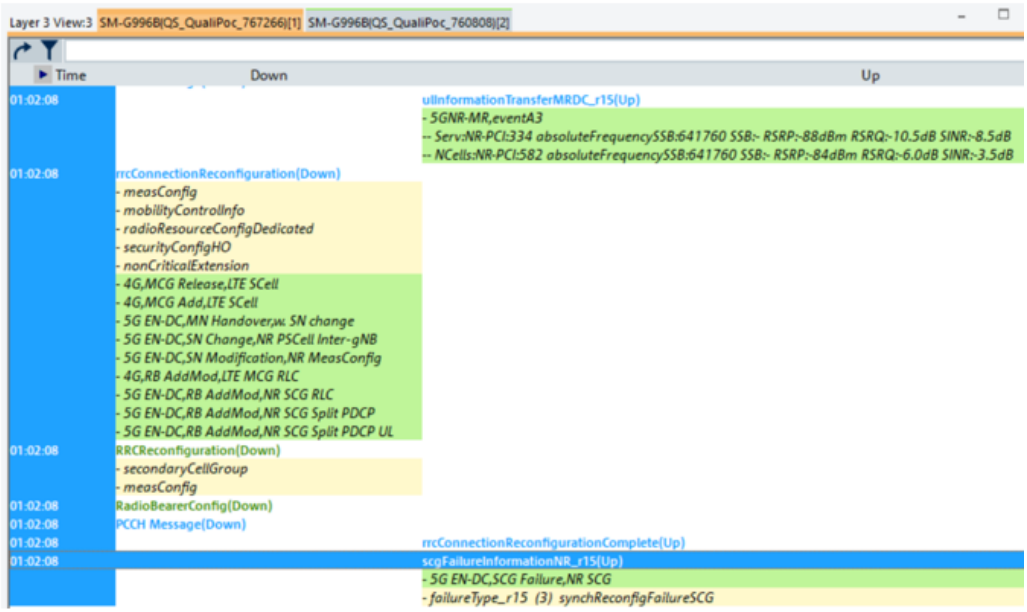


Figure 4-609: Layer 3 view shows synchronization failure

The previous screenshot shows a SynchReconfigFailure and indicates that initial cell synchronization failed, that is, detection and decoding of SS/PBCH block on PCI 582 failed.

Mobility problems

RRM solutions of different network equipment manufacturers show variety of used measurement report events to trigger connection control and mobility actions. In general, the following summary applies to any LTE and NR network:

- LTE and NR event A3, A4 and/or A5 report a better neighbor cell on serving cell frequencies. These events trigger RAN to take a handover decision where the PCell is changed to the reported neighbor.
- LTE event A6 reports better neighbor cell measured on serving SCell frequencies (CA case). The event triggers RAN to take a decision to change SCell.
- LTE event B1-NR and/or B2-NR are used to report an NR cell- They trigger RAN to take a decision to change operation mode to EN-DC and add the NR cell.
- NR event B1 and/or B2 are used to report an LTE cell. They trigger NR RAN to take a decision to perform an IRAT handover to LTE.

The commonality of the LTE and NR MR events is the set of parameters for threshold, hysteresis and offsets. These parameters define the cell quality conditions that the actual cell reference signal measurements are compared against.

The MR events have also the parameters time-to-trigger, report interval and the report amount. These parameters define when to trigger a report and how often to repeat it when the conditions are fulfilled.

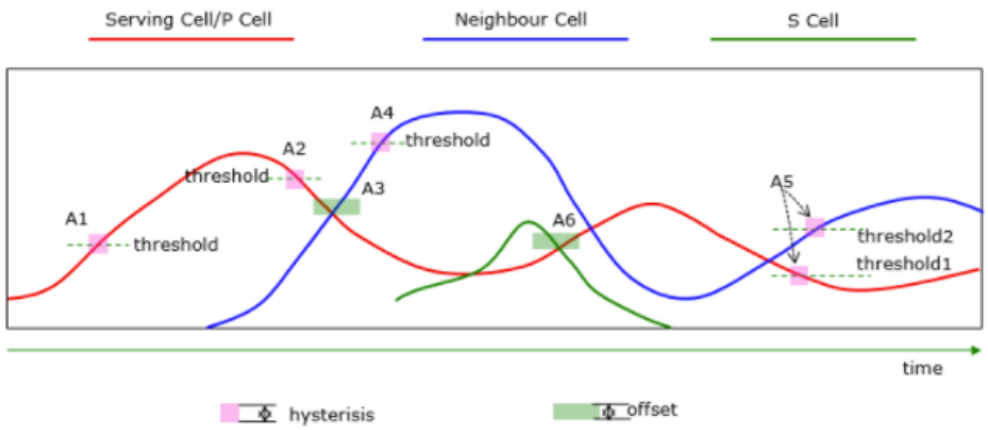


Figure 4-610: LTE multi-cell measurement

A common optimization principle is to reduce the number of unnecessary handovers. A high frequency of handovers increases the processing load in the network. The load on the signaling interfaces is also increased that can have impact on quality and traffic capacity of the mobile system. A typical case is the ping-pong handover where the UE is repeatedly handed over between same cells.

The following screenshot shows an example for EN-DC. In this example, the LTE Cell (MCG PCell) is switching between PCI 444 and 165 and the NR Cell (SCG PSCell) is switching between PCI 43 and 400.

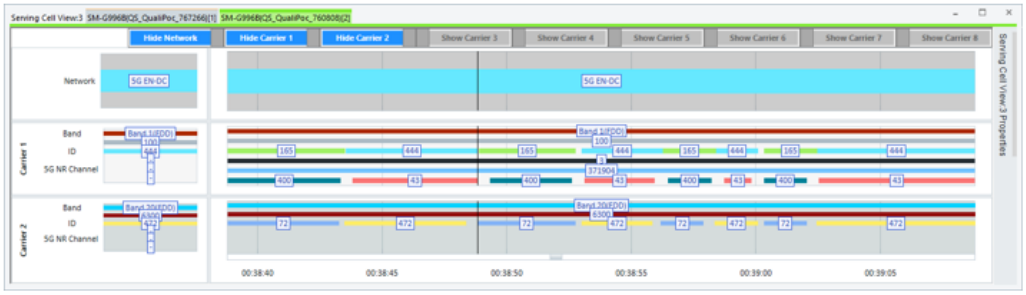


Figure 4-611: Problem - ping-pong handover in EN-DC

The figure Figure 4-605 showing the "LTE/5GNR RRM Mobility Analysis View" page also shows the previously mentioned sequence. The MR event A3 triggers the LTE handovers with SN change KPIs. A solution to this ping-pong problem is to optimize the A3 parameters, for example, to configure specific offset between these LTE cells.

4.4.16.3 KPIs for LTE/5G NR RRC connection control and mobility procedures

The following table contains the R&S ROMES4 supported KPIs for LTE and 5G NR RRC connection control and mobility procedures. The KPIs are based on the events related to 5G NR IRAT mobility and 5G NR CA/DC cell configurations. The events are shown in the "LTE UE and 5G NR UE events" on page 245.

KPI name	RAT	Description
4G - Handover (LTE A3)	LTE	LTE PCell intra-frequency handover triggered by LTE MR event A3
4G - IF Handover (LTE A3)	LTE	LTE PCell inter-frequency handover triggered by LTE MR event A3
4G - MCG Handover (LTE A3)	LTE CA	LTE PCell intra-frequency handover with SCell configuration (CA) triggered by LTE MR event A3
4G - MCG IF Handover (LTE A3)	LTE CA	LTE PCell inter-frequency handover with SCell configuration (CA) triggered by LTE MR event A3
4G - IF Handover (LTE A4)	LTE	LTE PCell inter-frequency handover triggered by LTE MR event A4
4G - MCG IF Handover (LTE A4)	LTE CA	LTE PCell inter-frequency handover with SCell configuration (CA) triggered by LTE MR event A4
4G - IF Handover (LTE A5)	LTE CA	LTE PCell inter-frequency handover triggered by LTE MR event A5
4G - MCG IF Handover (LTE A5)	LTE CA	LTE PCell inter-frequency handover with SCell configuration (CA) triggered by LTE MR event A5
4G - MCG Add SCell(LTE A6)	LTE CA	LTE MCG addition of SCell triggered by LTE MR event A6_r10
4G - eNB to MeNB Handover (LTE B1-NR)	LTE/LTE CA	LTE PCell reconfiguration with handover to 5G ENDC triggered by LTE MR eventB1-NR-r15
4G - eNB to MeNB Change (LTE B1-NR)	LTE/LTE CA	LTE PCell reconfiguration to 5G ENDC triggered by LTE MR eventB1-NR-r15
5G ENDC - MeNB to eNB Handover (LTE A3)	LTE-5G ENDC	MN LTE PCell reconfiguration with handover from 5G ENDC to LTE triggered by LTE MR event A3
5G ENDC - MeNB to eNB Change	LTE-5G ENDC	MN LTE PCell reconfiguration from 5G ENDC to LTE
5G ENDC - MN Handover w. SN Change (LTE A3)	LTE-5G ENDC	MN LTE PCell handover with SN 5G NR PSCell change triggered by LTE MR event A3
5G ENDC - MN Handover w. SN Change (5GNR A3)	LTE-5G ENDC	MN LTE PCell handover with SN 5G NR PSCell change triggered by 5G NR MR event A3
5G ENDC - MN Handover w/o SN Change (5GNR A3)	LTE-5G ENDC	MN LTE PCell handover without SN 5G NR PSCell change triggered by 5G NR MR event A3
4G - SN Addition NR PSCell (LTE B1-NR)	LTE/LTE CA	SN addition of 5G NR PSCell triggered by LTE MR eventB1-NR-r15

KPI name	RAT	Description
5G ENDC - SN Re-Addition NR PSCell (LTE B1-NR)	LTE-5G ENDC	SN (re-)addition of 5G NR PSCell triggered by LTE MR eventB1-NR-r15 when already in 5G ENDC
5G ENDC - SN Re-Addition NR PSCell (LTE A3)	LTE-5G ENDC	SN (re-)addition of 5G NR PSCell triggered by LTE MR eventA3 when already in 5G ENDC
5G ENDC - SN Re-Addition NR PSCell (5GNR A3)	LTE-5G ENDC	SN (re-)addition of 5G NR PSCell triggered by 5GNR MR eventA3 when already in 5G ENDC
5G ENDC - SN Change Inter-gNB (LTE A3)	LTE-5G ENDC	SN Inter-gNB change of 5G NR PSCell triggered by LTE MR event A3
5G ENDC - SN Change Inter-gNB (5GNR A3)	LTE-5G ENDC	SN Inter-gNB change of 5G NR PSCell triggered by 5G NR MR event A3
5G ENDC - SN Change Intra-gNB (5GNR A3)	LTE-5G ENDC	SN Intra-gNB change of 5G NR PSCell triggered by 5G NR MR event A3
5G ENDC - SN Change Intra-gNB (5GNR A4)	LTE-5G ENDC	SN Intra-gNB change of 5G NR PSCell triggered by 5G NR MR event A4
4G - No MR Response (LTE A3)	LTE	No response from eNB to LTE measurement reports triggered by event A3
4G - No MR Response (LTE A4)	LTE	No response from eNB to LTE measurement reports triggered by event A4
4G - No MR Response (LTE A5)	LTE	No response from eNB to LTE measurement reports triggered by event A5
4G - No MR Response (LTE A6)	LTE	No response from eNB to LTE measurement reports triggered by event A6
4G - IRAT LTE-NR Redirection (LTE B1-NR)	LTE → 5G NR IRAT	LTE RRC release with redirection to 5G NR carrier triggered by LTE MR eventB1-NR-r15
5G NR - Handover (5GNR A3)	5G NR	5G NR PCell intra-frequency handover triggered by NR MR event A3
5G NR - IF Handover (5GNR A3)	5G NR	5G NR PCell inter-frequency handover triggered by NR MR event A3
5G NR - IRAT NR-LTE Handover (5GNR B2)	LTE → 5G NR IRAT	5G NR to LTE inter-system handover triggered by NR MR event B2
5G NR - IRAT NR-LTE Redirection	LTE → 5G NR IRAT	5G NR RRC release with redirection to LTE carrier
5G NR - No MR Response (5GNR A1)	5G NR	No response from gNB to NR measurement reports triggered by event A1

KPI name	RAT	Description
5G NR - No MR Response (5GNR A2)	5G NR	No response from gNB to NR measurement reports triggered by event A2
5G NR - No MR Response (5GNR A3)	5G NR	No response from gNB to NR measurement reports triggered by event A3
5G NR - No MR Response (5GNR A4)	5G NR	No response from gNB to NR measurement reports triggered by event A4
5G NR - No MR Response (5GNR A5)	5G NR	No response from gNB to NR measurement reports triggered by event A5
5G NR - No MR Response (5GNR A6)	5G NR	No response from gNB to NR measurement reports triggered by event A6

4.4.17 QualiPoc messages view

A view displaying the log messages of the QualiPoc application is available.

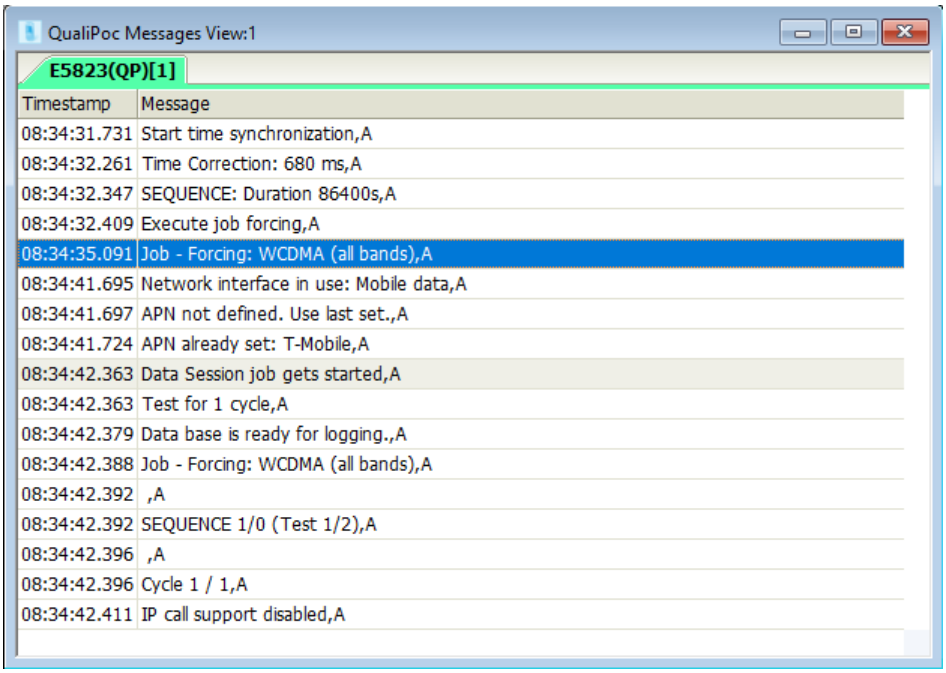


Figure 4-612: QP messages view

This is helpful to analyze quickly problems if jobs do not run as expected.

4.4.17.1 Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

Click the "Configuration" entry of the menu to open the "Info" page.

4.4.18 Serving cell view

The "Serving Cell Vew" tracks the network, band, channel type and channel ID for all available carriers.

The view contains the following possible sections:

- Network section - contains the information about current network type.
- Carier sections - whose number is dependent on number of component carriers selected for display, if a measurement file contains more carriers. For LTE, up to 9 LTE UE mobile signals can be selected, PCell and SCell 1 to SCell 8.For 5G NR, up to 12 5G NR UE mobile signals, PCell and SCell 1 to SCell 11.

On the right side of the view there is the the view's property bar, "Serving Cell View Properties". The property component lets you select for display carriers and controls the look and feel of the view.

The view is launched from the R&S ROMES4 "View" > "Mobile Views" > "Serving Cell View". It can also be launched from the context popup menu. Right click the empty view area to get the context menu.

The view supports LTE UE and 5G NR UE measurements. If the current measurement or replay file contains LTE and 5G signals (the RAT mode is "5G EN-DC"), a carrier section contains for both technologies the "Band" /"5G NR Band", "Channel"/"5G NR Channel" and channel "ID"/"5G NR ID" fileds. The 5G NR carrier fields are shown even when the no 5G carriers present if the "Display 5G Carrier" option is checked in the "Serving Cell View Properties", see Figure 4-620. The option is by default unchecked.

The following figure shows the "Serving Cell View" page for the case EUTRA-NR Dual Connectivity (EN-DC).

Figure 4-613: Serving cell view - EN-DC

Carrier values

Each possible carrier has one of the following sections.

Figure 4-614: Single chart view

The values on the left represent the band, channel number and channel ID for the given carrier at a specific point in time of the measurement file. The values in colored lines on the right represent duplex mode and type ID of a band of the measurement or replayed measurement file.

You can configure the size taken up by a section by clicking the size bar above or below the section. Move and drag the mouse to increase or decrease the section size.

Signals tracked

The view tracks the following signals:

- **Network**
  This is the network type (5G NR/ LTE/UMTS/GSM).
- **Carrier 1**
  For the network type 5G NR includes:
  - 5G NR Band - 5G NR band
  - 5G NR Channel - PCC NARFCN DL
  - 5G NR ID - PCI
- **Carrier 2 to Carrier 12**
  For the network type 5G NR includes:

  - 5G NR Band - SCC2 to SCC12 5G NR band
  - 5G NR Channel - SCC2 to SCC12 NARFCN DL
  - 5G NR ID - SCC2 to SCC12 PCI
- **Carrier 1**
  For the network type LTE includes:
  - Band - LTE band
  - Channel - PCC EARFCN DL
  - ID - PCC PCI
- **Carrier 2 to Carrier 9**
  For the network type LTE includes:
  - Band - SCC1 - SCC8 LTE band
  - Channel - SCC1 - SCC8 EARFCN DL
  - ID - SCC1 -SCC8 PCI
- **Carrier 10 to Carrier 9**
  For the network type LTE includes:
  - Band - N/A
  - Channel - N/A
  - ID - SCC1 -N/A
- **Carrier 1**
  For network type UMTS includes:
  - Band - UMTS FDD band x or UMTS TDD band x
  - Channel - UARFCN 0
  - ID - Scrambler Code 0
- **Carrier 2**
  For network type UMTS includes:
  - Band - UMTS FDD band x or UMTS TDD band x
  - Channel - UARFCN 1
  - ID - Scrambler Code 1
- **Carrier 3 to Carrier 12**
  For network type UMTS includes:
  - Band - N/A
  - Channel - N/A
  - ID - N/A
- **Carrier 1**
  For network type GSM includes:
  - Band – Used network for the given RAT. GSM 900, GSM 1800, GSM 1900, GSM 900/1800, GSM-R, GSM-E
  - Channel - BCCH
  - ID - BSIC
- **Carrier 2 to Carrier 12**
  For network type GSM includes:
  - Band - N/A

– Channel - N/A
– ID - N/A

4.4.18.1 Replay and measurement display items

During replay and measurement, the following items are available.

Figure 4-615: Mouse hovering over data

Moving the mouse over the time graph shows the values represented by that point in time.

Within the time chart, a solid vertical black line represents the current timestamp of the measurement.

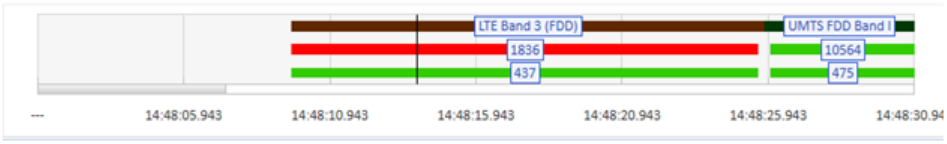


Figure 4-616: Current cursor position

While a replay of a measurement is paused, doubling clicking any point within the time graph rewinds or advances the replay file to that point. All other synced views should also be advanced to that point.

The user may scroll along the time axis by clicking and holding and moving the mouse on the scroll bar on the bottom chart. In addition, the user may scroll the time axis by clicking and holding then moving the mouse on any of the displayed charts.

If the user attempts to scroll the time axis to a point in the measurement where the current cursor (solid black line) cannot be displayed during replay and measurement, the view automatically scrolls the line graph back to a point where the current cursor can be displayed. This behavior can be changed in configuration, see the configuration chapter.

During the replay, the user may also zoom-in on the time axis by using the mouse wheel or by using touch pinch. The user can also zoom gestures if on a touch screen capable device.

4.4.18.2 Mobile serving cell view configuration

To configure the colors displayed on the serving cell view:

1. Stop and close the current replay or measurement file.
2. Click "Tool" > "Preference" > "Available Signals".

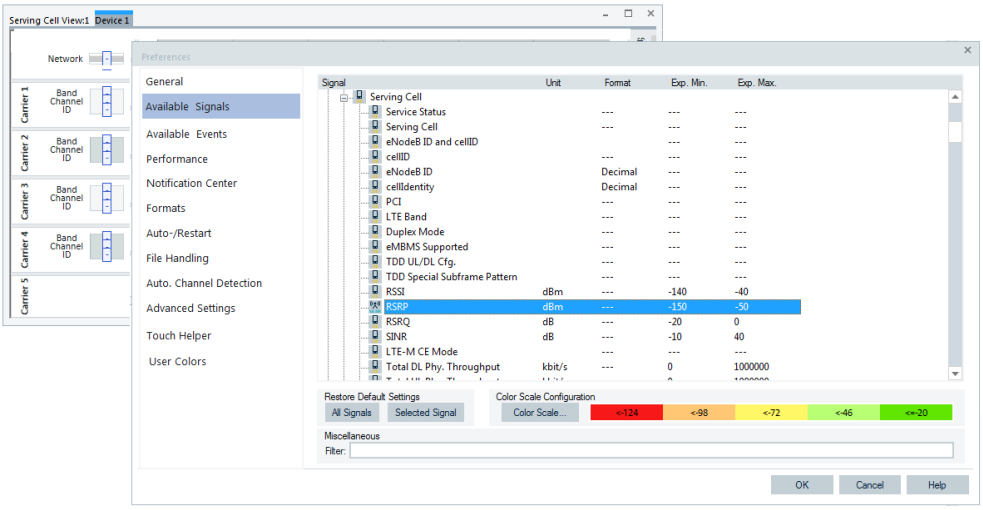


Figure 4-617: Customize serving cell signal colors

3. Select the desired signal and modify the colors to the desired values, as shown in the following figure.

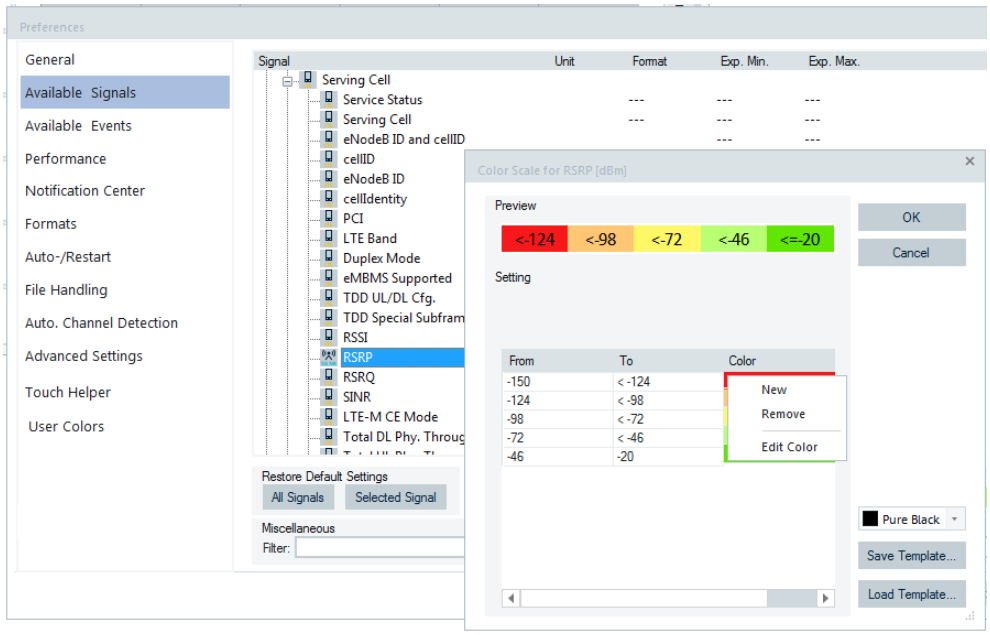


Figure 4-618: Changing signal colors

The configuration for the view can be accessed by clicking the "Serving Cell View Properties" tab. The tab is by default located in the upper right portion of the view.

Figure 4-619: Serving cell view properties tab

Click the properties tab to open the properties window.

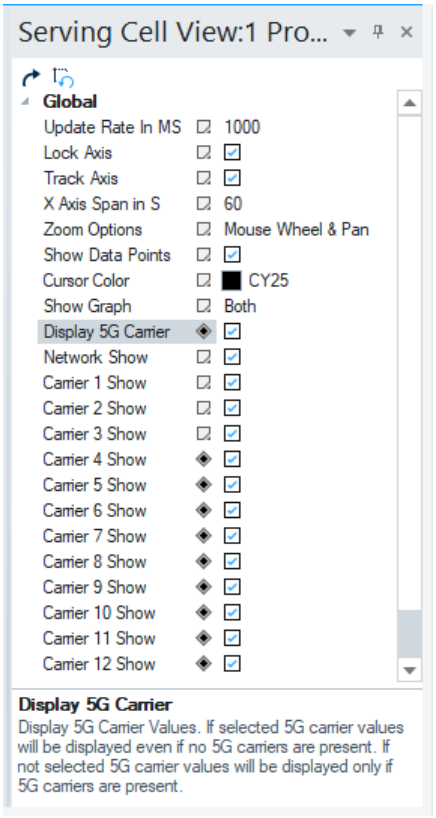


Figure 4-620: Serving Cell View Properties window

If the "Serving Cell View Property" tab is not visible, you can recover it via the "Properties" entry of the context menu. The menu pops-up if right click any point in the "Serving Cell View". The tab is invisible if you unpin it from the view.

The "Serving Cell View Property" tab can be pinned to the view so that it is always available. For that, the push-pin icon of the window has to look like .

A properties of the view can be changed in the properties window. The window is displayed all the time the view is active.

Once the properties window is un-pinned, it can be undocked from the view and made floating. For that, double click the title bar or single click the title bar and drag the panel off of the view.

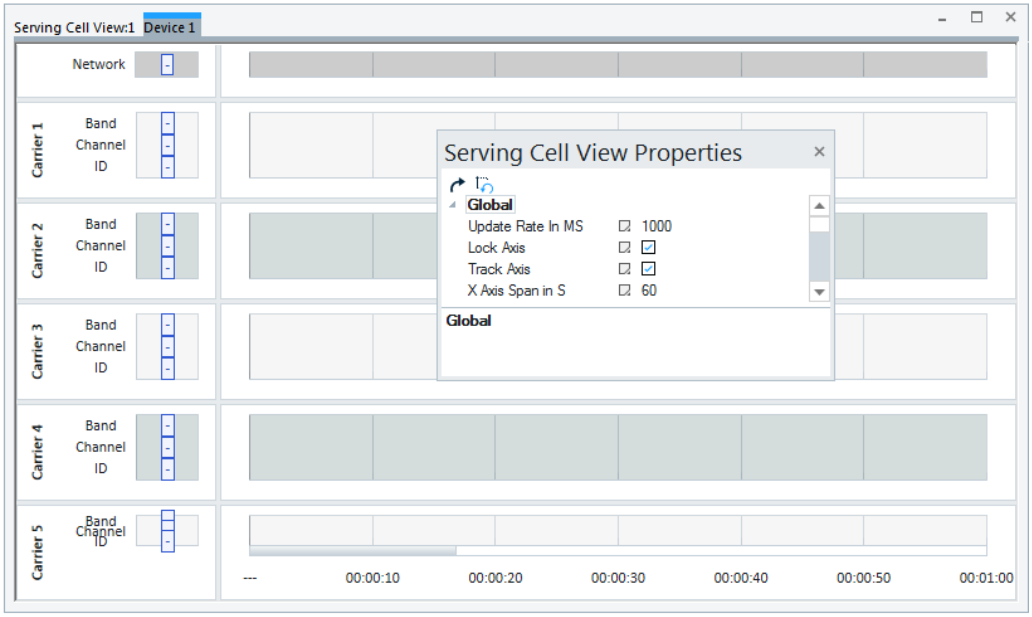


Figure 4-621: Unpinned Serving Cell View Properties window

The window can be re-docked to the serving Cell View by dragging the panel to the left, right, top or bottom of the view and dragging the panel to the display arrows. In this way you can dock the panel to the desired location on the view.

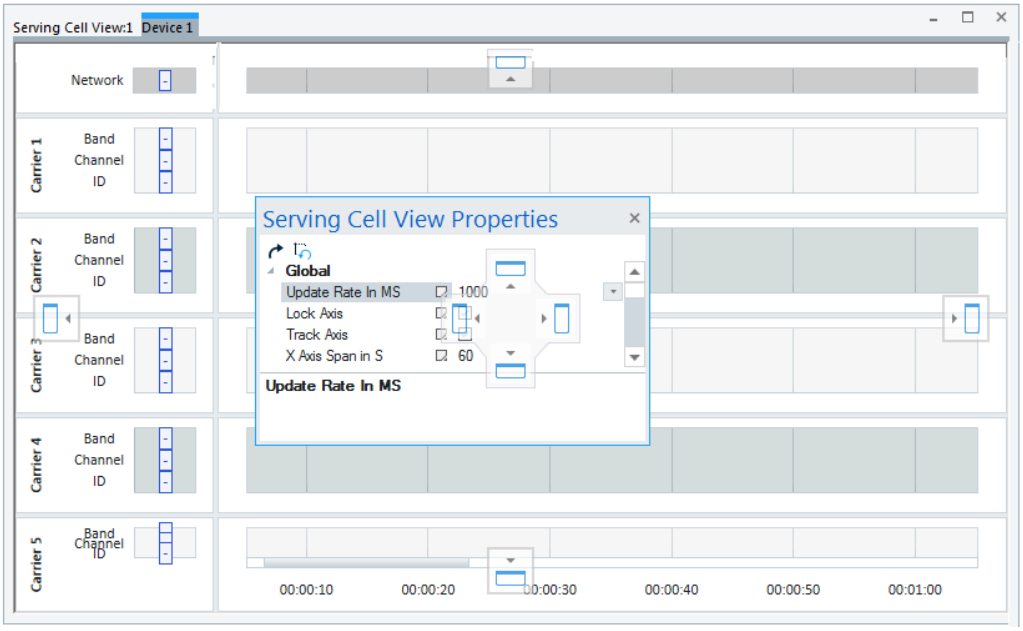


Figure 4-622: Serving Cell View Properties window docking options

The configured properties are saved when the workspace or measurement file is saved.

Within the properties window three buttons are available:

- "Restore All Values"
  restores the property values to their saved workspace values when the view was started for the first time. If a workspace/measurement file is loaded, the setting reverts to the values from the file. Any individual setting can be reverted by right mouse click the setting and choosing "Reset Value".
- "Reset Zoom"
  resets the axis for all the charts to the values defined in the configuration.
- "Global"
  Global shows/hides the contents of the "Serving Cell View Properties" window.

Properties available in the view - global

The following properties are available to be changed in the view.

Update Rate in MS
The number of milliseconds between the bar and the line graph display updates during a measurement or replay. This is done to help with system performance. The lower the number the more frequent the screen refresh during measurement or replay, thereby slowing overall system performance. A value of zero refreshes the screen every time a new data point is received.

Lock Axis
Setting this configuration property to false allows scrolling the X-axis of each line graph shown independently. Setting this value to true has all line graph X-axis scroll together.

Track Axis
Setting this configuration to false allows scrolling the line graph outside of the current cursor during replay and has no the view automatically scroll the line graph back to the current cursor.

X Axis Span is S
The new of second that is displayed on the line graph X-axis.

Zoom Option
The setting changes the way how the zoom control works for the line graph.

- "None"
  No zoom control for the charts will be enabled.
- "Mouse Wheel & Pan"
  Zoom the chart by using the mouse wheel
- "Magnify"
  Allow for zoom; the left mouse button click the line graph to zoom in, the right mouse button to zoom out.
- "Selection"
  Allow a specific location to be zoomed into by selecting an area with mouse.

Show Data Points
Allows changing the view so that when the mouse is moved over the line graph the individual antenna power levels are not shown.

Cursor Color
Allows changing the color of the cursor that indicates the current time in the measurement or replay.

Show Graph
The "Show Graph" drop box contains three possible values to choose.

- "Both": show both bars and lines (default)
- "Bar Graph": show current values
- "Line Graph": show value over time

Network Show
Show or hide the network section.

Carrier 1 to 12 Show
Show or hide this carrier group.

4.4.19 UE activity log view

The "UE Activity Log View" combines the most important logs from of all layers involved in UE tests. This view merges and condenses the information of the Layer 3 view, the RRC mobility view, the QP message view and the DQA message views. By merging the information from these views, it provides an overview of what is going on.

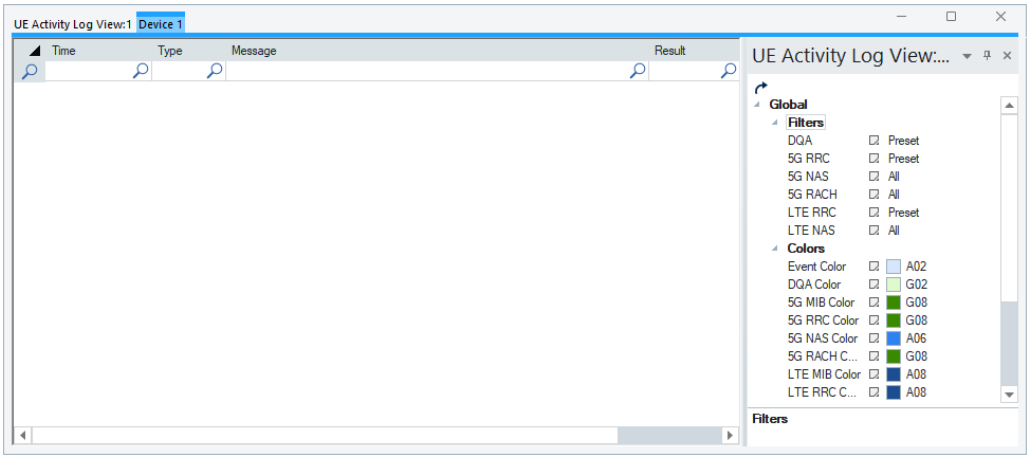


Figure 4-623: UE activity log view

The level of provided information can be controlled by the filters available for each layer. The filters are offered in the view's property pane, the "UE Activity Log View:1 Properties". The "Colors" in the properties pane provides control of information from different sources.

Colors are synchronized with the Layer 3 view's colors, if applicable. Using the F2 and F3 keys, it is possible to jump to the previous or next red message in the list. Use the "Hold" option of the context menu to avoid auto-scrolling during the measurement or replay.

4.4.19.1 UE activity log filter file format

The available filters can be adapted if necessary. The filter files are located in the folder <My Documents>\My ROMES\Configuration\UEActivityLog.

The names of the files are fixed and cannot be changed. The filter file format is the following:

```
<MessageLists>
<MessageList Name="Default" Protocol="5G RRC">
   <Message SourceID="0x0601"/>
   <Message SourceID="0x0302"/>
   <Message SourceID="0x0803"/>
</MessageList>
<MessageList Name="Little More" Protocol="5G RRC">
   <Message SourceID="0x0601"/>
   <Message SourceID="0x0302"/>
   <Message SourceID="0x0803"/>
   <Message SourceID="0x0406"/>
</MessageList>
<MessageList Name="Show All" Protocol="5G RRC">
 </MessageList>
 </MessageLists>
```

The filter file format also can be as following:

```
<!--
eTextMarkerCyan = 1,
eTextMarkerYellow = 2,
eTextMarkerRed = 3,
eTextMarkerGreen = 4,
eTextMarkerOrange = 7,
-->

<MessageLists>
<MessageList Name="Default" Protocol="DQA">
<Exclude Text="rtt="/>
<Colored Text="success" Color="4"/>
<Colored Text="sucess" Color="4"/>
<Colored Text="test ok" Color="4"/>
<Colored Text="start" Color="1"/>
<Colored Text="rat changed" Color="7"/>
</MessageList>
<MessageListName="Show All" Protocol="DQA">
  <Colored Text="success" Color="4"/>
```

```
  <Colored Text="sucess" Color="4"/>
  <Colored Text="test ok" Color="4"/>
  <Colored Text="start" Color="1"/>
  <Colored Text="rat changed" Color="7"/>
</MessageList>
</MessageLists>
```

The `MessageLists` is the container for n filters, specified by `MessageList`.

The `MessageList` has the following attributes:

- Name

- Protocol, it cannot be changed.

The `MessageList` specifies:

- Message, if one or more messages are specified, only these messages are show (applicable for Layer 3 layers only).

- Exclude, all items, which contain this text are not shown. Use lower case only.

- Colored, all items' messages and result columns, which contain the text are colored as specified. Use lower case only.

4.4.20 UE CA downlink performance view

There are UE CA downlink and uplink performance views. As being similar, explanations given here for the "UE CA Downlink Performance View" are applicable for the "UE CA Uplink Performance View" as well.

The differences between them two are:

- "UE CA Downlink Performance View" has sections and associated charts for RB/TP and MCSn/CQIn, n=1, 2.
- "UE CA Uplink Performance View" does not support CQI signal and the sections/charts are RB/TP and MCS.

Both views can be launched from the "View" > "Mobile Views" > "UE" menu. Instead, you can launch the views from the context menu which pops-up when right-mouse button click on the empty view area.

Figure 4-624: UE CA Downlink Performance View

The view is separated into three sections each having bar area and chart for a selected carrier.

The "Carrier" drop-down box lets you select LTE carriers and/or 5G NR CA carriers for display. You can choose up to 9 LTE carriers (PCell and SCell1 to SCell8) and up to 12 5G NR carriers (PSCell and SCell1 to SCell11).

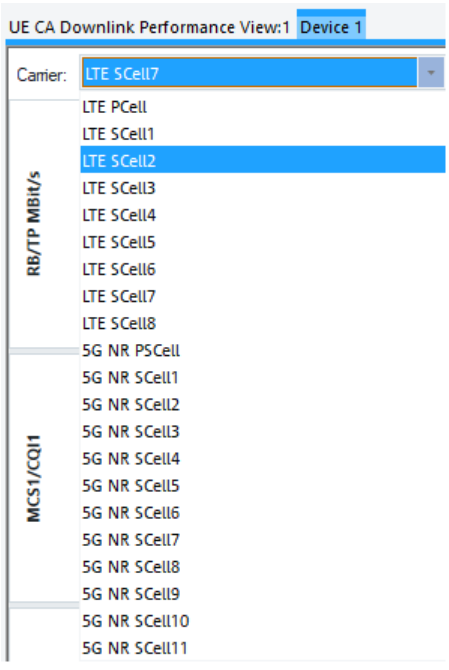


Figure 4-625: Supported carriers

The view also contains legends per section and the properties component placed on the right-hand side of the view by default. The properties components are used to select supported signal combinations of the selected carrier for display and to configure the view's layout.

If you click the "UE CA Downlink Performance View Properties" bar, the properties pane opens. Four default colors are used to display four different signals: RB, TP, MCS and CQI. The corresponding color areas are also used for showing the Y-axis of a section. A sector for the supported signals combination does not appear if not activated in the properties pane.

The X-axis is displayed at the bottom of the view.

Two Y-axes are displayed at both sides of bar and chart areas. Y-axes on the left of the graph are primary and Y-axes on the right the secondary ones.

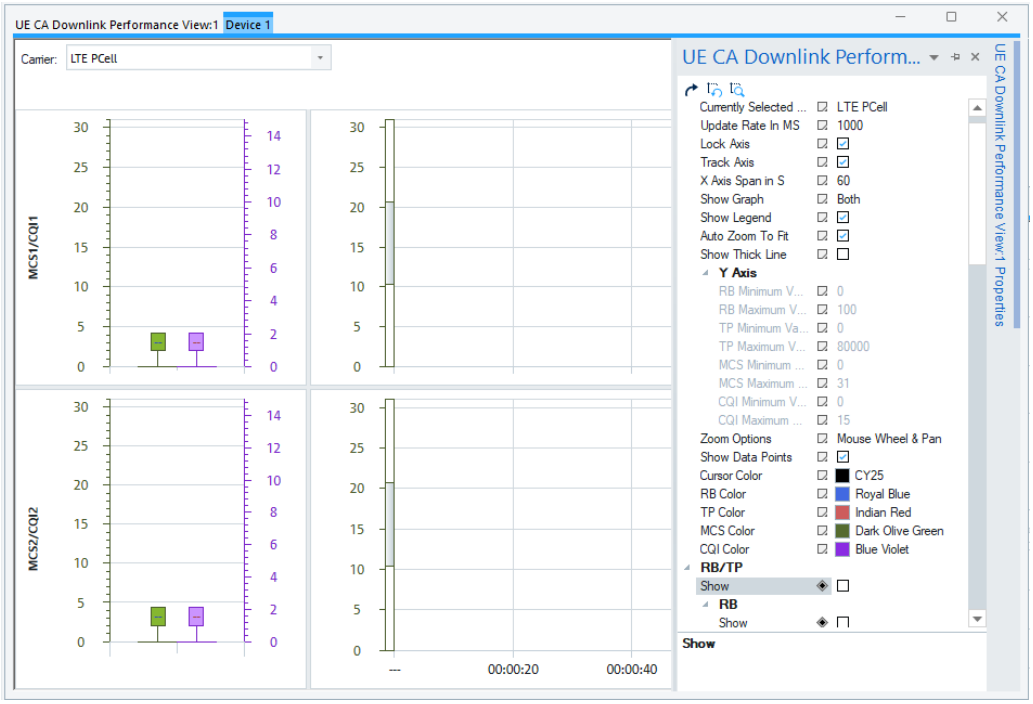


Figure 4-626: Partly selected charts with properties pane

If you resize the screen to reduce the width at the certain point, the legend is hidden to give more space to lines and bars.

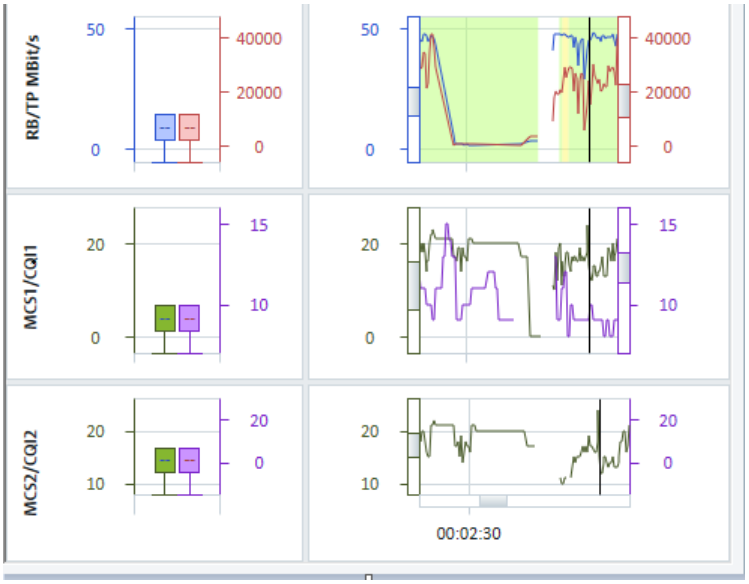


Figure 4-627: Hidden legend

By resizing the view to even smaller width, the lines are hidden to show only bars. Bby increasing the width of the view, the line and legend are restored if they are so configured.

4.4.20.1 Charts and legend

Charts

The view contains three signal sections:

- RB/TP
- MCS1/CQI1
- MCS2/CQI2

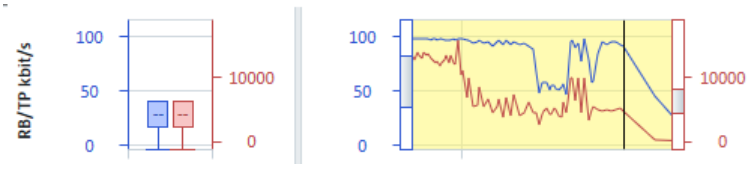


Figure 4-628: UE CA Download Performance View single chart

For each displayed section, the view displays a bar graph in the left pane and line graph in the right pane. You can configure the size of the screen taken up by a graph on the view. Click the size bar of a signal and drag the mouse to increase or decrease the size.

A section has a title displayed vertically on the left of the chart. If the section does not have enough space to show the entire title, ellipsis is displayed at the end.

You can hide bars, lines or legend in the properties bar using the "Show Graph" property, see "Properties available in the view" on page 1020.

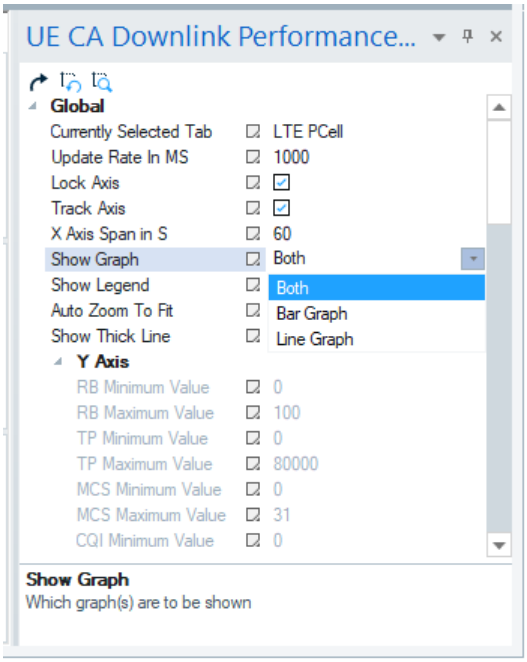


Figure 4-629: UE CA Downlink Performance View chart selection

Signal Charts

RB/TP Chart

The RB/TP chart shows the Resource Block Average number (RB), Throughput (TP) and Rank Indicator (RI).

RB and TP are displayed in bar and line graphs. RI is displayed as a graph background color.

RB and TP signals have two Y-axes. RB Y-axis is the primary one and is on the left of the graph. TP Y-axis is the secondary one and is on the right of the graph.

Different RI values are displayed using different colors, see the following figure.

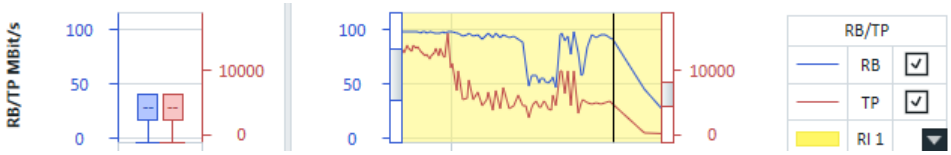


Figure 4-630: RB/TP selection

The following selections are available:

- Both bar and line background are filled with the color that represents a value.
- Possible values are displayed in legend, for example in the previous figure "RI 2" means that the value is 2 for RI signal and "RI 1" means 1 for RI signal.
- In total two values are available in this measurement file.
- RI color legend does not have check box to show/hide the signal.

MCSn/CQIn Chart

The MCSn/CQIn chart shows the MCS and CQI and modulation signals.

MCSn and CQIn are displayed in bar and line graphs and modulation is displayed as line chart background color.

MCS and CQI signals have two Y-axes. The MCSn Y-axis is the primary one and is on the left of the graph. The CQIn Y-axis is the secondary one and is on the right of the graph.

Different modulation values are displayed using different colors.

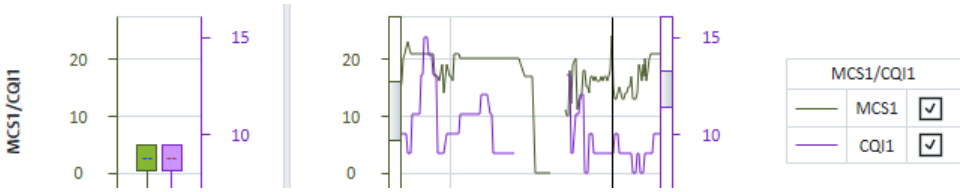


Figure 4-631: MCS/CQI selection

The following selections are supported:

- Both bar and line background are filled with the color that represents modulation value.
- Possible values are displayed in legend. If more values are available, an arrow is present to let user view more values.
- The modulation signals in the legend do not have a check box to show/hide the signal.

Legend

Legend is by default shown on the right side of the view. Following picture shows the legend for signal RB/TP chart. Other signal legends are similar.

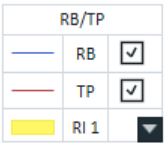


Figure 4-632: RB/TP legend

The legend can be entirely hidden to make more space for bars or lines by clearing the "Show Legend" check box in the configuration pane.

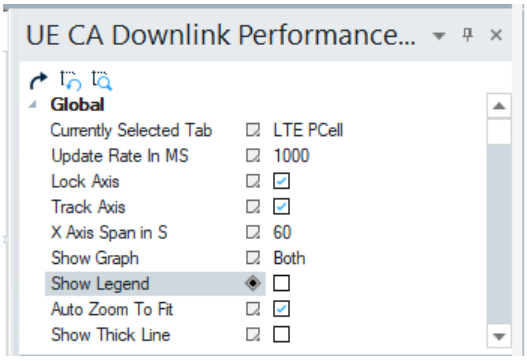


Figure 4-633: Hide legend

There is an up and down arrow to access the non-displayed items if the list of all options in the legend cannot be displayed due to screen size constraints.

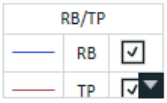


Figure 4-634: Legends scroll arrows

Click the arrow to scroll the list up and down accordingly.

4.4.20.2 Replay and measurement display items

During replay and measurement the following items are available. Moving the mouse over the line graph shows the power levels for each value represented by the current mouse location.

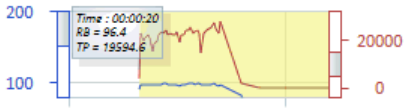


Figure 4-635: Mouse over display data

The bar shows the values for the current time within the measurement or replay.

Figure 4-636: Current values

Within the line graph, a solid vertical black line represents the current timestamp of the measurement.

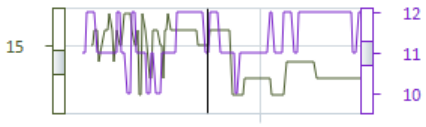


Figure 4-637: Current cursor position

During a replay of a measurement is paused double click at any point within the line graph rewinds or advances the replay file to that point. All other synced views can also be advanced to that point.

If the user scrolls on any one of the lines graphs X-axis, the X-axes of the other displayed line graphs scroll the same amount.

If you attempt to scroll the X-axis to a point in the measurement where the current cursor (solid black line) cannot be displayed during replay and measurement, the view automatically scrolls the line graph back to a point where the current cursor can be dis-

played. This behavior can be changed in configuration, see the configuration section for details.

The user can also scroll the Y-axis of line graph by clicking the scroll bar on the line graph and moving the mouse up and down. The Y-axis can be adjusted for each signal independently.

Zoom to Fit
The "Zoom to Fit" feature sets the Y-axis minimum and maximum automatically, so that all lines and bars are displayed properly using the available chart space.

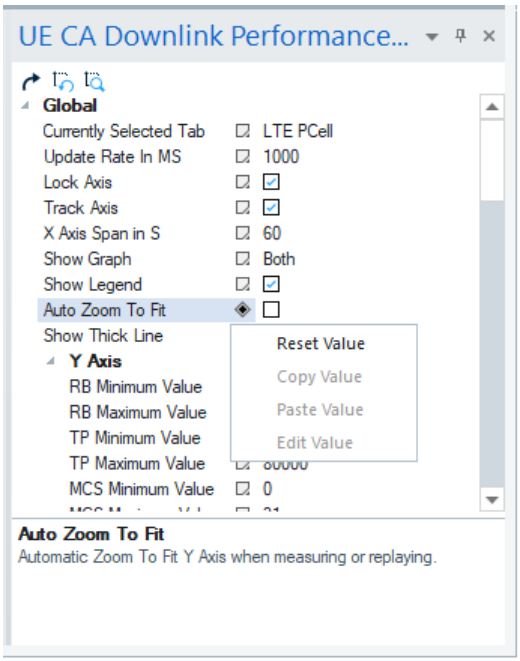


Figure 4-638: Auto zoom to fit

The following buttons are available in configuration bar:

- "Reset Zoom"
  Click to reset the Y-axis min and max to the default values in configuration.
- "Zoom To Fit"
  Click to recalculate the Y-axis min and max to show the lines/bars with all available chart spaces.

Hovering mouse over the icons displays their functions.

Auto Zoom to Fit ← Zoom to Fit
If the "Auto Zoom To Fit" check box is checked, the Auto Zoom mode is active. This zoom mode is useful during measurement or replay.

In Auto Zoom mode, when a new value that is outside of the current Y-axis scope enters the display, the Y-axis range is reconfigured. The new value is shown in the chart properly after the reconfiguration.

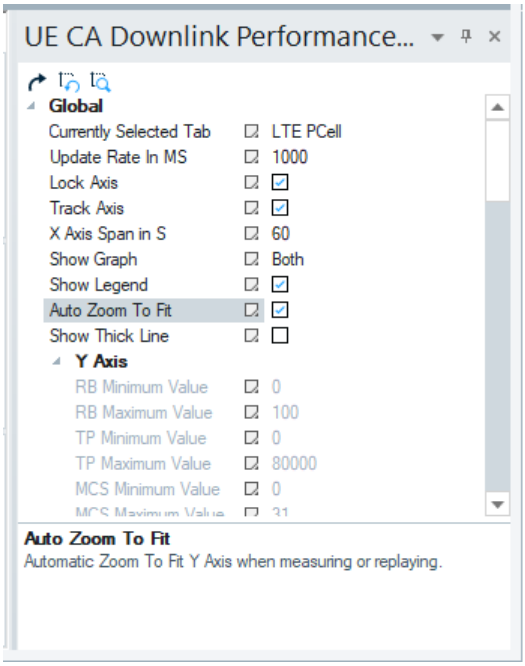


Figure 4-639: Y-axis configuration disabled by Auto Zoom To Fit

Note: The Y-axis is not reconfigured if the maximum or minimum value goes out of current display.

If you change the Y-axis or zoom-in to a line using mouse wheel in Auto Zoom mode, the mode turns off.

Click "Auto Zoom To Fit" icon to resume the Auto Zoom mode. The min and max value settings of Y-axis in configuration bar are disabled.

Manual Zoom to Fit ← Zoom to Fit
If the "Auto Zoom To Fit" check box is cleared, the Auto Zoom mode is deactivated, see Figure 4-638.

The default configured Y-axis used min and max settings.

Click the "Zoom To Fit" icon to zoom to fit the charts.

In this mode, the min and max value settings of Y-axis in configuration bar are activated.

4.4.20.3 UE CA downlink performance view configuration

The configuration for the view can be accessed by clicking the "UE CA Downlink Performance View Properties" tab, which is by default located on the upper right portion of the view.

Figure 4-640: UE CA Downlink Performance View Properties

If the tab is not visible, it can be recovered by right mouse-button click any point in the "UE CA Downlink Performance View" and selecting "Properties".

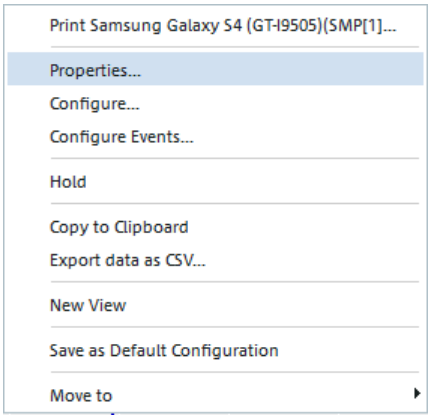


Figure 4-641: Accessing the view via context menu

If the tab is selected, a configuration item can be changed. The tab automatically hides itself if another item on the screen is selected.

The properties panel is displayed while the view is active.

The configuration properties can be pinned to the screen by clicking the pin icon in the properties panel.

Once the properties panel is pinned, it can be undocked from the view and made floating. To do undocking, double click the title bar of the properties panel or single click the title bar and drag the panel off of the view.

The properties bar can be redocked to the view by dragging the panel to the left, right, top or bottom of the view. Drag the panel to the display arrows to dock the panel to the desired location on the view.

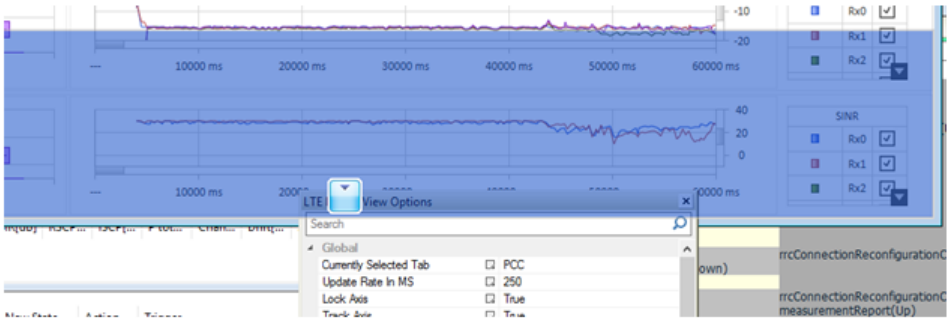


Figure 4-642: View properties docking

The configured properties are saved when the workspace or measurement file is saved.

Three buttons are available within the properties panel.

Figure 4-643: Available buttons in properties panel

Apart from the buttons "Reset Zoom" and "Zoom To Fit", there is the "Restore All Values" button. Click to restore all properties to the values existed when the view was first started. If a workspace/measurement file is loaded, the setting reverts to the values from the file. Any individual setting can be reverted by right mouse click the setting and choosing "Reset Value".

Properties available in the view - global

The following properties are available for selection in the view.

Current Selected Tab
This setting sets the default selected tab when R&S ROMES4 starts.

Update Rate in MS
The number of milliseconds between the bar and the line graph display updates during a measurement or replay. This update is done to help with system performance. The lower the number the more frequent the screen refresh during measurement or replay, therefore slowing overall system performance. A value of zero refreshes the screen every time a new data point is received.

Lock Axis
Unchecked, this configuration property allows scrolling the X-axis of each line graph independently. X-axes of all line graphs are scrolled together if the property is checked.

Track Axis
Unchecked, this configuration allows scrolling the line graph outside of the current cursor during replay. If checked, always returns to X-axis of the line graph back to the current cursor.

Properties available in the view

X Axis Span in S
Time in second to display on the line graph X-axis.

Show Graph
The "Show Graph" drop box contains three possible values to choose.

- "Both" - show both bars and lines (default)
- "Bar Graph" - show bars only
- "Line Graph" - show lines only

Show Chart Legend
If unchecked, this configuration property hides the legend. It is checked by default to show a chart legend.

Auto Zoom To Fit
Check "Auto Zoom To Fit" to activate the automatic zoom mode to fit Y axis when measuring or replaying. Unchecked, the mode is deactivated.

Show Thick Line
Check the check box to show thick chart line and vertical cursor bar.

Properties available in the view - y axis

RB Minimum Value
Minimum power level value to display on the Y-axis of the RB signal.

RB Maximum Value
Maximum power level value to display on the Y-axis of the RSSI signal.

TP Minimum Value
Minimum power level value to display on the Y-axis of the TP signal.

TP Maximum Value
Maximum power level value to display on the Y-axis of the TP signal.

MSC Minimum Value
Minimum power level value to display on the Y-axis of the MCSx signals.

MCS Maximum Value
Maximum power level value to display on the Y-axis of the MCSx signals.

CQI Minimum Value
Minimum power level value to display on the Y-axis of the CQIx signals.

CQI Maximum Value
Maximum power level value to display on the Y-axis of the CQIx signals.

Zoom Options
The setting changes the way how the zoom control works for the line graph.

- "None"
  No zoom control for the charts is enabled.
- "Mouse Wheel & Pan"
  Zoom the chart by using the mouse wheel
- "Magnify"
  Allow for zoom; the left mouse button click the line graph to zoom in, the right mouse button to zoom out.
- "Selection"
  Allow a specific location to be zoomed into by selecting an area with mouse.

Show Data Points
Allows changing the view so that when the mouse is moved over the line graph the individual antenna power levels are not shown.

Cursor Color
Allows changing the color of the cursor that indicates the current time in the measurement or replay.

RB Color
Allows changing the color that represents this item in the bar and graph charts.

TP Color
Allows changing the color that represents this item in the bar and graph charts.

MCS Color
Allows changing the color that represents this item in the bar and graph charts.

CQI Color
Allows changing the color that represents this item in the bar and graph charts.

LTE/5G carriers values

LTE carrier values

RB/TP [kbit/s]
The RB/TP signal includes the following values:

- Resource Blocks (RB)
- Throughput (TP)
- Rank Indicator

MSC1/QCI1
Shows the first modulation value MCS1 and the first quality of channel value QCI1.

MSC2/QCI2
Shows the second modulation value MCS2 and the second quality of channel value QCI2.

5G carrier values

RB/TP [kbit/s]
The RB/TP signal includes the following values:

- Resource Blocks (RB)
- Throughput (TP)
- Rank Indicator

MSC1/QCI1
Shows the MSC modulation value MCS1 and QCI1.

MSC2/QCI2
Not displayed

4.4.21 UE CA uplink performance view

The descriptions and explanations given in the Chapter 4.4.20, "UE CA downlink performance view", on page 1009 chapter apply for the "UE CA Uplink Performance View".

Figure 4-644: UE CA Uplink Performance View

There is the configuration possibility to display or hide the RB/TP and MCS sections. The "UE CA Uplink Performance View Properties" pane is used for the configuration. Check or uncheck the "Show" property next to a corresponding section name.

4.4.21.1 Carrier values

The "RB/TP Mbit/s" section shows the following signals for LTE or 5G NR selected carrier if selected in properties pane.

- Resource Blocks ("RB")

- Throughput ("TP") in MBit/s
- Rank Indicator

The "MSC" section shows the used UL modulation scheme values for LTE or 5G NR selected carrier.

4.4.22 UE capabilities view

The "UE Capabilities View" visualizes an UE capability information included in the Layer3 messages.

The view supports active and passive coupled focus.

The opening "Summary" page offers a summary of the most important capabilities of the 5G NR, LTE, UMTS and GSM UEs. The summary consists of the accumulated information retrieved by the corresponding Layer 3 messages.

The following figure shows the list of UE capabilities per technology. Shown is, for example, the UE category, its capability to support 5G NR and EN-DC, LAA, carrier aggregation in uplink and downlink, splitting DRB in UL and so on. LTE component carrier band combinations supported in downlink are marked green.

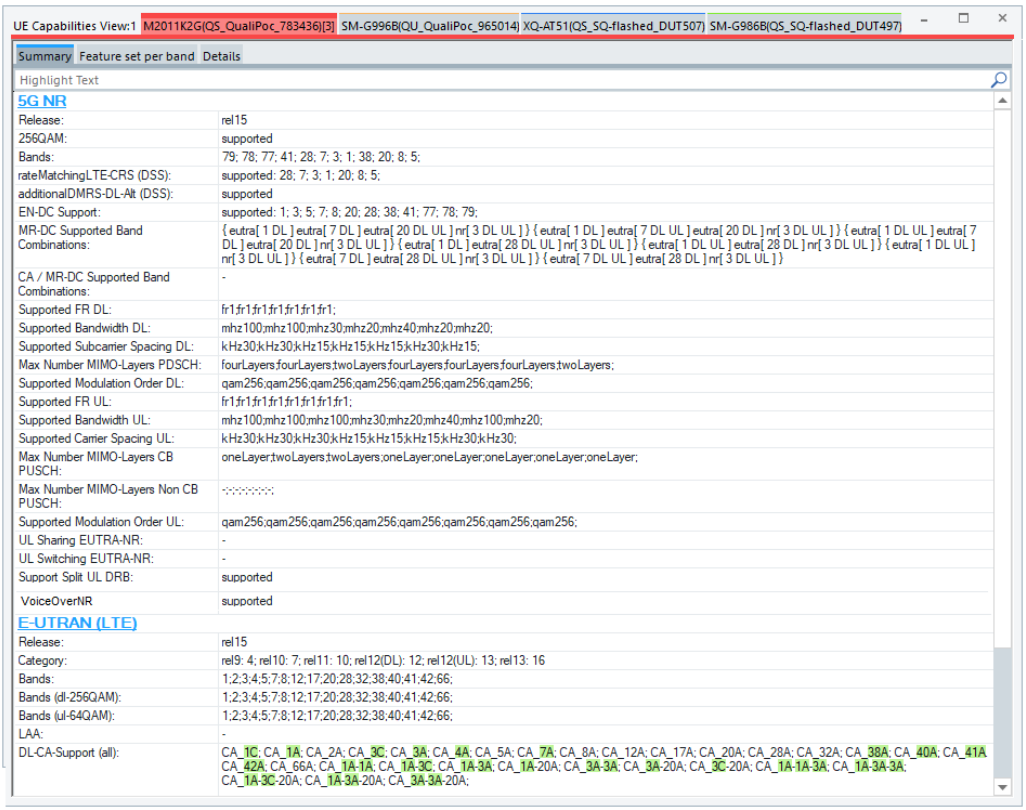
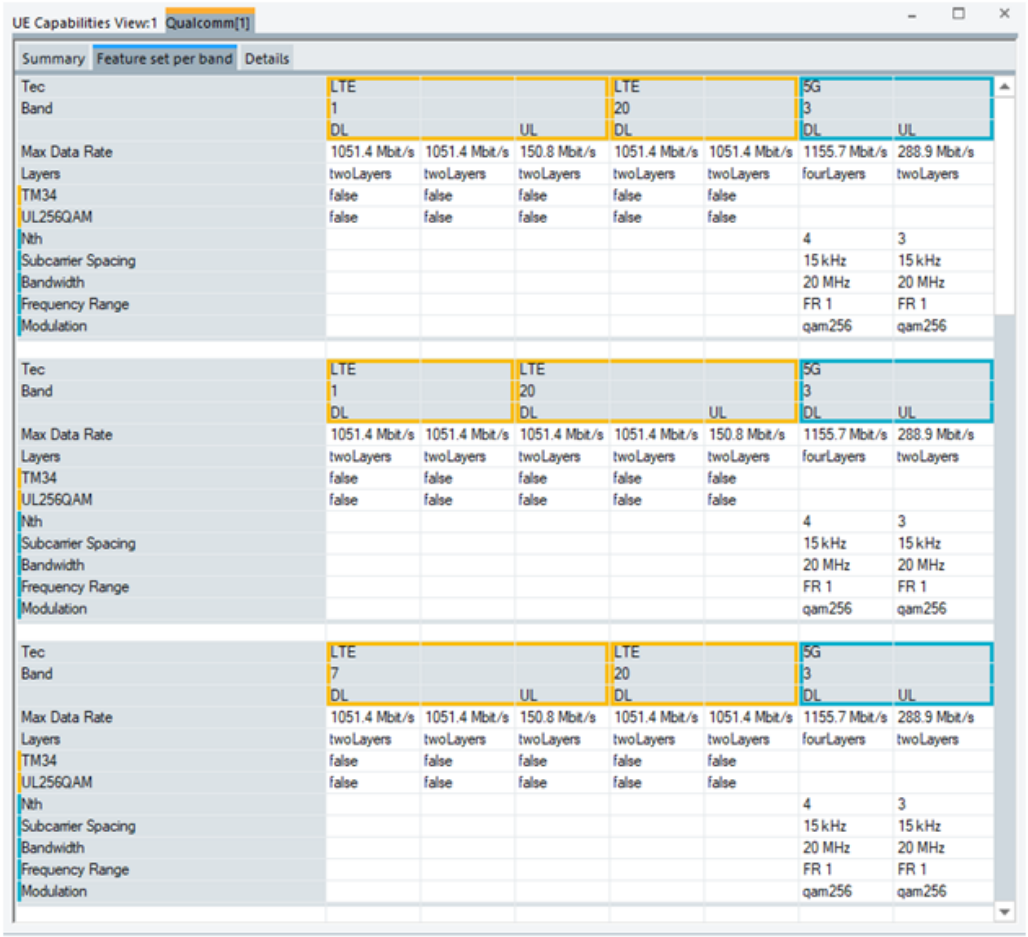


Figure 4-645: UE capabilities

It Is possible to highlight specific text by entering it into the "Summary" > "Highlight Text" box.

The all available band combinations for LTE and NR and the corresponding feature set supported by an UE are visible if you click the "Feature sets per band" tab.

The opened page shows in tabular way what the UE is able to support. Which feature set should be in use is decided by the network. The table shows also the max. available throughput of each carrier.



Tec	LTE			LTE		5G	
Band	1			20		3	
	DL		UL	DL		DL	UL
Max Data Rate	1051.4 Mbit/s	1051.4 Mbit/s	150.8 Mbit/s	1051.4 Mbit/s	1051.4 Mbit/s	1155.7 Mbit/s	288.9 Mbit/s
Layers	twoLayers	twoLayers	twoLayers	twoLayers	twoLayers	fourLayers	twoLayers
TM34	false	false	false	false	false		
UL256QAM	false	false	false	false	false		
Nth						4	3
Subcarrier Spacing						15 kHz	15 kHz
Bandwidth						20 MHz	20 MHz
Frequency Range						FR 1	FR 1
Modulation						qam256	qam256

Tec	LTE		LTE			5G	
Band	1		20			3	
	DL		DL		UL	DL	UL
Max Data Rate	1051.4 Mbit/s	1051.4 Mbit/s	1051.4 Mbit/s	1051.4 Mbit/s	150.8 Mbit/s	1155.7 Mbit/s	288.9 Mbit/s
Layers	twoLayers	twoLayers	twoLayers	twoLayers	twoLayers	fourLayers	twoLayers
TM34	false	false	false	false	false		
UL256QAM	false	false	false	false	false		
Nth						4	3
Subcarrier Spacing						15 kHz	15 kHz
Bandwidth						20 MHz	20 MHz
Frequency Range						FR 1	FR 1
Modulation						qam256	qam256

Tec	LTE			LTE		5G	
Band	7			20		3	
	DL		UL	DL		DL	UL
Max Data Rate	1051.4 Mbit/s	1051.4 Mbit/s	150.8 Mbit/s	1051.4 Mbit/s	1051.4 Mbit/s	1155.7 Mbit/s	288.9 Mbit/s
Layers	twoLayers	twoLayers	twoLayers	twoLayers	twoLayers	fourLayers	twoLayers
TM34	false	false	false	false	false		
UL256QAM	false	false	false	false	false		
Nth						4	3
Subcarrier Spacing						15 kHz	15 kHz
Bandwidth						20 MHz	20 MHz
Frequency Range						FR 1	FR 1
Modulation						qam256	qam256

Figure 4-646: Feature set per band view

The "Details" tab provides the UE capabilitiy details.

The details are shown in the lower part of the page if you click the message line of your interest. The filter/search string is marked blue. The details of the UE capabilities can be filtered by 5G NR, LTE, UMTS and GSM Layer 3 messages.

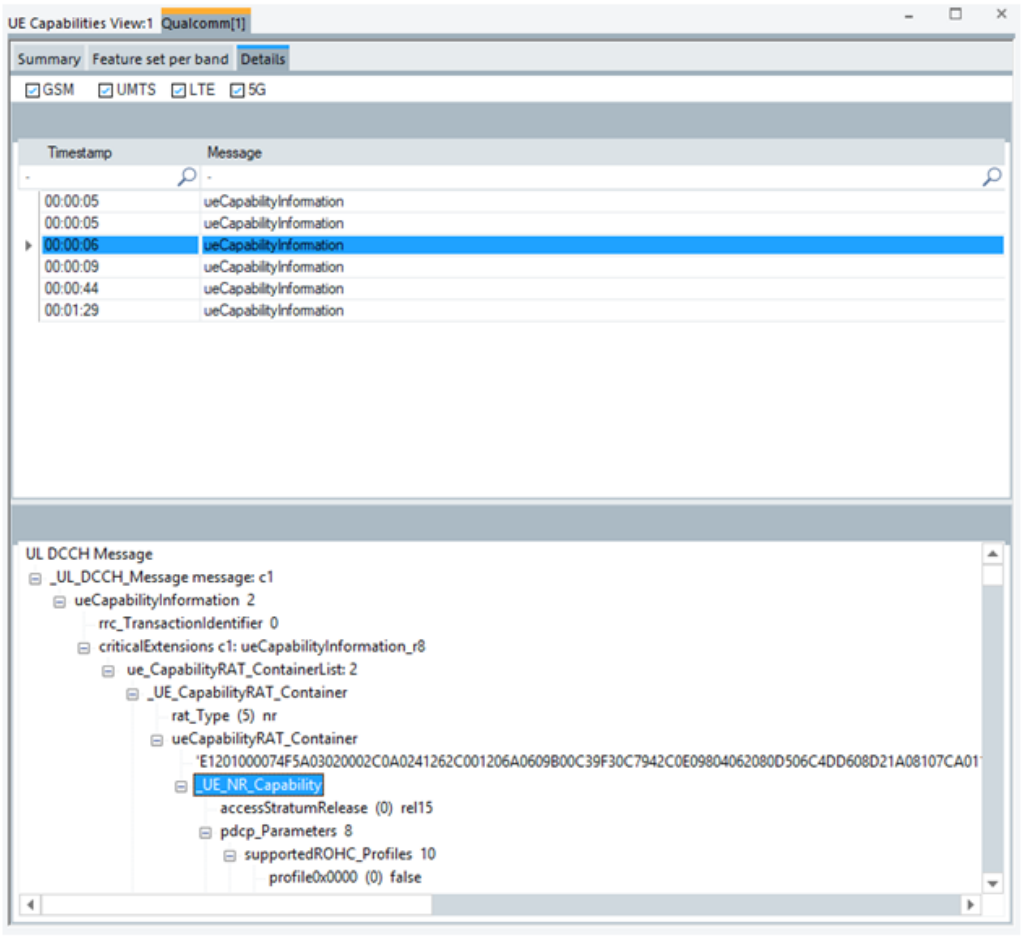


Figure 4-647: Details of UE capabilities

The UE Capabilities View can be exported in CSV format.

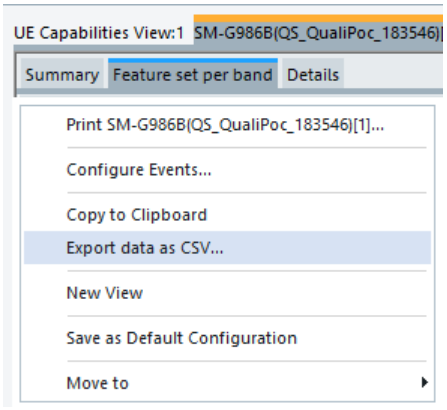


Figure 4-648: Exporting data as CSV

To export the view in CSV format, right mouse-button double click any point in the view's area to get the context menu. Select the "Export data as CSV" entry. The "Save As" window lets you to save the export.

4.4.22.1 5G NR UE capabilities

The following table lists the 5G NR UE capabilities and provides the additional explanations.

Table 4-27: 5G NR UE capabilities

RAT type	Parameters	Comment
EUTRA	EN-DC support	Indicates if the eNB supports dual conectivity
EUTRA	Bands	Supported bands
EUTRA-NR	MR-DC supported band combinations	TS 38.331 6.3.3 The IE `BandCombinationList` contains a list of NR CA and/or MR-DC band combinations (also including DL only or UL only band).
NR	Release	TS 38.331 6.3.3 The IE `AccessStratumRelease` indicates the release supported by the UE
NR	NR supported bands	TS 38.306 4.2.7.11 Includes the supported NR bands as defined in TS 38.101-1 [2] and TS 38.101-2 [3].
NR	NR supported band combinations	TS 38.306 4.2.7.11 Defines the supported CA and/or MR-DC band combinations by the UE. For each band combination the UE identifies the associated feature set combination by featureSetCombinations index referring to featureSetCombination. A fallback band combination resulting from the reported CA and MR-DC band combination is not signalled but the UE shall support it. For intra-band non-contiguous CA band combinations, the UE only includes one band combination, and exclude the others for which the presence of uplink CA bandwidth class in the band combination entry is different. One band combination entry can also indicate support of any other possible permutations in the presence of uplink CA bandwidth class where a paired downlink CA bandwidth class is the same or where the number of UL CCs is smaller than the one of paired DL CCs expressed by the CA bandwidth class, as specified in TS 36.306 [15]. For these band combinations not included in the capability, the supported feature set is the same as the ones for the band combination included in the UE capability.
NR	Supported carrier spacing DL	TS 38.306 4.2.7.6 Defines the supported sub-carrier spacing for DL by the UE indicating the UE supports simultaneous reception with same or different numerologies in CA. Note the UE shall support all mandated sub-carrier spacing for FR1/FR2. Same numerology for intra-band NR CA including both continuous and non-continuous is mandatory with capability in both FR1 and FR2. Two mixed numerologies between FR1 band(s) and FR2 band(s) in DL are mandatory with capability if UE supports inter-band NR CA including both FR1 band(s) and FR2 band(s). Optional for other cases.

RAT type	Parameters	Comment
NR	Supported bandwidth DL FR 1 Supported bandwidth DL FR 2	TS 38.306 4.2.7.6 Indicates maximum DL channel bandwidth supported for a given SCS that UE supports within a single CC, which is defined in Table 5.3.5-1 in TS 38.101-1 [2] for FR1 and Table 5.3.5-1 in TS 38.101-2 [3] for FR2. For FR1, all the bandwidths listed in TS38.101-1 v15.0.0 Table 5.3.5-1 for each band shall be mandatory with a single CC. For FR2, the set of mandatory CBW is 50, 100, 200 MHz. When this field is included in a band combination with a signle band entry and a single CC entry (i.e. non-CA band combination), the UE shall indicate the maximum channel bandwith for the band according to TS 38.101-1 [2] and TS 38.101-2 [3].
NR	Max number MIMO-layers PDSCH	TS 38.306 4.2.7.6 Defines the maximum number of spatial multiplexing layer(s) supported by the UE for DL reception. For single CC standalone NR, it is mandatory with capability signaling to support at least 4 MIMO layers in the bands where 4Rx is specified as mandatory for the given UE and at least 2 MIMO layers in FR2.
NR	Supported modulation order DL	TS 38.306 4.2.7.6 Indicates the maximum supported modulation order to be applied for downlink in the carrier in the max data rate calculation as defined in 4.1.2. The network may use a modulation order on this serving cell which is higher than the value indicated in this field as long as UE supports the modulation of higher value for downlink.
NR	Supported carrier spacing UL	TS 38.306 4.2.7.7 Defines the supported sub-carrier spacing for UL by the UE, indicating the UE supports simultaneous transmission with same or different numerologies in CA, or indicating the UE supports different numerologies on NR UL and SUL within one cell. Note the UE shall support all mandated sub-carrier spacing for FR1/FR2. Same numerology for intra-band NR CA including both continuous and non-continuous is mandatory with capability in both FR1 and FR2. Two mixed numerologies between FR1 band(s) and FR2 band(s) in UL are mandatory with capability if UE supports inter-band NR CA including both FR1 band(s) and FR2 band(s). It is optional for other cases.
NR	Supported Bandwidth UL FR 1 Supported Bandwidth UL FR 2	TS 38.306 4.2.7.7 Indicates maximum UL channel bandwidth supported for a given SCS that UE supports within a single CC, which is defined in Table 5.3.5-1 in TS38.101-1 [2] for FR1 and Table 5.3.5-1 in TS 38.101-2 [3] for FR2. For FR1, all the bandwidths listed in TS38.101-1 v15.0.0 Table 5.3.5-1 for each band shall be mandatory with a single CC. For FR2, the set of mandatory CBW is 50, 100, 200 MHz. When this field is included in a band combination with a single band entry and a single CC entry (i.e. non-CA band combination), the UE shall indicate the maximum channel bandwidth for the band according to TS 38.101-1 [2] and TS 38.101-2 [3].
NR	Max Number MIMO-layers CB PUSCH	TS 38.306 4.2.7.7 Defines supported maximum number of MIMO layers at the UE for PUSCH transmission with codebook precoding. UE indicating support of this feature shall also indicate support of PUSCH codebook coherency subset. This feature is not supported for SUL.

RAT type	Parameters	Comment
NR	Max number MIMO-layers NonCB PUSCH	TS 38.306 4.2.7.7 Defines supported maximum number of MIMO layers at the UE for PUSCH transmission using non-codebook precoding. This feature is not supported for SUL.
NR	Supported modulation order UL	TS 38.306 4.2.7.7 Indicates the maximum supported modulation order to be applied for uplink in the carrier in the max data rate calculation as defined in 4.1.2. The network may use a modulation order on this serving cell which is higher than the value indicated in this field as long as UE supports the modulation of higher value for uplink.
NR	UL sharing EUTRA-NR	TS 38.306 4.2.7.9 Indicates whether the UE supports EN-DC with EUTRA-NR coexistence in UL sharing via TDM only, FDM only or both TDM and FDM from UE perspective as specified in TS 38.101 3 [4].

4.4.23 UE carrier aggregation view

The "UE Carrier Aggregation View" makes possible the 5G NR and LTE carrier aggregation measurement analysis from a single view. The view is derived from the former "LTE Carrier Aggregation View".

Figure 4-649: Default UE Carrier Aggregation View

The "Carrier" drop-down box lets you select between LTE and 5G NR CA view. If you select "LTE", you can choose up to 9 carriers (PCell and SCell1 to SCell8) in the view's "UE Carrier Aggregation View Properties" field. If you select "5G-NR" for carrier, the properties field lets you select up to 12 5G NR carriers (PSCell and SCell1 to SCell11).

For selected carriers, in the Properties field, select the signals you want to be displayed in the associated charts of the view. The view contains five charts to display the following signals for LTE and 5G NR: RSSI (LTE only), RSRP, RSRQ, SINR and the DELTA (Maximum Carrier Value – Minimum Carrier Value). DELTA also contains legend and properties components.

The X-axis is displayed at the bottom of the view.

The view's legend and properties are located on the right-hand side of the view by default. In the "UE Carrier Aggregation View Properties" field you can select carriers and signals out of supported ones for display. The chosen color for the selected carriers is associated to the selected signals both in the bar and chart fields.

If you deselect, for example the RSRQ chart display, the RSRQ bar, line and legend in DELTA chart become invisible.

If you resize the screen to reduce the width, at certain point, legend is hidden to give more space to lines and bars.

Figure 4-650: Auto hidden chart legend

If you resize the view to even smaller width, the lines are hidden to show only bars.

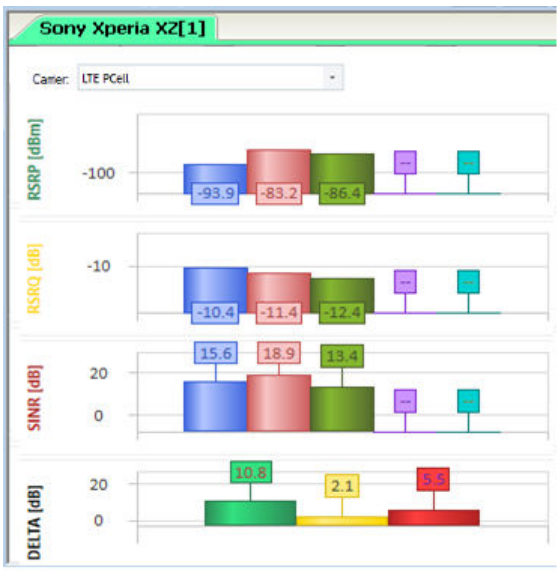


Figure 4-651: Auto hidden chart legend and line graph

If you increase the width of the view, the line and legend are restored if they are so configured.

4.4.23.1 Charts and legend

Chart

The view contains four signal charts and a DELTA chart. A chart has bars and lines.

Figure 4-652: Single chart display

For each displayed chart, the view shows a bar graph in the left pane and line graph in the right pane. The user can configure the size of the screen taken up by a graph on the view. Click the size bar of a signal and drag the mouse to either increase or decrease the size.

The width change is done for all bars or lines. The user cannot resize the width of an individual bar or line.

A chart has a title displayed vertically on the left of the chart. If the chart does not have enough space to show the entire title, ellipsis is displayed at the end.

Figure 4-653: Condensed chart title

You can hide bars, lines or legend in configuration bar using the "Show Graph" property.

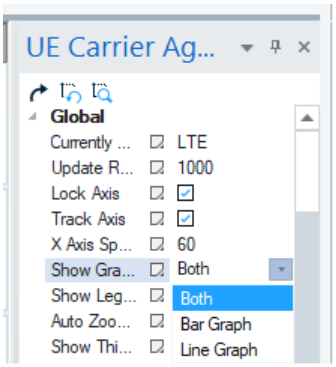


Figure 4-654: Chart selection

Three values are available in the "Show Graph" drop-down box.

- "Both" - show both bars and lines (default)
- "Bar Graph" - show bars only
- "Line Graph" - show lines only

Signal Charts

The RSSI, RSRP, RSRQ, SINR are signal charts.

For chart RSSI and RSRP, the bar and line graphs show power levels in [dBm] for PCC and SCC1 to SCC8 for LTE. For "5G- NR" carrier selection, RSRP power levels are shown for PSCell component carrier and component carriers of up to 11 SCells.

For chart RSRQ and SINR, the bar and line graphs show power ratios in [dB] for PCC, SCC1 to SCC8 for LTE. For "5G- NR" carrier selection, power ratios are shown for PSCell component carrier and component carriers of up to 11 SCells.

DELTA Chart

"DELTA" chart shows the signal differences. In the chart, the bar and line graphs show differences of the four values that are associated with charts RSSI (LTE only), RSRP, RSRQ and SINR.

The value for a line or a bar in DELTA chart is the difference between the maximum and minimum values of the corresponding signals.

For example, measured LTE SINR signal values in an instant of time are PCell = 33, SCell1 = 22, SCell2 = 32, SCell3 to SCell 8 = no value. The max is 33 and min is 22. So, the SINR value in "DELTA" chart at the given time is 11 (33 – 22 = 11).

The value in "DELTA" chart is valid if and only if at least two signal values of PCell/ PSCell and SCell1 to SCell8/SCell1 to SCell11(LTE /5G NR) are available and valid.

If the two valid values are not found at a given time, line and bar graph are empty in "DELTA" chart at that time. The following figure shows an empty "DELTA" chart, because only one signal, PCell, is available.

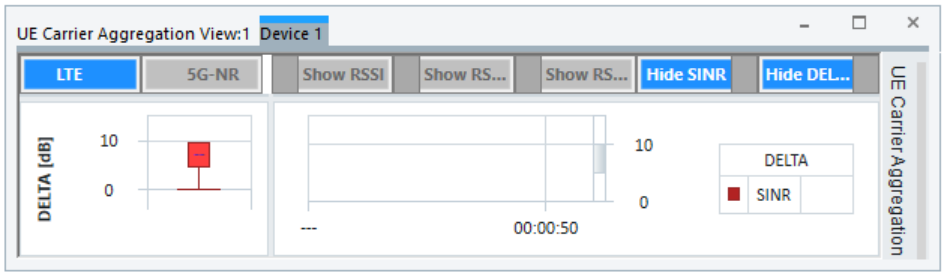


Figure 4-655: Empty DELTA chart

Legend

Legend is by default shown on the right side of the view.

The following figure shows the legends for signal RSSI and Delta charts.

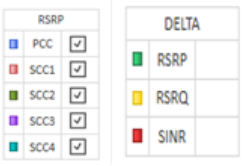


Figure 4-656: Legend for signal and DELTA charts

Other signal legends are similar. For signal charts, individual bar and line can be hidden by clearing the corresponding legend check boxes.

The DELTA legend does not have check boxes. The lines and bars for "DELTA" chart are associated with signal charts, RSSI, RSRP, RSRQ and SINR. You are not supposed to activate/deactivate those bar-/line-series using DELTA legend check boxes.

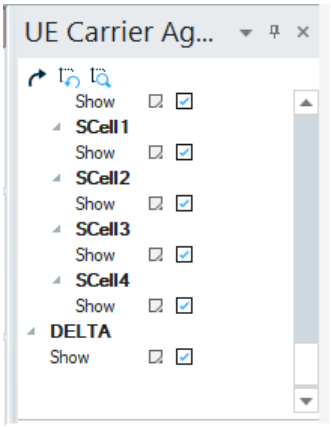


Figure 4-657: DELTA chart properties

For the same reason, DELTA properties bar does not have the "Show" properties for each individual series to show or hide the DELTA series.

The legend can be entirely hidden to make more space for bars or lines by clearing the "Show Legend" check box.

If the list of all properties in the legend cannot be displayed due to screen size constraints, you can use an up and down arrow to access the non-displayed items.

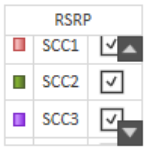


Figure 4-658: Legends scroll arrows

Click the arrow to scroll the list up and down accordingly.

4.4.23.2 Replay and measurement display items

During replay and measurement the following items are available.

Moving the mouse over the line graph shows the power levels for each component carrier represented by the current mouse location.

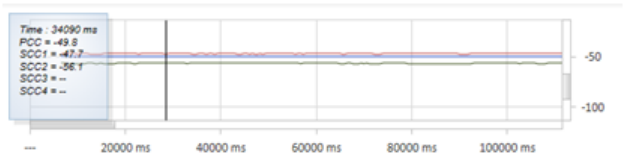


Figure 4-659: Mouse over display data

The bar shows the values for the current time within the measurement or replay.

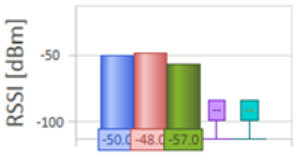


Figure 4-660: Bar chart values

Within the line graph, the current time stamp of the measurement is represented by a solid vertical black line. The approach is the same as in the "UE CA Downlink Performance View".

While a replay of a measurement is paused, double click at any point within the line graph rewinds or advances the replay file to that point. All other synced views are also advanced to that point.

If you scroll on any one X-axis of the line graphs, the X-axes of the other displayed line graphs scroll the same amount.

If you attempt to scroll the X-axis to a point in the measurement where the current cursor (solid black line) cannot be displayed during replay and measurement, the view automatically scrolls the line graph back to a point where the current cursor can be displayed. This behavior can be changed in configuration, see the configuration section for details.

You can scroll the Y-axis (power levels) of the power and line graph by clicking the scroll bar on the line graph. Move the mouse up and down. The Y-axis can be adjusted for each signal independently.

The thickness of the cursor and other lines in the line graph can be changed by clicking the "Show Thick Line" property in "UE Carrier Aggregation View Properties".

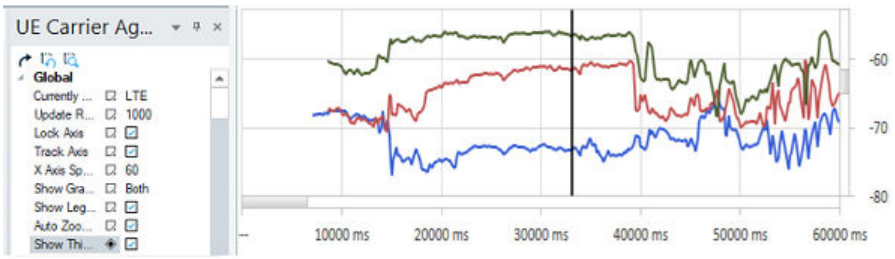


Figure 4-661: Line chart thickness property

Zoom to Fit

The "Zoom to Fit" feature sets the Y-axis minimum and maximum automatically, so that all lines and bars are displayed properly using the available chart space.

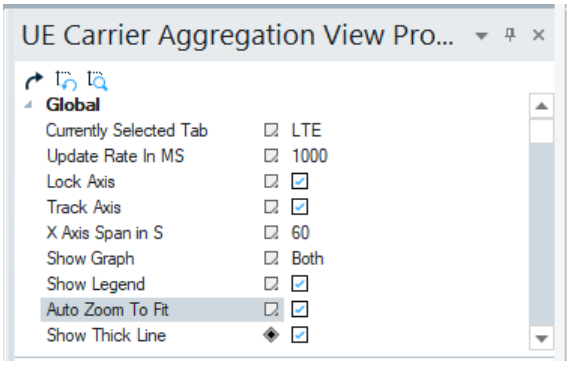


Figure 4-662: Zoom to fit

The following buttons for the feature are available in configuration bar:

- "Reset Zoom"
  Click to reset the Y-axis min and max to the default values in configuration.
- "Zoom To Fit"
  Click to recalculate the Y-axis min and max to show the lines/bars with all available chart spaces.

Hovering mouse over the icons displays the function of the associated icon.

Auto Zoom to Fit ← Zoom to Fit

If the "Auto Zoom To Fit" check box is checked, the Auto Zoom mode is active. This zoom mode is useful during measurement or replay.

In Auto Zoom mode, when a new value that is outside of the current Y-axis scope enters the display, the Y-axis range is reconfigured. The new value is shown in the chart properly after reconfiguration.

Note: The Y-axis is not reconfigured if the maximum or minimum value goes out of current display.

If you change the Y-axis or zoom-in to a line using mouse wheel in Auto Zoom mode, the mode turns off.

Click "Auto Zoom To Fit" icon to resume the Auto Zoom mode. The min and max value settings of Y-axis in configuration bar are disabled.

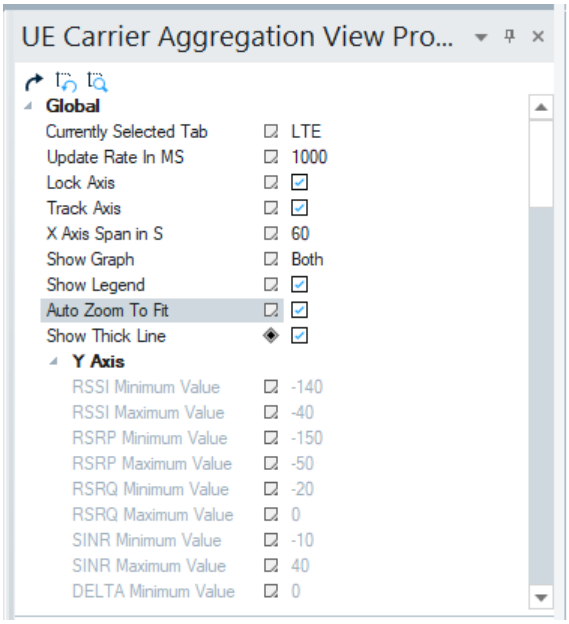


Figure 4-663: Y-axis configuration disabled by Auto Zoom to Fit

Manual Zoom to Fit ← Zoom to Fit
If the "Auto Zoom To Fit" check box is cleared, the Auto Zoom mode is deactivated.

The default configured Y-axis min and max settings are used.

Click the "Zoom To Fit" icon to zoom to fit the charts.

In this mode, the min and max value settings of Y-axis in configuration bar is enabled.

4.4.23.3 UE carrier aggregation view configuration

Click the "UE Carrier Aggregation View Properties" tab, which is by default located in the upper right portion of the view, to access the configuration.

If the tab is not visible, it can be recovered by right mouse-button click any point in the "UE Carrier Aggregation View" and selecting "Properties" in the drop-down menu.

By clicking the tab, a configuration item can be changed. The tab automatically hides itself if another item on the screen is clicked. The configuration properties can be pinned to the screen. To do that, click the pin icon of the "UE Carrier Aggregation View Properties" panel. The properties panel is displayed always when the view is active.

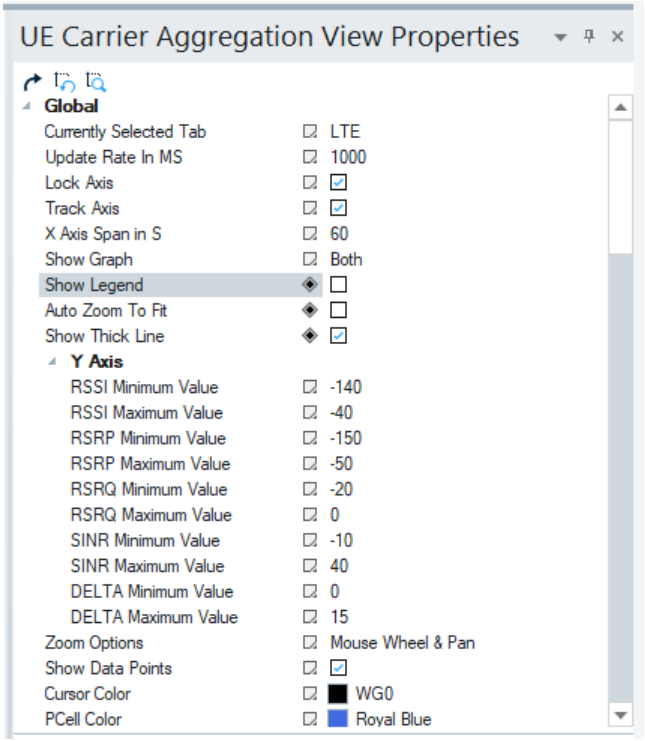


Figure 4-664: UE Carrier Aggregation View properties bar

Once the properties panel is pinned, it can be undocked from the view and made floating. To do undocking, double click the title bar of the properties panel or single click the title bar and drag the panel out of the view.

Drag the panel to the left, right, top or bottom of the view to redock the properties panel. Drag the panel to the display arrows to dock the panel to the desired location on the view.

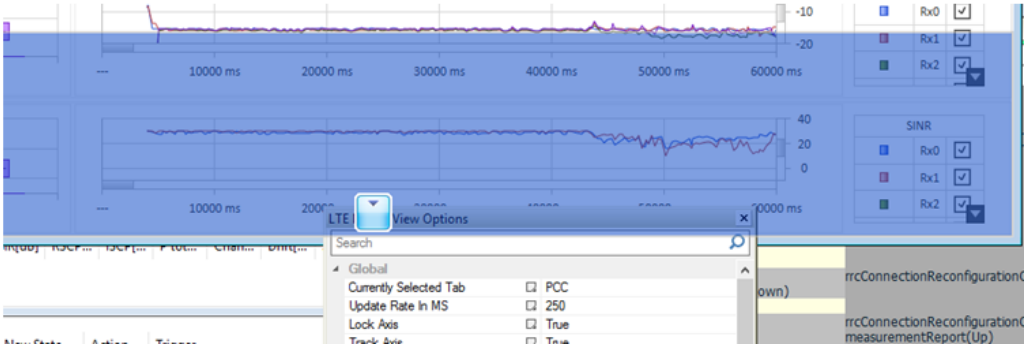


Figure 4-665: Redocking the properties panel

The properties configured are saved when the workspace or measurement file is saved.

Three buttons are available within the properties panel.

Figure 4-666: Available buttons in properties panel

Apart from the buttons "Reset Zoom" and "Zoom To Fit", there is the "Restore All Values" button. The associated icon is . Click the button to restore all properties to the values existed when the view was first started. If a workspace/measurement file is loaded, the setting reverts to the values from the file. Any individual setting can be reverted by right mouse click the setting and choosing "Reset Value".

Properties available in the view - global

The following properties are available for selection in the view.

Update Rate in MS
The number of milliseconds between the bar and the line graph display updates during a measurement or replay. This update is done to help with system performance. The lower the number the more frequent the screen refresh during measurement or replay, therefore slowing overall system performance. A value of zero refreshes the screen every time a new data point is received.

Lock Axis
Unchecked, this configuration property allows scrolling the X-axis of each line graph independently. X-axes of all line graphs are scrolled together if the property is checked.

Track Axis
Unchecked, this configuration allows scrolling the line graph outside of the current cursor during replay. If checked, always returns to X-axis of the line graph back to the current cursor.

Properties available in the view

X Axis Span is S
Time in second to display on the line graph X-axis.

Show Graph
The "Show Graph" drop box contains three possible values to choose.

- "Both" - show both bars and lines (default)
- "Bar Graph" - show bars only
- "Line Graph" - show lines only

Show Chart Legend
If unchecked, this configuration property hides the legend. It is checked by default to show a chart legend.

Auto Zoom To Fit
Check "Auto Zoom To Fit" to activate the automatic zoom mode to fit Y axis when measuring or replaying. Unchecked, the mode is deactivated.

Properties available in the view - y axis

RSSI Minimum Value
Minimum power level value to display on the Y-axis of the RSSI chart.

RSSI Maximum Value
Maximum power level value to display on the Y-axis of the RSSI chart.

RSRP Minimum Value
Minimum power level value to display on the Y-axis of the RSRP chart.

RSRP Maximum Value
Maximum power level value to display on the Y-axis of the RSRP chart.

RSRQ Minimum Value
Minimum power level value to display on the Y-axis of the RSRQ chart.

RSRQ Maximum Value
Maximum power level value to display on the Y-axis of the RSRQ chart.

SINR Minimum Value
Minimum power level value to display on the Y-axis of the SINR chart.

SINR Maximum Value
Maximum power level value to display on the Y-axis of the SINR chart.

DELTA Minimum Value
Minimum power level value to display on the Y-axis of the DELTA chart.

DELTA Maximum Value
Maximum power level value to display on the Y-axis of the DELTA chart.

Zoom Option
The setting changes the way how the zoom control works for the line graph.

- "None"
  No zoom control for the charts is enabled.
- "Mouse Wheel & Pan"
  Zoom the chart by using the mouse wheel
- "Magnify"
  Allow for zoom; the left mouse button click the line graph to zoom in, the right mouse button to zoom out.
- "Selection"
  Allow a specific location to be zoomed into by selecting an area with mouse.

Show Data Points
Allows changing the view so that when the mouse is moved over the line graph the individual antenna power levels are not shown.

Cursor Color
Allows changing the color of the cursor that indicates the current time in the measurement or replay.

PSCell Color/SCCell1 Color to SCCell8 Color
Allows changing the color that represents this item in the bar and graph charts ("Carrier" LTE).

PSCell Color/SCell1 Color to SCell11Color
Allows changing the color that represents this item in the bar and graph charts ("Carrier" 5G-NR).

RSSI

Show
Show signal for this type.

PCell, SCell1 to SCell8
Show signal strength on antenna for this signal.

RSRP

Show
Show signal of this type.

PCell, SCell1 to SCell8
Show reference signal strength on antenna for this carrier (LTE).

PSCell, SCell1 to SCell11
Show reference signal strength on antenna for this carrier (5G-NR).

RSRQ

Show
Show signal of this type.

PCell, SCell1 to SCell8
Show reference signal quality for this carrier (LTE).

PSCell, SCell1 to SCell11
Show reference signal quality for this carrier (5G-NR).

SINR

Show
Show signal of this type.

PCell, SCell1 to SCell8
Show reference signal quality for this carrier (LTE).

PSCell, SCell1 to SCell11
Show reference signal quality for this carrier (5G-NR).

DELTA

Show
Show signal of this type.

4.4.24 UE MIMO view

The "UE MIMO View" offers a quick overview of all LTE and 5G NR component carrier cells. The provided information types are the same for both technologies.

Figure 4-667: UE MIMO view - MIMO Layer, RI, RSRP, RSRQ, SINR sections

The view fully supports LTE and 5G NR technologies. It lets you select for display one out of 9 LTE carriers ("LTE PCC" or "LTE SCC1" to "LTE SCC8") and one out of 12 5G NR carriers ("5G NR PCC" and "5G NR SCC1" to "5G NR SCC11"). To select carrier for display, use the "Carrier" drop-down box.

There are some preconditions that have to be noticed in 5G NR:

- Create the measurement file with the current version. Older measurement files do not show the complete content.
- Exynos chipsets
  The minimal required ICD version is 6.12.
- Qualcomm chipsets
  - RSRQ per antenna is not supported.
  - RSRP is supported for two antennas only.
  - RSSI log is switched off by default as this log generates a high load on the UE. It can be switched on in the UEs configuration page.

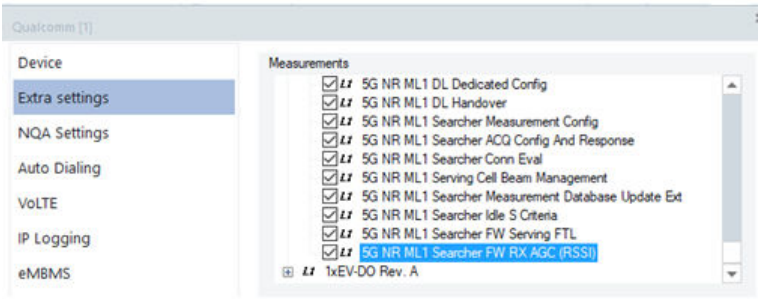


Figure 4-668: Extra settings for Qualcomm chipset based device

The MIMO Layer, RI, RSRP, RSRQ and SINR sections can be shown or hidden. The configuration if to be shown or not is done in the "UE MIMO View Properties" window. Check or uncheck the "Show" property next to a corresponding section name.

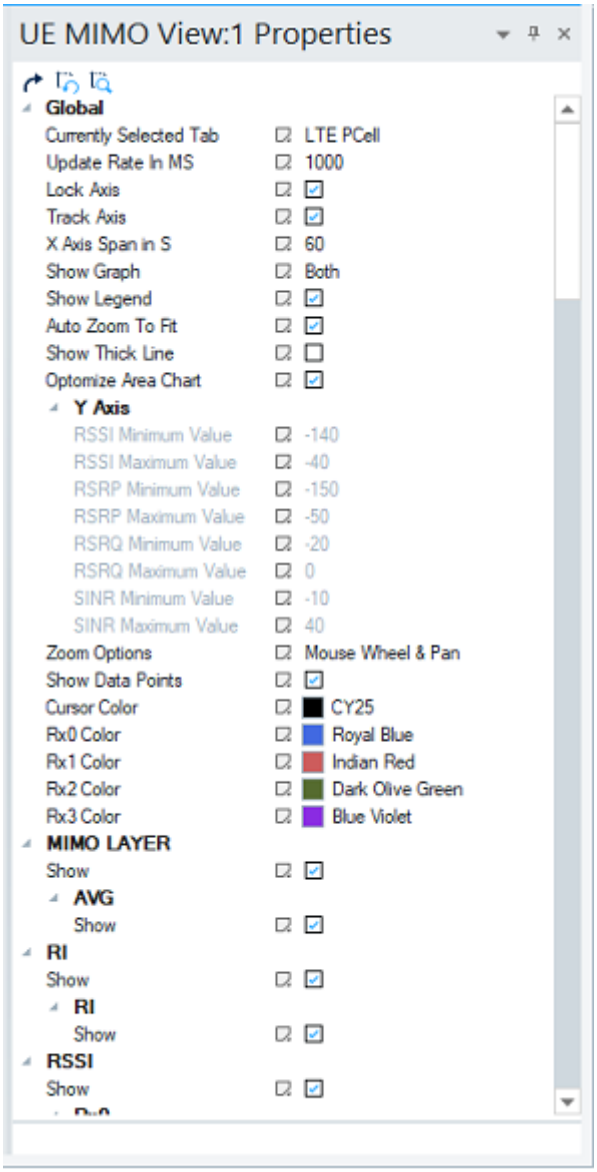


Figure 4-669: UE MIMO view properties

4.4.24.1 Charts and legend

Chart

UE MIMO view contains six signal charts.

A chart has bars and lines.

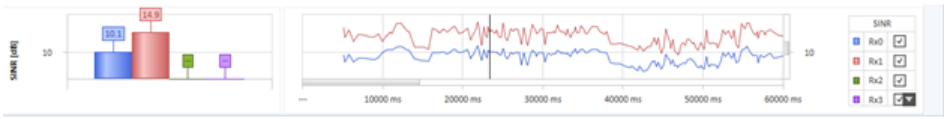


Figure 4-670: UE MIMO view - chart

For each displayed chart, the view displays a bar graph in the left pane and line graph in the right pane. You can configure the size of the screen taken up by a graph on the view. Click the size bar of a signal and drag the mouse to either increase or decrease the size.

The width change is done for all bars or lines. The user cannot resize the width of an individual bar or line.

A chart has a title displayed vertically on the left of the chart. If the chart does not have enough space to show the entire title, ellipsis is displayed at the end.

User can hide bars, lines or legend in configuration bar using the "Show Graph" property.

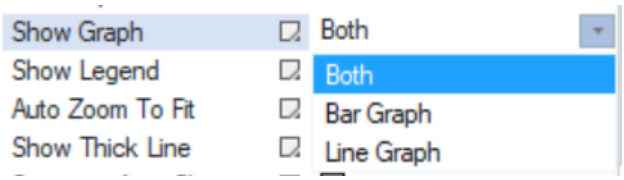


Figure 4-671: Show graph options

Three values are available in the "Show Graph" drop-down box.

- "Both" - show both bars and lines (default)
- "Bar Graph" - show bars only
- "Line Graph" - show lines only

Signal Charts

The MIMO Layer, RI, RSSI, RSRP, RSRQ, SINR are signal charts.

In the all charts, the bar and line graphs show values for:

- Primary and four secondary LTE cells
- Primary secondary 5G NR cell and four secondary 5G NR cells

Legend

Legend, by default, is shown on the right side of the view. The following figure shows the signal legends for RSSI chart. Other signal legends are similar.

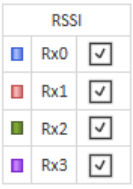


Figure 4-672: Chart legend for RSSI

The individual bar and line can be hidden by clearing the corresponding legend check boxes.

The legend can be entirely hidden to make more space for bars or lines by clearing the "Show Legend" check box in "UE MIMO View Properties".

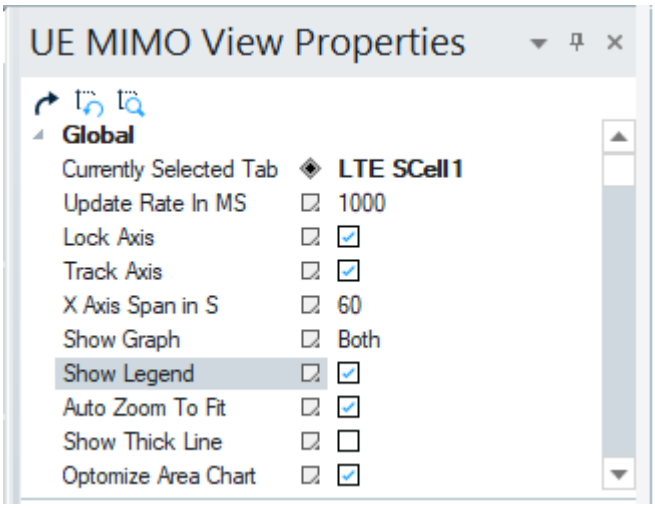


Figure 4-673: Show legend options

If the list of all options in the legend cannot be displayed due to screen size constraints, use one up and down arrow to access the non-displayed items.

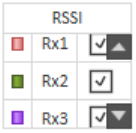


Figure 4-674: Legends scroll arrows

Click the arrow to scroll the list up and down accordingly.

4.4.24.2 Replay and measurement display items

During the replay and measurement, the following items are available.

Moving the mouse over the line graph shows the power levels for each antenna represented by the current mouse location.

Figure 4-675: Box showing the power levels

The bars show the power levels for the current time within the measurement or replay.

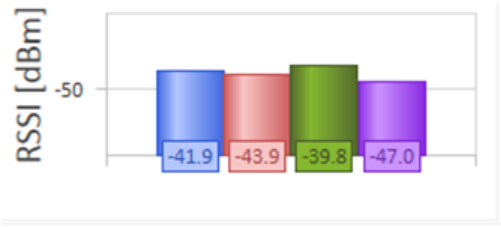


Figure 4-676: Bar showing the power levels

Within the line graph, a solid black line shows the current time stamp of the measurement.

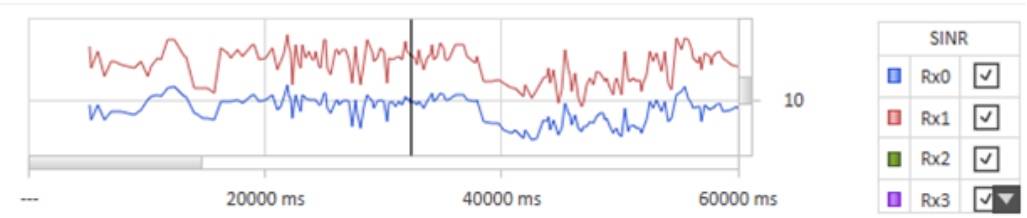


Figure 4-677: Vertical solid black line

While a replay of a measurement is paused, double clicking any point within the line graph rewinds or advances the replay file to that point. All other synced views are also advanced to that point.

If you scroll on any one X-axis of the line graphs, the X-axes of the other displayed line graphs scroll the same amount.

If you attempt to scroll the X-axis to a point in the measurement where the current cursor (solid black line) cannot be displayed during replay and measurement, the view automatically scrolls the line graph back to a point where the current cursor can be displayed. This behavior can be changed in configuration, see the configuration section for details.

You can also scroll the Y-axis (power levels) of the power and line graph by clicking the scroll bar on the line graph and moving the mouse up and down. The Y-axis can be adjusted for each signal independently.

The thickness of the cursor and other lines in the line graph can be changed by clicking the "Show Thick Line" options in the UE MIMO properties view bar, see the following figure.

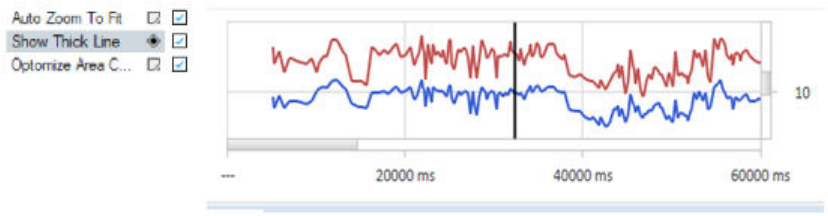


Figure 4-678: Line thickness options

Zoom to Fit

The "Zoom to Fit" feature sets the Y-axis minimum and maximum automatically, so that all lines and bars are displayed properly using the available chart space.

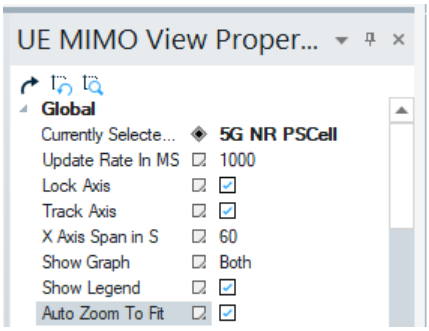


Figure 4-679: Zoom to fit

The following buttons for the feature are available in configuration bar:

- "Reset Zoom"
  Click to reset the Y-axis min and max to the default values in configuration.
- "Zoom To Fit"
  Click to recalculate the Y-axis min and max to show the lines/bars with all available chart spaces.
  See Figure 4-685 for the configuration bar.

Hovering mouse over the icons displays the function of the associated icon.

Auto Zoom to Fit ← Zoom to Fit

If the "Auto Zoom To Fit" check box is checked, the Auto Zoom mode is active. This zoom mode is useful during measurement or replay.

In Auto Zoom mode, when a new value that is outside of the current Y-axis scope enters the display, the Y-axis range is reconfigured. The new value is shown in the chart properly after the reconfiguration.

Note: The Y-axis is not reconfigured if the maximum or minimum value goes out of current display.

If you change the Y-axis or zoom-in to a line using mouse wheel in Auto Zoom mode, the mode turns off.

Click "Zoom To Fit" icon to resume the Auto Zoom mode. The min and max value settings of Y-axis in configuration bar is disabled.

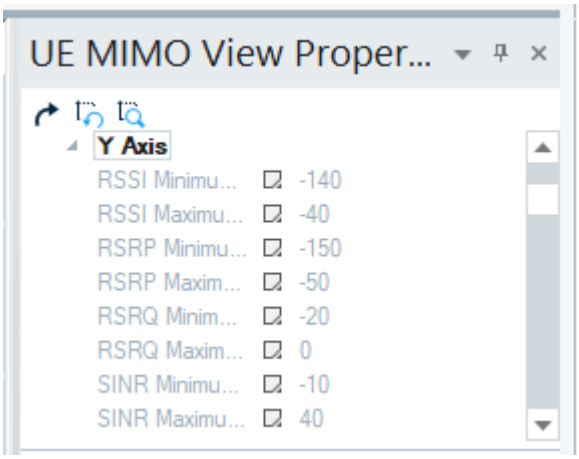


Figure 4-680: Y-axis configuration disabled in Auto Zoom to Fit mode

Manual Zoom to Fit ← Zoom to Fit

If the "Auto Zoom To Fit" check box is cleared, the Auto Zoom mode is deactivated.

The default configured Y-axis min and max settings are used.

Click the "Zoom To Fit" icon to zoom to fit the charts.

In this mode, the min and max value settings of Y-axis in configuration bar is enabled.

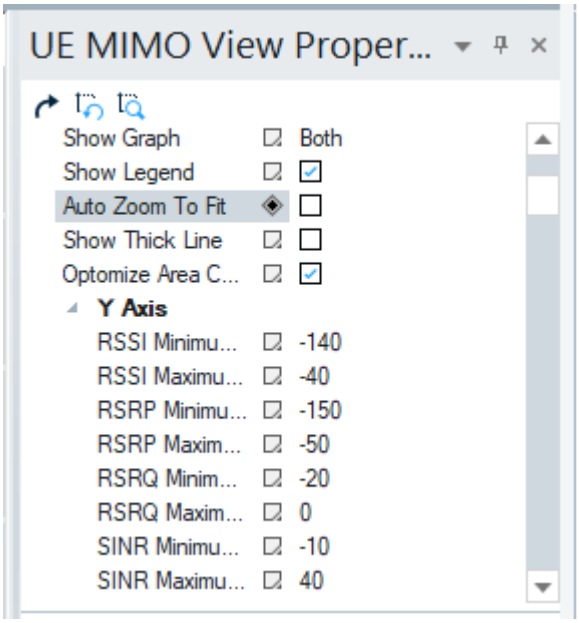


Figure 4-681: Auto Zoom To Fit deactivated

4.4.24.3 UE MIMO view configuration

To access the configuration, click the "UE MIMO View Properties" tab located by default in the upper right portion of the view.

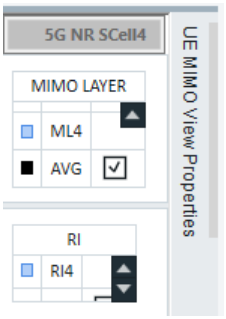


Figure 4-682: UE MIMO View Properties tab

If the tab is not visible, it can be recovered by right mouse-button click any point in the "UE MIMO View" and selecting "Properties" in the drop-down menu.

By clicking the tab, a configuration item can be changed. The tab automatically hides itself if another item on the screen is clicked. The configuration properties can be pinned to the screen. To do that, click the pin icon in the "UE MIMO View Properties" panel. The properties panel is displayed always when the view is active.

Once the options panel is pinned, it can be undocked from the view and made floating. To do undocking, double click the title bar of the options panel or single click the title bar and drag the panel off of the view.

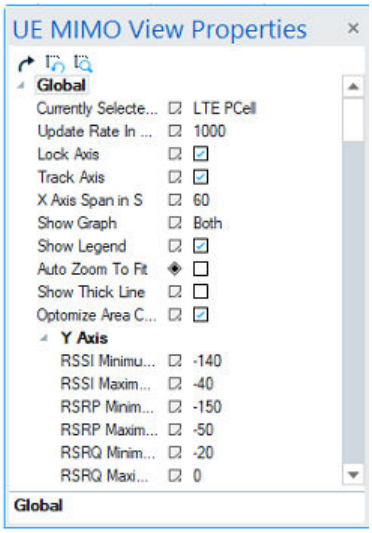


Figure 4-683: Undocked options panel

The options panel can be redocked to the view. Drag the panel to the left, right, top or bottom of the view. To dock the panel to the desired location on the view, drag the panel to the display arrows.

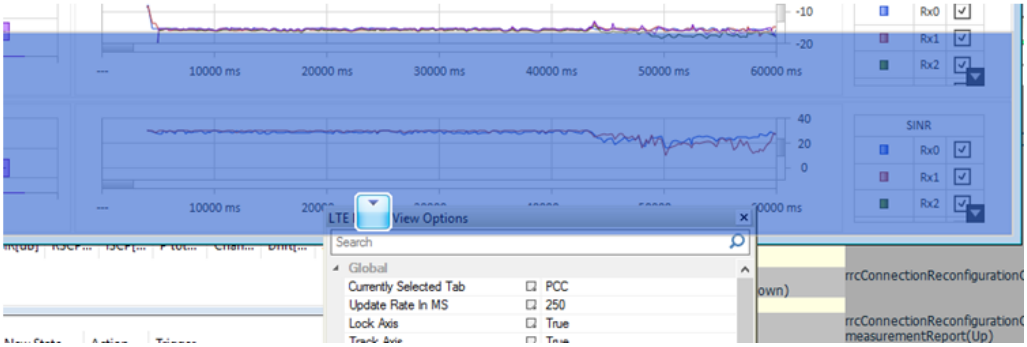


Figure 4-684: Redocking the options panel

The properties configured are saved when the workspace or measurement file is saved.

Three buttons are available within the properties panel.

Figure 4-685: Available buttons in properties panel

Apart from the buttons "Reset Zoom" and "Zoom To Fit", there is the "Restore All Values" button. The associated icon is . Click the button to restore all properties to the values existed when the view was first started. If a workspace/measurement file is loaded, the setting reverts the values from the file. Any individual setting can be reverted by right mouse click the setting and choosing "Reset Value".

Properties available in the view - global

The following properties are available for selection in the view.

Currently Selected Tab
This setting sets the default selected tab when R&S ROMES4 starts.

Update Rate in MS
The number of milliseconds between the bar and the line graph display updates during a measurement or replay. This update is done to help with system performance. The lower the number the more frequent the screen refresh during measurement or replay, therefore slowing overall system performance. A value of zero refreshes the screen every time a new data point is received.

Lock Axis
Unchecked, this configuration property allows scrolling the X-axis of each line graph independently. X-axes of all line graphs are scrolled together if the property is checked.

Track Axis
Unchecked, this configuration allows scrolling the line graph outside of the current cursor during replay. If checked, always returns to X-axis of the line graph back to the current cursor.

X Axis Span is S
Time in second to display on the line graph X-axis.

Show Graph
Indicate which graph to be shown. The "Show Graph" drop box contains three possible values to choose.

- "Both" - show both bars and lines (default)
- "Bar Graph" - show bars only
- "Line Graph" - show lines only

Show Chart Legend
If unchecked, this configuration property hides the legend. It is checked by default to show a chart legend.

Auto Zoom To Fit
Automatic zoom to fit Y Axis when measuring or replaying

Check "Auto Zoom To Fit" to activate the Auto Zoom mode.

Clear "Auto Zoom To Fit" to deactivate this mode.

Check "Auto Zoom To Fit" to activate the automatic zoom mode to fit Y axis when measuring or replaying. Unchecked, the mode is deactivated.

Y Axis

RSSI Minimum Value ← Y Axis
Minimum power level value to display on the Y-axis of the RSSI chart.

RSSI Maximum Value ← Y Axis
Maximum power level value to display on the Y-axis of the RSSI chart.

RSRP Minimum Value ← Y Axis
Minimum power level value to display on the Y-axis of the RSRP chart.

RSRP Maximum Value ← Y Axis
Maximum power level value to display on the Y-axis of the RSRP chart.

RSRQ Minimum Value ← Y Axis
Minimum power level value to display on the Y-axis of the RSRQ chart.

RSRQ Maximum Value ← Y Axis
Maximum power level value to display on the Y-axis of the RSRQ chart.

SINR Minimum Value ← Y Axis
Minimum power level value to display on the Y-axis of the SINR chart.

SINR Maximum Value ← Y Axis
Maximum power level value to display on the Y-axis of the SINR chart.

Zoom Property
The way how the zoom control works for the line graph.

- "None"
  Zoom control for the charts is inactive.
- "Mouse Wheel & Pan"
  Zoom the chart by using the mouse wheel.
- "Magnify"
  Allow for zoom; the left mouse button click the line graph to zoom in, the right mouse button to zoom out.
- "Selection"
  Allow a specific location to be zoomed into by selecting an area with mouse.

Show Data Points
Allows changing the view so that when the mouse is moved over the line graph the individual antenna power levels are not shown.

Cursor Color
Allows changing the color of the cursor that indicates the current time in the measurement or replay.

Rx0 Color to Rx3 Color
Allows changing the color that represents this item in the bar and graph charts.

Properties available in the view - MIMO layer

Show signal of MIMO layer type.

ML1, ML2, ML3, ML4, AVG Shown
Show MIMO layers signal and its average.

Properties available in the view - RI

Show signal type Rank Indicator.

RI1, RI2, RI3, RI4 Shown
Show signals of this type.

Properties available in the view - RSSI

Show
Show signal for this type.

Rx0, Rx1, Rx2, Rx3 Shown
Show antenna for this signal.

Properties available in the view - RSRP

Show
Show signal value of this type.

Rx0, Rx1, Rx2, Rx3 Show
Show for this antenna reference signal received power.

Properties available in the view - RSRQ

Show
Show signal value of this type.

Rx0, Rx1, Rx2, Rx3 Shown
Show for this antenna reference signal received quality.

Properties available in the view - SINR

Show
Show signal of this type.

Rx0, Rx1, Rx2, Rx3 Shown
Show for this antenna signal to noise and interference.

4.4.25 UE modulation view

The "UE Modulation View" makes possible the 5G NR and LTE measurement analysis from a single view. The view is derived from the former "LTE Modulation View".

The view is launched from the R&S ROMES4 menu "View" > "Mobile Views" > "UE". The view can also be launched from the context pop-up menu by right mouse button clicking the empty view area.

The "UE Modulation View" tracks the uplink and downlink modulation values of all LTE carriers and of all 5G NR carriers.

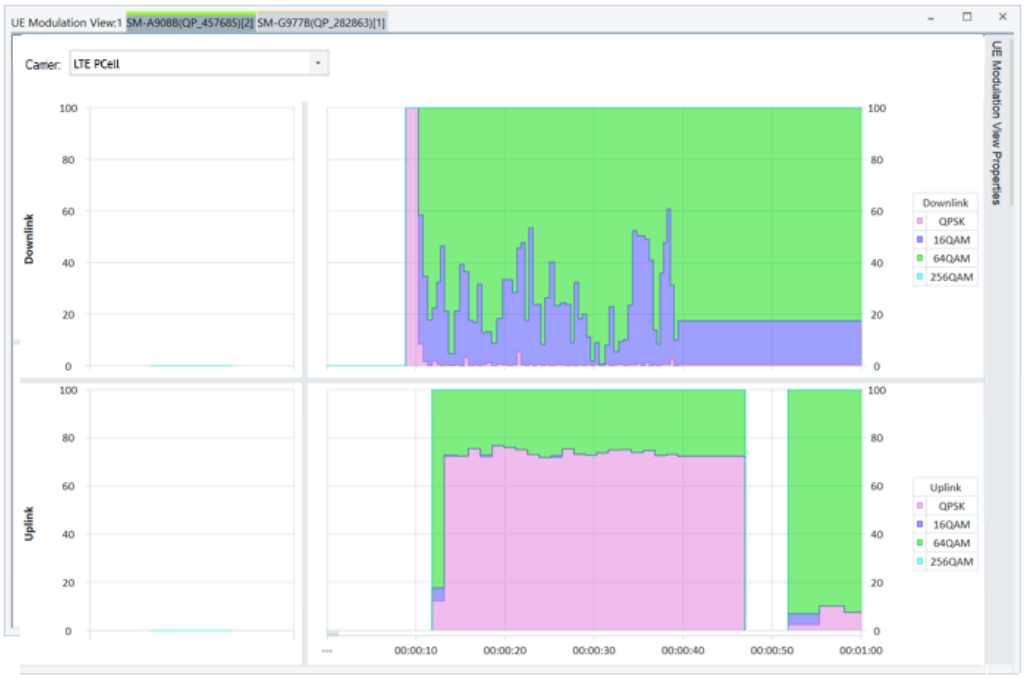


Figure 4-686: Default UE Modulation View

The "Carrier" drop-down box lets you select for display these values of LTE primary cell ("LTE PCell") and up to 8 secondary cells ("LTE SCellx", where x = 1 to 8) or of 5G NR primary secondary cell ("5G NR PSCell") and up to 11 %G NR secondary cells("5G NR Scellx").

The view contains two sections:

- Downlink section shows modulation for downlink signal per selected carrier type.
- Uplink section shows modulation for uplink signals per selected carrier type.

Each section can be configured to be shown or not from the "UE Modulation View Properties" panel. Check or uncheck the "Show" property next to corresponding section name.

Properties are by default located on the right side of the "UE Modulation View".

In each section displayed is a current value column that shows the modulation signal percentage (based on 100%) for a given time in the measurement file. An over time graph chart that shows modulation percentages over the life of the measurement file is displayed on the left-hand side of the chart.

You can configure the size of the view taken up by a section. Click the horizontal size bar that divides "Downlink" and "Uplink" section and drag the mouse to either increase or decrease the size.

Tracked signals

The view tracks the following signals.

- LTE PCell - Downlink
  PDSCH – QSPK Rate/16QAM Rate/64QAM Rate/256QAM Rate

- LTE PCell - Uplink
  PUSCH – QSPK Rate/16QAM Rate/64QAM Rate
- LTE SCellx - Downlink, x = 1 to 8 secondary component carriers
  PDSCH – QSPK Rate/16QAM Rate/64QAM Rate/256QAM Rate
- LTE SCellx - Uplink, x = 1 to 8 secondary component carriers
  SCCn PUSCH – QSPK Rate/16QAM Rate/64QAM Rate

4.4.25.1 Replay and measurement display items

During replay and measurement, the following items are available.

Moving the mouse over the time graph shows the values that are present at that point in time.

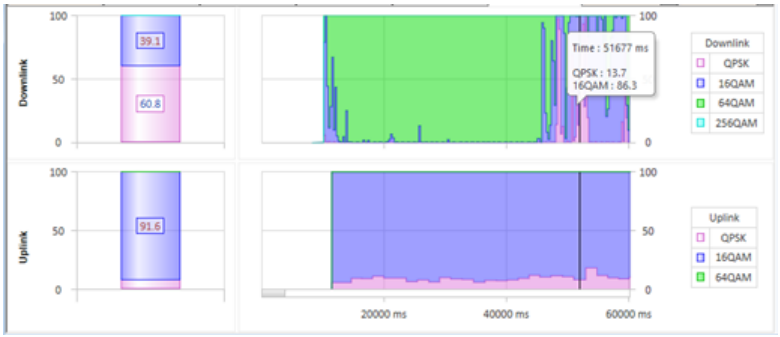


Figure 4-687: Mouse hovering over data

Tooltips are displayed in the upper left section of each chart. When the mouse is moved over the chart the Tooltip information box in the upper left of the chart displays the current value for all chart elements. If the mouse leaves the chart, the Tooltip box is no longer displayed.

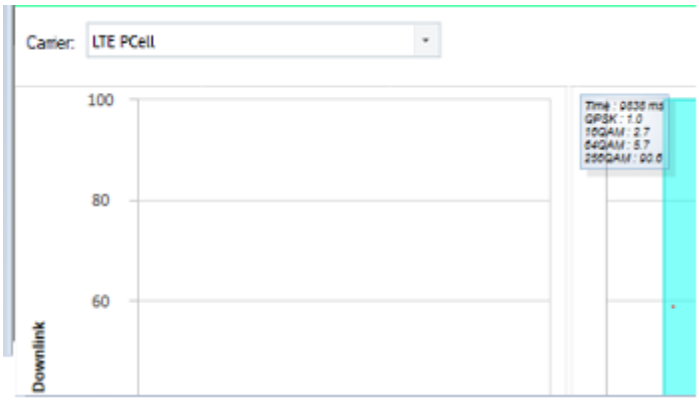


Figure 4-688: Tooltip for UE Modulation View

Within the time chart, a solid vertical black line represents the current time stamp of the measurement.

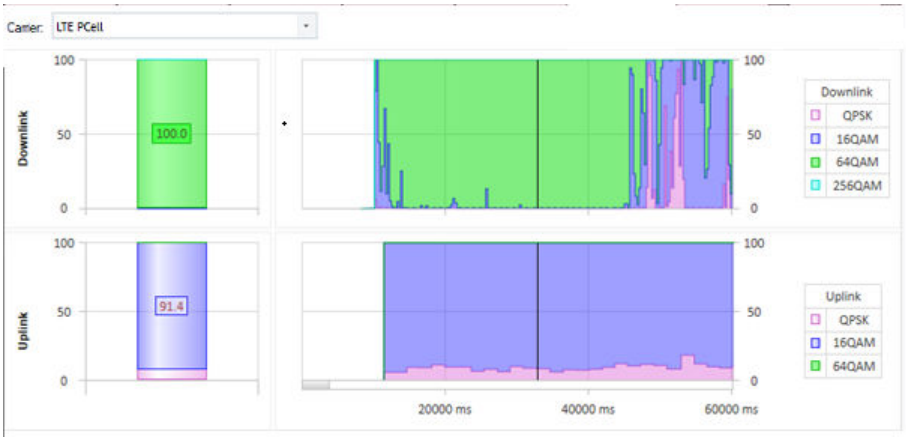


Figure 4-689: Black line showing current cursor

While a replay of a measurement is paused, double clicking any point within the line graph rewinds or advances the replay file to that point. All other synced views are also advanced to that point.

You can scroll along the time axis by clicking, holding and then moving the mouse on the scroll bar on the bottom chart.

Also, you can scroll the time axis by clicking, holding and then moving the mouse on any of the displayed charts. If you attempt to scroll the time axis to a point in the measurement where the current cursor (solid black line) cannot be displayed during replay and measurement, the view automatically scrolls the line graph back to a point where the current cursor can be displayed. This behavior can be changed in configuration.

During the replay, you can also zoom in on the time-axis by using the mouse wheel or by using touch pinch and zoom gestures.

4.4.25.2 UE modulation view configuration

The configuration for the view can be accessed by clicking the "UE Modulation View Properties" bar. The tab is by default located in the upper right portion of the view.

Click the bar to open the properties panel and to change some configurations. The panel automatically hides itself when another item on the screen is clicked.

The configuration properties can be pinned to the screen by clicking the pin icon the properties panel. The properties panel is displayed as long as the view is active.

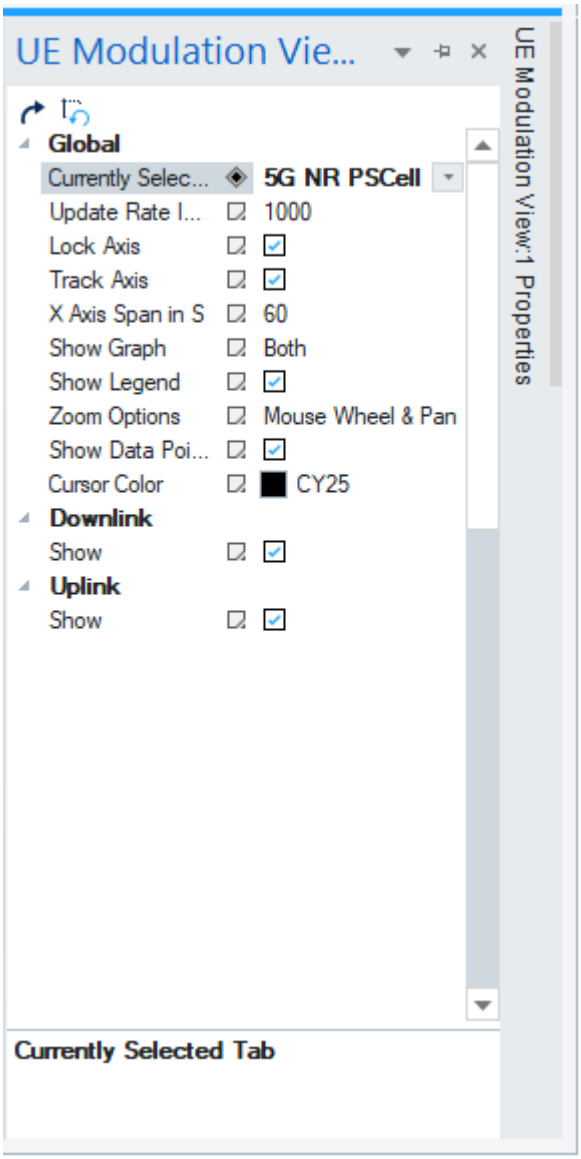


Figure 4-690: UE Modulation View properties

If this pane is not visible, it can be recovered by right mouse-button click any point in the "UE Modulation View" and selecting "Properties" in the drop-down menu.

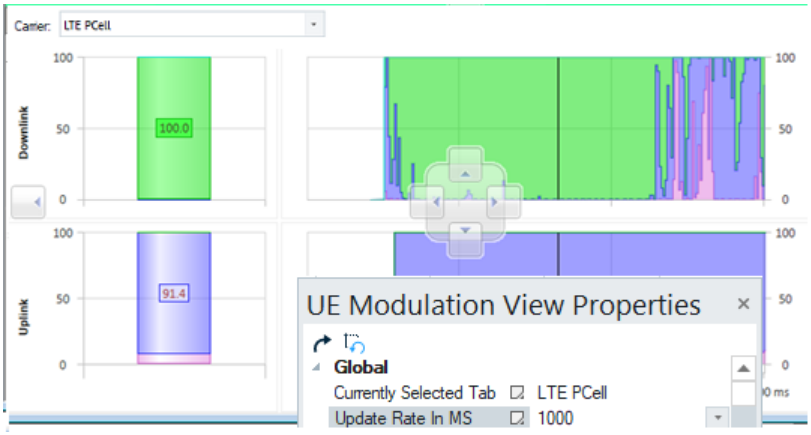


Figure 4-691: UE Modulation View docking options

Properties available in the view - global

The following properties are available for changing in the view.

Update Rate in MS
The number of milliseconds between the bar and the line graph display updates during a measurement or replay. This update is done to help with system performance. The lower the number the more frequent the screen refresh during measurement or replay, therefore slowing overall system performance. A value of zero refreshes the screen every time a new data point is received.

Lock Axis
Unchecked, this configuration property allows scrolling the X-axis of each line graph independently. X-axes of all line graphs are scrolled together if the property is checked.

Track Axis
Unchecked, this configuration allows scrolling the line graph outside of the current cursor during replay. If checked, always returns to X-axis of the line graph back to the current cursor.

X Axis Span is S
Time in second to display on the line graph X-axis.

Show Graph
The "Show Graph" drop box contains three possible values to choose.

- "Both" - show both column and area graphs (default)
- "Column Graph" - show current value
- "Line Graph" - show values over time

Show Chart Legend
If unchecked, this configuration property hides the legend. It is checked by default to show a chart legend.

Zoom Option
The setting changes the way how the zoom control works for the line graph.

- "None"
  No zoom control for the charts is enabled.
- "Mouse Wheel & Pan"
  Zoom the chart by using the mouse wheel
- "Magnify"
  Allow for zoom; the left mouse button click the line graph to zoom in, the right mouse button to zoom out.
- "Selection"
  Allow a specific location to be zoomed into by selecting an area with mouse.

Show Data Points
Allows changing the view so that when the mouse is moved over the line graph the individual antenna power levels are not shown.

Cursor Color
Allows changing the color of the cursor that indicates the current time in the measurement or replay.

Downlink Show
Show or hide the downlink section for the current carrier.

Uplink Show
Show or hide the uplink section for the current carrier.

4.5 CW views

The "CW Views" offers only the "Alphanumeric View for CW".

Figure 4-692: CW views

Click the entry to get the alphanumeric view for CW

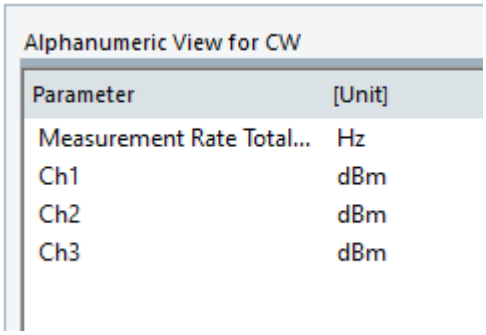


Figure 4-693: Alphanumeric view for CW of the selected measurements

Click any point in the "Alphanumeric View for CW" to get the view's configuration page. In the drop-down menu select the "Configuration" entry. The displayed opening "Values" tab offers signals available for display in the view.

The following screenshot shows the CW view configuration page and the selection of the signals. The "Settings" tab allows you to select coloring for the selected signals when displayed in the view. Refer also to Chapter 4.2.3, "Alphanumeric view", on page 466.

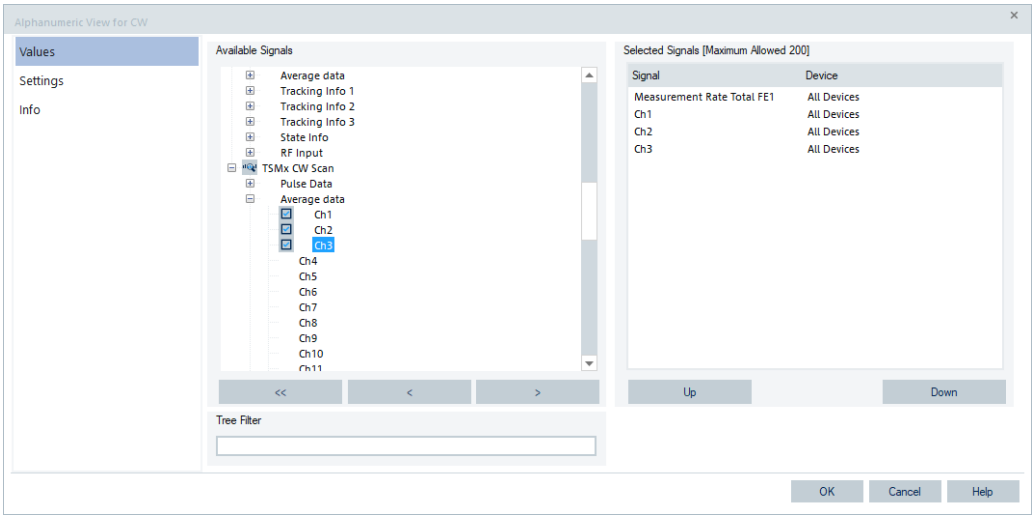


Figure 4-694: CW view configuration page

4.6 QoS views

The "QoS Views" display the test results obtained by the R&S data quality tester, named R&S ROMES4DQA. The purpose of the DQA measurement is to evaluate the Quality of Service (QoS) of any kind of data transfer connection.

DQA measurements are performed using the DQA tester (see chapter 6, Devices). Loading the tester does not require any hardware or additional test devices. An example procedure for setting up and testing a connection is described in chapter Chapter 2.2.1, "Test mobiles", on page 72.

Many of the QoS results can also be displayed in other R&S ROMES4 views, for example, in the "Alphanumeric View", "2D Chart View" and "ROMESMAP Route Track View".

The QoS views can be selected from a submenu displayed on the right side of the "View" menu when the mouse pauses over "QoS Views".

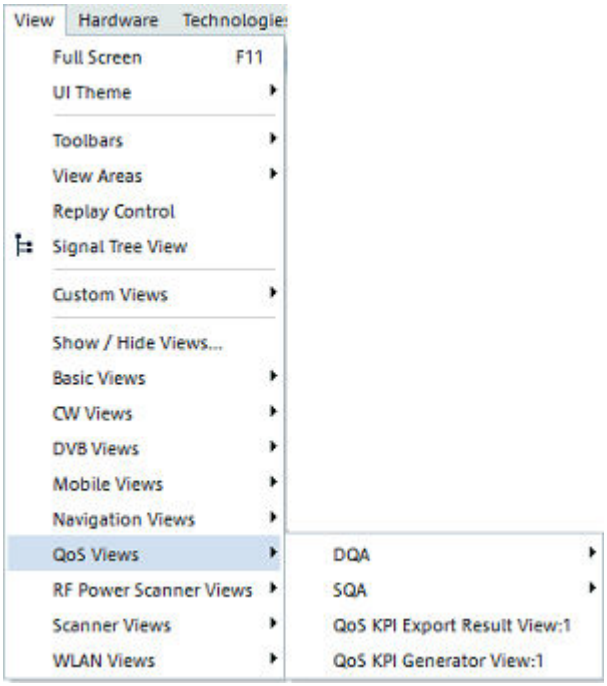


Figure 4-695: QoS views

4.6.1 QoS SQA view

The QoS SQA view displays the results of the speech quality analysis (SQA).

The SQA -Voice Quality PESQ needs the R&S ROMES4 SQA option.

The view can be accessed from a submenu displayed on the right side of the "View" menu when the mouse pauses over "SQA" entry.

Figure 4-696: QoS SQA view selection

4.6.1.1 SQA message view

The "SQA Message View" shows the progress of the test. It displays the state of the measurement engine and also the values of the done measurements.

To obtain results for the "SQA Message View", the SQA must be enabled and configured using the "Speech Quality" tab of the test mobile devices. For a detailed description of the device configuration, the SQA procedure and the test setup, see Chapter 6.4.12.3, "Configuration – speech quality", on page 1689.

SQA is provided for different mobile types and the 3GPP specified technologies.

If an audio file is recorded for a certain MOS value, the corresponding line is written in blue. By using the context menu, the user is able to listen and/or export the degraded audio file.

In addition to the results in the "SQA Message View", R&S ROMES4 generates a wide range of SQA signals.

The signals are under the "SQA Tester" node of the signal tree (to get it, click "Tools" > "Preferences" > "Available Signals").

You can analyze the signals in one of the basic views. For example, you can see the PESQ score in a series of consecutive loops and calculate average, minimum and maximum values in the "Statistic Histogram View".

SQA Message View:1

SQA[1] <SRG3900[1]>

Time	Message
5025 ms	[Down] Preparing for SQA downlink measurement with reference file: G:\Data\ROMES\SQA Sprachsamples\or105.wav (All)
5025 ms	[Down] Initial pause : 11300 ms ; Sample window : 8402 ms ; Pause between : 2500 ms
5025 ms	[Up] Preparing for SQA uplink measurement with reference file: G:\Data\ROMES\SQA Sprachsamples\or105.wav (All)
5025 ms	[Up] Initial pause : 2500 ms ; Sample window : 8402 ms ; Pause between : 11300 ms
26204 ms	[Down] State Changed: initialized -> prepared
26205 ms	[Down] State Changed: prepared -> running
26205 ms	[Up] State Changed: initialized -> prepared
26205 ms	[Down] waiting initial pause
26205 ms	[Up] State Changed: prepared -> running
26205 ms	[Up] placing initial silence on playback buffer
28202 ms	[Up] placing reference sample on playback buffer
36602 ms	[Up] placing silence on playback buffer
37504 ms	[Down] entering loop 0; Offset: 0 ms ; Threshold: 8402 ms
37504 ms	[Down] waiting till threshold is reached
45907 ms	[Down] waiting in pesq evaluation queue
45907 ms	[Down] performing pesq evaluation
46320 ms	[Down] Pesq calculated delays: min 318.13 ms avg 318.19 ms max 318.25 ms ; Compensating with EWMA : 286 ms
46332 ms	[Down] PESQ Result of degraded file: Offset: 0 ms ; MOS-LQ0 P862.1: 2.5 ; Attenuation: 8.3 dB
46405 ms	[Down] entering loop 1; Offset: 11188 ms ; Threshold: 19590 ms
46405 ms	[Down] waiting till threshold is reached
47903 ms	[Up] placing reference sample on playback buffer
56819 ms	[Up] uplink measurement completed
56821 ms	[Up] State Changed: running -> initialized
57092 ms	[Down] waiting in pesq evaluation queue
57092 ms	[Down] performing pesq evaluation
57511 ms	[Down] Pesq calculated delays: min 32.88 ms avg 32.88 ms max 32.88 ms ; Compensating with EWMA : 58 ms
57518 ms	[Down] PESQ Result of degraded file: Offset: 11188 ms ; MOS-LQ0 P862.1: 2.6 ; Attenuation: 8.2 dB
57597 ms	[Down] entering loop 2; Offset: 22148 ms ; Threshold: 30550 ms
57597 ms	[Down] waiting till threshold is reached
68052 ms	[Down] waiting in pesq evaluation queue
68052 ms	[Down] performing pesq evaluation
68465 ms	[Down] Pesq calculated delays: min -24.50 ms avg -24.43 ms max -24.38 ms ; Compensating with EWMA : -16 ms
68469 ms	[Down] PESQ Result of degraded file: Offset: 22148 ms ; MOS-LQ0 P862.1: 2.6 ; Attenuation: 8.3 dB
68551 ms	[Down] entering loop 3; Offset: 33034 ms ; Threshold: 41436 ms
68551 ms	[Down] waiting till threshold is reached
78936 ms	[Down] waiting in pesq evaluation queue
78936 ms	[Down] performing pesq evaluation
79347 ms	[Down] Pesq calculated delays: min -7.88 ms avg -7.80 ms max -7.75 ms ; Compensating with EWMA : -9 ms
79358 ms	[Down] PESQ Result of degraded file: Offset: 33034 ms ; MOS-LQ0 P862.1: 2.6 ; Attenuation: 8.3 dB
79431 ms	[Down] downlink measurement completed
79436 ms	[Down] State Changed: running -> initialized
87054 ms	[Up] abort requested
87054 ms	[Down] abort requested
116303 ms	[Down] State Changed: initialized -> prepared
116304 ms	[Up] State Changed: initialized -> prepared
116304 ms	[Up] State Changed: prepared -> running
116304 ms	[Down] State Changed: prepared -> running
116304 ms	[Up] placing initial silence on playback buffer
116304 ms	[Down] waiting initial pause
118304 ms	[Up] placing reference sample on playback buffer
126704 ms	[Up] placing silence on playback buffer
127604 ms	[Down] entering loop 0; Offset: 0 ms ; Threshold: 8402 ms
127604 ms	[Down] waiting till threshold is reached
136009 ms	[Down] waiting in pesq evaluation queue
136009 ms	[Down] performing pesq evaluation
136447 ms	[Down] Pesq calculated delays: min 331.00 ms avg 331.00 ms max 331.00 ms ; Compensating with EWMA : 298 ms
136454 ms	[Down] PESQ Result of degraded file: Offset: 0 ms ; MOS-LQ0 P862.1: 2.5 ; Attenuation: 8.1 dB
136531 ms	[Down] entering loop 1; Offset: 11200 ms ; Threshold: 19602 ms
136531 ms	[Down] waiting till threshold is reached
138005 ms	[Up] placing reference sample on playback buffer
146921 ms	[Up] uplink measurement completed
146923 ms	[Up] State Changed: running -> initialized
147206 ms	[Down] waiting in pesq evaluation queue
147206 ms	[Down] performing pesq evaluation
147618 ms	[Down] Pesq calculated delays: min 33.63 ms avg 33.70 ms max 33.75 ms ; Compensating with EWMA : 60 ms
147624 ms	[Down] PESQ Result of degraded file: Offset: 11200 ms ; MOS-LQ0 P862.1: 2.5 ; Attenuation: 8.2 dB
147701 ms	[Down] entering loop 2; Offset: 22162 ms ; Threshold: 30564 ms

Figure 4-697: SQA Message View

Example:

The SQA message view of the speech quality measurement results made with smartphone

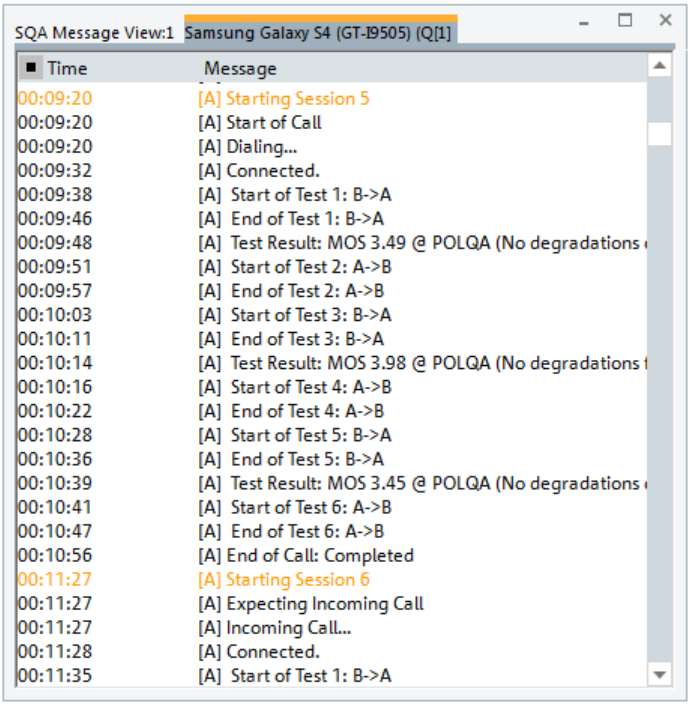


Figure 4-698: SQA message view measurement results with smartphone

The possible prefixes in the "SQA Message View" are explained in the following table.

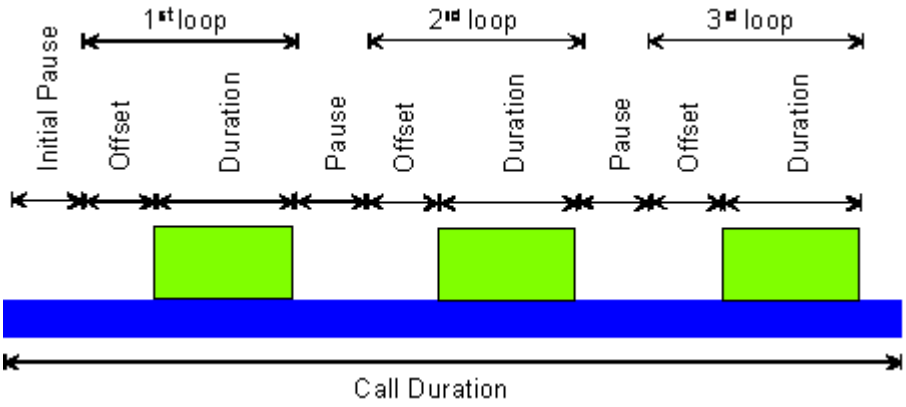
Table 4-28: SQA message view prefixes

Prefix	Description
[A]	A-Party Mobile: The mobile which is configured for speech quality.
[B]	B-Party Mobile: The mobile which is configured as a B-Party.
[L]	Land Unit: After having merged the land unit files into the measurement file, these messages appear in the same view as the [A] messages do.

For more information on Land Unit, see "Measurement setup with land unit as B-Party" on page 1672.

SQA measurement explanation

An SQA measurement consists of a specified number of test loops. In each test loop, R&S ROMES4 uploads or downloads voice data for a specified duration and calculates the PESQ score according to ITU-T recommendation P.862. An offset time precedes each data transfer. Moreover the individual loops are separated by a pause time. All timing parameters can be set in the device configuration menu; for the configuration see Chapter 6.4.12.2, "SQA settings", on page 1684.



The interval between two consecutive PESQ evaluations is calculated as a sum of a sample length, end pause and delay (EWMA), as shown in the following figure. The delay is adjusted with each new PESQ calculation.

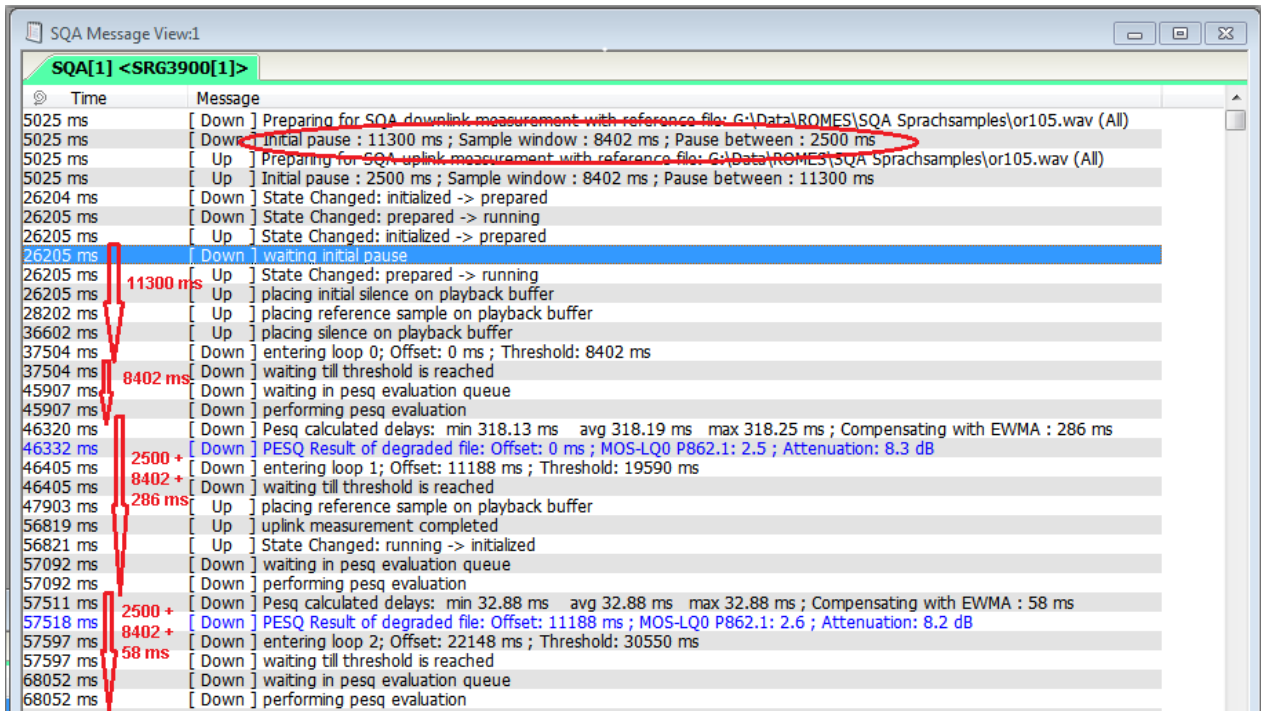


Figure 4-699: SQA timing intervals

In case shown in the Figure 4-699, initial pause is for downlink set to 11300 ms and the sample duration is 8402 ms. The first PESQ evaluation is obtained after 11300 ms + 8402 ms + 0 ms = 19 702 ms. In the equation the value 0 ms is the configured offset, i.e delay at the beginning of SQA measurement with reference file.

The second PESQ evaluation referring to the first one happens after 2500 ms + 8402 ms + 286 ms = 11188 ms. The third PESQ evaluation happens after 11188 ms + 2500 ms + 8402 ms +58 ms = 22148 ms, and so on. In the equation the value 2500 ms is the configured downlink end pause between two consecutive PESQ evaluations.

For definition of the timing parameters, see "SQA settings dialog" on page 1686.

The following figure shows a low confidence SQA message, due to not trusted reliability check.

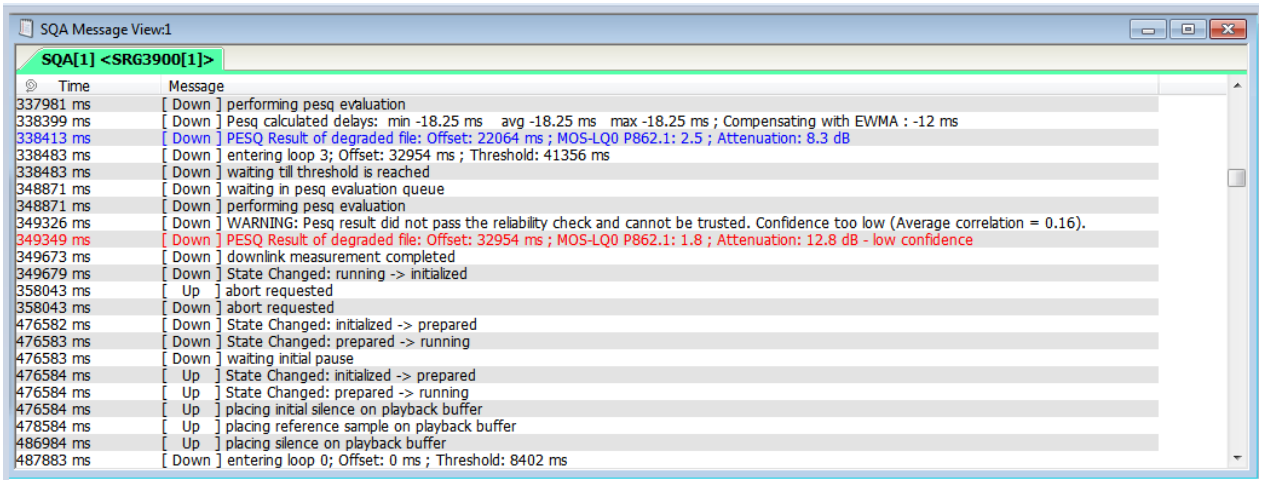


Figure 4-700: Low confidence SQA message

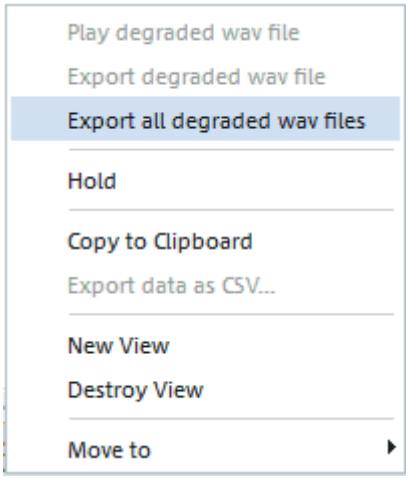
SQA messages

The "SQA Message View" contains a chronological record of the generated SQA messages. An SQA message either describes an event (i.e. the beginning of a particular stage of the measurement), a measurement result, or an error. The messages depend on the measurement mode (download, upload). The basic events and results are repeated for each loop.

Degraded voice samples are stored in the `*.rscmd` measurement file if selected in the SQA configuration. When the voice sample was stored in the `*.rscmd` file, the line with the measurement value is marked blue.

Context menu of a selected voice sample

It is possible to select/de-select the view for hold, copy the current view to the clipboard and create views, see Chapter 4.1.3, "Context menu", on page 429.



To open the context sensitive menu of the SQA View, mark the line of the voice sample and a right mouse click.

To replay the selected voice sample, click "Play degraded wav file".

To export the selected voice, click "Export degraded wav file".

To export all wave files of a device, click "Export all degraded wav files". If this option is selected, R&S ROMES4 stores the files in the export folder named as the currently loaded measurement file. The wave files' names include the device name and a counting index. The following figure shows a result of an export.

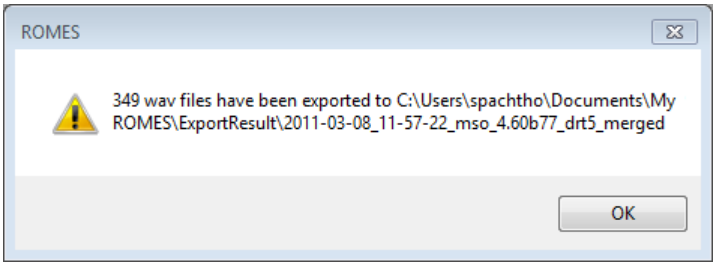


Figure 4-701: Files export result

Export all degraded wave files

Create a logfile holding meta info to the all wave file export

A file is generated, holding some meta data for the all wave file export.

This file is generated automatically at .\My ROMES\ExportResult\<RSCMD_name>\

The name is `ExportAllWav_<SQAname>_<mobileName>_.txt`.

For example, `ExportAllWav_SQA[1]_STP8000[1]_.txt`

Example:

Case: One data set

```
#Meta data for
.\My ROMES\ExportResult\<Tetra Alternate 5\2017.05.22_335325ms_SQA[1]
_STP8000[1]__OK.wav
Timestamp: 2017.05.22;10:21:31.937
Coordinates: 48.15310000 11.64410000 6400m
Model: SQA[1]<STP8000[1]>
Version: ROMES 4.50
Origin: D:\TetraAlternate5.rscmd
```

Naming of the export wave files

Exporting all WAV files ("SQA Messsage View" > Context menu > "Export all degraded wav files") names the files as

`<Date>_<Time>_<SQA[2]_STP9000[3]_OK.wav`

For example,

`2017.05.22_155331ms_SQA[2]_STP9000[2]__OK.wav` or

`2017.05.22_14:15:16.789_SQA[2]_STP9000[2]__OK.wav`, which gives more information at a glance.

Events and results: downlink

- **Entering loop <nr>**
  Start time of the loop, beginning of the transferred file. The actual data transfer starts after the "Offset" defined in the configuration menu. The system waits until enough data have been transferred to start the PESQ evaluation.
- **Performing PESQ evaluation**
  Start time of the PESQ evaluation in the current loop.
- **Resulting delays: ...**
  Time delay between reference file and acquired sample in ms. Different network signaling for sending and receiving mobile and the speech codec can introduce variable delays within the sample; therefore the PESQ result contains the minimum, average, and maximum delay. If the average delay exceeds 30 ms, the system corrects the timing and repeats the PESQ evaluation.
- **PESQ Result**
  Offset between the start of the loop and the calculation of the result. The offset includes the transmission time through the communication system; it is not identical to the offset defined in the device configuration menu. The PESQ P862.1 result is the calculated PESQ score which is converted to a scale between 1 and approx. 4.55; see Table 4-29 and the following background information.
- **Searching for next valid sample data**
  The PESQ evaluation failed or crashed in a first attempt, however, the system tries to repeat the evaluation in the current loop with a shifted evaluation interval.
- **Repeating this sample using new delay information**
  The PESQ evaluation failed or crashed in a first attempt, the delay between the acquired sample and the reference file was larger than 30 ms. The system tries to repeat the evaluation in the current loop with a shifted evaluation interval.
- **Using new delay information for next sample**
  The delay between the acquired sample and the reference file was larger than 30 ms. Therefore, the evaluation of the current sample cannot be repeated (e.g. because the beginning of the sample was lost). The system tries to synchronize to the next sample (next loop) using the delay information; the PESQ result in the current loop is omitted.
- **Waiting until data threshold is reached**
  Audio data is acquired (recorded) until the length of the recorded sample is identical to the length of the reference sample.

Events and results: uplink

- **Playing initial silence**
  Initial pause before the start of the first loop (loop 0). The length of the initial pause is defined in the device configuration menu.
- **Playing sample**
  The loop was started; the sample file (play file) is being played.

- **Playing silence between samples**
  Pause time between two consecutive loops of the sample file (play file).

Errors: downlink

- **PESQ evaluation failed**
  The system could not determine a PESQ result. The reason can be, for example, because the delay between the acquired sample and the reference file was too large, or because the two files were hardly correlated. The PESQ evaluation is repeated with a shifted evaluation interval until the end of the loop is reached.
- **PESQ evaluation crashed…**
  The system crashed during the PESQ evaluation (possible reason see above). The PESQ evaluation is repeated with a shifted evaluation interval until the end of the loop is reached.
- **Abort requested**
  The measurement was aborted.

Errors: uplink

- **Abort requested**
  The measurement was aborted.

Correction of low PESQ values

The SQA device introduced in R&S ROMES4 4.69 was performing SQA measurements based on the PESQ algorithm synchronized to the incoming signal. The synchronization however was performed in a per-call basis, which means that with each new call all calculations were performed all over. Repeating the calculation leds to relatively low PESQ values at the beginning of each call, since the PESQ algorithm interpreted the large delay as a perceptual quality loss.

The problem of relatively low PESQ values at the beginning of a call is solved by transferring the estimated delay information from call to call. In this way achieved is better delay estimation overall. Also, some stability and safety issues are improved to avoid problems while using the SQA tester.

In some rare occasions unexpected low PESQ values were observed at the end of the call as well. Two causes were identified.

The first cause is due to an error when the SQA configuration calculates the number of loops that could fit inside the call window.

The second cause of low PESQ values is when performing the SQA measurements during TETRA group calls. It was observed, that group calls were held by the network much longer after the call is released by the initiating party.

This problem is solved by adding the function "Loop as much as possible" to the SQA, see "SQA settings dialog" on page 1686.

The following figure shows how the synchronization algorithm keeps PESQ values constant from call to call.

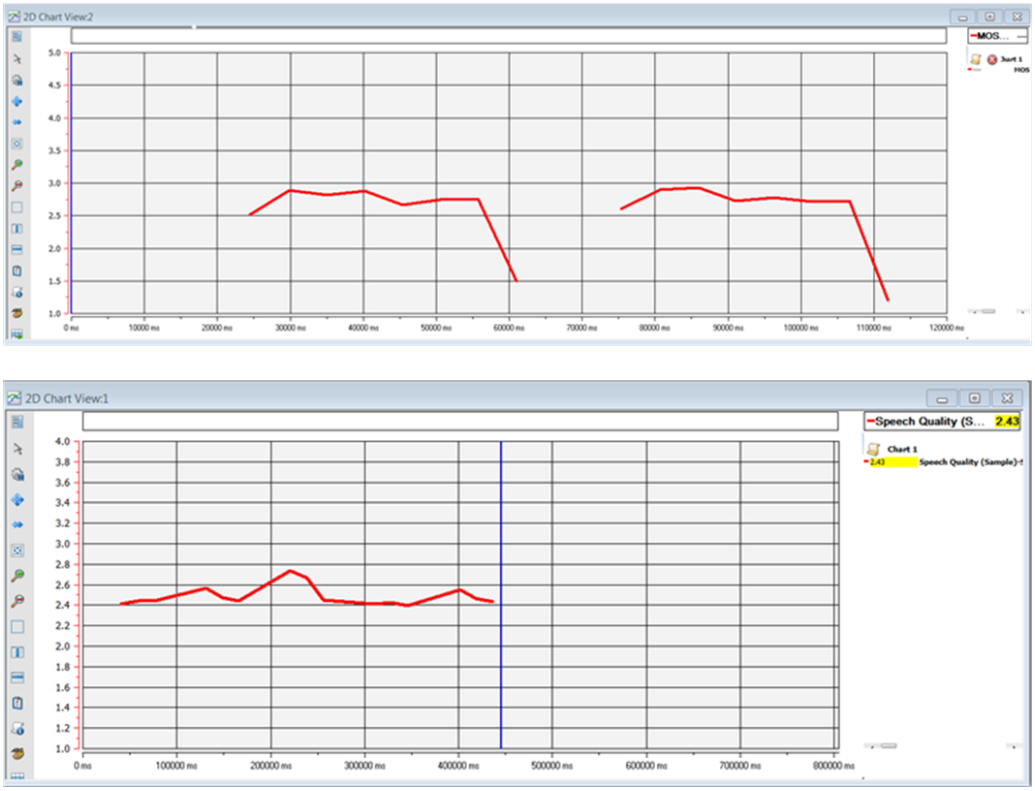


Figure 4-702: PESQ evaluation with old (upper) and improved algorithm

Mapping of PESC score and ITU P.800 values

According to ITU-T recommendation P.862, the PESC score expresses the speech quality on a scale between -0.5 and +4.5, as shown in following figure.

An appropriate conversion formula has been standardized by the ITU in P.862.1 to map the PESQ P 862.1 score values to ITU P800 scale values.

This scale ranges between approx. +1 and +4.55, as shown in the lower diagram of Figure 4-702.

R&S ROMES4 displays the converted values as "PESQ P862.1" results, it means in a scale between 0 and +4.5.

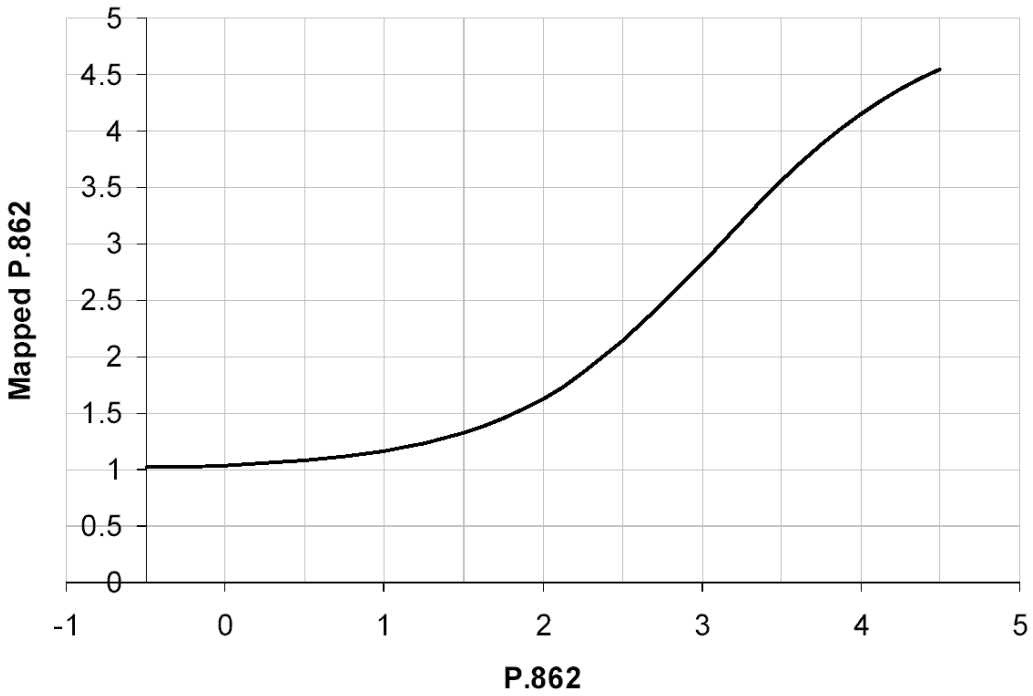


Figure 4-703: Mapping of PESC score (P862) to ITU P.800 values according to ITU P862.1

The meaning of the PESQ P862.1 scaling is described in Table 4-29.

Table 4-29: PESQ p862.1

PESQ P862.1	Speech Quality	Impairments
4 - 5	Excellent	Imperceptible
3.2 - 4	Good	Perceptible, but not annoying
2.3 - 3.2	Fair	Slightly annoying
1.5 - 2.3	Bad	Annoying
0 - 1.5	Poor	Very annoying

Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The degraded voice samples are stored in a `*.rscmd` measurement file if selected in the SQA configuration.

It is possible to play or export the degraded `*.wav` file.

If the voice sample is stored in the `*.rscmd` file, the line with the measurement value is marked blue.

To export the voice sample mark the line, open the context menu and select "Export degraded wav file". This function is also available during a measurement with recording.

The "SQA Message View" has no a configuration menu assigned.

4.6.2 QoS DQA views

The "QoS DQA Views" display the result of the Data Quality Analysis (DQA, with option R&S ROMES4DQA, "Voice Quality PESQ").

The QoS DQA views can be selected from a submenu displayed on the right-hand side of the "View" menu when the mouse pauses over "DQA".

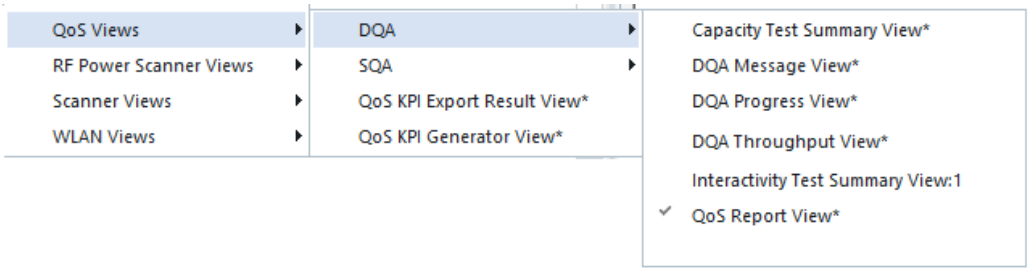
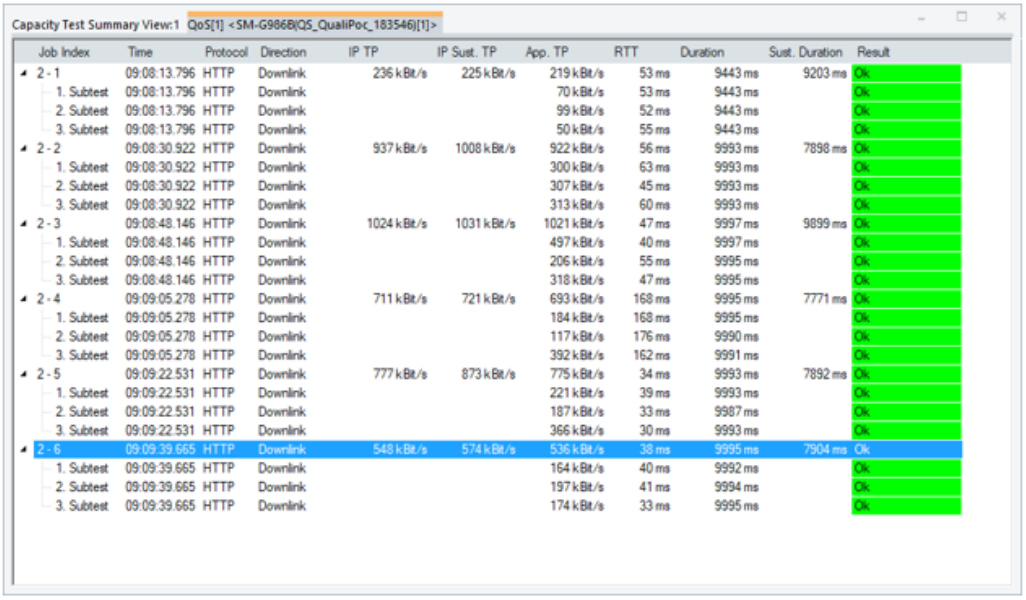


Figure 4-704: QoS DQA views

4.6.2.1 Capacity test summary view

To see the different throughput values of the capacity test job, use the "Capacity Test Summary View".



Job Index	Time	Protocol	Direction	IP TP	IP Sust. TP	App. TP	RTT	Duration	Sust. Duration	Result
2 - 1	09:08:13.796	HTTP	Downlink	236 kBit/s	225 kBit/s	219 kBit/s	53 ms	9443 ms	9203 ms	Ok
1. Subtest	09:08:13.796	HTTP	Downlink			70 kBit/s	53 ms	9443 ms		Ok
2. Subtest	09:08:13.796	HTTP	Downlink			99 kBit/s	52 ms	9443 ms		Ok
3. Subtest	09:08:13.796	HTTP	Downlink			50 kBit/s	55 ms	9443 ms		Ok
2 - 2	09:08:30.922	HTTP	Downlink	937 kBit/s	1008 kBit/s	922 kBit/s	56 ms	9993 ms	7898 ms	Ok
1. Subtest	09:08:30.922	HTTP	Downlink			300 kBit/s	63 ms	9993 ms		Ok
2. Subtest	09:08:30.922	HTTP	Downlink			307 kBit/s	45 ms	9993 ms		Ok
3. Subtest	09:08:30.922	HTTP	Downlink			313 kBit/s	60 ms	9993 ms		Ok
2 - 3	09:08:48.146	HTTP	Downlink	1024 kBit/s	1031 kBit/s	1021 kBit/s	47 ms	9997 ms	9899 ms	Ok
1. Subtest	09:08:48.146	HTTP	Downlink			497 kBit/s	40 ms	9997 ms		Ok
2. Subtest	09:08:48.146	HTTP	Downlink			206 kBit/s	55 ms	9995 ms		Ok
3. Subtest	09:08:48.146	HTTP	Downlink			318 kBit/s	47 ms	9995 ms		Ok
2 - 4	09:09:05.278	HTTP	Downlink	711 kBit/s	721 kBit/s	693 kBit/s	168 ms	9995 ms	7771 ms	Ok
1. Subtest	09:09:05.278	HTTP	Downlink			184 kBit/s	168 ms	9995 ms		Ok
2. Subtest	09:09:05.278	HTTP	Downlink			117 kBit/s	176 ms	9990 ms		Ok
3. Subtest	09:09:05.278	HTTP	Downlink			392 kBit/s	162 ms	9991 ms		Ok
2 - 5	09:09:22.531	HTTP	Downlink	777 kBit/s	873 kBit/s	775 kBit/s	34 ms	9993 ms	7892 ms	Ok
1. Subtest	09:09:22.531	HTTP	Downlink			221 kBit/s	39 ms	9993 ms		Ok
2. Subtest	09:09:22.531	HTTP	Downlink			187 kBit/s	33 ms	9987 ms		Ok
3. Subtest	09:09:22.531	HTTP	Downlink			366 kBit/s	30 ms	9993 ms		Ok
2 - 6	09:09:39.665	HTTP	Downlink	548 kBit/s	574 kBit/s	536 kBit/s	38 ms	9995 ms	7904 ms	Ok
1. Subtest	09:09:39.665	HTTP	Downlink			164 kBit/s	40 ms	9992 ms		Ok
2. Subtest	09:09:39.665	HTTP	Downlink			197 kBit/s	41 ms	9994 ms		Ok
3. Subtest	09:09:39.665	HTTP	Downlink			174 kBit/s	33 ms	9995 ms		Ok

Figure 4-705: Capacity test job summary view

The meaning of the view's entries/columns are described in the following table:

Table 4-30: Capacity Test Summary View entries

Column	Description
"Job Index"	DQA job index with its execution count or the subtest with its index
"Time"	Time the test has been stopped
"Protocol"	HTTP, FTP or UDP
"Direction"	Link direction (Uplink or Downlink)
"IP TP"	Throughput on the IP Layer
"IP Sust. TP"	Sustainable throughput on the IP layer
"App. TP"	Throughput on the application layer
"RTT"	Round trip time
"Duration"	Duration of the test
"Sust. Duration"	Sustainable duration of the test
"Result"	Result of the test

4.6.2.2 DQA message view

The "DQA Message View" monitors all actions of the currently running job. Each action is described with a message and the associated time. The causes of possible errors are reported with the messages.

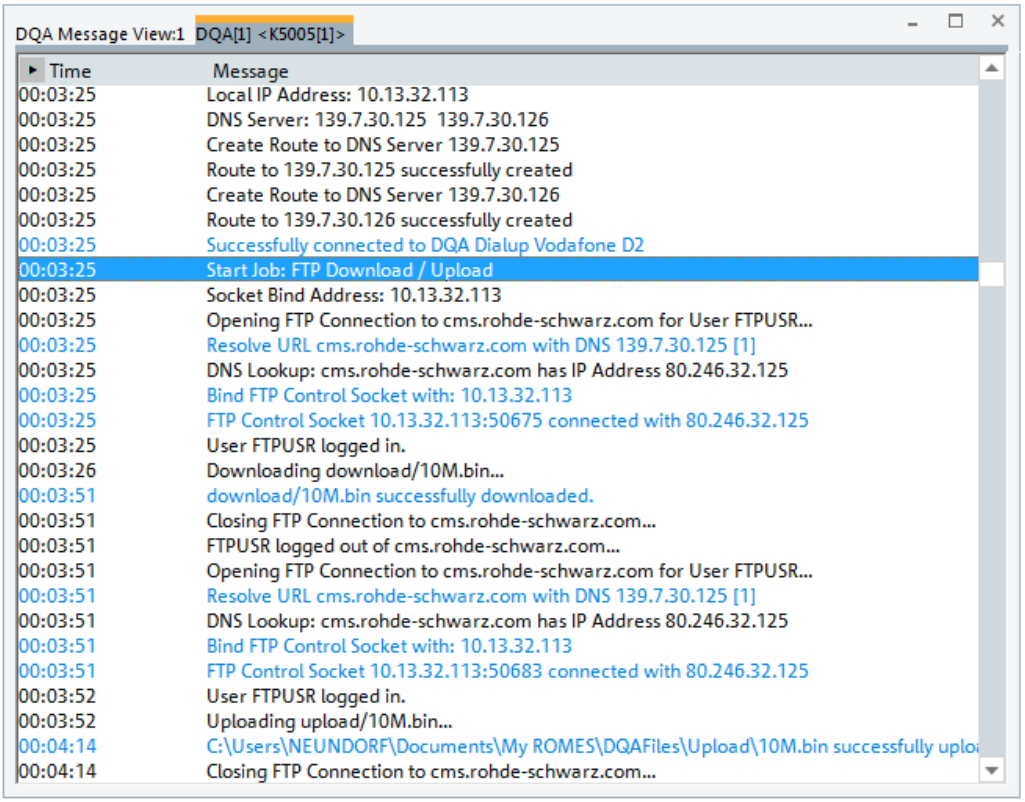


Figure 4-706: DQA Message View - FTP download / upload action

Disconnect from network

The "DQA Message View" displays the message `Successfully Disconnected` before the Disconnect from Network job performs the `idle time`.

The length of the `idle time` command is also displayed in the "DQA Message View", for example "Waiting 5000 ms…", shown in the following figure.

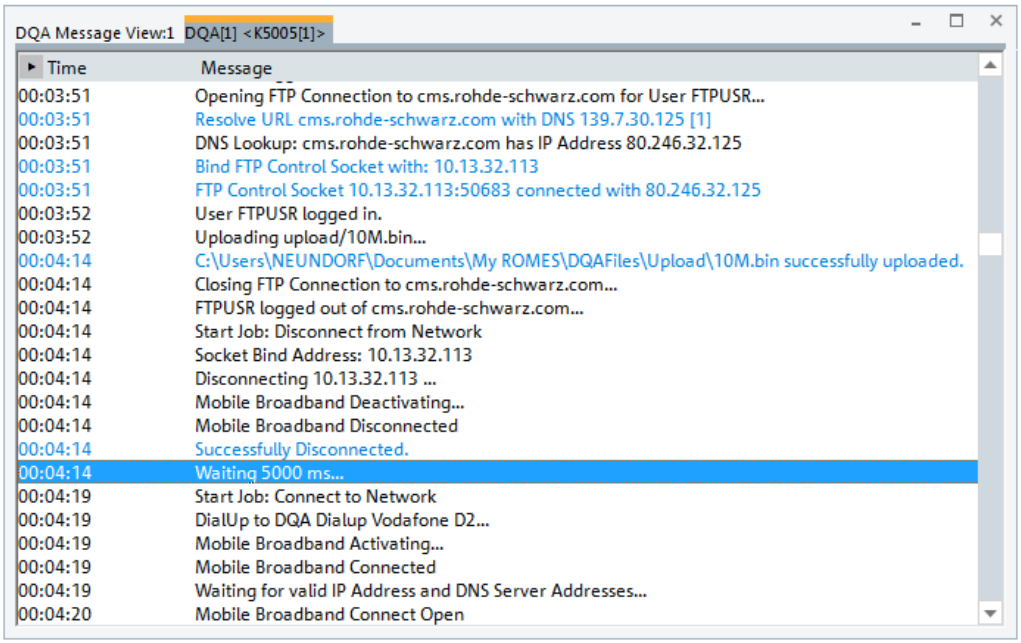
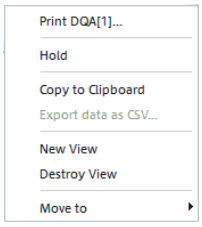


Figure 4-707: DQA Message View - Disconnect from network

View contents

The messages depend on the job that is being executed but are all self-explanatory. The previous Figure 4-706 shows the messages generated during the "Connect to Network" job with the download / upload of a binary files 10M.bin.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "QoS DQA Message View" has no configuration menu assigned.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.6.2.3 DQA progress view

The QoS "DQA Progress View" monitors the progress and the status of the current job measured on the Service Socket. The view contents depend on the job and the DQA job setting mode that is being executed.

For more information, refer to the description in chapter Chapter 6.5.1, "Data quality tester (DQA)", on page 1880.

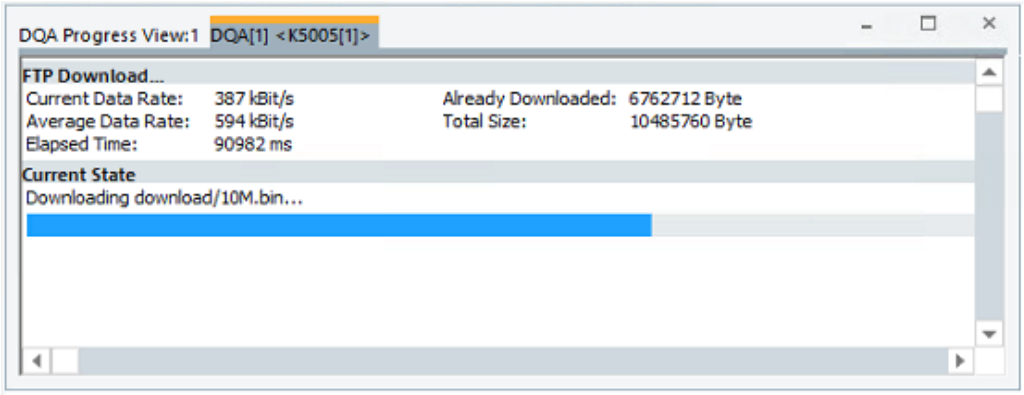


Figure 4-708: DQA Progress View (FTP download)

View contents

The job name forms the heading of the upper panel, which also shows the most important properties of the job and its current state.

A detailed list of the different actions involved in the job is given in the "Trigger Points" table. The entries in the table are self-explanatory. In particular, the table contains the duration of each action and the number of transmitted and received bytes.

The "DQA Progress View" shows all jobs which are started, pending or finished.

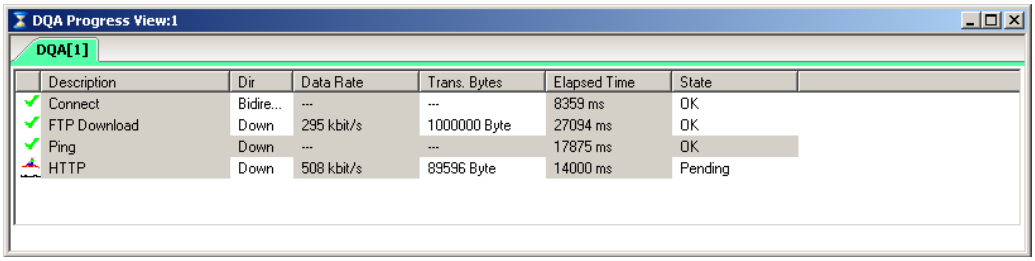


Figure 4-709: Progress view of multiple DQA services

A double click on a list item of the pending jobs shows the details of the selected item's progress.

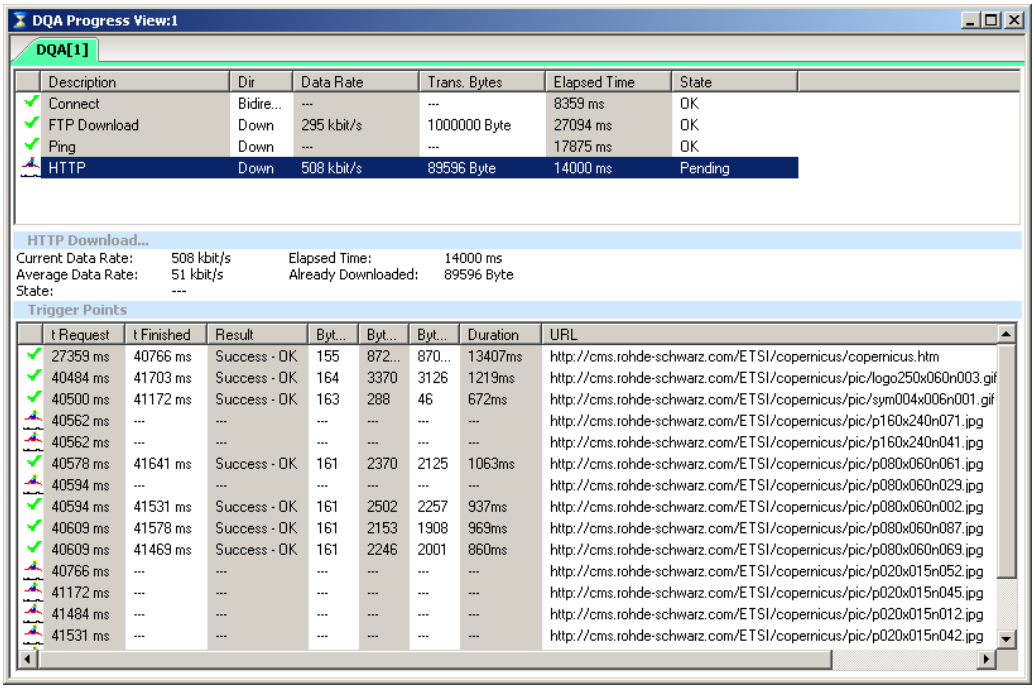
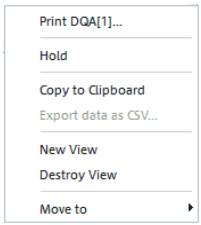


Figure 4-710: Detailed DQA Progress View of the selected HTTP job

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The "DQA Progress View" has no configuration menu assigned.

The "Info" page for different views and technologies can be obtained in general via the "Tools" > "Configuration Active View" command. Dependent on a selected view, the opened page is the "Info" page only or the configuration page containing the "Info" tab among others.

4.6.2.4 DQA throughput view

The QoS "DQA Throughput View" monitors the current, maximum and average data rate in UL/upload and DL/download direction measured on a network adapter (Ethernet/NDIS/modem).

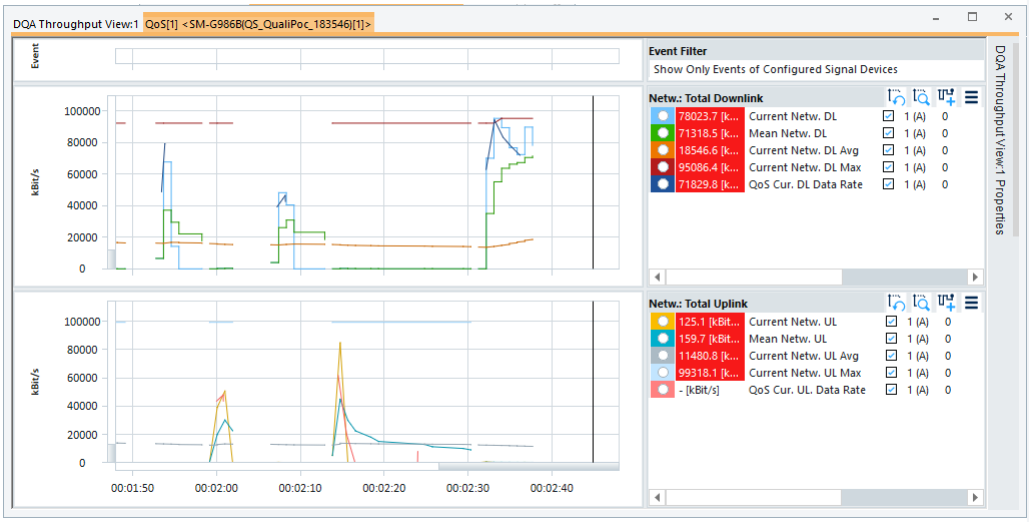


Figure 4-711: DQA Throughput View

The DL and UL data rate is shown in the two 2D charts. The scale and appearance of the two charts (DL and UL throughput) can be configures and modified using the "DQA Throughput View: <variable> Propeties" pane of the view.

For the view configuration, see Chapter 4.2.1, "2D chart view", on page 448.

The 2D chart provides the following:

- "Mean Netw. DL/UL" shows the average throughput since the beginning of the current job, DQA session, or measurement session, depending on the DQA throughput view configuration
- "Current Netw. DL/UL" shows the net throughput vs. time
- "Current Netw. DL/UL Avg" shows the average throughput since the beginning of the current job
- "Current Netw. DL/UL Max" shows the maximum throughput since the beginning of the current job
- "DQA Cur. DL/UL Data Rate" shows the current DL/UL data rate
  The listed values are the same as the ones displayed in the "3GPP Overview View". They are calculated by the DQA which measures the throughput of all download and upload sockets (in the application layer).

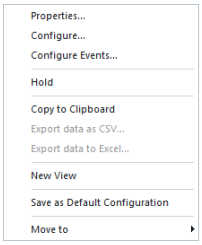
The "DQA Throughput View" works also with network adapters.

If working with network adapters, it is important to activate the "Use Gateway for Routing" option to establish the correct network connections. The option is activated in "DQA Settings" > "Connect to Network" > "Advanced Connection Settings".

Since version 4.66, the "DQA Throughput View" shows data for the connection initiated outside of R&S ROMES4. In this way shown data works only if one Internet connection is activated on a PC. It is necessary to specify the IP addresses for the server because no DNS solution is performed via the DQA. Otherwise, a failure message turns up, for example, "Could not create FTP Socket" for an FTP Download.

To obtain valid results, the "Record the computer network throughput" option must be enabled in the "Connection Statistics" tab of the DQA configuration menu. The data is recorded and displayed by checking the "Global" > "Update Rate..." options in the view's properties pane.

Context menu



The "DQA Throughput View" configuration is done in the "DQA Throughput View: <variable> Properties" pane. Selecting the "Configure" command in the context sensitive menu of the view opens only the "Info" page.

4.6.2.5 Interactivity test summary view

Interactivity test summary view

The "Interactivity Test Summary View" supports the Interactivity test job events. This view is able to identify spots/timings with high latency variation and through sync to other views to look for possible reasons of these variations.

The view complies with the recommendation ITU-T G.1051 (accepted in January 2023) which assumes the following:

- Support of differentiation between QoS parameters without considering an application and a respective packet delay budget and the input to the interactivity model. R&S ROMES 4 outputs the raw RTT and PDV values without discarding packets.
- Adaption of the pattern 'Interactive remote meeting' to be asynchronous by applying one peak only in uplink and the other only in downlink.
  The case that each side shares content at some point in the meeting is an realistic case.
- The "Interactivity Score Model" adaption to take the standard deviation of the PDV instead of the median as input.
  The model constants for this term have been adapted.

The "Interactivity Test Summary View" is divided into the grid and graphic display of data. The graphic display provides a better understanding of the grid display of data.

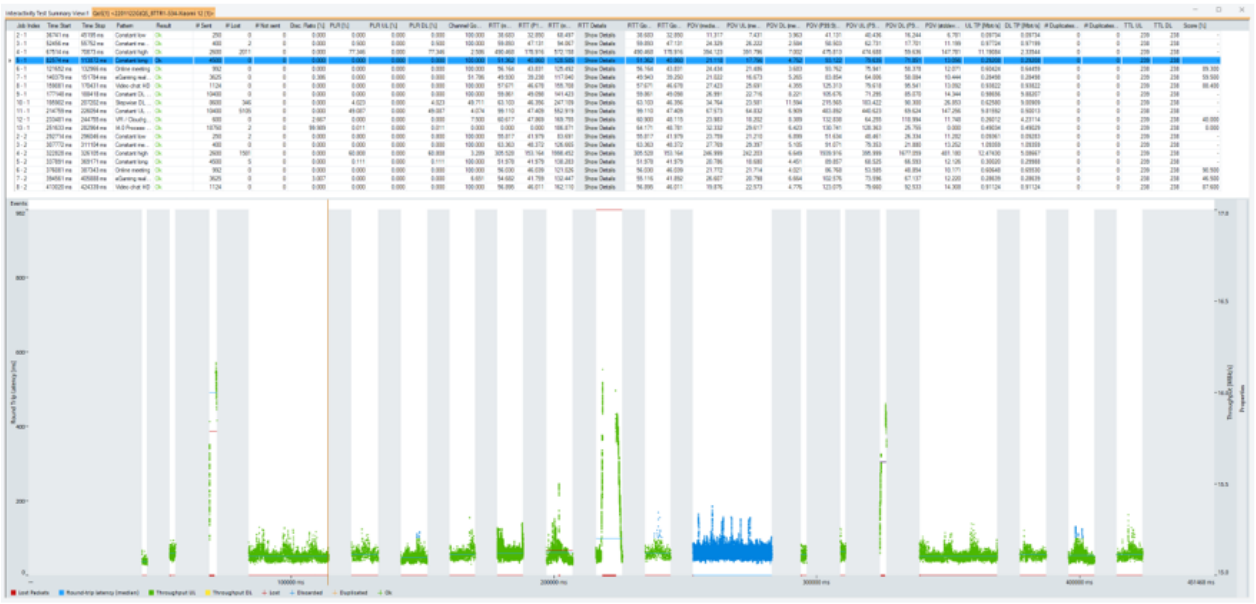


Figure 4-712: Summary view of the interactivity test job

Selecting one row in the grid synchronizes all views to the selected time.

The "Properties" button on the right on the graphic display shows or hides the configurable properties of the view.

The Interactivity Test job events can be configured in the view's context sensitive menu and displayed in the graphic view.

The context sensitive menu opens if you click any point in the view.

Grid display

The following table lists the entries included in the grid's columns.

Table 4-31: Interactivity test summary view entries in the grid

Column	Description
"Job Index"	DQA job index with its execution count or the subtest with its index
"Time"	Time the test has been stopped
"Pattern"	Configured pattern used for the test
"# Sent Packets"	Number of sent packets
"# Lost Packets"	Number of lost packets
"Disc. Ratio [%]"	Percentage of discarded packets
"PLR [%]"	Packet lost ratio
"PLR UL [%]"	Uplink packet lost ratio
"PLR DL [%]"	Downlink packet lost ratio
"Channel QoS [%]"	The channel QoS 3GPP is a single value. It expresses the quota of valid packets that arrived in time compared to the maximum allowed packet error rate (PER) for a given traffic pattern (application) [0,1] (display as %).

Column	Description
"RTT (median) [ms]"	Median round-trip time of all individual packets returned within the given packet delay budget
"RTT (P10th) [ms]"	10th percentile of the round-trip times of all individual packets returned within the given packet delay budget
"RTT (max) [ms]"	Max RTT, what is the worst case
"RTT Details"	The grid's "RTT Details" column is a button "Show Details". It opens a detailed list of RTT data of the underlying job. The "Interactivity Statistic Details" dialog is displayed if you click the button, see Figure 4-714.
"RTT QoS (median)"	Median round-trip time in [ms] of all individual packets returned on QoS level, i.e. not taking the packet delay budget given by the target application into account. The signal value floats.
RTT QoS [10p]""	10th percentile of the round-trip time in [ms] of all individual packets returned on QoS level, i.e. not taking the packet delay budget given by the target application into account. The signal value floats.
"Interactivity Score"	QoE score as expert model that takes the technical results (RTT, PDV, PLR) as input and delivers a single score value [0,100] (display as %)
"PDV (median) [ms]"	Median of the packet delay variation distribution based on all packets returned within the given packet delay budget
"PDV UL (median) (ms)"	Median of the PDV at the point of the packets being received by the server regarding the sending timestamps of the client
"PDV DL (median) [ms]"	Median of the PDV at the point of the packets being received by the client regarding the sending timestamps of the server
"PDV (P99.9th) [ms]"	99.9th percentile of the packet delay variation within the given packet delay budget
"PDV UL (P99.9)"	99.9th percentile of the PDV at the point of the packets being received by the server regarding the sending timestamps of the client.
"PDV DL (P99.9)"	99.9th percentile of the PDV at the point of the packets being received by the client with reference of the sending timestamps of the server
"PDV DL (stddev)"	Standard deviation of the packet delay variation distribution in [ms] of all individual packets returned on QoE level, i.e. within the given packet delay budget. The signal value floats.
"UL TP [Mbit/s]"	Uplink throughput on UDP application layer
"DL TP [Mbit/s]"	Downlink throughput on UDP application layer
"# Duplicate UL"/"# Duplicate DL"	Number of packets that were duplicated during uplink, respectively downlink transfer and eventually were received at the a client. The range is from 0 to N.
"Time To leave UL (average)"	Average number of hops left for the packets in uplink direction before they would have been dropped. A measure for the path length between client and server. The signal value floats.
"Time To leave DL (average)"	Average number of hops left for the packets in uplink direction before they would have been dropped. A measure for the path length between server and client. The signal value floats.
"Score [%]"	Result of a test

Click the "RTT Details" button in the grid, to get the "Interactivity Statistics Details" dialog of the selected job index.

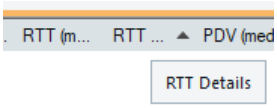


Figure 4-713: RTT details button

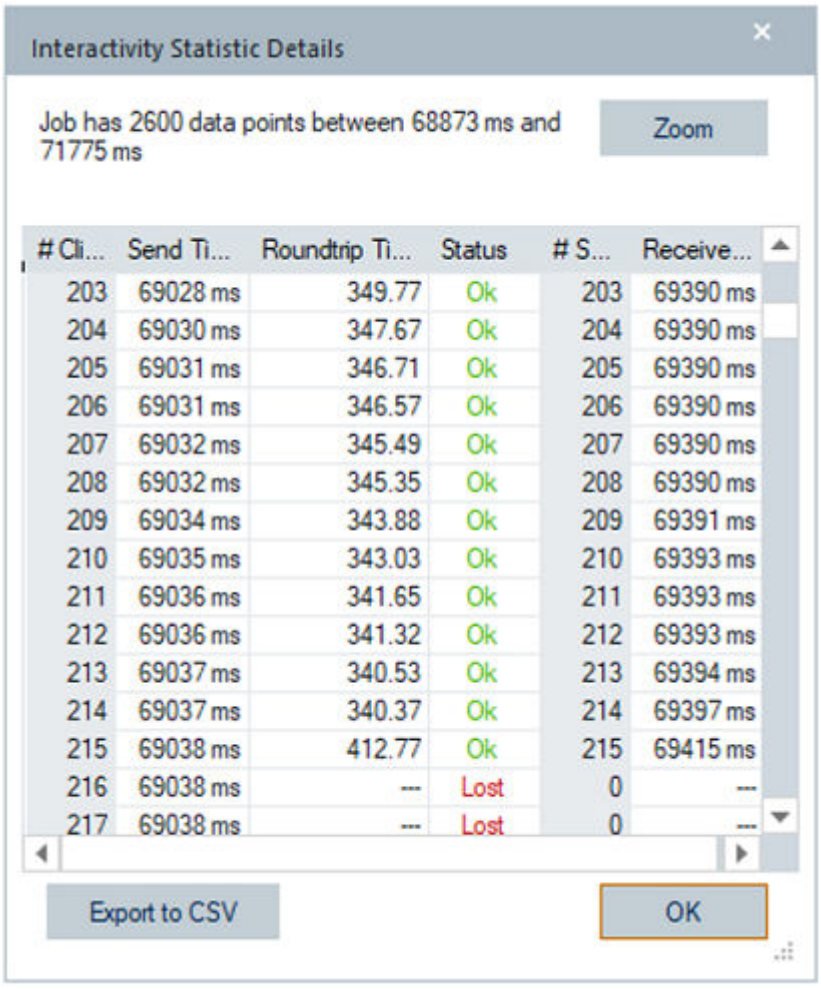


Figure 4-714: Details of an interactivity job

In the "Interactivity Statistic Details" dialog, the "Zoom" button lets you zoom the graphic view to the time range of the measured data. The per-packet statistics related to a sequence number at the server side and received timestamp of the server are available in the details dialog. A paket status indicated in the diagram can be "OK", "Lost","Discarded" or "Duplicated". The status is displayed with the same color as the corresponding cross in the graph view.

The grid can be sorted per each column.

The "Export to CSV" button lets you export the complete list as it is sorted.

You can sort the grid on time or on the round-trip time. These sorting options make it easy to see how many measured RTTs are above a threshold.

Graph display

The graphic displays the following entries for the job selected in the grid:

- "Lost Packets"
- "Round-Trip Latency (median) in [ms]"
- "Round Trip Latency per packet in [ms]"
- "Throughput Upload in [kBit/s]"
- "Throughput Download in [kBit/s]"
- Packet status as previously mentioned: "Lost", "Discarded", "Duplicated" and "OK"

All-time ranges between jobs are grayed out.

Y-axis shows the throughput on the right-hand side and the round-trip latency or lost packets on the left-hand side.

The time-axis floats with the zoomed time-axis of the TimeLine control. While in replay, a time ruler is displayed. During measurement, up to the last 5 minutes are displayed.

The graph legend displays the colors of the entries in it and their meaning.

All axes in the graph can be scrolled (Shift+mousewheel) and zoomed (Ctrl+mouse-wheel).

Properties

The "Properties" pane controls the displayed axes (range, auto-zoom). It can be collapsed to a "Properties" button on the right to increase the size available for the graph.

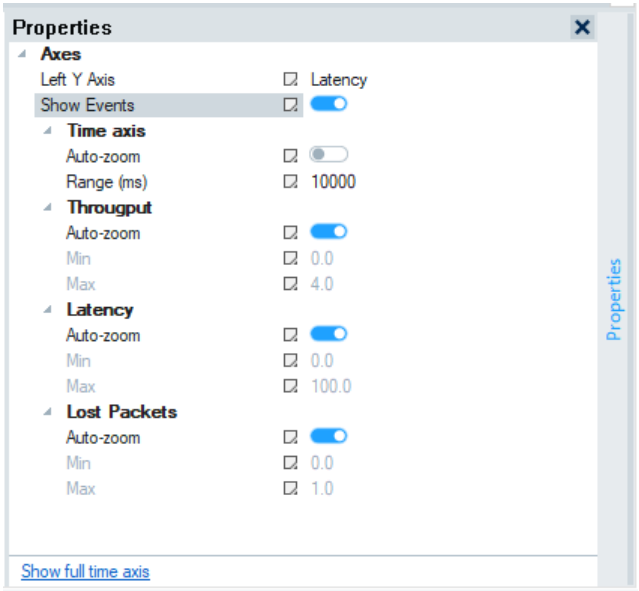


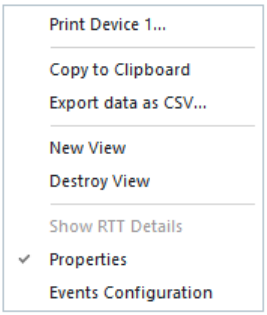
Figure 4-715: Properties of the Interactivity Test Summery View

The following functions to control the view are included in the "Properties" pane:

- "Show full time axis" - resets/fully zooms out the time-axis with one click.
- "Axes" > "Left Y Axis" - lets select display of left Y-axis between "Latency" and "Lost Packets".
- "Axes" > "Show Events" - configured events can be shown using a Boolean flag.
- "Axes" - all axes ("Time axis", "Throughput", "Latency" and "Lost Packets") can be changed. Setting the "Time Axis" to auto-zoom selects automatically the time range of a single job during replay.

Context menu

The context menu offers to export the view's data in CSV format, also to show and hide the "Properties" pane. The "Show RRT Details" entry of the menu opens a detailed list of RTT data of the underlying job. The "Events Configuration" entry, when clicked, opens the configuration dialog where can be selected events for display in the graphic view.



Use "Properties" to show or hide event in the top line of the graphic display.

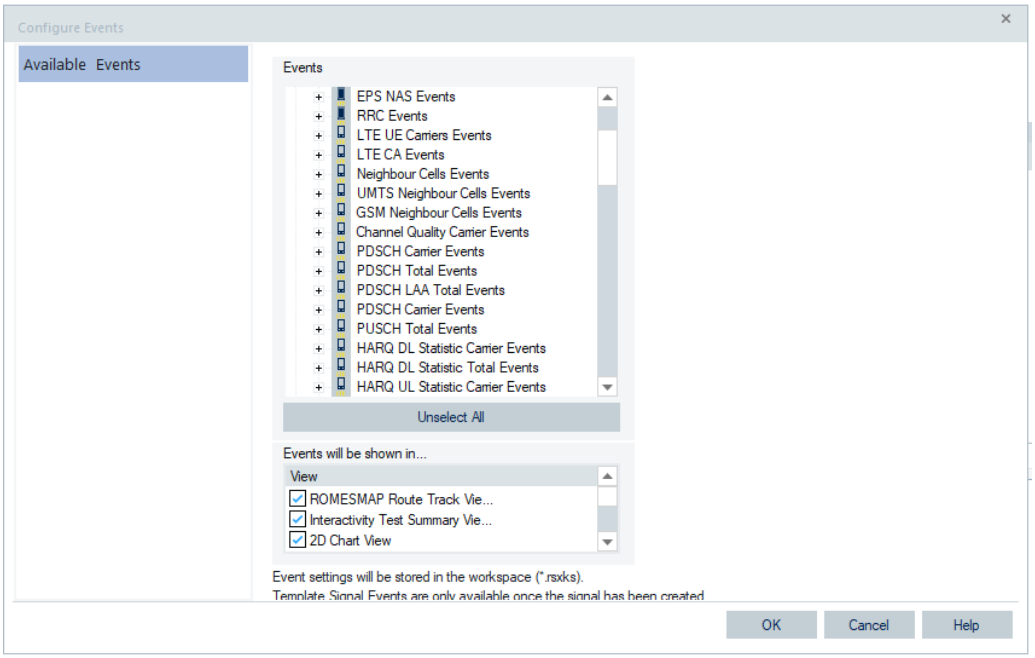


Figure 4-716: Available events of the Interactivity test job

4.6.2.6 QoS report view

To get the start page of the view, click "QoS Views" > "DQA" > "QoS Report View".

If the view is started outside of replay mode or with no mobiles attached and configured, the window is without data.

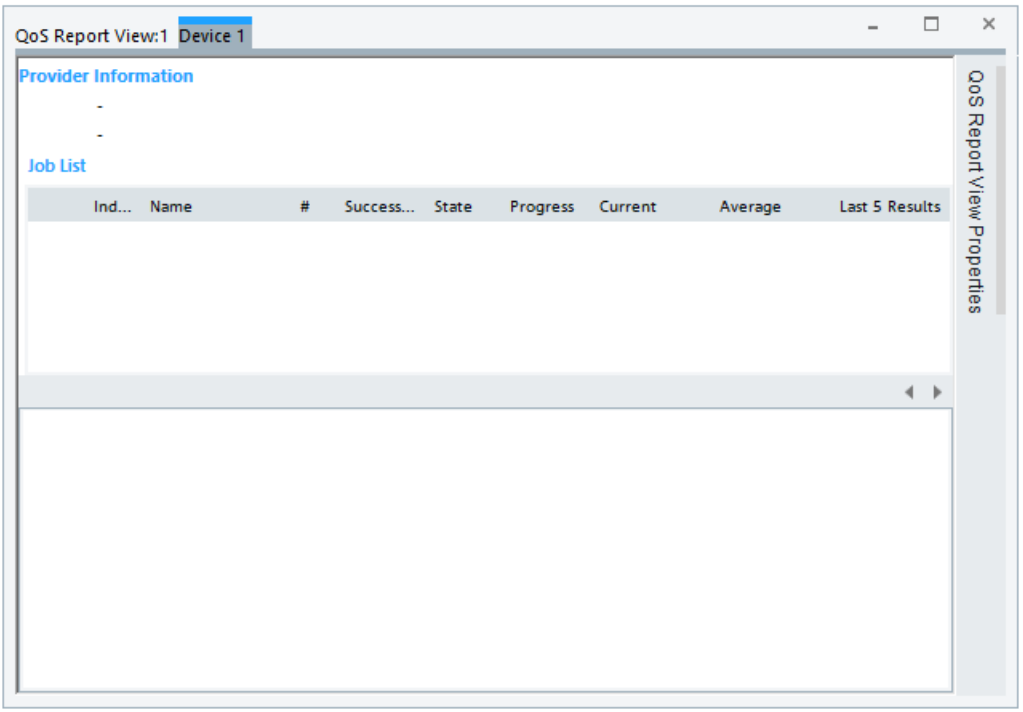


Figure 4-717: QoS Report View opening page

Once a replay is loaded or mobiles attached and configured for DQA test, the "QoS Report View" creates a tab in the title bar of the view for each attached mobile.

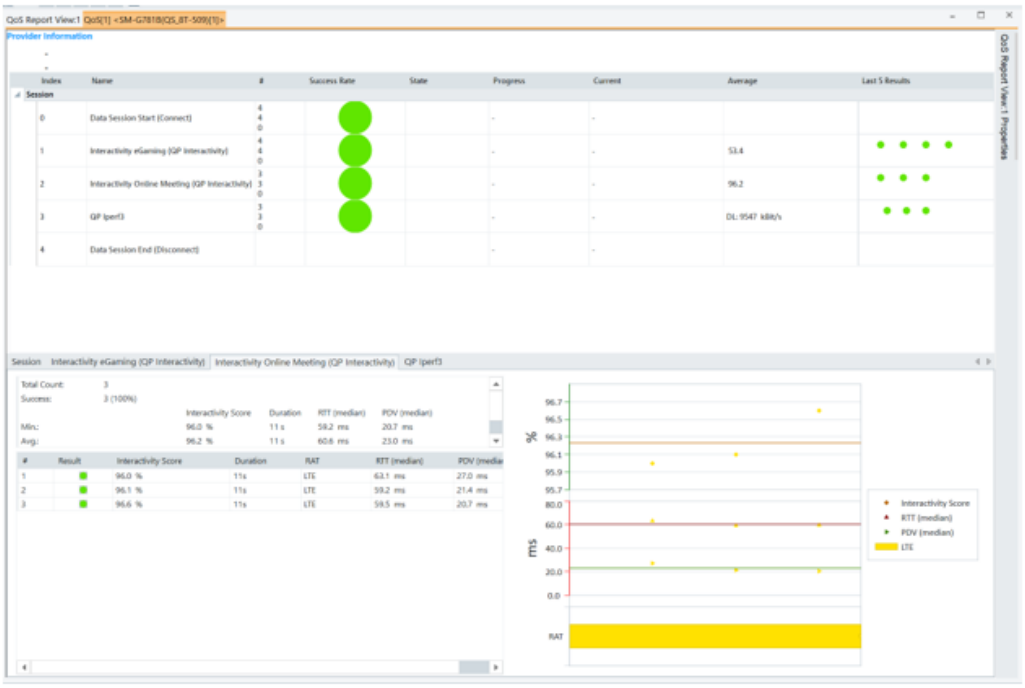


Figure 4-718: Opening page - replay mode

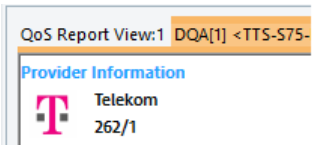
The "QoS Report View" contains the following panes:

- "Provider Information"
- "Job List"
- Details - grid and chart

Loading workspaces created with R&S ROMES4 19.3 or older versions does not load the "QoS Report View" automatically. Add the view manually again.

Provider information

This pane shows the current providers' information for the associated mobile device. Information displayed is provider's name and MCC/MNC.



Job list

The "Job List" > "Session" table displays the controls of each configured and connected job. The controls are the same for data and voice jobs. If configured, the data and voice sessions have their own section.

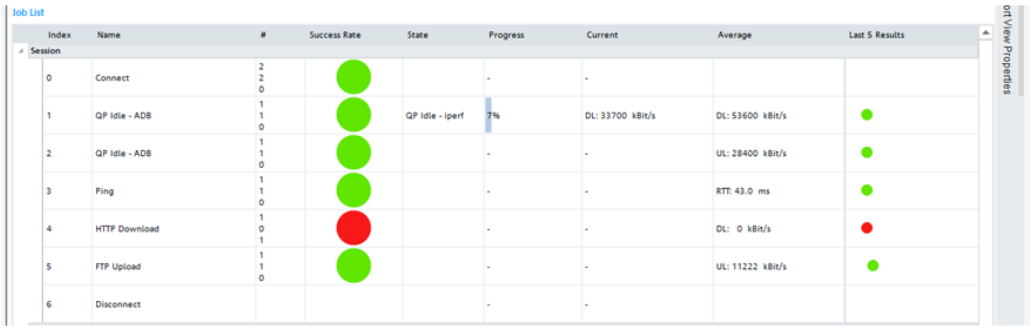


Figure 4-719: QoS Report View - job list

The following controls are displayed for each connected job.

- "Index" - index associated to a job in the "Job List"
- "Name" - name of the job
- "#" - the overall number of times the job has been run (top number)
- "Success Rate" - the number of times the job has run successfully (middle number)
- "State" - the current state of the job execution
- "Progress" - the progress percentage of the current job execution
- "Current" - the throughput rate of the current job execution.
  Considered is upload or download jobs throughput (UL or DL labels). Dependent on job type, can be the current RTT, example given Ping job, or MOS and CST for voice call.
- "Average" - the average of the quantities named in the previous bullet
- "Last 5 Results" - the last 5 results of the job executions
  Green dot indicates successful execution and red one an unsuccessful execution.

- "Call Session Start", "Call Session End" and "Disconnect" jobs contain the "Index" and "Name" controls only in the "Job List".
- "Connect" job contains the "#" and "Success Rate" control in the "Job List".

Details - grid and chart

The lowest pane shows the statistics of monitored DQA jobs. Each executed job is assigned own tab showing the monitored quantities in a grid and chart.

Session

The "Session" option/tab monitors the statistics of a connection that R&S ROMES4 sets up to a remote network. The connection can be a radio link towards a network established by test mobiles or a connection via dial-up network.

The "Session" tab is available for each Connect to Network/Disconnect from Network job.

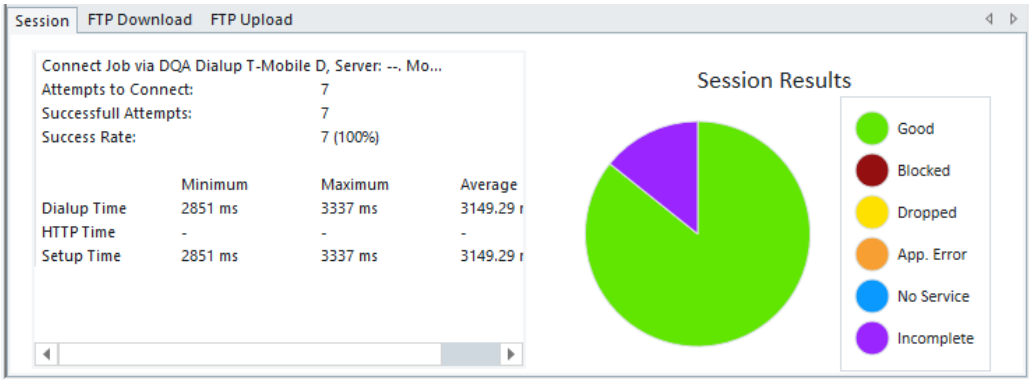


Figure 4-720: QoS Report View – session details in session tab

The left part of the "Session" pane displays the connect job's name as set in the DQA configuration dialog, an overview of the attempted connections and the time statistics of the connections.

The "Session" pie chart on the right displays the percentage of good, blocked, dropped, incomplete session and no service/application error.

- **Good**
  Every call successfully established and terminated by the system after exactly the "Call duration" set in the "Autodialing" tab.
- **Blocked**
  A call is qualified as blocked if one of the following applies:
  – An idle message was detected during call setup but the call was not canceled. The idle message detection happens in all cases where a call setup was performed at least up to the Layer 3 message SERVICE REQUEST, but not up to ALERTING / CONNECT, and where no DISCONNECT, RELEASE or CHANNEL RELEASE was executed **or**
  – The call was canceled, call setup was not performed up to ALERTING and/or CONNECT **or**
  – A dial command has been sent to the mobile at a moment with sufficient coverage, but because of temporarily insufficient coverage no call could be established: The NQA state machine remains IDLE. On the next dialing, the system recognizes that no call could be established and one blocked call is added.
- **Dropped**
  A call is qualified as dropped if one of the following applies:
  – An established call is canceled before the "Call duration" set in the Autodialing tab has passed **or**
  – An established call is terminated not to order. A NQA data package will be generated when an "Idle" or "Error (No Service)" state is detected after a call was established and the "Call duration" has not passed yet.
- **No service**
  A "No service" call is added every time the system wants to dial but the mobile is out of service. If the mobile remains out of service the time interval between two subsequent "No service" calls is equal to the "Call duration" plus the "Idle time", both set in the "Autodialing" tab.

- **Call Canceled**

  A call is canceled if one of the following applies:

  – Manual hang up by user
  – Stop measurement during a call
  – Called party did a hang up
  – Call starts in a certain RAT, for example, in UMTS and during the call the RAT changes, for example, to GSM and the "Hang up call, if a RAT handover occurred" is checked.

Voice Call Table

Result	Start Time	End Time	RAT	Network Provider	Device ID	Start CI/LA	End CI/LA	Setup Time [s]
Good	3/19/13 12:30 PM	3/19/13 12:31 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	4.681
Good	3/19/13 12:32 PM	3/19/13 12:33 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	5.365
Good	3/19/13 12:34 PM	3/19/13 12:35 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	6.22
Call Cancelled	3/19/13 12:36 PM	3/19/13 12:36 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	
Call Cancelled	3/19/13 12:36 PM	3/19/13 12:37 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	
Good	3/19/13 12:37 PM	3/19/13 12:37 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	
Call Cancelled	3/19/13 12:38 PM	3/19/13 12:38 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26016	
Call Cancelled	3/19/13 12:38 PM	3/19/13 12:39 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26016	

Figure 4-721: Voice call canceled

The tabs alongside the "Session" tab, show the results of other DQA executed jobs.

QoS report view grid

The third pane of the "QoS Report View" displays on the left side the QoS jobs reported values. In the figure Figure 4-718 opened is the report view of the interactivity job as an example.

The following controls, dependent on the QoS job, are displayed first.

- "Total Count" - the total execution count of the job
- "Success" - the number of successful executions and the percentage of successful executions
- "Minimum", "Maximum", "Avg" of the throughput across all execution of the job
- "DL/UL UR" - the URL used for the test

The grid at the bottom on th left side contains the following controls:

- "#" - the index of the job execution
  The currently executing job is indicating with a right arrow icon.

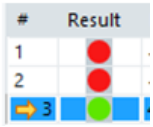


Figure 4-722: Icon for currently executing job

- "Result" - shows the job execution result. Green dot stands for successful and red dot for unsuccessful execution.
- The third column can host the following controls:
  – "UL Throughput"/"DL Throughput" - upload/download throughput of the jobs like FTP, HTTP upload/download in kbits/s
  – "Interactivity Score" - 5G interactive jobs in percentage

  - "MOS" - voice call, mean observation score as an integer number
  - "RTT" - ping job in ms
- "Duration"/"CST" - time it took the job to execute in seconds
- "RAT" - the technology that is used during the job execution
- "Call Status" - the status of voice call only

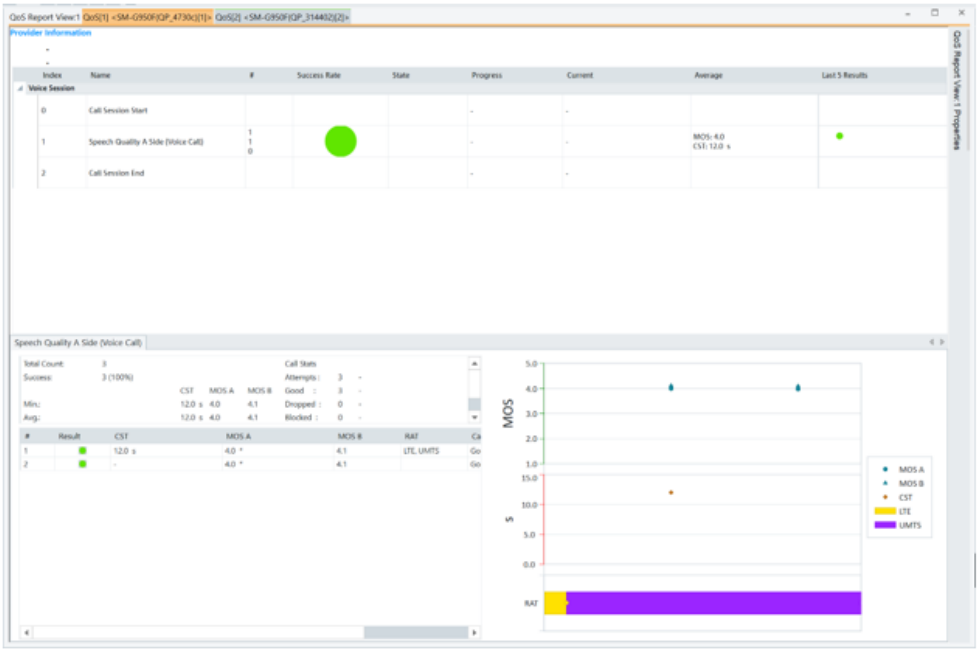


Figure 4-723: QoS Report View of a call session

- "MOC/MTC" - mobile originating call/mobile terminating call
- "RTT (median)" - RTT interactivity jobs only
- "PDV (median)"- PDV interactivity jobs only

Double click any entry in a job grid results in the replay moving to the beginning of selected jobs execution if replay mode.

QoS report view distribution chart

The distribution chart, of in time selected job tab, is placed on the right-hand side of the third "Qos Report View" pane.

The chart summarizes the distribution of the throughput/Interactivity score/RTT/MOS of a DQA job execution.

Each successful execution of a job adds a data point on the chart. After three successful executions of the job, a solid horizontal line is placed on the chart. The line indicates the average value for a reported control which is specified by the color of the line.

Data points in the chart have different shape (diamond and circle shape) to differentiate among the reported controls.

The color of the data point corresponds the technology that was active during the job executions, see Figure 4-718.

RAT is displayed with 100% bar length in the chart. The bar shows the percentage for a given RAT usage over the entire measurement or replay.

The amount of time the RAT was active can be found by moving the mouse over the RAT bar and examining the Tooltip that pops up.

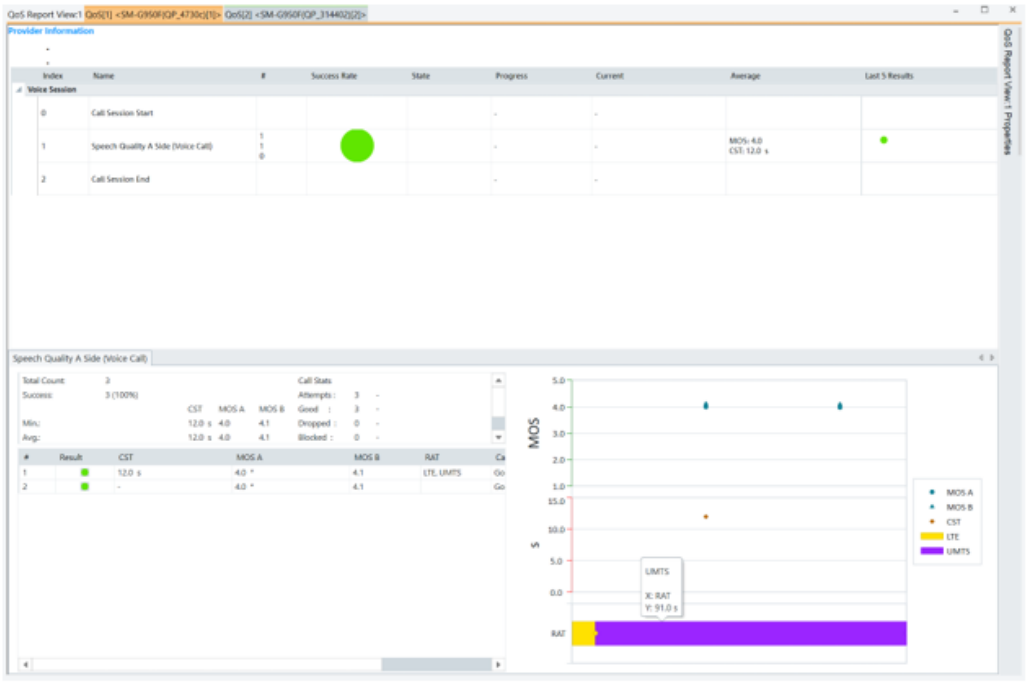


Figure 4-724: RAT bar in the distribution chart

Elements of voice call

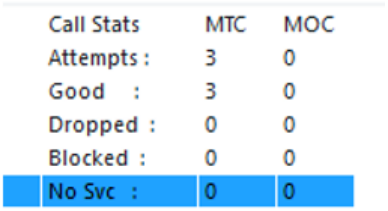
The "Call Stats", "MTC" and "MOC" columns in the "QoS Report View" grid are added to aid analysis and determination of voice call quality.

For the CST, MOS A and MOS B shown are minimum, maximum and average values.

	CST	MOS A	MOS B
Min.:	10.0 s	3.7	3.2
Avg.:	11.0 s	3.9	3.6
Max.:	12.0 s	4.1	4.0

Figure 4-725: CST, MOS counted values

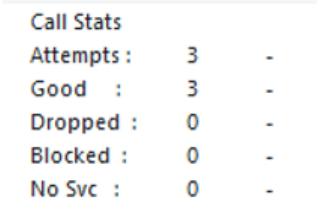
The voice call data considered in the call status are focused in the following figure.



Call Stats	MTC	MOC
Attempts :	3	0
Good :	3	0
Dropped :	0	0
Blocked :	0	0
No Svc :	0	0

Figure 4-726: Additional columns in QoS Report View of voice call

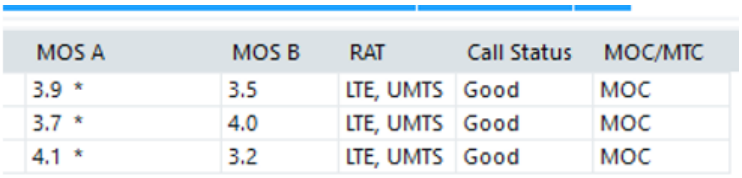
If none of the call results of a MOC/MTC value are available, then only one group of call statics is displayed and the MTC, MOC headers are removed.



Call Stats		
Attempts :	3	-
Good :	3	-
Dropped :	0	-
Blocked :	0	-
No Svc :	0	-

Figure 4-727: Missing MTC/MOC header

The items contained in the call result grid are shown in the following figure.



MOS A	MOS B	RAT	Call Status	MOC/MTC
3.9 *	3.5	LTE, UMTS	Good	MOC
3.7 *	4.0	LTE, UMTS	Good	MOC
4.1 *	3.2	LTE, UMTS	Good	MOC

Figure 4-728: Call result grid

Voice call data	Description
MOS A/MOS B	MOS value for side A and side B of the voice call. A “*” alongside of the value indicates if the call is side A or side B.
Call status	Possible results of a call: "Good", "Dropped", "Blocked" or "No Svc".

The distribution chart on the right-hand side of the view shows both CST and MOS values. The MOS values are allocated along the upper y-axis and the CST values along the lower y-axis in the chart. In the figure Figure 4-723 the axes are colored green and red, respectively.

Display of current job execution

The "DQA [1] <variable>" tab for the currently executing job is shown during replay or measurement. This default option can be disabled by unselecting the "Auto Tab" entry of the "QoS Report View Properties" pane.

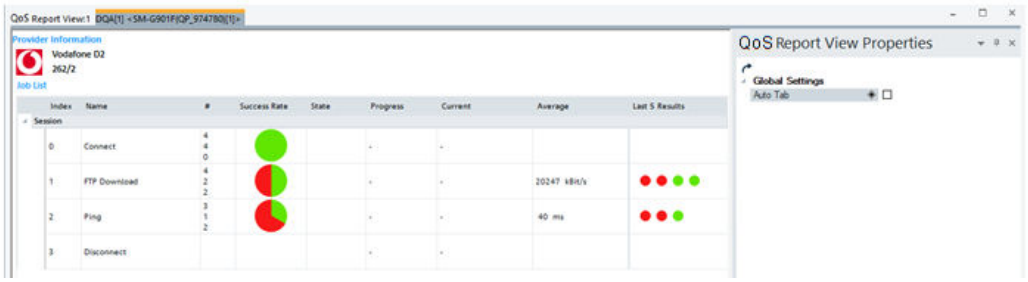


Figure 4-729: Auto Tab entry

Calculation of DQI/PQI

DQI: Data Quality Indicator

PQI: Performance Quality Indicator

The IREG specification declares the following constants:

Minimum Connection Setup Time:*MIN_CON_SETUP* = 3000ms

Maximum Connection Setup Time: *MAX_CON_SETUP* = 60000ms

DQI Time Constant: *DQI_TIME_CONST* = 3600000ms (1Hour)

$$DQI\,[\%] = \left(1 - \frac{Connection\ Setup\ Time - MIN_CON_SETUP}{MAX_CON_SETUP - MIN_CON_SETUP}\right) * 100.0$$

$$PQI\,[\%] = \left(1 - \frac{Avg.\ Connection\ Setup\ Time - MIN_CON_SETUP}{MAX_CON_SETUP - MIN_CON_SETUP}\right) * 100.0$$

$$HTTP\ DQI\,[\%] = 100 * \frac{DQI_TIME_CONST - HTTP\ DL\ Time}{DQI_TIME_CONST}$$

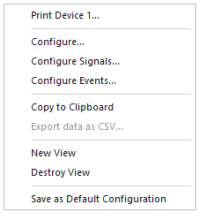
$$FTP\ DL\ DQI\,[\%] = 100 * \frac{DQI_TIME_CONST - FTP\ DL\ Time}{DQI_TIME_CONST}$$

$$FTP\ UL\ DQI\,[\%] = 100 * \frac{DQI_TIME_CONST - FTP\ UL\ Time}{DQI_TIME_CONST}$$

- Cut off Session Ratio: Ratio of the incomplete sessions and the sessions that were started successfully
- Service Non Accessibility: Ratio of failed connections and tried connections
- Network Non Accessibility: Ratio of unavailable services and the connect attempts
- Service Success Rates:
  - FTP DL: DQI average of all successful FTP DL services
  - FTP UL: DQI average of all successful FTP UL services
  - HTTP DL: DQI average of all successful HTTP DL services

– HTTP UL: DQI average of all successful HTTP UL services

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

QoS report view configuration

The "QoS Report View" contains only the general "Info" tab.

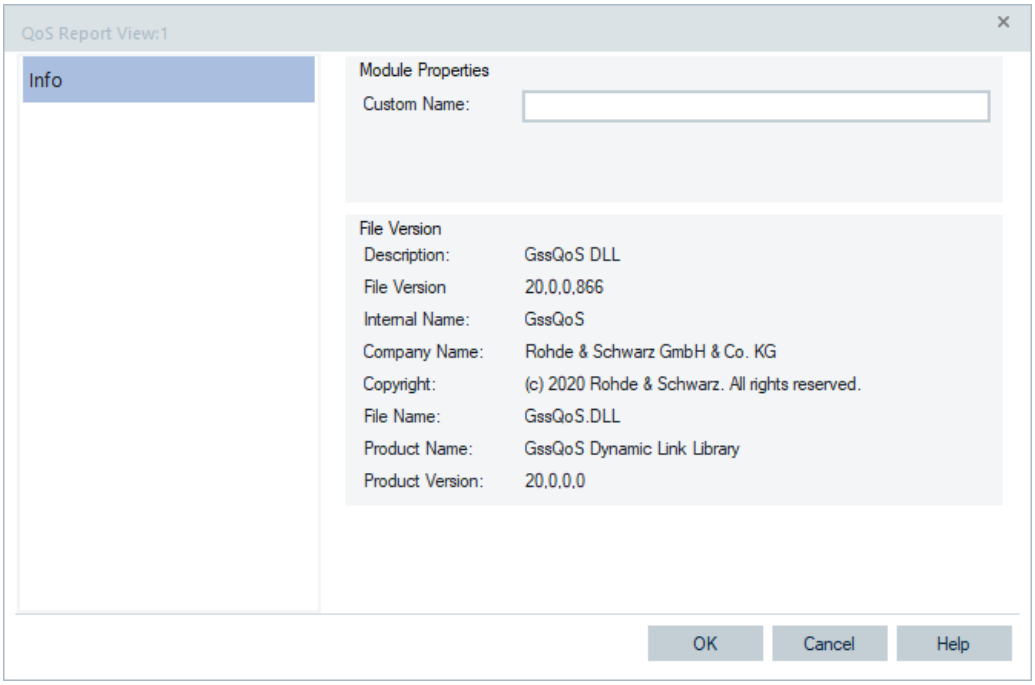


Figure 4-730: QoS Report View configuration

4.6.3 QoS KPI export result view

The "QoS KPI Export View" shows the result of an exported `*.csv` file from the KPI export definition. Every row of type `header` is a tree node for the rows of type `session`, see the `KPI Definition File.doc`.

The rows and columns depend on the KPI export definition. All devices of a measurement which are recognized by the KPI Generator are displayed in separate table.

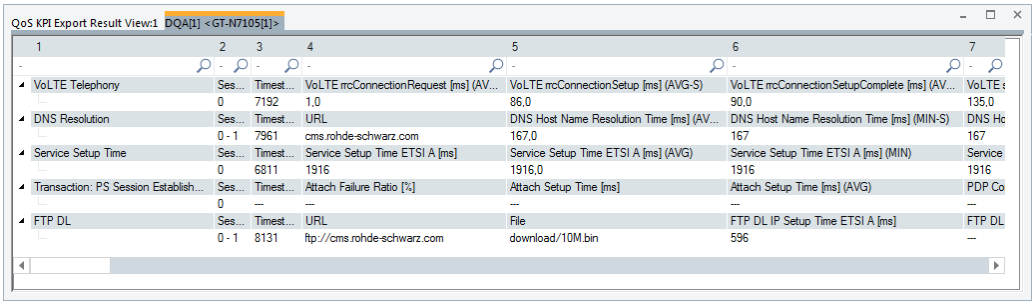


Figure 4-731: QoS KPI Export Result View

If you click the header of a column, the contents is sorted as alphanumeric.

Example:

QoS KPI export result view of speech quality measurement made with smartphone

The "KPI Export Result View" displays the average of the MOS values per session and per measurement, see the following figure.

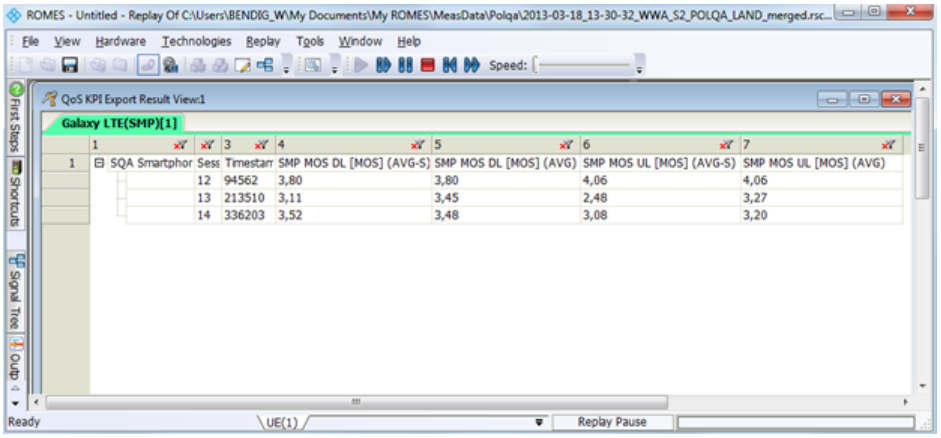
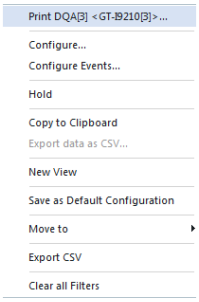


Figure 4-732: Exported smartphone speech quality (MOS) measurement results

4.6.3.1 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

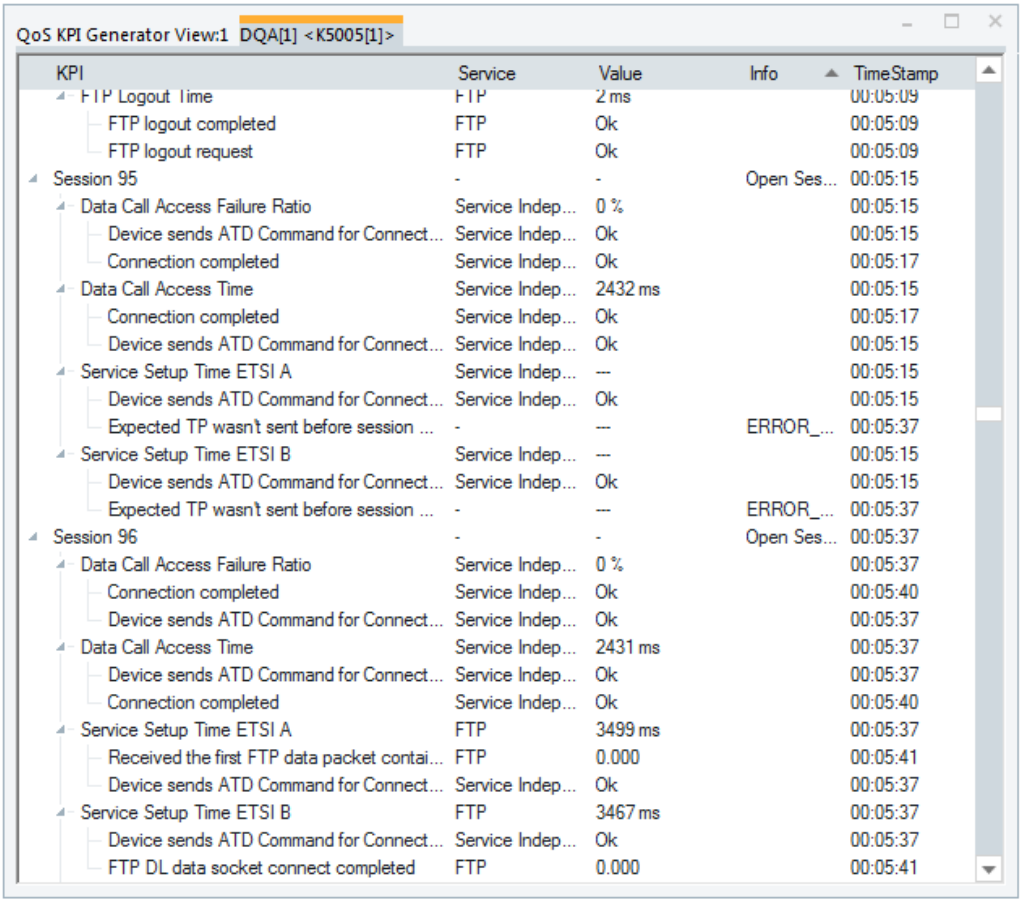
The context menu provides the following additional commands:

- **Export CSV**
  It is possible to export the content of the table as a `*.csv` file.
- **Clear all Filters**
  This command is used to clear all created filters.

4.6.4 QoS KPI generator view

The KPI generator displays in the "QoS KPI Generator View" the KPIs for which it has found trigger points. Also the KPIs with trigger points outside the session are displayed. By defining a session (normally a connect – disconnect sequence), all the session's KPIs are shown under it is tree node.

The QoS KPIs of measurement devices recognized by the KPI generator are displayed in a separate table.



KPI	Service	Value	Info	TimeStamp
FTP Logout Time	FTP	2 ms		00:05:09
FTP logout completed	FTP	Ok		00:05:09
FTP logout request	FTP	Ok		00:05:09
Session 95	-	-	Open Ses...	00:05:15
Data Call Access Failure Ratio	Service Indep...	0 %		00:05:15
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:15
Connection completed	Service Indep...	Ok		00:05:17
Data Call Access Time	Service Indep...	2432 ms		00:05:15
Connection completed	Service Indep...	Ok		00:05:17
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:15
Service Setup Time ETSI A	Service Indep...	---		00:05:15
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:15
Expected TP wasn't sent before session ...	-	---	ERROR_...	00:05:37
Service Setup Time ETSI B	Service Indep...	---		00:05:15
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:15
Expected TP wasn't sent before session ...	-	---	ERROR_...	00:05:37
Session 96	-	-	Open Ses...	00:05:37
Data Call Access Failure Ratio	Service Indep...	0 %		00:05:37
Connection completed	Service Indep...	Ok		00:05:40
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:37
Data Call Access Time	Service Indep...	2431 ms		00:05:37
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:37
Connection completed	Service Indep...	Ok		00:05:40
Service Setup Time ETSI A	FTP	3499 ms		00:05:37
Received the first FTP data packet contai...	FTP	0.000		00:05:41
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:37
Service Setup Time ETSI B	FTP	3467 ms		00:05:37
Device sends ATD Command for Connect...	Service Indep...	Ok		00:05:37
FTP DL data socket connect completed	FTP	0.000		00:05:41

Figure 4-733: QoS KPI generator view

R&S ROMES4 separates the measurement of trigger points and the postponed KPI calculation based on them. This separation implies the following:

- Trigger points are stored in the measurement file only
- KPI generator calculates the KPIs and sends them to the "KPI Generator View"

The calculation method is adaptable and extensible for specific customer requests. It is defined in a KPI definition file in XML format. A basic definition file is delivered for calculating all common KPIs, which the R&S ROMES4 was calculating until now.

The calculated KPIs can be exported to a CSV file. Which KPIs to export can be defined in XML format of a KPI export definition file, see Chapter 3.8.2.15, "TEC for QoS tester", on page 367. The calculation of average, minimum or maximum value over sessions, and the whole measurement is possible in the export. The export result is visualized in the "KPI Export Result View".

Average Export on Time Basis

To be able to calculate throughput correctly, rate has to be calculated on a time basis. The rate depends on how long the last value was valid. Start and End Trigger points are the same. For example, a trigger point at t1 = 100 is 2000 Bytes, a second one at t2 = 200 is 3000 Bytes. The single KPI would be (3000-2000)/(200-100) = 1000 / 100 = 10 Bytes per second. If a third TP occurs at t3 = 500 with 9000 Bytes, the second KPI would be (9000-3000)/(500-200) = 6000 / 300 = 20 Bytes per second. The average as implemented now is (10 + 20) / 2 = 15, what is wrong. The rate on time basis is (10 * 100 + 20 * 300) / (100+300) = 17,5. So an attribute “method” for the key word AVG and AVG_PER_SESSION for the XML file is available. The method can be “time” or “sample”. If the method is not specified, the “sample” is the default value.

4.6.4.1 View contents

The "QoS KPI Generator View" displays different values depend on a job that is being executed.

Column description

- **KPI**
  KPI name defined in the KPI definition.
- **Service**
  Service whose trigger points were measured. If the service of start and stop trigger point are not identical, the service of the KPI is taken from the stop trigger point.
- **Value**
  The value of the KPI and the trigger points. The value types (units) of the KPI and their trigger points can be different due to the reason illustrated with the following example. KPI FTP Mean User Data Rate is calculated as the number of bytes between start and stop trigger point divided by the time span between start and stop trigger point. The result value of the KPI has the unit kbit/s. The values of the trigger points have the unit bytes to calculate the number of bytes between start and stop trigger point.
- **Info**
  A trigger point can have meta data such like the URL, IP Address (see Trigger Point Definitions.doc for available meta data keys). This meta data information is displayed here. The KPI displays the meta data both of start and stop trigger point.
- **Timestamp**
  The timestamps of the KPIs and its trigger points. It corresponds to the timestamp of the start trigger point.

Short Keys

- **<Ctrl+F>**
  Opens the "Find" dialog.
- **<F3>**
  Continues a previous search, searching from top to bottom for a next occurrence of the search string.
- **<Shift+F3>**

Continues a previous search, searching from bottom to top for a next occurrence of the search string.

4.6.4.2 SQA trigger points and KPI

The trigger points related to a speech quality analysis (SQA) are included in the R&S ROMES4. The trigger points mark the beginning and the end of playback of the selected speech sample, during an ongoing uplink SQA measurement.

These events are logged as the key performance indicators (KPIs) and can be viewed inside the QoS KPI generator view, as shown in the following figure. For the KPIs and the trigger points in general, refer to the Chapter 9.4, "R&S ROMES4 KPI Description", on page 2312 and Chapter 9.3, "Trigger point definitions", on page 2243.

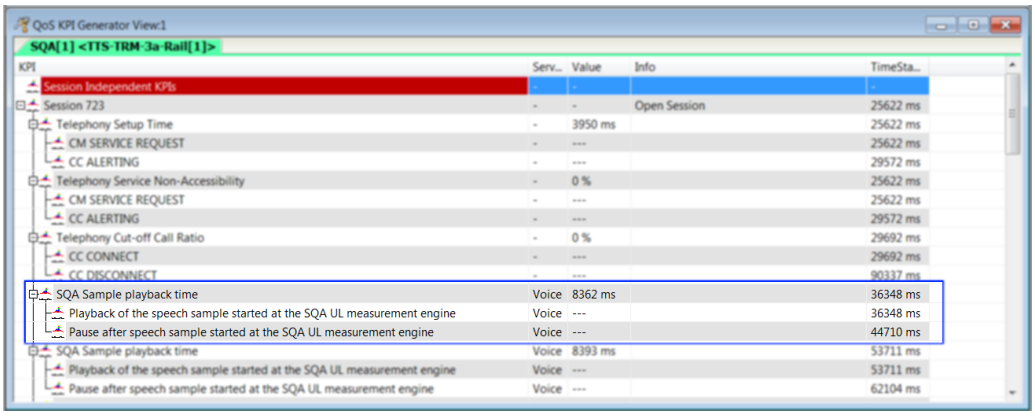


Figure 4-734: KPI records - the beginning and end of a speech sample during an uplink SQA measurement

Like all other trigger points, the SQA trigger points are associated with timestamps, which can be used precisely to determine the time at which these events occur.

Note that the precision of logged timestamps is affected by internal delays due to processing and audio buffering, and can only be used as an approximate value.

The trigger points of some KPI are also available as signals in the "QoS Trigger Points (Legacy)" signal tree branch, if selected in "Tools" > "Preferences" > "Available Signals".

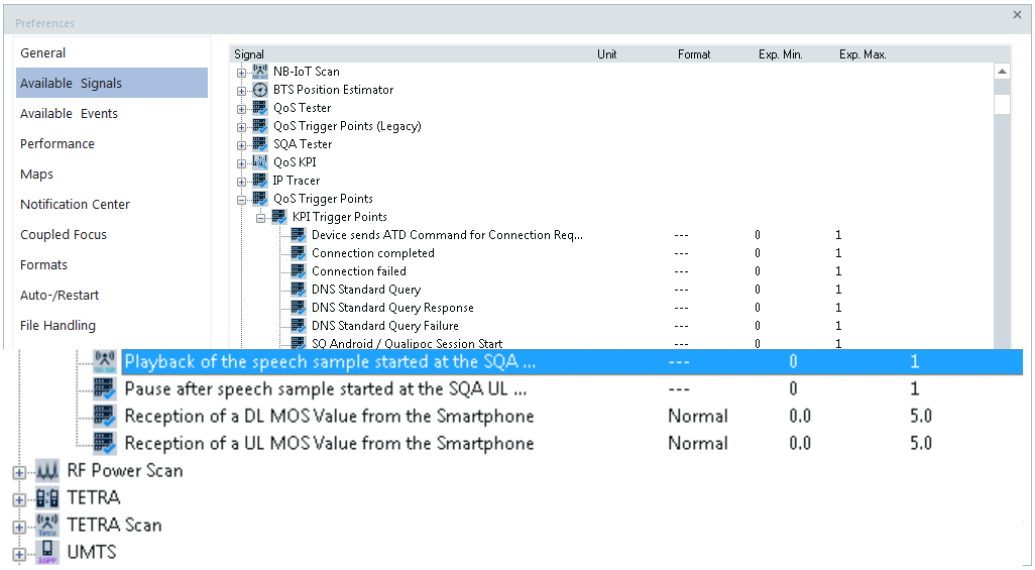


Figure 4-735: Selected signal as a KPI trigger point

The selected signal, for example "Playback of the speech sample...", can be used as an event recorded during the measurement.

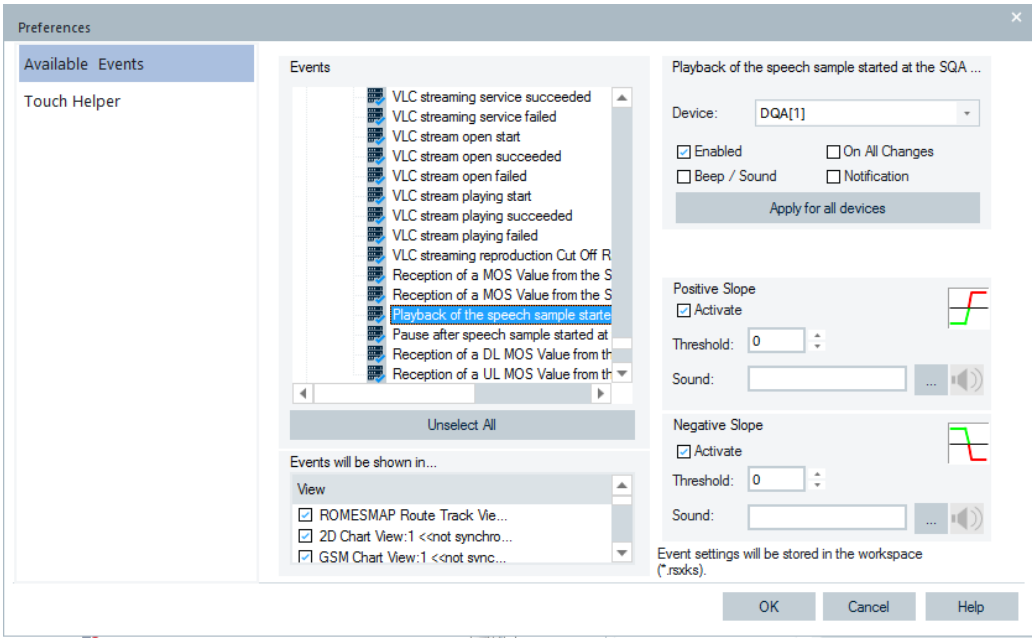


Figure 4-736: Selected event

Example:

QoS KPI generator view of speech quality measurement made with a smartphone

The following figure shows the "QoS KPI Generator View" of speech quality measurement results made with a smartphone. The view displays KPIs based on Layer 3 messages and the KPIs for the DL MOS values.

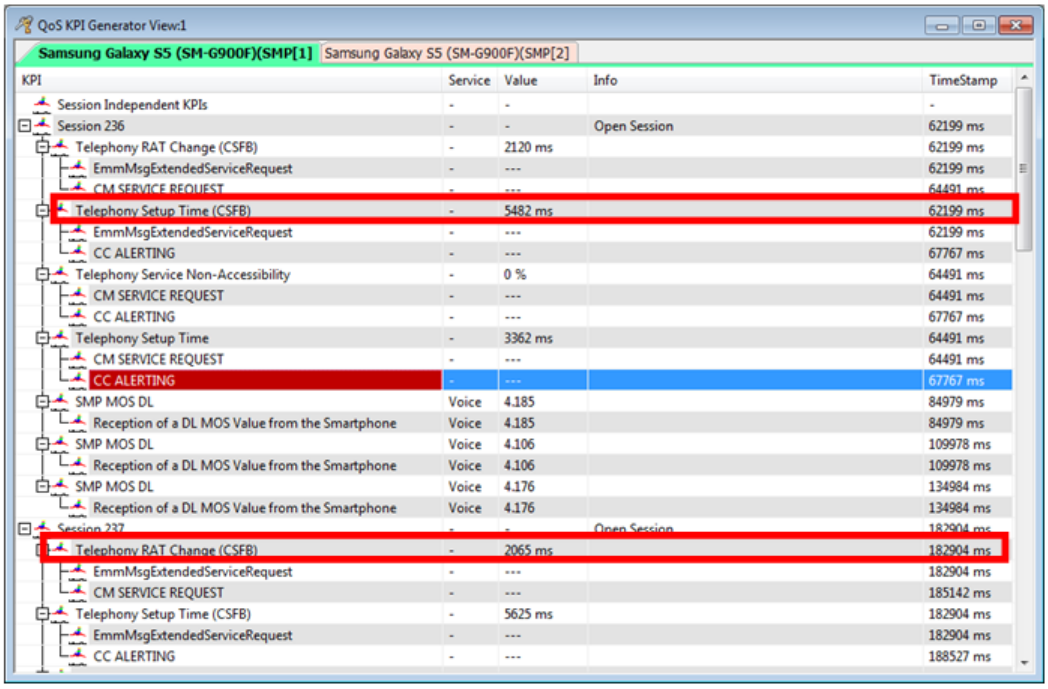


Figure 4-737: Trigger points and KPI (MOS) of smartphone speech quality measurement

The marked KPIs in the figure are related to the introduced KPIs for CSFB and VoLTE calls, "Telephony Setup Time (CSFB)" and "Telephony RAT Chance (CSFB)".

4.6.4.3 DQA jobs supported by the QoS KPI generator

The following table shows the availability of trigger points for the DQA jobs.

Table 4-32: Availability of trigger points for DQA jobs

DQA Job	Service / Protocol	Application Trigger Points	TCP/IP Trigger Points	Remarks
Connect	Service Independent	Yes	No	IP Tracer start is after successful connection
Disconnect	Service Independent	Yes	No	IP Tracer stop is before disconnect request
FTP DL	FTP	Yes	Yes	
FTP UL	FTP	Yes	Yes	
FTP DL/UL	FTP	Yes	No	IP Tracer can only detect TPs for one action per job

DQA Job	Service / Protocol	Application Trigger Points	TCP/IP Trigger Points	Remarks
FTP Multi	FTP	Yes	No	IP Tracer can only detect TPs for one action per job
HTTP DL	HTTP	Yes	Yes	
HTTP UL	HTTP	Yes	Yes	
HTTP with IE	HTTP	Yes	Yes	
WEB 2.0	HTTP	Yes	Yes	
Email DL	POP3	Yes	Yes	
Email DL	IMAP	Yes	No	TCP/IP not available
Email UL	SMTP	Yes	Yes	
Ping	ICMP	Yes	Yes	
Ping	ICMPv6	Yes	No	TCP/IP not available
VLC	VLC	Yes	No	
Run External Process	-	No	-	n.a.
Auto Dial	-	No	-	not available
SMS	-	No	-	not available
DQA Multi Service (Flow)	Several Services	Yes	No	IP Tracer cannot detect TPs for parallel running jobs

Example:

The following figure shows the trigger points and associated KPI for the HTTP Upload DQA job.

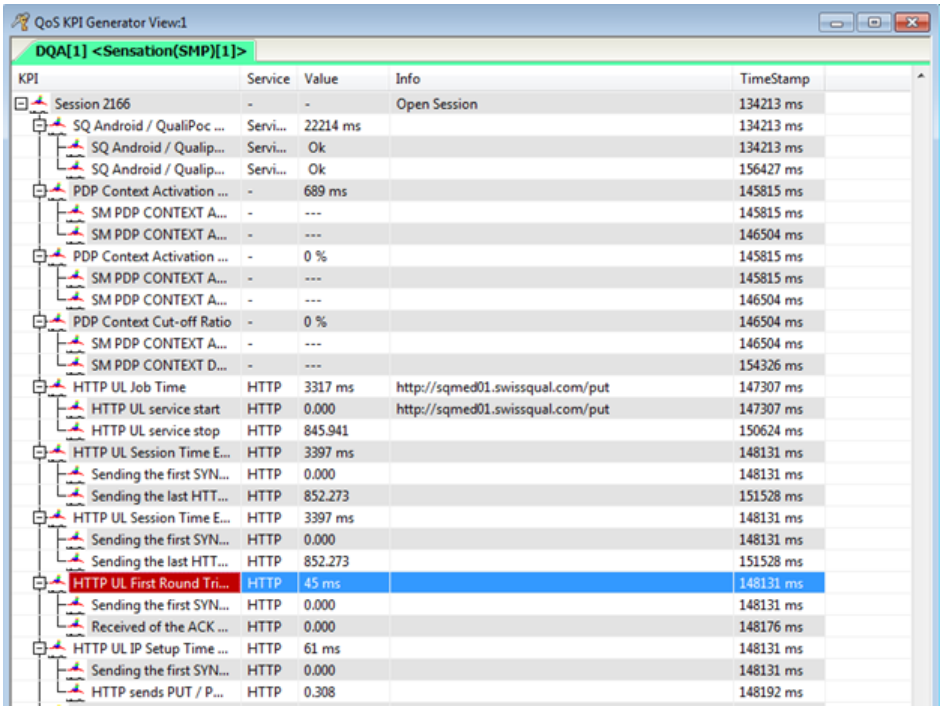


Figure 4-738: Trigger points and KPI for HTTP upload DQA job

The trigger points of this KPI are also available as the signals in "Available Signals" > "QoS Tester" > "HTTP UL Progress", see Chapter 3.8.1.2, "Available signals configuration", on page 228.

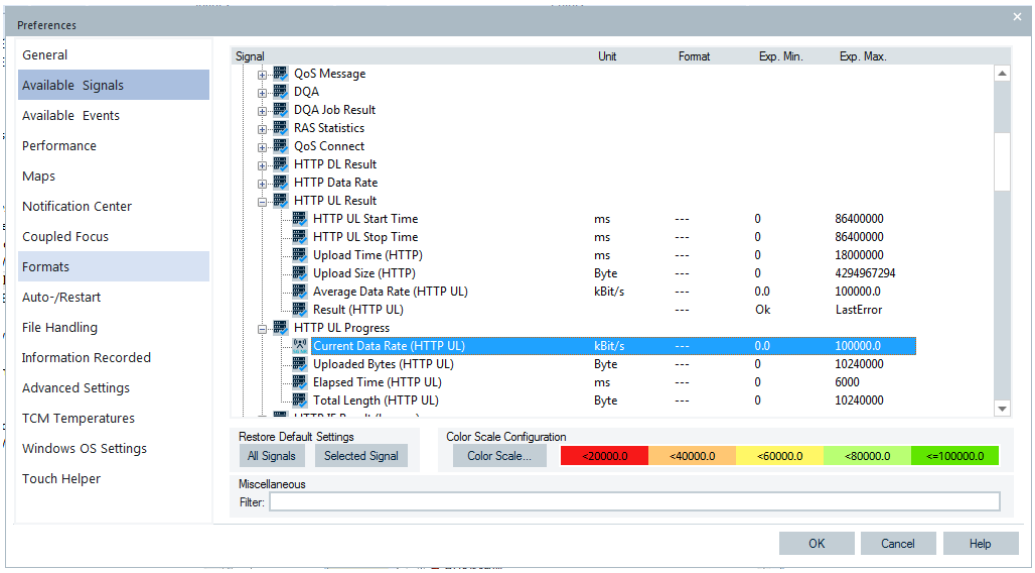
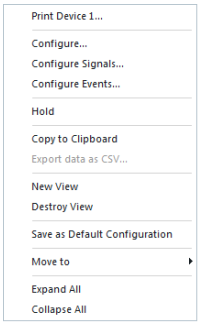


Figure 4-739: Selected signal used as KPI of HTTP upload job

The current version only visualizes trigger points related to a DQA session. This visualization leads to the limitations, that no KPIs for circuit switched services are displayed.

Currently Generic RAT trigger points based on Layer 3 messages are supported for GSM and UMTS only.

4.6.4.4 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.7 WLAN views

The "WLAN Views" show the WLAN information obtained in the network scans performed by a WLAN adapter in regular intervals. WLAN data can be acquired with all common WLAN devices listed in the MS Windows "Connection Manager" > "Wireles Network Connection".

The "WLAN Views" can be selected from a submenu displayed on the right side of the "View" menu when the mouse pauses over "WLAN Views".

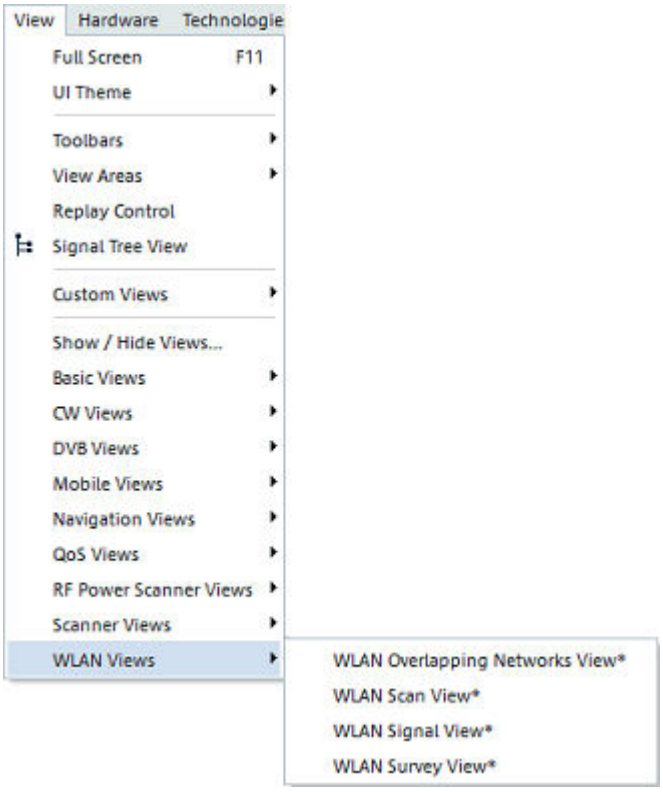


Figure 4-740: WLAN views

The WLAN scan view and the WLAN overlapping networks view use a configurable observation interval. The observation interval is necessary because the hardware can only scan 32 available networks in one run. Available stations disappear from these views when they are not scanned anymore in the configured observation time. The approach leads to a more stable display of available stations, for more see "Observation" on page 1111.

WLAN signals

WLAN adapters constantly monitor and report many parameters describing the current signal quality and data traffic. The parameters are used to generate the signals in the WLAN section of the data tree. The signals complement the WLAN interface status and statistics information, the WLAN network scan information, the WLAN connection status and the information related to WLAN radio state.

For example, the WLAN set of signals and the signals can be viewed in the "Available Signals" > "WLAN" list of the "Alphanumeric View" > "Configuration" window, see the following figure.

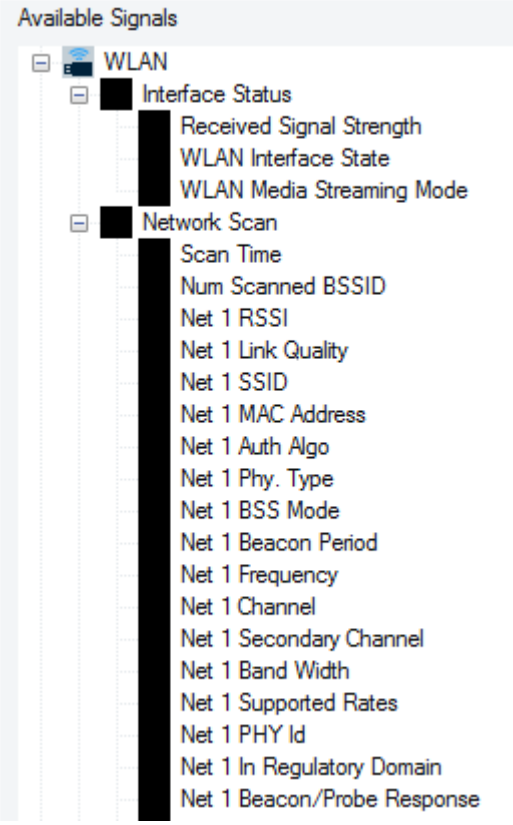


Figure 4-741: Some WLAN signals

The WLAN signal sets in the data tree are:

- **Interface Status**
  The signals related to information on the current interface status.
- **Network Scan**
  The signals related to all scanned networks. The maximum number of scanned networks for one scanner is 32.
- **Connection Status**
  The signals of this set are only available when the device is connected to network.
- **Interface statistics**
  The signals related to statistics. The “Phy” signals in this set are only available when the device is connected to network.
- **Radio state**
  The signal is related to the current radio state.

- WLAN overlapping networks view 1106
- WLAN scan view 1108
- WLAN signal view 1112
- WLAN survey view 1114

4.7.1 WLAN overlapping networks view

The "WLAN Overlapping Networks View" displays information about the co-existing channels and overlapping channels.

At the left side of the view, a table containing all access points with co-existing and overlapping channels is displayed. At the right side, the details are displayed if an access point has been selected in the table. During measurement and replay, the details of the selected access point are updated until a new access point has been selected in the table.

The table can be sorted by each column of the table.

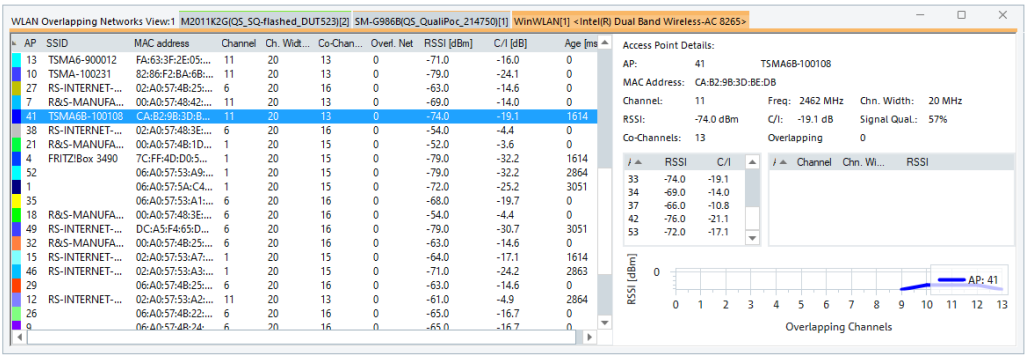


Figure 4-742: WLAN Overlapping Network view -AP selected

The table contains the following parameters:

- "AP"
  Access point number
- "SSID"
  Service set identifier (network name)
- "MAC address"
  MAC address of the access point or other client, depending on whether the test device operates in infrastructure or ad hoc mode.
  The MAC is a unique serial number assigned to a networking device by the manufacturer.
- "Chan."
  Channel identifier of the radio channel that the test device uses for communication.
  For 40 MHz channels, the secondary channels follow the "+" separator.
- "Ch. Width"
  The channel width in MHz (20 or 40).
- "Co-Channel"
  The number of detected co-existing channels for this AP.
- "Overl. Net"
  The number of detected overlapping access points.
- "RSSI"
  Signal strength for all received packets.
- "C/I"

Carrier to interference in dB; only available if co-existing channels were detected for the access point.

- "Age"
  Time since the Probe/Beacon response is received in ms.

The "Access Point Details" window displays the table of the access points which are on the same channel of the selected access point, the table of the access points which overlap the selected access point and a graph which contains the RSSI value of the overlapping access points along the channels.

The thick line in the figure Overlapping network view is the selected access point.

4.7.1.1 WLAN overlapping networks view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

WLAN overlapping networks view settings

The "Overlapping Networks View..." option lets you choose whether to filter the list of signals by the co-existing channels and overlapping networks or not and specify the contents of the view.

You can choose all the scanned networks to be displayed in the table. By default, the list shows only networks with existing co-channels and overlapping networks.

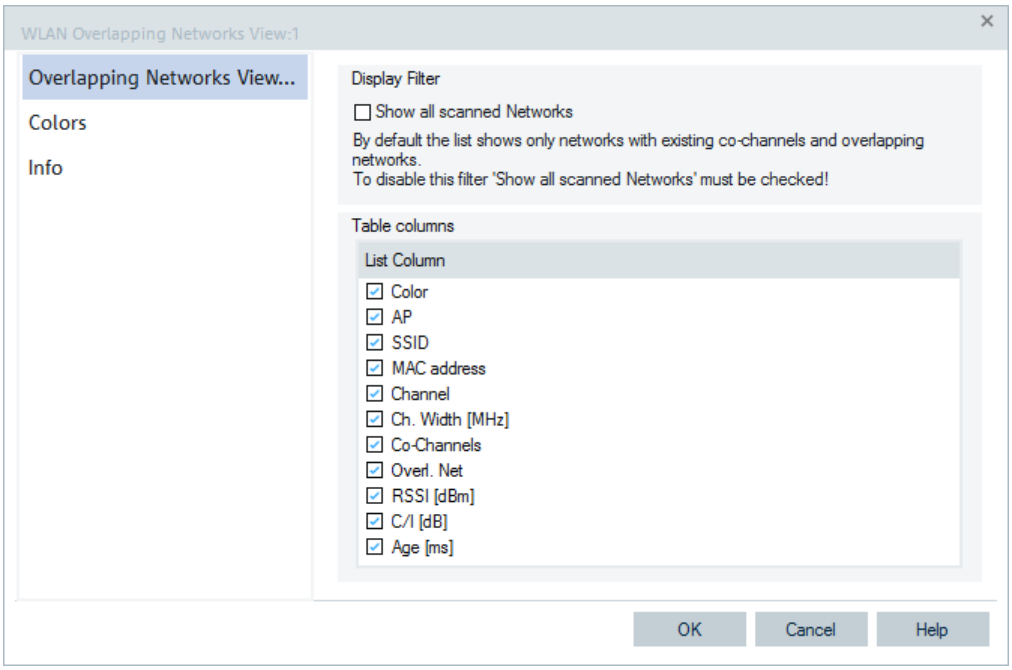


Figure 4-743: WLAN Overlapping Networks View - settings

The parameters you want to be displayed in the view have to be selected in the "Table columns" panel.

WLAN overlapping networks view: colors

The "Colors" option lets you set the colors in the view.

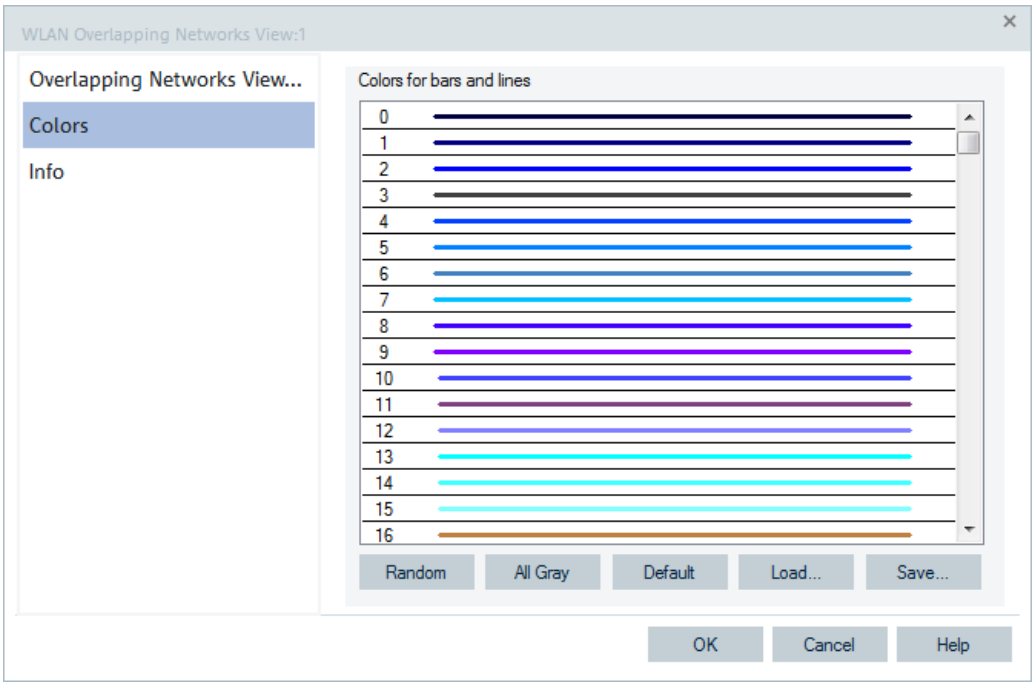


Figure 4-744: WLAN Overlapping Networks View - colors configuration

You can select the colors for bars and lines here.

The color settings in the WLAN configuration menus apply to all WLAN views. The color definitions overwrite each other.

Note the following features of the WLAN color settings:

- The color no. 0 is always used for the noise signal which is measured in a single, fixed channel defined in the NDIS configuration menu.
- The colors no. 1 to 500 can be assigned to signals from access points or other clients (the maximum number of signals received simultaneously is 32). The assignment is chronological. The first detected signal is displayed with color code no. 1, the second with color code no. 2, etc.

4.7.2 WLAN scan view

The "WLAN Scan View" displays basic information acquired in a WLAN network scan (WLAN BSSID list information).

Each access point generates a table row with a colored analog bar. The columns displayed and the maximum number of rows (access points) can be limited in the configuration menu. The length of each bar is a measure for the received signal strength

(RSSI) of the signal from the access point. The numeric RSSI value appears in the RSSI (in dBm) row. The scale settings in the configuration menu define the length of the bars.

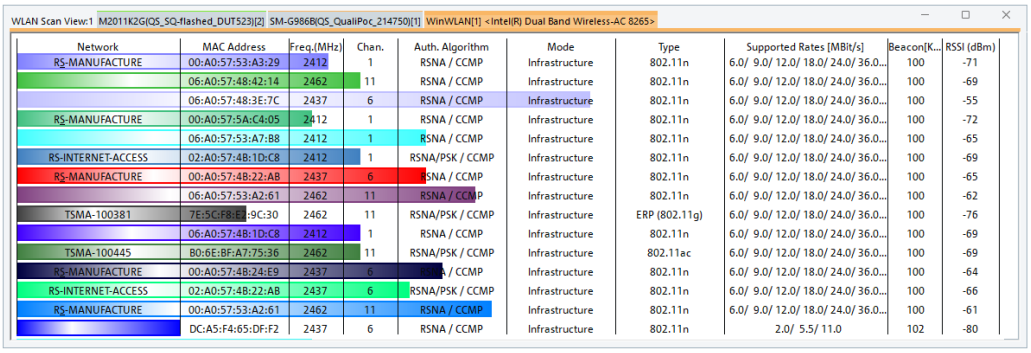


Figure 4-745: WLAN Scan View

The table contains the following parameters:

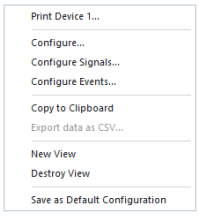
- "Network"
  Network name
- "MAC Address"
  MAC address of the access point or other client, depending on whether the test device operates in infrastructure or ad hoc mode.
  The MAC is a unique serial number assigned to a networking device by the manufacturer.
- "Frequency"
  Center frequency of the used channel in MHz. According to standard IEEE 802.1, it is 2484 MHz. Depending on the regulatory domain, the channel range can be restricted.
- "Channel"
  Channel identifier of the radio channel that the test device uses for communication.
- "Auth. Algorithm"
  Gives information about the required authentication and cipher algorithms.
- "Mode"
  "Infrastructure" or "Ad hoc" mode. In "Infrastructure" mode the test device can communicate with access points and other network infrastructure devices; in "Ad hoc" mode, it can also communicate with other client devices.
- "Type"
  Spread-spectrum type used for the physical layer: Direct Sequence ("DS") or Frequency Hopping (FS).
- "Supported Rates"
  Data rate at which the test device transmit or receive data, unit MBit/s.
  "1/2/5/11/18/24/36/54" means that a 5-GHz test device uses Auto Rate Selection.
- "Beacon"
  Beacon period in the range between 20 Kµs and 976 Kµs, specifies the duration between beacon packets. The beacon packets help clients to find each other in ad hoc mode.

(Kµs is a measurement unit in software terms, K = 1024, µ = 10^{-6}, s = seconds, therefore 1 Kµs = 0.001024 seconds = 1.024 ms)

- "RSSI"
  Signal strength for all received packets in dBm.

The results provided by each test device are displayed in a separate table. Each tab shows the WLAN parameters of the signals from the access points detected by the test device in a network scan. The results are updated every time the test device terminates a network scan.

4.7.2.1 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.7.2.2 WLAN scan view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration

The "Configuration" option lets you specify the scale and the contents of the view, defines the color settings, and displays information about the view version.

The "Configuration" defines the scale for the bars in the "WLAN Scan View", the maximum number of bars and selects the parameters shown in the table.

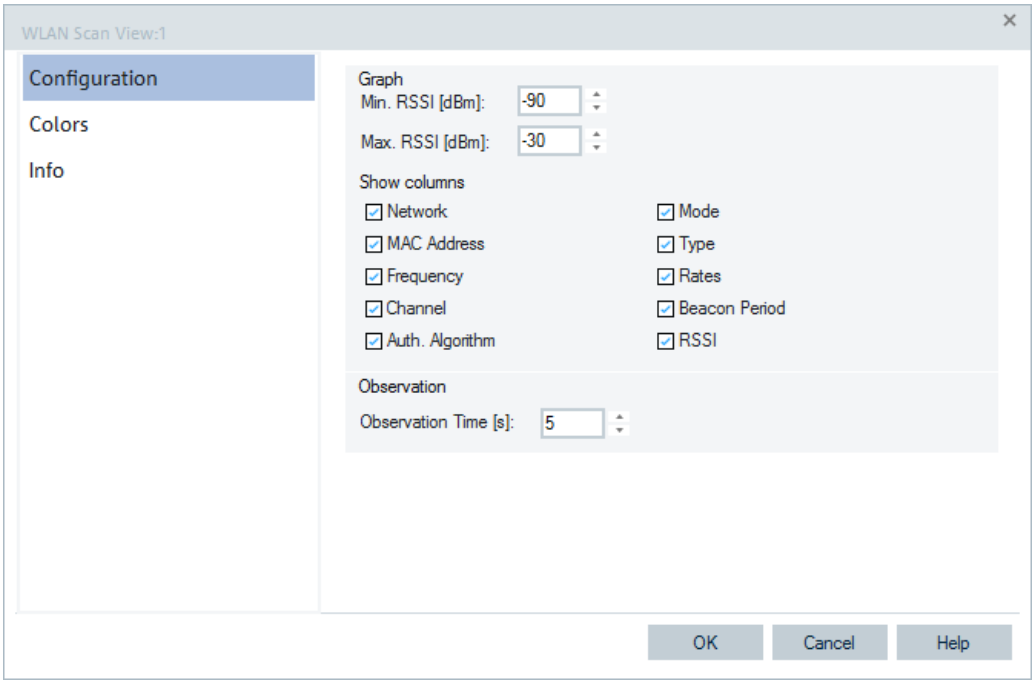


Figure 4-746: WLAN Scan View Configuration

Graph

The three input fields in the Graph panel define the RSSI levels corresponding to bars of zero length and full-length.

The actual length of the bars in the "WLAN Scan View" is equal to:

- L = RSSI [dBm] * <full length> / (Max. RSSI [dBm] – Min. RSSI [dBm])
  - "Max. Count"
    Maximum number of bars/access points displayed in the "WLAN Scan View". The actual number can be smaller, if less than "Max. Count" access point signals are detected.

Show Columns

"Show Columns" lets you select previously described parameters for display in the "WLAN Scan View" table.

Observation

The WLAN scan view and the WLAN overlapping networks view use a configurable observation interval.

The observation time can be configured in the configuration dialog of the "WLAN Scan View" and takes also effect to the WLAN overlapping networks view. The default value is 5 seconds.

WLAN scan view: colors

The "Colors" lets you define the colors for bars and lines in the WLAN view.

The configuration page is the same as the "Colors" page of the "WLAN Overlapping Networks View", see "WLAN overlapping networks view: colors" on page 1108.

4.7.3 WLAN signal view

The "WLAN Signal View" displays the power of all received signals of the frequency bands 2.4 GHz and 5 GHz in the stacked chart. Only the channels which show activity are displayed.

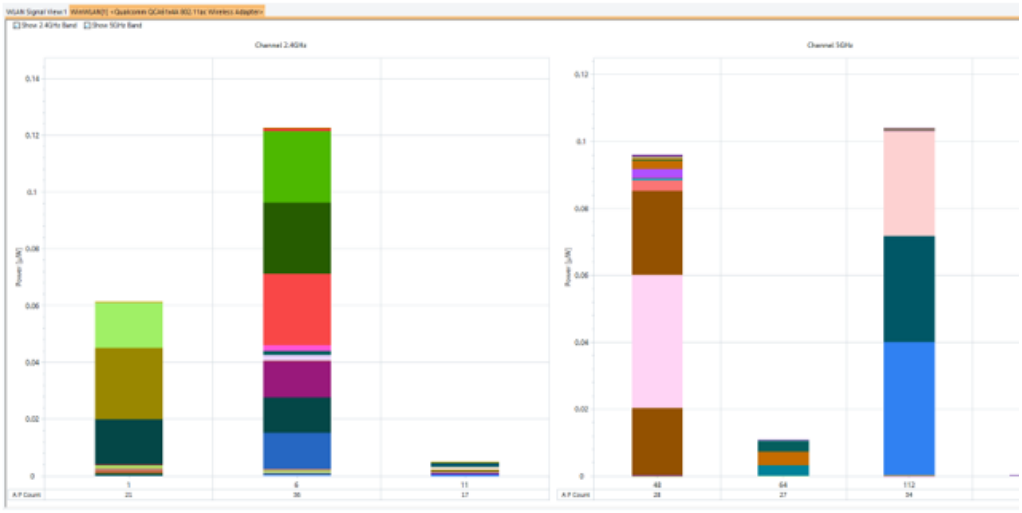


Figure 4-747: WLAN Signal View

The view shows by default the charts of both bands. You can hide a chart of the band you are not interested in if you uncheck the "Show 2,4GHz Band" or "Show 5GHz Band" checkbox in the view.

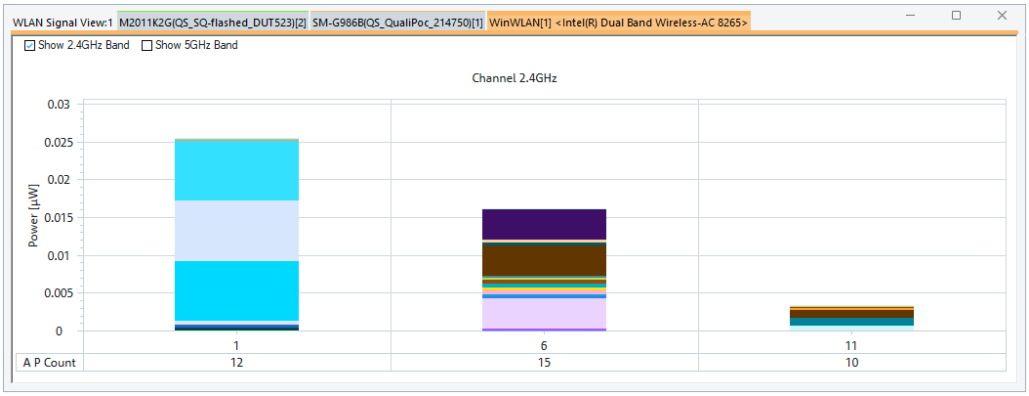


Figure 4-748: Band 5 GHz is unchecked

The X-axis of the chart shows the channel numbers of the band. Below a channel number, the number of involved access points (AP) is displayed. Since the power of the single values is added in this view, the power is displayed in [µW] on Y-axis.

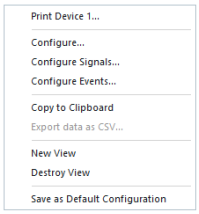
Each received signal power generates a colored bar. The length of the bars is a measure of the received power.

The numeric RSSI value appears in the "RSSI" column of the Chapter 4.7.2, "WLAN scan view", on page 1108.

On a linear scale, the power values can be small, so that the calculated values are less than one pixel. For this reason, it looks like the channels have less different values than they have. For example, channel 64 of 5 GHz band in the previous screenshot looks like 4 different values. However there are another 23 values which are too small to display (4 different colors + 23 values below one pixel sums up to 27 access points involved).

A test device operating in ad hoc mode can also communicate with other clients. The "WLAN Signal View" does not the show access point signals in this case but all the signals used in communication.

4.7.3.1 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.7.3.2 WLAN signal view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration

The "Configuration" option lets you set the scale for the bars in the "WLAN Signal View".

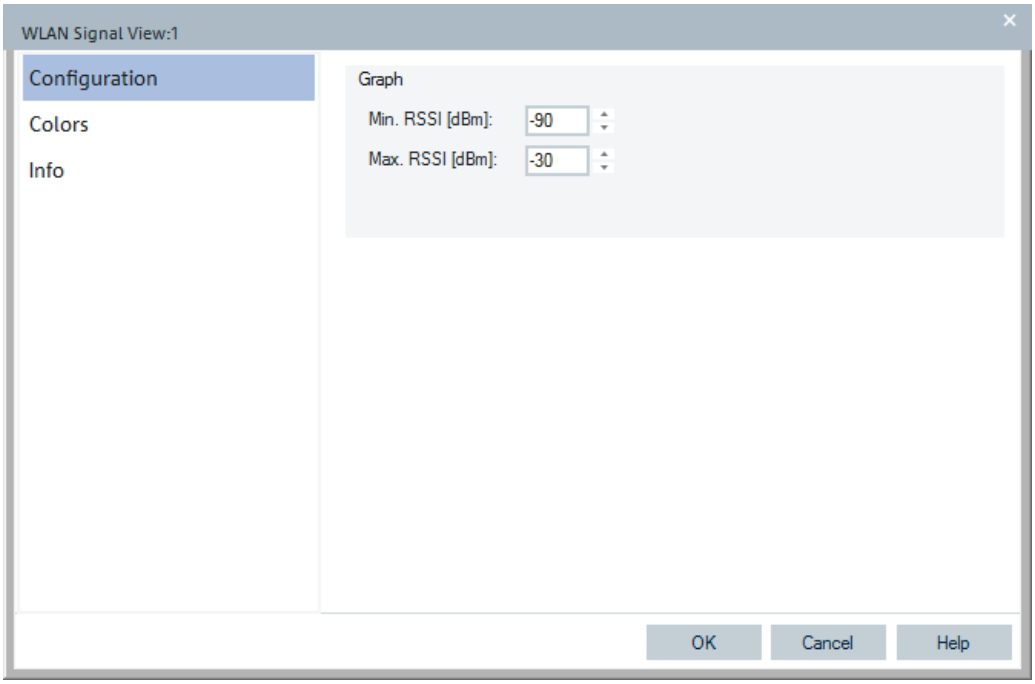


Figure 4-749: WLAN Signal View configuration

WLAN signal view configuration: colors

The "Colors" lets you define the colors for bars and lines in the WLAN view.

The configuration page is the same as the "Colors" page of the "WLAN Overlapping Networks View", see "WLAN overlapping networks view: colors" on page 1108.

4.7.4 WLAN survey view

The "WLAN Survey View" gives an overview of the measured WLAN parameters from all access points including the distribution of the RSSI, C/I, and S/N values.

If a replayed measurement file was recorded in "Block Mode", the "WLAN Survey View" generates block-specific statistical results. Blocks are defined in the "ROMES-MAP Route Track".

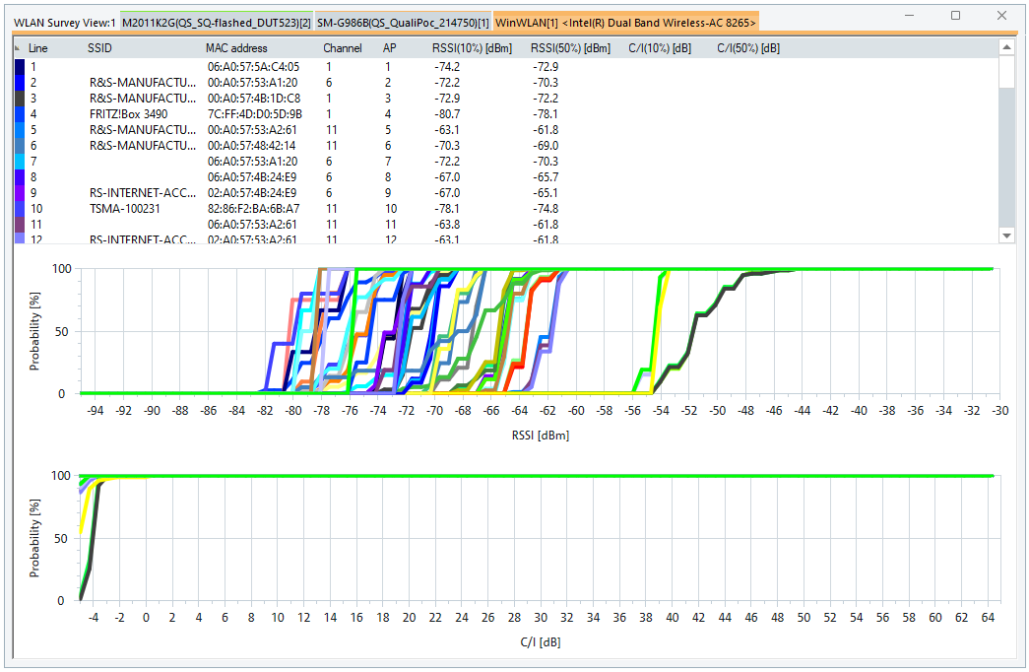


Figure 4-750: WLAN Survey View

The WLAN Survey View contains an access point table, a percentage table, and two 2D chart diagrams.

In the access point table, each access point generates a table row with a color code. The columns displayed and the colors can be defined in the configuration menu.

The access point table contains the following parameters:

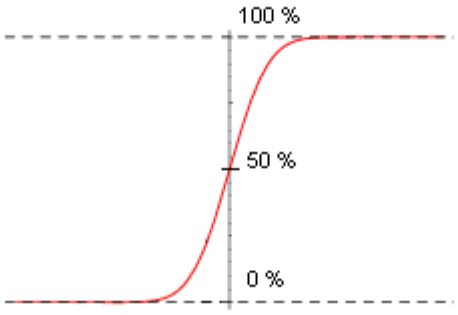
- **Line**
  Number of the table row, assigned in the order the row is created. If n rows are displayed, the line numbers are 1 to n.
- **MAC Address**
  MAC address of the access point.
  The MAC is a unique serial number assigned to a networking device by the manufacturer.
- **Channel**
  Channel number that the access point uses for communication.
- **AP**
  Number of the access point, assigned in ascending order according to the detection time of the access point signal. New access points always receive a new (higher) AP number, so the AP numbers and line numbers can be different when signal is no longer detected.
- **RSSI (10%)**
  RSSI that is reached or exceeded by 90% of the measured values (10% of the measured RSSIs are below RSSI (10%)). RSSI denotes the received signal strength of the signal from the access point in dBm
- **RSSI (50%)**
  RSSI that is reached or exceeded by 50% of the measured values.

- **C/I (10%)**
  C/I that is reached or exceeded by 90% of the measured values (10% of the measured C/I are below C/I (10%)). C/I denotes the ratio of the RSSI of the strongest (carrier) signal to the sum of the RSSIs of all other signals in the channel.
- **C/I (50%)**
  C/I that is reached or exceeded by 50% of the measured values.

4.7.4.1 RSSI chart

Shows the integrated distribution of the measured RSSI values from all access points. For a given RSSI, the curves show the percentage of measured RSSI values that fall below this RSSI. The complement, i.e. 100% minus the "Probability [%]", corresponds to the percentage of measured RSSIs above this RSSI. The colors of the curves correspond to the color codes in the access point table.

For a Gaussian distribution of the measured RSSI values around the center value of RSSI (50%), the integrated distribution corresponds to an error function:

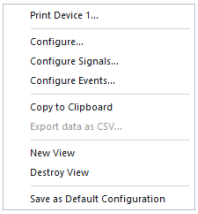


The curve which rises at the highest RSSI values (i.e. in the right side of the diagram) corresponds to the access point with the strongest signal.

4.7.4.2 C/I chart

Shows the integrated distribution of the measured C/I values from all access points. The diagram is analogous to the RSSI chart.

4.7.4.3 Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

4.7.4.4 WLAN survey view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

WLAN survey view: access points

The "Access Points" option lets you select the contents of the access point table, that is, the columns of the table is some of the parameters mentioned in Chapter 4.7.4, "WLAN survey view", on page 1114.

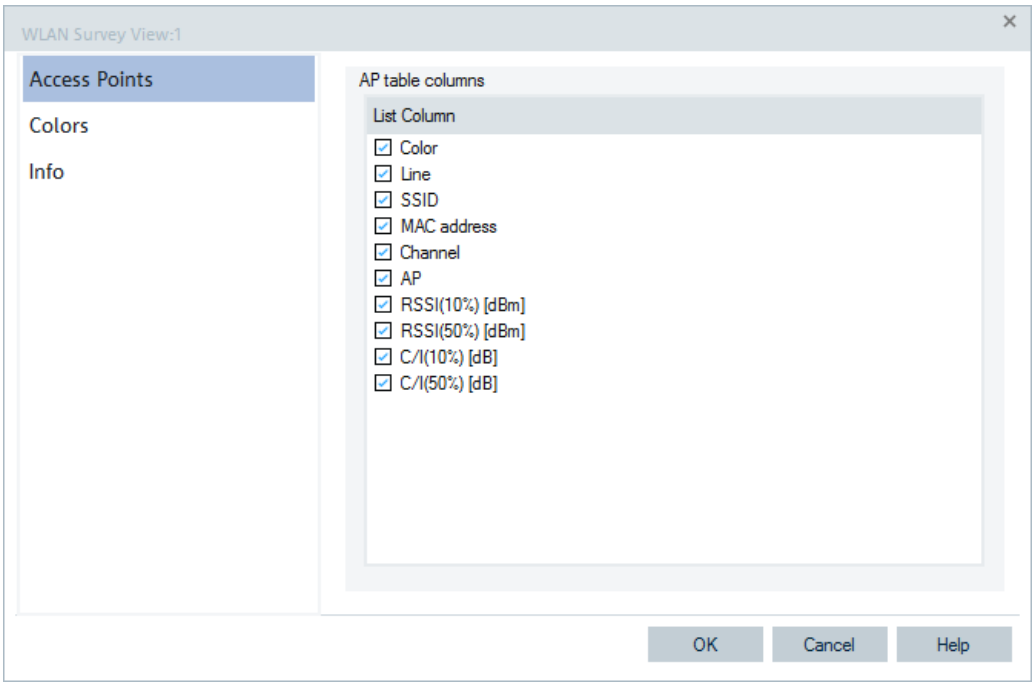


Figure 4-751: Access Points - configuration

WLAN survey view: colors

The "Colors" lets you define the colors for bars and lines in the WLAN view.

The configuration page is the same as the "Colors" page of the "WLAN Overlapping Networks View", see "WLAN overlapping networks view: colors" on page 1108.

4.8 Scanner views

From the "Views" > "Scanner Views" menu select the RAT and the scanner view you want to be displayed.

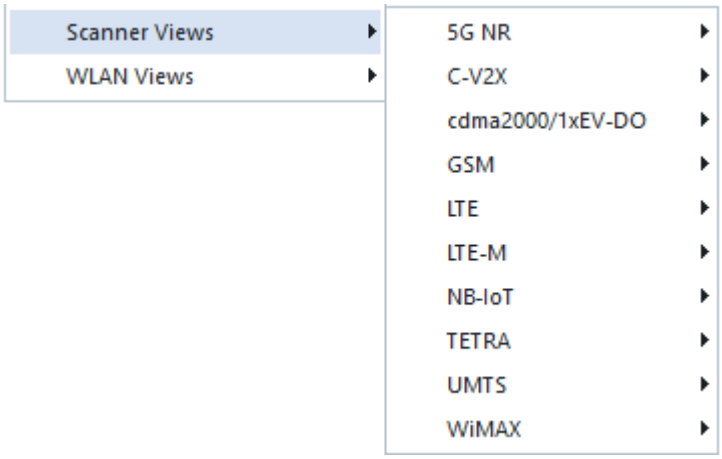


Figure 4-752: Scanner Views

Many views that display scanner data are implemented as tab views, showing a tab for each configured scanner device.

- Scanner views commonalities 1118
- 5G NR scanner views 1126
- C-V2X scanner views 1151
- CDMA2000/1xEV-DO scanner views 1160
- GSM scanner views 1179
- LTE scanner views 1204
- LTE-M scanner views 1273
- NB-IoT scanner views 1297
- RF power scanner views 1319
- TETRA scanner views 1339
- UMTS scanner views 1370
- WiMAX scanner views 1412

4.8.1 Scanner views commonalities

4.8.1.1 Scanner BCH view

The scanner BCH views of the 3GPP specified RATs allow multiple views to open in a such way, that each view displays the data of a single device. This means, the second view displays the data of the second device, while the first view displays the data of the first device.

To open a new instance of the scanner BCH View:

1. Select a device instance in the view.
2. Click any point in the view with the right mouse button.

   The context menu appears.

3. Select the "New View" menu entry.

   The scanner view for that device instance appears.

To remove a view, do the same, but select the "Destroy View" entry instead. This entry is only available in the context menu on the view also created with "New View". That means, the view instance number must be bigger than one. The instance number is visible in the title bar of the view. For example, for the second GSM scanner BCH view, it is "GSM Scanner BCH View:2".

Once only one instance of the view is left, the data of all devices is displayed in this single instance.

The functions and the user interface for exporting operation are present in each RAT BCH scanner view.

The operation has two parts:

- Global export settings
- Filter and export options for the view

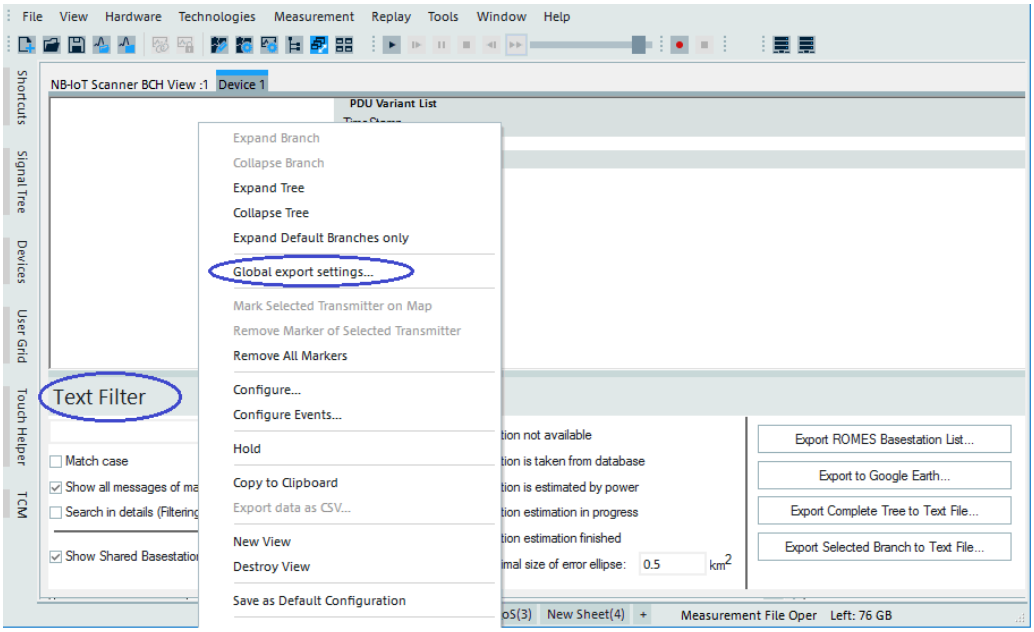
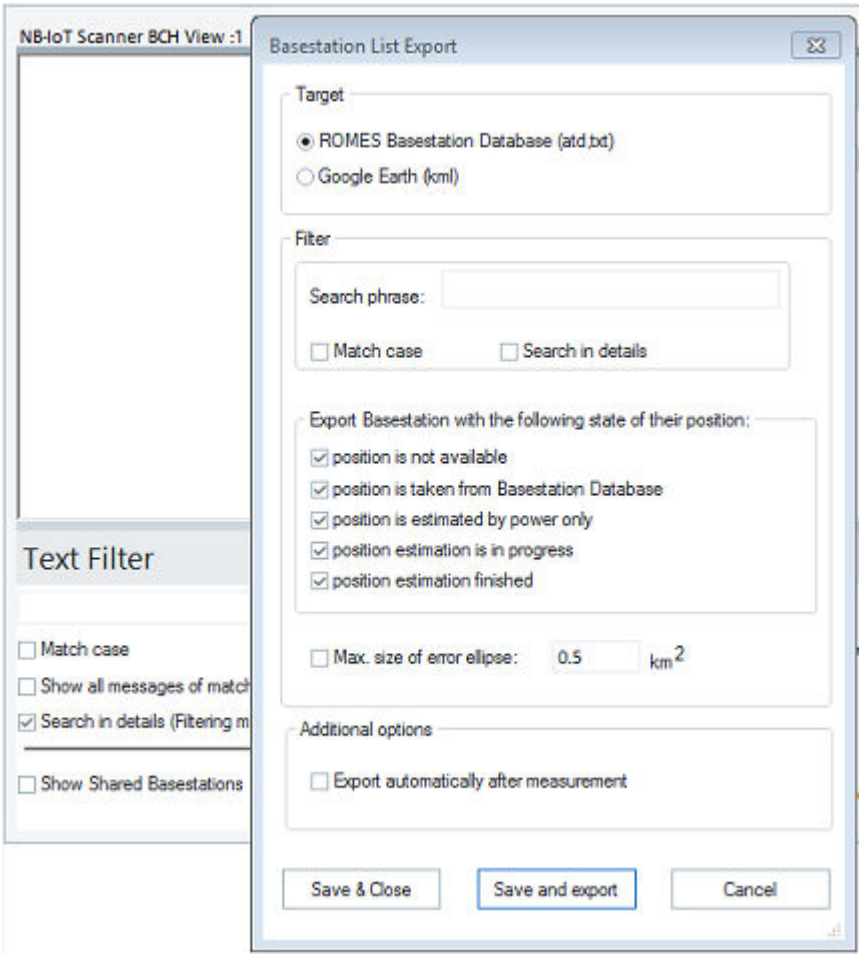


Figure 4-753: Scanner BCH View

Global export settings

Global export settings are done via the "Global export settings" entry of the context-sensitive menu. To get the menu, right-mouse button click any point in the "Scann BCH View" area, see the blue ellipse on the previous figure. The export settings page looks like shown in the following figure.



This dialog combines export and filter functionality in one.

Global export provides the following functions:

- "Target"
  Defines export output format (Romes ATD, TXT or Google Earth KML format). If you choose the "Google Earth" format, the "position is not available" and "position is taken from Basestation Database" options are dimmed and the base stations with these characteristics are not included into the final document.
- "Filter"
  In this section of dialog user can define filter for export. Export filter combines the text search options ("Search phrase", "Match case" and "Search in details"), base station position filter and error ellipse filter (if appropriate checkbox was selected). If search phrase is empty, it means "the text filter is not applied at all".
- "Additional options"
  Export automatically after measurement. If this checkbox was selected, export starts immediately after the end of measurement, if the user presses the "Stop measurement" button).

User has three possibilities to close this dialog:

- Press the "Save and close" button. In this case all settings will be stored in the registry immediately and would be applied only for automatic export after measurement (if appropriate checkbox was selected).
- Press "Save and export" button. In this case all settings is stored in the registry immediately and system starts the export follows filter settings.
- Press the "Cancel" button. Dialog closes, no filter changes are stored in the registry.

Note: The settings of this dialog have no effect for the BCH views.

Filter & export options for view

Every "Scanner BCH View" dialog has in the left-bottom corner the "Text Filter" dialog.

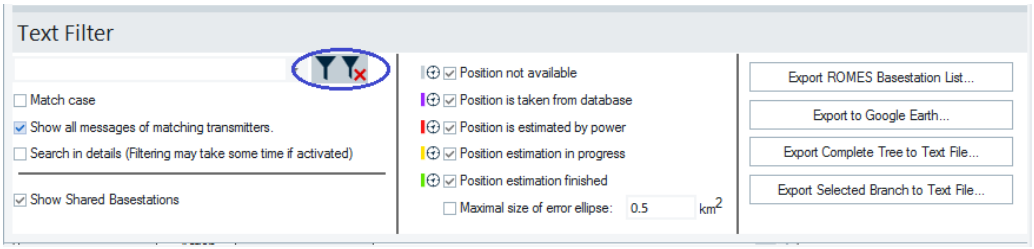


Figure 4-754: Filter & Export Options

Unlike the "Global export settings" dialog, this dialog effects only for appropriate view and does not impact another dialogs. This dialog has the following special features:

- "Set filter"
  The "Set filter" button applies filter to the dialog. If the filter was defined, but not applied, this button is gray.
- "Clear filter"
  The "Clear filter" resets all filter settings and restores original (non–filtered) settings of the view.
- "Show all messages of matching transmitters"
  "Always show messages of transmitters" allows you to see info on base stations even if the base station information does not match with the text filter settings, but the parent node does.

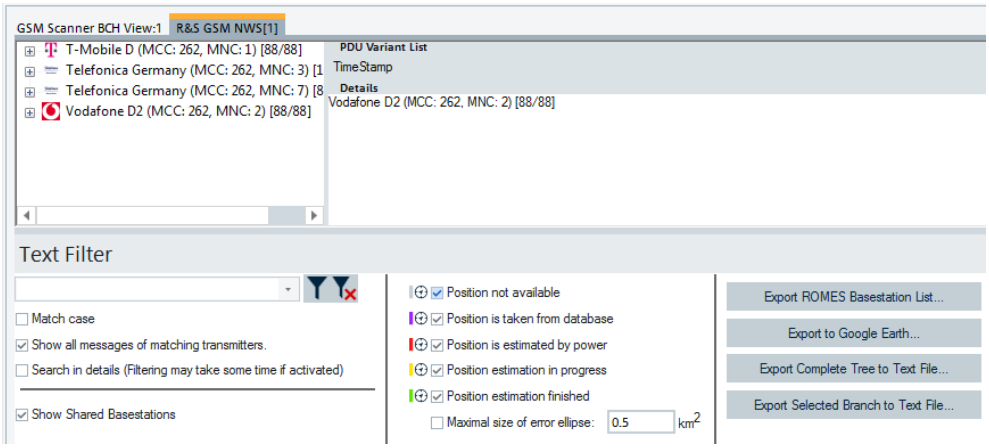
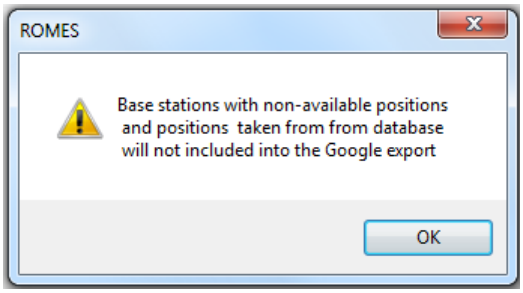


Figure 4-755: Show messages of matching transmitters

For example, if you type in the text search field “1800” and check this option, you see all base stations of the node “GSM 1800”, because “GSM 1800” contains search phrase and "Always show messages of transmitters" was selected as shown in the figure above.

The "Text Filter" dialog has also the export functionality. The dialog provides four different kinds of export:

- "Export ROMES Basestation List"
  Exports actual view (What You See Is What You Get) to the file in the R&S ROMES data format.
- "Export to Google Earth"
  The same as previous, but to the Google Earth format, and selection of "Position not available" and "Position is taken from database" check boxes are ignored for this kind of export. In this case user gets the following notification.



- "Export Complete Tree to Text File"
  This option exports whole tree of the view into the plain text file of the following format:

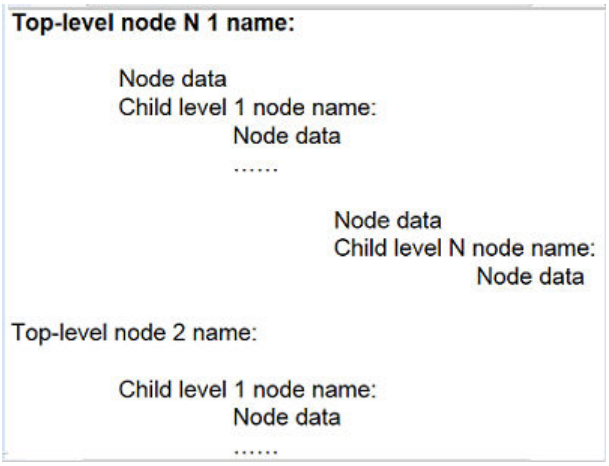


Figure 4-756: Format of tree views export

- "Export Selected Branch to Text File"
  This option exports information in the same format as a previous option, but only for selected node. If selected, node has child nodes. You get the following question:

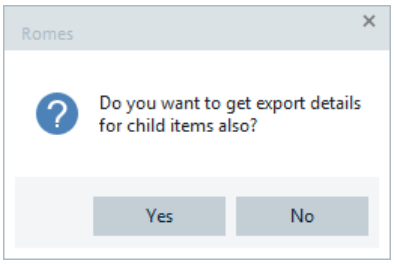


Figure 4-757: Export child items

Depending on the answer, an export file contains export data only for selected node or for the all child nodes. You are informed with the following message about the export of tree.

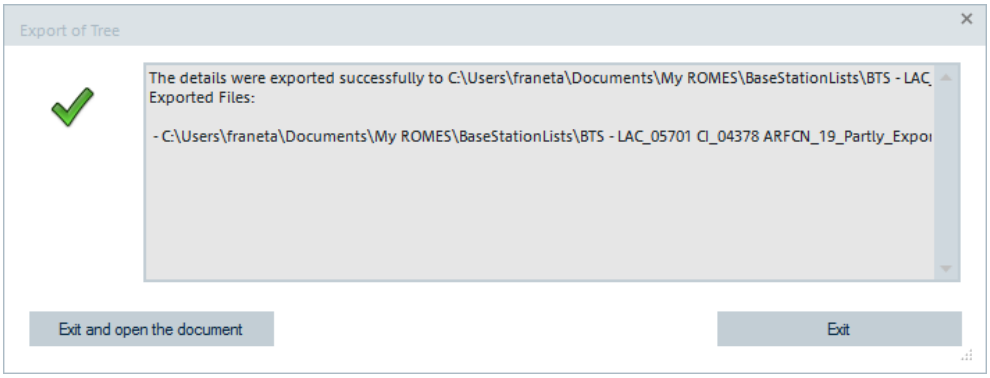


Figure 4-758: Successful export

The filter is automatically restored and applied to the view when launching the program again next time. Each technology view saves and restores own filter settings separately.

4.8.1.2 Scanner Top N view

GSM, UMTS, LTE, NB-IoT, LTE-M, 5G NR, WiMAX, TETRA and cdma200/1xEV-DO technologies share the generic implementation of the Top N processing and the Top N display functions. This generic implementation is achieved with a common Top N user interface and more common Top N views for these technologies, among others in respect of:

- Choice of a power value for the graph
  There are two ways to visualize the power of the mentioned technologies. The power values of supported technologies are shown in the "List" and "Chart" of the Top N scanner views, for example, see Figure 4-1071.
- Hovering with mouse over the parameters of a scanner Top N view's "List" line the Tooltips shows up. The ToopTip contains the definition of the parameter.

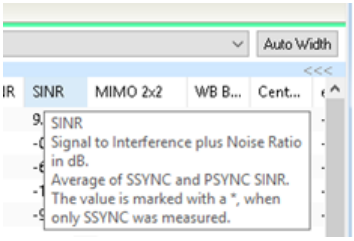


Figure 4-759: Description of SINR column

- BTS distance display in the Top N view
  The optional parameter "Dist.(km") and the related column in the view are available for display for each supported technology.
- "Auto Width" button in the "Top N" line for automatic adjustment of the widths of the columns in the "Top N List". For details, see Chapter 4.8.11.7, "UMTS scanner Top N view", on page 1404.

However, the Scanner Top N view and some other views suppose a device-specific configuration, for example, displaying data for a specific UMTS scrambling code. In this case it does not make a sense to apply the configuration to the complete list of loaded scanner devices.

The "Device-specific configuration" feature allows a single scanner device to select for display. Click "Device Selection" to configure scanner views for selected device on this page. The selection can be done by the device instance or its name on this configuration page, see Figure 4-1065.

The feature works with the second selection option only if the devices or `*.rscmd` files are loaded.

The result of the device selection is shown in Figure 4-1066.

Commonalities applicable to 3GPP technologies

For the Scanner Top N views of the 3GPP defined technologies, i.e, for GSM, UMTS, LTE, LTE-M, NB-IoT and 5G NR scanner views, the following applies:

- Top N view is set to show all Top N pools
- Option to display the Top N pools as a grid with 2D bar charts instead of standard 3D bar chart.

The following figures of LTE Scanner Top N view illustrate the two mentioned options of displaying Top N pools in the view's chart.

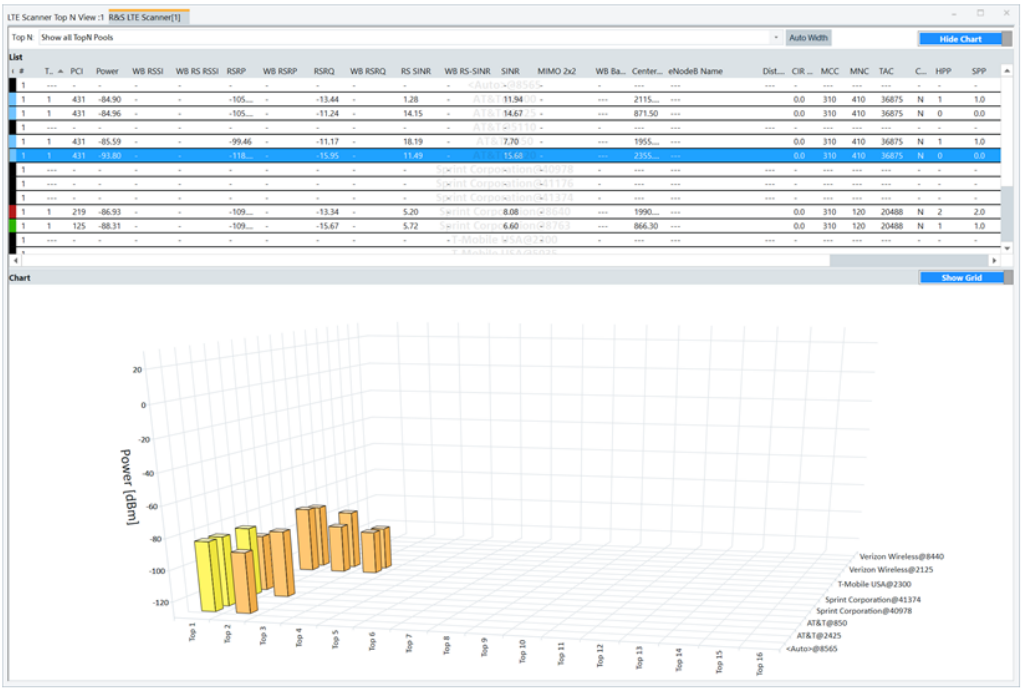


Figure 4-760: Standard 3D bar chart

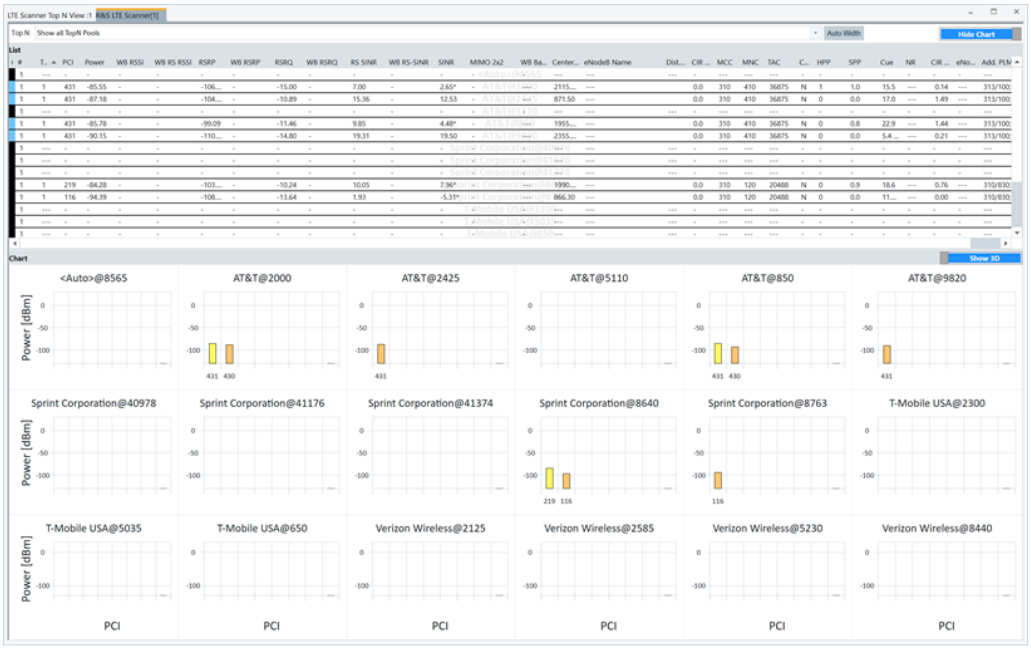


Figure 4-761: Grid with 2D charts

For more details, see "UMTS scanner Top N view for automatic pool configuration" on page 1406.

4.8.2 5G NR scanner views

The 5G NR scanner views show the information obtained in the 5G network scans performed by the R&S 5G NR radio network analyzer.

Currently supported views are shown in the following figure.

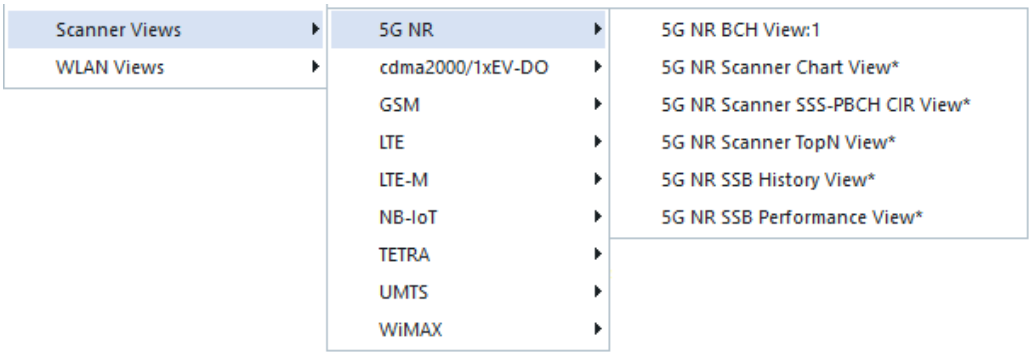


Figure 4-762: 5G NR scanner views

The 5G NR supports several broadcast beams named SSB blocks which contain four signals, PBCH, DM-RS, SSS and PSS. Each block contains optionally two symbol types: Full Symbol (Fs) and Not Full Symbol (NFs).

The signals showing the best beam indexes are based on SSB RSRP and SSB SINR values.

R&S ROMES4 supports also mixed SSB RSSI signals.

The mixed SSB RSSI is calculated as a function of SSB blocks and their associated Fs and NFs symbols, using the following expression:

[Fs(PBCH + DMRS + SSS + PSS RSSI) + NFs(PBCH + DMRS + SSS + PSS RSSI)] / (2*NumberOfValidPairs)

The 5G NR scanner views show the beam values in the following way:

- If a beam value is available, it is shown by "beamindex", for example "5"
- If a beam value is not available but beamindexMod8 is available, it is shown by "**beamindexMod8", for example "**3"
- If none is available, it is shown as "-"

The values are included in the list of 5G NR scanner available signals within the "gNodeB Templates" branch.

The 5G NR scanner provides the information if a gNodeB operates in NSA or SA mode. The information is available in the "Top N Templates" signal branch of the scanner and as the optional column in the "5G NR Scanner Top N View".

5G NR RAT supports the RAN sharing like LTE does. The additional PLMNs, if configured, are also shown as the "Top N Templates" signal branch of the scanner and in the "5G NR Scanner Top N View". If selected auto Top N per provider, one Top N is created for each provider.

The BCH view creates a provider branch for each PLMN.

To derive the 5G NR operation mode or the additional configured PLMNs for RAN sharing, 5G Demodulator v47.97 or higher is required during recording.

The Alphanumeric, Top N and 2D Chart views show the signals.

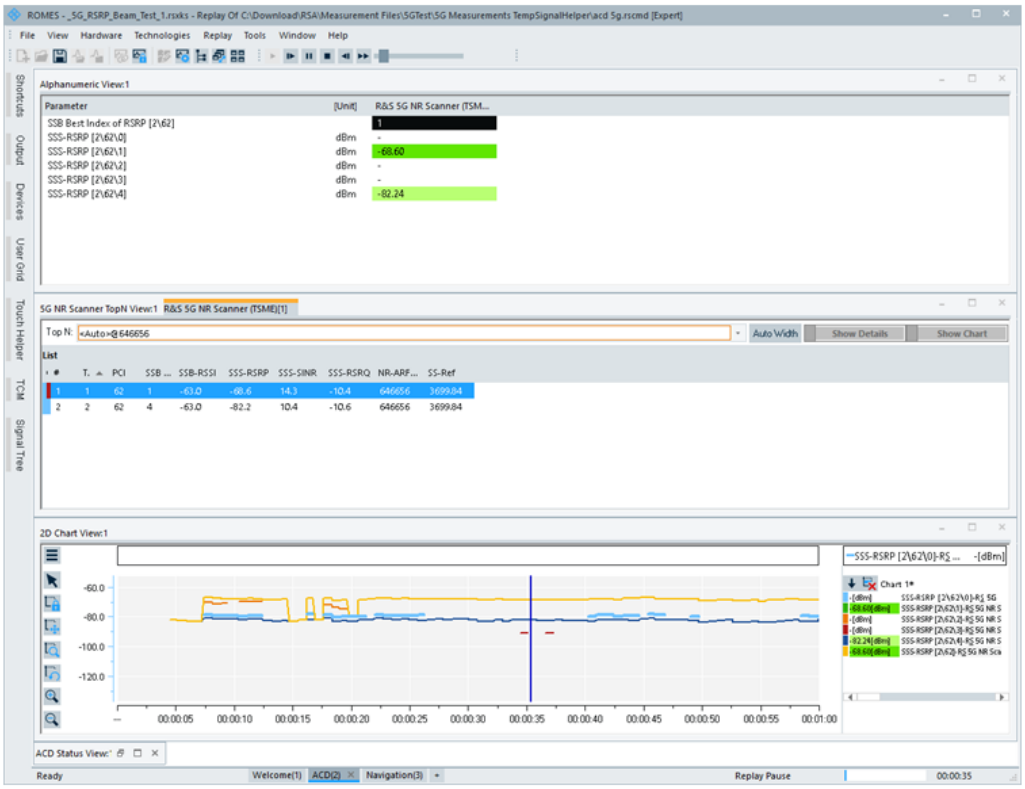


Figure 4-763: R&S ROMES4 basic and 5G NR scanner TopN views - SSB best index for RSRP

The SSB best index signals have associated events. The events are shown in the following figure.

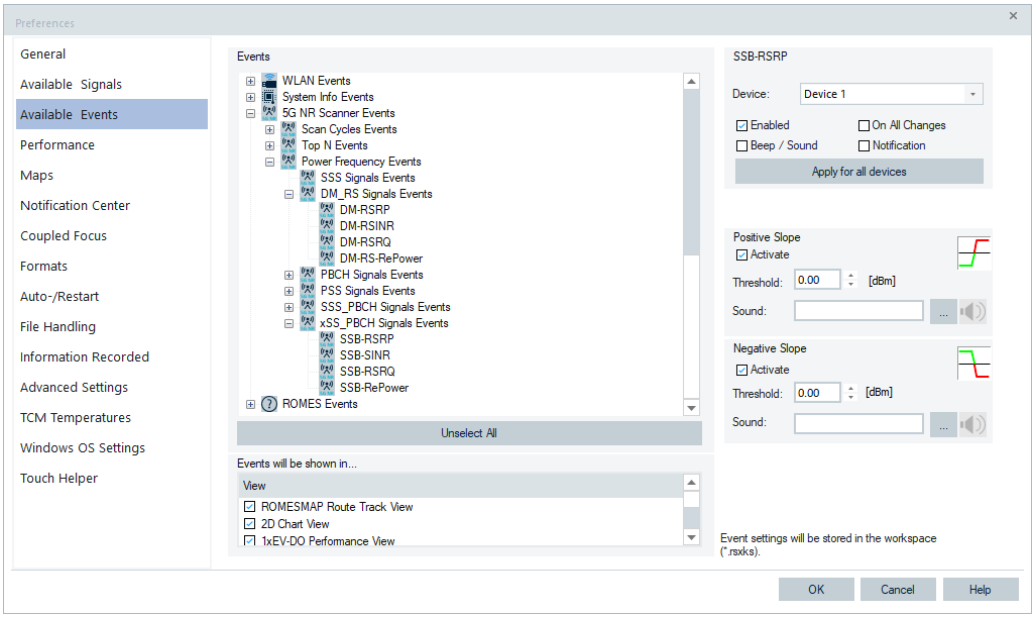


Figure 4-764: Events associated to SSB best index signals

The Top N pool members offer an Top N reference signal ("Top N UE Reference") which reflects the usage of an gNode by the UEs of the current measurement. The signal provides information on UE's number and its carrier which uses this gNode of the Top N pool member. The signal is available in the "5G NR Scanner TopN View" as optional signal. The signal is available in the "SignalTree" > "5G NR Scan" > "Top N Templates" and in the "Alphanumeric View".

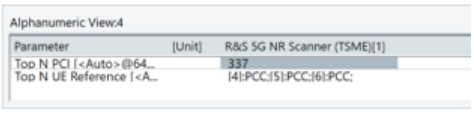


Figure 4-765: Top N UE reference of Top N pool member

The screenshot shows that PCI 337 is currently used as Primary Component Carrier by UE 4, 5 and 6.

For the detailed of the previously mentioned signals, see "Description of R&S ROMES4 signals" document.

- 5G NR scanner signals templates.....1129
- 5G NR BCCH view.....1136
- 5G NR scanner chart view.....1141
- 5G NR scanner SSS-PBCH CIR view.....1143
- 5G NR scanner Top N view.....1145
- 5G NR SSB history view.....1149
- 5G NR SSB performance view.....1150

4.8.2.1 5G NR scanner signals templates

The 5G NR scanner signals templates offer easy access to the measurement data of a specific gNB. Specify he PCI and the SSB index of the wanted measurement item to access the measurement data. Most notably in conjunction with the map view is that you only carry about the SSB index with the best value.

The "Top N Templates" and the "gNodeB Templates" branch of the "Signal Tree" > "5G NR Scanner" tree are a home of all created template signals.

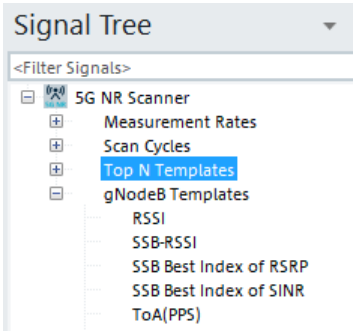


Figure 4-766: 5G NR scanner signal templates

The best SSB beams for a specific PCI available in the branch improve the usability and representation of 5G NR parameters in R&S ROMES4. With these signals, you

can fix PCI and plot all the SSBs for the chosen PCI based on the best measured beam, RSRP or SINR value.

5G NR scanner template signals can be filtered by Channel/NR-ARFCN, PCI and SSB index.

To create a template signal, do the following:

1. Select from the "Top N Templates" or "gNodeB Template" branch a signal that you want to see in a R&S ROMES4 basic view and in the "Signal Tree" as a template signal for the specified filtering.
2. Drag the selection into the basic view dialog or double click the item in the view's configuration page.

   A dialog pops-up where you can define the filter for the signal.
3. The filter requires you to specify a combination of PCI and SSB index.
   If you have selected several signals, tick the "Apply for all signal" box to apply the same filter for all signals.

   The filter for the signal is entered.

   The signal now appears in a R&S ROMES4 basic (generic) view and in a template of the "Signals Tree" > "5G NR Scan" tree.

The template signals can be used to filter the scanner data on the R&S ROMES4 map. The SSB best index signals are shown as black and white.

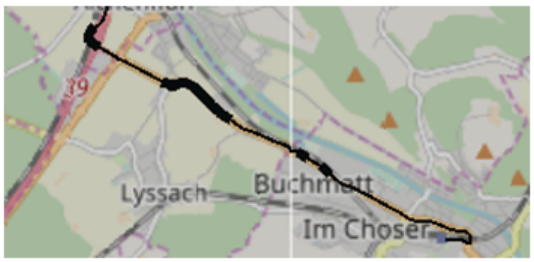


Figure 4-767: Matched PCI/SSB combination

If the data matches with the configured PCI/SSB combination, the plot on the map turns black. If there is no match, it remains white.

Configuration of 5G NR scanner Top N templates

There are no separate branches for each Top N pool and Top N member. Instead, there is only a single Top N node under the "Top N Templates" node.

The Top N template signal can be configured on any generic view. If a signal is configured on the generic view, a prompt for specific Top N pool and Top N member to be configured is displayed.

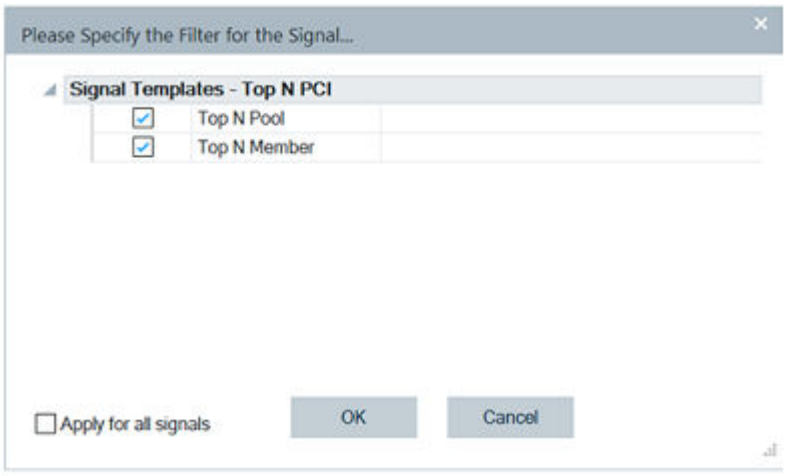


Figure 4-768: Template to filter Top N PCIs

Configuration of Template Top N Pool: Enter the desired Top N pool number. A range of Top N pools can be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represent pools 1, 2 and 4 and 1 to 4 would represent an entry of pools 1 to 4.

If measurement is running or measurement replay is in progress, the valid Top N pools are available for selection if you click the down arrow. Click one or more of the valid pools.

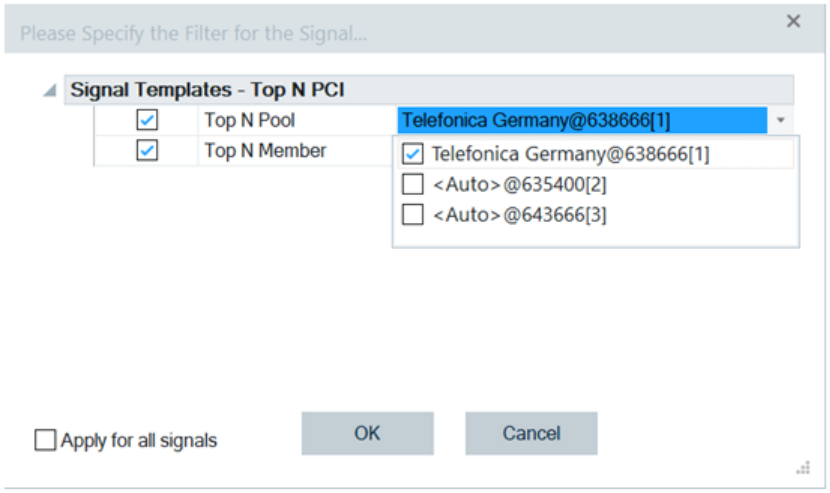


Figure 4-769: Available Top N pools

Once all selections are made, click another field or "OK" to close the selection window.

Configuration of Template Top N Member: Enter the desired Top N member number. A range of Top N members can be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represent members 1, 2 and 4 and 1 to 4 would represent an entry of members 1 to 4.

Selection of Field Color Code: Once a valid selection is made, the field gets a green background color. If a selection is not valid, the background color is red.

Figure 4-770: Colored fields for Top N PCI filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior User Selections". (These selections are reset each time R&S ROMES4 is restarted). To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear if all prior selection boxes have been deselected.

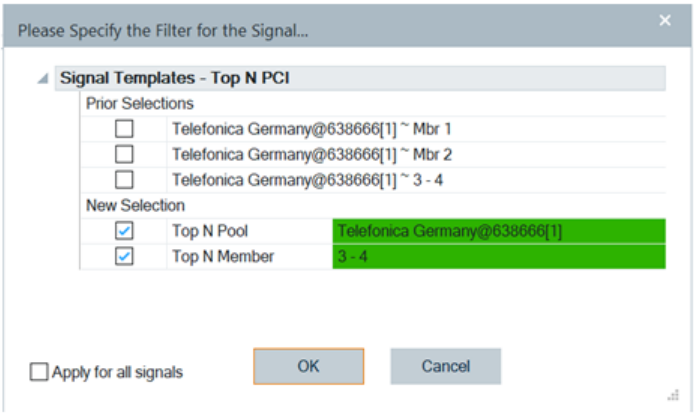


Figure 4-771: Prior selections

Configuration of gNodeB signals templates

The signals that are directly under the "gNodeB Templates" node prompt only for Channel/NR-ARFCN.

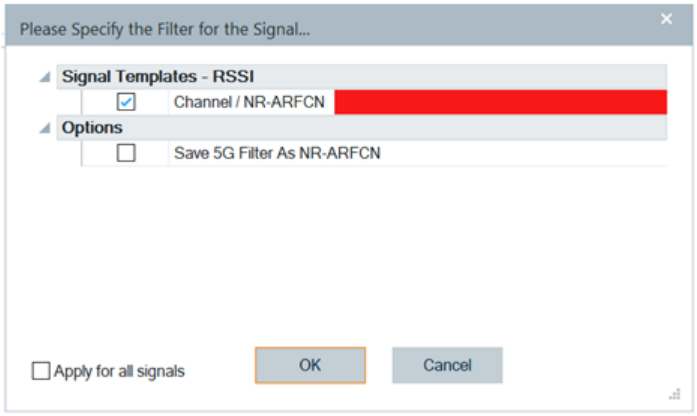


Figure 4-772: Channel / NR-ARFCN prompted signal

The signals that are in the nodes under the "gNodeB Templates" prompt only for "Channel/NR-ARFCN/PCI/SSBx".

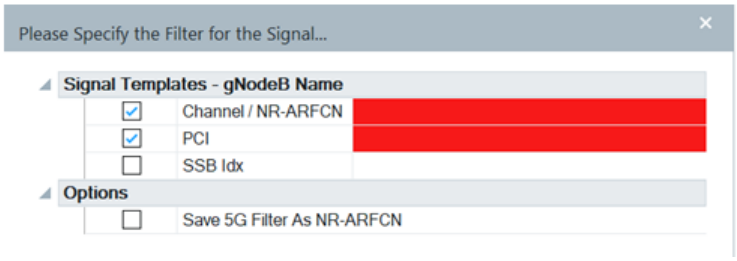


Figure 4-773: Prompted signals in subnode

To allow signal configuration with just PCI, uncheck the "SSB Idx" check box. R&S ROMES4 uses then the best SSB value for that PCI to represent the signal.

Configuration of Channel / NR-ARFCN Value: A Channel Index or ARFCN value can be entered. Multiple Channel Index/NR-ARFCN can be entered by separating the values with a “,”sign. For example, by entering 1, 2 selected are the channels 1 and 2.

If a measurement replay file is opened or a measurement is in progress, a list of currently valid NR-ARFCN values is displayed by clicking the down arrow. One or more of the values can be selected if you check the box next to the desired choice.

Once all selections are made, click another field or "OK" to close the selection window.

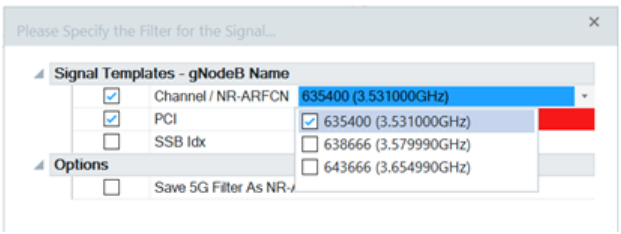


Figure 4-774: Entered and selected NR-ARFCN

Configuration of PCI: PCI Cell ID value can be entered. Multiple PCI values can be chosen by separating the values with “,” sign. For example, entered values 393, 394 select PCI value 393 and 394.

Click the down arrow to see a list of valid PCI values of the selected NR-ARFCN in the opened measurement replay file or in a maeasurement in progress. One or more of the values can be selected if you check the box next to the desired choice.

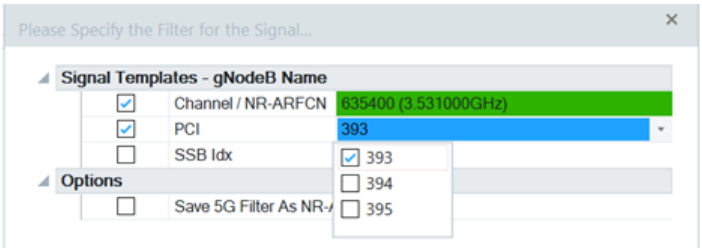


Figure 4-775: Entered PCI values

Once all selections are made, click another field or "OK" to close the selection window.

Configuration of SSB Idx: Optionally, a SSB index can be supplied. If not supplied, the best SSB index for the cell is used when displaying signal values. To select the SSB index, check the box next to the "SSB Idx" row. A SSB index can be entered.

Multiple SSB indexes can be entered by separating the values with a “,” sign. Click the drop-down arrow to see the valid SSB indexes of the selected Channel/PCI combination in opened measurement replay file or in a measurement in progress. One or more of the values can be selected if you check the box next to the desired choice,

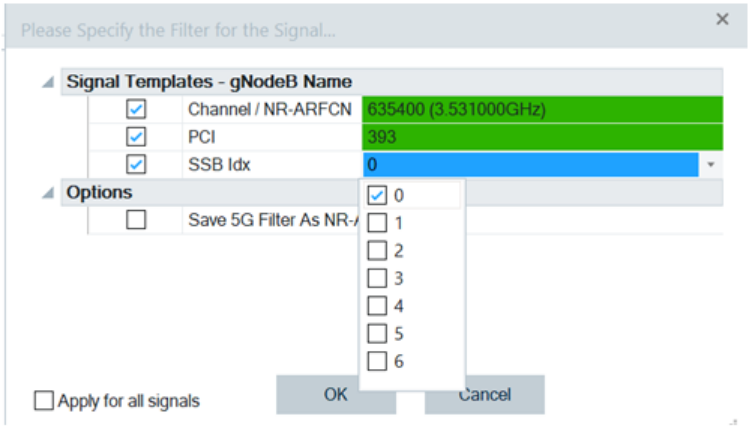


Figure 4-776: Selection of SSB Index

Once all selections are made, click another field or "OK" to close the selection window.

Selection of Field Color Code: Once a valid selection is made, the field gets green background color. If a selection is not valid, the background color is red.

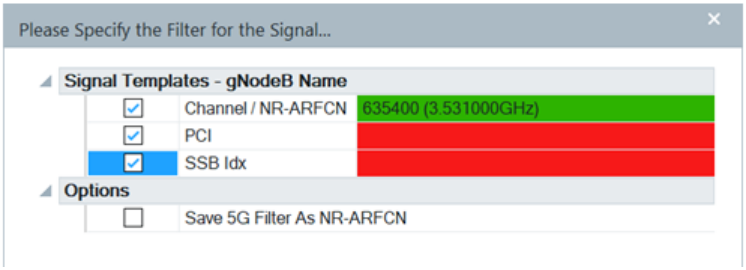


Figure 4-777: Colored fields for gNodeB Name filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections" rows. (These selections are reset each time R&S ROMES4 restarts).

To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear if all prior selection boxes have been deselected.

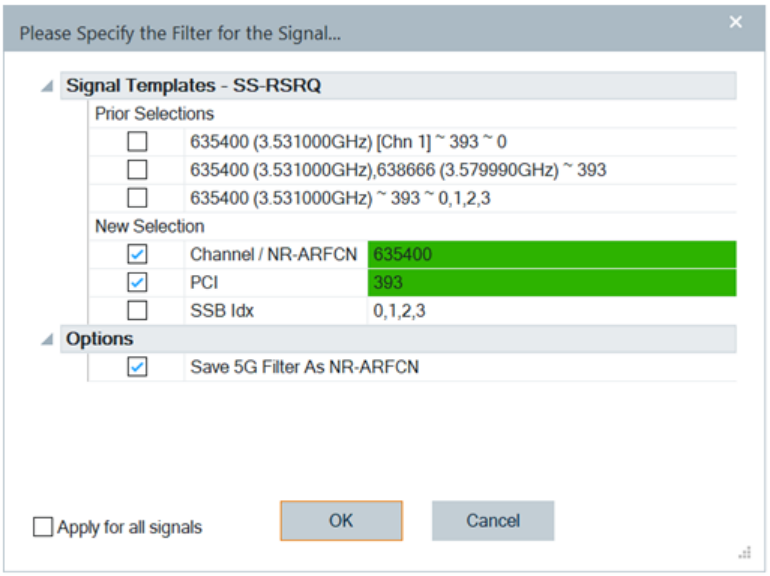


Figure 4-778: Preselected template signals

Availability of 5G NR gNodeB info

The "Top N Templates" and "gNodeB Templates" branches contain the optional signals that provide the 5G NR gNodeB info, that is, a gNodeB name and a distance of a device to the base station.

The first mentioned branch supports the signal which shows the configured TDD full-slot pattern apart from the TDD slot pattern signal. The "TDD Pattern(full)" signal provides the slot number added to the slot letter and the info on slot's symbols configuration. A symbol is marked as "d" for DL, "u" for UL and "f" for flexible symbol. For the

"Top N TDD Pattern" and the "Top N TDD Pattern(full)" signal, see the Tooltip in the branch or refer to "Description of R&S ROMES4 signals" document. To see the signals displaying the TDD configuration only, type filtering criterion "tdd" in "Signal Tree".

Activate the optional signals. They are then visible under the following conditions:

- GPS hardware is connected and properly initialized.
- 5G NR channel has a valid NR-ARFCN (Some low frequency channels can have valid GSCNs, but not NR-ARFCN).
- 5G NR Cell Database is available and contains the entry for the NR_ARFCN.

4.8.2.2 5G NR BCCH view

The "5G NR BCH View" shows the 5G NR mode of operation, NSA or SA, the signals derived from SIB1, the signals from other activated SIBs and the all detected beams of a specific channel. The view shows the configured TDD Pattern(full).

If selected auto Top N per provider, one Top N is created for each provider. The "5G NR BCH View" creates a provider branch for each PLMN in this case.

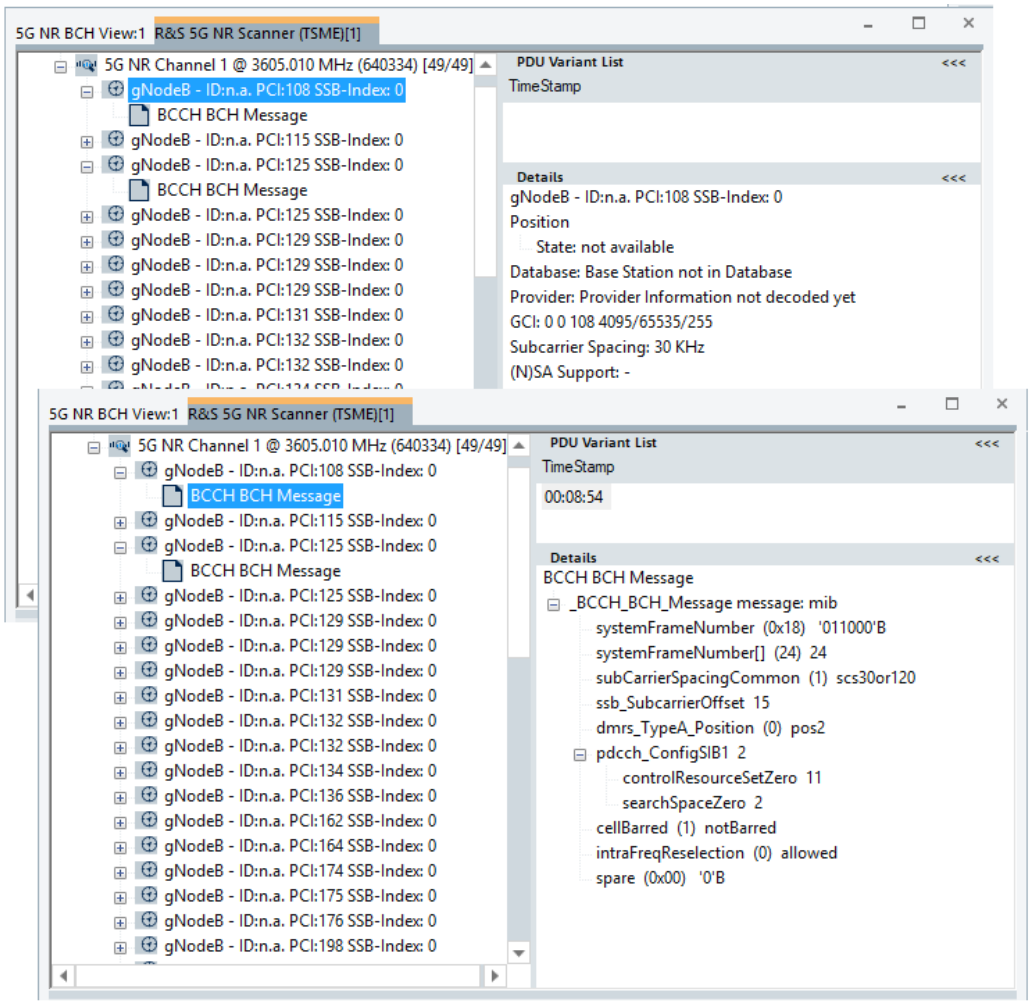


Figure 4-779: 5G NR scanner BCH view

The "5G NR BCH View" can show all R&S ROMES4 supported SIBs if configured to be demodulated. The following screenshot shows that demodulated are SIB 1, SIB 2 and SIB 21 of the PCI 52 cell. The details of the SIB 21 are visible on the view's right-hand side.

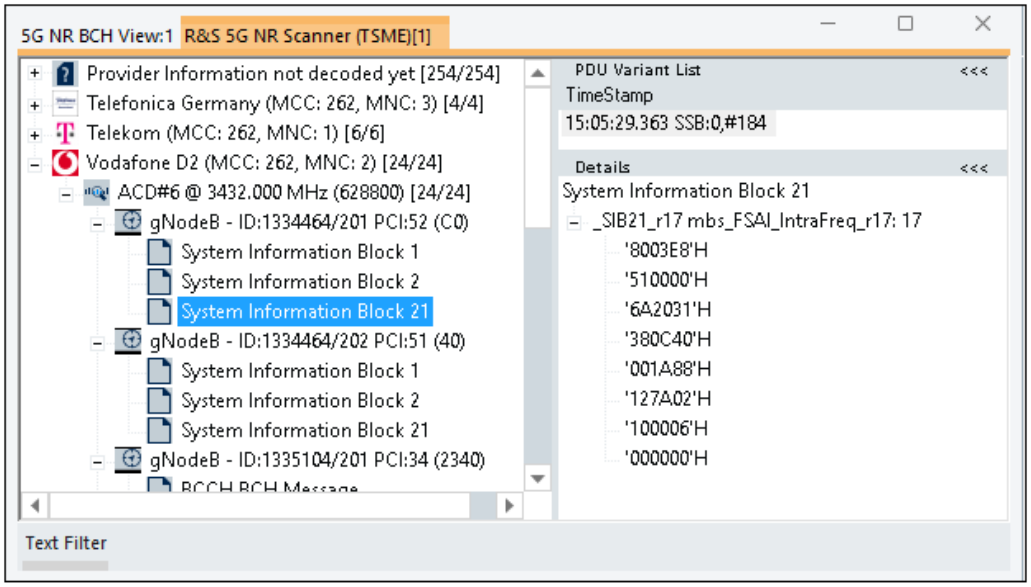


Figure 4-780: Demodulated 5G NR SIB 21

You can obtain the 5G NR SIB demodulation information from the "Open" page when you run a measurement file. The SIB information including PDU and internals is available in "BCH Demod" line of the page.

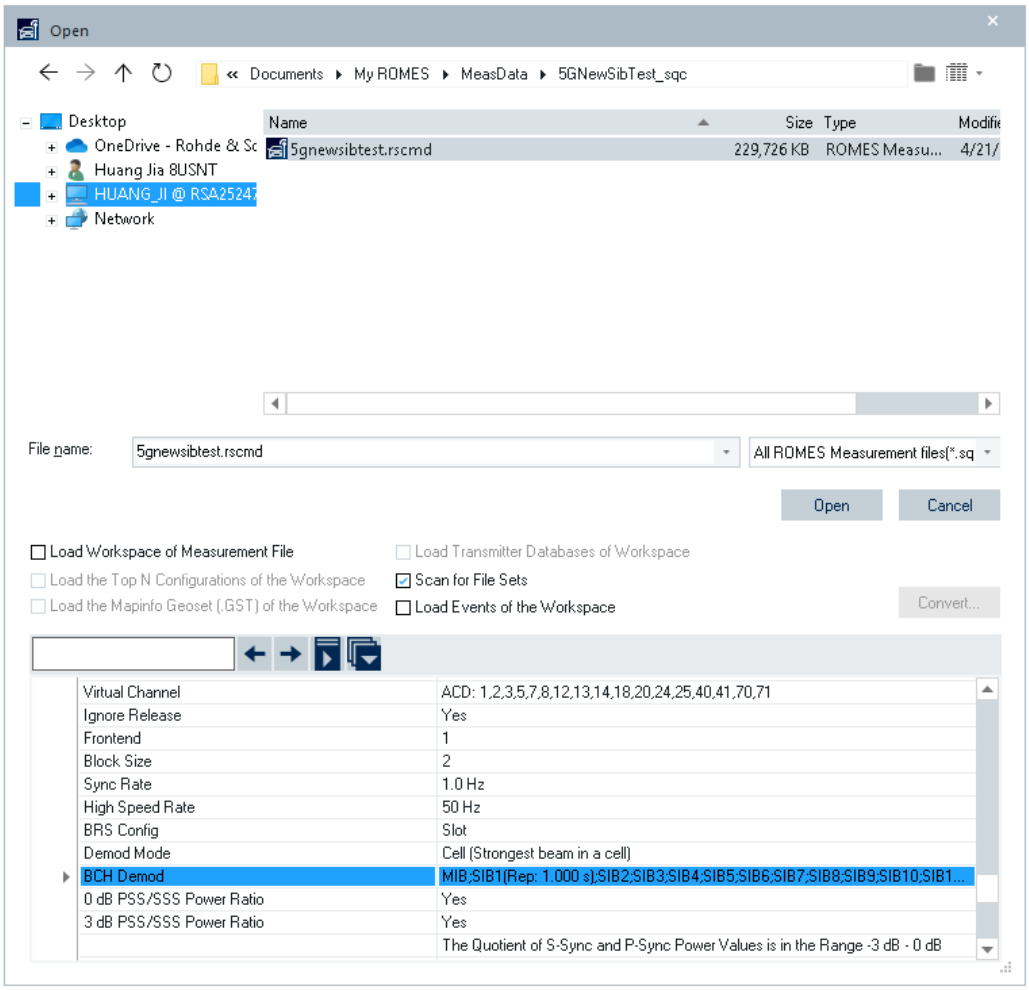


Figure 4-781: Open page shows demodulated 5G NR SIBs

For the supported SIBs, see Figure 6-237.

All beams of a provider whose MCC and MNC are not demodulated are listed below the "Provider information not decoded yet" branch.

Cell identity display in 5G NR BCH view

According to 3GPP TS 38.331 specification, a 5G NR cell identity is 36 bits long string composed of a gNB identity and local cell identity. A gNB is specified to be of variable length 22 bits to 32 bits. However the specification does not strictly define how to split these 36 bits between gNB and local cell ID.

Splitting the specified number of bits for cell identity between gNB identity and local cell identity is a customer decision.

The R&S ROMES4"5G NR BCH View" shows 36 bits of a cell ID and applies as default the gNB/local cell ID split 28/8. You can change this cell ID default display in gNB by entering the wanted split into the registry. The figure shows where to set splitting and default splitting.

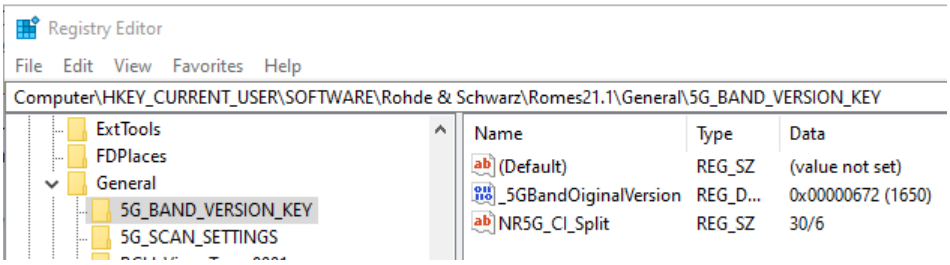


Figure 4-782: Default splitting of cell ID bits in registry

The following splits are supported by R&S ROMES4.

```
[HKEY_CURRENT_USER\Software\Rohde & Schwarz\Romes20.3\General\5G_BAND_VERSION_KEY]
"NR5G_CI_Split"="30/6"
; "NR5G_CI_Split"="36"
; "NR5G_CI_Split"="28/8"
; "NR5G_CI_Split"="20/8/8"
```

The sum of bits cannot exceed 36 bits - most right bits bigger than 36 are cut.

The cell ID is available in the "5G NR BCH View" only if SIB1 is present, otherwise the view shows "n.a.", see Figure 4-779.

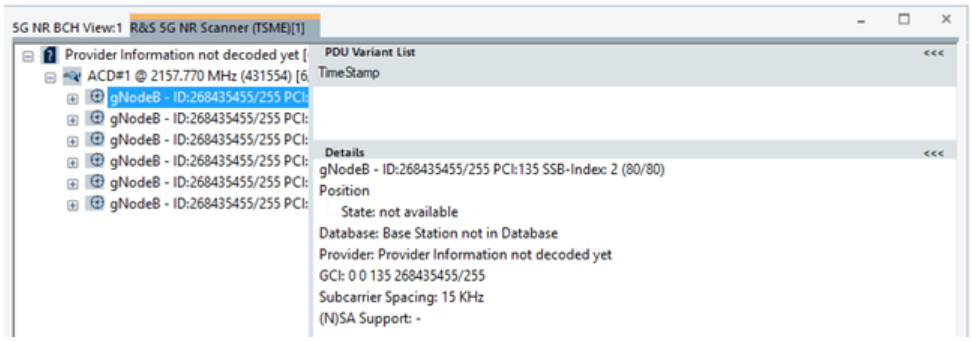


Figure 4-783: "NR5G_CI_Split"="28/8"

3GPP TS 38.413 defines a Global gNB ID where the gNB ID as a variable from 22 bits to 32 bits corresponds to the leftmost bits of the NR cell Identity IE contained in the NR CGI IE ("GCI" in the figure) of each cell served by the gNB.

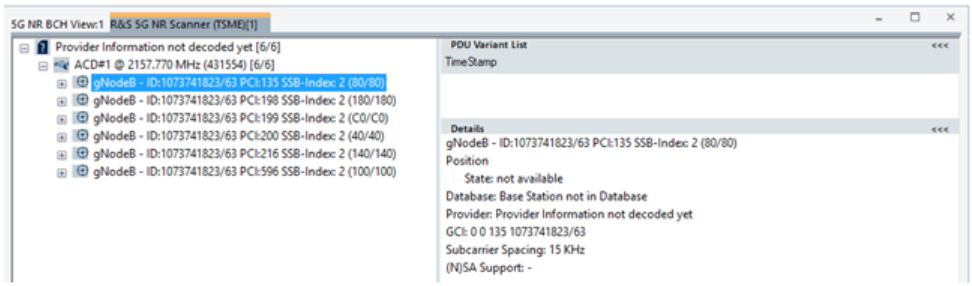


Figure 4-784: "NR5G_CI_Split"="30/6"

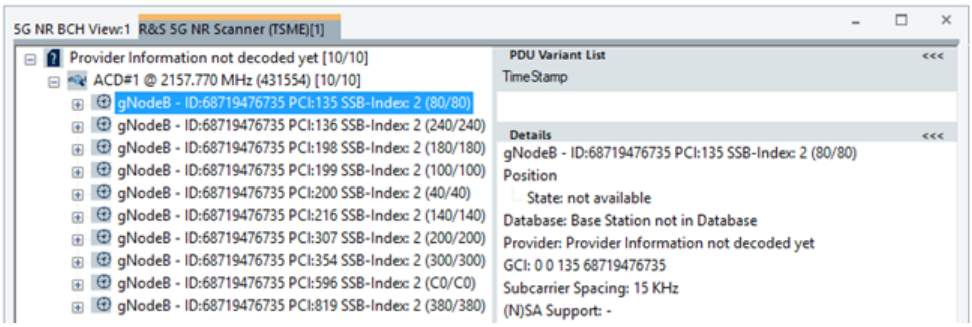


Figure 4-785: "NR5G_CI_Split"="36"

4.8.2.3 5G NR scanner chart view

The "5G NR Scanner Chart View" shows the n best beams over all. The view can be filtered by PCI and frequency.

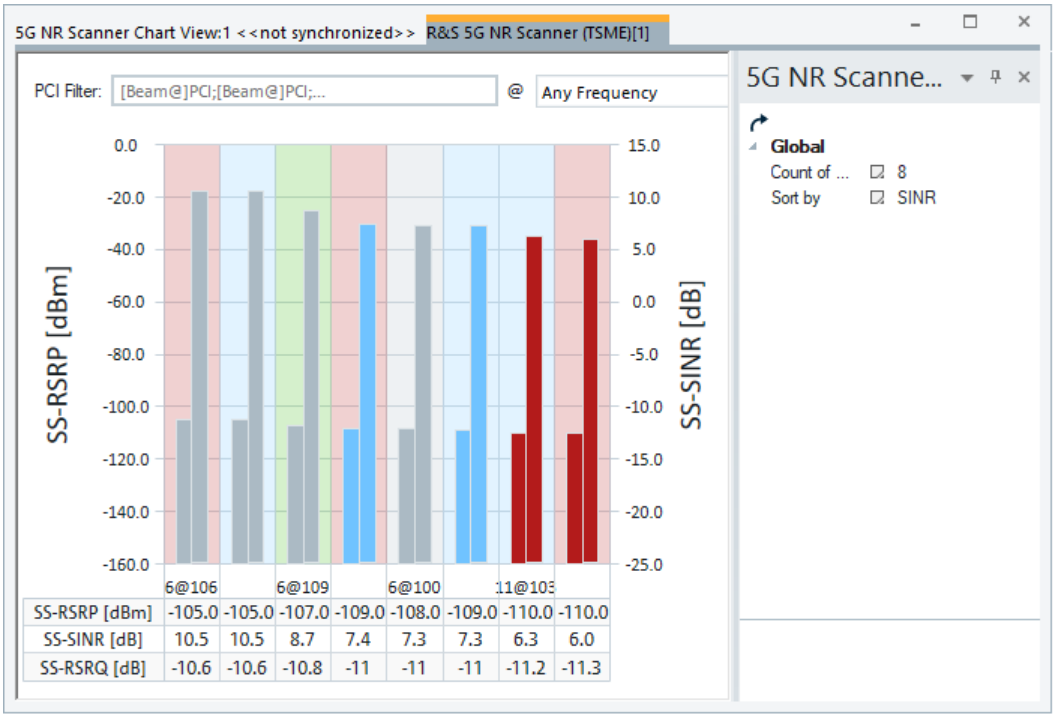


Figure 4-786: 5G NR Scanner Chart View

The view shows all beams sorted by the selected sorting algorithm. The view is independent from any Top N pools and gets all data unsorted. The sorting is done in the view itself. The view sorts the reported beams every time new measurement values are reported by SS-SINR.

The background color of the columns corresponds to the PCI and the color of the column to the beam index.

The filter accepts string of the following format: [Beam@]PCI;[Beam@]PCI;…

The beam value of the filter works as follows:

1. If the beam index is available, the beam is accepted only if the beam index matched the filter value.

2. If the beam index is not available

- a. If the beamindexMod 8 is available, the beam is accepted only if the beamindexMod 8 matches the filter value.
- b. If the beamindexMod 8 is not available, the beam is not accepted.

Example:

449 All beams of gNBs with PCI 449 are shown.

31@449 Only the beam 31 of PCI 449 is shown.

449;12@1005 All beams of gNB with PCI 449 and the beam 12 of PCI 1005 are shown.

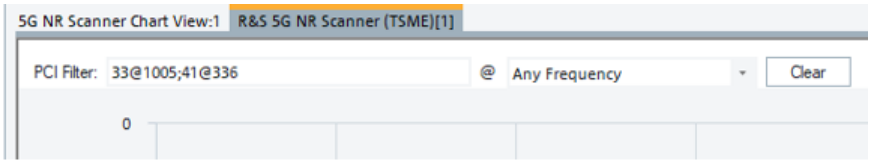


Figure 4-787: An example of filtering

4.8.2.4 5G NR scanner SSS-PBCH CIR view

The "5G NR Scanner SSS_PBCH CIR View" shows the CIR of the different beams.

The CIR results are displayed as NR-ARFCN/PCI/Beam Index combinations.

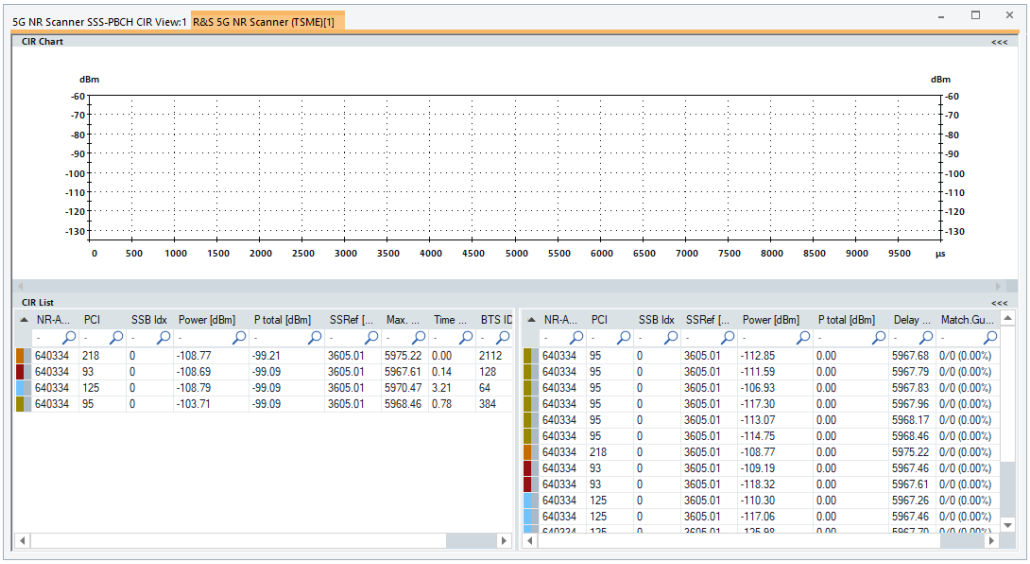


Figure 4-788: 5G NR Scanner SSS CIR View

The "CIR List" pane provides an option for filtering results displayed in the pane.

The list can be filtered on any of the available columns. The filtering option offers the following formats:

- XXX - Exact match for the data
  Example 1: Inserted value 13 in the filter of the "PCI" column shows only CIR values of the cells having PCI 13 in the "CIR Chart".
- >XXX - Greater than
  Example 2: > -50 in "P total" column would show values greater than -50
- >=XXX - Greater than equal
- <XXX - Less than
  Example 3: < -50 in "P total" column would show values less than -50
- <=XXX - Less than equal
- !XXX - Not data value
  Example 4: The PCI filter !13, shows all items other than !13

Multiple filters can be applied to each cell and with each filter separated by either comma or semicolon mark. For example, if you want only PCI 13 and 15 to be shown, then enter "13,15" in the PCI filter.

In the filter string, there is no difference between using comma or semicolon to spate filters. For example, "13,15" in the PCI filter produces the same filter result as "13;15". Only PCI 13 and 15 are displayed.

Update the chart by new input data once the list's filter has been changed.

For the 5G NR scanner CIR signals, see the "Description of R&S ROMES4 Signals" document.

5G NR scanner SSS CIR view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "CIR View" lets you customize the diagram and the contents of the table in "5G NR Scanner CIR View".

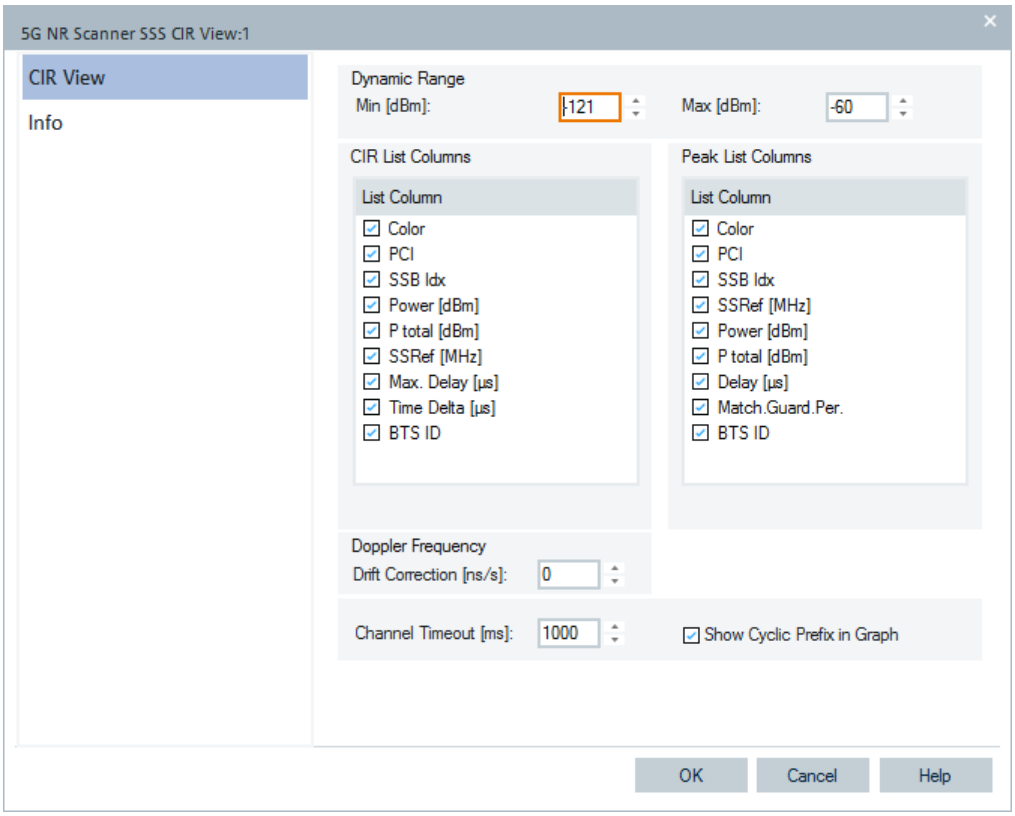


Figure 4-789: 5G NR Scanner SSS CIR View - configuration

The configuration scales the y-axis of the "CIR View", selects the information to be displayed in the table and corrects the Doppler drift.

Dynamic Range
The two input fields in this panel define the maximal/minimal signal level to be displayed in the view. The signal levels out of the range defined with maximal and minimal signal levels are not displayed.

CIR List Column
The CIR list selects which information to display in the left table below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Peak List Column
The peak list selects which information to display in the right table below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Doppler Frequency
The panel provides an input field for correcting the Doppler frequency displayed in the "Peak List". The purpose of the correction in the measured frequency is to subtract frequency offsets not originating from the speed of the test vehicle relative to the signal source.

The frequency offset is calculated as follows:

```
Meas. Freq. [Hz] * Drift Correction [ns/s] * 10^-9.
```

Channel Timeout
If there is no data on a channel anymore, the "CIR List" entries for this channel are removed after a timeout.

Show Cyclic Prefix in Graph
The display of the cyclic prefix in the CIR chart can be switched on or off via "Show Cyclic Prefix in Graph". If the checkbox is ticked, the Cyclic Prefix is displayed as a dotted vertical line of the cell ID color in "CIR Chart" for each "CIR List" element.

4.8.2.5 5G NR scanner Top N view

The columns in the "5G NR Scanner TopN View" are generated automatically from the Top N signals.

To see all possible 5G NR scanner Top N signals, the default and the optional ones which can be included in the "List" pane on Top N view, refer to Chapter 12.1, "5G NR scanner Top N signals mapping", on page 2381.

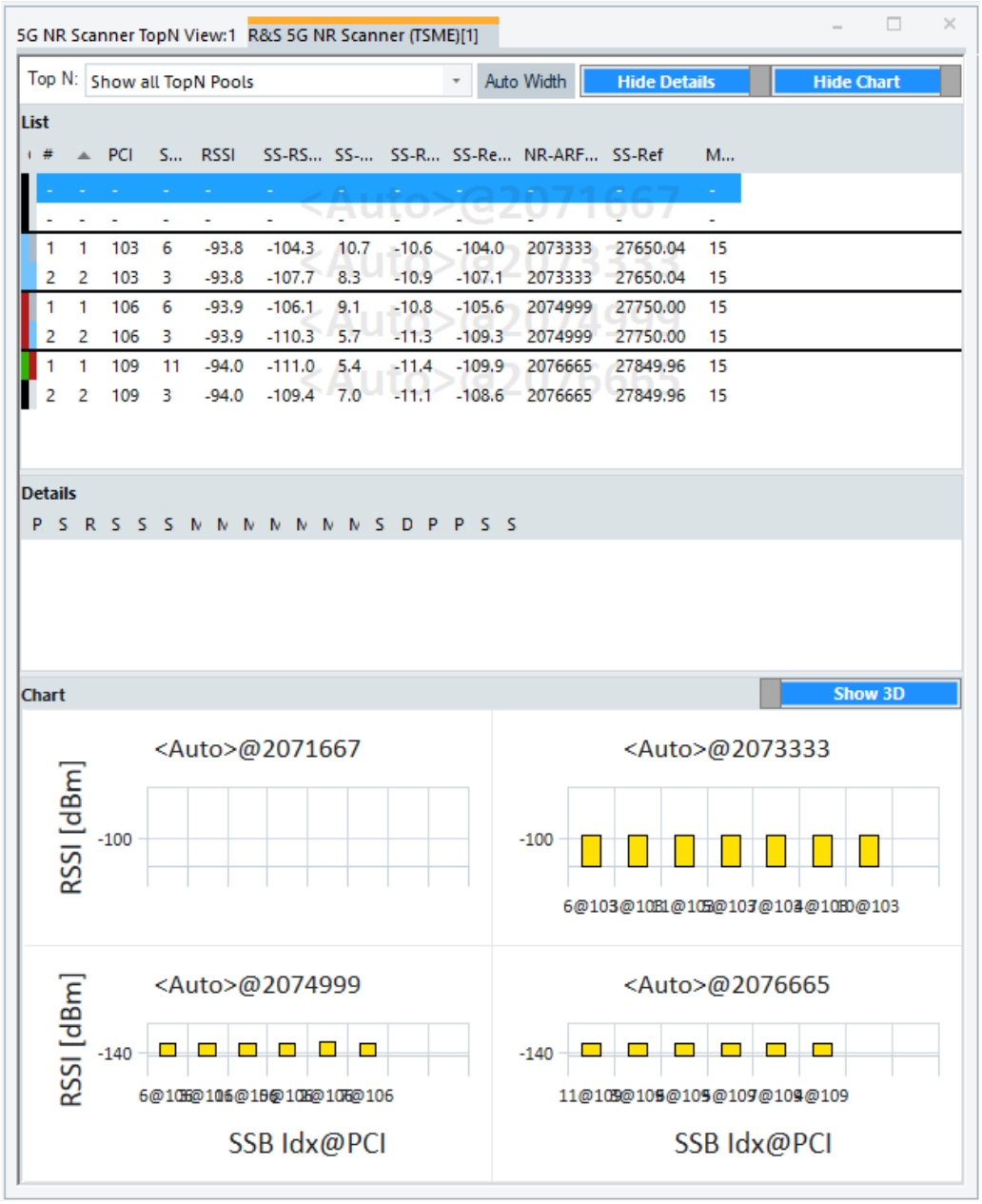


Figure 4-790: 5G NR Scanner Top N View

To fill the "Details" pane, set the "Value" to "Cell-xxx" value in "Top N Pool Settings". The figure shows the possible setting as Cell-RSRP value.

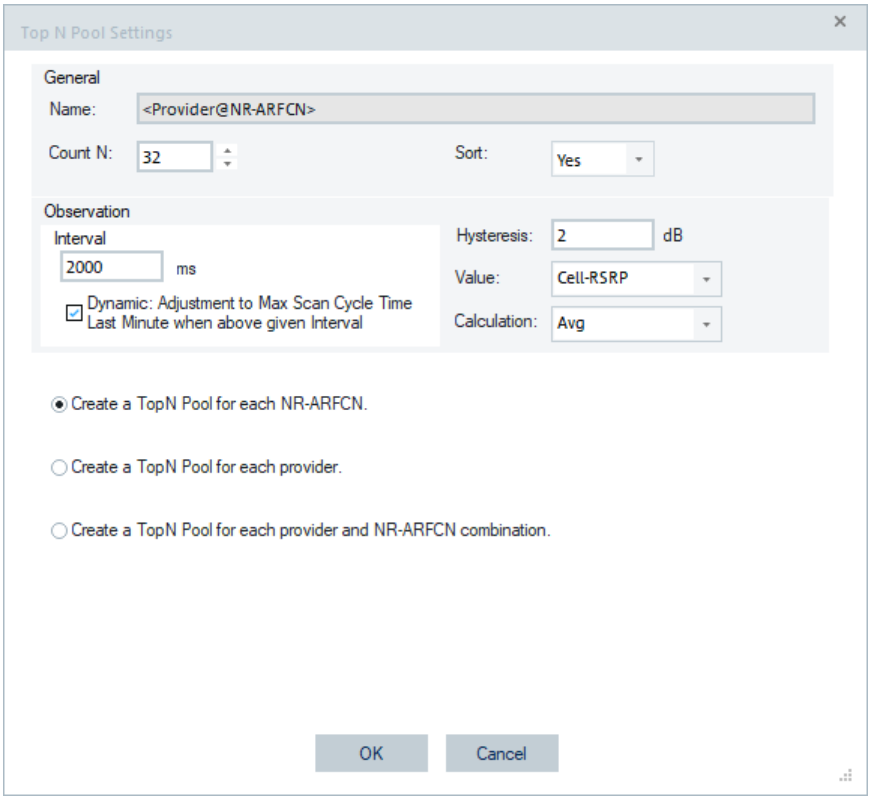


Figure 4-791: Needed setting to fill Details

Enlarge the page by clicking the "Auto Width" button to see the activated optional signals in the Top N "List".

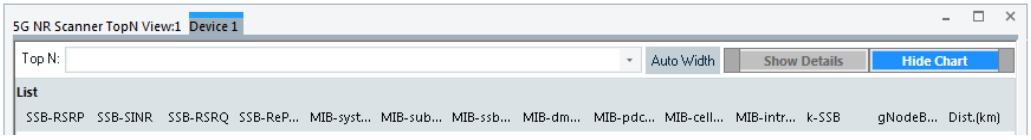


Figure 4-792: Enlarged 5G NR Scanner Top N view

If an optional signal is not configured for display in the "Signal Tree", it is not displayed in the Top N view.

The automatic pool configuration feature is supported with "5G NR Scanner Top N View". Applied are the common functions and rules as for other 3GPP specified technologies, see "Scanner Top N view for automatic pool configuration" on page 1262.

For the "Chart" layout in case the feature is active, see Figure 4-761.

5G NR scanner TopN pools calculation

The beam-based 5G TopN pools calculation uses the high-speed data measurements of a scanner.

The 5G NR scanner delivers measurement data packets at a maximum of every 200ms. Such an packet can contain several high-speed data measured during the last measurement period. The all single high-speed measurements are put into the TopN algorithm. This approach can have an impact, especially if max. is used for TopN pool ranking.

The TopN pool ranking is based on the observation interval. By default, it is set to 1 second. Therefore, measurement data, which has been reported within the last second is accounted. It is possible to decrease the observation interval down to 100 ms.

If the "Dynamic: Adjustment to Max Scan Cycle Time Last Minute when above given Interval" option in the "TEC for 5G NR Scanner" > "Top N Pool Settings" > "Properties" dialog is active, the observation time is increased to the max. cycle time during the measurement. If the option is inactive, it can happen that the TopN algorithm invalidates the data due to missing measurement data in the observation interval. The lack of measurement data can happen during measurement on more than one channel.

The TopN pools ranking is triggered by every scanner measurement packet but does the calculation at a maximum rate of 1 per second. The example is given for the observation interval 100ms.

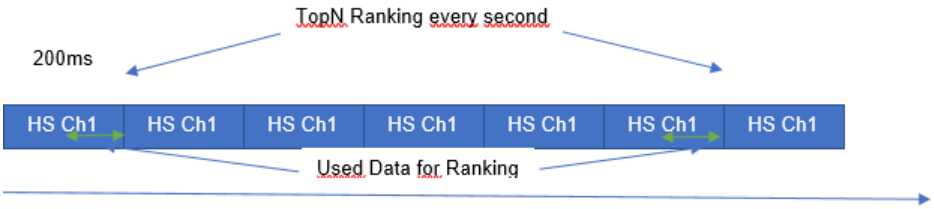


Figure 4-793: TopN ranking observation interval

5G NR scanner TopN view configuration

For the description of the tabs functions included in the configuration page, see "LTE scanner Top N view configuration" on page 1272.

For the activated optional signals that are selected for visualization, you can choose whether the SSB-RSSI or SSB-RSRP value to show as the first 2D and 3D chart value.

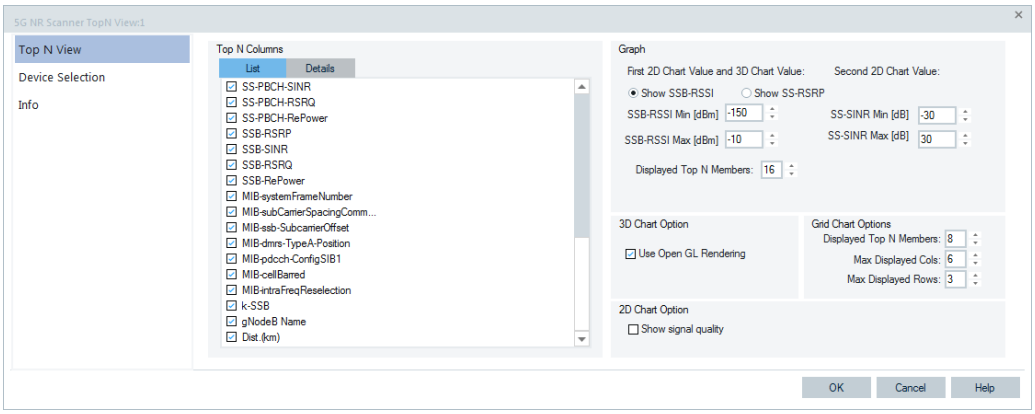


Figure 4-794: 5G NR Scanner Top N View - configuration

4.8.2.6 5G NR SSB history view

The view is only available during measurement.

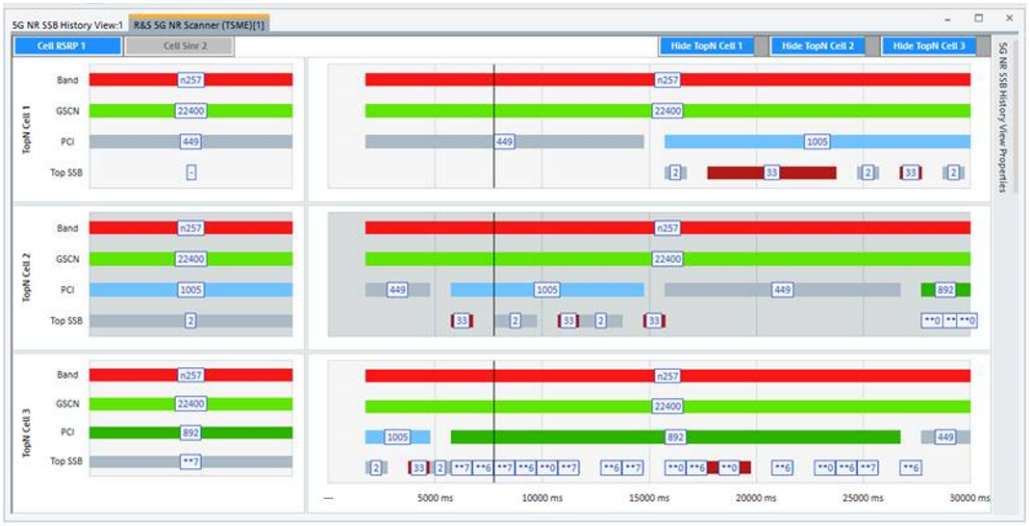


Figure 4-795: 5G NR SSB History View

The maximum number of TopN cells can be configured, the range is 1 to 6.

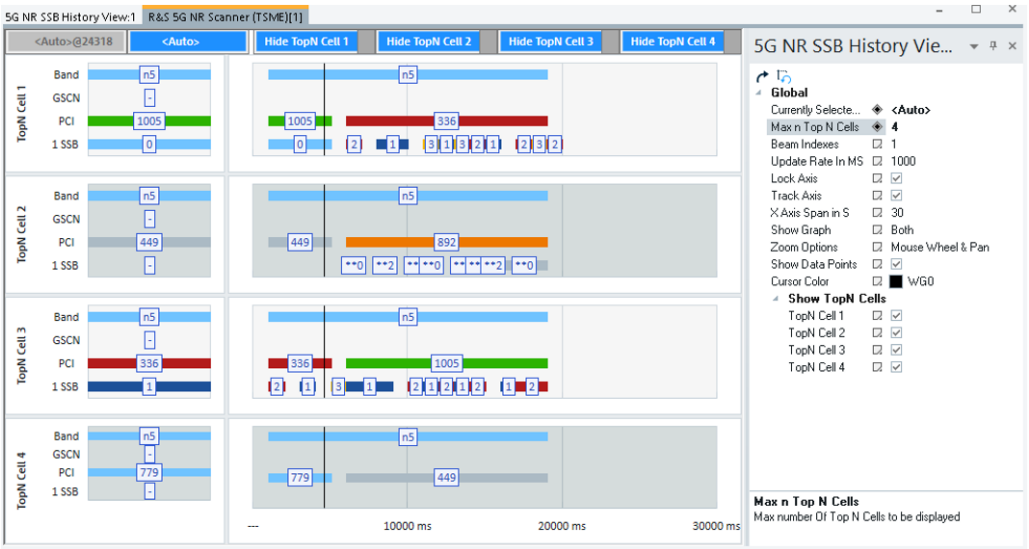


Figure 4-796: 5G NR SSB History View - set the number of Top N cells

The max number of beam indexes can be also configured, the range is 1 to 6.

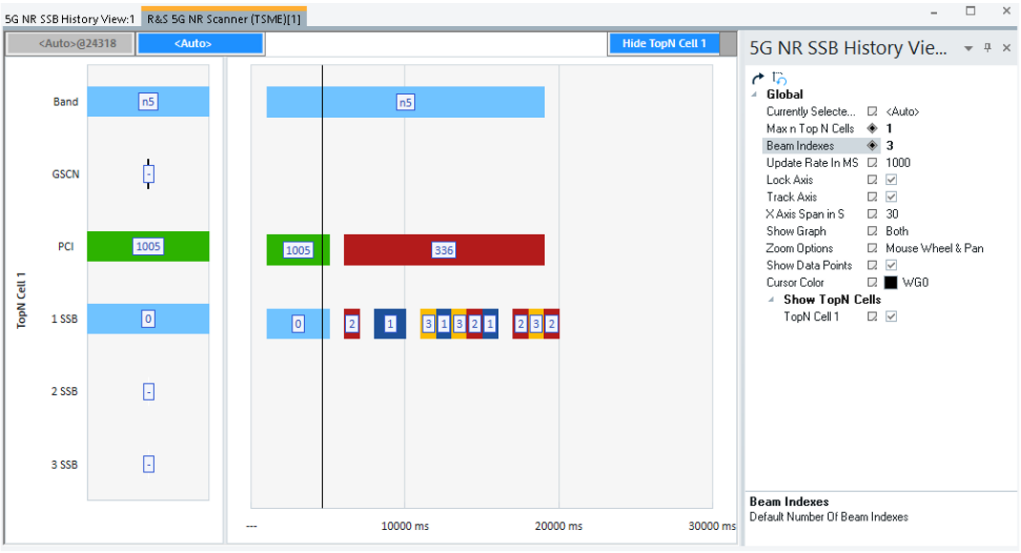
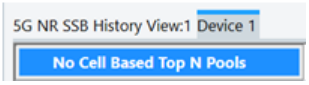


Figure 4-797: 5G NR SSB History View - set the number of beam indexes

To display data in the view, at least one TopN pool must be configured per cell. If cell-based TopN pools are not configured, the "No Cell Based Top N Pools" error message is displayed at the top left of the view.



4.8.2.7 5G NR SSB performance view

The view is only available during measurement.

You can select the Top N pool, which you want to be visualized by pressing the corresponding blue button on the upper left corner. Only the Top N pools based on cell signals are applicable for this view.

The left part of the view shows the best n members of the pool. For each member, the background column in the color of the corresponding PCI visualizes the average value. In the front, m bars for the m best beams of the cell are drawn in the color of the beam index. The values n and m are configurable.

On the right-hand chart, the values of the n best cells are drawn over time. The background color corresponds to the PCU of the best member (Top1).

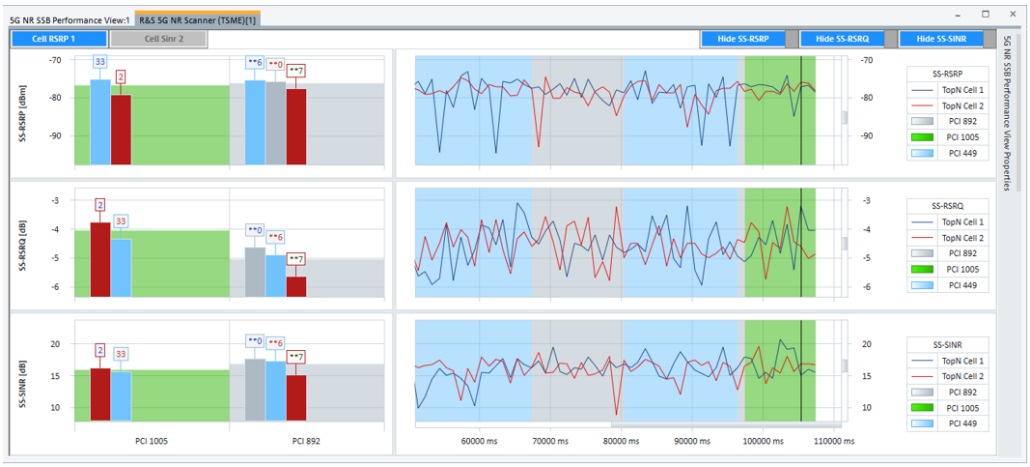
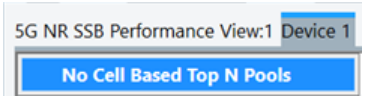


Figure 4-798: 5G NR SSB performance view

Figure 4-799: 5G NR SSB performance view - set details

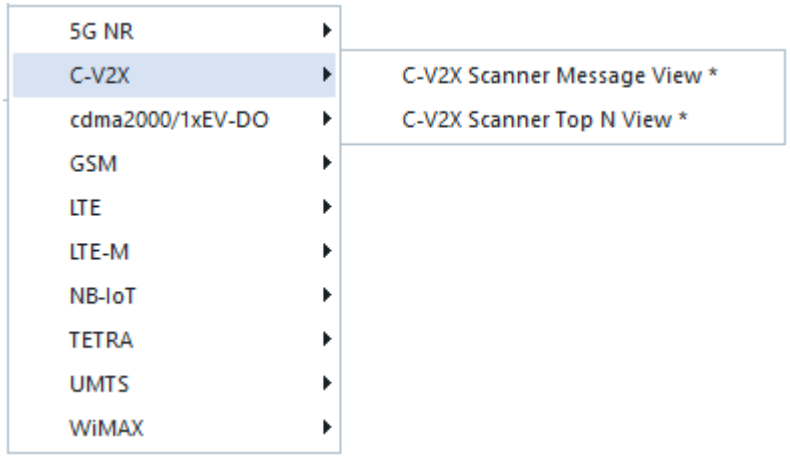
To display data in the view, at least one TopN pool must be configured per cell. If cell-based Top N pools are not configured, the "No Cell Based Top N Pools" error message is displayed at the top left of the view.



4.8.3 C-V2X scanner views

The C-V2X scanner views show the information of cellular vehicle scans obtained with the R&S TSME6 scanner.

Currently supported views are shown in the following figure.



Equation 4-1: C-V2X scanner views

During a measurement or file replay, assuming that C-V2 eNodeB signal is configured for use on a generic view, a list of all available MAC2SrcvIDs of the measurement/ replay is available. The list of all available MAC2SrcvIDs is shown in the L2 MAC Source ID drop down box of the signal filter dialog.

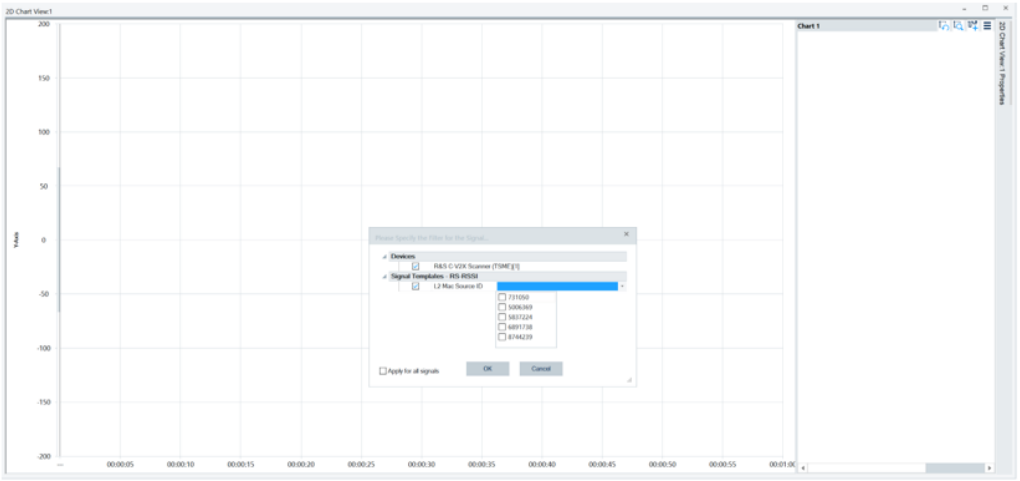


Figure 4-800: L2 MAC Source IDs added to eNodeB signal

For the R&S ROMES4 supported C-V2X scanner signals, see the "Description of R&S ROMES4 supported signals".

To get the C-V2X scanner views, check the C-V2X box in the "Romes Technology Selector" page. The page pops-up during the R&S ROMES4 installation. The box is by default unchecked.

4.8.3.1 C-V2X scanner message view

The "C-V2X Scanner Message View" shows the signals measured and decoded by the R&S TSME. The following screenshot displays this view.

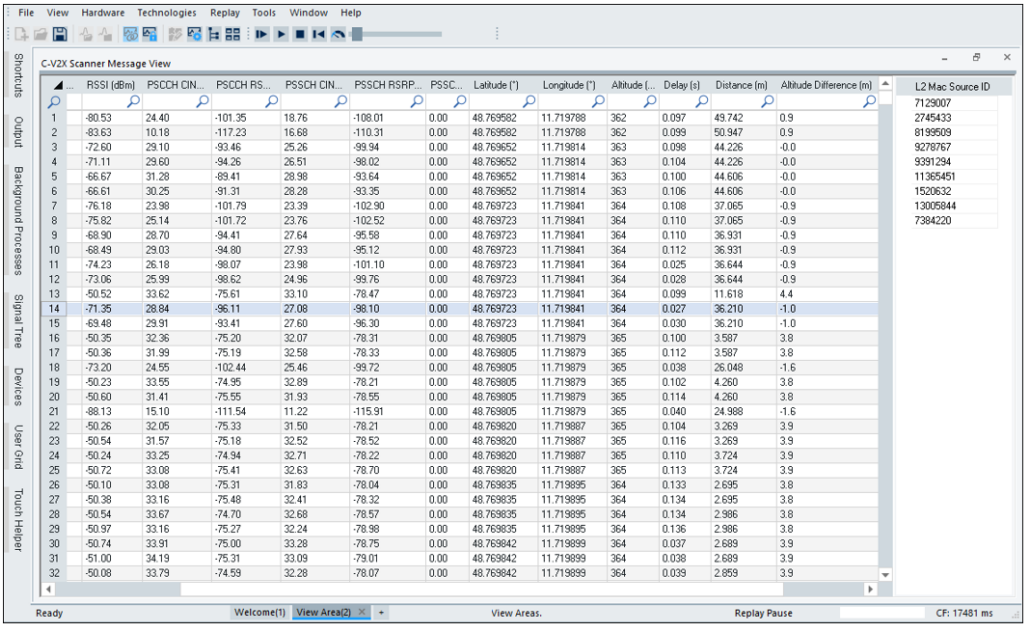


Figure 4-801: C-V2X Scanner Message View - C-V2x and GPS device loaded

The measured signals are displayed in the columns of the "C-V2X Scanner Message View" grid.

- "UTC Timestamp"- UTC time of this message
- "L2 Mac Source ID" - layer 2 source Id provided by the media access controller
- "RSSI (dBm)" - C-V2X PSCCH RSSI in dBm
- "PSCCH CINR (dB)" -C- V2X PSCCH CINR in dB
- "PSCCH RSRP(dBm)" - C-V2X PSCCH RSRP in dBm
- "PSSCH CINR (dB)" - C-V2X PSSCH CINR in dB
- "PSSCH RSRP (dBm)" - C-V2X PSSCH RSRP in dBm
- "PSSCH BER (%)" - PSSCH block error rate in percentage format
- "Latitude (°)" - C-V2X GPS latitude
- "Longitude (°)" - C-V2X GPS longitude
- "Altitude (m)" - C-V2X GPS altitude in meters
- "Delay (s)" - time delay between the creation of the ITS message in the OBU and its reception in the R&S TSME scanner.
- "Distance (m)" - distance between the R&S TSME scanner and the C-V2X transmitting OBU/RSU.
- "Altitude Difference (m)" - elevation difference between the R&S TSME scanner and the C-V2X transmitting OBU/RSU. A positive value indicates that the C-V2X source of the transmitter is higher.

The Latitude, Longitude and Altitude signals filling the associated columns in the view are GPS position signals. They can come from two sources, the R&S ROMES4 GPS device or C-V2X scanner, see the following section.

The last three signals offer more data related to coverage and range of C-V2X signals. These signals are based on decoded ITS information during replay. If the L2 MAC Source ID is not decoded for the Delay, Distance and Altitude Difference signals, no value is available in the associated columns. The hyphen “-“ is displayed instead.

If double-click any list-item during replay of a selected measurement file, the details dialog pops up. The details are not supported during recording.

All unique L2 Mac Source IDs are listed on the right side of "C-V2X Scanner Message View".

The "C-V2X Scanner Message View" supports Coupled Focus feature. Clicking one view synchronizes its timestamp with other views.

GPS position display

The GPS position data for filling the GPS columns of the "C-V2X Scanner Message View" can come from two sources: the R&S ROMES4 GPS device or the C-V2X scanner.

1. If you load C-V2X scanner and R&S ROMES4 GPS device, the GPS position columns of the view are filled by R&S ROMES4 GPS device as shown in the previous screenshot.

2. If you load C-V2X scanner, without loading any R&S ROMES4 GPS device, GPS data in C-V2X scanner are used. In this situation, the symbol “*” appears at the end of the GPS position values.

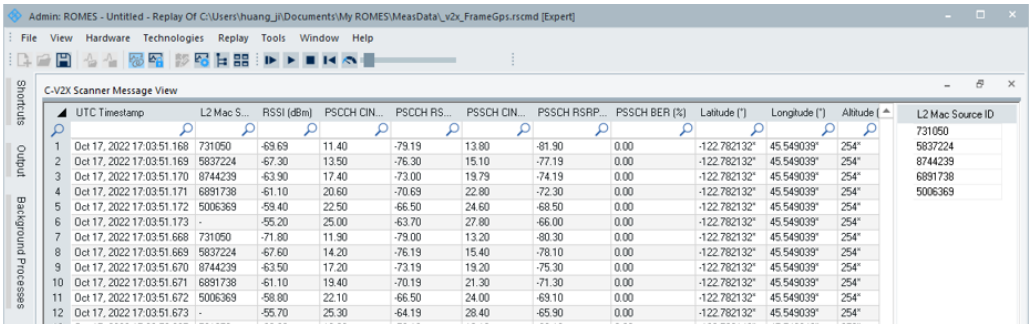


Figure 4-802: C-V2X Scanner Message View - GPS position data w/o GPS device load

C-V2X measurement does not start if GPS is not available.

The "C-V2X Scanner Message View" supports warning message if GPS signal is not available for longer time. The error message appears every other 20 seconds in that case.

Figure 4-803: Error message - no GNSS information

Decoding of ITS messages

To improve the performances, the full ITS Info in a measurement file is decoded in batch mode.

The ITS messages are decoded in replay mode only and they are not available in measurement mode. The initial ITS messages decoding starts automatically after a C-V2X measurement file is loaded. A progress message is displayed.

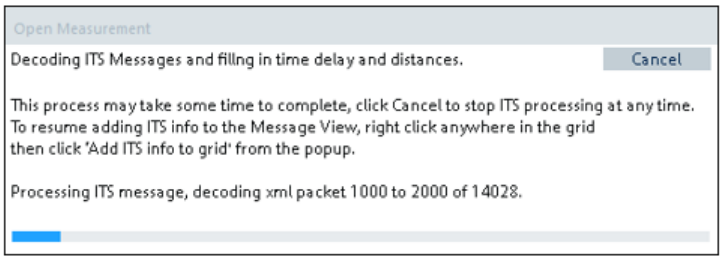


Figure 4-804: Progress of ITS messages decoding

A measurement file contains multiple frames. Each frame contains multiple XML packets or ITS messages.

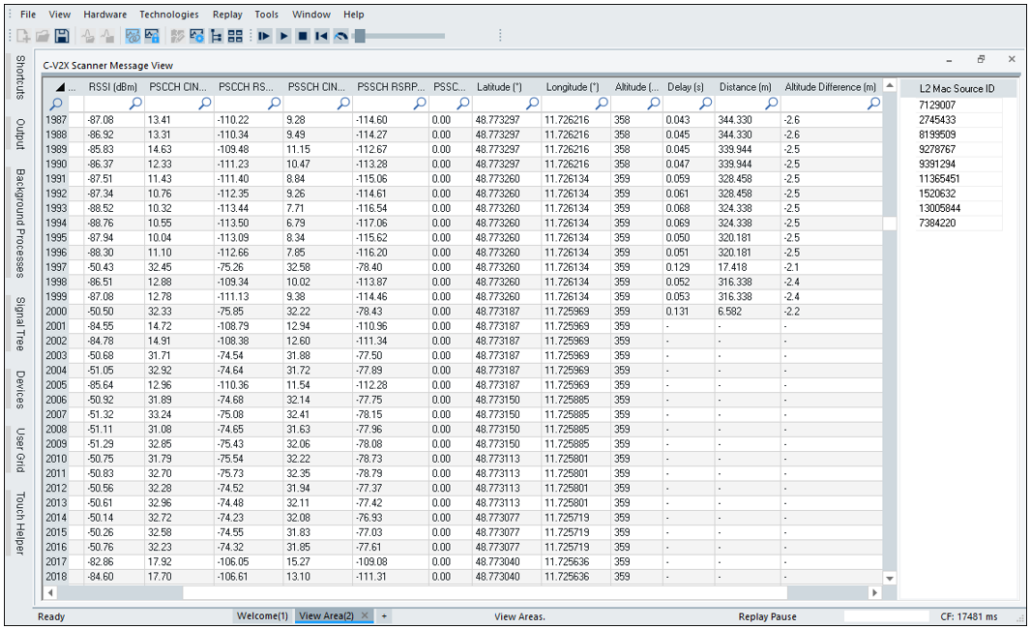
The XML packets are processed in batch mode, each batch contains 1000 packets by default.

ITS messages decoding only occurs after measurement file is fully loaded. Decode ITS messages using "Add ITS info to grid".

Figure 4-805: Enabled/disabled Add ITS info to grid

Decoding process can be stopped at any time using the "Cancel" button, for example, if the decoding takes too long for large measurement files.

If the decoding is stopped before it is done, the ITS decoding is partially finished. The three previously mentioned columns of the "C-V2X Scanner Message View" can be partially filled.



	RSSI (dBm)	PSCCH CIN...	PSCCH RS...	PSSCH CIN...	PSSCH RSRP...	PSSC...	Latitude (°)	Longitude (°)	Altitude (...	Delay (s)	Distance (m)	Altitude Difference (m)	L2 Mac Source ID
1987	-87.08	13.41	-110.22	9.28	-114.60	0.00	48.773297	11.726216	358	0.043	344.330	-2.6	7129007
1988	-86.92	13.31	-110.34	9.49	-114.27	0.00	48.773297	11.726216	358	0.045	344.330	-2.6	2745433
1989	-85.83	14.63	-109.48	11.15	-112.67	0.00	48.773297	11.726216	358	0.045	339.944	-2.5	8199509
1990	-86.37	12.33	-111.23	10.47	-113.28	0.00	48.773297	11.726216	358	0.047	339.944	-2.5	9278767
1991	-87.51	11.43	-111.40	8.84	-115.06	0.00	48.773260	11.726134	359	0.059	328.458	-2.5	9391294
1992	-87.34	10.76	-112.35	9.26	-114.61	0.00	48.773260	11.726134	359	0.061	328.458	-2.5	11365451
1993	-88.52	10.32	-113.44	7.71	-116.54	0.00	48.773260	11.726134	359	0.068	324.338	-2.5	1520632
1994	-88.76	10.55	-113.50	6.79	-117.06	0.00	48.773260	11.726134	359	0.069	324.338	-2.5	13005844
1995	-87.94	10.04	-113.09	8.34	-115.62	0.00	48.773260	11.726134	359	0.050	320.181	-2.5	7384220
1996	-88.30	11.10	-112.66	7.85	-116.20	0.00	48.773260	11.726134	359	0.051	320.181	-2.5	
1997	-50.43	32.45	-75.26	32.58	-78.40	0.00	48.773260	11.726134	359	0.129	17.418	-2.1	
1998	-86.51	12.88	-109.34	10.02	-113.87	0.00	48.773260	11.726134	359	0.052	316.338	-2.4	
1999	-87.08	12.78	-111.13	9.38	-114.46	0.00	48.773260	11.726134	359	0.053	316.338	-2.4	
2000	-50.50	32.33	-75.85	32.22	-78.43	0.00	48.773187	11.725969	359	0.131	6.582	-2.2	
2001	-84.55	14.72	-108.79	12.94	-110.96	0.00	48.773187	11.725969	359	-	-	-	
2002	-84.78	14.91	-108.38	12.60	-111.34	0.00	48.773187	11.725969	359	-	-	-	
2003	-50.68	31.71	-74.54	31.88	-77.50	0.00	48.773187	11.725969	359	-	-	-	
2004	-51.05	32.92	-74.64	31.72	-77.89	0.00	48.773187	11.725969	359	-	-	-	
2005	-85.64	12.96	-110.36	11.54	-112.28	0.00	48.773187	11.725969	359	-	-	-	
2006	-50.92	31.89	-74.68	32.14	-77.75	0.00	48.773150	11.725885	359	-	-	-	
2007	-51.32	33.24	-75.08	32.41	-78.15	0.00	48.773150	11.725885	359	-	-	-	
2008	-51.11	31.08	-74.65	31.63	-77.96	0.00	48.773150	11.725885	359	-	-	-	
2009	-51.29	32.85	-75.43	32.06	-78.08	0.00	48.773150	11.725885	359	-	-	-	
2010	-50.75	31.79	-75.54	32.22	-78.73	0.00	48.773113	11.725801	359	-	-	-	
2011	-50.83	32.70	-75.73	32.35	-78.79	0.00	48.773113	11.725801	359	-	-	-	
2012	-50.56	32.28	-74.52	31.94	-77.37	0.00	48.773113	11.725801	359	-	-	-	
2013	-50.61	32.96	-74.48	32.11	-77.42	0.00	48.773113	11.725801	359	-	-	-	
2014	-50.14	32.72	-74.23	32.08	-76.93	0.00	48.773077	11.725719	359	-	-	-	
2015	-50.26	32.58	-74.55	31.83	-77.03	0.00	48.773077	11.725719	359	-	-	-	
2016	-50.76	32.23	-74.32	31.85	-77.61	0.00	48.773077	11.725719	359	-	-	-	
2017	-82.86	17.92	-106.05	15.27	-109.08	0.00	48.773040	11.725636	359	-	-	-	
2018	-84.60	17.70	-106.61	13.10	-111.31	0.00	48.773040	11.725636	359	-	-	-	

Figure 4-806: Delay, Distance and Altitude Difference columns display of partly decoded ITS messages

To resume the ITS messages decoding:

1. Right mouse click any point in the view's grid. The configuration menu pops-up.
2. Click "Add ITS info to the grid" from the menu.

   The ITS decoding continues from where it was stopped.

If measurement file is configured to be loaded when R&S ROMES4 starts, the ITS decoding is disabled.

Under the following situations, the "Add ITS info to the grid" is grayed out and decoding is disabled:

1. The ITS messages are fully decoded.
2. The measurement file replay is in progress.
3. The measurement file is closed.

C-V2X scanner message details dialog

To see the details dialog of the C-V2X scanner messages, right mouse button double click a list-item during replay of the measurement. A message detail dialog pops up.

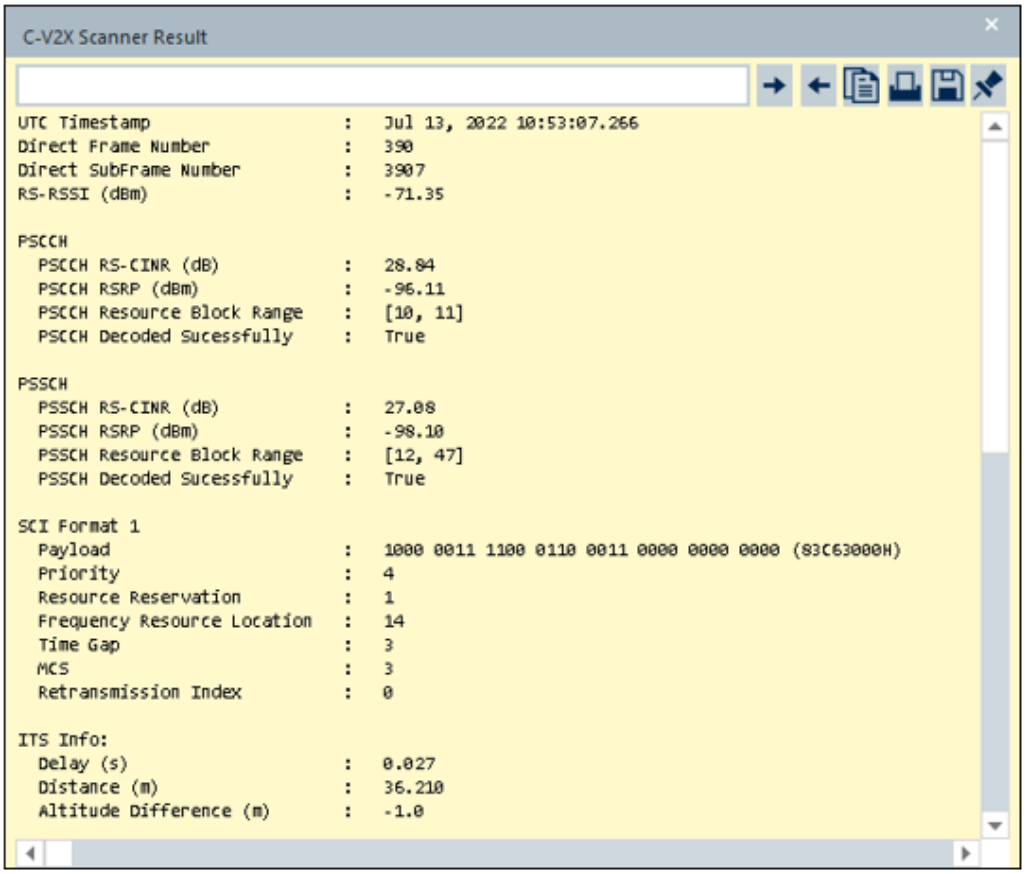


Figure 4-807: Details dialog of the C-V2X Scanner Message View

The top line of the dialog provides some functions for the dialog easier handling.

Figure 4-808: Functions of the details dialog

The functions are described in the following table.

Function	Meaning
1	Edit box for searching ITS message tree
2	Search for the next message
3	Search for the previous message
4	Copy to clipboard
5	Print
6	Save to disk
7	Pin to screen

The pinned box stays and shows the message details if the box is pinned. Double-click again to get the updated detail box.

The top line is followed by the dissector result of the message.

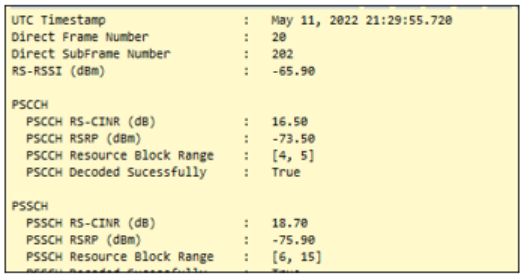


Figure 4-809: Results of measured channels

ITS info is displayed on the ITS Info dissection in the middle of the detail dialog.

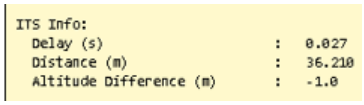


Figure 4-810: Signals in the ITS Info section

The auto-scroll-down feature shows the recorded messages in the list during the C-V2X messages recording.

C-V2X scanner message data export

With the right mouse button double-click any point in the view, you get the pop-up menu shown in the screenshot.

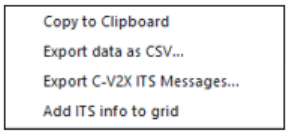


Figure 4-811: Options to export the measurement list

You can export the list content to a CSV file if you select "Export data as CSV" from the menu. The default export file name is `V2X_Message_CSV_Export.csv`.

The exported file is here shown. The first line is the header of exported measurement list.

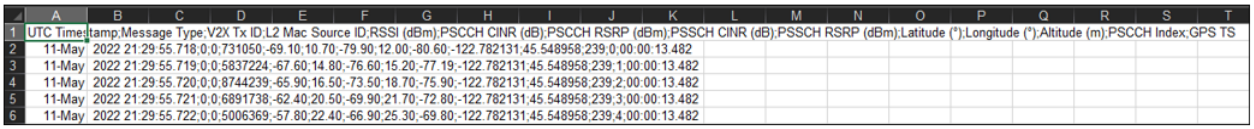


Figure 4-812: Export file layout

If you select "Export C-V2X ITS Messages", the ITS messages associated with the list can be exported. The default exported message name is

`ITS_Message_Export.its`. The exported data is many lines of hexadecimal strings of the ITS messages. The first line in this file is also the header.

4.8.3.2 C-V2X scanner Top N view

The "C-V2X Scanner Top N View" is displayed in the following screenshot.

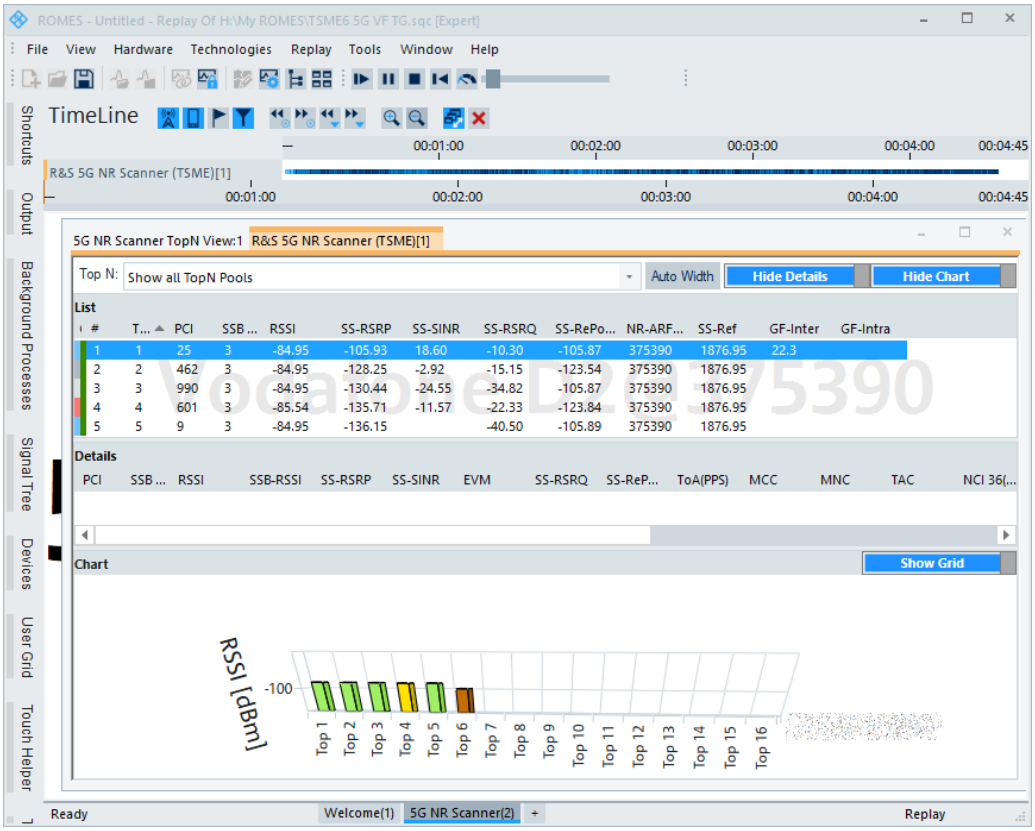


Figure 4-813: C-V2X Scanner Top N View

The following signals are measured and displayed in the view.

- "#"- amount of measured SCH within Top N pool
- "TopX" - top x
- "Center Frequency" - center frequency of the C-V2X channel in Hz
- "EARFCN" - E-UTRA absolute radio frequency channel number. ":" separates the channel frequencies in the list
- "TopX" - layer 2 source Id provided by the media access controller
- "RS-RSSI (dBm)" - reference signal RSSI in dBm
- "RSRP (dBm)" - RSRP in dBm
- "RS-CINR (dB)" - CINR of the physical sidelink control channel

4.8.4 CDMA2000/1xEV-DO scanner views

The CDMA2000/1xEV-DO scanner views show the CDMA2000/1xEV-DO information obtained in the CDMA2000/1xEV-DO network scans performed by an R&S radio network analyzer. The R&S TSME scanner with its hardware R&S TSME-K22 option for cdma2000 and the R&S TSME-24 option for 1xEVDO is required.

The CDMA2000/1xEV-DO network scan available option for R&S TSME is R&S ROMES4T1E.

The CDMA2000/1xEV-DO network PNS configuration is described in Chapter 6.4.20, "CDMA2000 1xEVDO pseudo noise scanner (PNS)", on page 1806.

The "cdma2000/1xEV-DO Scanner Views" can be selected from a submenu displayed on the right side of the "View" menu when the mouse hovers over "cdma2000 1x EV-DO Scanner Views".

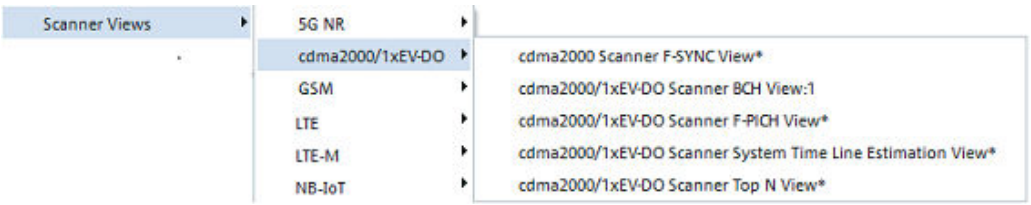


Figure 4-814: cdma2000 1x EV-DO Scanner views

4.8.4.1 CDMA2000/1xEV-DO scanner F-PICH view

The "cdma2000/1xEV-DO Scanner F-PICH View" shows the average signal power of the received Forward Pilot Channels (F-PICHs) and a comprehensive analysis of the properties of all DL signals received in the CDMA2000 PN scan.

The F-PICH is an unmodulated, direct-sequence spread spectrum signal transmitted continuously by each CDMA base station. The Pilot Channel allows a mobile station to acquire the timing of the Forward CDMA channel. It also provides a phase reference for coherent demodulation, and a means for signal strength comparisons between base stations. The signal strength comparison is used to determine when to handoff and for the forward link signal strength measurement.

Different base stations are identified by different pilot PN sequence time phases ("Offset" values). Signals with different timing but equal PN offset originate from the same BTS but propagated along different paths. A comparison of those signals provides important information on reflections and possible interferences.

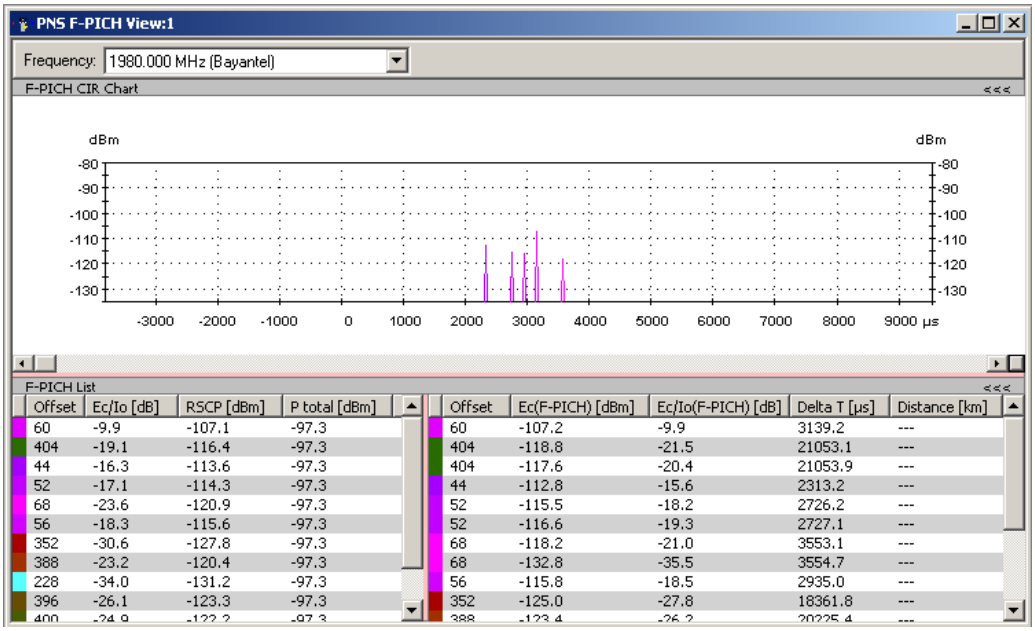


Figure 4-815: Scanner F-PICH View

Frequency

Below the view title, the "Frequency" pull-down list contains all measured frequencies selected in the "Receiver" tab of the scanner configuration menu. The list is also provided in the "Scanner F-SYNC View".

Changing the frequency in one of these views automatically adapts the frequencies in all other views. This capability provides that the views have the same current number in their title bar (e.g. the 1 in the figure above). The feature generates different groups of views by the same current number (opened by the context menu) and selects frequencies for an entire group by a single mouse click.

View area

The entire view area is horizontally split to accommodate a chart and a table/list. The "F-PICH CIR Chart" shows the average signal power of the F-PICHs of all received signals over the time. The displayed powers and times correspond to the "E_c (F-PICH) [dBm]" and "Delta T[µs]" values listed in the "Peak List" (right-hand part of the "F-PICH List").

Click the "F-PICH CIR Chart" or "F-PICH Lists" title bar to compress or expand the 2D-chart or table. A compressed chart leaves more space for the table and vice versa. Moreover, the tables appear in several Scanner views so that compressing them can help to avoid redundancies. A compressed sub diagram is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Diagram scale

The diagram is opened with a default x-axis scale of little more than one F-SYNC frame length (25.666 ms, the F-PICH frame is 20 ms long). If placed inside the diagram

area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside). A vertical line is displayed at the cursor position.

A left mouse click magnifies the diagram in x-direction around the cursor position, "Ctrl" plus left mouse click causes the opposite. An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed. "Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

The scale of the y-axis (power in dBm) can be set in the configuration menu.

Table entries

Below the diagram, the "F-PICH List" gives an overview of the received signals together with their scrambling codes, different power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

The entire table is divided into the "F-PICH List" and the "Peak List". In the configuration menu, it is possible to show or hide each individual table row in both lists.

F-PICH list

The "F-PICH List" (left-hand part of the "F-PICH Lists") provides a general description of the received F-PICH signals from each BTS. Each signal is characterized by its PN sequence offset, corresponding to the transmitting BTS, and includes all possible peaks (reflections) indicated in the Peak List on the right-hand side.

The list can contain the following F-PICH-related values (see also standard TIA-2000.2-D and related standards. All power results in the F-PICH List and Peak List are obtained in an unbiased measurement: The contribution of the noise floor to the powers is subtracted.

- **Offset**
  Pilot PN sequence offset index; time offset of the Forward Pilot Channel from CDMA system time, as transmitted by the base station. The offset is expressed in units of 64 PN chips of the F-PICH. It ranges from 0 to 511.
  Each offset is identified by a color, to be customized in the configuration menu. The offset color codes are also shown in the "ROMESMAP Route Track View" menu.

Signal power

- "Ec/Io [dB]"
  Ratio of the received energy per PN chip of the F-PICH to the total inband power spectral density. The value equals to the sum of the "Ec/Io (F-PICH) [dB]" values of all individual peaks of the same PN offset displayed in the "Peak List".
- "RSCP [dBm]"
  F-PICH Received Signal Code Power; sum of the received powers of all peaks on one code, measured within the correlation section of the F-PICH.
- "P total [dBm]"
  Total average inband power measured within the correlation sections of the F-PICH. The correlation section is the same for all signals, so "P total" is the same for all BTSs. The "P total" is equal to Io within the F-PICH correlation section so that the following relation holds:

"P total + Ec/Io = RSCP"

Peak list

The rows of the "Peak List" (right-hand part of the "F-PICH Lists") describe the single peaks (reflections) that contribute to the different BTS signals.

The list can contain the following values (see also standard TIA-2000.2-D and related standards):

- "Offset"
  Pilot PN sequence offset index

Signal power

- "Ec (F-PICH) [dBm]"
  Average energy per transmitted PN (Pseudo Noise) chip for the F-PICH, divided by the chip period and thus converted into an average received signal power
- "Ec/Io (<Ch>) [dB]"
  Ratio of the received energy per PN chip for the F-PICH to the total transmit power spectral density

Signal timing

- "Delta T [µs]"
  Time delay of the signal slot timing relative to the CDMA system time or GPS time (hardware-dependent). The reference time (left edge of the diagram) is of minor importance. The importance is minor because the diagram extends over more than one frame, which is enough to display and separate all received signals.
- "Distance [km]"
  Distance to BTS

Special table entries

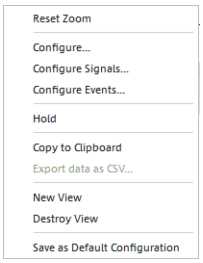
Depending on the conditions of the measurement, the tables show some particular results:

- An invalid result "---" denotes that a peak or the entire BTS signal was too weak to be accurately measured. Selecting "SR1 High Dynamic mode" in the measurements tab of the scanner configuration menu generally reduces the number of invalid results.
- A number (":1, :2" etc.) behind the offset denotes that signals with the same PN offset but with a significant difference in their time delays were received.

  Two different scenarios can cause multiple PN offsets:

  – If several of those signals occur at the same time, they are likely to belong to different BTSs that accidentally use the same PN offset.
  – Two signals, having different numbers behind their PN offsets received at different times, can belong to the same BTS, but actually indicate a strong time drift.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu has the additional "Reset Zoom" command to reset the x-axis scale. The reset range is 0 ms to approx. 26.5 ms.

CDMA2000/1xEV-DO scanner F-PICH view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: F-PICH view

The configuration menu of the "cdma2000/1xEV-DO Scanner F-PICH View" customizes the diagram in the view and the contents of the table.

Via the "cdma2000/1xEV-DO Scanner F-PICH View" tab the user can set the y-axis scale of the "cdma2000/1xEV-DO Scanner F-PICH View", select the information to be displayed in the table and correct the Doppler frequency.

In addition, the data which is shown during replay in two lists of the view can be exported to `*.xml` files. Instead, export to CSV format is also possible.

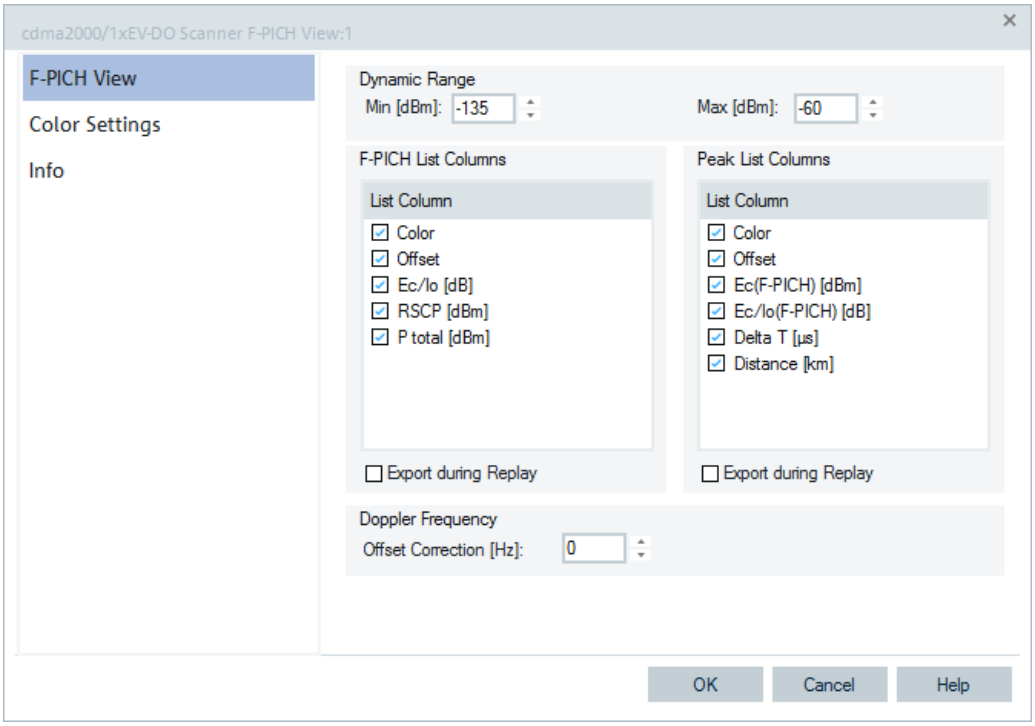


Figure 4-816: cdma2000/1xEV-DO Scanner F-PICH View

Dynamic Range

The two input fields in the "Dynamic Range" panel define the minimum "(Min [dBm])" and the maximum "(Max [dBm])" level to be displayed in the "Scanner F-PICH" view diagram.

F-PICH List/Peak List

The "F-PICH List" and "Peak List" panels select which information is displayed in the tables below the "Scanner F-PICH" diagram, see Figure 4-816. Clearing a box hides the corresponding column in the diagram.

Export During Replay

The export during replay is active if "Export during Replay" is checked. The content of the corresponding tables is then exported into a text file of the R&S ROMES4 export directory.

The file names are generated from the cmd file name, the view name, plus “CIR” or “Peaks" and the scanner instance, for example:

```
C2K-EVDO-PE-Scan-Pantech_cdma2000_
1xEV_DO_Scanner_F_PICH_View_1_
CIR_0.xml
```

The xml content for CIR looks like:

```
<ListContent Timestamp="10574 ms" SelectedFrequency=" 881.520 MHz">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=" "/>
                <Offset Value="---"/>
                <Ec_Io__dB_ Value="-12.2"/>
                <RSCP__dBm_ Value="-87.5"/>
                <P_total__dBm_ Value="-75.3"/>
            </Line>
            <Line Value="2">
                <Color Value=" "/>
                <Offset Value="---"/>
                <Ec_Io__dB_ Value="-5.1"/>
                <RSCP__dBm_ Value="-80.4"/>
                <P_total__dBm_ Value="-75.3"/>
            </Line>
</ListContent>
```

The xml content for Peaks looks like:

```
<ListContent Timestamp="10574 ms" SelectedFrequency=" 881.520 MHz">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=" "/>
                <Offset Value="---"/>
                <Ec_F_PICH___dBm_ Value="-101.7"/>
                <Ec_Io_F_PICH___dB_ Value="-26.4"/>
                <Delta_T__us_ Value="4622.0"/>
                <Distance__km_ Value="---"/>
            </Line>
            <Line Value="2">
                <Color Value=" "/>
                <Offset Value="---"/>
                <Ec_F_PICH___dBm_ Value="-94.6"/>
                <Ec_Io_F_PICH___dB_ Value="-19.3"/>
                <Delta_T__us_ Value="4622.8"/>
                <Distance__km_ Value="---"/>
            </Line>
</ListContent>
```

Note: Position data for every <ListContent> entry is available in CIR and CIR peak export files.

Configuration: color settings

The "Color Settings" option in the scanner views lets you define the color scale of different signals dependent on technology. The color codes are also shown in the ROMESMAP Route Track menu.

The following settings are available:

- "Random"
  No ordering; colors are assigned to a signal at random.
- "All Gray"
  Color scale suppressed; all colors are gray. This option is suitable, for example to distinguish a single scrambling code or preamble index (or a few scrambling codes and a few preamble indexes, respectively).
- "Default"
  Predefined color scale: colors change continuously as a signal changes
- "Load"/ "Save"
  A color scale can be loaded from a color file (e.g SC color file `*.scc`) and user-defined color scales can be stored to `*.scc` files to be reused in a later session.

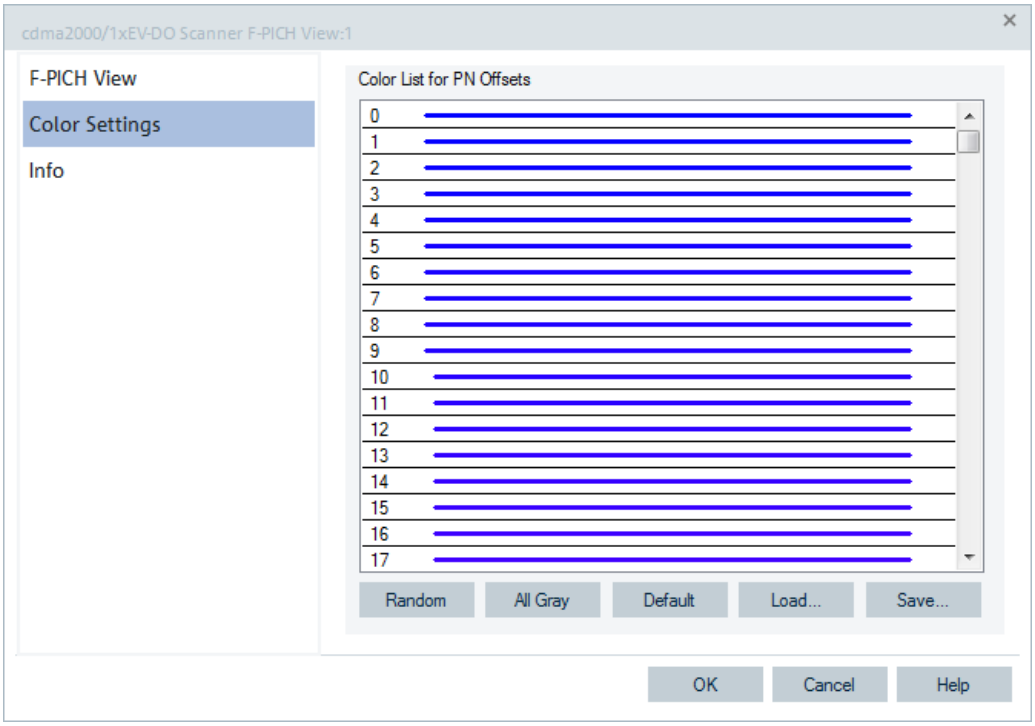


Figure 4-817: cdma2000/1xEV-DO Scanner F-PICH View color settings

4.8.4.2 CDMA2000/1xEV-DO scanner BCH view

The "cdma2000/1xEV-DO Scanner BCH View" shows a list of all CDMA/1xEV-DO System Information (SI) messages (the cdma2000 Layer 3 messages) and the ATIM PDU decoded from the BCH demodulator. The messages are the Layer 3 messages from the CDMA/1xEV-DO sync. channel and the CDMA/1xEV-DO paging channel.

The SI messages are available only if the PNS data is recorded. The data is recorded if the "BCH Demodulation" is active. Decoding of each SI message type must be enabled explicitly in the CDMA/1xEV-DO PNS scanner configuration menu, see Chapter 6.4.20.2, "Configuration menus CDMA2000 1xEVDO PNS", on page 1807.

If the position information is available in a Layer 3 message, it is extracted and handled, as if the position estimation information had been applied, see "BTS position estimation" on page 1170. The contents appear in a tree view.

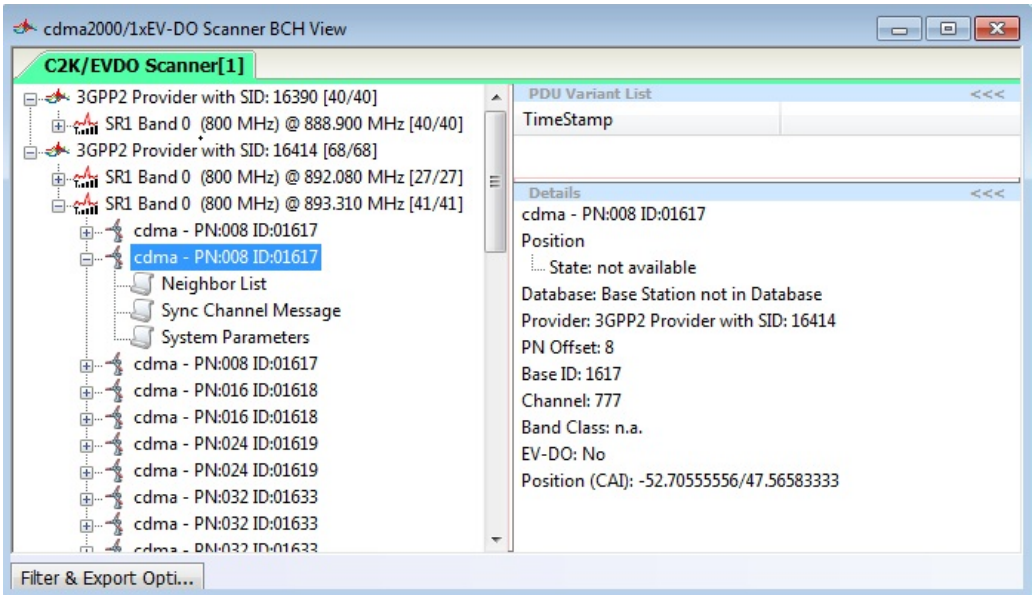


Figure 4-818: cdma2000/1xEV-DO Scanner BCH View - selected BTS details

The view accumulates the acquired SI messages and displays them on the left side of the view. The SI messages are grouped under the network providers who are identified by their NID and SID.

Each second-level node of the data tree shown represents a CDMA/1xEV-DO BTS sector identified by NID, SID and ID. If it can be found in the CDMA/1xEV-DO database loaded, the corresponding name is shown, e.g. MXU811A. Otherwise, the name is composed as follows:

BTS<Base_ID>_<NID>_<SID>, where

<Base_ID> is a decimal Base_ID value, 5 digits.

<NID> is a decimal NID value, 5 digits.

<SID> is a decimal SID value, 5 digits.

e.g.: BTS00509_00002_00030.

Some parameters (PN, ID, position) are appended to the BTS name. If the BTS has been retrieved from the database, the position is displayed as Lon <value> Lat <value>. If the BTS has been generated from Layer 3 measurement without a corresponding database entry, the position is displayed as Lon *<value> Lat *<value>. The formats of the position values depend on the corresponding global R&S ROMES4 setting.

Referring to the R&S ROMES4 support of dynamic PDU handling described in "Implementation of the dynamic PDU handling" on page 284, the "cdma2000/1x EV-DO Scanner BCH View" is enhanced to show the list of measured variants of PDUs over time. The PDU variants are shown as leaves of the base station.

Select a signal on the left side of the "cdma2000/1x EV-DO Scanner BCH View" to get the details of your selection in "Details" pane. The "PDU Variant List" is a list of time

stamps if there were different variants found. The "TimeStamp" shows the most recent measurement of the PDU variant.

BTS position estimation

If the position estimation is active, the estimated positions are added to the BTS entries. Estimated positions are marked by an asterisk.

At the end of measurement, the view automatically generates a BTS list import file with an entry for every estimated BTS position.

Files

Two files are generated for each `*.rscmd` measurement file.

- **`CDMA_BTS_LIST<measurement filename>.ATD`**
  Contains the database definition.
- **`CDMA_BTS_LIST<measurement filename>.TXT`**
  Contains the BTS data.

The CDMA list files are stored in the R&S ROMES4 measurement directory. When the measurement file replay ends, the same BTS list can be created via the view's context menu "Generate CMDA List" option.

Example

- **Measurement file:**
  `zgb-muc.rscmd`
- **Generated files:**
  `CDMA_BTS_LIST_ zgb-muc.ATD`
  `CDMA_BTS_LIST_zgb-muc.txt`

Content *.ATD and *.TXT files

For a detailed example, refer to "Example" on page 1185.

Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

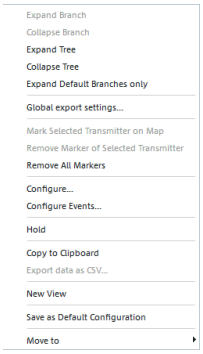
- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.



The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

CDMA2000/1xEVDO scanner BCH configuration

The "Configuration" option lets you set the color for the selected BTS symbols in the "ROMESMAP Route Track View" and define the filter for generating a BTS list.

Open the configuration page by a right mouse click on a point inside the view or via the "Tools" > "Configuration Active View" command.

It is possible to get the BTS position information from the BTS Position Estimator or to use the information from the Layer 3 messages.

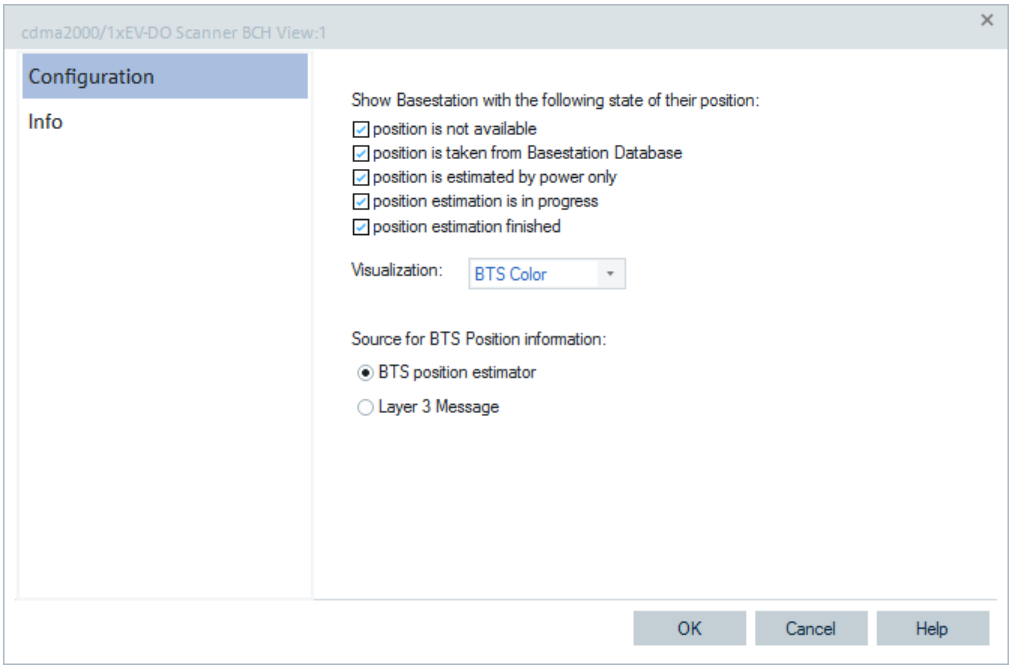


Figure 4-819: cdma2000/1xEVDO Scanner BCH View – configuration

Note: Layer 3 messages do not always have the BTS position information. Also, the data from Layer 3 messages can be imprecise, which depends on the provider.

4.8.4.3 CDMA2000/1xEV-DO scanner F-SYNC view

The "cdma2000/1xEV-DO Scanner F-SYNC View" shows the information that the network analyzer, see Chapter 4.8.4, "CDMA2000/1xEV-DO scanner views", on page 1160 decoded from the Forward Synchronization Channel (F-SYNC). The F-SYNC corresponds to code channel 32 in the forward CDMA channel which transports the synchronization message to the mobile station.

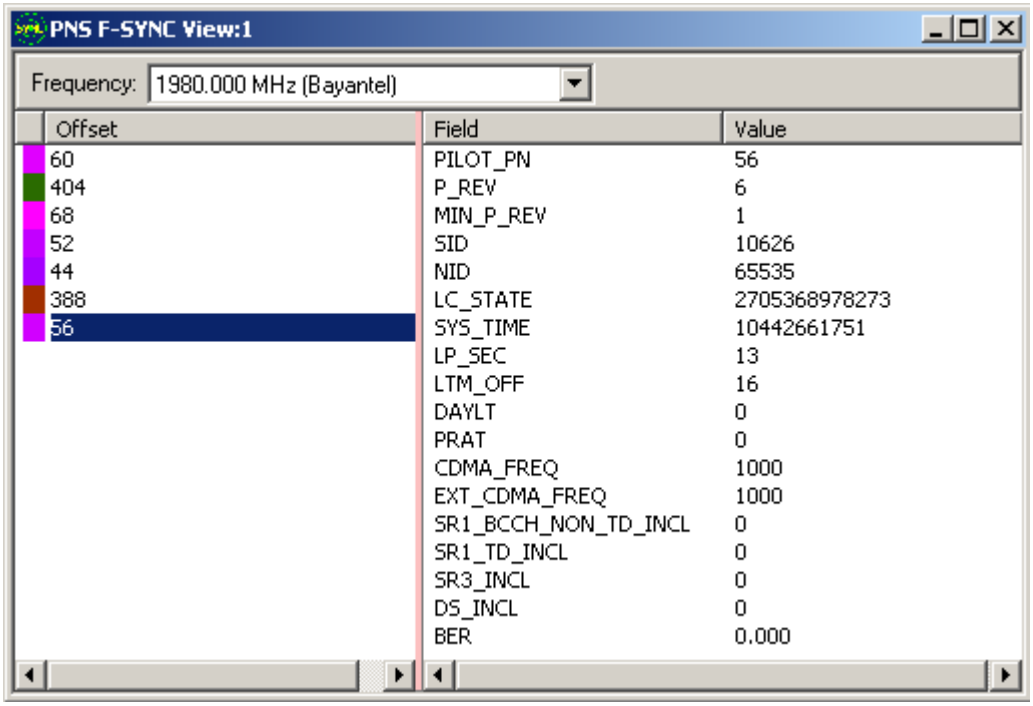


Figure 4-820: cdma2000/1xEV-DO Scanner F-SYNC View

Frequency

Below the view title, the "Frequency" pull-down list contains all measured frequencies selected in the "Receiver" tab of the scanner configuration menu. The list is also provided in the "cdma2000/1xEV-DO Scanner F-PICH View".

Changing the frequency in one of these views automatically adapts the frequencies in all other views, provided they have the same current number in their title bar (e.g. the 1 in the figure above). Using this feature, it is possible to generate different groups of views with the same current number (opened with the context menu). You can select frequencies for an entire group with a single mouse click.

View area

The entire view area is vertically split in two parts:

- The left part displays all PN offset values decoded from the F-SYNC. The frequency of F-SYNC demodulation can be set in the "CDMA measurements" on page 1818 tab of the CDMA PNS scanner configuration menu. The setting is done once for each frequency, once for each new pilot, or once for each new pilot but not more than once per 30 s. The color code is set in the "cdma2000/1xEV-DO Scanner F-SYNC View" configuration menu.
- The left part displays the name of the different information elements in the synchronization message and the last decoded values.

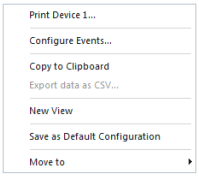
Information elements

The contents of the synchronization message are described in standard TIA-2000.5-D.

- "PILOT_PN"
  Pilot PN sequence offset index, see Chapter 4.8.4.1, "CDMA2000/1xEV-DO scanner F-PICH view", on page 1160).
- "P_REV"
  Protocol revision level
- "MIN_P_REV"
  Minimum protocol revision level
- "SID"
  System identification
- "NID"
  Network identification
- "LC_STATE"
  Long code state
- "SYS_TIME"
  System time
- "LP_SEC"
  Number of leap seconds that have occurred since the start of the system time
- "LTM_OFF"
  Offset of local time from system time
- "DAYLT"
  Daylight savings time indicator
- "PRAT"
  Paging channel data rate
- "CDMA_FREQ"
  Frequency assignment
- "EXT_CDMA_FREQ"
  Extended frequency assignment
- "SR1_BCCH_NON_TD_INCL"
  SR1 Non-TD BCCH support indicator
- "SR1_TD_INCL"
  SR1 TD BCCH support indicator

- "SR3_INCL"
  SR3 support indicator
- "DS_INCL"
  Direct spread (DS) system and information available

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

Scanner F-SYNC view configuration

For the "Scanner F-SYNC View" configuration, see "Configuration: color settings" on page 1167.

4.8.4.4 CDMA2000/1xEV-DO scanner system time line estimation view

The "cdma2000/1xEV-DO Scanner System Time Line Estimation View" shows the estimated time of the PN offset arrival time intervals.

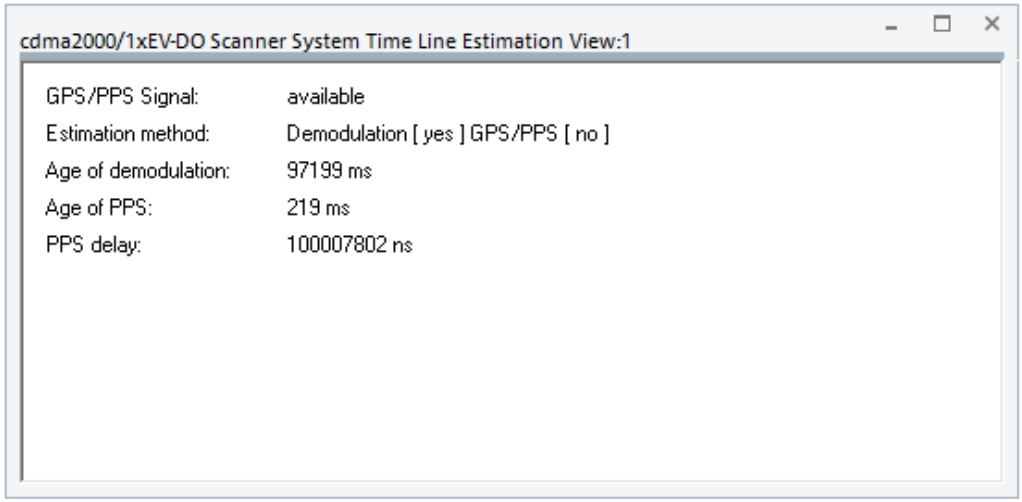


Figure 4-821: cdma2000/1xEV-DO Scanner System Time Line Estimation View

View area

The PPS signal from GPS and its delay have to be assessed continuously even when the GPS signal is not available.

This view shows the parameters related to the CDMA time line measurement. The "System Time Line Estimation View" has no configuration menu assigned.

Information elements

The contents of the System Time Line Estimation View are described in this section.

- "GPS/PPS Signal"
  Shows if arrival time was measured via GPS.
- "Estimation Method"

  The following combinations are possible:
  - 1. No Demod. / no GPS PPS: Offset value is random, transmit time is estimated by receive time.
  - [2. No Demod. / GPS PPS: not used]
  - 3. Demod. / no GPS PPS: Offset value is correct, transmit time was estimated by received pilots.
  - 4. Demod. / GPS PPS: Offset value is correct, transmit time has GPS PPS accuracy.
- "Age of demodulation"
  Age of the last GPS PPS demodulation
- "Age of PPS"
  Age of the last PPS signal from GPS.
- "PPS Delay"
  Measured GPS PPS time difference in [ns].
  Range: -1 ms (-1000000) to 999 ms (999000000)
  The PPS delay shows the GPS arrival time for the case that the measurement results (delays) are correct. If a time delay for a BTS signal is known, the measurement error of the PN Scanner result can be calculated. The same error applies to this value.
  Example: PN Offset 271 was measured. The frame of this signal is transmitted 271*64/1228800 sec = 14114.58 µs after a frame with offset 0.
  Assumption: The distance to the BTS is 5 km. So a measurement result of 14114.58 µs + 16.67 µs = 14131.31 µs is the expected measurement value. If for instance, a delay of 14141.31 µs is measured as a delay value for this BTS, the measurement result has an error of +10 µs. Now both delay value and PPS delay value can be reduced by 10 µs to obtain the correct results.

4.8.4.5 CDMA2000/1xEV-DO scanner Top N view

The "cdma2000/1xEV-DO Scanner Top N View" displays the properties of the signals from the NodeBs that are elements of the "Top N Pools" defined in the scanner configuration menu. A Top N pool contains up to N NodeBs with specific characteristics providing the strongest P-CPICH level at a given position and time. For more information, refer to the description of the scanner configuration menu in chapter 6.

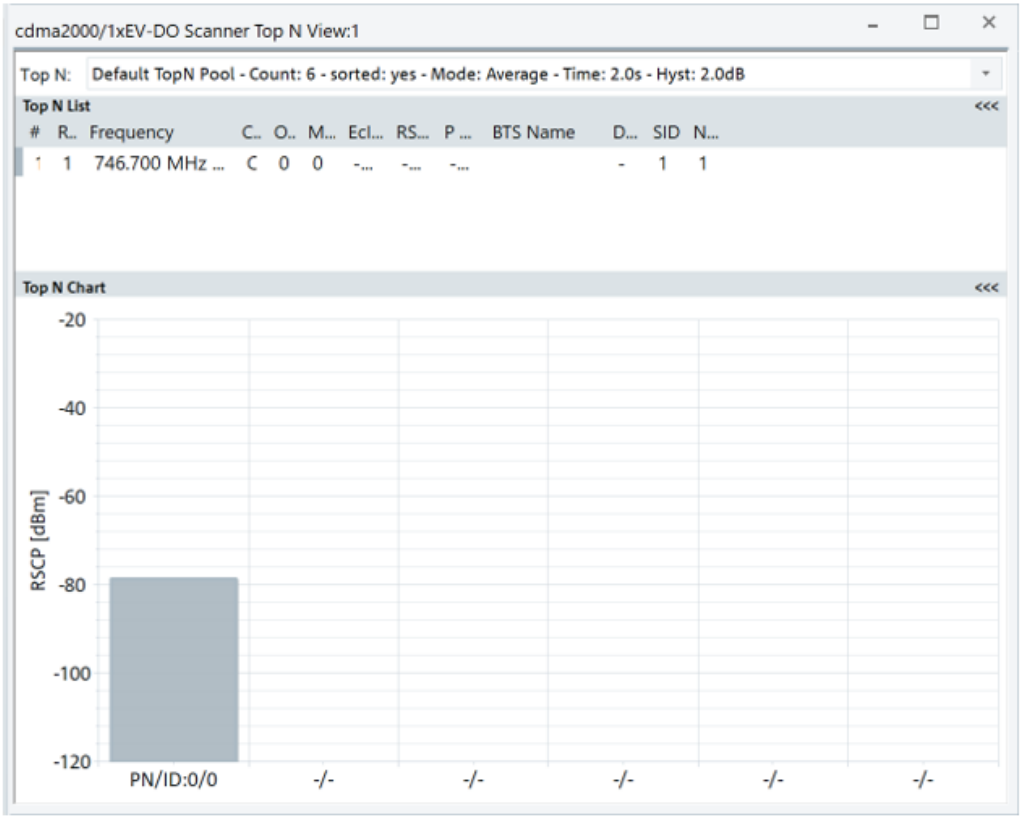


Figure 4-822: cdma2000 1xEVDO scanner Top N view

The "cdma2000 1xEVDO Scanner Top N View" screenshot shows the cdma detected physical channel (frequency) of one received CIPCH.

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

The splitter position between the upper and lower part of the scanner view area and the open or closed state of the "Top N List" and "Top N Chart" are restored from the workspaces.

Top N list

The cdma2000/1xEV-DO "Top N List" gives an overview of the received signals in the current Top N pool including measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

The "Top N List" contains the following columns:

- "Color"
  Sequence number and the configured PN color.
- "#"
  Number of the measured BTS (Node B) within a Top N pool.
  NodeBs are numbered in ascending order, according to the time when they enter the Top N pool. The current numbers tend to increase as the measurement progresses.
- "Rank"
  Current rank of a Node B within the Top N pool, according to its average or maximum Ec/Io (see scanner configuration menu)
  The ranks are reassigned every time the pool is updated; they are in the range 1 ≤ Rank ≤ N.
- "Frequency"
  Frequency of the received physical CPICH
- "Channel type"
  Channel type 1xRTT (C2K) or 1xEV-DO (EVDO)
- "Offset"
  Channel offset
- "MeasID"
  Measurement ID for measurements of a specific BTS
  Measurement results with equal channel and MeasID values are expected to be from the same BTS. If the results are not certain but the measurement was at the same channel as a previous measurement, the ID is incremented. In this case, still the measurement results can be from the same BTS but not with certainty. The PN Offset in the measurement results is not used to indicate that results belong to the same BTS as the PN Offset is time-estimated, demodulated, or invalid until the time line estimation was finished.
- "EcIo (dB)"
  Average Ec/Io= Ec Chip energy of the F-CPICH (unbiased), Io=Total inband energy during one chip
- "RSCP (dBm)"
  Integrated received signal code power for all measured peaks (unbiased)
- "P Total (dBm)"
  Total averaged inband power within the correlation section on P-CPICH
- "BTS Name"
  Name of the closest BTS with matching channel/PN
- "Dist. (km)"
  Distance to the potential interferer, calculated from the BTS database; 0 km means that the interferer is a different sector of the same BTS
- "SID"
  Sub-net identifier
- "NID"
  Network identifier
- "Base ID"

The identity value derived from demodulated CDMA2000/1xEV-DO system message. It is not always available.

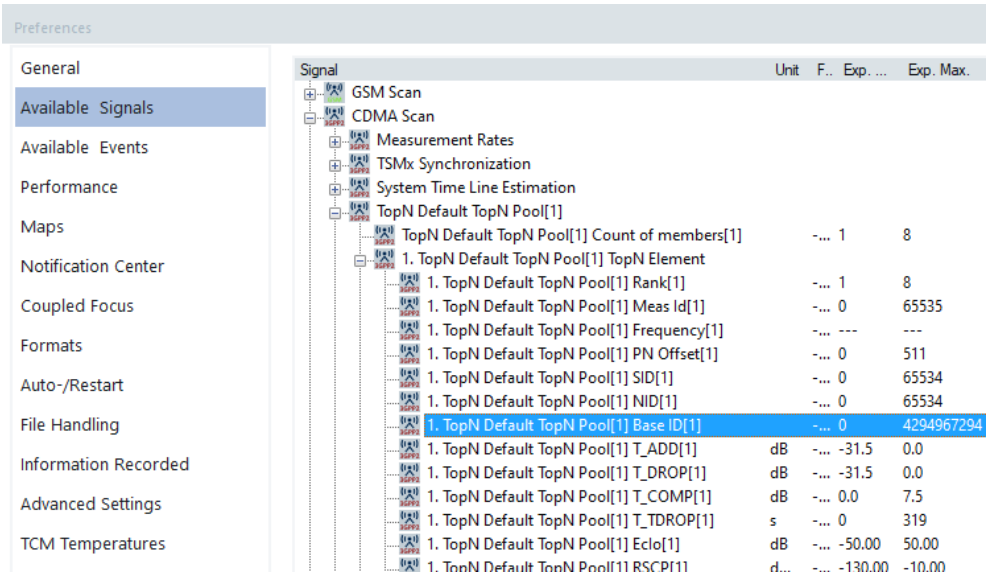


Figure 4-823: Base ID signal in CDMA PNS

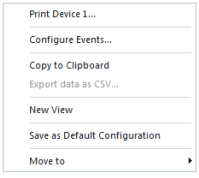
Diagram

Below the "Top N List" there is the "Top N Chart" showing the RSCP for all NodeB signals in the current Top N measurement.

Signals from different NodeBs are distinguished by their "PN" offset and "ID" displayed along the x-axis. The scales for the RSCP and Ec/Io (signal quality) are displayed on the left and right edge of the diagram, respectively. The y-axis scales (RSCP in dBm and Ec/Io in dB) can be set independently in the configuration page. The left y-axis is displayed if the "Show signal quality" box is checked in the configuration menu.

The color of the bars reflects the color of the PN offset. This color you can remark on the very left column of the "TopN List" pane.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

CDMA scanner Top N view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

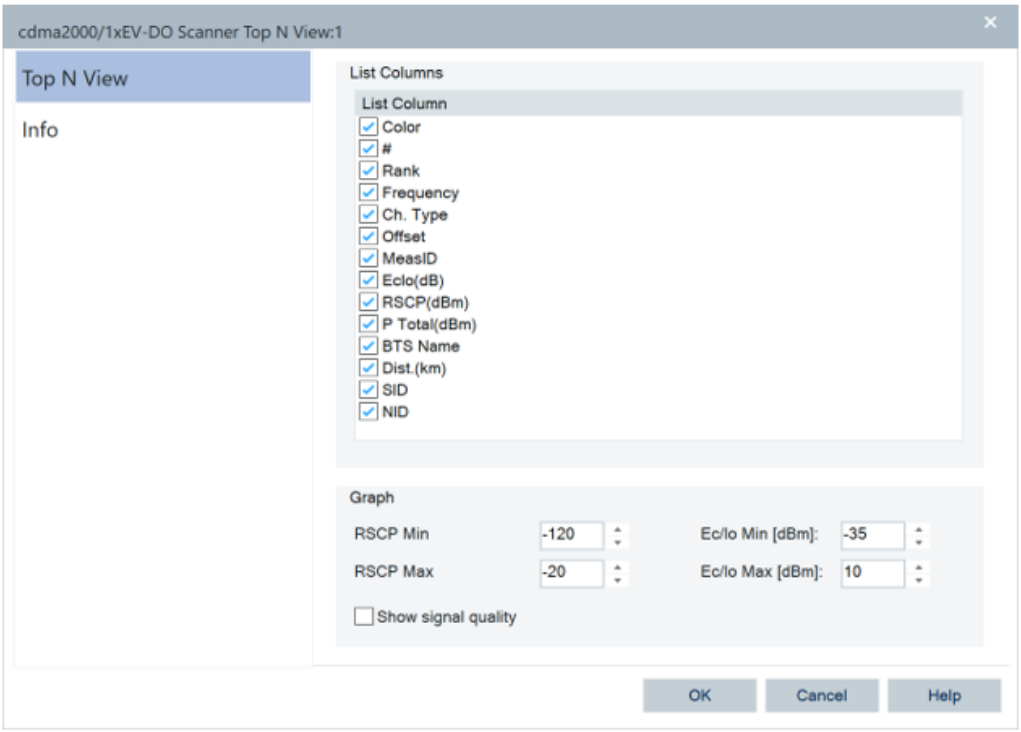


Figure 4-824: cdma2000/1xEV-DO Scanner Top N View configuration

The "cdma2000/1xEVDO Top N View" option lets you configure the following:

- Signals to be displayed in the "Top N List" of the scanner's Top N view. The "Top N list" on page 1176 provides the signals' definitions. A signal is activated if the associated check box in the "List Column" is checked.
- Y-axis scale of the "Top N Chart". You can configure for display the minimum and the maximum value of signal level RSCP[dBm] and signal quality Ec/Io [dB].
- You can select for display the signal quality if the "Show signal quality" box is checked in the "Graph" pane. Switch on or off the second y-axis on the chart and quality signal bars.
  If this option is selected, consider that you get the result of the switching in the next frame. The chart must redraw at least once for it.

4.8.5 GSM scanner views

The GSM scanner views show the GSM network scan data obtained by a R&S radio network analyzer. For this purpose used is the R&S TSME sanner with its hardware R&S TSME-K23 option.

The GSM network scan available option for R&S TSME is R&S ROMES4T1E.

The GSM network scanner is described in the Chapter 6.4.18, "GSM network scanner", on page 1775.

The GSM scanner views can be selected from a submenu displayed in the "View" menu when the mouse hovers over "Scanner Views" > "GSM".

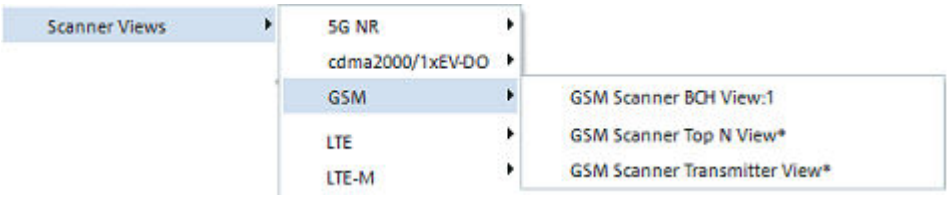


Figure 4-825: GSM scanner views

- GSM scanner signals templates....1180
- GSM scanner BCH view....1181
- GSM scanner Top N view....1187
- GSM scanner transmitter view....1196

4.8.5.1 GSM scanner signals templates

R&S ROMES4 offers easy access to the measurement data of a specific scanned channel using the "Scanned Channel<ARFCN\BSCI>Template" branch of the "Signal Tree".

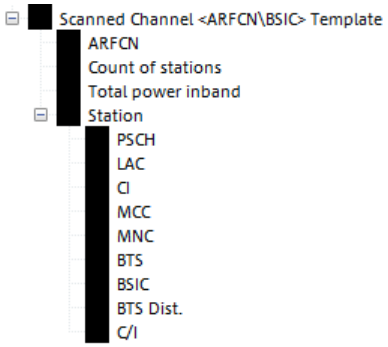


Figure 4-826: GSM scanner template signals

1. Select from the "Scanned Channel<ARFCN\BSCI>Template" branch a signal you want to be shown in a R&S ROMES4 view and in the "Signal Tree" as a template signal. Drag & drop the selection into the view or double click the item in the view's configuration page.
2. A dialog pops-up asking you to define the filter for the signal. In the case of GSM scanner, this filter asks for the ARFCN or the combination of ARFCN and BSIC.

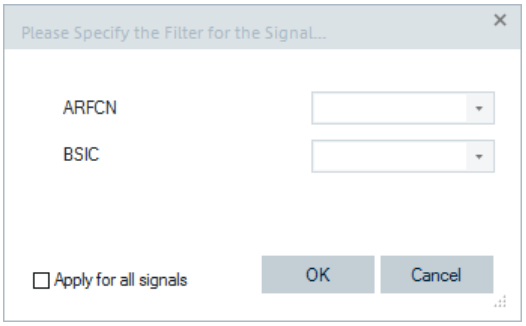


Figure 4-827: Enabling GSM scanner templates

If you have selected several signals, check the "Apply for all signal" check box. This will apply the same filter for all signals.

Enters the filter for the signal.

The signal now appears in the R&S ROMES4 view and in the "Template Signals" branch added to the "Signal Tree".

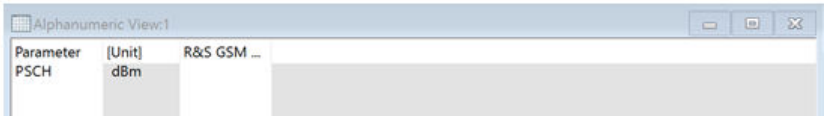


Figure 4-828: Alphanumeric view of the template signal PSCH

The template signals branch is a home of all created template signals.

The dialog remembers the last set values.

The template signals are a part of the workspace. This means that they will be stored to the workspace and restore when loading a workspace. Creating a new workspace will remove the template signals.

4.8.5.2 GSM scanner BCH view

The "GSM Scanner BCH View" shows a list of System Information (SI) types decoded by the GSM BCH demodulator. The content of each SI appears in a tree view on the right side of the view as soon as the block is selected. The SI types and their information elements are described in standard 3GPP TS 44.018.

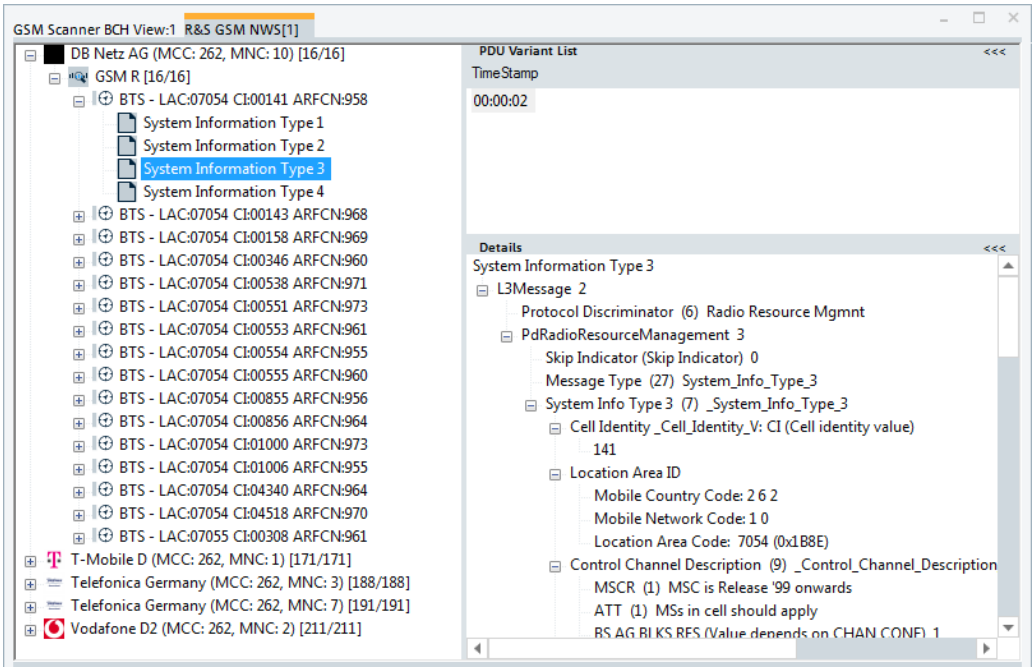


Figure 4-829: GSM Scanner BCH View - selected SI Type 3

The "GSM Scanner BCH View" contains the tabs for multiple scanners if the option is activated, see Figure 3-200.

Extraction of system information

The SI is available only if the scanner data is recorded with the "BCH Demodulation" enabled. Decoding of each SI type must be enabled explicitly in the GSM NWS scanner configuration menu, see Chapter 6.4.18.4, "BCH demodulation", on page 1782.

The view accumulates the SI types of a BTS (Base Transceiver Station sector) acquired as a tree. The information is grouped under the BTS details, see Figure 4-829.

If a SI Type n is selected by clicking it, its decoded content is shown as a tree on the left side of the view, in the "Details", see Figure 4-829. If a BTS node is selected, its parameters are shown instead.

For example, the SI Type 3 contains the information on cell identity, PLMN, control channel and so on. The SI Type 2 and SI Type 2bis contain the information on neighbor cells which can be seen as "2G Neighbours".

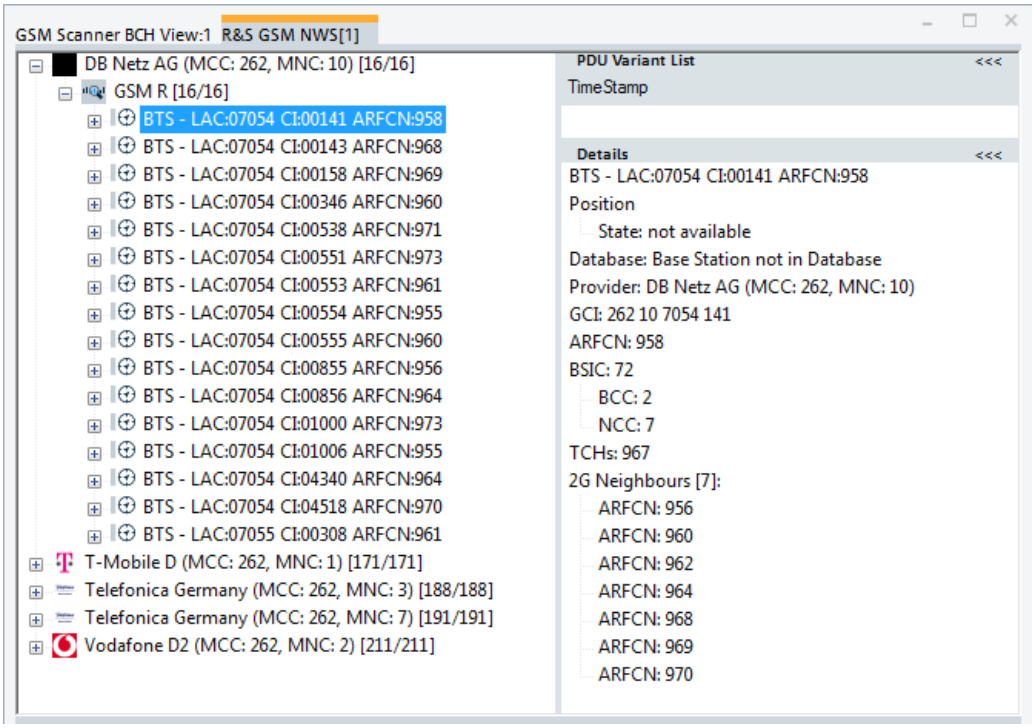


Figure 4-830: GSM Scanner BCH View – serving and 2G neighbours

The first level node of the data thee shows the network operator details, that means, MCC and MNC. Each second node level of the data tree represents a BTS identified by LAC, CI and ARFCN. If it can be found in the loaded GSM BTS database, the BTS name is shown, e.g. MXB053A. Otherwise, the name is composed as “S” followed by the hexadecimal values of the parameters: "S[MCC]_[MNC]_[LAC]_[CI]". For example, S262_001_34567_30641.

Based on R&S ROMES4 support of dynamic PDU handling described in "Implementation of the dynamic PDU handling" on page 284, the "GSM Scanner BCH View" is enhanced to show the list of variants of PDUs over time. This is shown for the SI Type 3 in Chapter 6.4.18.4, "BCH demodulation", on page 1782. The PDU variants are shown as leaves of the base station.

If a SI type is selected on the left side of the "GSM Scanner BCH View", the list of PDU variants and the list of associated time stamps are displayed on the view's right side. The "PDU Variant List" in the upper right of the view shows one time stamp as there was one variant found in the mentioned figure.

The "PDU Variant List" shows the most recently found measurement of the variants.

See also Chapter 4.8.11.2, "UMTS scanner BCH view", on page 1377.

Extraction of SI2ter and SI2quater

The R&S ROMES4 GSM network scanner automatically demodulates all indices of the SI Type 2ter and SI Type 2quater messages and shows them in BCH view, if the demodulation of Layer 3 messages is activated.

The performances of ACD are increased in sense of faster and more sensitive channel detection if ACD is configured to use the SI Type 2quater message.

To see the message contents, select a PDU in the "PDU Variant List".

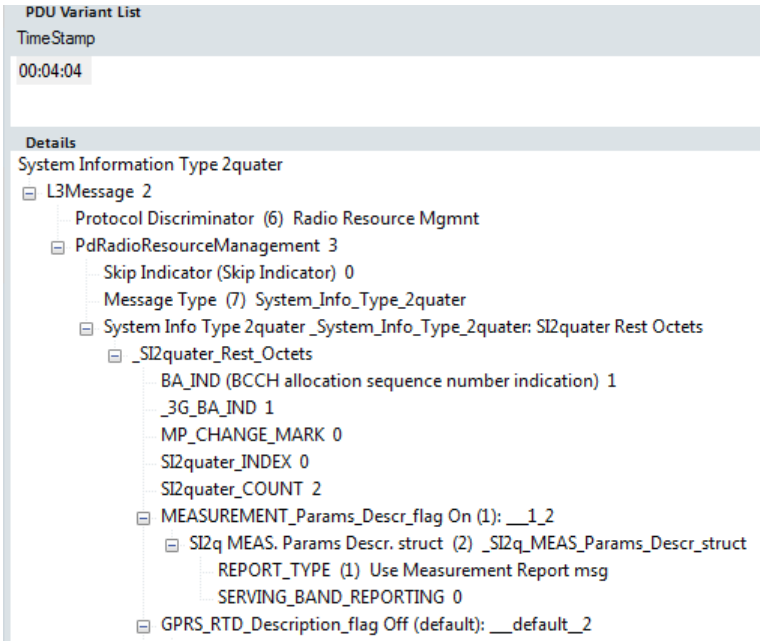
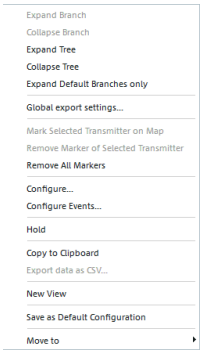


Figure 4-831: Demodulated SI2quater message

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.

- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

BTS position estimation

If BTS position estimation is active (see "Hardware" > "Available Devices" > "BTS Position Estimatior"), the estimated positions are added to the BTS entries. The estimated positions are marked by an asterisk.

During a measurement, the view automatically generates a BTS list import files with an entry for every estimated BTS position.

Files

Two files are generated for each `*.rscmd` measurement file.

- **GSM_BTS_LIST<measurement filename>.ATD**
  Contains the database definition.
- **GSM_BTS_LIST<measurement filename>.TXT**
  Contains the BTS data.

Example

- Measurement file:
  manert_bts-position-estimation__2008-01-11_20-32-07.rscmd
- Generated files:
  - GSM_BTS_LIST_manert_bts-position-estimation__2008-01-11_20-55-47.ATD
  - GSM_BTS_LIST_manert_bts-position-estimation__2008-01-11_20-55-47.TXT

Content ATD file

```
[Main]
Type=ATD
[Table1]
Name=
File=GSM_BTS_LIST_manert_bts-position-estimation__2008-01-11_20-55-47.TXT
Columns_Size=13
Columns0_Name=BTS_Name
Columns0_Type=utDynChar
Columns1_Name=Longitude
Columns1_Type=utDouble
Columns2_Name=Latitude
Columns2_Type=utDouble
Columns3_Name=BCC
Columns3_Type=utUTInt
Columns4_Name=C0
```

```
Columns4_Type=utUSInt
Columns5_Name=CI
Columns5_Type=utUSInt
Columns6_Name=NCC
Columns6_Type=utUTInt
Columns7_Name=LAC
Columns7_Type=utUSInt
Columns8_Name=MNC
Columns8_Type=utUTInt
Columns9_Name=MCC
Columns9_Type=utUTInt
Columns10_Name=#PosErr1
Columns10_Type=utFloat
Columns11_Name=#PosErr2
Columns11_Type=utFloat
Columns12_Name=#Err1Axis
Columns12_Type=utFloat
```

Content TXT file

```
#Sectorname;#Longitude;#Latitude;#BCC;#BCCH;#CI;#NCC;#LAC;#MNC;#MCC;#PosErr1;#PosErr2;#Err1Axis;
S0106000A1B8F02ED; 11.301098; 48.106977; 7; 967;  749; 7;  7055; 10; 262;  316;  178; -45.8;
S0106000395AF83AD; 11.301593; 48.106943; 4; 998; 33709; 3; 38319;  3; 262;   0;   0;   0.0;
S0106000395AF35B5; 11.303235; 48.107451; 3; 987; 13749; 3; 38319;  3; 262;   0;   0;   0.0;
S0106000395AF83C1; 11.301747; 48.107044; 0; 985; 33729; 3; 38319;  3; 262;   0;   0;   0.0;
S0106000395AF83B7; 11.302060; 48.107289; 0; 992; 33719; 3; 38319;  3; 262;  145;  112;  -30.6;
S0106000203481BD1; 11.301003; 48.106554; 7;   1;  7121; 3;  840;  2; 262;   0;   0;   0.0;
S01060001840A0C6C; 11.238018; 48.106229; 4; 101;  3180; 3; 33802;  1; 262; 9718; 5794;  -91.9;
S01060001840ACB67; 11.318230; 48.110330; 7;  85; 52071; 3; 33802;  1; 262;   0;   0;   0.0;
S01060001840A7869; 11.300633; 48.106320; 6;  95; 30825; 3; 33802;  1; 262;   0;   0;   0.0;
```

The BTS List files are stored in the R&S ROMES4 measurement directory.

This BTS list can also be generated after the complete file has been replayed and R&S ROMES4 has been stopped via the view's context menu option “Generate BTS List”

GSM scanner BCH configuration

The "Configuration" option lets you set the color for the selected BTS symbols in the "ROMESMAP Route Track View" and define the filter for generating a BTS list.

Open the configuration page by a right mouse click on a point inside the view or via the "Tools" > "Configuration Active View" command.

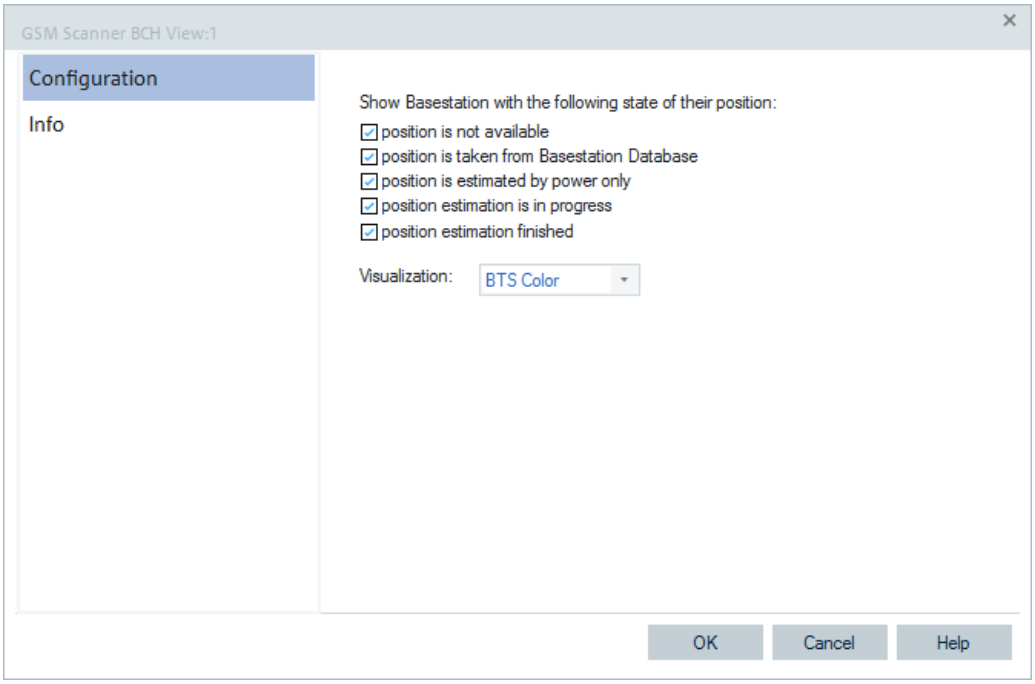


Figure 4-832: GSM Scanner BCH View - configuration

The BCH view configuration page is common for all RATs. For the cdma2000/1xEV-DO technology only, the page lets you choose the source of BTS position information, see "CDMA2000/1xEVDO scanner BCH configuration" on page 1171

4.8.5.3 GSM scanner Top N view

The "GSM Scanner Top N View" displays the properties of the signals received from the base transceiver stations. These signals are the selected elements of the "List Column" in the scanner configuration menu, see Figure 4-837. A Top N pool contains up to n BSICs with specific characteristics providing the strongest synchronization signal P(SCH) level at a given position and time.

The view area is divided into a list and a chart panel. The following figure shows the list area only for enabled multiple scanners option, see Figure 3-200.

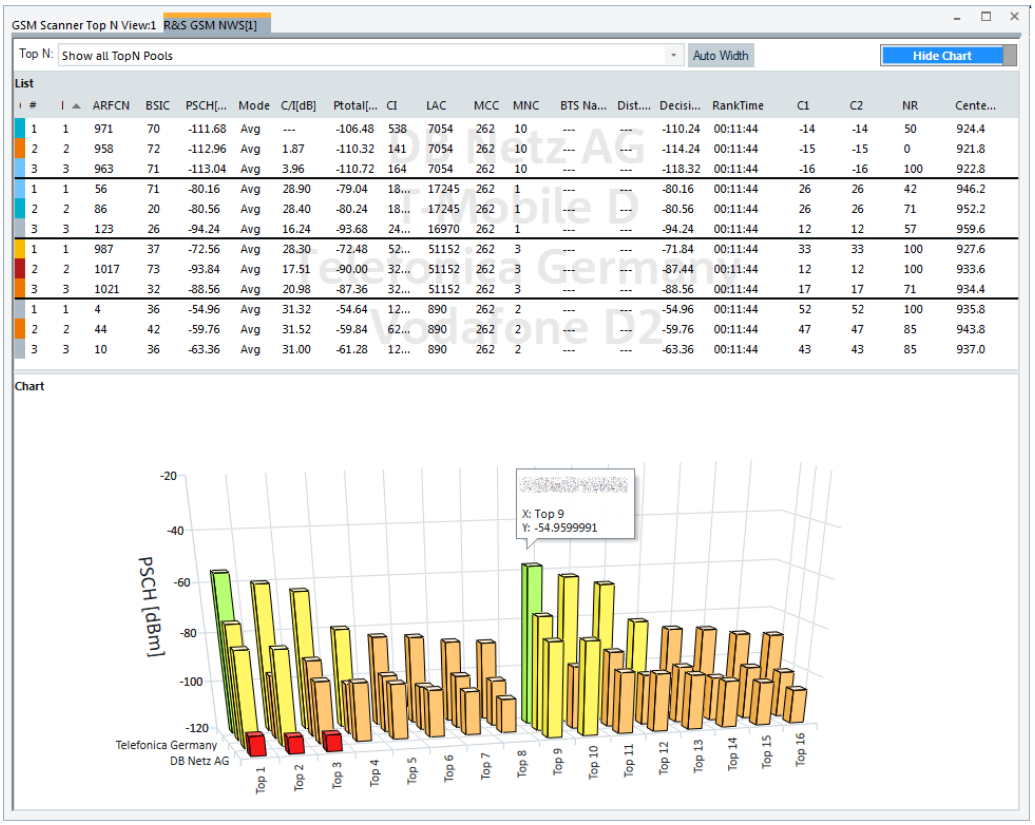


Figure 4-833: GSM Scanner Top N View - selection

The "ARFCN" column in the Top N the "List" pane may contain equal channel numbers of both GSM 1800 and GSM1900 band. To differentiate between them, the band shows “P” prefix to represent GSM 1900 channels. Therefore, the "ARFCN" column has the GSM1900 channels clearly marked with “P” prefix.

A cell's center frequency is included in the "List" of the "GSM Scanner Top N View", see the last column in the following figure.

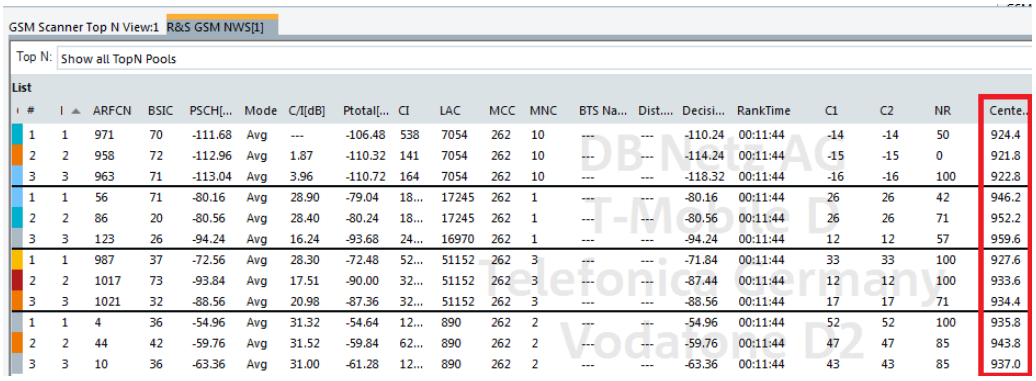


Figure 4-834: GSM Scanner Top N View

GSM scanner Top N view for automatic pool configuration

The scanner Top N view of the R&S ROMES 3GPP technologies displays the all “automatically configured Top N pools" on the screen.

If you select "Top N Pools" > "Automatic Pool Configuration" for a corresponding technology, the Top N selector control gets the additional entry "Show all TopN Pools" in the view.

By selecting this entry, you can see all Top N pools in the list. The number of displayed members per pool depends on the size of the window. It is calculated automatically in such a way that all Top N pools can be observed without scrolling the list (if even one member does not fit, scrollbars are added).

The signals and their decision values which users can select for ranking of the Top N pools are available in the "Available Signals" tree.

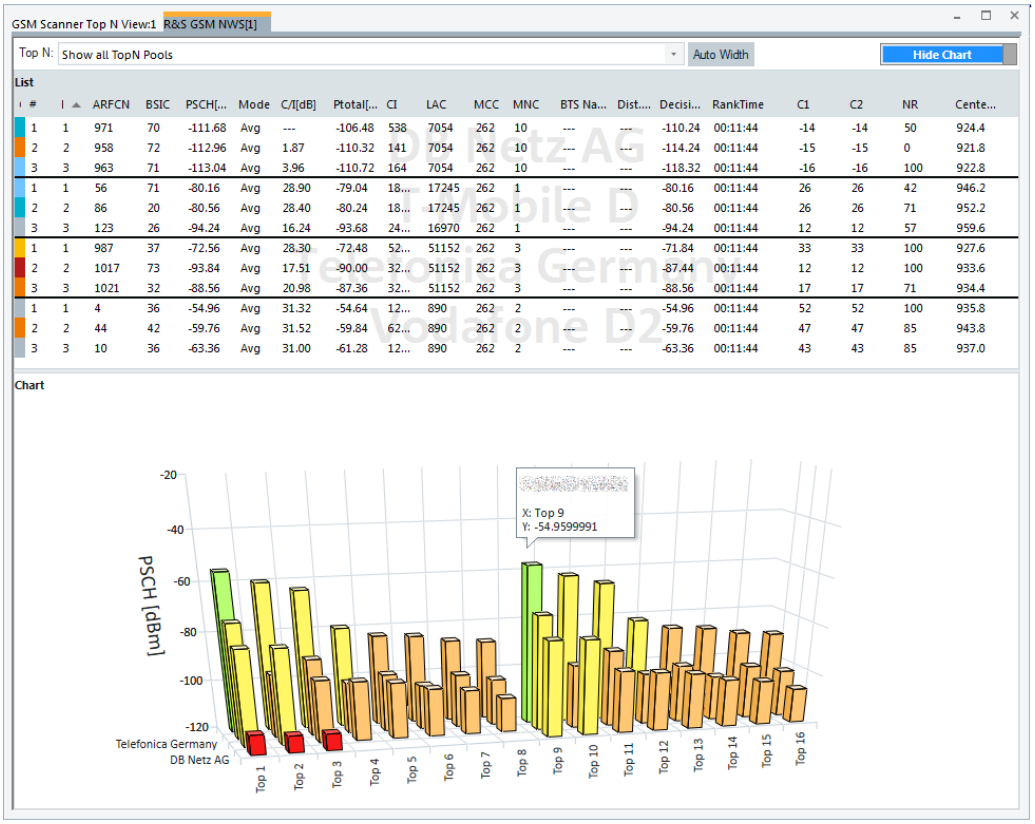


Figure 4-835: GSM scanner - all Top N pools and Top N chart

The Top N "Chart" pane displays the 2D and 3D values of the signal selected for ranking, see Figure 4-837.

The "Chart" panel is shown in 3D in case the automatic Top N pool configuration active. The values of the selected signal used for ranking and display are shown as 3D bars.

The Top N chart can be rotated moving the mouse while pressing the left button (x-axis, y-axis and z-axis when pressing the CTRL key additionally). Press the R key to reset the 3D chart to its default orientation.

The configuration of the Top N view allows to configure the colors for the 3D chart and the minimum and maximum for the Top N values.

The color of each bar represents the state of the signal based on the signals color scale defined in the "Available Signals" configuration page. Typically this is green for high values and red for low values.

You have the option to display the Top N pools as the grid with 2D charts instead of the standard 3D bar chart.

To enable the grid with 2D bar charts, click on the "Show Grid" slider at the right top if the 3D "Chart".

You may return to the 3D chart at any time by clicking the "Show 3D" slider at the right top if the 2D "Chart".

For the Scanner Top N view the grid arrangement is dynamic to allow the best use of space to display as many pools as possible.

Note: The maximum size of the grid is to be 6 columns and 3 rows.

The following figure shows how many rows and columns to expect in the grid.

Number of Pools	Grid Cols	Grid Rows
1	1	1
2	2	1
3	3	1
4	2	2
5	3	2
6	3	2
7	3	3
8	3	3
9	3	3
10	4	3
11	4	3
12	4	3

Figure 4-836: Allowed sizes of the grids in 2D chart

For the "Chart" layout in this case, see Figure 4-761.

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

The splitter position between the upper and lower part of the scanner view area and the open or closed state of the "Top N List" and "Top N Chart" are restored from the workspaces.

Top N

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.
- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

If you start R&S ROMES4 with an empty workspace, the initial widths of the columns in "Top N View" are initialized and scaled properly based on the current screen DPI setting.

Top N list

The "Top N List" gives an overview of the received signals in the current top N pool together with their measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

The "Top N List" contains the following columns:

- "Color"
  Applied color scale settings for the members of a Top N pool.
- "#"
  Numbering index of the measured signal in the list.

The SCH burst power, C/I or Cue can be selected for measurement and are numbered in ascending order, according to the time when they enter the Top N pool. This means that the current numbers tend to increase as the measurement progresses.

- "Rank"
  Current rank of the measured signals. The ranks are reassigned every time the pool is updated; they are in the range 1 (Rank N).
- "ARFCN"
  GSM channel number of the measured SCH. The GSM1900 channels in CH column are clearly marked with "P" prefix. In that way is overcome the problem of possible existence of equal channel numbers for both GSM1800 and GSM1900 bands, see Figure 3-200.
- "BSIC"
  Base transceiver station (BTS) identity code. In this view, the BSIC is always octal (so that BSIC = ab where a is the NCC and b is the BCC), irrespective of the format selected in the "Preferences > Available Signals" tab (octal/decimal/hex).
- "PSCH [dBm]"
  Burst power of the measured SCH (synchronization channel).
- "Mode"
  Valuation method: average/min./max./last
- "C/I [dB]"
  Carrier-to-Interference-ratio
- "Ptotal [dBm]"
  Total channel power
- "CI"
  Cell Identity (16 bit)
- "LAC"
  Location Area Code
- "MCC"
  Mobile Country Code
- "MNC"
  Mobile Network Code
- "BTS Name"
  Name of the closest base transceiver station with matching MNC, MCC, LAC, and CI. This parameter is displayed if a valid BTS list is available. Detailed information can be obtained by double-clicking the BTS name.
  Note: R&S ROMES4 uses the BCCH and the BSIC to identify the BTS name. If the BTS assignment is ambiguous because several BTS with the same BCCH and BSIC are encountered, then a plus “+” sign precedes the BTS name.
- "Dist. [km]"
  Distance to the BTS; getting this information requires a valid BTS database and availability of own geographic position by GPS.
- "DecisionValue"
  Top N ranking decision value
- "RankTime"
  Top N ranking timestamp

- "C1"
  Cell selection criterion emulated by the mobile device
- "C2"
  Cell reselection criterion emulated by the mobile device.
- "NR"
  Neighbor Relation to the other members of the Top N pool; it is a percentage of members which are listed in the BA list. It is only available if at least SI2 was demodulated.
- "Center Frequency"
  GSM center frequency

The Top N pools configuration is done in the GSM NWS technology component. From this follows, that the Top N pool configuration can be modified from the same measurement file in order to get different results.

It is possible to show or hide each individual table column in the view.

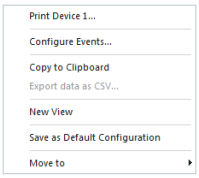
Up to 3 different named pools can be configured in the default setup. Each pool has several configurable parameters.

Diagram

Below the table, the "Top N Chart" shows the C/I value and the code power of the measured SCH (synchronization channel) for all ARFCN signals in the current Top N measurement as a bar chart.

In the configuration menu, it is also possible to select the upper and lower P(SCH) levels for the y-axis of the chart.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

GSM scanner Top N view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The Scanner Top N View is the R&S ROMES4 common view for all supported 3GPP and non-3GPP defined technologies, see "Generic implementation of the Top N processing and display features" on page 281.

Configuration: Top N view

The "Top N View" lets you the following:

- Select the Top N list contents
- Select the power signal type to be displayed in the 3D Top N chart and used for ranking the pools. For example, the total channel power or the synchronization channel burst power can be selected as the first 2D and 3D chart value.
- Select a GSM specific graph y-axis titles and limits to be displayed in the chart. That assumes setting the minimum and the maximum value to be displayed for the selected power signal. For example, the "PSCH Min [dBm]" and the "PSCH Max [dBm]" signal level to be displayed in the view can be selected.
- Select the colors and the number of color definitions in the 3D chart view
- Select the signal quality to be displayed as a 2D chart option

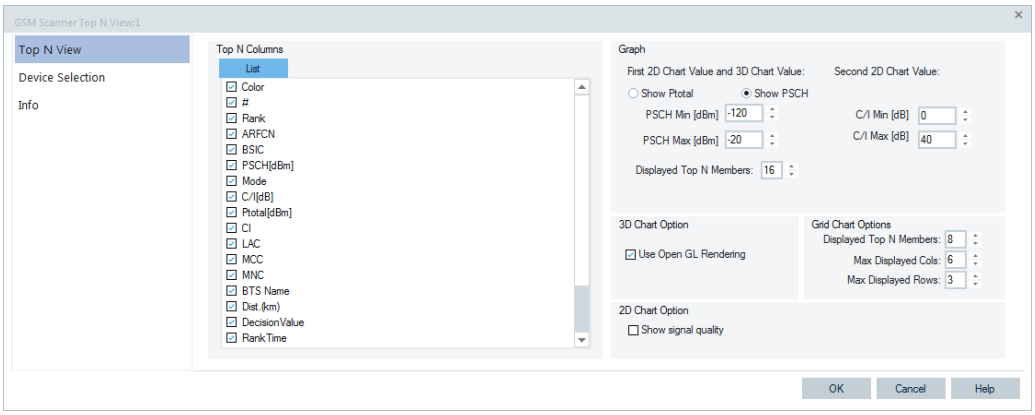


Figure 4-837: GSM Scanner Top N - configuration

Graph

- "Show Ptotal"
  Shows the total channel power if selected.
- "Show PSCH"
  Shows the synchronization burst power if selected.
- "Ptotal Min/Max [dBm]"
  Sets the upper and lower Ptotal for the y-axis of the chart if Ptotal selected.
- "PSCH Min/Max [dBm]"
  Sets the upper and lower PSCH levels for the y-axis of the chart if PSCH selected.
- "C/I Min/Max [dBm]"
  Sets the upper and lower carrier to interference levels for the y-axis of the chart.

3D Chart Option

- "Use Open GL Rendering"
  The option determines if the 3D chart is rendered open GL (hardware) rendering or software rendering. Using open GL allows faster rendering of the 3D chart.

Grid Chart Options

- "Displayed Top N Members"
  The check box lets you select the number of Top N member that each chart in the grid will display.
- "Max Displayed Cols"
  The check box lets you select the maximum number of displayed columns in the grid. Allowed values are from 1 to 6.
- "Max Displayed Rows"
  The check box lets you select the maximum number of displayed rows in the grid. Allowed values are from 1 to 3.

2D Chart Options

The signal quality is displayed in the scanner Top N view, if the "2D Chart Option> Show signal quality" is selected. This is actually possibility to switch "on" or "off" the second y-axis on the chart and quality signal bars.

For LTE scanner Top N view users can select the wideband values to be displayed in the 2D chart instead.

If the option is selected, consider that you will see the result of the switching only on the next frame, chart must redraw at least once for it.

See "Configuration: Device selection" on page 1402.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

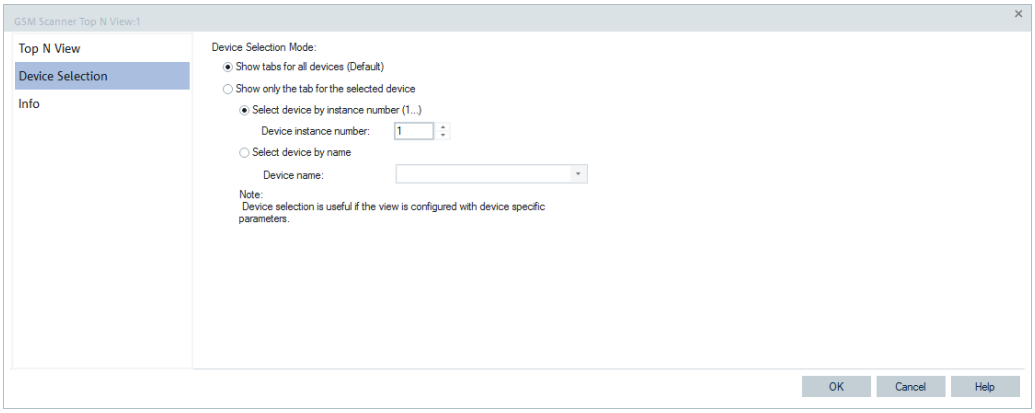
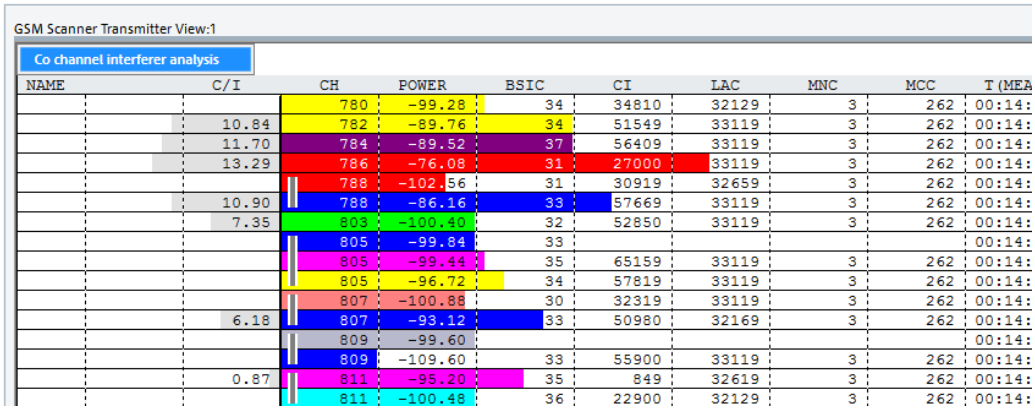


Figure 4-838: Device selection

4.8.5.4 GSM scanner transmitter view

The "GSM Scanner Transmitter View" displays the demodulated data acquired by the scanner during the GSM network scan. The data also contains information transmitted on the "Synchronization Channel" (BSIC and TDMA frame number) and the "System Information Type 3" of the BCCH. The measured and detected sectors in the air are displayed, sorted and updated in different rows. The view can show measurements from more than one GSM NWS.



NAME	C/I	CH	POWER	BSIC	CI	LAC	MNC	MCC	T(MEA
		780	-99.28	34	34810	32129	3	262	00:14:
	10.84	782	-89.76	34	51549	33119	3	262	00:14:
	11.70	784	-89.52	37	56409	33119	3	262	00:14:
	13.29	786	-76.08	31	27000	33119	3	262	00:14:
		788	-102.56	31	30919	32659	3	262	00:14:
	10.90	788	-86.16	33	57669	33119	3	262	00:14:
	7.35	803	-100.40	32	52850	33119	3	262	00:14:
		805	-99.84	33					00:14:
		805	-99.44	35	65159	33119	3	262	00:14:
		805	-96.72	34	57819	33119	3	262	00:14:
		807	-100.88	30	32319	33119	3	262	00:14:
	6.18	807	-93.12	33	50980	32169	3	262	00:14:
		809	-99.60						00:14:
		809	-109.60	33	55900	33119	3	262	00:14:
	0.87	811	-95.20	35	849	32619	3	262	00:14:
		811	-100.48	36	22900	32129	3	262	00:14:

Figure 4-839: Transmitter View - several BSIC measured

Each table row corresponds to a GSM downlink signal received from one BTS. It is underlined with a gray or colored bar, where the color denotes the measured BCC (the second digit of the octal BSIC) of the signal in this channel. If no color code could be measured an empty bar is drawn. Gray bars and brackets in the table row characterize how complete or how recent the displayed results are; refer to the description of chapter "Info levels" on page 1199. The length of this bar corresponds to the received PSCH, according to the dBm scale displayed across the bottom of the view.

The channel column (CH) of the “GSM Scanner Transmitter View” ” which may contain equal channel numbers from both GSM 1800 and GSM1900 bands, will show a “P” prefix for GSM 1900 channels. The column CH indicates clearly which channels are from GSM 1900.

View contents

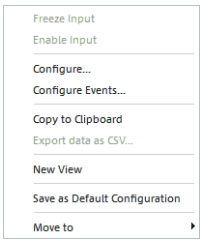
The columns contain the following information:

- "Name"
  Name of a Base Station (if available from the data base)
- "C/I"
  Carrier-to-Interference ratio; the C/I values are visualized as gray bars which originate from the middle to the left. The numeric values are shown in a column.
- "CH"
  The number of the measured channel; if two or more consecutive lines are measurements on the same channel, they are marked with a vertical bar.
  The column"CH" has the GSM 1900 channels clearly indicated with "P" prefix. In that way is overcome the problem of possible existence of equal channel numbers for both GSM1800 and GSM 1900 bands.

Figure 4-840: Marked channels

- "PSCH"
  Synchronization channel power displayed in the second column, with a dynamic range from -120 dBm to 0 dBm.
- "BSIC"
  BSIC in octal representation; the first digit denotes the NCC, the second BCC.
- "CI"
  Cell Identity
- "LAC"
  Location Area Code (decimal)
- "MNC"
  Mobile Network Code (decimal)
- "MCC"
  Mobile Country Code (decimal)
  The four preceding elements uniquely identify a BTS worldwide. So this set of information is especially useful in border regions where two network operators may share the same frequency range, to identify a BTS of a network when there is no base station list available.
- "T(MEAS)"
  Time (hh:mm:ss) indicates the last measurement update of the displayed line. The time is counted from the start of the measurement. Although T(MEAS) is displayed in seconds it is internally stored in ms. This is important when T(MEAS) is used for sorting, see "Sort Sequence".
- "T(TDMA)"
  Time offset of the correlated burst; this time is given by T(MEAS) modulo one TDMA frame. The unit is the length of one time slot, so the range is 0 (T(TDMA) < 8).
- "FN"
  TDMA frame number of the correlated burst in the range 0 to FN_MAX where FN_MAX = (26 x 51 x 2048) -1 = 2715647 (one hyperframe length) as specified in GSM 05.02. The FN is obtained from the measured Synchronization Channel (SCH). The FN column shows the FN at T(TDMA) which is calculated from the FN at the SCH time T(SCH) and the time offset between T(SCH) and T(TDMA); see Figure 4-841.
- "T3"
  Frame number FN modulo 51 (one multiframe length)
  Notes:
  In case those two sectors are synchronized, both values T3 and T(TDMA), are identical up to a measurement error. Synchronization can be checked this way.
  For the interference analysis identical values of T3 and T(TDMA) imply that the signals in the interference diagram are on identical positions and cannot be distinguished.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

- "Freeze Input"
  Additional input from the measurement or replay is not displayed. Meanwhile, the data is still stored during measurement. Sorting of the data and changes in the parameter settings are possible during input freezing.
- "Enable Input"
  Terminates the input freezing.

Frame timing

The values T(MEAS), T(TDMA), FN are visualized in the following figure:

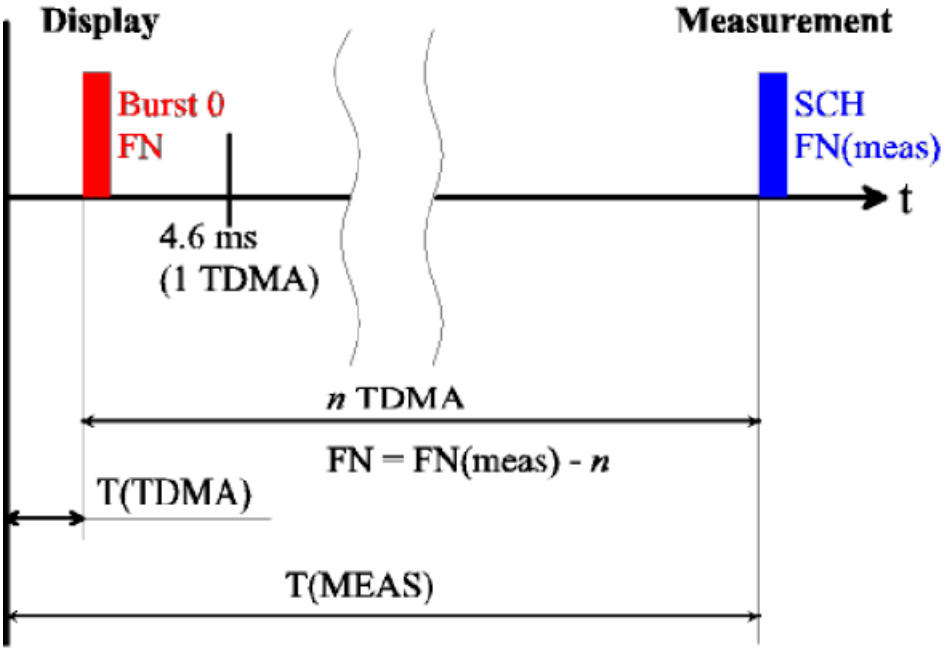


Figure 4-841: Display of the GSM NWS Transmitter Scan View time measurements

The start of the measurement is shown as a vertical bar on the left side of the diagram. At "T(MEAS)" a SCH is detected and demodulated, giving the information about the BSIC and the TDMA frame number "FN(MEAS"). "T(MEAS)" is shifted back to the time period of the first TDMA frame after the start of the measurement by subtracting the

duration of "n" TDMA frames. This yields the value "T(TDMA"). In the same way, the demodulated frame number is reduced by "n" (modulo 2715648). So, both values, "T(TDMA)" and "FN" denote the measurement time and frame number of a BTS if it would have been measured within the first TDMA frame period after the start of the measurement assuming no drift of both the BTS and the test receiver and assuming no timing advance due to different measurement locations.

The advantage of this definition of frame numbers and measurement times is that the values for one BTS are approximately constant with only small changes produced by:

- Drift of the BTS
- Drift of the test receiver
- Time shift on different measurement locations due to the finite speed of light
- Different offset times when repeater signals are received
- Additional time delay produced by reflections

Info levels

The "GSM Scanner Transmitter" view distinguishes three different info levels, depending on the amount of information that could be extracted from the received signal. At level 3 the most complete information is available.

- **Info level 1**
  A C0 channel of a BTS could be identified by correlating the FCCH and the extended training sequence of a SCH burst. As a result, the C0 channel number, the measured power of the BCCH signal and the frame synchronization time are known.
- **Info level 2**
  This info level is reached when the SCH could be reliably demodulated. The validity of the demodulated data is checked with the 10 parity bits available, so the probability that an error is not detected is about 1/1000. However, as the values have restricted ranges, this probability can be improved to an estimated 1/3000. Because this probability is still too high, the data is only considered to be reliable if there are at least two independent SCH demodulations of one BTS reducing the error rate to a negligible value. The probability that an error is not detected is reduced to less than the factor (1/3000)^2, because the comparison of the SCH content of both signals provides an additional constraint.
  The additional information obtained at this info level is the BCC, NCC and frame number. As soon as this info level is reached, the bars showing the measured power become colored.
- **Info level 3**
  The info level 3 is reached when the system information type 3 on the BCCH channel could be demodulated. The additional information obtained is the Cell Identity (CI), Location Area Code (LAC), Mobile Network Code (MNC) and Mobile Country Code (MCC).

By default, every new measurement result is compared with those already shown in the list. The values of a measurement in the list matching with the new one are updated. If the older measurement had a higher info level, the old values missing in the new measurement are kept in the display, indicated by values in brackets. This behavior can be changed in the configuration menu; see description of "Matching Entries:

Action" on page 1202. The decision algorithm for two measurements belonging to the same BTS is described in chapter "Configuration: Matching entries" on page 1202.

GSM scanner transmitter view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Transmitter view

The "Transmitter View" option lets you criteria for the transmitter scanand shows information on the current view version.

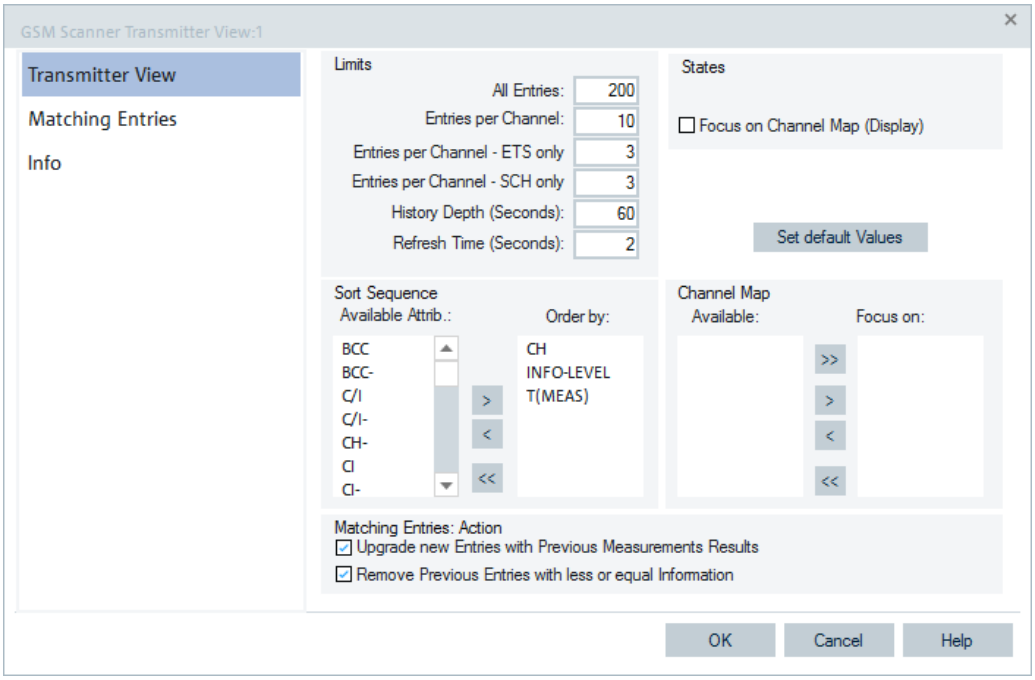


Figure 4-842: GSM Scanner Transmitter View - configuration

This configuration dialog contains the following panels:

Limits
Limits the displayed data. The entries denote the following limitations:

- "All Entries": The maximum number of signals displayed.
- "Entries per Channel": The maximum number of signals displayed for each channel.
- "Entries per Channel" – ETS only: The maximum number of entries per channel which only have reached info level 1 (ETS: Extended Training Sequence).
- "Entries per Channel – SCH only": The maximum number of entries per channel which only have reached info level 2.
- "History Depth (Seconds)": Entries which have not been updated during the given amount of time are discarded from the display.

- "Refresh Time (Seconds)": The display is refreshed every time the Refresh Time has passed. Using higher values avoids the flickering of the diagram.

When the number of measurement data exceeds the above limitations, the oldest entries are discarded in the view.

Sort Sequence
Specifies the criteria how the lines in the display are sorted.

- "Available Attrib."
  List of available criteria (attributes). Any attribute can be selected to be appended to the end of Order by: list; see description of buttons below.
- "Order by"
  Specifies how the lines are sorted.
  In the example of Figure 4-842, the list is sorted according to channel numbers, all lines with the same channel number are sorted according to their info level, and so on. Sorting is always in ascending order.

The buttons between the two lists move a selected entry from one list to the other

- ››
  Removes the elements from the Order by: list and loads the default values.
- ›
  A selected element in the Available Attributes list is moved to the end of the Order by: list. Alternatively, the element can be double clicked.
- ‹
  A selected element in the Order by: list is moved to the Available Attrib. list. Alternatively, the element can be double clicked.
- ‹‹
  Empties the Order by: list.

Note: The measurement time "T(MEAS)" is stored internally in microseconds, although it is displayed in seconds. So it is recommended to use "T(MEAS)" only as a last sorting criterion in the "Order by:" list.

States
The "States" panel can be used to restrict the measurement range. Note that these restrictions can be changed even during a running measurement.

- "Focus on Channel Map (Display)"
  Restricts the displayed channels to those on which the focus is set in "Channel Map".

Channel Map
The "Channel Map" is used to select the channels on which a focus can be set in the "States" panel, see the previous figure.

The map consists of the following lists:

- List with the available channels.
- List of channels, which specify the focus if a corresponding entry in "States" is selected.

The buttons between the two lists move a selected entry from one list to the other; see "Sort Sequence" on page 1201.

Matching Entries: Action
The "Matching Entries: Action" panel determines how a new entry to the "GSM NWS Transmitter Scan" view is displayed if it matches with one that was recorded before.

- "Upgrade new Entries with Previous Measurement Results"
  If this box is checked the entries in the old measurement are updated even if the new measurement has reached a lower info level. The missing entries in the new measurement result are taken over from the old entry and displayed in brackets. If the box is not checked, a new measurement with a lower info level is displayed in a separate line.
- "Remove Previous Entries with less or equal Information"
  A new measurement only updates the old one if this item is selected, otherwise it is displayed in a separate line. Deselecting this item allows e.g. to investigate the drift behavior of a BTS.

Configuration: Matching entries

The "Matching Entries" option lets you set the conditions to decide whether two measurements belong to the same BTS.

For the decision whether two measurement results originate from the same BTS the following criteria apply:

- The decoded information available in both signals (info level 2 or 3) must correspond.
- The offset times of both bursts must match to some measurement error.

In the "Matching Entries: Range" pane set the criteria for the allowed measurement error in order to decide whether criterion 2 is fulfilled. In case of doubt it is recommended to keep the default values.

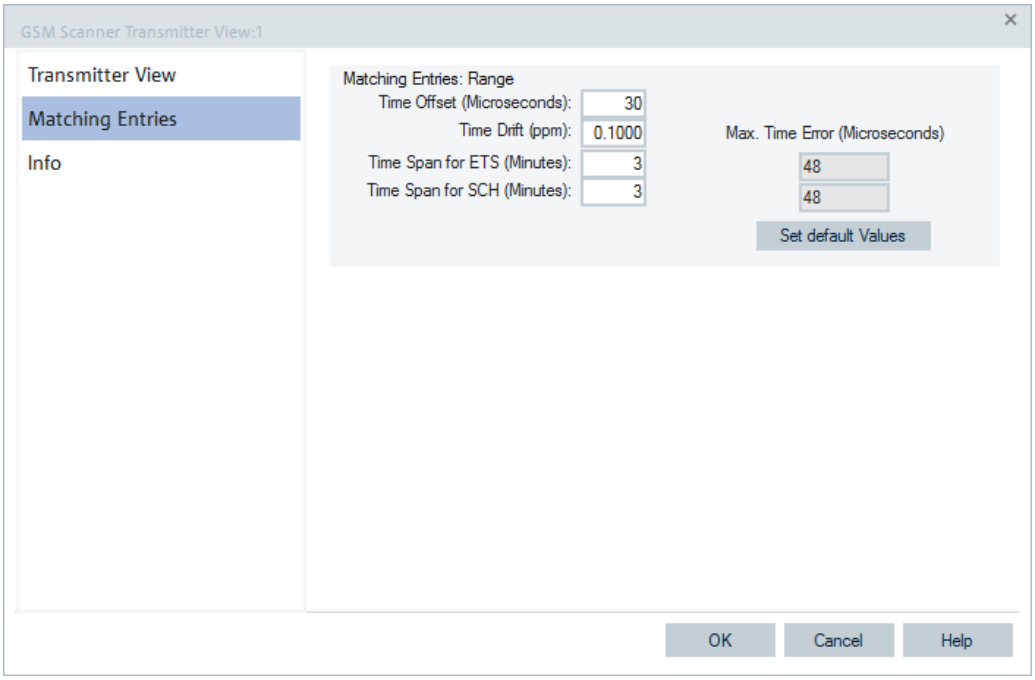


Figure 4-843: GSM Scanner Transmitter View - Matching Entries

The matching entries are illustrated in the following figure:

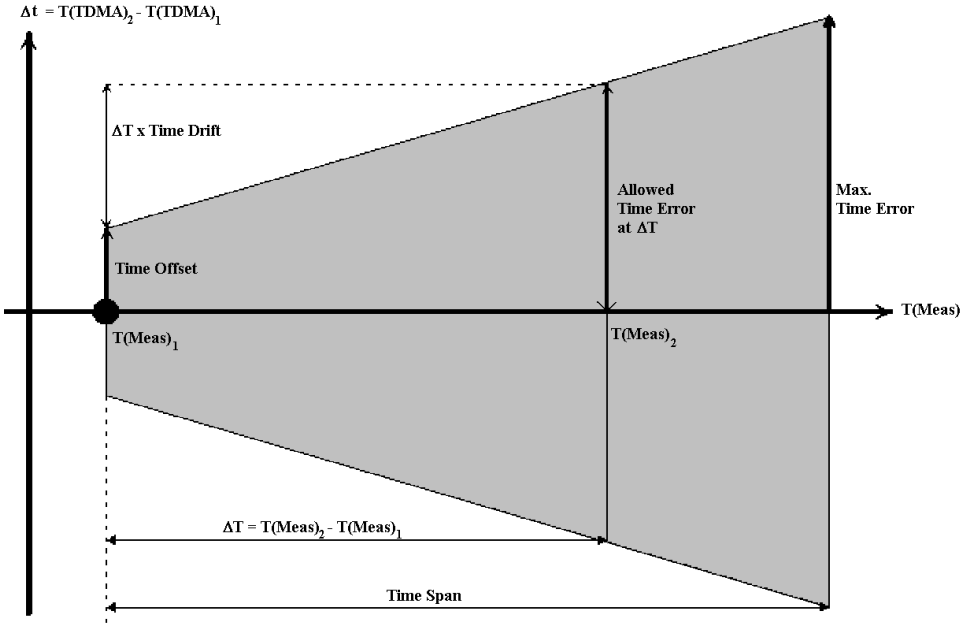


Figure 4-844: Matching Entries: Range - parameters explanation

The decision whether two detected signals originate from the same BTS is based on a comparison of the measurement times T(Meas) for both signals and of their measured time offsets T(TDMA). The figure above shows the matching entries in the T(Meas)-T(TDMA)-plane: If the large dot at T(Meas)1 corresponds to the measurement result for signal 1 and the result for signal 2 is within the shaded area, then the two signals are considered to originate from the same BTS. If both signals contain at least info level 2, then the TDMA frame number is compared in addition, which extremely enhances the accuracy.

Matching Area
The shaded matching area is bordered by the measurement time of the first signal detected T(Meas)1, the measurement time T(Meas)1 plus the "Time Span", the straight lines parametrized by the equations

$\Delta t = \pm(<\textit{Time Offset}> + <\textit{Time Drift}> \times [T(Meas) - T(Meas)_1])$. (Equation 1)

The "Time Offset", "Time Drift", "Time Span" can be entered in the input fields in the "Matching Entries: Range" tab. They provide estimates for possible errors from different sources that might cause the measured time offsets T(TDMA) for two signals from the same BTS to be different.

Time Offset
Difference of the measured time offsets T(TDMA) for two signals due to measurement inaccuracies, e.g. caused by reflections.

Time Drift
Drift of T(TDMA) in time, caused by the BTS, the receiver, or a time delay due to a location update.

Time Span for
Maximum difference of the measurement time beyond which two signals are generally considered to be different. The "Time Span" can be set independently for the case that at least one signal has only reached info level 1 ("Time Span for ETS)" and for the case that both signals have reached at least info level 2 ("Time Span for SCH"). In the latter case, higher values for the "Time Span" are reasonable, because the inclusion of the TDMA frame number minimizes the accidental time offset coincidences considerably.

Max. Time Error
Maximum time error allowed calculated according to the equation 1, where T(Meas) = Time Span; used as an information only.

4.8.6 LTE scanner views

The LTE scanner views show the information obtained in the LTE network. The scans are performed by the R&S scanners.

For this purpose, the R&S TSME scanner with its hardware option R&S TSME-K29 is needed.

The LTE-MIMO scan measurements need the R&S TSME-K30. The eMBMS measurements need the R&S TSME-K32 option.

The LTE network scan available option for R&S TSME is R&S ROMES4T1E.

How to install and configure the LTE network scanner is described in Chapter 6.4.15, "LTE scanner", on page 1726.

The LTE scanner views can be selected from a submenu displayed on the right-hand side of the "View" menu if the mouse hovers over "Scanner Views" > "LTE".

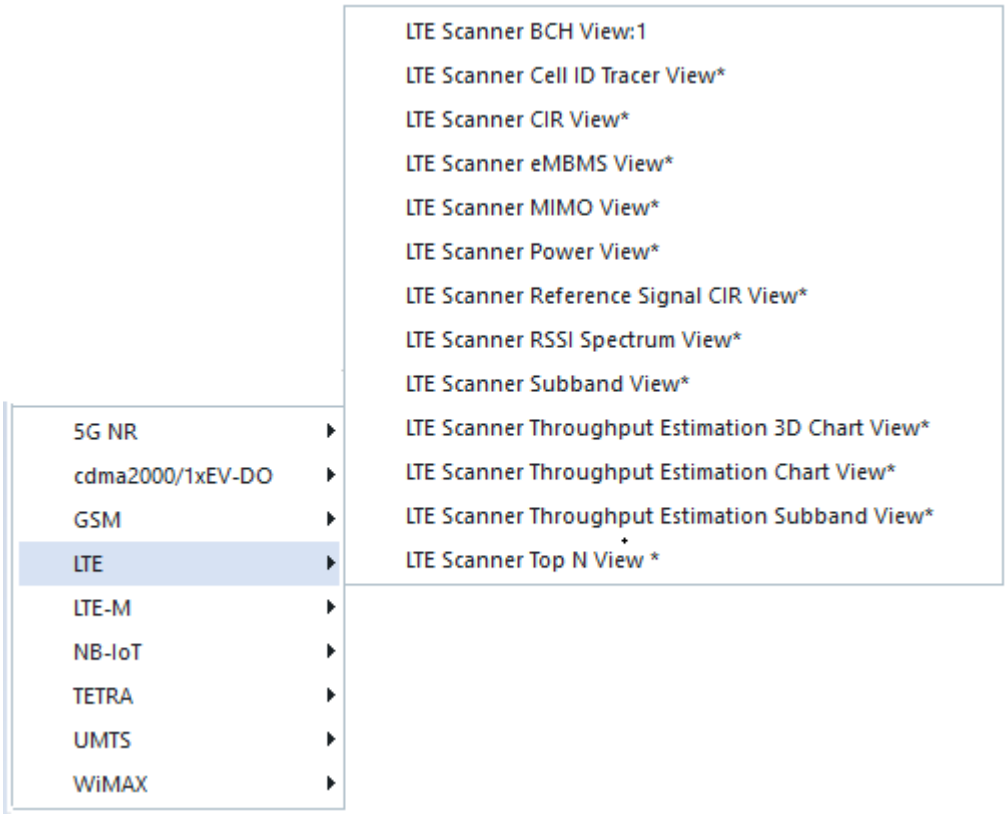


Figure 4-845: LTE scanner views

All LTE scanner views accumulate the configured channels. In the frequency combo boxes currently inactive frequencies are marked with an asterisk (*), see Figure 6-272.

The choice of channel type for scanning (selected or virtual) has no impact on scanner BCH view. It is so because the choice of channel type accumulates and shows all decoded eNodeBs, regardless on what channels they are measured on.

On the contrary, the scanner Top N algorithm is based on the currently measured channels. It is a snapshot of the current measurement, so that its result depends on the channel configuration done by the primary device.

The Top N pool members offer an Top N reference signal ("Top N UE Reference") which reflects the usage of an eNode by the UEs of the current measurement. The signal provides information on UE's number and its carrier which uses this eNode of the Top N pool member. The signal is available in the "LTE Scanner TopN View" as optional signal. The signal is available in the "SignalTree" > "LTE Scan" > "Top N Templates" and in the "Alphanumeric View". For the signal description, see "Description of R&S ROMES4 signals" document.

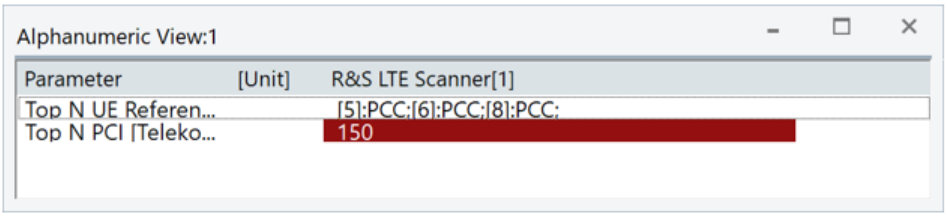


Figure 4-846: Top N UE reference of Top N pool member

The screenshot shows that PCI 150 is used as Primary Component Carrier by UE 5, 6 and 8.

- LTE scanner signals templates 1206
- LTE scanner BCH view 1212
- LTE scanner cell ID tracer view 1222
- LTE scanner CIR view 1227
- LTE scanner eMBMS view 1232
- LTE scanner MIMO view 1234
- LTE scanner power view 1238
- LTE scanner reference signal CIR view 1241
- LTE scanner RSSI spectrum view 1243
- LTE scanner subband view 1244
- LTE scanner throughput estimation 3D chart view 1248
- LTE scanner throughput estimation chart view 1252
- LTE scanner throughput estimation subband view 1255
- LTE scanner Top N view 1258

4.8.6.1 LTE scanner signals templates

The configuration of all signals PCIs and specification of several EARFCNs leads to a huge number of measured signals. R&S ROMES4 makes the combination of frequencies and PCIs. The huge number of measured signals makes it difficult to find and select the required measurement data.

The LTE scanner signals templates offer an easy access to the measurement data of a specific eNodeB. The easy access is achieved by specifying the EARFCN and the PCI whose measurement data that you want to display in the "Top N Templates" and the "eNodeB<EARFCN/PCI> Template" branch of the "Signals Tree" > "LTE Scan" tree.

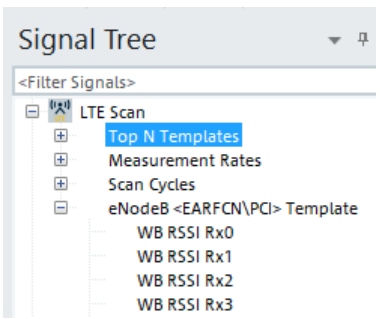


Figure 4-847: LTE scanner signals templates

1. Select a signal for display in a R&S ROMES4 basic (generic) view. You can select it from the "Top N Templates" or the "eNodeB<EARFCN/PCI> Template" branch and in the "Signals Tree" as a template signal for a specific eNodeB. Drag & drop the selection into the view. Instead, double click the item in the view's configuration page.
2. A dialog pops-up asking you to define the filter for the signal. For LTE scanner, this filter asks for the EARFCN or the combination of EARFCN and PCI.
   If you have selected several signals, check the "Apply for all signal" check box. The function applies the same filter for all signals.

   The filter for the signal is entered.

   The signal appears in the R&S ROMES4 basic views and in a template branch of to the "Signals Tree" > "LTE Scan" tree.

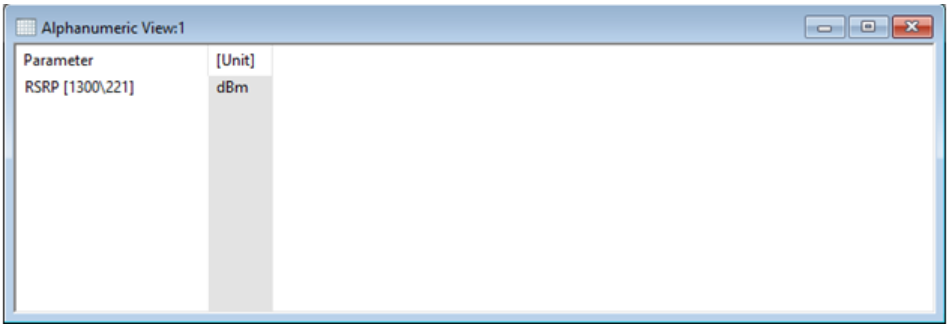


Figure 4-848: Alphanumeric view of the template signal RSRP

The filtering dialogs remember the last set values. You can select a eNodeB in the "LTE Scanner BCH View" to preset the filter values for the dialog.

The template branches are a home of all created template signals. You can select the signal directly from these branches if needed.

The template signals are part of the workspace. They are stored to the workspace and restore when loading it. Creating a workspace removes the template signals.

Configuration of LTE scanner Top N templates

There are no separate branches for each Top N pool and Top N member. Instead there is only a single Top N node under the "Top N Templates" node.

The Top N template signal can be configured on any generic view. If a signal is configured on the generic view, a prompt for specific Top N pool and Top N member to be configured is displayed.

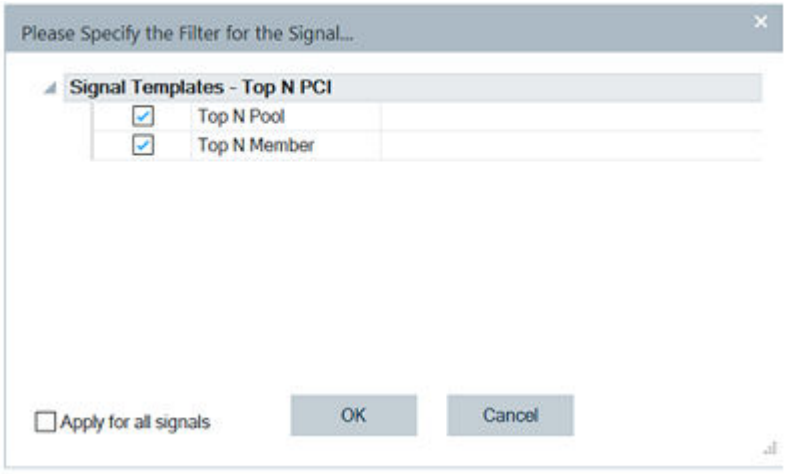


Figure 4-849: Template to filter Top N PCIs

Configuration of Template Top N Pool: Enter the desired Top N pool number. A range of Top N pools can be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represents the pools 1, 2 and 4 and 1 to 4 would represent an entry of pools 1 to 4.

If measurement or measurement replay is in progress, the valid Top N pools are available for selection if you click the down arrow. Click one or more of the valid pools.

Once all selections are made, click another field or "OK" to close the selection window.

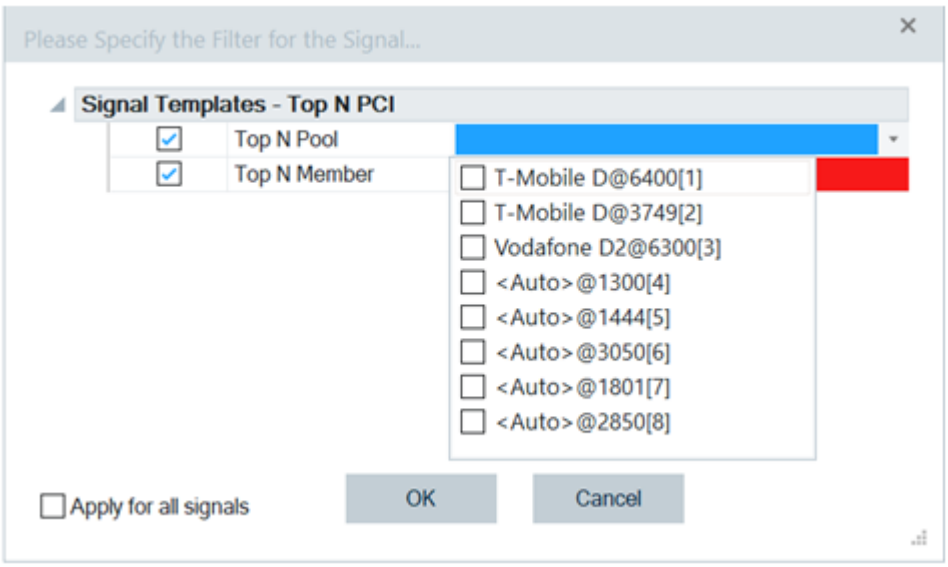


Figure 4-850: Available Top N pools

Configuration of Template Top N Member: Enter the desired Top N member number. A range of Top N members can be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represents the members 1, 2 and 4 and "1-4" represents an entry of members 1 to 4.

Selection of Field Color Code: Once a valid selection is made, the field gets a green background color. If a selection is not valid, the background color is red.

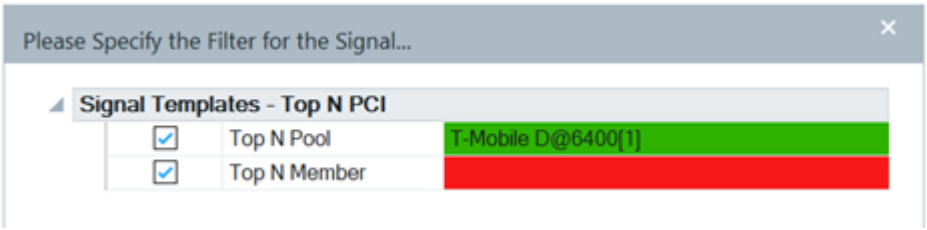


Figure 4-851: Colored fields for Top N PCI filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections". (These selections are reset each time R&S ROMES4 is restarted). To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear when all prior selection boxes have been deselected.

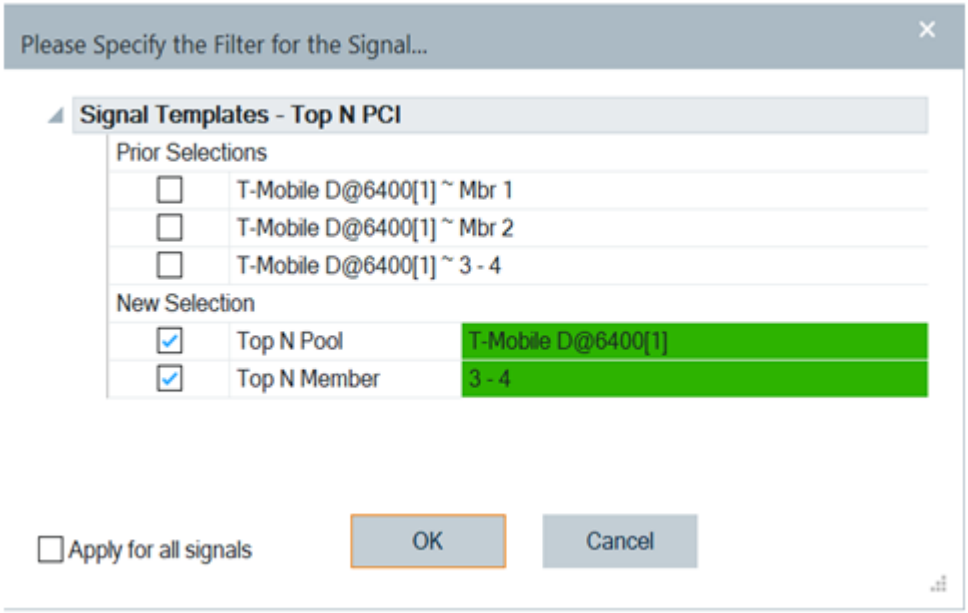


Figure 4-852: Prior selections

Configuration of LTE scanner eNodeB<EARFCN\PCI> templates

If an eNodeB signal is configured to be used on a generic view, a prompt to configure the signal with desired filter values is displayed.

All the EARFCN signals for a given channel that are found under the "eNodeB<EARFCN\PCI>" signal filter dialog box are prompted as shown in the following figure.

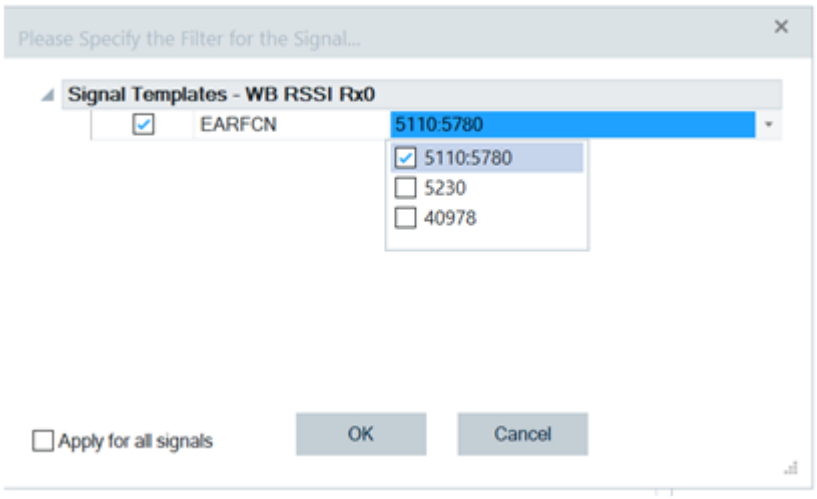


Figure 4-853: WB RSSI template signal filtering

The highlighted line indicates that the channel has the primary and the multifrequency band EARFCNs, refer to Figure 4-907 and the explanation below the figure.

The signals that are found under the "eNodeB<EARFCN\PCI>" > "eNodeB" are prompted as shown in the following figure.

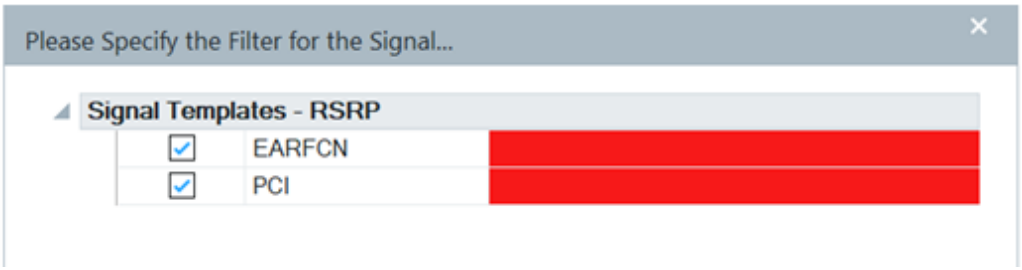


Figure 4-854: RSRP template signal filtering

Configuration of EARFCN Value: An EARFCN value can be entered. Multiple EARFCN can be entered by separating the values with a “,”. For example, by entering 1300, 1444 selected are channels with EARFCN 1300 and 1444.

If a measurement or measurement replay is in progress, a list of currently valid EARFCN values is displayed by clicking the down arrow. One or more of the values can be selected if you check the box next to the desired choice.

Once all selections are made, click another field or "OK" to close the selection window.

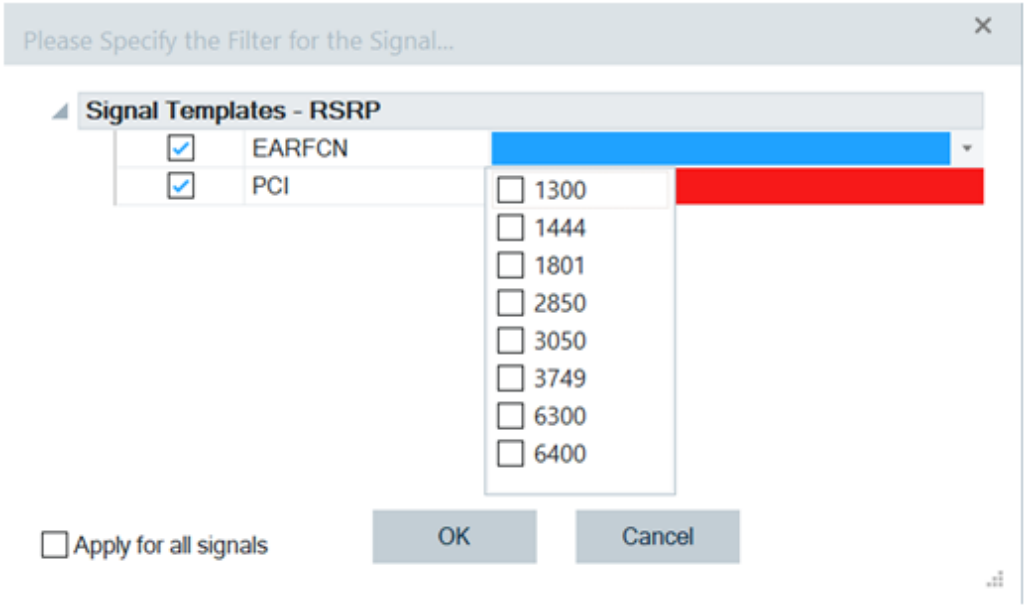


Figure 4-855: Entered EARFCN values

Configuration of PCI: A PCI value can be entered. Multiple PCI values can be chosen by operating the values with a ",". For example, entered values 103 and 104 select PCI value 103 and 104.

If a measurement or measurement replay is in progress, a list of valid PCI values for the currently selected EARFCN is displayed by clicking the down arrow. One or more of the values can be selected if you check the box next to the desired choice,

Once all selections are made, click another field or "OK" to close the selection window.

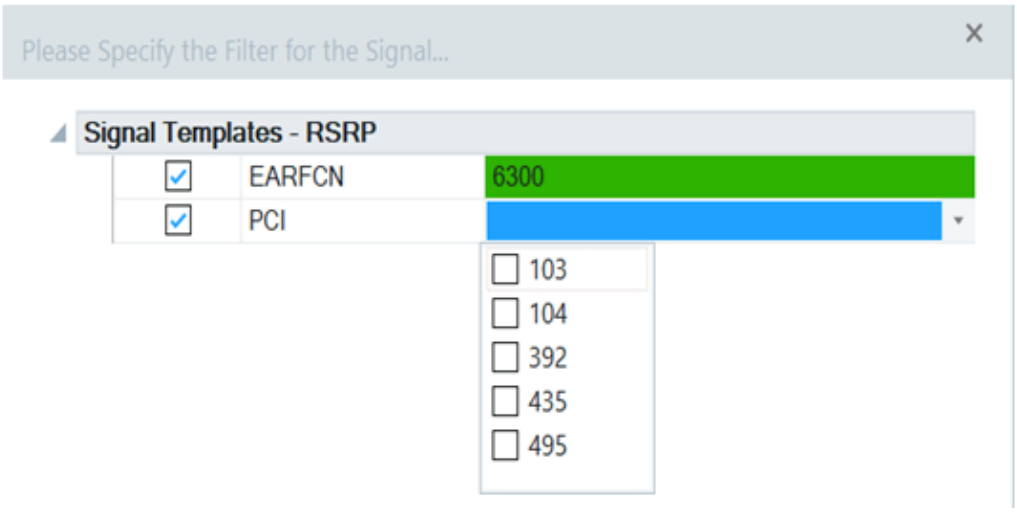


Figure 4-856: Entered PCI values

Selection of Field Color Code: Once a valid selection is made, the field gets green background color. If a selection is not valid, the background color is red.

Figure 4-857: Colored fields for RSRP filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections" rows. (These selections are reset each time R&S ROMES4 restarts).

To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear when all prior selection boxes are deselected.

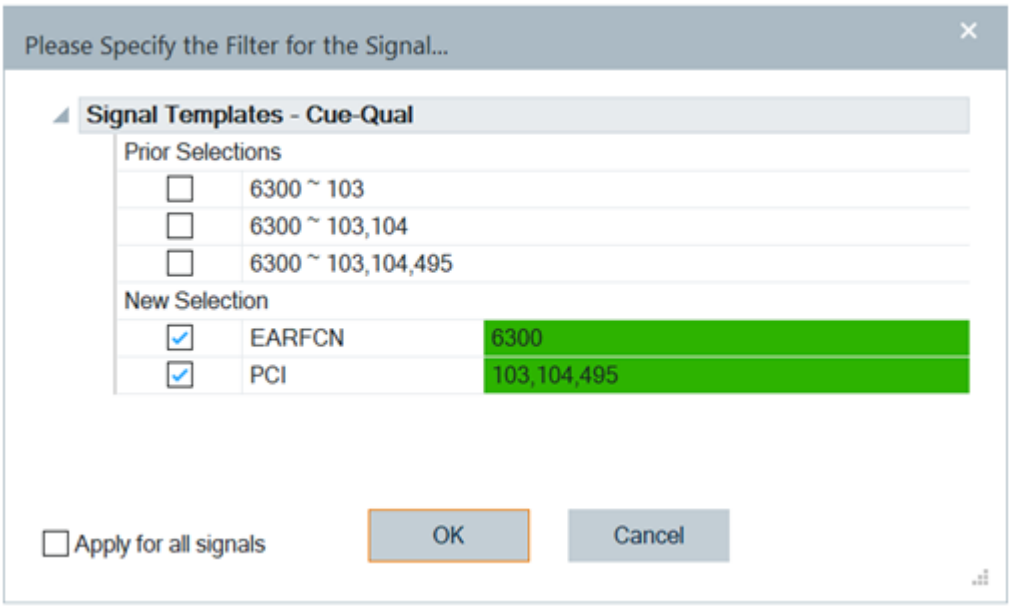


Figure 4-858: Prior selected template signals

4.8.6.2 LTE scanner BCH view

The "LTE Scanner BCH View" shows a list of detected BTSs with their details decoded from MIB and SIBs, included in related blocks. The contents of each block appears in the tree view, when the block is selected.

MIB and SIB1 are displayed correctly. All other SIBs are shown under the BTS entry without label, as a BCCH DL SCH message (which can contain several SIBs). The cell information from SIB1 is used to derive the BTS identification.

If a SIB is selected on the left-hand side of the "LTE Scanner BCH View", the list of PDU variants and the list of associated time stamps are displayed on the view's right-hand side. This selection is shown in the following figure for PDUs carrying SIB 1.

For the list of supported LTE SIBs see, Figure 6-282.

The "LTE Scanner BCH View" is enhanced based on R&S ROMES4 support of dynamic PDU handling described in "Implementation of the dynamic PDU handling" on page 284. The enhancement is the list of PDU variants over time. The PDU variants are shown as leaves of the base station branch.

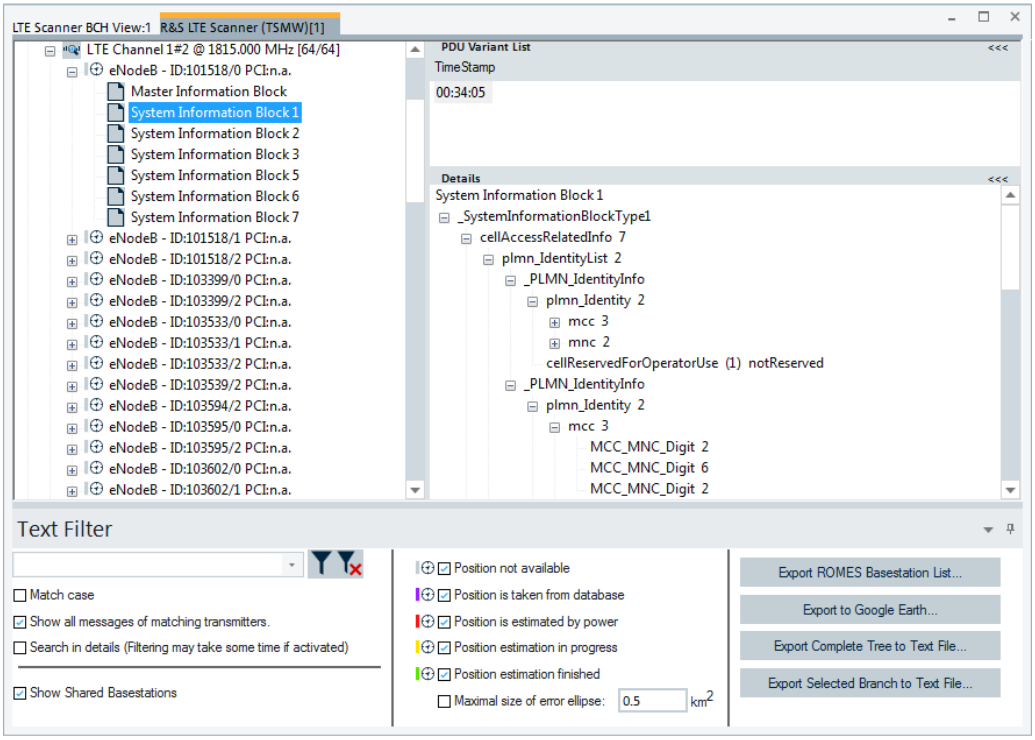


Figure 4-859: LTE Scanner BCH View - eNodeB SIB1 details

The "PDU Variant List" in the upper right-hand part of the view shows a list of time stamps if different variants were found. In the shown case of SIB 1, there was only one variant found. "TimeStamp" shows the most recent measurement of the variant.

"LTE Scanner BCH View" > "Details" shows the details of the entry selected in the pane on the left-hand side. If you select eNodeB, you get the basic data such as the eNodeB identity, PCI, EARFCN, PLMN, antenna port number. Added is enhanced info on DL bandwidth, support of Nb-IoT, LTE-M, eMBMS and 5G NR.

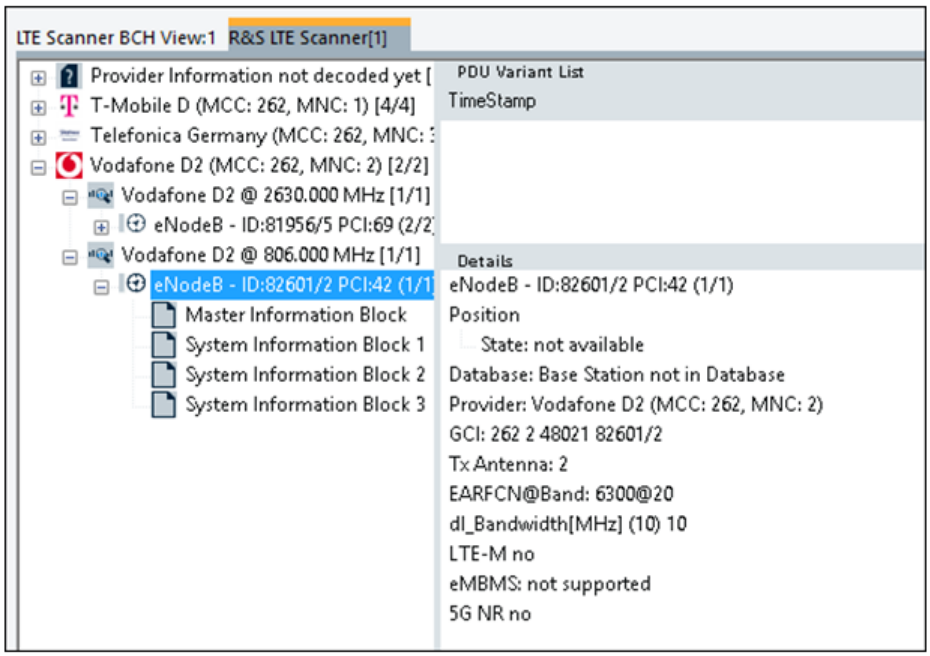


Figure 4-860: LTE Scanner BCH View - details

The enhanced info assumes the following:

- "dl Bandwidth [MHz] (xx) xx" is the same information as the one displayed in the MIB pane.
- "NB-IoT Same PCI (EARFCN:Xxxx)", where Xxxx is the EARFCN of NB-IoT station, indicates that the NB-IoT has the same PCI as the eNodeB.
- "LTE:-M yes/no" is based on "schedulingInfoSIB1_BR_r13" field of the MIB message. If the field exists and is greater than zero, shown is "LTE:-M yes". Otherwise, shown is "LTE:-M no".
- "eMBMS: not supported/supported" is based on "mbsfn_SubframeConfigList" field of SIB 2 message. The following cases are possible
  - If SIB 2 is not present, shown is "eMBMS:-".
  - If SIB 2 is present, but "mbsfn_SubframeConfigList" does not exist, shown is "eMBMS: not supported".
  - If SIB 2 is presents, and "mbsfn_SubframeConfigList" is found, shown is "eMBMS:supported".
- 5G NR is supported or not by the LTE scanner.

If the eNodeB has been generated from SIB 3 measurement without a corresponding database entry, the position is displayed as "Lon *<value> Lat *<value>". The format of the position values depends on the corresponding global R&S ROMES4 setting.

The "LTE Scanner BCH View" can show all R&S ROMES4 supported SIBs if configured to be demodulated. The following screenshot shows that demodulated is SIB 22 of the PCI 210 cell. The details of the SIB 32 are visible on the view's right-hand side.

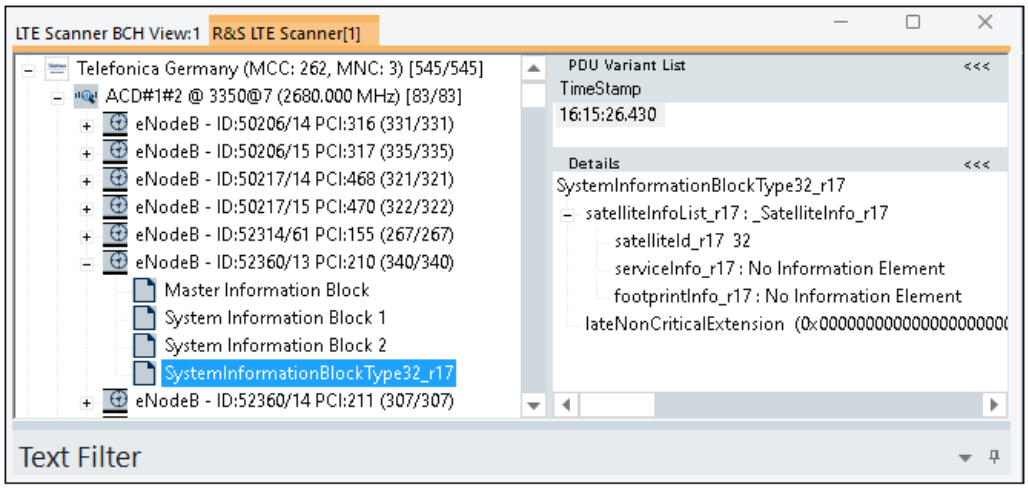


Figure 4-861: Demodulated LTE SIB 32

You can obtain the SIB demodulation information from the "Open" page when you open a LTE measurement file. The SIB information including PDU and internals is available in "BCH Demod" line of the page.

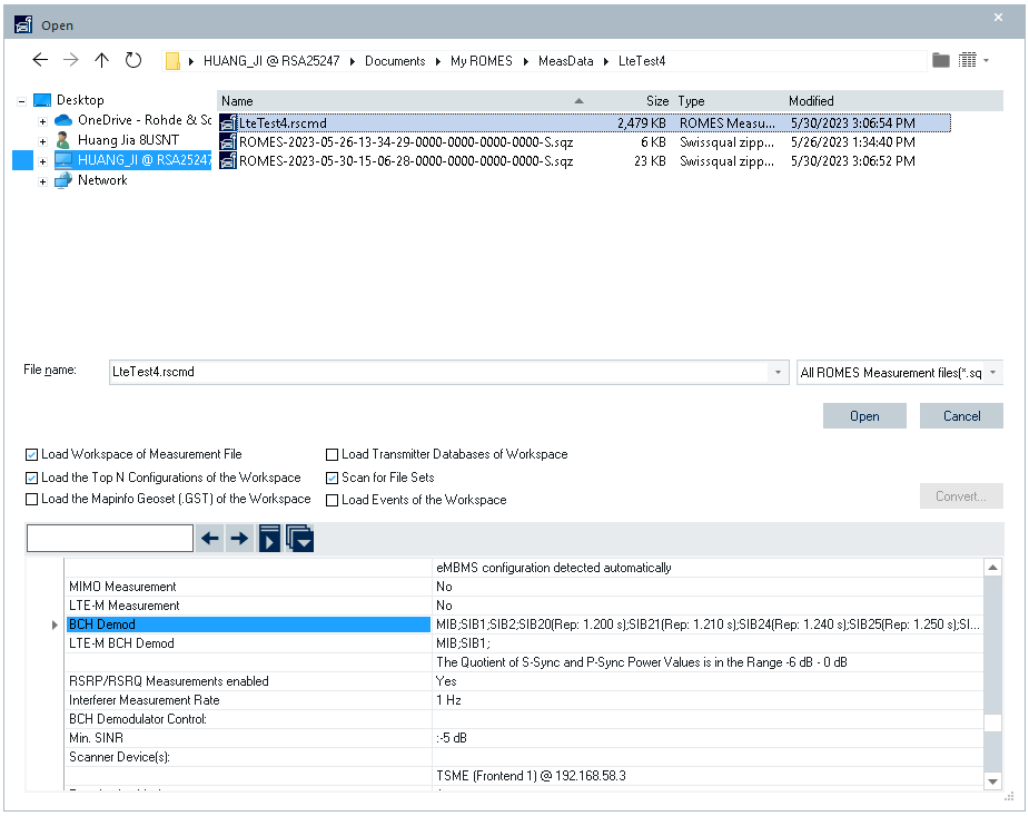


Figure 4-862: Open page shows demodulated LTE SIBs

The MIB and SIBs information is available only if the LTE scanner data is recorded with the "BCH Demodulation" enabled.

RAN sharing in LTE scanner BCH view

The "LTE Scanner BCH View" displays eNodeBs of all PLMNs reported in the SIB1, see Add. PLMNs.

For example, the base stations which serve the PLMN 123,1 and PLMN 123.2 are visible in the view in the branch for PLMN 123,1 and PLMN123, 2 respectively.

A base station listed below a PLMN which is not its primary PLMN is displayed with an "'" appended to its name.

The LTE scanner BCH view creates branches for all the PLMNs of a base station, instead of base stations of the primary PLMN only.

In this case the number of shown base stations does not reflect the number of physically existing ones.

Text filter

The "Text Filter" function offers filtering and exporting a base station list based on different criteria. For details, see "BTS export settings" on page 1217.

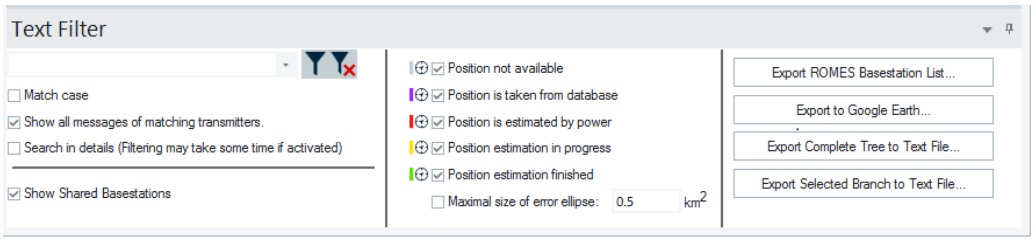


Figure 4-863: Show/hide shared base stations option

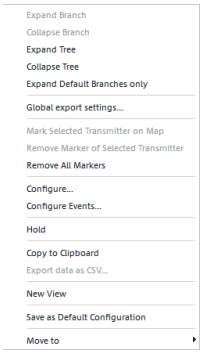
It is possible to hide the base stations, which are displayed as non-primary PLMNs if the "Text Filter" > "Show Shared Basestations" box is checked.

Base stations export can be done based on state of their position.

The base stations in the scanner BCH view have different position states. The following colors indicate the state of a base station:

- grey: position is not available
- grey with database symbol: position is taken from database
- red: position is estimated by power only
- yellow: position estimation is in progress
- green: position estimation finished

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

BTS export settings

If the export had been started before measurement or replay has been stopped, the file contains all the System Information starting from the selected node in the BCH tree. The file includes all SIBs of the selected eNodeB or all SIBs belonging to all eNodeBs of one provider (MCC, MNC).

If the export has been started after measurement or replay had been stopped, the file contains all System Information belonging to all eNodeBs included in the "LTE Scanner BCH View".

The System Information can be exported to an ASCII file in the EXPORT directory of R&S ROMES4. The name of the export file is

`LTE_SysInfo_<measurement filename>.txt`

If the Position Estimation is active, the estimated positions are added to the eNodeB entries. Estimated positions are marked by an asterisk.

After stopping the measurement, the view automatically generates an eNodeB list of import files with an entry for every estimated eNodeB position. The eNodeB list files are stored in the R&S ROMES4 measurement directory.

Table 4-33: Files generated for a measurement RSCMD file

Measurement file	`*.rscmd`	
Generated files	`LTE_eNodeB_LIST<measurement filename>.atd`	Contains the database definition
	`LTE_eNodeB_LIST<measurement filename>.txt`	Contains the eNodeB data
Note: After stopping the replay of a measurement file, the same eNodeB list can be created via the view's "Generate eNodeB List" entry.		

Table 4-34: Example

Files	Measurement file	`zgb-muc.rscmd`
	Generated files	`LTE_eNodeB_LIST_ zgb-muc.atd`
		`LTE_eNodeB_LIST_zgb-muc.txt`
Content	For the content of an ATD or a TXT file, see Example	

Basestation list export

Click the "Global Export Settings" command of the view context sensitive menu to get the "Basestation List Export" page.

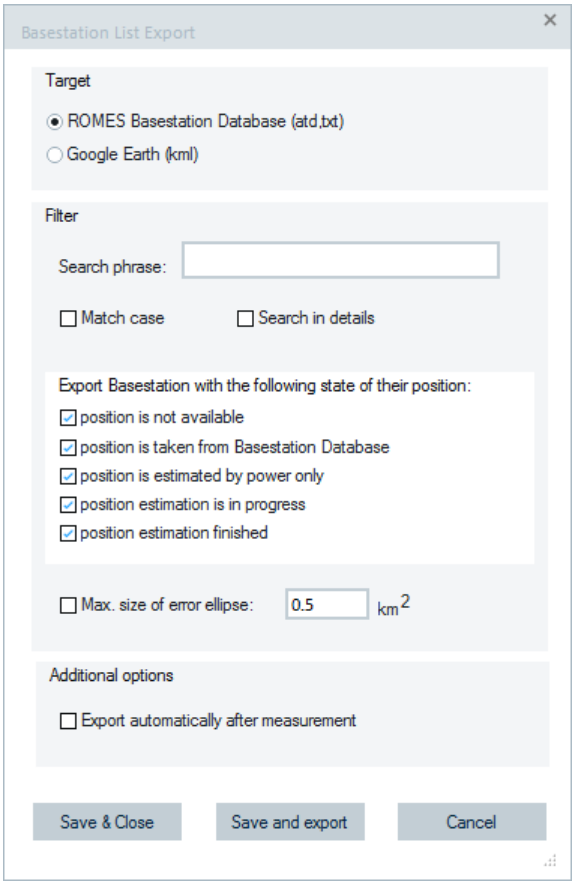


Figure 4-864: Base station list export

The following BTS list export entries are available:

- "Export ROMES Basestation List"
  The content of the BCH views can be exported to a ROMES base station list.
- "Export to Google Earth"
  Estimated base stations can be exported also to a KML file, which can be loaded into Google Earth. The KML file shows the base stations positions, the error ellipse and the most important data of the station.
- "Filter"
  - "Search phase"
    The export dialog allows to select which base station states are to be exported. If mandatory columns of the list are not available, dummy data are inserted, e.g. 0.0, 0.0 for an unknown position. All lists can be loaded into R&S ROMES4 afterwards, but they are not useful for further measurement due to missing data.
  - "Search in details"
    The current visible details setting can be exported to a text file.
  - "position..."
    It is possible to show and hide the stations according to their different position states by using the position filtering.
  - "Max. size of error ellipse"

The export can be filtered by a maximum size of the error ellipse of an estimated base station, which must not be exceeded.
The filtering is done by a threshold value for the error ellipse area of the estimated position. If this value is zero, all BTS entries with estimated position are exported. Otherwise, only entries whose error ellipse area is less than the threshold value are exported via the BCH view's "Global export settings" context menu item.
The error ellipse area A_ε can be calculated from the position error values:
$A\varepsilon = PosErr1 * PosErr2 * \pi$
Note: The specified error ellipse's area defines a confidential interval of 66% confidence.

- "Export Complete Tree to Text File"/"Export Selected Branch to Text File"
  The content of the complete or selected branch of the BCH view can be exported to an ASCII file.
- "Additional options"
  If "Export automatically after measurement" checked, the BCH views for all technologies can export the database file automatically after a measurement was finished.
- "Save and export"
  The button saves the settings of the export dialog and creates the export database file.
- "Save & Close"
  To store the settings without creating an export, click the button.
- "Cancel"
  Cancels the made settings.

Neighbors are exported for GSM, UMTS, LTE, LTE-M and TETRA technologies. The standard columns for the R&S ROMES4 base station list cannot be used, as they require the global cell identity, which is not available in the broadcast information. Instead of using the standard column, the following columns are used for exporting the decoded information.

- GSM
  The "2GNC-ARFCN" column is exported that contains the ARFCNs of the 2G neighbors.
- UMTS
  - "2GNC-NCC,BCC,Band,ARFCN" column is exported that contains the NCC, BCC, band and the ARFCN of the 2G neighbors.
  - "Intra3GNC-SC" column is exported that contains the scrambling codes of the intra-frequency neighbors.
  - "Inter3GNC-DL_UARFCN,UL_UARFCN,SC" column is exported that contains the DL/UL UARFCN and the scrambling code of the inter-frequency neighbors.
- TETRA
  The "NeighbourCellParameters" column is exported that contains the MCC, MNC (both only if available) and the LA and carrier of the neighbors.

The settings of the export dialog are stored in the registry and valid for all technologies.

The "Output" view informs about the executed exports of the BCH views.

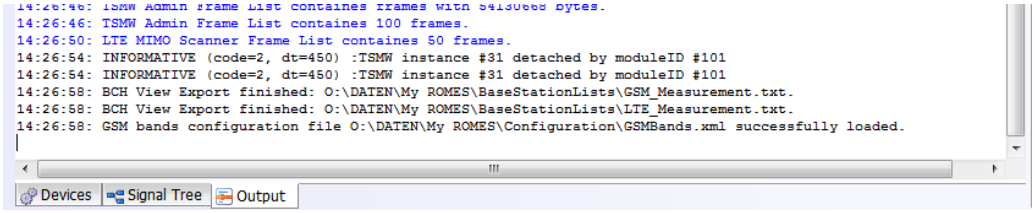


Figure 4-865: Finished BCH view export

LTE scanner BCH view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Y

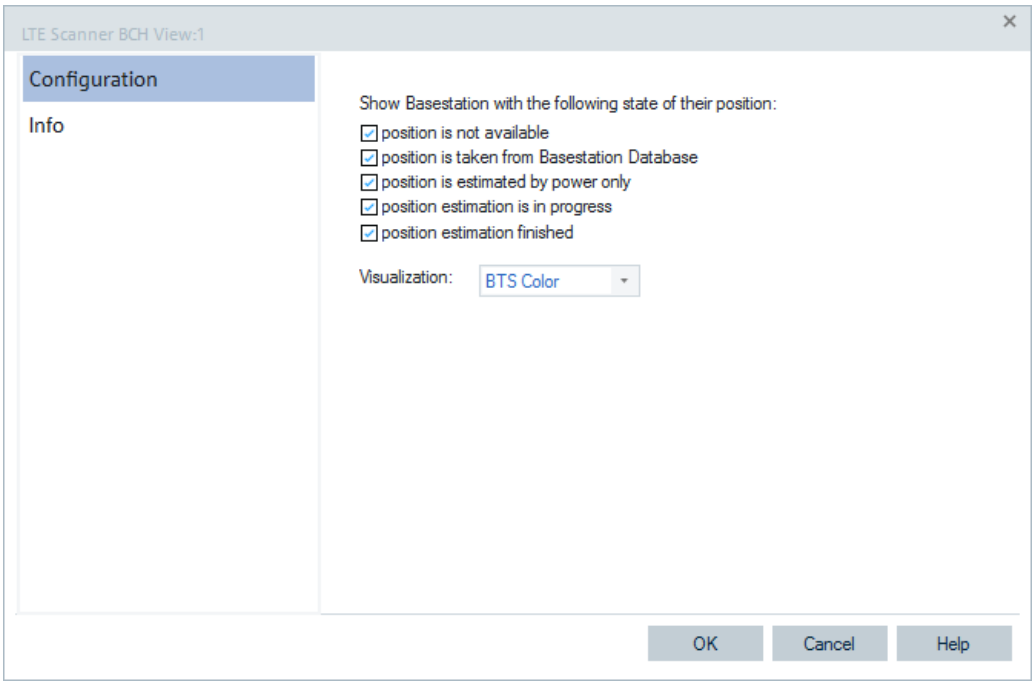


Figure 4-866: LTE Scanner BCH View - configuration

The "Configuration" option lets you filter base stations by selecting different states of their position in the "Text Filter" pane. Select a base station color that you want to be used in the "ROMESMAP Route Track View" in the "Visualization" drop-down box.

4.8.6.3 LTE scanner cell ID tracer view

The "LTE Scanner Cell ID Tracer View" displays the evolution in time of the time delay and power of all received LTE peaks with a particular Cell ID or a particular rank in a Top N pool.

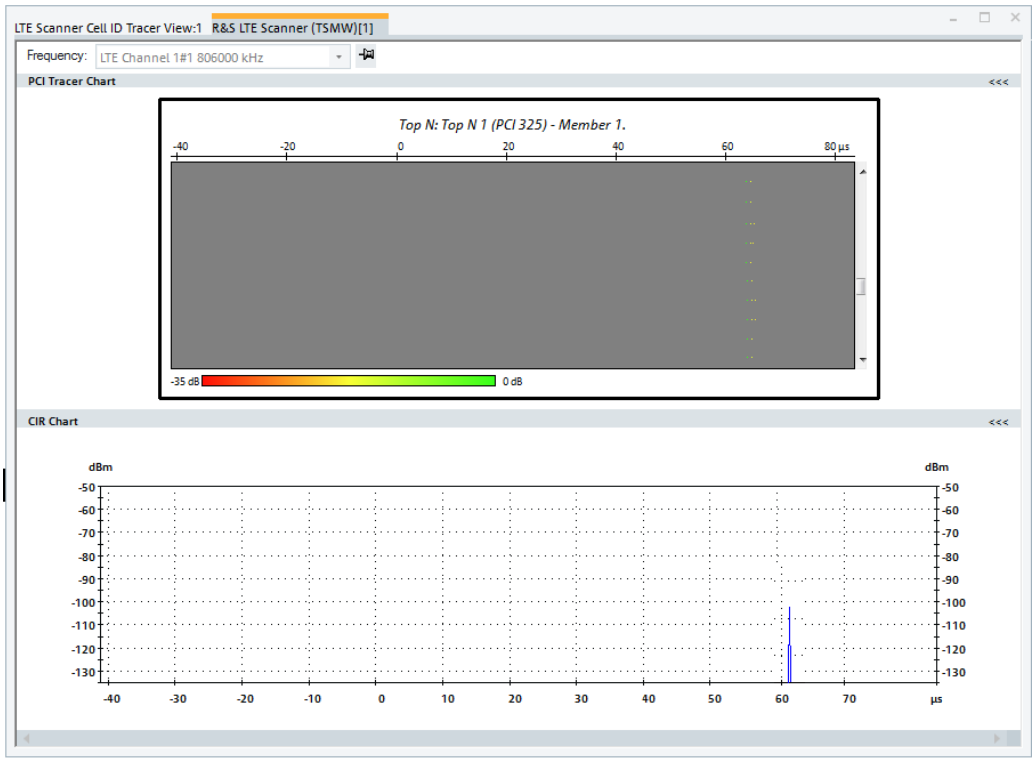


Figure 4-867: LTE Scanner Cell ID Tracer

Any deviations of the regular 1ms TTI can be seen by a non-vertical line in the waterfall diagram. Usually the reason is missing or wrong synchronization, typically caused by problem in the transport network connection.

Frequency

The "Frequency" pull-down list, contains all measured frequencies of the channels ticked in "Channels" of the LTE scanner configuration tab, see Figure 6-272.

Fix current cell ID

The pin icon to the right of the "Frequency" list forces the system to trace the current "Cell ID", even if "Trace TopN Element" is selected in the configuration menu. In fixed Phy. Cell ID mode, the icon is crossed out with red color and "Fixed Top N" is indicated in the title of the "Cell ID Trace Chart".

Click the crossed-out icon again to release the fixed Cell ID. The system continues tracing the selected Top N element.

If "Trace a fixed Phy. Cell ID" is selected in the configuration menu, the pin icon has no effect.

View area

The view area is horizontally split to accommodate two different charts.

Click "Cell ID Tracer Chart" or "CIR Chart" to compresses / expand the corresponding chart. A compressed chart leaves more space for the other chart. A compressed chart is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Cell ID tracer chart

The colored rectangular diagram shows the evolution in time of the CIR [dB] and the time delay "Delta T[µs]" using the color scheme defined in the configuration menu.

"Power [dBm]" and "Delta T[µs]" are listed in "CIR View" > "Peak List".

- X-axis (delta time)
- Y-axis (time)
  Symmetric range centered on the first measured relative timing slot. The delay time span is fixed and equals 100 µs.
  Linear time scale of the measurement. The diagram consists of 100 to 800 lines, arranged from top to bottom. The diagram is continuously updated during the measurement or replay by adding new lines. It is scrolled and a scrollbar is added along the right border when a line reaches the bottom of the diagram.

CIR chart

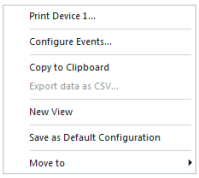
The "CIR Chart" shows the power of all received peaks over the time.

The displayed powers and times correspond to the "Power [dBm]" and "Delta T[µs]" values listed in the "CIR View" >"Peak List".

A scrollbar is provided to move the magnified diagram to the right or left. The scale of the y-axis (power in dBm) can be set in the configuration menu.

By default, the diagram shows current results corresponding to the last line in the "Cell ID Tracer Chart". To select a previous result for viewing, use the display line in the "Cell ID Tracer Chart".

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

LTE scanner cell ID tracer view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Subband target selection

The "Subband Target" option lets you set the signals to be displayed in the "LTE Scanner Cell ID Tracer View".

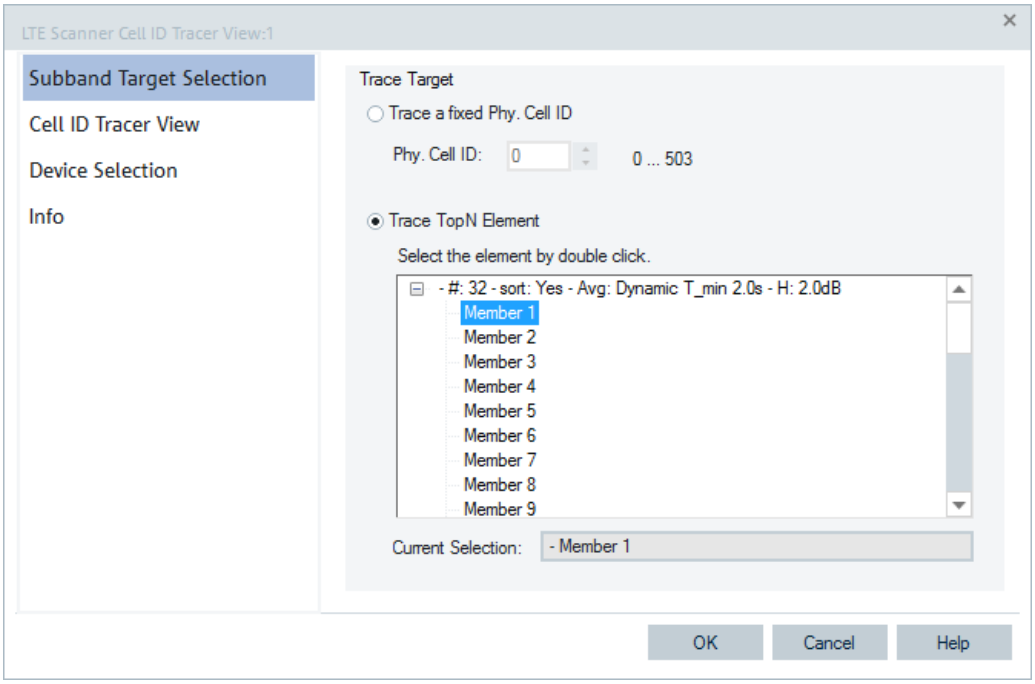


Figure 4-868: LTE Scanner Cell ID Tracer View - subband target selection

Trace Target
The "Trace Target" option lets you select a signal for tracing with a defined Cell ID or a particular Top N element.

- Trace a fixed Cell ID
  Define a fixed Cell ID for a trace.
  Note: If the selected Cell ID is not assigned to any measured signal, the view remains empty.
- Trace TopN Element
  List of all Top N pools configured in the scanner's menu. The current Top N pool selection is marked in the list.

Current Selection
Shows the current Cell ID selection.

Configuration: Cell ID tracer view

The "Cell ID Tracer View" option lets you scale the diagrams and set the colors in the view.

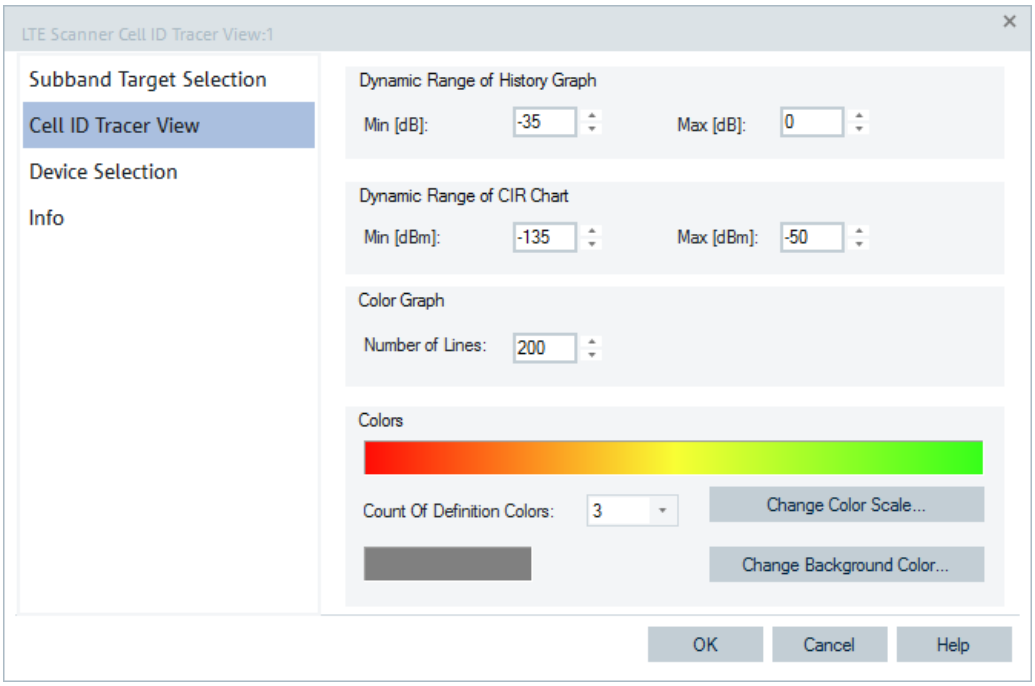


Figure 4-869: LTE Scanner Cell ID Tracer View - configuration

Dynamic Range
The input fields in "Dynamic Range" define the minimum and the maximum signal level displayed in the diagrams of the "Cell ID Tracer View". The signals exceeding the dynamic range are not displayed.

Color Graph
The "Color Graph" panel defines the number of lines to be displayed in the view. A line corresponds to a single frequency sweep. The corresponding frequency range and the measurement rate are set in the "Measurements" tab of the scanner's configuration menu.

Colors
The "Color" panel defines a color scale for the lines in the "LTE Scanner Cell ID Tracer View" and for the background. The scale is derived from 2 to 16 "definition colors". The definition colors are entered at equidistant positions on the color scale, the first and last color defining the beginning and the end of the scale. Between the definition colors, the hue changes continuously.

- "Count of Definition Colors"
  Pull down list to select the number of definition colors in the range 2 to 16.
- "Change Color Scale"
  Opens the colors dialog to select or define the definition colors.

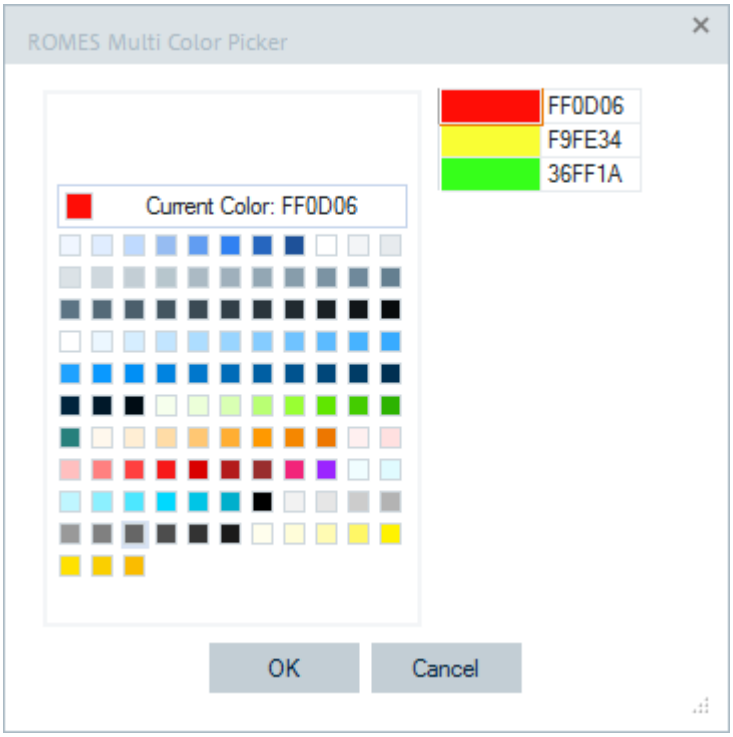


Figure 4-870: ROMES color scale

The current definition colors are displayed in the custom colors section.

- "Change Background Color"
  Opens the colors dialog to select or define a background color for the diagram, as shown in the previous figure.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

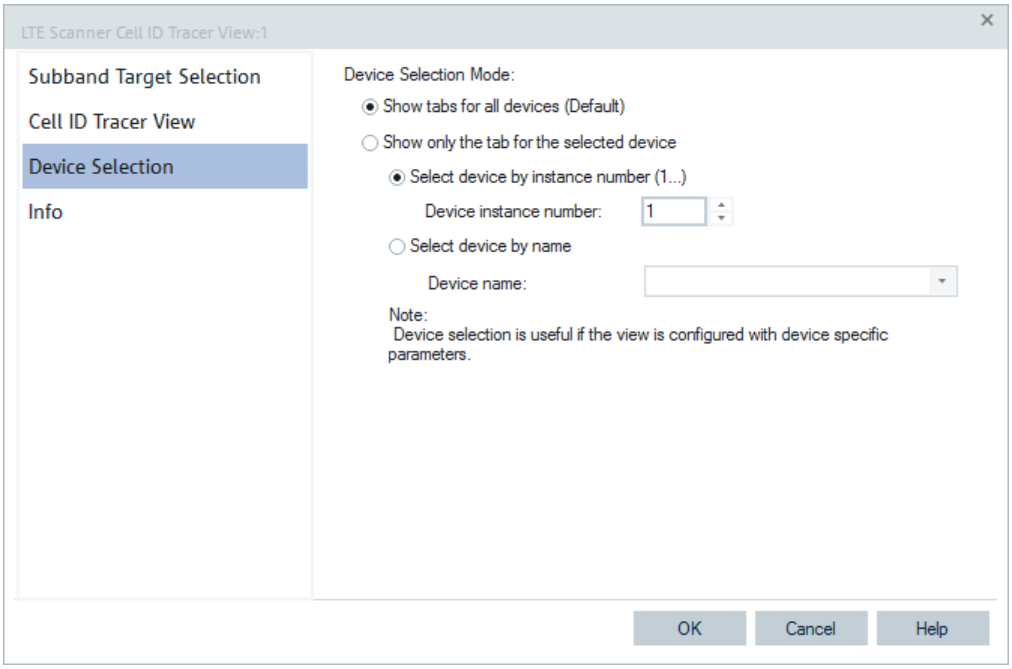


Figure 4-871: LTE Scanner Cell ID Tracer View - device selection

4.8.6.4 LTE scanner CIR view

The "LTE Scanner CIR View" displays the channel impulse response of the LTE signals.

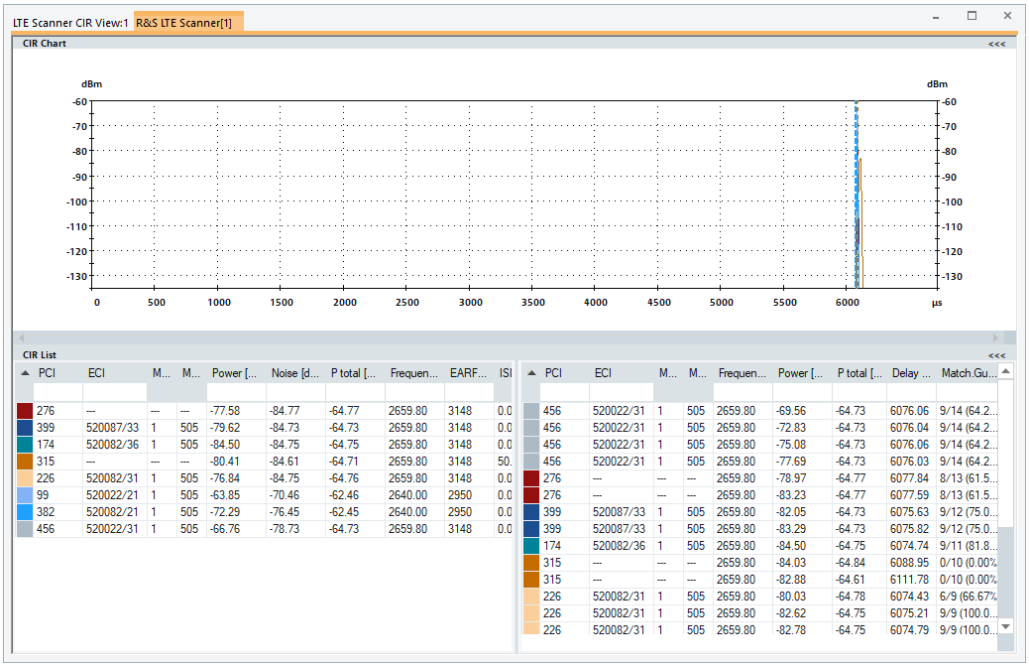


Figure 4-872: LTE Scanner CIR View

The CIR results of the LTE scanner are displayed as EARFCN/PCI combinations.

The "LTE Scanner CIR View" allows filtering of the "CIR List" content. The list can be filtered on any of the available columns.

The "CIR Chart" of the view shows in the figure the same PCI as the "CIR List" does.

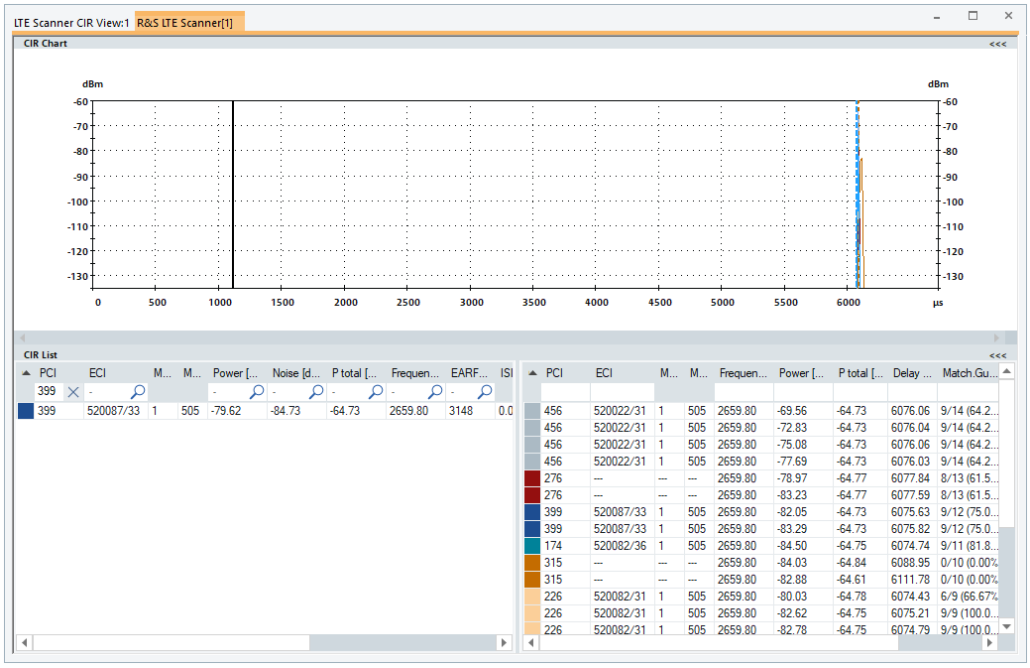


Figure 4-873: Filtered LTE scanner CIR list

Updated the chart by new input data once the list's filter has been changed.

View area

The entire view area is horizontally split to accommodate a chart and a table/list. The "CIR Chart" shows the channel impulse response of the different LTE signals which have been scanned. The graph allows zooming into the chart. The small button on the right of the scroll bar reset the zoom level.

Click "CIR Chart" or "CIR Lists" to compresses/expand the 2D-chart or table. A compressed chart leaves more space for the table and vice versa.

Moreover, the tables appear in several views so that compressing them can help to avoid redundancies. To compress/expand table, use the ">>>"/"<<<" symbols in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Diagram scale

If placed inside the diagram area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside). A vertical line is displayed at the cursor position.

The cyclic prefix is shown in the "CIR Chart" for each "CIR List" element as a dotted vertical line in the cell ID color.

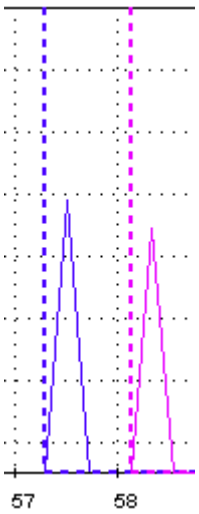


Figure 4-874: Cyclic prefix as dotted vertical line

The display of the cyclic prefix in the CIR chart can be switched off in the "LTE Scanner CIR View" configuration.

A left mouse click magnifies the diagram in x-direction around the cursor position. CTRL + left mouse click causes the opposite. An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed.

"Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

Left table

The table lists all the scanned LTE segments:

- "Color"
  Sequence number and physical cell ID color. The color can be configured in the views configuration page.
- "Physical Cell ID"
  Physical Cell Identity, range 0 to 503
- "ECI"
  E-UTRAN Cell Identifier (format ENB-ID 20 bits, CI 8 bits), unique for a cell even if the physical cell IDs are identical.
- "MNC"
  Mobile Network Code
- "MCC"
  Mobile Country Code
- "Power [dBm]"
  The received power on S-Sync signal
- "Noise [dBm]"
  Noise floor based on S-Sync signal

- "P total [dBm]"
  Total in-band power based on S-Sync signal, including thermal noise and noise generated in the receiver
- "Frequency [MHz]"
  Center Frequency
- "EARFCN"
  Evolved Absolute Radio Frequency Channel Number
- "ISI"
  CIR outside of cyclic prefix
- "Exp. Drift [ns/s]"
  Expected time drift against the receiver time
- "Sigma Drift [ns/s]"
  Expected standard deviation of the expected time drift
- "Max.Delay [µs]"
  Maximum delay of the relating peaks
- "Time Delta [µs]"
  Time difference between the first and the last arrived peak
- "Unique ID"
  Unique BTS ID generated by the scanner per on a channel identified BTS
- "Count of Peaks"

Right table

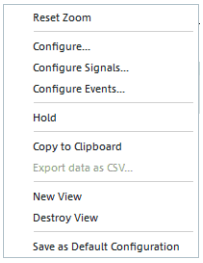
The right table shows the different path of the segments. The table lists all scanned LTE segments.

The specific ones are listed here.

- "Delay [µs]"
  Signal's delay time
  The delay values are calculated with the offset to the first measured CIR value in the current scan. The delay in the peak list correspondents to the delay seen in the CIR chart.
- "Match.Guard Per."
  Display the number of the matching guard periods for each peak

For other signals in this table, see "Left table" on page 1229.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional command.

- "Reset Zoom"
  Resets the x-axis scale to 0 ms to approx. 26.5 ms.

LTE scanner CIR view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

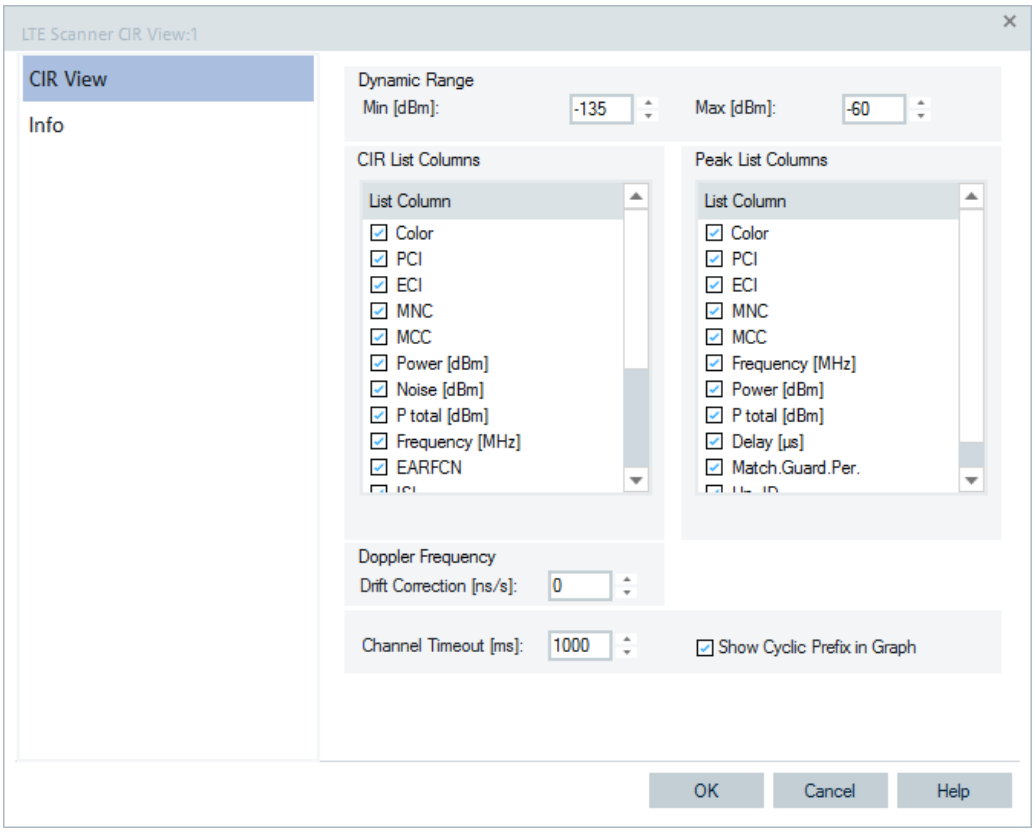


Figure 4-875: LTE Scanner CIR View - configuration

Dynamic Range
The two input fields in this panel define the maximal/minimal signal level to be displayed in the "LTE Scanner CIR View". The signal levels out of the range defined with maximal and minimal signal levels are not displayed.

CIR List Column
The CIR list selects which information to display in the left table below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Peak List Column
The peak list selects which information to display in the right table below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Doppler Frequency
The panel provides an input field for correcting the Doppler frequency displayed in the "Peak List". The purpose of the correction is to subtract frequency offsets in the measured frequency that cannot originate from the speed of the test vehicle relative to the signal source.

The frequency offset is calculated as follows:

```
Meas. Freq. [Hz] * Drift Correction [ns/s] * 10^-9.
```

Example:

Frequency: 2 GHz

Drift Correction: 100 ns/s

Frequency Offset: 200 Hz

Channel Timeout
If there is no data on a channel anymore, the "CIR List" entries for this channel are removed after a timeout.

Show Cyclic Prefix in Graph
The display of the cyclic prefix in the CIR chart can be switched on or off via "Show Cyclic Prefix in Graph". If the check box is ticked, the Cyclic Prefix is displayed as a dotted vertical line of the cell ID color in "CIR Chart" for each "CIR List" element.

4.8.6.5 LTE scanner eMBMS view

The "LTE Scanner eMBMS View" displays the results of the eMBMS signals measurement.

eMBMS signal measurements per area ID are displayed in a tabular form in the upper part of the view. The middle part of the view displays in the same way the measurements per eNodeB branch. The lower part of the view is a chart containing CIRs of the involved eNodeBs for the selected area.

The following figure shows the "LTE Scanner eMBMS View".

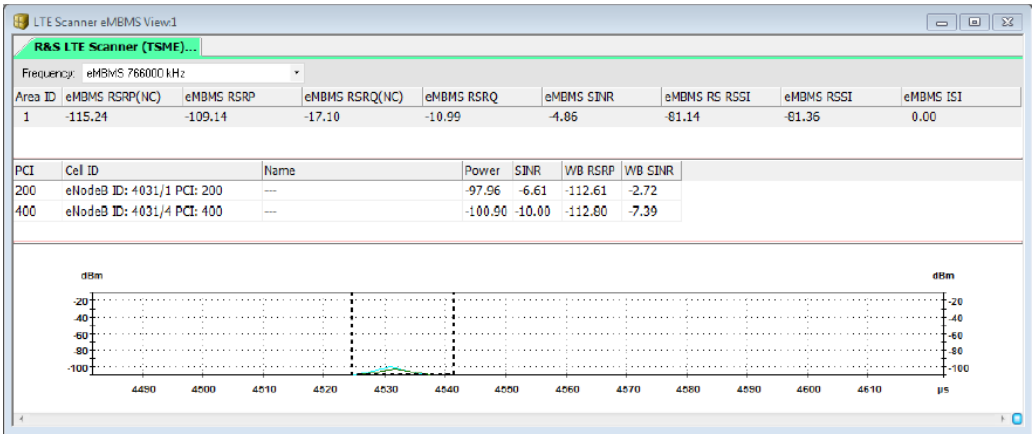


Figure 4-876: LTE scanner eMBMS view

It is possible to configure n MBMS Area IDs, by default 12. Each of them can be assigned to the actual measured areas automatically or manually by definition of channel and area pairs.

Signals per area ID:

- "Area ID" (MBSFN Area ID)
- "eMBMS RSRP (NC)"
  RSRP of eMBMS Reference Signals with noise clipping; the signal includes the RS power only
- "eMBMS RSRP"
  RSRP of eMBMS Reference Signals
- "eMBMS RSRQ (NC)"
  RSRQ of eMBMS Reference Signals with noise clipping; the signal includes the RS power only
- "eMBMS RSRQ"
  RSRQ of eMBMS Reference Signals
- "eMBMS RS SINR"
  SINR of eMBMS Reference Signals
- "eMBMS RS RSSI"
  Carrier RSSI measured in eMBMS Reference Signals
- "eMBMS RSSI"
  Carrier RSSI measured at the time as the eMBMS measurements
- "eMBMS ISI"
  Inter-symbol Interference calculated from the synchronization signals

The middle field contains count of involved eNodeBs.

Signals per eNodeB branch (n active members of an area ID, default 5 per area):

- "PCI"
- "CellId"
- "Power"
  S-SYNCH Power, the same definition as normal TopN pool.
- "SINR"

S-SYNCH Power, the same definition as normal TopN pool.

- "WB RSRP"
  The same definition as normal TopN pool.
- "WB RS SINR"
  The same definition as normal TopN pool.

Two dashed vertical lines in the CIR's chart show the duration of extended cyclic prefix of the area. The CIR values are colored in the PCI color. The current zoom is reset, if you change the area selection.

During the eMBMS measurements, all narrowband measurements, like RSRP, RSRQ and RS-SINR are disabled.

You can configure the max/min values of the eMBMS signals in the "Available Signals" tree under the "LTE Scan" > "eMBMS Area [n]".

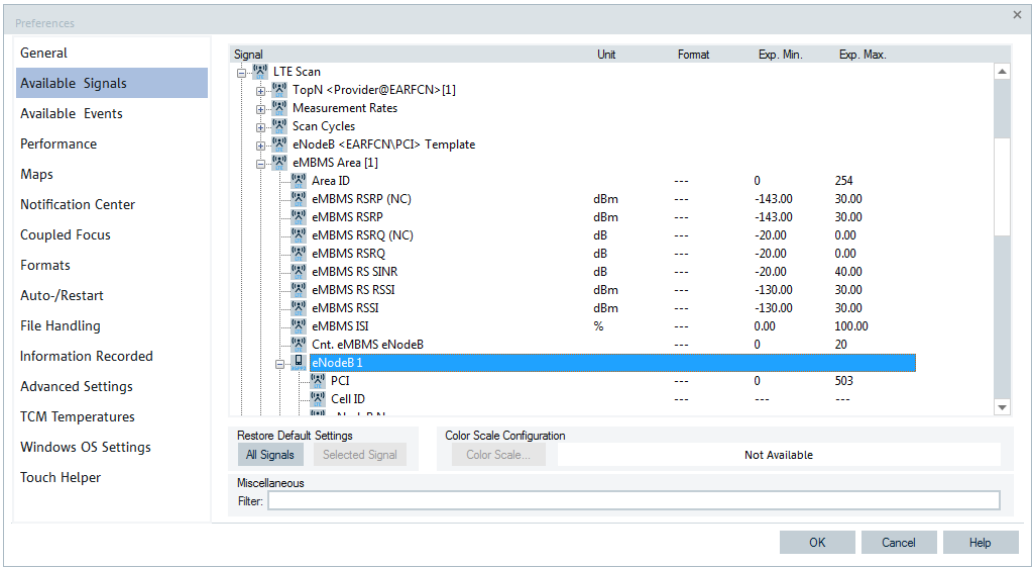


Figure 4-877: eMBMS available signals

An overview of the eMBMS signals is included in "Signal Tree" > "LTE Scan" > "eMBMS Area [n]".

LTE scanner eMBMS view configuration

The "LTE Scanner eMBMS View" parameters are configurable in the "TEC for LTE Scanner" configuration page, see Figure 3-225.

The number of area IDs, the number of eNodeBs per an area ID and a frequency/area ID assignment are configurable.

4.8.6.6 LTE scanner MIMO view

The "LTE Scanner MIMO View" area is divided into two panels.

- "Condition Number Waterfall Diagram"
  The diagram shows as a color-coded the measured Condition Numbers (CN) of transmitted Resource Blocks per cell. The cell can be specified either by a physical cell ID (PCI) or a certain Top N member number. If hovering mouse over the panel, the SINR and the Rank values, apart from CN, are shown for the mouse position.
- "H Matrix Chart"
  The chart shows measurement values of the signals selected for display and listed on the right-hand side of the chart. In addition to the H-matrix signals, you can select for display the Rank signal (up to 4 RI values available for 4x4 MIMO).

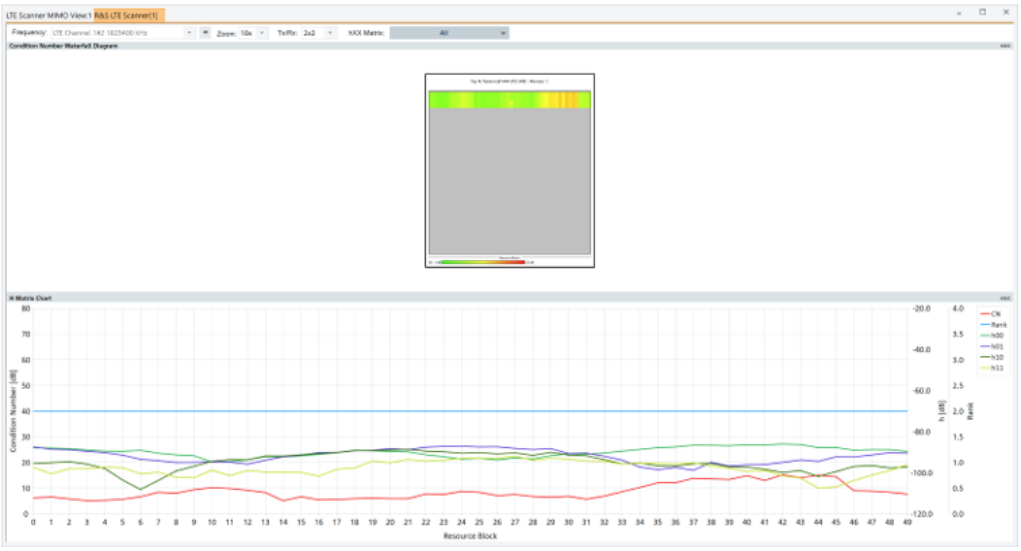


Figure 4-878: LTE Scanner MIMO View

The view zooming works with the mouse wheel. For panning, press the left mouse button and move the mouse. All parameters in the chat provide Tooltips when you hover with the mouse over them.

View area

Each line represents one measurement over all resource blocks in this view. Evaluating an IQ data block up to N measurements can be performed. The IQ data block is x seconds long, dependent on what is configured as a measurement speed in the wideband configuration page of the scanner. N depends on the length of a measured signal and the MIMO measurement resolution.

The default values are 50 ms for the length of signal and 10 ms for the resolution, which result in 4 measurements per IQ block. The view can show the condition numbers for the 2x2, 4x2 and 4x4 MIMO configuration, dependent on the selection in "Tx/Rx" of the view, see the following figure.

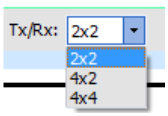


Figure 4-879: Selection of the Tx/Rx combination

A cursor displays details of the pixels. The active and the passive coupled focus is supported.

The lower part is the H-matrix chart. You can select the H-matrix elements you want to be shown in the chart in the "hXX Matrix" drop-down box, see the following figure.

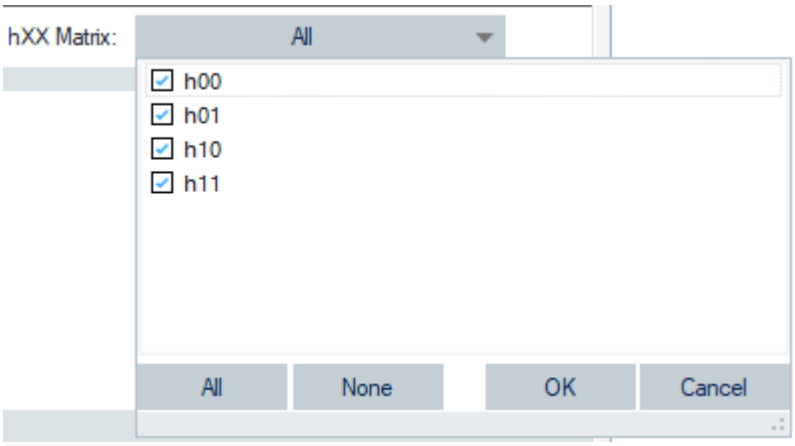


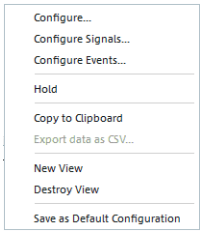
Figure 4-880: Selection of the H-Matrix elements

Select or unselect the checkbox to show or hide a channel in the H-matrix chart.

The graph shows CN, the selected elements of H-matrix and the MIMO rank. During the measurement and replay, the H-matrix of the last measurement is displayed. The graph of the H-matrix is updated by using the cursor in the waterfall diagram.

The Rank Indicator values are displayed on y-axis located on the right-hand side of the chart, besides the axis for the H-matrix elements.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

LTE scanner MIMO view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Subband target

The "Subband Target Selection" option lets you select the targets you want to trace and see in the "LTE Scanner MIMO View".

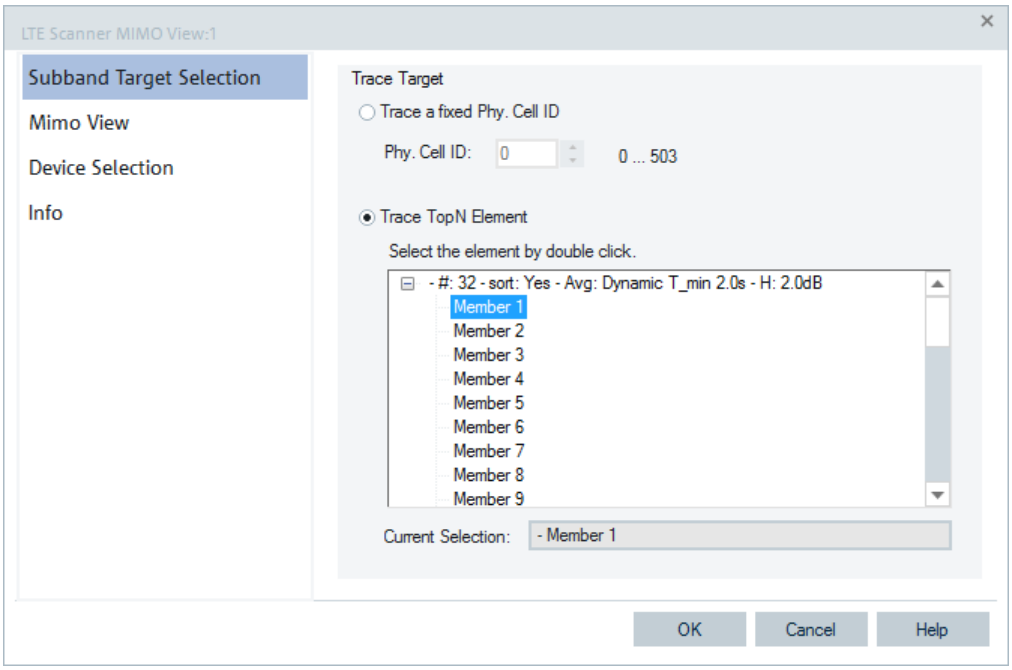


Figure 4-881: LTE Scanner MIMO View - subband target selection

Trace Target
Lets you select a target for tracing. Target can be traced with a fixed PCI or as a particular Top N element.

- "Trace a fixed Phy. Cell ID"
  The Phy. Cell ID is defined in the format selected in "TEC for LTE Scanner", see Chapter 3.8.2.12, "TEC for LTE scanner", on page 341.
- "Trace Top N Element"
  List of all the Top N pools defined in the scanner configuration menu. The current Top N pool selection is indicated in the list "Top N Pools", see Chapter 3.8.2.12, "TEC for LTE scanner", on page 341.

Configuration: MIMO view

The "MIMO View" option lets you scale the diagrams and define the colors in the view.

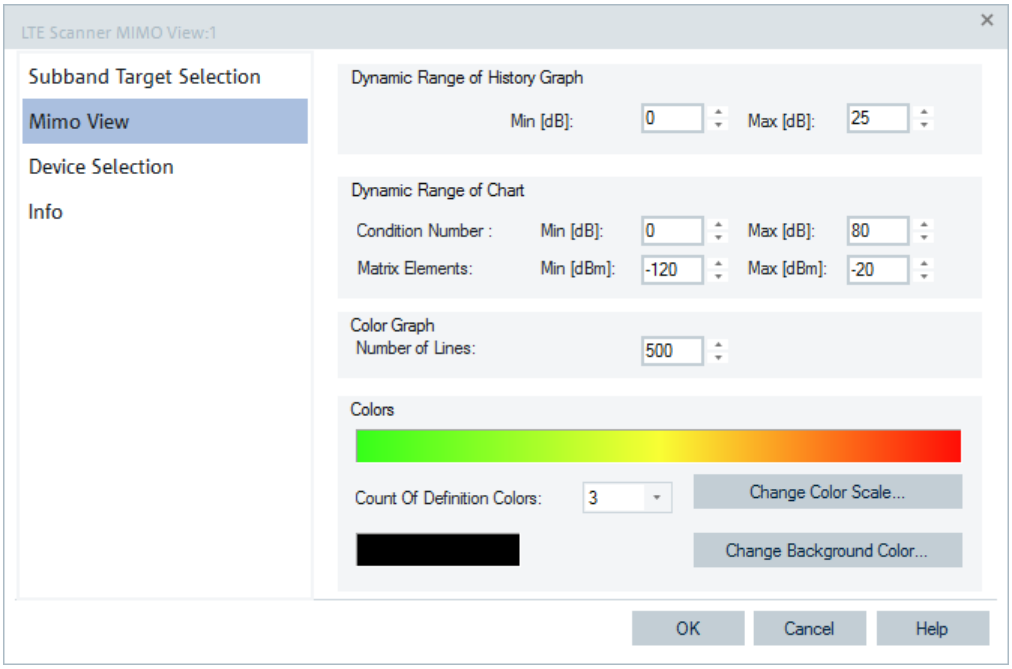


Figure 4-882: LTE Scanner MIMO View - MIMO view

Dynamic Range
The dynamic range includes the configuration of:

- History graph
  Set the minimum and maximum size of the history graph, expressed in [dB].
- Chart
  Set the minimum and maximum of the Condition Number and the signal level of a matrix element, displayed in the "LTE Scanner MIMO View" in [dB] and [dBm], respectively.

The signals exceeding the configured dynamic range are not displayed.

Color Graph
For details, see "Configuration: Cell ID tracer view" on page 1225.

Colors
For details, see "Configuration: Cell ID tracer view" on page 1225.

Configuration: Device selection

The "Device Selection" page is identical to that one described in "Configuration: Device selection" on page 1226.

4.8.6.7 LTE scanner power view

"LTE Scanner Power View" displays measured values of SINR, SINR of P-Sync and SINR of S-Sync. The measured values are shown in the chart for the selected Cell ID or selected Top N pool member configured in the view configuration page, see Figure 4-884. The selected Cell ID can be the physical Cell ID or the measured internal

Cell ID. The cell ID selection can be done in the view configuration or by changing the combo box and the edit field.

To select the cell ID, use the view configuration page or the tab at the top-left corner of the "LTE Scanner Power View".

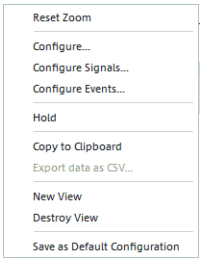
Figure 4-883: LTE Scanner Power View

View area

The scale of the x-axis (history) and the visibility of the y-values can be set in the view configuration. The y-axis can be tracked while pressing the left mouse button when the hand cursor appears when moving the mouse over the y-axis.

The Top N pools configuration is done in the "TEC for LTE Scanner".

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Reset Zoom"
  Resets the x-axis scale to 0 ms to approx. 26.5 ms.

LTE scanner power view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The configuration pages let you customize the diagram in the view.

Configuration: Power view configuration

The "Power View Configuration" option lets you set the x-axis scale of the view. Also the option is used to select the parameters for display in the view.

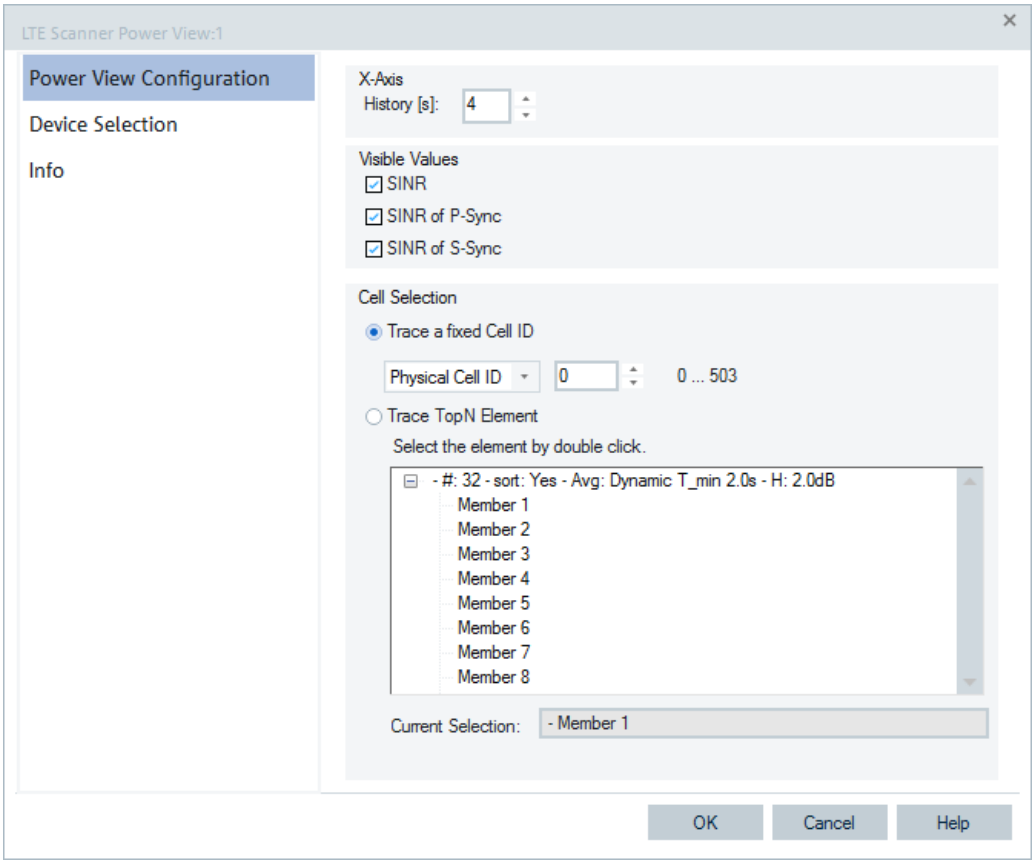


Figure 4-884: LTE Scanner Power View - configuration

X-Axis
Define the scale of the x-axis by time information. The time interval that is shown range between 1 and 60 seconds.

Visible Values
Checks the values to be visible in the view. To change the used color for the selected value, click with the right-mouse button the value in the view.

Cell Selection
The "Cell Selection" option lets you select for tracing a signal with a definite Cell ID or a particular Top N element.

- "Trace a fixed Cell ID"
  Define a fixed Cell ID for trace. The selected Cell ID can be the physical Cell ID or the measured internal Cell ID.
  Note: If the selected Cell ID is not assigned to any measured signal, the "LTE Scanner Power View" remains empty.
- "Trace Top N Element"
  List of all Top N pools defined in the scanner configuration menu. The current Top N pool selection is indicated below the list.

Current Selection
Shows the current Cell ID selection.

Configuration: Device selection

The "Device Selection" page is identical to that one described in "Configuration: Device selection" on page 1226.

4.8.6.8 LTE scanner reference signal CIR view

The "LTE Scanner Reference Signal CIR View" displays the CIR and CIR peaks of the reference signal measurements. The following figure shows the results of measurements in the RS CIR chart and RS CIR lists of the view.

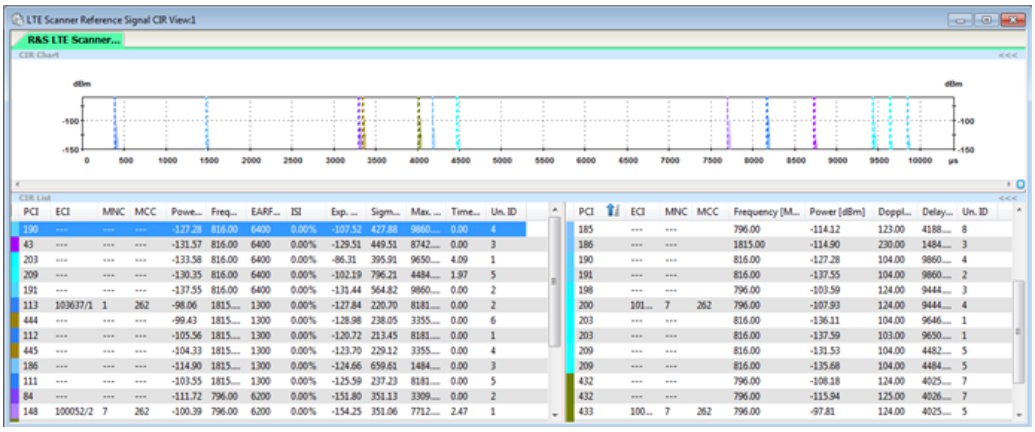


Figure 4-885: LTe Scanner Reference Signal CIR View

The LTE scanner export supports the CIRs and CIR peaks export based on reference signal measurements, see Chapter 7.2.5.2, "Interactive export", on page 2134.

An example of the LTE CIR and LTE CIR peak export to XML format is shown in the following example.

Example:

```
<ListContent Timestamp="16848 ms">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=""/>
                <PCI Value="330"/>
                <Un__ID Value="5"/>
                <Power__dBm_ Value="-93.05"/>
                <Noise__dBm_ Value="-97.83"/>
                <P_total__dBm_ Value="-89.83"/>
                <Frequency__MHz_ Value="796.00"/>
                <EARFCN Value="6200"/>
                <ISI Value="0.00%"/>
                <Exp__Drift__ns_s_ Value="-98.48"/>
                <Sigma_Drift__ns_s_ Value="1270.45"/>
                <Max__Delay__us_ Value="64.05"/>
                <Time_Delta__us_ Value="0.02"/>
            </Line>
```

Figure 4-886: LTE CIR export file layout

NOTE: The <ListContent> entry contains not only the timestamp but also the position data.

Example:

```
<ListContent Timestamp="16848 ms">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=""/>
                <PCI Value="330"/>
                <Frequency__MHz_ Value="796.00"/>
                <Un__ID Value="5"/>
                <Power__dBm_ Value="-96.06"/>
                <P_total__dBm_ Value="-89.83"/>
                <Doppler__Hz_ Value="34.00"/>
                <Delay__us_ Value="64.03"/>
                <Match_Guard_Per_ Value="11/70 (15.71%)"/>
            </Line>
```

Figure 4-887: LTE CIR Peak export file layout

Position data for every <ListContent> entry is available in CIR and CIR peak export files.

The export to CSV format is supported.

View area

The "LTE Scanner Reference Signal CIR View" view area is similar to the LTE scanner CIR view based on S-Sync signal measurements.

For the explanation of the view area and meaning of configurable parameters, see "View area" on page 1228, "Left table" on page 1229 and "Right table" on page 1230.

LTE scanner reference signal CIR view configuration

The LTE scanner RS CIR view configuration is similar to the LTE scanner CIR view configuration.

The difference between them two is that the "RS CIR View" configuration page does not include the following entries:

- "Noise" and "P total" in the "CIR List Columns"
- "Match. Guard Per." in the "Peaks List Columns"

4.8.6.9 LTE scanner RSSI spectrum view

The "LTE Scanner RSSI Spectrum View" displays the RSSI spectrum in two ways:

- In a waterfall diagram (so called history graph) for a time span (upper part)
- In a chart for a specific timestamp (lower part)

The view supports the coupled focus function and the "Jump to timestamp" function.

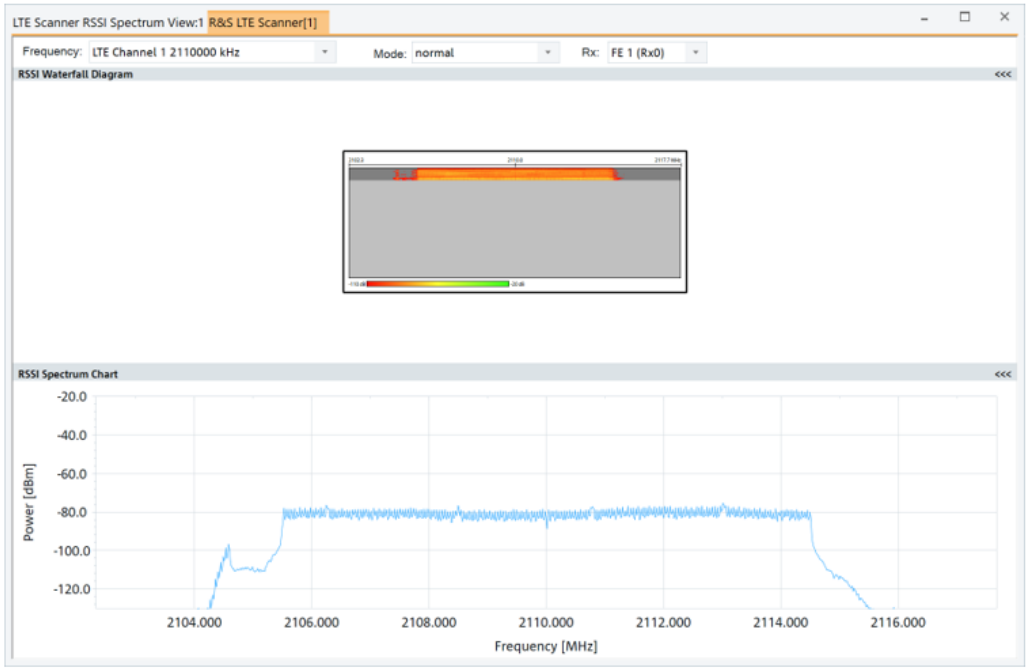


Figure 4-888: LTE Scanner RSSI Spectrum View

The view zooming works with the mouse wheel. For panning, press the left mouse button and move the mouse.

LTE scanner RSSI spectrum view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The opened page contains the "RSSI Spectrum View" tab and the common "Device Selection" tab.

Configuration: RSSI spectrum view

The "RSSI Spectrum View" option lets you set the parameters of the RSSI chart. The page is analog to the "LTE Scanner Cell ID Tracer View" > "Call ID Tracer View" page.

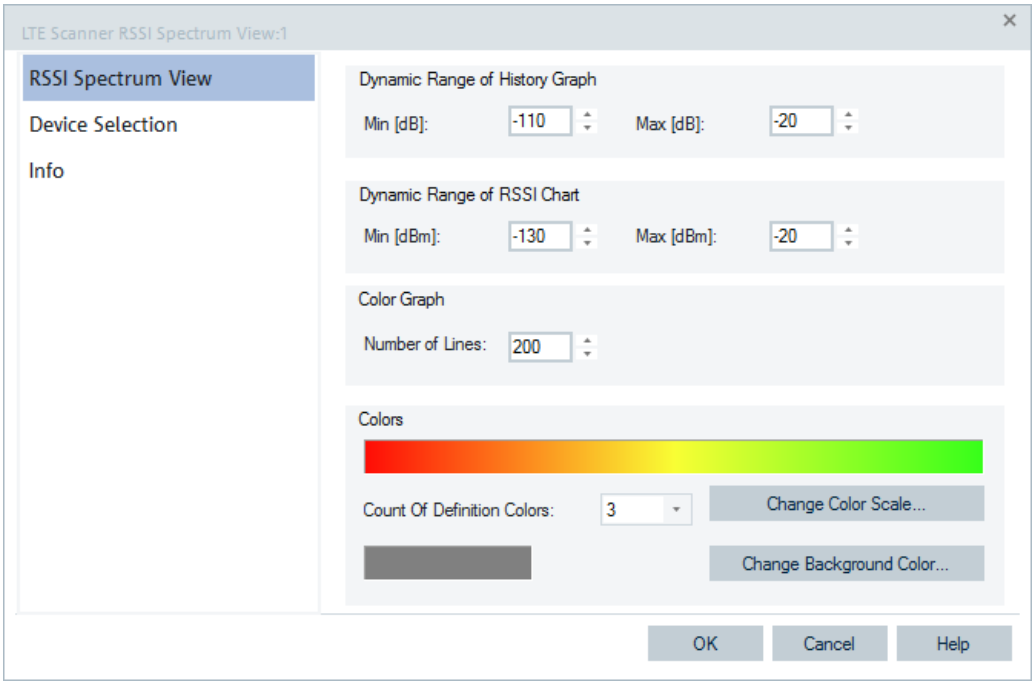


Figure 4-889: LTE RSSI Spectrum View - configuration

Configuration: Device selection

The "Device Selection" page is identical to that one described in "Configuration: Device selection" on page 1226.

4.8.6.10 LTE scanner subband view

This view works analog to Chapter 4.8.6.3, "LTE scanner cell ID tracer view", on page 1222. The view shows the measured RS-SINR, RS-RSRP or RS.RSRQ subband values of one cell in its waterfall diagram.

The cell can be specified either by a physical cell identity (PCI) or a certain Top N member. The header section allows you to choose the LTE channel, the zoom factor and the combinations of Tx and Rx antennas for display. The "Value" combo-box in the header section allows switching between RS-SINR, RS-RSRP and RS.RSRQ display.

The selected value of the measured block is displayed in colors. The selected antenna combinations are displayed side by side. A Tooltip shows detailed information on the point below the mouse cursor. The active and the passive coupled focus is supported.

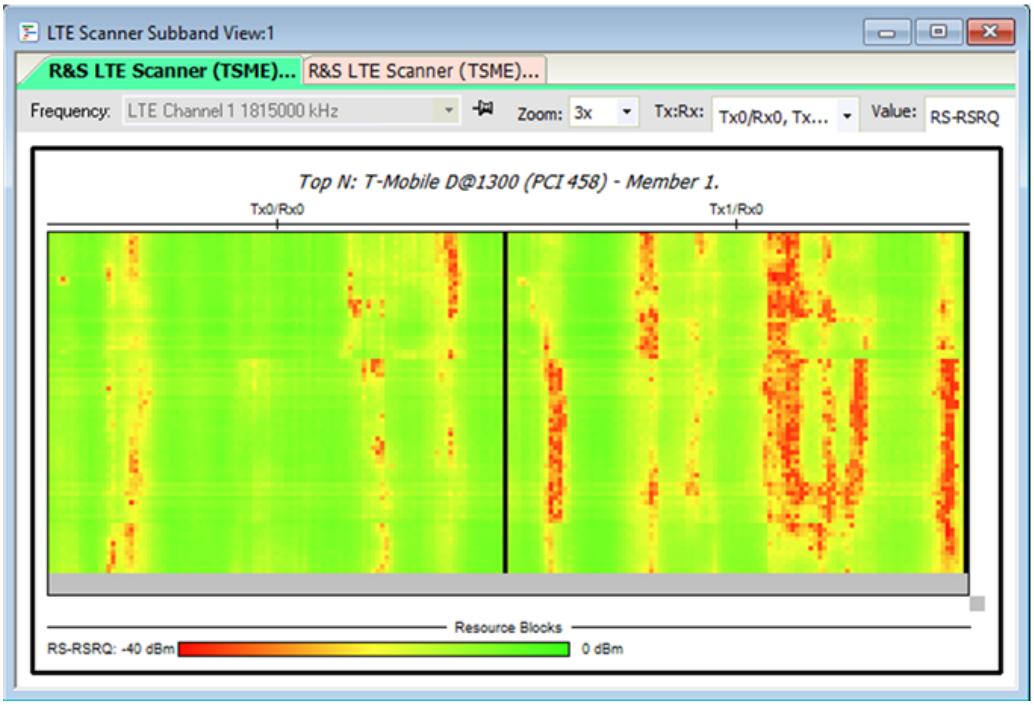


Figure 4-890: LTE Scanner Subband View

If the R&S ROMES NB-IoT scanner is configured to measure on that particular PRB, the "LTE Scanner Subband View" shows where NB-IoT PRBs are configured during the measurement. To avoid the overlapping between the NB-IoT PRBs, the view has added the NB-IoT indicators ▽ and the legend.

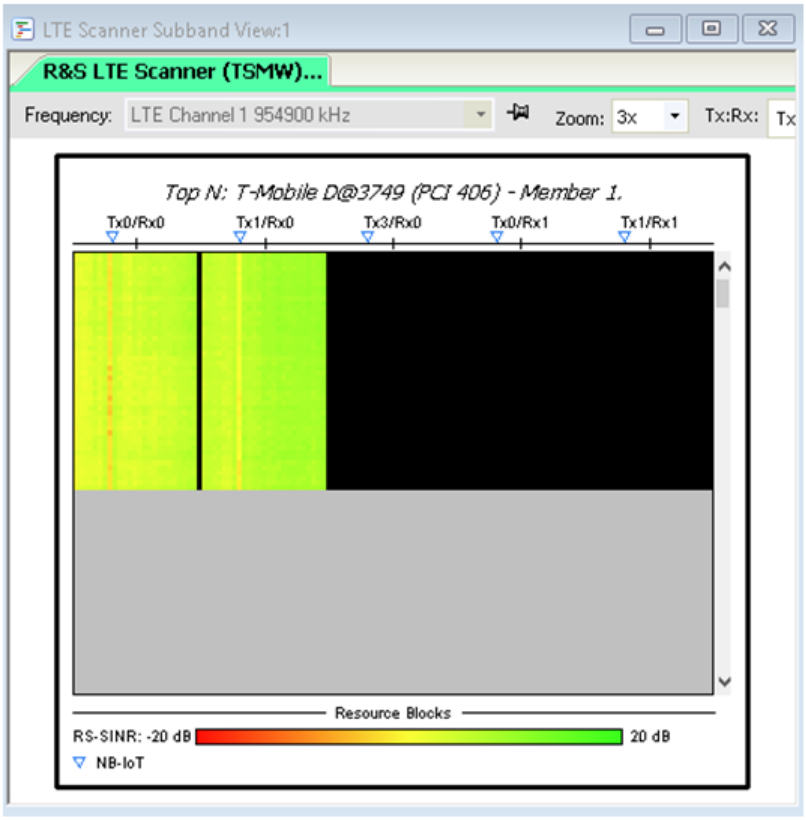


Figure 4-891: Indicators show configured NB-IoT PRBs

There is no change in the scanner subband view if NB-IoT is not present.

Suffix for WB subband RSRP and RSRQ signals

WB subband RSRP and RSRQ signals are marked with the NC suffix meaning noise clipping in the "Available Signals" > "LTE Scan" tree and in the associated Tooltips.

The suffix is intended to avoid naming confusion in the following signals:

- Top N Pool WB Subband RSRP(NC) and WB Subband RSRQ(NC) signals

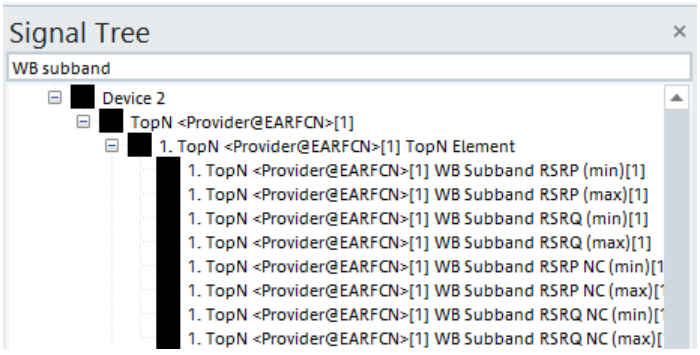


Figure 4-892: Top N pool WB subband signals

- Template WB Subband RSRP(NC) and WB Subband RSRQ(NC) signals

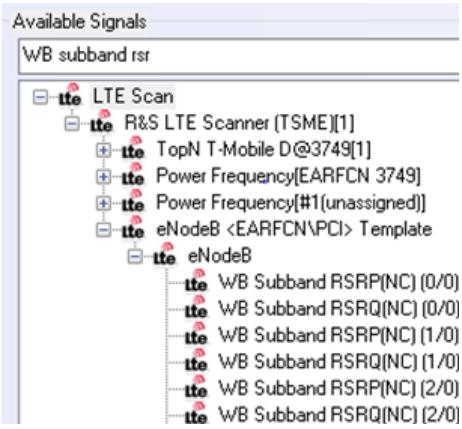


Figure 4-893: eNodeB template WB subband signals

- WB Subband RSRP(NC) signal Tooltip description
- WB Subband RSRQ(NC) signal Tooltip description

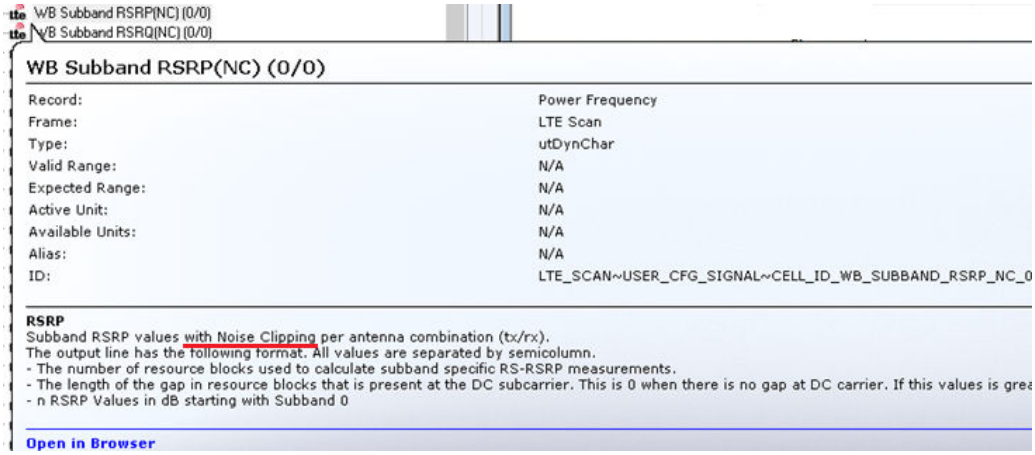
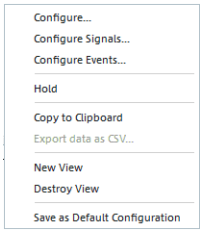


Figure 4-894: Example for the introduced WB subband Tooltips

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

LTE scanner subband view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Subband target selection

The "Subband Target Selection" option lets you select whether to be traced a signal with a definite Cell ID or a particular Top N element.

Configuration: Subband view

The "Subband View" option lets you set supported parameters for RS-SINR, RS-RSRP or RS-RSRQ and scale diagrams and the colors in the view.

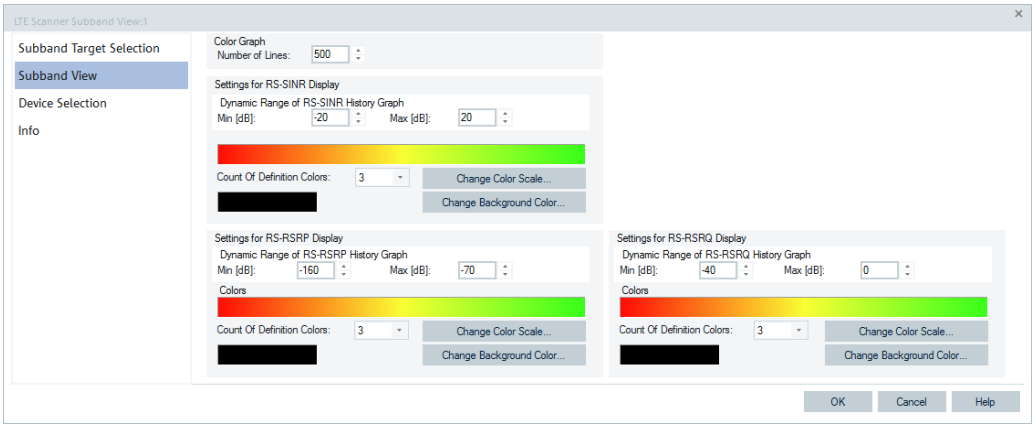


Figure 4-895: LTE Scanner Subband View - configuration

Configuration: Device selection

The "Device Selection" page is identical to that one described in "Configuration: Device selection" on page 1226.

4.8.6.11 LTE scanner throughput estimation 3D chart view

The "LTE Scanner Throughput Estimation 3D Chart View" visualizes the current estimated throughput and CQI of each subband of a selected Top N member or PCI in 3D chart.

The cell can be specified either by PCI or certain Top N member.

Each LTE scanner throughput estimation view has a header for fast view configuration.

The header section of the "LTE Scanner Throughput Estimation 3D Chart View" lets you visualize the following parameters:

- LTE channel in the "Frequency" combo box
- Transmission modes and spatial layers if an item is selected in the "Transmission Mode / Layer" drop-down box

- CQI or estimated throughput (Est. TP) for each subband in the "Value" combo box
  The bars of the CQI values are colored by the color definition of the corresponding Est. TP values. The bars of the Est. TP values are colored by the color definition of the corresponding CQI values.

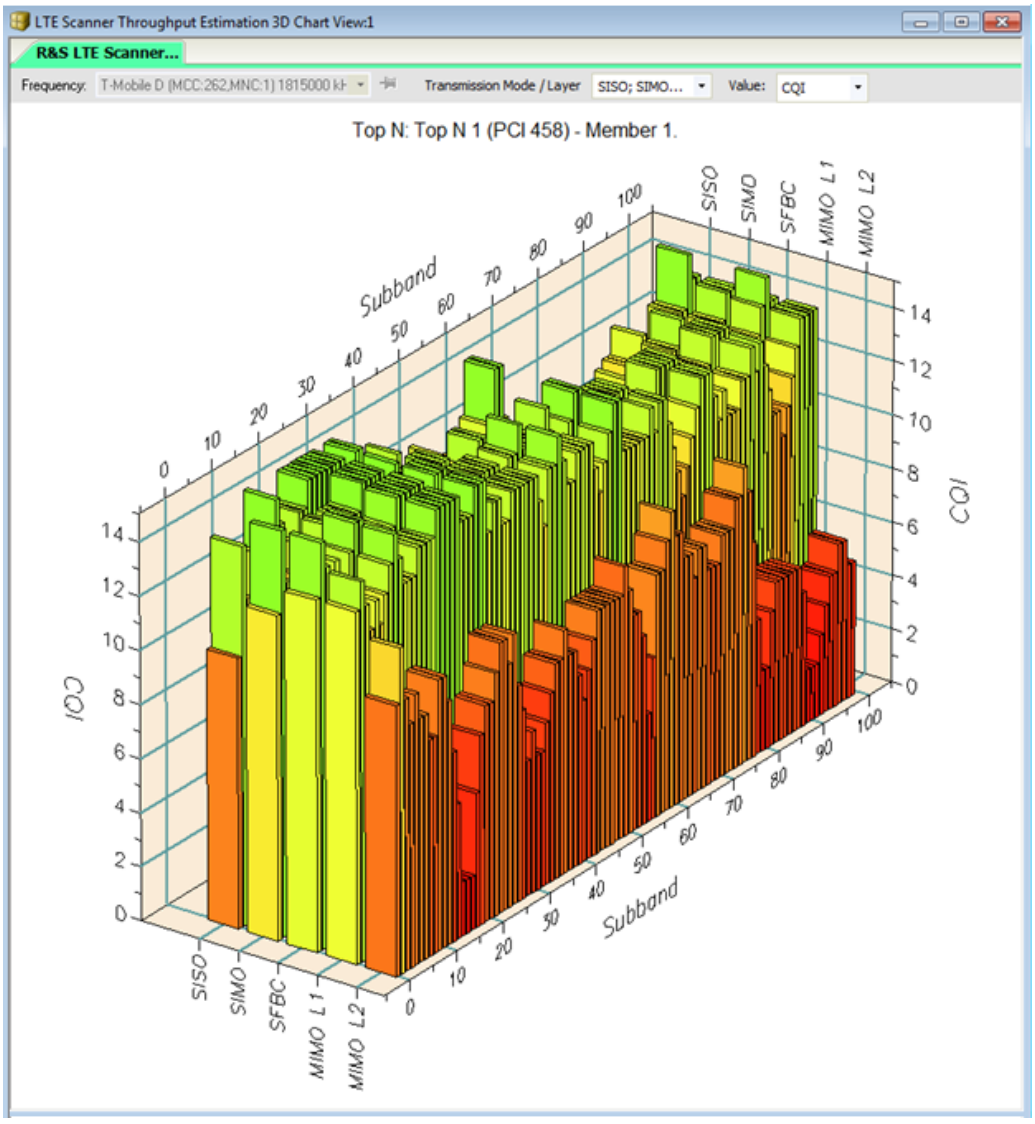


Figure 4-896: CQI 3D chart view

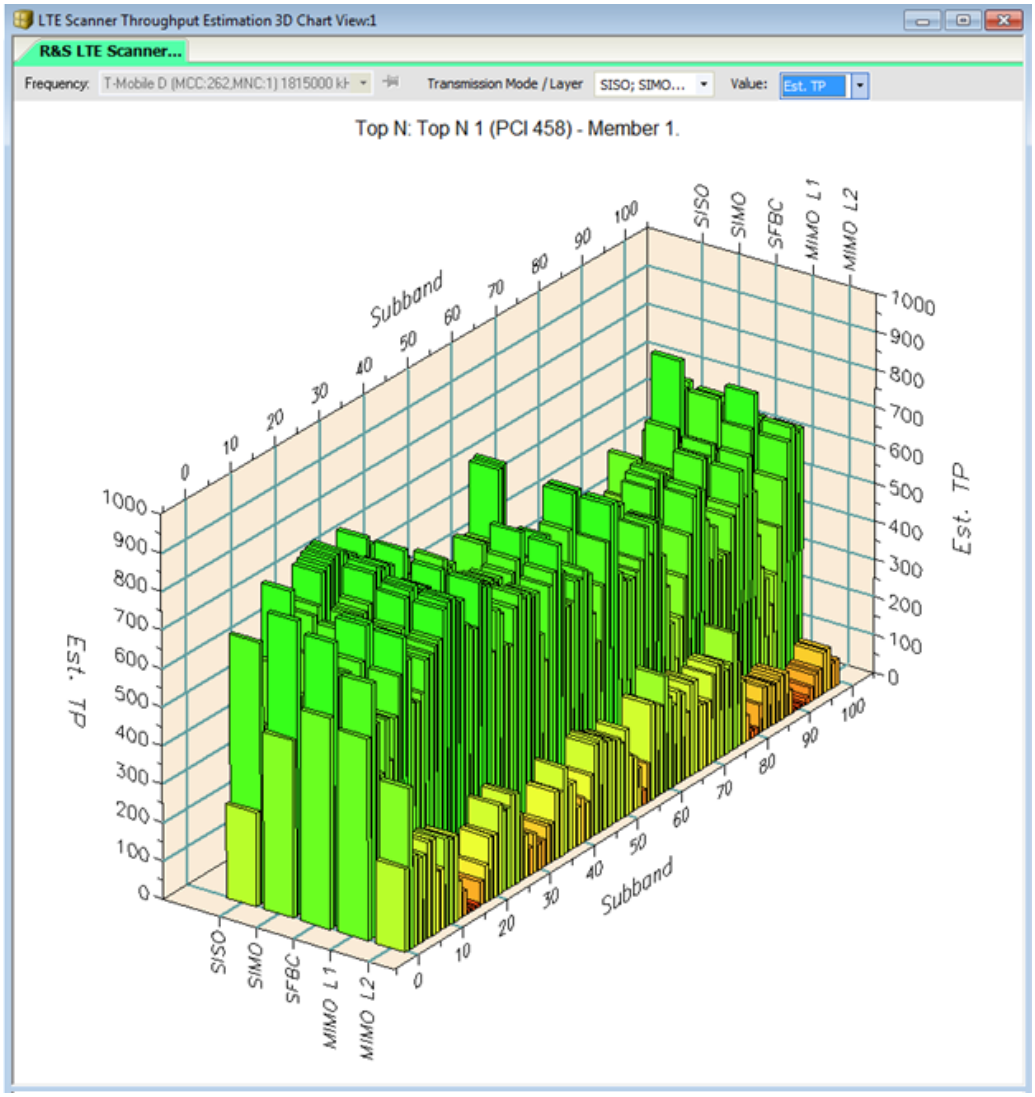


Figure 4-897: Throughput estimation 3D chart view

Passive coupled focus is supported.

The definitions of the transmission modes and the value display are coupled. If the transmission mode or value display of one of the throughput estimation views changes, the other views of the same view instance are updated with these definitions.

LTE scanner throughput estimation 3D chart view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Subband target selection

The "Subband Target Selection" option lets you select to trace signals, which you want to be displayed in the view, via fixed PCI or as the members of the selected Top N pool.

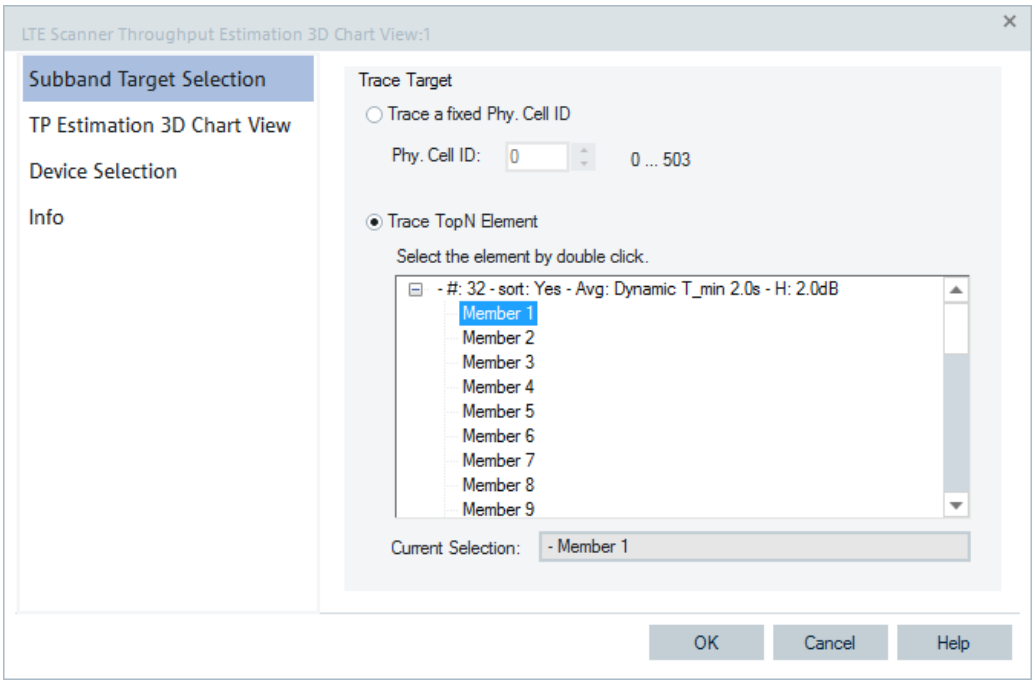


Figure 4-898: Subband target selection - configuration

Trace Target
The option buttons lets users select either a signal with a definite Cell ID or a particular Top N element to be traced.

- "Trace a fixed Cell ID"
  Define a fixed Cell ID for trace.
- "Trace Top N Element"
  List of all Top N pools defined in the scanner configuration menu. If the "Trace TopN Element" is checked, a Top N member of a pool in the list can be selected for trace.
- "Current Selection"
  Shows the current selection.

Configuration: TP estimation 3D chart view

The "TP Estimation 3D Chart View" option lets you scale the diagrams and sets the colors of the CQI or Est. TP history graphs in the throughput estimation 3D chart view. The panels include combo boxes for defining the range and the color of CQI and Est. TP.

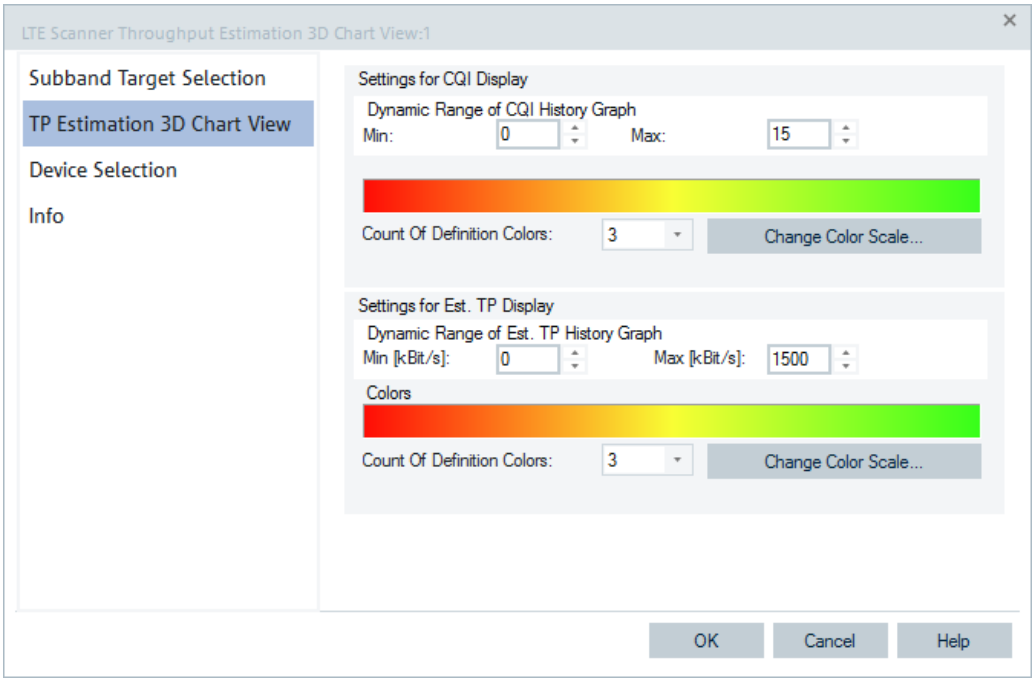


Figure 4-899: Throughput estimation 3D chart view - configuration

The input fields in the "Settings for..." panels define the minimum and the maximum CQI and estimated throughput values to be displayed in the diagrams of the view.

Signals that exceed the configured dynamic range are not displayed.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

4.8.6.12 LTE scanner throughput estimation chart view

The "Throughput Estimation Chart View" visualizes the current estimated throughput and CQI for each subband of a selected Top N member or a selected PCI.

The cell can be specified either by a physical cell identity (PCI) or a certain Top N member.

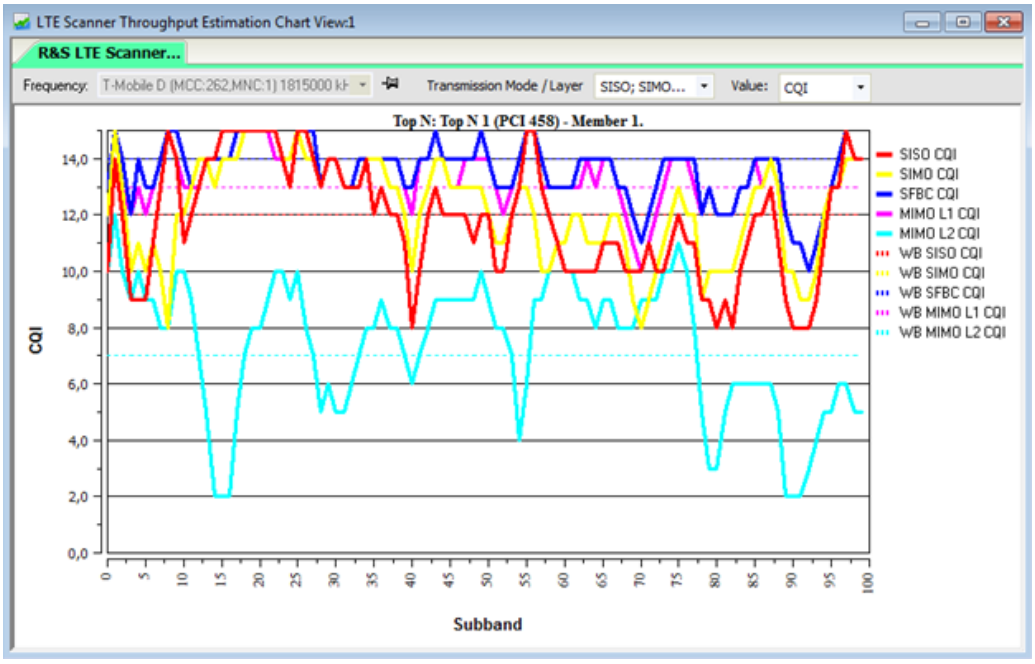


Figure 4-900: CQI chart view

The view displays the CQI or Est. TP value for each subband of the measured block. The selected transmission modes/spatial layers are displayed in different (automatically assigned) colors. The mean wideband CQI or Est.TP (total measured WB CQI or Est. TP divided by the count of subbands) is displayed in a dotted line for each transmission mode. The spatial layer is displayed in the same color as the corresponding subband value.

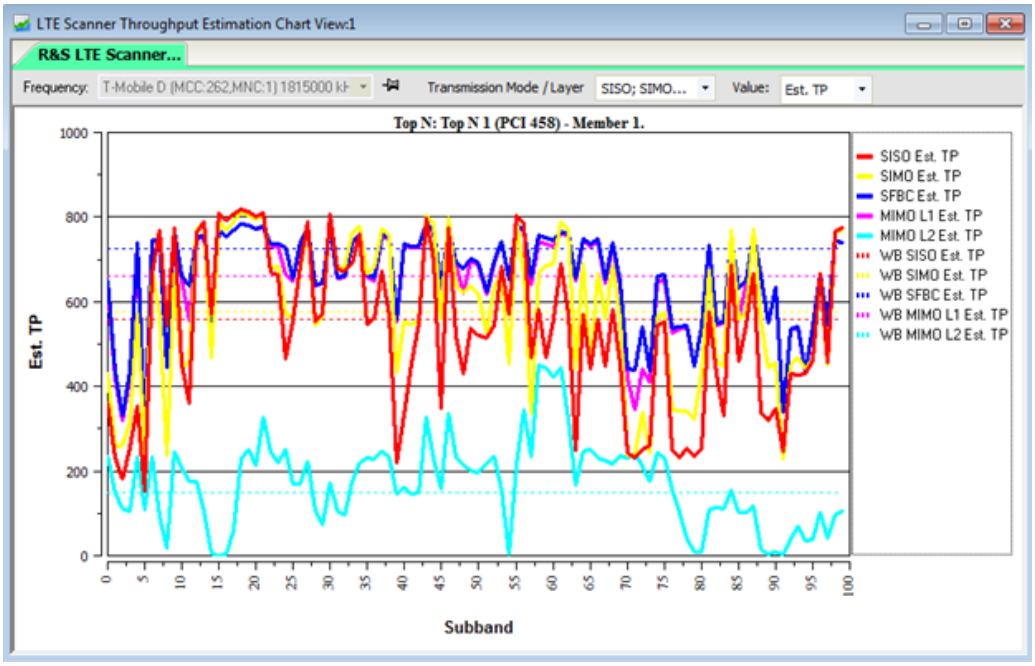


Figure 4-901: Throughput estimation chart view

The header section of the "LTE Scanner Throughput Estimation Chart View" allows users to visualize the following parameters using the available combo boxes.

- LTE channel in the "Frequency" combo box
- Transmission modes and spatial layers if an item is selected in the "Transmission Mode / Layer" drop-down box
- CQI or estimated throughput (Est. TP) for each subband in the "Value" combo box

Passive coupled focus is supported.

LTE scanner throughput estimation chart view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Subband target selection

The "Subband Target Selection" page is the same as one of the "Throughput Estimation 3D Chart View", see "LTE scanner throughput estimation 3D chart view configuration" on page 1250.

Configuration: TP estimation chart view

The "TP Estimation Chart View" option lets you scale the diagrams of the CQI or Est. TP history graphs in the throughput estimation chart view. The tab's panels include combo boxes for defining the range of displayed CQI and estimated throughput in this view.

Signals exceeding the dynamic range are not displayed.

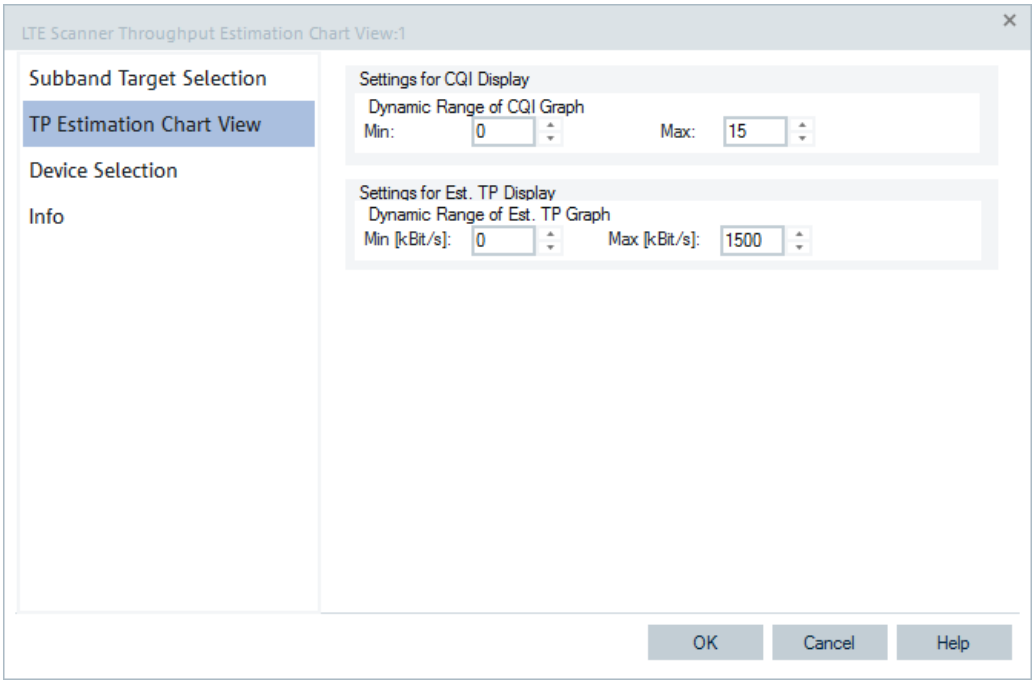


Figure 4-902: Throughput estimation chart view - configuration

Configuration: Device selection

See "Configuration: Device selection" on page 1252.

4.8.6.13 LTE scanner throughput estimation subband view

The "Throughput Estimation Subband View" visualizes the current estimated throughput and CQI for each subband of a selected Top N member or a selected PCI in a waterfall diagram. The cell can be specified either by a PCI or a certain Top N member.

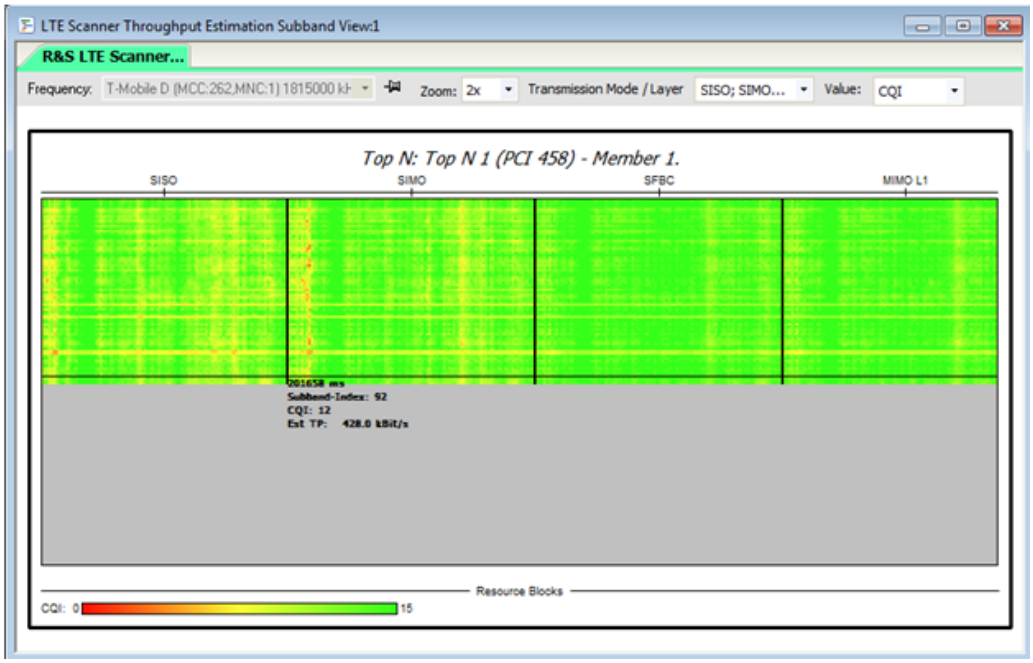


Figure 4-903: CQI Subband View

The view displays the CQI or Est. TP value of the measured block in color. The selected transmission modes/spatial layers are displayed side by side. A Tooltip shows detailed information on the point below the mouse cursor.

Figure 4-904: Throughput Estimation Subband View

The header section of the "LTE Scanner Throughput Estimation Subband View" allows users to visualize the following parameters:

- LTE channel in the "Frequency" combo box
- Zoom factor in the "Zoom" combo box
- Transmission modes and spatial layers if an item is selected in the "Transmission Mode/Layer" drop-down box

- CQI or estimated throughput (Est. TP) for each subband in the "Value" combo box

Active and passive coupled focus is supported.

LTE scanner throughput estimation subband view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Subband target selection

See "Configuration: Subband target selection" on page 1251.

Configuration: TP estimation subband view

The "TP Estimation Subband View" option lets you scale the diagrams and sets the colors of the CQI or Est. TP history graphs in the throughput estimation subband view. The panels include combo boxes for defining the range and the color of CQI and Est. TP history graphs.

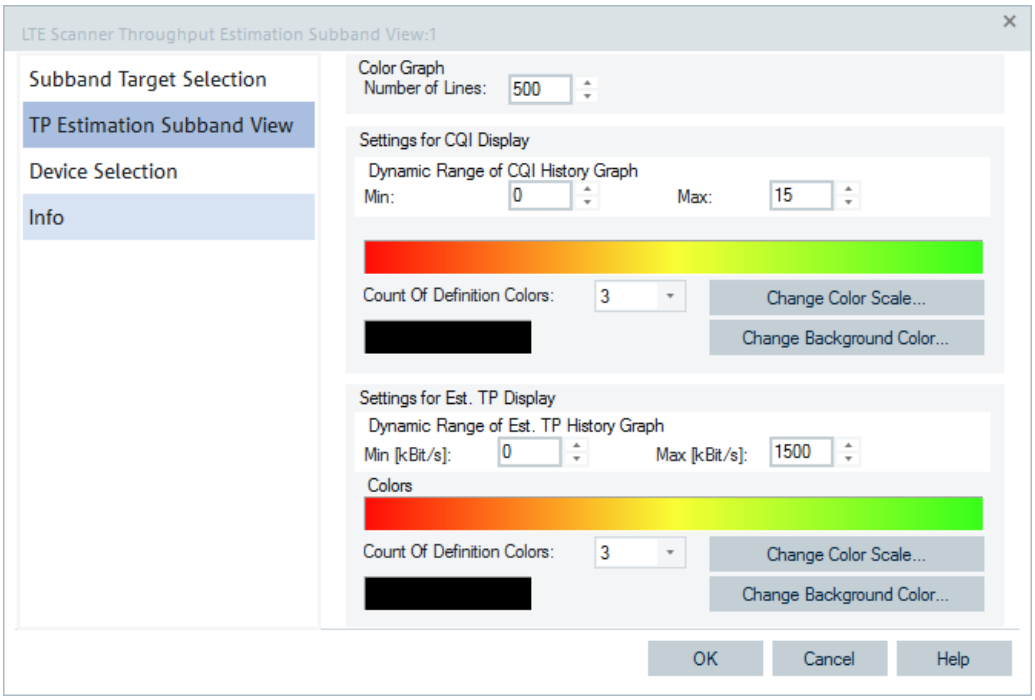


Figure 4-905: Throughput estimation subband view settings

Configuration: Device selection

See "Configuration: Device selection" on page 1252.

LTE scanner throughput estimation signals

The following signals are available in the Top N tree and every defined PCI tree.

- Wideband CQI for each transmission mode and spatial layer
- Wideband Est. TP for each transmission mode and spatial layer
- Min. Subband CQI for each transmission mode and spatial layer
- Max. Subband CQI for each transmission mode and spatial layer
- Average Subband CQI for each transmission mode and spatial layer
- All Subband CQI as text for each transmission mode and spatial layer
- Min. Subband Est.TP for each transmission mode and spatial layer
- Max. Subband Est.TP for each transmission mode and spatial layer
- Average Subband Est.TP for each transmission mode and spatial layer
- All Subband Est.TP as text for each transmission mode and spatial layer

For the detailed signal description, see the "Description of R&S ROMES4 Signals" document.

4.8.6.14 LTE scanner Top N view

The "LTE Scanner Top N View" shows the parameters of the signals received from the eNodeBs. These signals are the selected elements of the "Top N Columns" > "List" pane in the scanner configuration menu, see Figure 4-926.

A Top N pool includes cells which have the strongest power, SINR, Cue or RSRP at a given position and time. The cells are presented with several of their parameters, for example, PCI, RSRP and RSRQ.

The columns in "LTE Scanner Top N View" > "List" carry the full names of the parameters.

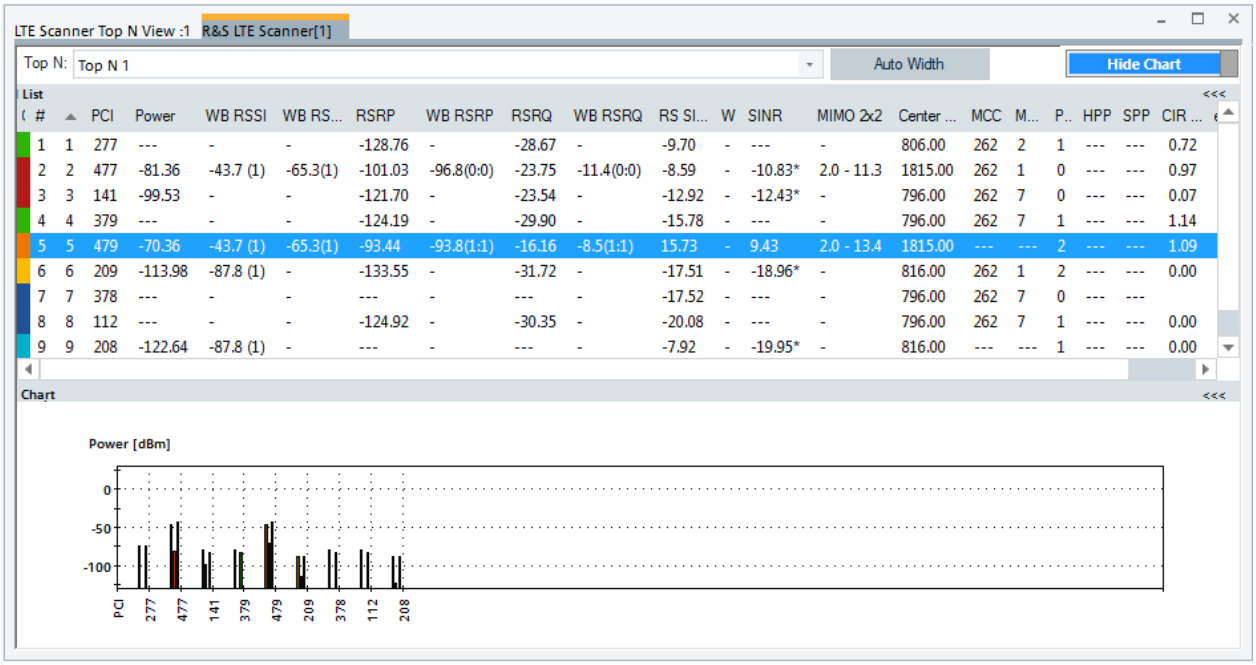


Figure 4-906: LTE Scanner Top N View - detailed

Scanner Top N view shows multiple EARFCN

The default EARFCN(MFBI) column shows the current frequency value of the cell as received in SIB 1 “multiBandInfoList” or “multiBandInfoList_v9e0” field. The "EARFCN" optional column shows the primary band EARFCN value of the given Top N pool if the signal is selected for display in the "TEC for LTE Scanner" > "Top N Settings".

Select "Show All TopN Pools" in the "Top N" box for a pool name. All Top N pools are shown. Those ones having both primary and multifrequency band EARFCN for the given channel are recognized by showing two EARFCN values.

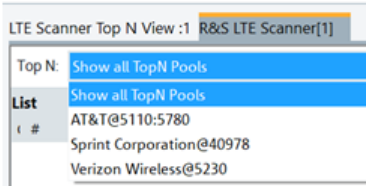


Figure 4-907: All Top N pools shown

The primary band EARFCN is shown first and the EARFCN(MFBI) follows separated by a “:” in the pool name.

The EARFCN signals are visualized in the basic views, example given, in the "Alpha-numeric View".

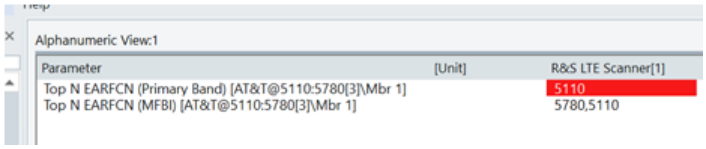


Figure 4-908: Primary and multifrequency band EARFCNs in Alphanumeric View

Scanner Top N view shows LTE-M

The optional column "LTE-M" in the "List" of the view shows if LTE-M is available on the selected eNodeB. To have the column displayed, go to the configuration screen and check the "LTE-M" check box, see Figure 4-926.

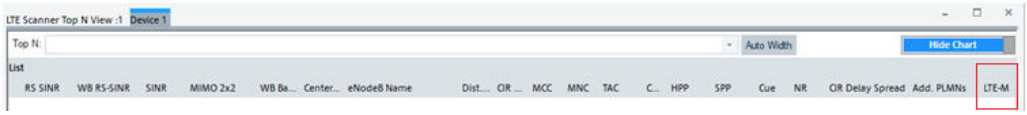


Figure 4-909: LTE-M column in the LTE Scanner Top N view list

The following values of the LTE-M column can be shown during replay or measurement:

- "yes": LTE-M present
- "no": LTE-M not present
- "-": MIB of the eNodeB not detected

Scanner Top N view shows eNodeB name

The list contains the column "eNodeB Name" among other ones. To see the eNodeB name, the transmitter database has to contain the provider name and the channel number.

At least are needed:

- EARFCN and PCI or
- EARFCN, TAC and Cell ID

Two types of search for eNodeB name are available:

- PCI partial search
  PCI partial search is based on EARFCN and PCI. The result can contain more than one record. The geographically closest station is displayed.
- PCI full search
  Full search is based on EARFCN, TAC and CellID. The result is unique with both name and ECIs.

If provider or channel information (EARFCN) is missing, the eNodeB name is not available.

eNodeB name and ECI are generated in steps during the decoding of information blocks.

1. By detecting a cell, MIB is decoded first. At this moment, only EARFCN and PCI are available. PCI search is performed and ECIs is not available.

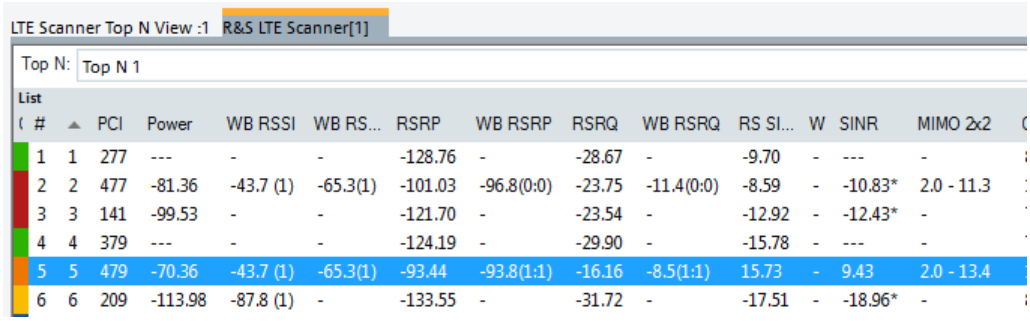
2. After receiving SIB1, the full search can be performed and both eNodeB name and ECIs become available.

Scanner Top N view shows wideband measurements

WB RSSI Min (not shown by default), WB RSSI, WB RSRP, WB RSRQ and WB SINR signals improve the display of the wideband measurement results in the basic views, see Chapter 4.2, "Basic views", on page 445.

The wideband (default) columns show the maximum value of the measured corresponding signal over all antennas or antenna combinations (Tx/Rx). Display of antenna/antenna combination is given in parentheses. For example, a WB RSSI of -95.8 (2) means that this RSSI value was measured on antenna 2, and that the RSSI value measured on antenna 1 is less than or equal to -95.8 dBm.

For the frontend configuration in the previous figure, see Chapter 6.4.15, "LTE scanner", on page 1726.



(	#	▲	PCI	Power	WB RSSI	WB RS...	RSRP	WB RSRP	RSRQ	WB RSRQ	RS SI...	W	SINR	MIMO 2x2
	1	1	277	---	-	-	-128.76	-	-28.67	-	-9.70	-	---	-
	2	2	477	-81.36	-43.7 (1)	-65.3(1)	-101.03	-96.8(0:0)	-23.75	-11.4(0:0)	-8.59	-	-10.83*	2.0 - 11.3
	3	3	141	-99.53	-	-	-121.70	-	-23.54	-	-12.92	-	-12.43*	-
	4	4	379	---	-	-	-124.19	-	-29.90	-	-15.78	-	---	-
	5	5	479	-70.36	-43.7 (1)	-65.3(1)	-93.44	-93.8(1:1)	-16.16	-8.5(1:1)	15.73	-	9.43	2.0 - 13.4
	6	6	209	-113.98	-87.8 (1)	-	-133.55	-	-31.72	-	-17.51	-	-18.96*	-

Figure 4-910: LTE Scanner Top N View for antenna ports 0 and 3

The Tooltips of WB RSRP and WB RSRQ column of this view show Noise Clipping.

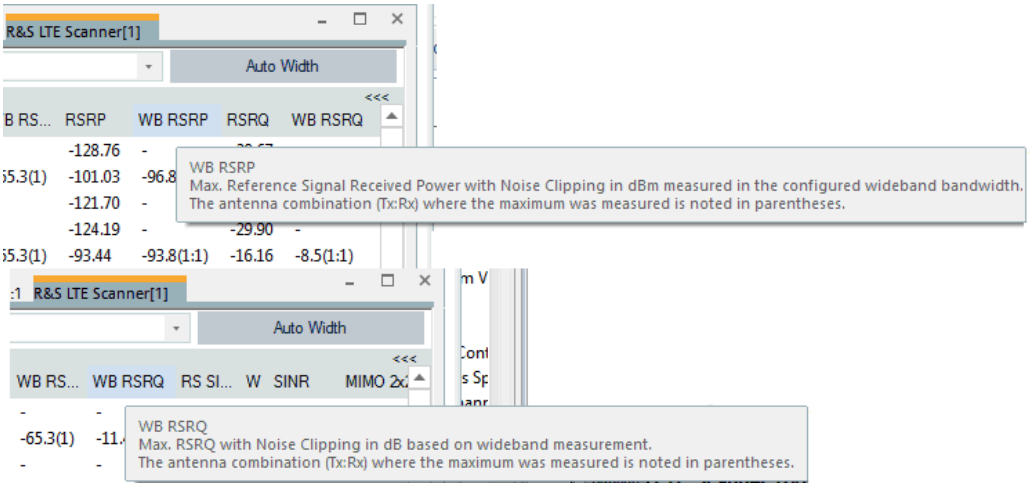


Figure 4-911: Measured wideband signals Tooltips

Scanner Top N view for automatic pool configuration

The scanner Top N view of the R&S ROMES 3GPP technologies displays the all “automatically configured Top N pools" on the screen.

If you select "Top N Pools" > "Automatic Pool Configuration" for a corresponding technology, the Top N selector control gets the additional entry "Show all TopN Pools" in the view.

By selecting this entry, you can see all Top N pools in the list. The number of displayed members per pool depends on the size of the window. It is calculated automatically in such a way that all Top N pools can be observed without scrolling the list (if even one member does not fit, scrollbars are added).

The signals and their decision values which users can select for ranking of the Top N pools are available in the "Available Signals" tree.

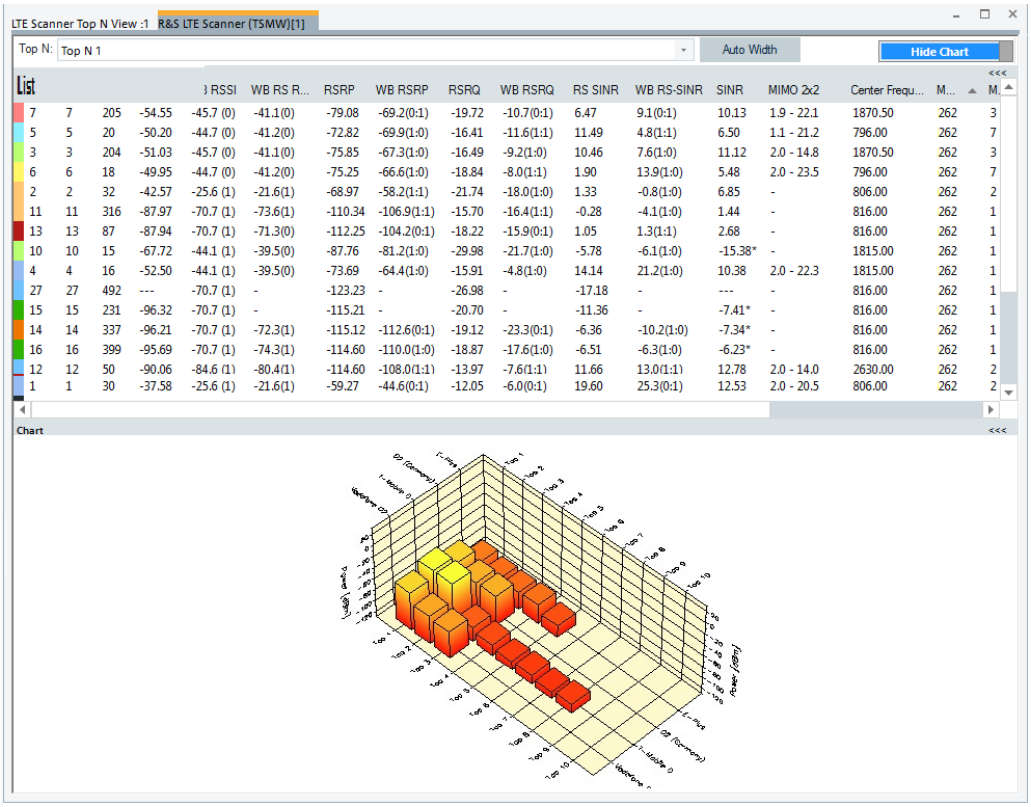


Figure 4-912: LTE scanner - all Top N pools and Top N chart

The "Chart" panel is shown in 3D in case the automatic Top N pool configuration active. The values of the selected signal used for ranking and display are shown as 3D bars.

The Top N chart can be rotated moving the mouse while pressing the left button (x-axis, y-axis and z-axis when pressing the CTRL key additionally). Press the R key to reset the 3D chart to its default orientation.

The configuration of the Top N view allows to configure the colors for the 3D chart and the minimum and maximum for the Top N values.

The color of each bar represents the state of the signal based on the signals color scale defined in the "Available Signals" configuration page. Typically this is green for high values and red for low values.

You have the option to display the Top N pools as the grid with 2D charts instead of the standard 3D bar chart.

To enable the grid with 2D bar charts, click on the "Show Grid" slider at the right top if the 3D "Chart".

You may return to the 3D chart at any time by clicking the "Show 3D" slider at the right top if the 2D "Chart".

For the Scanner Top N view the grid arrangement is dynamic to allow the best use of space to display as many pools as possible.

Note: The maximum size of the grid is to be 6 columns and 3 rows.

The following figure shows how many rows and columns to expect in the grid.

Number of Pools	Grid Cols	Grid Rows
1	1	1
2	2	1
3	3	1
4	2	2
5	3	2
6	3	2
7	3	3
8	3	3
9	3	3
10	4	3
11	4	3
12	4	3

Figure 4-913: Allowed sizes of the grids in 2D chart

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

Top N

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.
- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

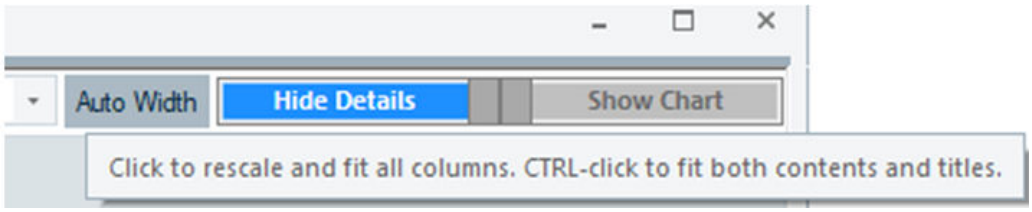


Figure 4-914: ToopTip for adjustment

If you start R&S ROMES4 with an empty workspace, the initial widths of the columns in "Top N View" are initialized and scaled properly based on the current screen DPI setting.

Top N list

The "List" gives an overview of the received signals in the current Top N pool together with their measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

It is possible to show or hide each individual table column in the view configuration menu. Up to three differently named pools can be configured in the default setup. Each pool has several configurable parameters.

The list contains the following columns:

- "Color"
  Applies the configured color scale for the pool members.
- "#"
  Number of the measured cell and Cell ID within the Top N pool.
- "TopX"

Current rank within the Top N Pool.

- "PCI"
  Physical Cell Identity, unique physical-layer cell identifier.
- "Power [dBm]"
  Received signal power based on S-Sync (average/maximum/minimum/last value taken in observation period, depending on the Top N pool settings).
- "WB RSSI Min"
  Wideband Receive Signal Strength Indicator Min
  Minimum received signal power in dBm based on wideband measurement, see the following figure. The Tx antenna where the minimum was measured is noted in parentheses.
  The column is not shown by default.

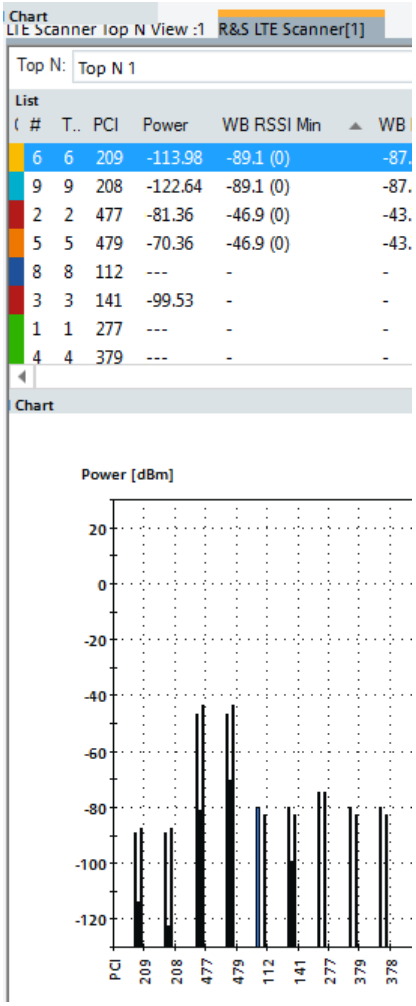


Figure 4-915: WB RSSI Min column in Top N list and chart

- "WB RSSI"
  Wideband Receive Signal Strength Indicator
  Maximum received signal power in dBm based on wideband measurement. The Tx antenna where the maximum was measured is noted in parentheses.
- "WB RS RSSI"

Maximum received signal power in dBm observed only in OFDM symbols containing reference symbols for antenna port 0 (OFDM RS symbols in slot 0 & 4) based on wideband measurement. The Tx antenna where the maximum was measured is noted in parentheses.

- "RSRP"
  Reference Signal Received Power, unit [dBm]
  It is the linear average over the power contributions (in [W]) of the resource elements that carry cell-specific reference signals within the 6 innermost resource blocks.
  If receiver diversity is in use by the UE, the reported value cannot be lower than the corresponding RSRP of any of the individual diversity branches (3GPP TS 36.214).
- "WB RSRP"
  Maximum wideband Reference Signal Received Power per antenna combination (Tx/Rx). The reference signal is like a pilot signal. RSRP is a measure of signal strength and indicates the average received power over the resource elements that carry cell-specific reference signals within a certain frequency bandwidth.
- "RSRQ"
  Reference Signal Received Quality, unit [dB]
  The signal is the ratio N×RSRP/(E-UTRA carrier RSSI), where N is the number of RBs of the E-UTRA carrier RSSI measurement bandwidth. The measurements in the numerator and denominator are made over the same set of resource blocks. E-UTRA Carrier Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in OFDM symbols containing reference symbols for antenna port 0, in the measurement bandwidth, over N number of resource blocks by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc. (3GPP TS 36.214)
- "WB RSRQ"
  Wideband maximum RSRQ per antenna combination (Tx/Rx). The reference signal is like a pilot signal. RSRQ is a measure of quality (similar to C/I). It is defined as (N*RSRP)/(E-UTRA Carrier RSSI). The carrier RSSI measures the average total received power observed only in OFDM symbols containing reference symbols for antenna port 0 (OFDM RS symbols in slot 0 & 4) in the measurement bandwidth over N resource blocks. The total received power of the carrier RSSI includes the power from co-channel serving & non-serving cells, adjacent channel interference, thermal noise, etc.
- "RS SINR"
  Signal-to-Interference-plus-Noise Ratio measured in the 6 innermost resource blocks per antenna combination (Tx/Rx).
- "WB RS-SINR"
  Maximum Signal-to-Interference-plus-Noise Ratio measured on RS in the configured wideband bandwidth per antenna combination (Tx/Rx).
- "SINR"
  Signal-to-Interference-plus-Noise Ratio averaged over SSYNC and PSYNC SINR for strong cell in [dB]. The value is marked with "*", if only SSYNC was measured what is the case when the weak cell is measured.
- "MIMO nxm"

The characteristics of the eNodeB, that is, the average Rank Indicator (RI) and Condition Number (CN) in dB, where n, m is 2 and/or 4. MIMO 2x2 is the default setting in the "LTE Scanner Top N View" configuration dialog, as shown in the following figure.

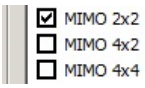


Figure 4-916: Default MIMO configuration

If MIMO 4x2 and/or MIMO 4x4 are selected, the associated measured RI and CN values are also shown in the Top N List.

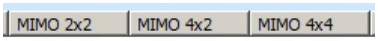


Figure 4-917: Top N list - detail

- "WB Bandwidth"
  Detected wideband bandwidth [MHz]
- "Center Frequency"
  Center frequency of the used channel, unit [GHz]. According to standard IEEE 802.16.
- "eNodeB Name"
  LTE base station's name
- "Dist.(km)"
  Distance to the eNodeB.
- "CIR out of CP"
  CIR values in percent that are outside of the Cyclic Prefix.
- "ECI(20/8), ECI(28)"
  EUTRAN Cell Identifier columns, showing the 28 bits long string, are added to the "Top N List". The information is the same as the one in the ECGI column, but the formatting of these parameters in the list is different.

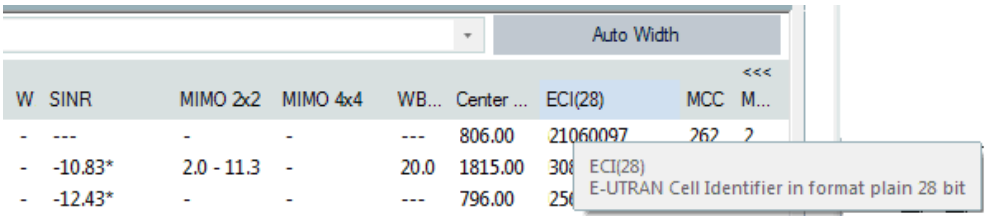


Figure 4-918: ECI in the Top N list

- "EARFCN"
  Evolved Absolute Radio Frequency Channel Number, see the "Scanner Top N View Shows Multiple EARFCN" section.
- "ECGI"
  Evolved Cell Global Identity
  Cell Identifier: CellID*256 (or << 16) + eNodeB ID
- "MCC"
  Mobile Country Code
- "MNC"

Mobile Network Code

- "TAC"
  Tracking Area Code
- "Cyclic Prefix"
  Cyclic Prefix type
- "Physical-Layer Cell Identity"
  A part of PCI, identifies a cell in the group. Possible value 0, 1 or 2
- "HPP"
  Hard Pilot Pollution of the eNode B signal
- "SPP"
  Soft Pilot Pollution of the eNode B signal
- "Cue"
  The Cue criterion is used for UE emulation-based Top N ranking. At the point in time, the ranking has to be performed. If selected, this algorithm calculates the Cue for the detected cells and is used for sorting.
  To calculate the Cue, that it is necessary to decode the broadcast message which delivers the PLMN and the Cell Identity (SIB1). Only cells for which this information is available are fed into the ranking algorithm.
- "NR"
  Neighbor relation is the percentage of cells in the current Top N pool, which are members of the specific cells intra-frequency neighbor list. It is available only after demodulation of SIB4.
- "4G Drift"
  The time drift against the receiver time, expressed in ns
- "Frame Time of Arrival Offset to PPS"
  LTE frame time of arrival offset to PPS given in ms
- "CIR Delay Spread"
  Time between the first and the last peak in the CIR sync measurement
- "eNodeB Tx Ports"
  Number of eNodeB Tx antenna ports decoded from MIB
- "Add. PLMNs"
  Additional PLMNs shared with this eNodeB, see "Top N pool signal settings" on page 342.
  Note: The shown MCC and MNC signals of the eNodeB in the "List" are always related to the primary PLMN. However, for Top N pools, filtering of eNodeB signals accounts all PLMNs that are in the list. The mentioned signals are shown in the "Add. PLMNs" column, see the following figure.

CIR...	ECI(20...	MCC	MNC	TAC	C...	HPP	SPP	Cue	NR	CIR...	eN...	Add. PLMNs
0.0	11222...	232	10	10143	N	1	1.9	49.4	---	1.03	2	232/5;
0.0	11239...	232	10	10143	N	---	---	43.1	---	0.00	2	232/5;

Figure 4-919: MCC and MNC of additional PLMNs

- "MIB DL Bandwidth"
  LTE downlink bandwidth decoded from MIB, expressed in MHz.
- "SIB eMBMS / DSS"

SIB2 eMBMS subframe configuration. For details, see "Description of R&S ROMES4 Signals".

- "LTE-M"
  Shows if LTE-M is available on the selected eNodeB. To have the column displayed in the "Top N" table, check the associated check-box in the "Top N Columns" list of the view's configuration page.
- "5G NR"
  The right-most column in the "LTE Scanner Top N View" > "List" table is dedicated to the LTE scanner support of 5G NR measurements.
  To have the column displayed in the table, check the "5G NR" check-box in the "Top N Columns" list. The possible displayed content is:
  – "-:" or "---" if there is no data
  – "no" if 5G NR is not supported
  – "yes" if 5G NR is supported
- "Sch. SIBs"
  Shows the SIBs scheduled in SIB1. The signal is available as a Top N template and a cell signal.

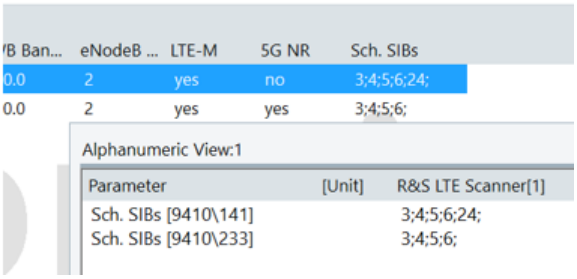


Figure 4-920: Scheduled SIBs displayed in two views

If the number of Top N members to display is limited, see "Measurement" on page 253, the red line at the bottom of the last displayed member appears. It is a hint that the Top N pool has more members and that some are not displayed.

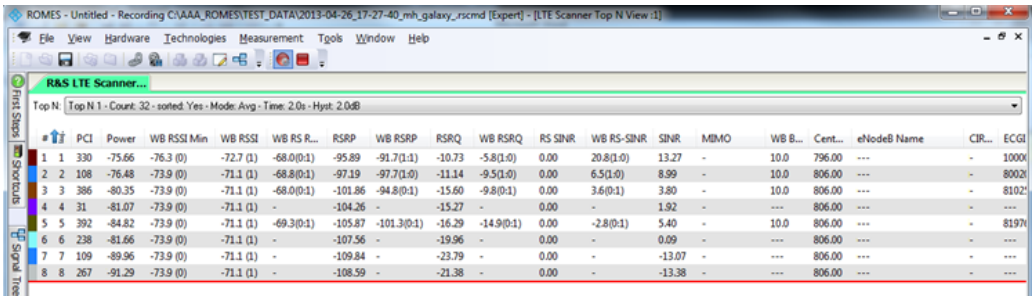


Figure 4-921: Limited display of Top N members - red line

Visualization of the Frame ToA Offset to PPS

The LTE frame time of arrival offset per PPS is calculated for all LTE cells. The result can be optionally visualized as the equally named signal in the "Alphanumeric View" and "2D Chart View". It is illustrated in the following figure.

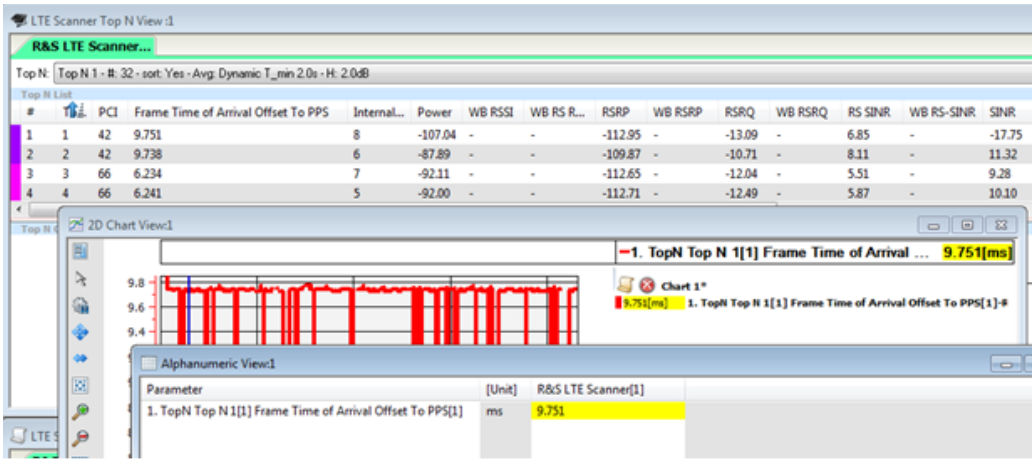


Figure 4-922: Frame time of arrival offset to PPS enabled

Visualization of the CIR delay spread signal

If activated in the "Top N Pool Signal Settings", the CIR Delay Spread signal values are displayed in this view and in the "Basic Views", see "Top N settings" on page 342.

The following figure illustrates the signal visualization in "Scanner LTE Top N View" (the last column in the figure) and "Alphanumeric View".

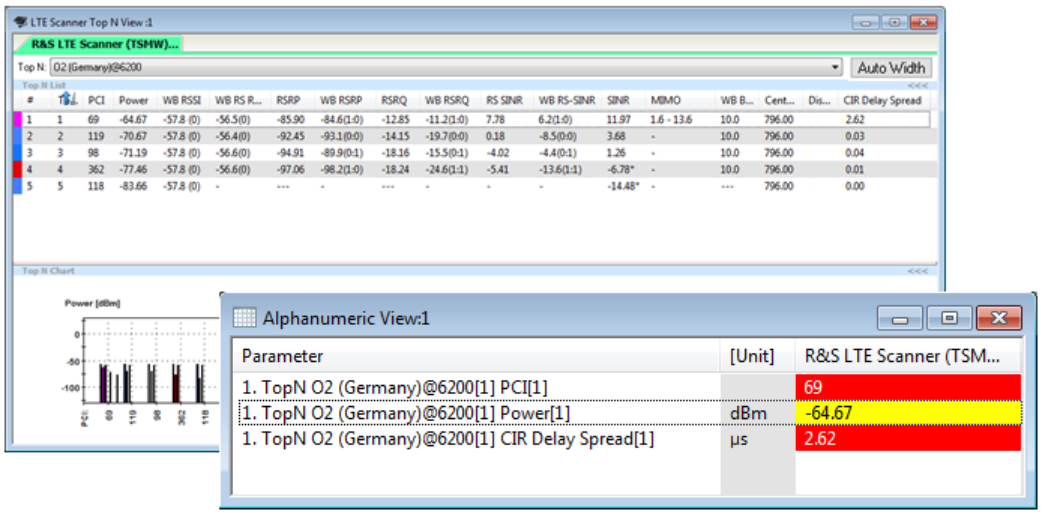


Figure 4-923: CIR Delay Spread visualization

Visualization of the eNodeB Tx antenna ports signal

If the function to create power signals for each PCI is activated, the LTE scanner's demodulator detects the number of Tx antenna ports of the eNodeB from MIB, see "LTE signals settings" on page 352). The signal is in that case included in the "Signal Tree" > "LTE Scan" tree, in the "eNodeB<EARFCN\PCI>Template" > "eNodeB" branch as "WB num. Tx Antennas (MIB]".

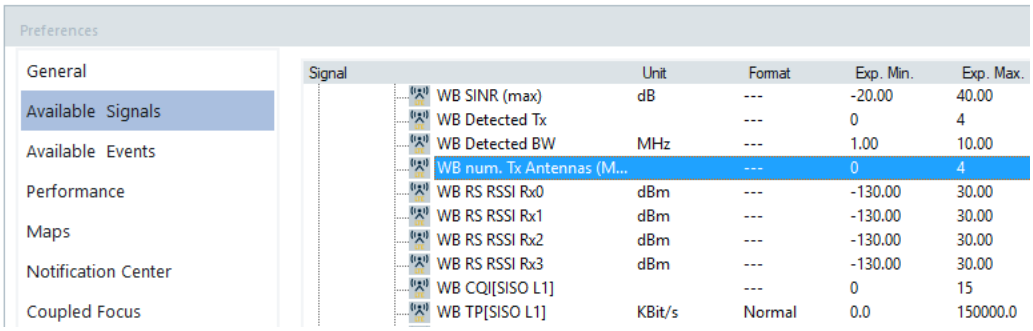


Figure 4-924: Number of Tx antenna port signals

The signal is visualized in the "Scanner LTE Top N View".

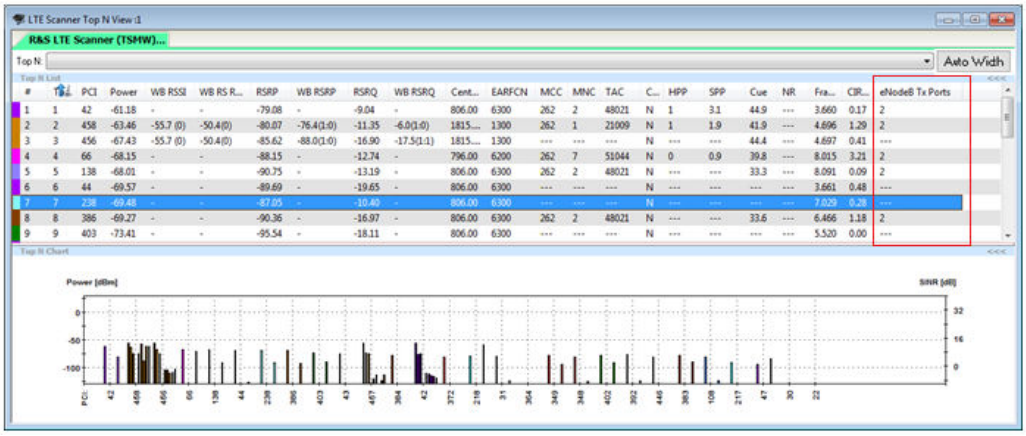


Figure 4-925: eNodeB Tx antenna ports visualization

Top N chart

The "Chart" shows the power and SINR as a 3D bar chart for all cells in the current Top N pool measurement.

The bars for available WB values are also shown in the chart. In this case, the Power/ RSSI and SINR/WB-SINR signals are displayed for each cell.

The bars of the WB values slightly differ in color from the default color of the cell. The bars of narrow band values are displayed in the exact color of the cell.

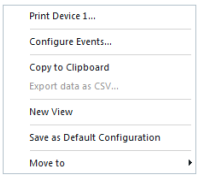
Up to eight bars per cell can be shown in the chart.

- The left side bars show: RSSI Rx1, Narrow band power, RSSI Rx2
- The right side bars stand for the quality values: SINR Rx1:Tx1, SINR Rx1:Tx2, Narrow band SINR, SINR Rx2:Tx1, SINR Rx2:Tx2.

In the Figure 4-915 the leftmost bar of each cell display shows the measured "WB RSSI Min" signal. The second bar is the "Power" and the third one is the "WB RSSI".

You can select the upper/lower power and SINR level for the y-axis of the chart in the configuration menu, see Figure 4-926.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

LTE scanner Top N view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Top N view

The "Top N View" option lets you the following:

- Selection of the Top N list contents.
- Selection of the power signal type to be displayed in the 2D/3D chart and used for ranking the pools. For example, the received signal power based on S-Sync signal or RSRP measured on the 6 innermost resource blocks can be selected as the first 2D and 3D chart value.
- Display the LTE-specific graph y-axis titles and limits in the chart, that is, the minimum and the maximum value to be displayed for the selected power signal in the view.
- Selection of the colors and the number of color definitions in the 3D chart view.
- Selection of the signal quality and/or wideband values (power and quality) to be displayed as a 2D chart option.

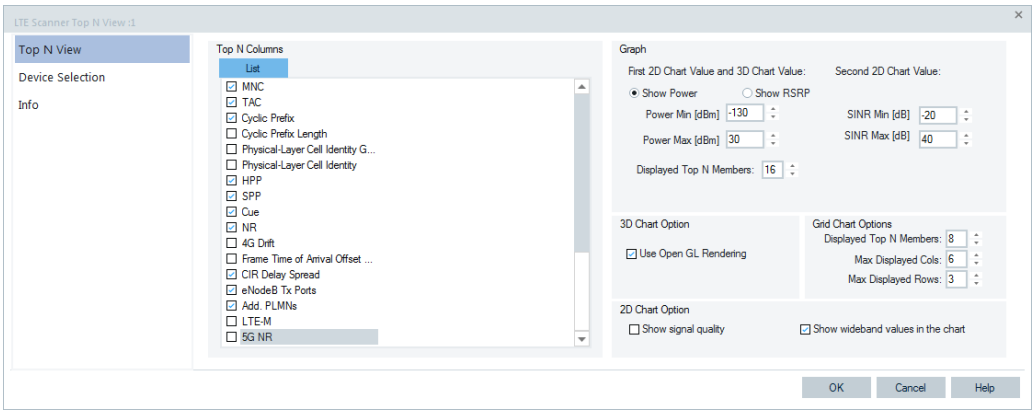


Figure 4-926: LTE Scanner Top N View - configuration

Graph

- "Show Power"
  Shows the received signal power based on S-Sync in the chart, if selected.
- "Show RSRP"
  Shows the Reference Signal Received Power in the chart, if selected.
- "Power Min/Max [dBm]"
  Set the upper and lower Power levels for the left y-axis of the chart.
- "SINR Min/Max [dBm]"
  Set the upper and lower SINR level for the right y-axis of the chart.

3D Chart Option ← Graph

- "Use Open GL Rendering"
  The option determines if the 3D chart uses the open GL (hardware) rendering or software rendering. Using open GL rendering allows faster rendering of the 3D chart.

Grid Chart Options ← Graph

- "Displayed Top N Members"
  The check box lets you select the number of Top N members that each chart in the grid displays.
- "Max Displayed Cols"
  The check box lets you select the maximum number of displayed columns in the grid. Allowed values are from 1 to 6.
- "Max Displayed Rows"
  The check box lets you select the maximum number of displayed rows in the grid. Allowed values are from 1 to 3.

2D Chart Option ← Graph

- "Show signal quality"
  If the option is selected, it shows the signal quality in the Top N chart. The option gives the possibility to switch "on" or "off" the second y-axis on the chart and quality signal bars.
- "Show wideband values in the chart"
  The option makes the bars for wideband values visible in the chart. Deactivating it makes the chart less crowd in case there are many members.

For both options, if selected, the result of the switching is visible in the next frame, as the chart must redraw at least once for it.

Configuration: Device selection

See "Configuration: Device selection" on page 1252.

4.8.7 LTE-M scanner views

The LTE-M scanner views show the information obtained in the LTE-M network. The scans are performed by the R&S TSME scanner with its hardware R&S TSME-K29 option. LTE-MIMO scan and the LTE-M measurements need the R&S TSME-K35 option.

The LTE network scanner available option for R&S TSME is R&S ROMES4T1E.

How to install and configure the LTE network scanner is described in Chapter 6.4.15, "LTE scanner", on page 1726.

The LTE-M scanner views can be selected from a submenu displayed on the right-hand side of the "View" menu if the mouse hovers over "Scanner Views" > "LTE-M".

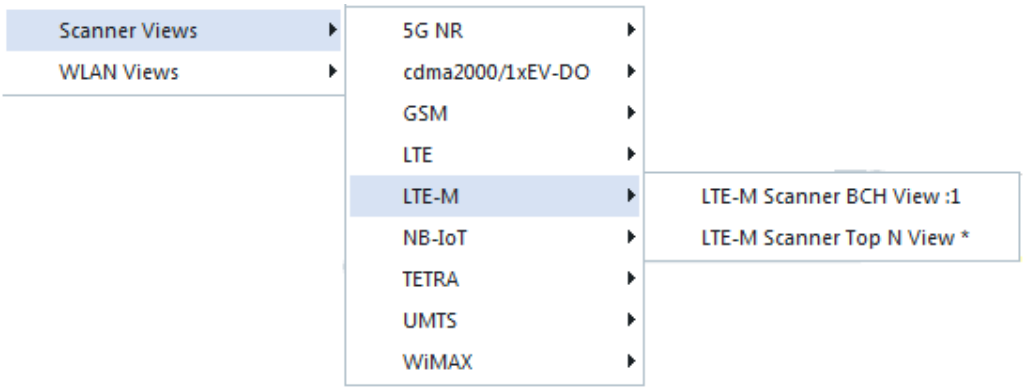


Figure 4-927: LTE-M scanner views

4.8.7.1 LTE-M scanner signals templates

Creating signals for all PCIs and specifying a number of EARFCNs leads to a huge amount of measured signals as R&S ROMES4 makes the combination of frequencies and PCIs. The huge amount of measured signals makes it difficult to find and select the required measurement data.

The LTE-M scanner signals templates offer an easy access to the measurement data of a specific eNodeB. This is achieved by specifying the EARFCN and the PCI for which you want measurement data to be shown in a basic (generic) view and "Top N Templates" and the "eNodeB Templates" branch of the "Signals Tree" > "LTE-M Scan" tree.

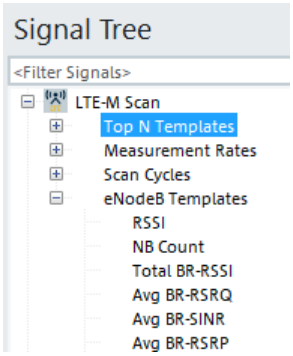


Figure 4-928: LTE-M scanner signals templates

1. Select from a template branch a signal you want to be shown in a R&S ROMES4 basic view and in the "Signals Tree" as a template signal. Drag & drop the selection into the view or double click the item in the view's configuration page.

2. A dialog pops-up asking you to define the filter for the signal. In the case of LTE-M scanner, this filter asks for the EARFCN or the combination of EARFCN and PCI. If you have selected several signals, check the "Apply for all signal" box. The action applies the same filter for all signals.

   The filter for the signal is entered.

3. To select data for a specific narrowband, select narrowband signal. For that, select the narrowband index ("NB Idx") of the narrowband you want to measure in addition to the EARFCN/PCI combination,.

   The signal appears in the R&S ROMES4 basic view and in a template branch of the "Signals Tree" > "LTE-Scan" tree.

The filtering dialogs remember the last set values. You can select a LTE-M eNodeB in the "LTE-M Scanner BCH View" to preset the filter values for the dialog.

The "Top N Templates" and the "eNodeB Templates" branch are a home of all created template signals. You can select a signal directly from this branch if needed.

The signals templates are the part of the workspace. They will be stored to the workspace and restore when loading it. Creating a new workspace removes the templates.

Configuration of LTE-M scanner Top N branches

There are no separate branches for each Top N pool and Top N member. Instead, there is a single Top N node under the "Top N Templates" branch.

The Top N template signal may be configured on any generic view. If a signal is configured on the generic view, a prompt for specific Top N pool and Top N member to be configured is displayed.

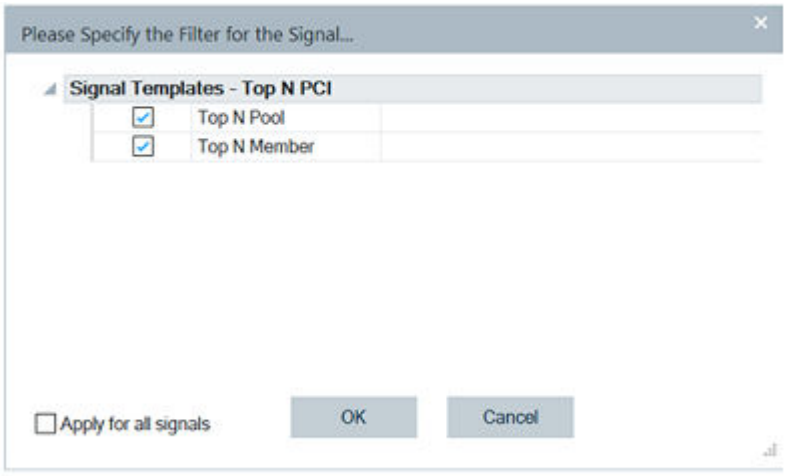


Figure 4-929: Template to filter Top N PCIs

Configuration of Template Top N Pool: Enter the desired Top N pool number. A range of Top N pools may be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represents the pools 1, 2 and 4 and 1-4 would represent an entry of pools 1 to 4.

If measurement or measurement replay is in progress, the valid Top N pools are available for selection if you click the down arrow. Click one or more of the valid pools.

Once all selections are made, click an another field or "OK" to close the selection window.

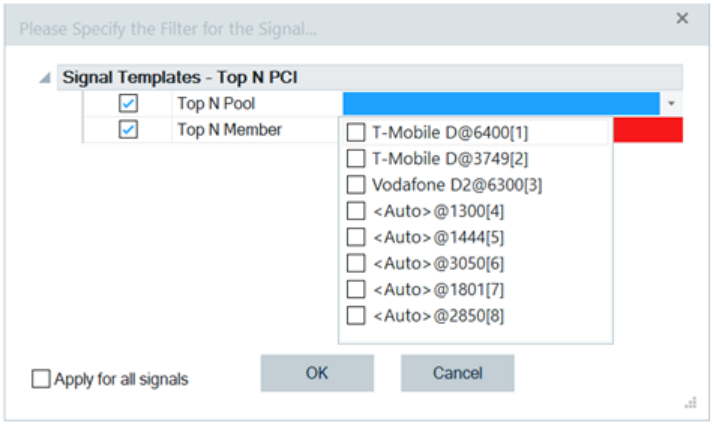


Figure 4-930: Available Top N pools

Configuration of Template Top N Member: Enter the desired Top N member number. A range of Top N members may be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represents the members 1, 2 and 4 and 1-4 would represent an entry of members 1 to 4.

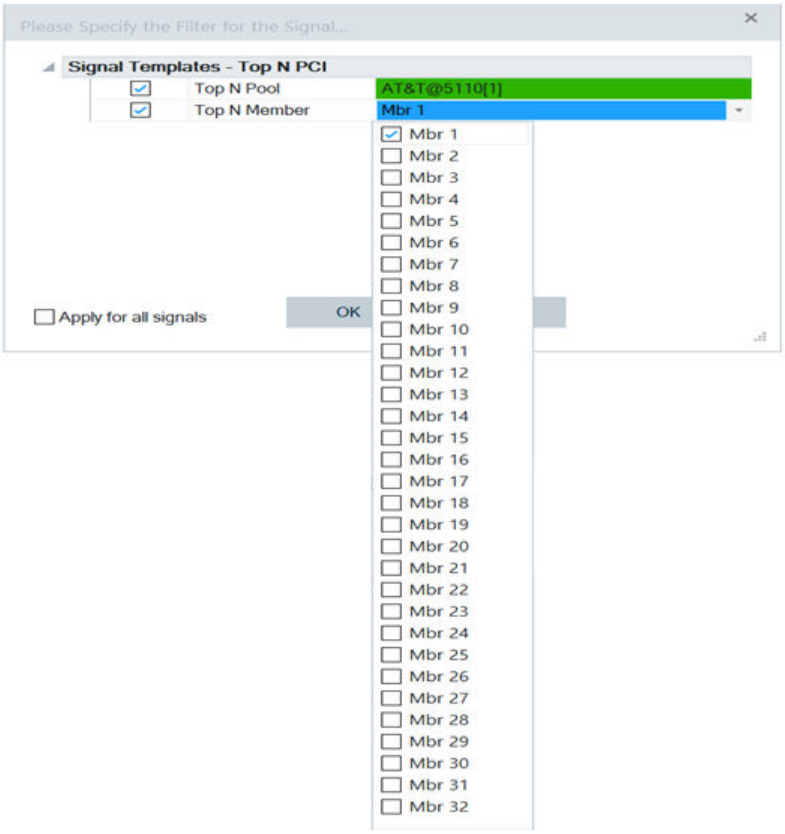


Figure 4-931: Available members of the Top N pool

Selection of Narrowband Index: Enter the desired narrowband index. A range of narrowbands may be entered by using a comma separator to separate individual members or a dash to define a range of members. For example, entered 1, 2, 4 represents the member 1, 2 and 4 and 1-4 represent an entry of member 1–4.

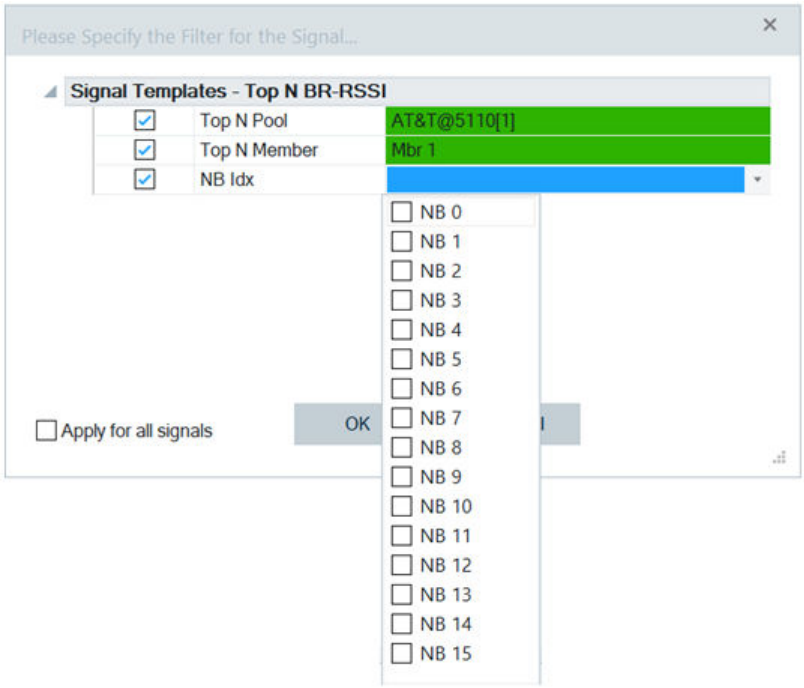


Figure 4-932: Available narrowband indexes

Selection of Field Color Code: Once a valid selection is made, the field gets a green background color. If a selection is not valid, the background color is red.

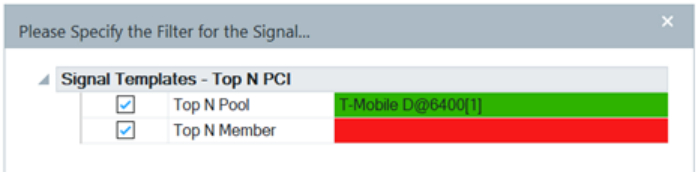


Figure 4-933: Colored fields for Top N PCI filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections". (These selections are reset each time R&S ROMES4 is restarted). To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear if all prior selection boxes have been deselected.

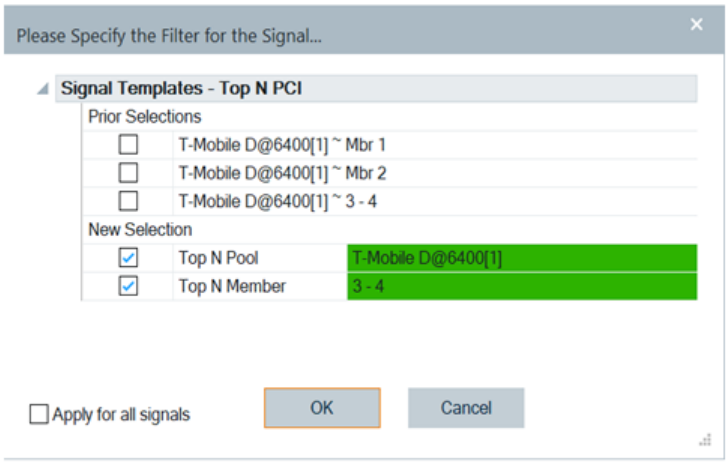


Figure 4-934: Prior selections

Configuration of LTE-M scanner eNodeB signals templates

If an eNodeB signal is configured for use on a generic view, a prompt to configure the signal with desired filter values is displayed.

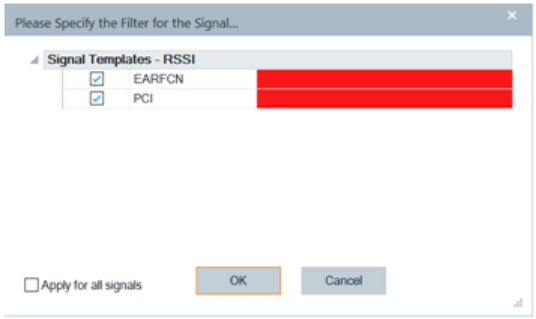


Figure 4-935: RSSI template signal filtering

Configuration of EARFCN Value: An EARFCN value can be entered. Multiple EARFCN may be entered by seperating the values with a “,”. For example, by entering 1300, 1444 selected are channels with EARFCN 1300 and 1444.

If a measurement or measurement replay is in progress, a list of currently valid EARFCN values is displayed if you click the down arrow. One or more of the values may be selected if you check the box next to the desired choice.

Once all selections are made, click an another field or "OK" to close the selection window.

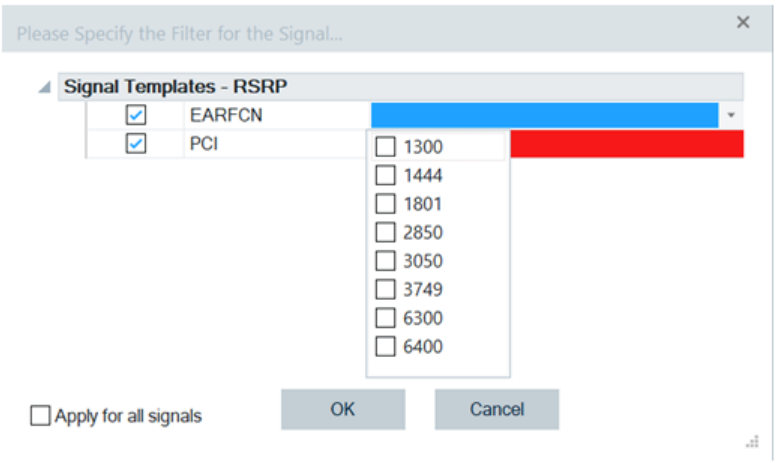


Figure 4-936: Entered EARFCN values (LTE-M)

Configuration of PCI: A PCI value may be entered. Multiple PCI values may be chosen by sperating the values with a “,”. For example, entered values 3, 4 select PCI value 3 and 4.

If a measurement or measurement replay is in progress, a list of valid PCI values for the currently selected EARFCN is displayed by clicking the down arrow. One or more of the values may be selected if you check the box next to the desired choice,

Once all selections are made, click an another field or "OK" to close the selection window.

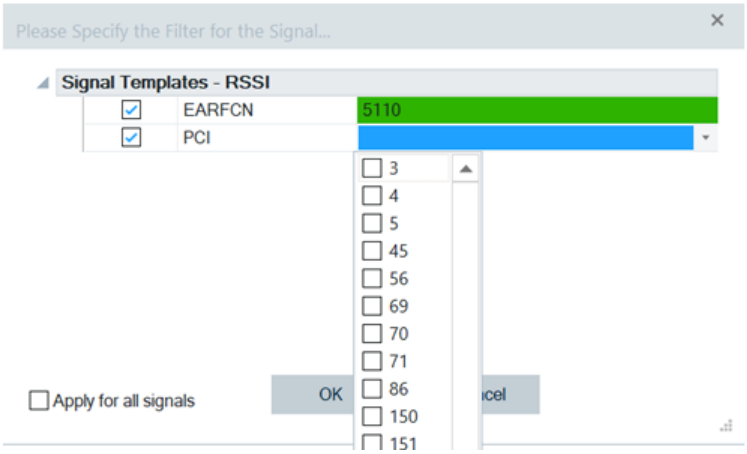


Figure 4-937: Entered PCI values for RSSI

Selection of Field Color Code: Once a valid selection is made, the field gets green background color. If a selection is not valid, the background color is red.

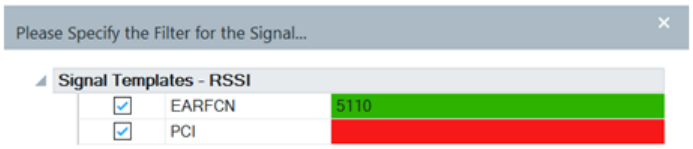


Figure 4-938: Colored fields for RSSI filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections" rows. (This selections are reset each time R&S ROMES4 restarts).

To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear when all prior selection boxes are deselected.

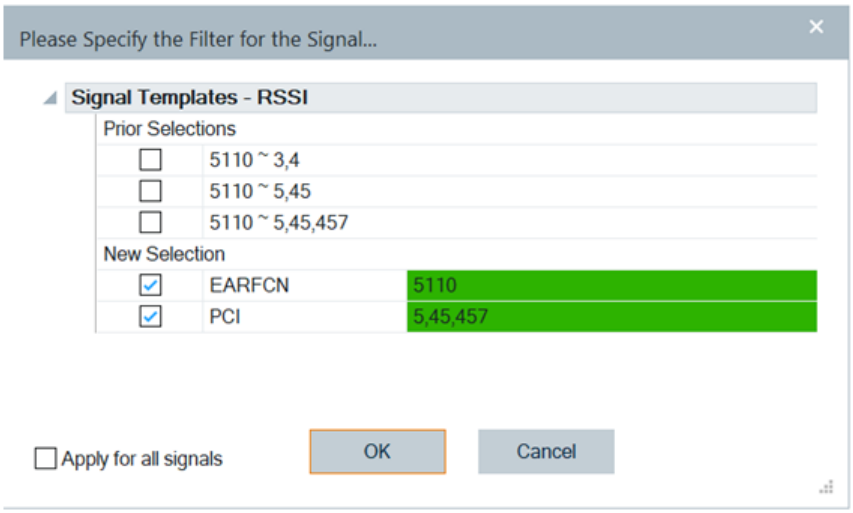


Figure 4-939: Prior selected RSSI template signals

4.8.7.2 LTE-M scanner BCH view

The "LTE-M Scanner BCH View" shows a list of detected BTSs with their details decoded from MIB and SIBs, included in related blocks.

Currently R&S ROMES4 supports only MIB decoding.

The contents of each block appears in a tree view, as soon as the block is selected. MIB and SIB1 are displayed correctly. All other SIBs are shown under the BTS entry without label, as a BCCH DL SCH message (which can contain several SIBs).

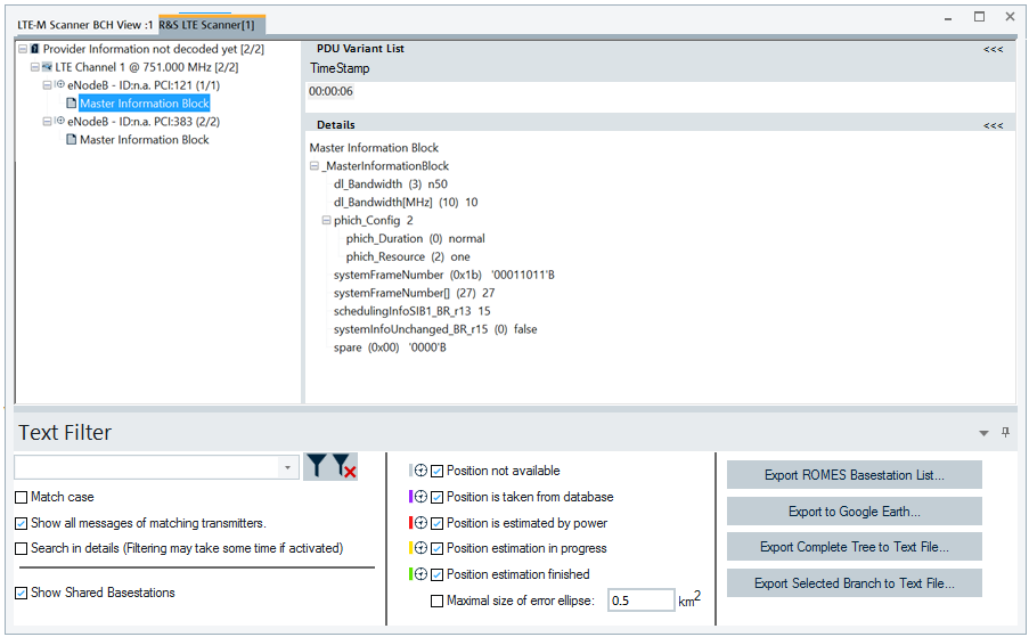


Figure 4-940: LTE-M scanner BCH view - MIB content

The cell information from SIB1 is used to derive the BTS identification.

If MIB or SIB is selected on the left-hand side of the "LTE-M Scanner BCH View", the list of PDU variants and the list of associated time stamps are displayed on the view's right hand side. This selection is shown in the previous figure for PDUs carrying MIB. The "LTE-M Scanner BCH View" is enhanced based on R&S ROMES4 support of dynamic PDU. The enhancement is the list of PDU variants over time. The PDU variants are shown as leaves of the base station branch.

The "PDU Variant List" in the upper right-hand part of the view shows a list of time stamps if different variants were found. In the shown case of MIB, there was only one variant found. "TimeStamp" shows the most recent measurement of the variant.

"LTE-M Scanner BCH View" > "Details" shows the details of the entry selected in the pane on the left-hand side. If you select eNodeB, you get the basic data such as the eNodeB identity, PCI, EARFCN, PLMN, antenna port number. Added is enhanced information on DL bandwidth, support of Nb-IoT, LTE-M and eMBMS.

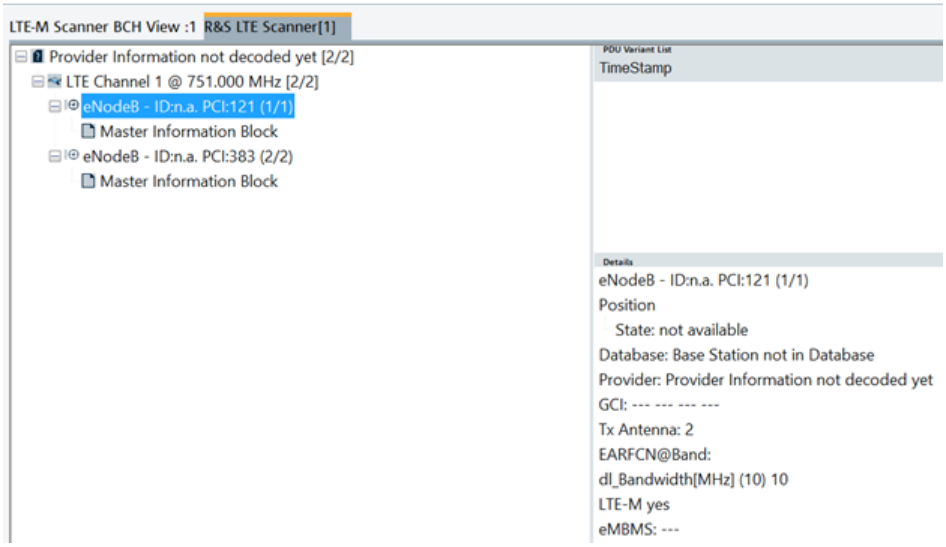


Figure 4-941: LTE-M scanner BCH view - cell details

The marked data in the previous figure stands for the following view enhancements:

- "dl Bandwidth [MHz] (xx) xx" is the same information as the one displayed in Figure 4-940, the "Details" pane.
- "NB-IoT Same PCI (EARFCN:Xxxx)", where Xxxx is the EARFCN of NB-IoT station, indicates that the NB-IoT has the same PCI as the eNodeB.
- "LTE:-M yes/no" is based on "scheduling InfoSIB1_BR_r13" field of the MIB message. If this field exists and is greater than zero, shown is "LTE:- M yes". Otherwise, shown is "LTE:-M no".
- "eMBMS: not supported/supported" is based on "mbsfn_SubframeConfigList" field of SIB 2 message. The following cases are possible
  - If SIB 2 is not present, shown is "eMBMS:-".
  - If SIB 2 is present, but "mbsfn_SubframeConfigList" does not exist, shown is "eMBMS: not supported".
  - If SIB 2 is presents, and "mbsfn_SubframeConfigList" is found, shown is"eMBMS:supported".

If the eNodeB has been generated from SIB 3 measurement without a corresponding database entry, the position is displayed as Lon *<value> Lat *<value>. The format of the position values depends on the corresponding global R&S ROMES4 setting.

The MIB and SIBs information is available only if the LTE scanner data is recorded with the "BCH Demodulation" enabled.

The base stations in the scanner BCH views have different states. The following colors indicate the state of a base station:

- grey: position is not available
- grey with database symbol: position is taken from database
- red: position is estimated by power only
- yellow: position estimation is in progress

- green: position estimation finished

RAN sharing in LTE scanner BCH view

The "LTE-M Scanner BCH View" displays eNodeBs of all PLMNs reported in the SIB1, see Add. PLMNs.

For example, the base stations which serve the PLMN 123,1 and PLMN 123,2 are visible in the view in the branch for PLMN 123,1 and PLMN123, 2 respectively.

A base station listed below a PLMN which is not its primary PLMN is displayed with an "'" appended to its name.

The LTE-M scanner BCH view creates branches for all PLMNs of a base station, instead of base stations of the primary PLMN only.

In this case the amount of shown base stations does not reflect the amount of physically existing ones.

Text Filter

The "Text Filter" function offers filtering and exporting a base station list based on different criteria. For details, see "BTS export settings" on page 1217.

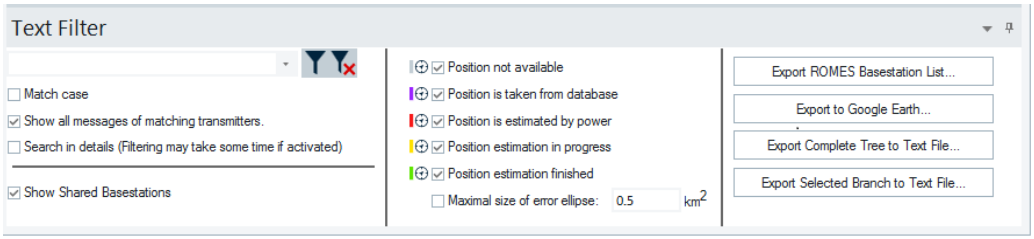


Figure 4-942: Show/hide shared base stations option

It is possible to hide the base stations, which are displayed as non-primary PLMNs if the "Text Filter" > "Show Shared Basestations" box is checked.

Base stations export can be done based on state of their position.

Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

Basestation list export

Click the "Global Export Settings" command of the view context sensitive menu to get the "Basestation List Export" page.

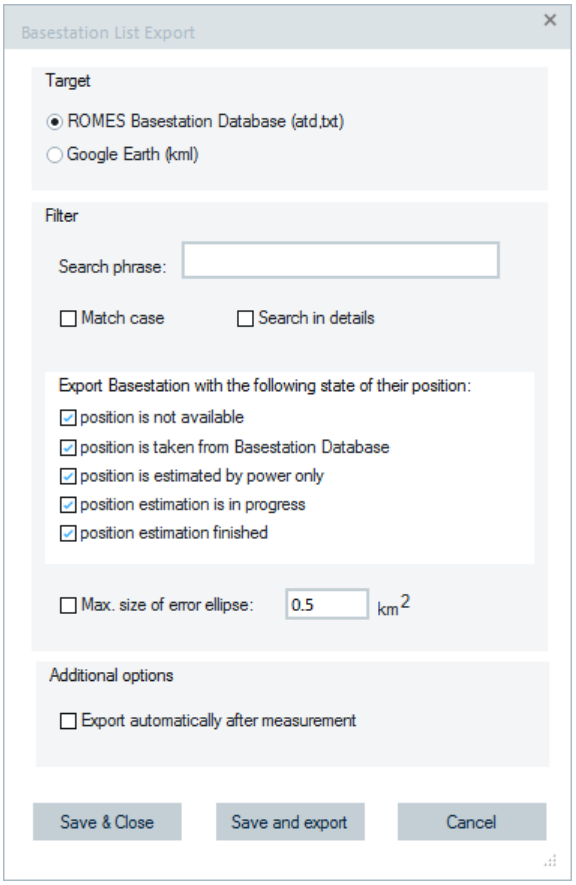


Figure 4-943: Base station list export

The following BTS list export entries are available:

- "Export ROMES Basestation List"
  The content of the BCH views can be exported to a ROMES base station list.
- "Export to Google Earth"
  Estimated base stations can be exported also to a KML file, which can be loaded into Google Earth. The KML file shows the base stations positions, the error ellipse and the most important data of the station.
- "Filter"
  - "Search phase"
    The export dialog allows to select which base station states are to be exported. If mandatory columns of the list are not available, dummy data are inserted, e.g. 0.0, 0.0 for an unknown position. This means, all lists can be loaded into R&S ROMES4 afterwards, but they are not useful for further measurement due to missing data.
  - "Search in details"
    The current visible details setting can be exported to a text file.
  - "position..."
    It is possible to show and hide the stations according to their different position states by using the position filtering.
  - "Max. size of error ellipse"

The export can be filtered by a maximum size of the error ellipse of an estimated base station, which must not be exceeded.
The filtering is done by a threshold value for the error ellipse area of the estimated position. If this value is zero, all BTS entries with estimated position are exported. Otherwise, only entries whose error ellipse area is less than the threshold value will be exported via the BCH view's "Global export settings" context menu item.
The error ellipse area A_ε can be calculated from the position error values:
$A\varepsilon = PosErr1 * PosErr2 * \pi$
Note: The specified error ellipse's area defines a confidential interval of 66% confidence.

- "Export Complete Tree to Text File"/"Export Selected Branch to Text File"
  The content of the complete or selected branch of the BCH view can be exported to an ASCII file.
- "Additional options"
  If "Export automatically after measurement" checked, the BCH views for all technologies can export the database file automatically after a measurement was finished.
- "Save and export"
  The button saves the settings of the export dialog and creates the export database file.
- "Save & Close"
  To store the settings without creating an export, click the button.
- "Cancel"
  Cancels the made settings.

Neighbors are exported for GSM, UMTS, LTE, LTE-M and TETRA technologies. The standard columns for the R&S ROMES4 base station list cannot be used, as they require the global cell identity, which is not available in the broadcast information. Instead of using the standard column, the following columns are used for exporting the decoded information.

- GSM
  The "2GNC-ARFCN" column is exported that contains the ARFCNs of the 2G neighbors.
- UMTS
  - "2GNC-NCC,BCC,Band,ARFCN" column is exported that contains the NCC, BCC, band and the ARFCN of the 2G neighbors.
  - "Intra3GNC-SC" column is exported that contains the scrambling codes of the intra-frequency neighbors.
  - "Inter3GNC-DL_UARFCN,UL_UARFCN,SC" column is exported that contains the DL/UL UARFCN and the scrambling code of the inter-frequency neighbors.
- TETRA
  The "NeighbourCellParameters" column is exported that contains the MCC, MNC (both only if available) and the LA and carrier of the neighbors.

LTE-M scanner BCH view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

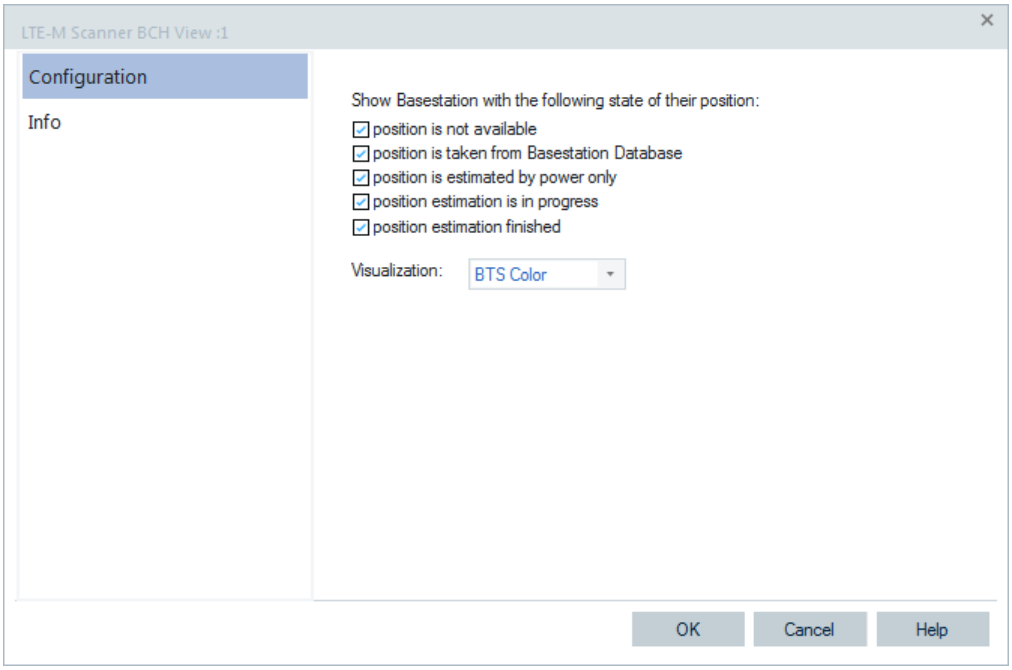


Figure 4-944: LTE-M scanner BCH view - configuration

The "Configuration" option lets you filter base stations by selecting different states of their position in the "Text Filter" pane. Select a base station color you want to be used in the "ROMESMAP Route Track View" in the "Visualization" drop-down box.

4.8.7.3 LTE-M scanner Top N view

The "LTE-M Scanner Top N View" shows the parameters of the signals received from the eNodeBs.

These signals are the selected elements of the "List" pane. A Top N pool includes cells which have the Avg SINR, Avg RSRP, Avg RSRQ at a given position and time.

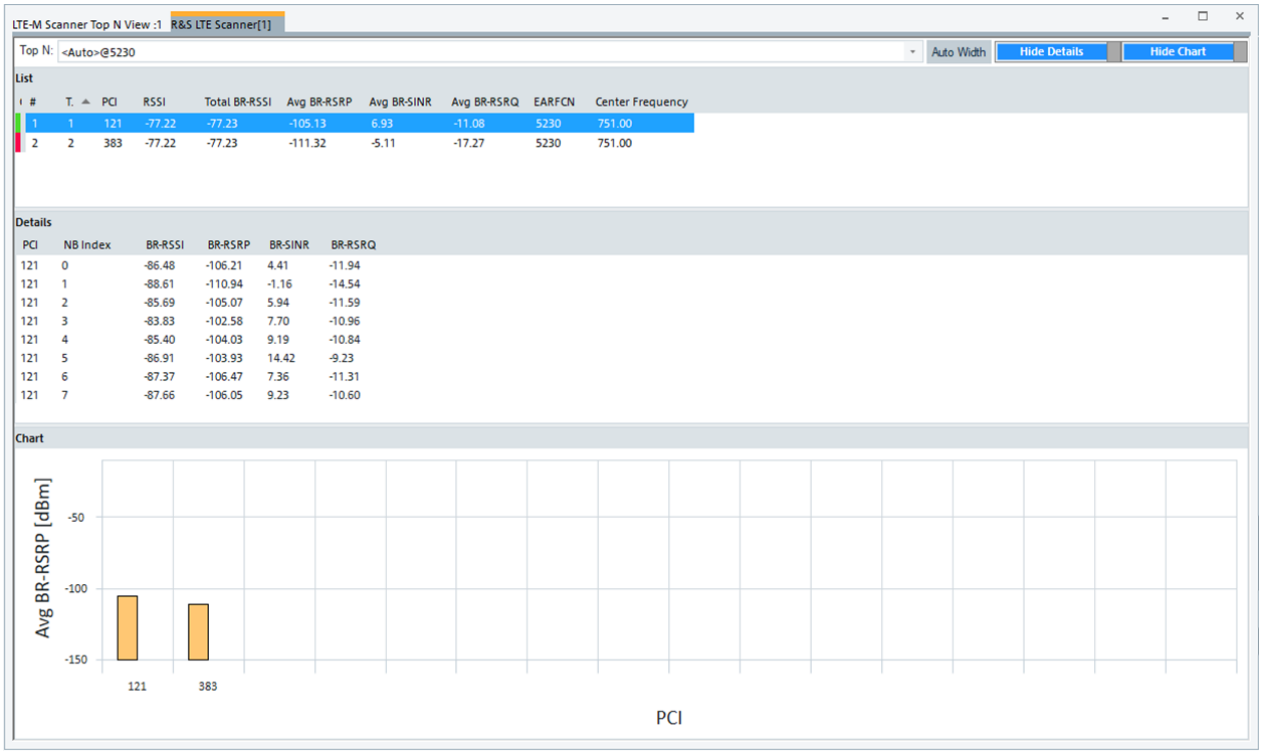


Figure 4-945: LTE-M scanner Top N view

The cells are presented with a number their parameters, for example, PCI, RSRP, RSQ and so on.

The columns in "LTE-M Scanner Top N View" > "List" carry the full names of the parameters.

The details of each narrow band are listed in the "Details" pane for a selected (blue highlight) eNodeB. If you don't select an eNodeB for display, the first available eNodeB is automatically selected in this pane.

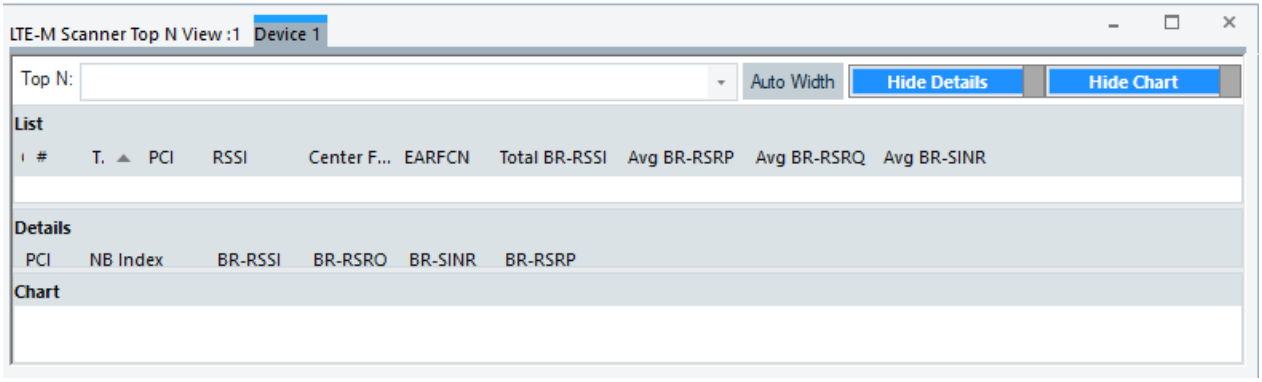


Figure 4-946: Default columns in the LTE-M scanner Top N view list

Scanner Top N view shows multiple EARFCN

The "LTE-M Scanner Top N View" supports the visualization of two EARFCNs for the given channel in a same way the "LTE Scanner Top N View" does.

If the "LTE-M" and "EARFCN" optional signals are selected in the "TEC for LTE Scanner" > "Top N Settings", the "LTE-M Scanner View" is available and the optional EARFCN(Primary Band) column is present apart from the default EARFCN(MFBI) column in the "LTE-M Scanner Top N View" > "List".

The default EARFCN(MFBI) column shows the current frequency value of a cell as received in SIB 1 “multiBandInfoList” or “multiBandInfoList_v9e0” field. The "EARFCN" optional column shows the primary band EARFCN value of the given Top N pool under the previously mentioned conditions for setting.

Select "Show All TopN Pools" in the "Top N" box for a pool name. All Top N pools are shown. Those ones having both primary and multifrequency band EARFCN for the given channel are recognized by showing two EARFCN values, see Figure 4-907.

The primary band EARFCN is shown first and the EARFCN(MFBI) follows separated by a “:” in the pool name.

The EARFCN signals are visualized in the R&S ROMES4 basic views, example given, in the "Alphanumeric View".

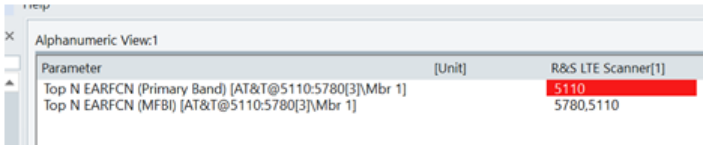


Figure 4-947: Primary and multifrequency band EARFCNs in Alphanumeric View

Scanner Top N view for automatic pool configuration

The scanner Top N view of the R&S ROMES 3GPP technologies displays the all “automatically configured Top N pools" on the screen.

If you select "Top N Pools" > "Automatic Pool Configuration" for a corresponding technology, the Top N selector control gets the additional entry "Show all TopN Pools" in the view.

By selecting this entry, you can see all Top N pools in the list. The number of displayed members per pool depends on the size of the window. It is calculated automatically in such a way that all Top N pools can be observed without scrolling the list (if even one member does not fit, scrollbars are added).

The signals and their decision values which users can select for ranking of the Top N pools are available in the "Available Signals" tree.

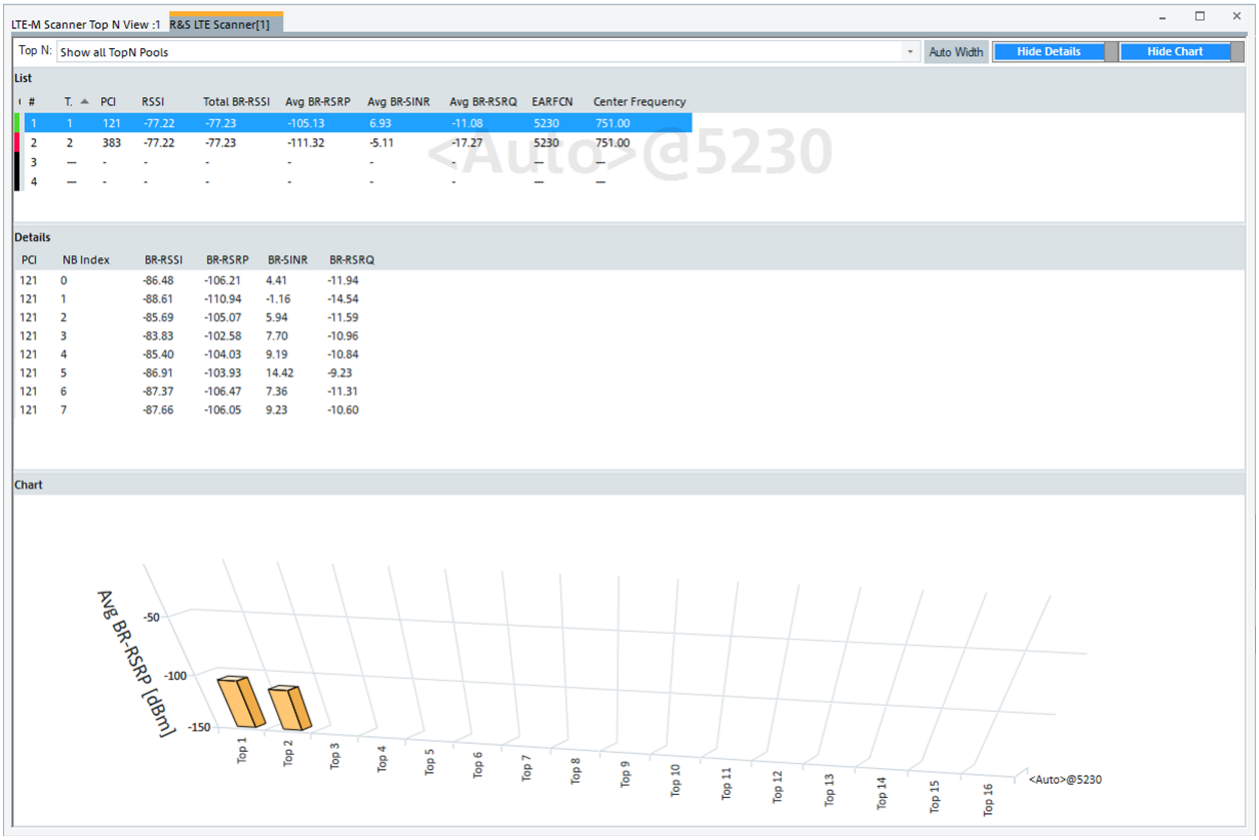


Figure 4-948: LTE-M scanner Top N view - 3D chart

The "Chart" panel is shown in 3D in case the automatic Top N pool configuration active. The values of the selected signal used for ranking and display are shown as 3D bars.

The Top N chart can be rotated moving the mouse while pressing the left button (x-axis, y-axis and z-axis when pressing the CTRL key additionally). Press the R key to reset the 3D chart to its default orientation.

The configuration of the Top N view allows to configure the colors for the 3D chart and the minimum and maximum for the Top N values.

The color of each bar represents the state of the signal based on the signals color scale defined in the "Available Signals" configuration page. Typically this is green for high values and red for low values.

You have the option to display the Top N pools as the grid with 2D charts instead of the standard 3D bar chart.

To enable the grid with 2D bar charts, click on the "Show Grid" slider at the right top if the 3D "Chart".

You may return to the 3D chart at any time by clicking the "Show 3D" slider at the right top if the 2D "Chart".

For the Scanner Top N view the grid arrangement is dynamic to allow the best use of space to display as many pools as possible.

Note: The maximum size of the grid is to be 6 columns and 3 rows.

The following figure shows how many rows and columns to expect in the grid.

Number of Pools	Grid Cols	Grid Rows
1	1	1
2	2	1
3	3	1
4	2	2
5	3	2
6	3	2
7	3	3
8	3	3
9	3	3
10	4	3
11	4	3
12	4	3

Figure 4-949: Allowed sizes of the grids in 2D chart

For the "Chart" layout in this case, see Figure 4-761.

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

Top N

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.

- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

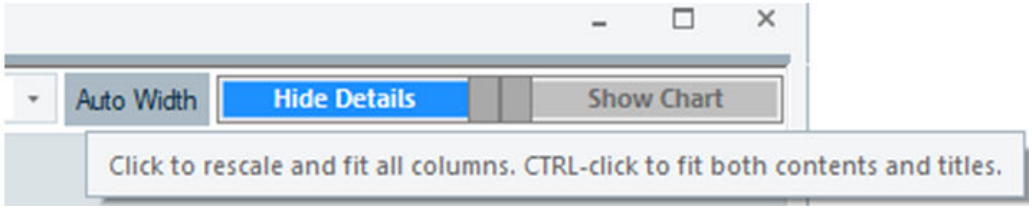


Figure 4-950: ToopTip for adjustment

If you start R&S ROMES4 with an empty workspace, the initial widths of the columns in "Top N View" are initialized and scaled properly based on the current screen DPI setting.

Top N list

The "List" table gives an overview of the received signals in the current Top N pool together with their measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

It is possible to show or hide each individual table column in the view configuration menu. Up to three differently named pools can be configured in the default setup. Each pool has several configurable parameters.

The "Top N List" contains the following columns:

- "Color"
  Applies the configured color scale for the pool members.
- "#"
  Number of the measured cell and Cell ID within the Top N pool.
- "TopX"
  Current rank within the Top N Pool.
- "PCI"
  Physical Cell Identity, unique physical-layer cell identifier.
- "RSSI"
  Received signal strength indicator; the RSSI measurement provides the total average power of the received waveform within the signal bandwidth. It will contain signal power from the signal of interest, noise and interferers.
- "EARFCN"
  Evolved Absolute Radio Frequency Channel Number.
  The signal stands for the primary EARFCN value of the given Top N pool (Primary Band). It has to be differentiated from the Top N EARFCN (MFBI) signal which is by default visible in the "LTE Scanner Top N View" and "Signal Tree".

Top N Signal EARFCN(MFBI) shows the frequency current value of the cell as received in SIB 1 “multiBandInfoList” or “multiBandInfoList_v9e0” fields.

- "Center Frequency"
  Center frequency of the used channel, according to standard IEEE 802.16.
- "Internal CellID"
  Unique cell identity.
- "Total BR-RSSI"
  Total BR-RSSI across all narrow bands.
- "Avg BR-RSRP"
  Average BR-RSRP across all narrow bands.
- "Avg BR-SINR"
  Average BR-SINR across all narrow bands.
- "Avg BR-RSRQ"
  Average BR-RSRQ across all narrow bands.
- "NB Index"
  List of the values of the Top N decision value for each narrow band of the eNodeB.
- "NB Count"
  The number of narrow bands for a given cell.

Top N details

The "Details" table gives an overview of a specific narrow band for the currently selected eNodeB.

Each cell in the table header provides a short explanation of the corresponding column on mouse rollover. It is possible to show or hide each individual table column in the view configuration menu.

The table contains the following columns:

- "PCI"
  Physical Cell Identity, unique physical-layer cell identifier.
- "NB Index"
  Index of the specified narrow band.
- "NB RB Offset"
  Narrow band Resource Block Offset.
- "Internal CellID"
  Unique cell identity
- "BR-RSSI"
  Reference signal received signal strength indicator; the measurement provides the total average power of OFDM symbols that carry cell specific reference signals.
- "BR-RSRP"
  Reference signal received power; the measurement represents the linear average over the power contributions [mW] of the resource elements that carry cell specific LTE-M reference signals (CRS) within the measurement bandwidth. By default, the CRS from eNodeB antenna port 0 is are used for this purpose, but CRS of other ports may also be used for the measurement.
- "BR-SINR"

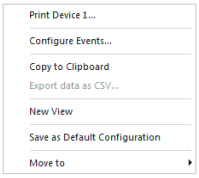
Reference signal carrier to interference and noise ratio; the measurement is a ratio of the power of the LTE-M signal from a particular cell and noise and interference that are present. This measurement is performed at the resource elements occupied by cell specific reference signals.

- "BR-RSRQ"
  Reference signal received quality; the measurement is computed as the following ratio. Remember that the RS-RSSI measurement extends over the full signal bandwidth BR-RSRQ = (NRB · BR-RSRP) / BR-RSSI.

Top n chart

The "Chart" shows the Avg BR-RSRP and BR-SINR as a 2D bar chart for all cells in the current Top N pool measurement. You can select the upper/lower Avg BR-RRP and Avg BR-SINR level for the y-axis of the chart in the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

LTE-M scanner Top N pool configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Top N view

The "Top N View" option lets you the following:

- Selection of the Top N list contents.
- Selection of the Top N details contents.
- Selection of the power signal type to be displayed in the 2D/3D chart.
- Display the LTE-M -specific graph y-axis titles and limits in the chart, that is, the minimum and the maximum value to be displayed for the selected power signal in the view.

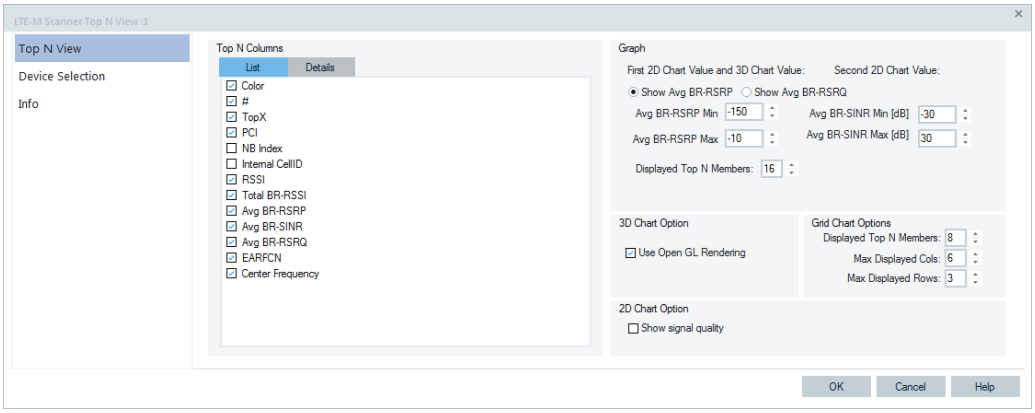


Figure 4-951: LTE-M Scanner Top N View - configuration

Graph

- "Show Avg BR-RSRP"
  Shows the Reference Signal Received Power in the chart, if selected.
- "Show Avg BR-RSRQ"
  Shows the Reference Signal Received Quality in the chart, if selected.
- "Avg BR-RSRP Min/Max [dBm]"
  Sets the upper and lower Avg BR-RSRP for the left y-axis of the chart.
- "Avg BR-SINR Min/Max [dBm]"
  Sets the upper and lower SINR level for the right y-axis of the chart.
- "Displayed Top N Members"
  In the drop-down box select the number of a Top N members .

3D Chart Option ← Graph

- "Use Open GL Rendering"
  The option determine if the 3D Chart is rendered open GL (hardware) rendering or software rendering. Using open GL will allow for faster rendering of the 3D chart.

Grid Chart Options ← Graph

- "Displayed Top N Members"
  The check box lets you select the number of Top N member that each chart in the grid will display.
- "Max Displayed Cols"
  The check box lets you select the maximum number of displayed columns in the grid. Allowed values are from 1 to 6.
- "Max Displayed Rows"
  The check box lets you select the maximum number of displayed rows in the grid. Allowed values are from 1 to 3.

2D Chart Option ← Graph

- "Show signal quality"
  If the option is selected, shows the signal quality in the Top N chart. This is the possibility to switch "on" or "off" the second y-axis on the chart and quality signal bars. The result of the switching is visible in the next frame, as the chart must redraw at least once for it.

4.8.8 NB-IoT scanner views

The NB-IoT scanner views show the information obtained in the scanners performed by a R&S radio network analyzer.

The NB-IoT scanner views can be selected from a submenu displayed on the right side of the "View" menu when the mouse hovers over "Scanner Views" > "NB-IoT".

Click one of the available view entries to see the layout of the selection.

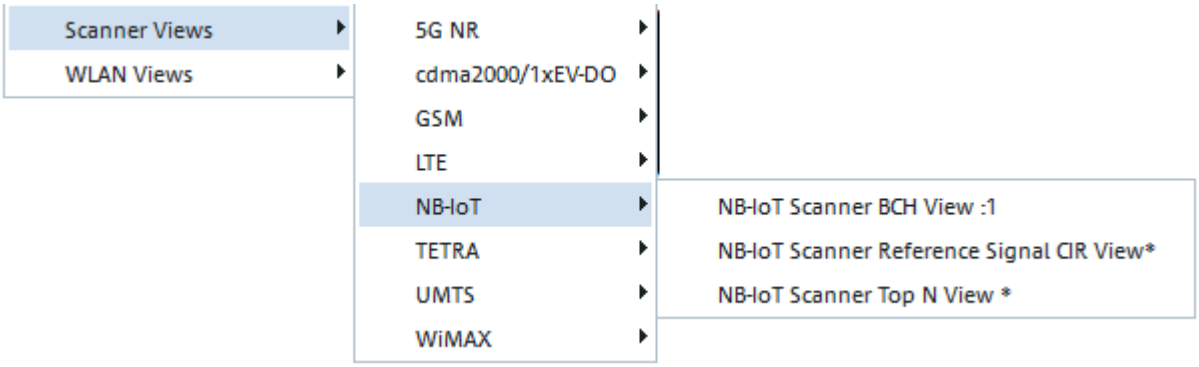


Figure 4-952: NB-IoT Scanner view

The NB-IoT scanner views offer the extended center frequency output to four digits after the decimal point.

The basic views show the measurement values of the available, configured and detected NB-IoT signals.

The Alphanumeric View also shows the center frequency with four digits after the decimal point.

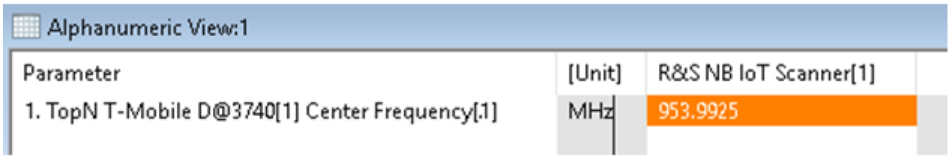


Figure 4-953: Center frequency shown in Alphanumeric View

4.8.8.1 NB-IoT scanner signals tempates

The NB-IoT scanner signals templates offer an easy access to the measurement data of a specific eNodeB. This is achieved by specifying the EARFCN\NPCI whose measurement data you want to be shown in a basic (generic) view and in the "Top N Templates" and the "eNodeB<EARFCN/NPCI> Template" branch of the "NB-IoT Scan" tree.

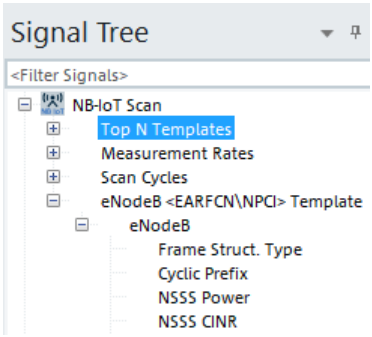


Figure 4-954: NB-IoT scanner signals templates

1. Select from the "Top N Templates" or the "eNodeB<EARFCN/NPCI> Template" branche a signal you want to be shown in a R&S ROMES4 basic view as a template signal. Drag & drop the selection into the view or double click the item in the view's configuration page.
2. A dialog pops-up asking you to define the filter for the signal. In the case of NB-IoT scanner, this filter asks for the EARFCN or the combination of EARFCN and NPCI. If you have selected several signals, check the "Apply for all signal" box. The action applies the same filter for all signals.

   The filter for the signal is entered.

   The signal of the specific eNodeB appears in the R&S ROMES4 basic (generic) view and the "Top N Templates" or "eNodeB<EARFCN/NPCI> Template" branch of the "NB-IoT Scan" tree.

The filtering dialogs remember the last set values. You can select a eNodeB in the "NB-IoT Scanner BCH View" to preset the filter values for the dialog.

The template branches are a home of all created template signals. You can select the signal directly from these branches if needed.

The template signals are part of the workspace. They will be stored to the workspace and restore when loading it. Creating a new workspace removes the template signals.

Configuration of NB-IoT scanner Top N branches

There are no separate branches for each Top N pool and Top N member. Instead, there is a single Top N node under the "Top N Templates" branch.

The Top N template signals may be configured on any generic view. If a signal is configured on the generic view, a prompt for specific Top N pool and Top N member to be configured is displayed.

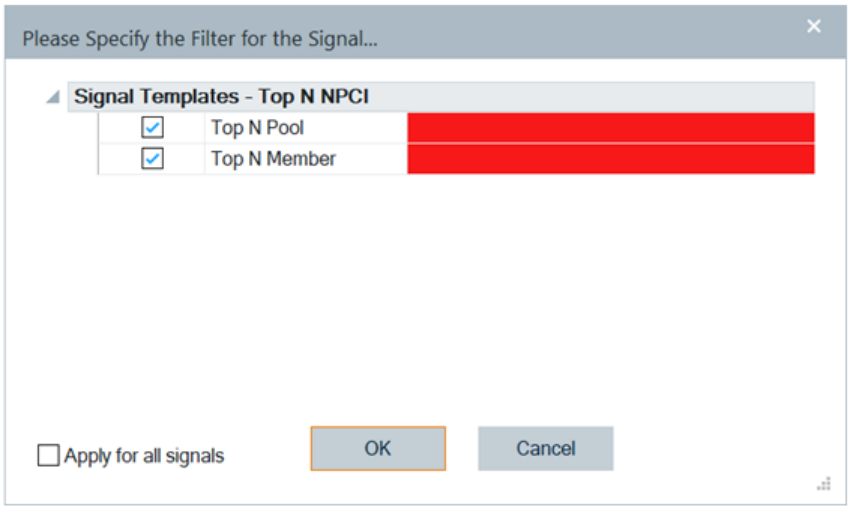


Figure 4-955: Template to filter Top N NPCIs

Configuration of Template Top N Pool: Enter the desired Top N pool number. A range of Top N pools may be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represent pools 1, 2 and 4 and 1-4 would represent an entry of pools 1 to 4.

If measurement or measurement replay is in progres, the valid Top N pools are available for selection by clicking the down arrow. Click one or more of the valid pools.

Once all selections are made, click an another field or "OK" to close the selection window.

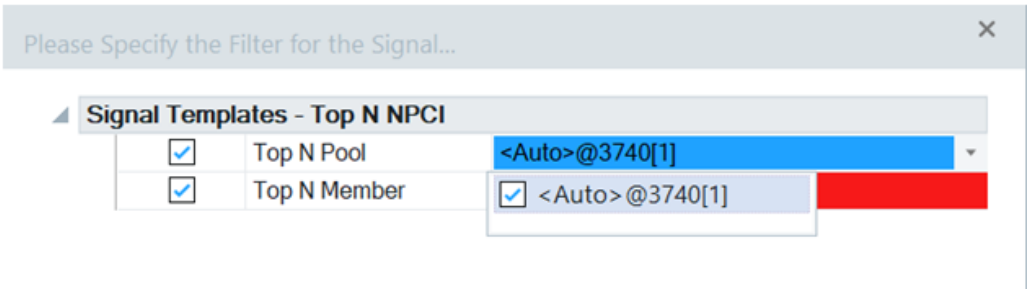


Figure 4-956: Available Top N pools

Configuration of Template Top N Member: Enter the desired Top N member number. A range of Top N members may be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represent members 1, 2 and 4 and 1-4 would represent an entry of members 1 to 4.

Selection of Field Color Code: Once a valid selection is made, the field gets a green background color. If a selection is not valid, the background color is red.

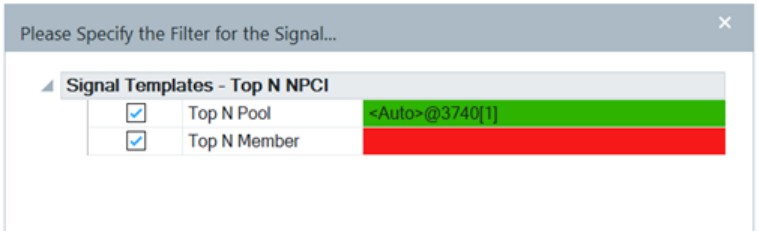


Figure 4-957: Colored fields for Top N NPCI filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections". (These selections are reset each time R&S ROMES4 is restarted). To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear if all prior selection boxes have been deselected.

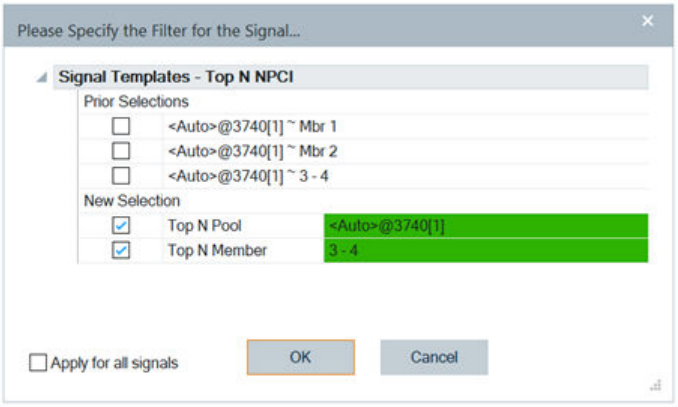


Figure 4-958: Prior selections

Configuration of NB-IoT scanner eNodeB<EARFCN\NPCI> Signals Tempates

If an eNodeB signal is configured to be used on a generic view, a prompt to configure the signal with desired filter values is displayed.

The signals that are found under the "eNodeB<EARFCN\NPCI>" are prompted as shown in the following figure.

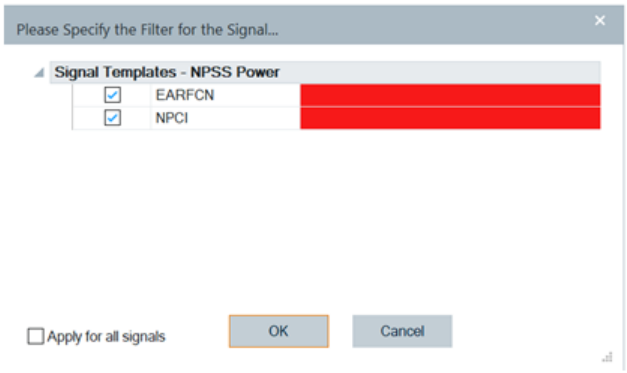


Figure 4-959: NPSS power template signal filtering

Configuration of EARFCN Value: An EARFCN value can be entered. Multiple EARFCN may be entered by seperating the values with a “,”. For example, by entering 1300, 1444 selected are channels with EARFCN 1300 and 1444.

If a measurement or measurement replay is in progress, a list of currently valid EARFCN values is displayed if you click the down arrow. One or more of the values may be selected by checking the box next to the desired choice.

Once all selections are made, click an another field or "OK" to close the selection window.

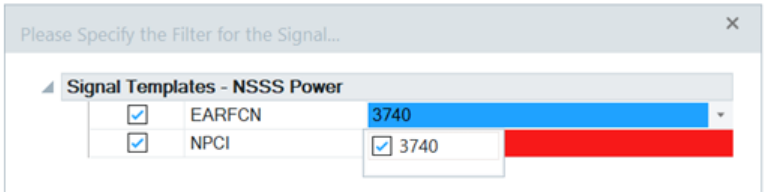


Figure 4-960: Entered EARFCN values

Configuration of NPCI: A NPCI value may be entered. Multiple NPCI values may be chosen by sperating the values with a “,”. For example, entered values 393, 394 select NPCI value 393 and 394.

If a measurement or measurement replay is in progress, a list of valid NPCI values for the currently selected EARFCN is displayed if you click the down arrow. One or more of the values may be selected if you check the box next to the desired choice,

Once all selections are made, click an another field or "OK" to close the selection window.

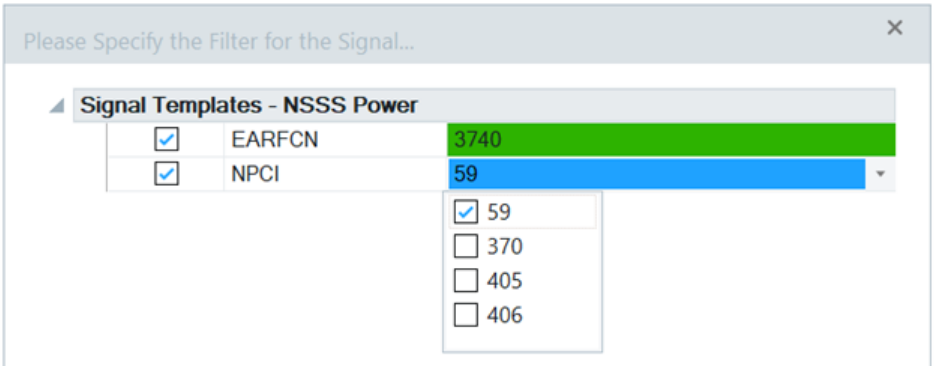


Figure 4-961: Entered NPCI values

Selection of Field Color Code: Once a valid selection is made, the field gets green background color. If a selection is not valid, the background color is red.

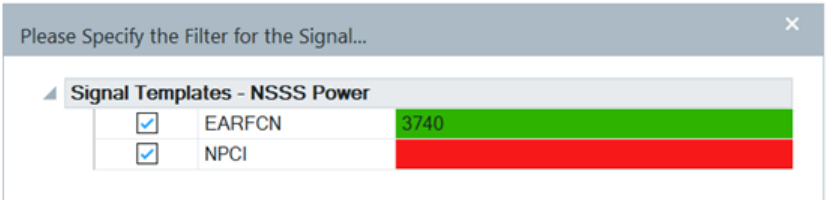


Figure 4-962: Colored fields for NSSS power filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections" rows. (This selections are reset each time R&S ROMES4 restarts).

To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear when all prior selection boxes are deselected.

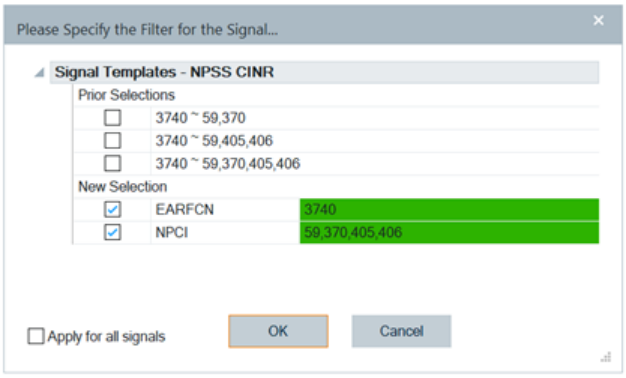


Figure 4-963: Prior selected template signals

4.8.8.2 NB-IoT scanner BCH view

The"NB-IoT Scanner BCH View" shows a list of detected BTSs and their MIB and SIBs decoded from the NB-IoT BCH. The contents of each block appear in a tree view, as soon as the block is selected.

MIB and SIB1 are displayed correctly. All other SIBs are shown as BCCH DL SCH message (which can contain several SIBs) under the BTS entry without label. Additionally, the cell information from SIB1 is used to derive the BTS identification.

If the eNodeB is generated from SIB3 measurement without corresponding database entry, the position is displayed as Lon*<value>Lat*<value>. The format of the position values depends on the corresponding global R&S ROMES4 setting.

The MIB and SIBs information is available only if the NB-IoT scanner data is recorded with the activated "BCH Demodulation".

Referring to R&S ROMES4 support of dynamic PDU handling described in Chapter 3.8.2.1, "Technologies", on page 280, the "NB-IoT Scanner BCH View" is enhanced. The enhancement is the list of measured PDU variants over time. The PDU variants are shown as leaves of the base station branch.

Further enhancement in the "Details" of the view is the info "operationModeInfo_r13_inband SamePCI..." indicating the same PCI as the eNodeB has.

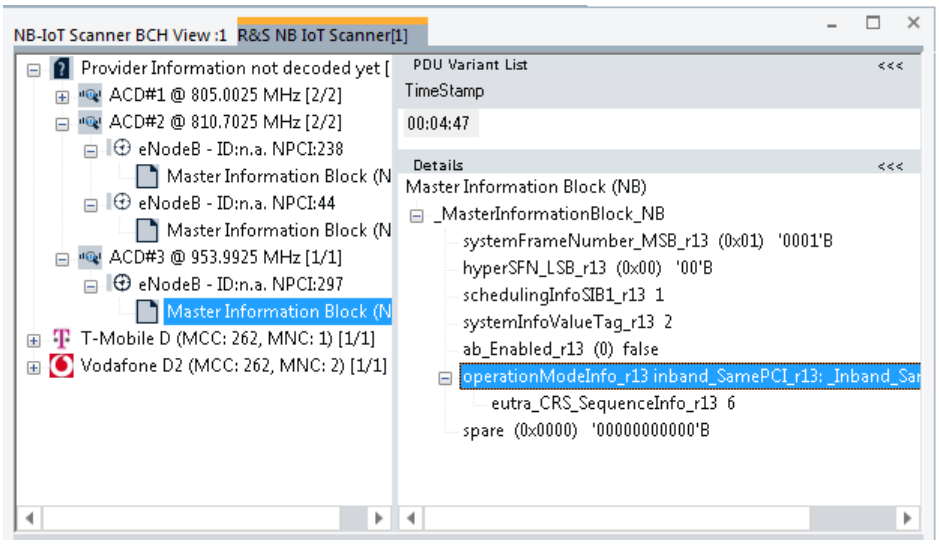


Figure 4-964: BCH eNodeB MIB may show following information

The "NB-IoT Scanner BCH View" displays eNodeBs of all PLMNs reported in the SIB1, see "Add. PLMNs" in "Top N list" on page 1316.

If a SIB is selected on the left-hand side of the "NB-IoT Scanner BCH View", the list of PDU variants and the list of associated time stamps are displayed on the view's right-right hand side.

The "PDU Variant List" in the upper right-hand part of the view shows a list of time stamps if there were different variants found. In the shown case of SIB 1, there was

only one variant found. "TimeStamp" shows the most recent measurement of the variant.

The "NB-IoT Scanner BCH View" > "Details" shows the previously mentioned support of four digits after decimal point in the frequency output.

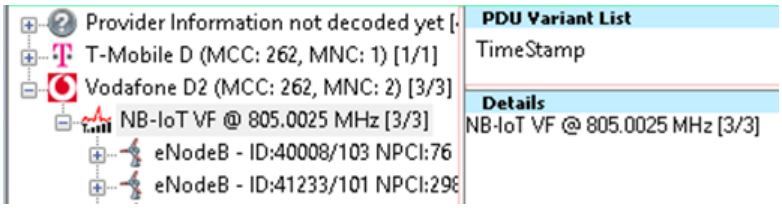


Figure 4-965: Center frequency shown in BCH View

The base stations in the scanner BCH view have different position states. The following colors indicate the state of a base station:

- grey: position is not available
- grey with database symbol: position is taken from database
- red: position is estimated by power only
- yellow: position estimation is in progress
- green: position estimation finished

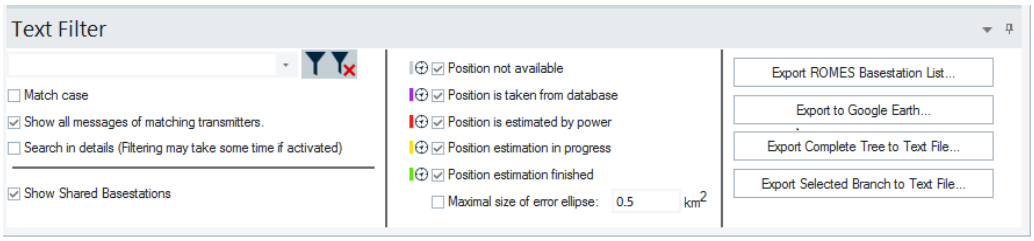


Figure 4-966: Show or hide shared base stations

A base station, which is listed below a PLMN that is not its primary PLMN is displayed with an ' appended to its name.

The view creates branches for all PLMNs of the base stations, instead of base stations only for the primary PLMN. It is possible to hide the base stations, which are displayed as non-primary PLMNs if you check the "Text Filter" > "Show Shared Basestations" check-box in the view.

BTS export parameters configuration

If the export has been started before measurement or replay has been stopped, the file contains all the System Information starting from the selected node in the BCH tree, that is, all SIBs of the selected eNodeB or all SIBs belonging to all eNodeBs of one provider (MCC, MNC).

If the export has been started after measurement or replay has been stopped, the file contains all System Information belonging to all eNodeBs included in the "NB-IoT Scanner BCH View".

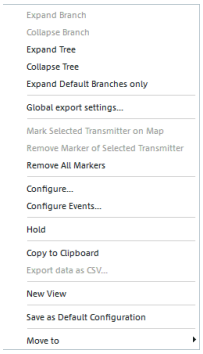
The System Information can be exported to an ASCII file in the EXPORT directory of R&S ROMES4. The name of the export file is

`NB-IoT_<measurement filename>.txt`

If the position estimation is active, the estimated positions are added to the eNodeB entries. Estimated positions are marked by an asterisk.

After stopping the measurement, the view automatically generates an eNodeB list of import files with an entry for every estimated eNodeB position. The eNodeB list files are stored in the R&S ROMES4 measurement directory.

Context Menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

Nb-IoT scanner BCH view configuration

The NB-IoT Scanner BCH View configuration assumes base stations filtering based on selection of their position.

Click with the right-mouse button any point within the view to open the configuration page.

The option allows you to filter base stations using their different state of position in the "Text Filter" pane. The base station color to be used in the ROMESMAP Route Track view you can select in the lower pane of the view.

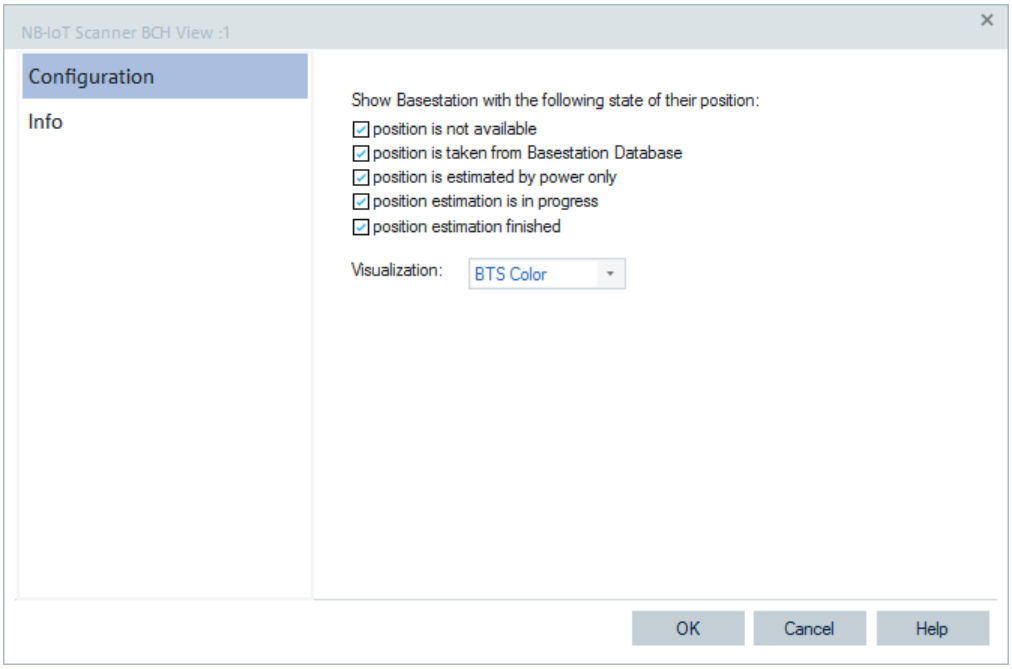


Figure 4-967: NB-IoT Scanner BCH View - configuration

4.8.8.3 NB-IoT scanner reference signal CIR view

The "NB-IoT Scanner Reference Signal CIR View" displays the CIR and CIR peaks of the reference signal measurements. The following figure shows the results of measurements in the RS CIR chart and RS CIR lists of the view.

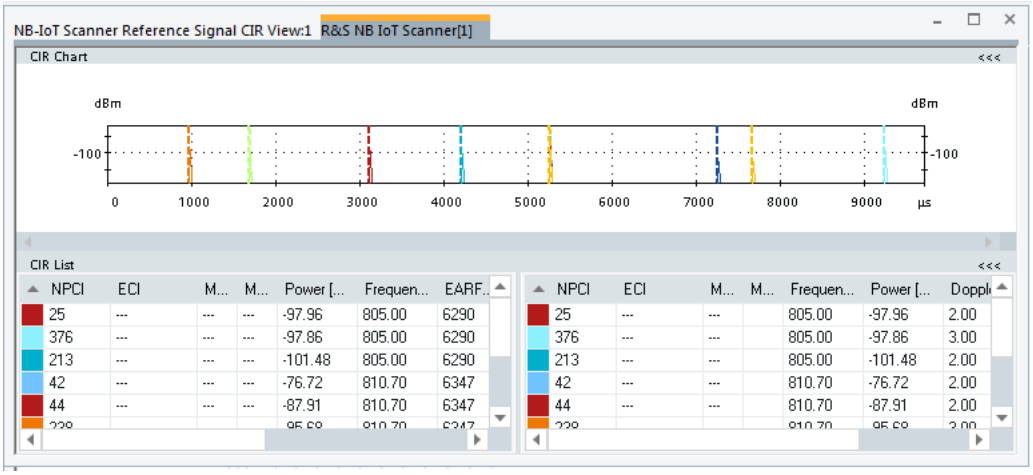


Figure 4-968: NB-IoT Scanner Reference Signal CIR View

The NB-IoT scanner export supports the CIRs and CIR peaks export based on reference signal measurements. An example of the NB-IoT CIR and NB-IoT CIR peak export to XML format is shown in the following example.

Example:

```
<ListContent Timestamp="16848 ms">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=""/>
                <PCI Value="330"/>
                <Un__ID Value="5"/>
                <Power__dBm_ Value="-93.05"/>
                <Noise__dBm_ Value="-97.83"/>
                <P_total__dBm_ Value="-89.83"/>
                <Frequency__MHz_ Value="796.00"/>
                <EARFCN Value="6200"/>
                <ISI Value="0.00%"/>
                <Exp__Drift__ns_s_ Value="-98.48"/>
                <Sigma_Drift__ns_s_ Value="1270.45"/>
                <Max__Delay__us_ Value="64.05"/>
                <Time_Delta__us_ Value="0.02"/>
            </Line>
```

Figure 4-969: NB-IoT CIR export file layout

NOTE: The <ListContent> entry contains not only the timestamp but also the position data.

Example:

```
<ListContent Timestamp="16848 ms">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=""/>
                <PCI Value="330"/>
                <Frequency__MHz_ Value="796.00"/>
                <Un__ID Value="5"/>
                <Power__dBm_ Value="-96.06"/>
                <P_total__dBm_ Value="-89.83"/>
                <Doppler__Hz_ Value="34.00"/>
                <Delay__us_ Value="64.03"/>
                <Match_Guard_Per_ Value="11/70 (15.71%)"/>
            </Line>
```

Figure 4-970: NB-IoT CIR Peak export file layout

The export to CSV format is supported.

View area

The entire view area is horizontally split to accommodate a chart and a table/list.

The "CIR Chart" shows the channel impulse response of the different NB-IoT signals which have been scanned. The graph allows zooming into the chart. The small button on the right of the scroll bar reset the zoom level.

Click "CIR Chart" or "CIR Lists" to compresses/expand the 2D chart or table. A compressed chart leaves more space for the table and vice versa.

Moreover, the tables appear in several views so that compressing them can help to avoid redundancies.

To compress/expand table use the ">>>"/"<<<" symbol in its title bar.

Diagram scale

If placed inside the diagram area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside), and a vertical line is displayed at the cursor position.

The cyclic prefix is shown in the "CIR Chart" for each "CIR Lists" element as a dotted vertical line in the cell ID color.

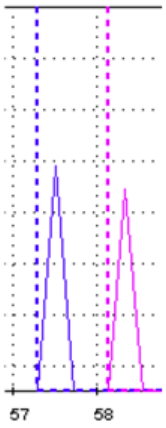


Figure 4-971: Diagram scale

The display of the cyclic prefix in the CIR chart can be switched off in the "NB-IoT Scanner Reference Signal CIR View" configuration.

A left mouse button click magnifies the diagram in x-direction around the cursor position. CTRL + left mouse click causes the opposite.

An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed

"Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

Left table

The table lists all the scanned NBI-IoT segments:

- "Color"

Sequence number and physical cell ID color. The color can be configured in the views configuration page.

- "Physical Cell ID"
  Physical Cell Identity, range 0 to 503
- "ECI"
  E-UTRAN Cell Identifier (format ENB-ID 20 bits, CI 8 bits), unique for a cell even if the physical cell IDs are identical.
- "MNC"
  Mobile Network Code
- "MCC"
  Mobile Country Code
- "Power [dBm]"
  The received power on S-Sync signal
- "Noise [dBm]"
  Noise floor based on S-Sync signal
- "P total [dBm]"
  Total in-band power based on S-Sync signal, including thermal noise and noise generated in the receiver
- "Frequency [MHz]"
  Center Frequency
- "EARFCN"
  Evolved Absolute Radio Frequency Channel Number
- "ISI"
  CIR outside of cyclic prefix
- "Exp. Drift [ns/s]"
  Expected time drift against the receiver time
- "Sigma Drift [ns/s]"
  Expected standard deviation of the expected time drift
- "Max.Delay [µs]"
  Maximum delay of the relating peaks
- "Time Delta [µs]"
  Time difference between the first and the last arrived peak
- "Unique ID"
  Unique BTS ID generated by the scanner per on a channel identified BTS

Right table

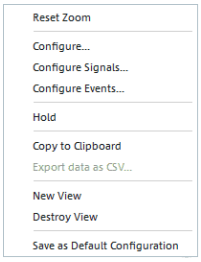
The right table shows the different path of the segments. The table lists all scanned NB-IoT segments.

The specific ones are listed here:

- "Delay [µs]"
  Shows signal's delay time. The delay values are calculated with an offset to the first measured CIR value in the current scan.
  The delay in the peak list correspondents to the delay seen in the CIR chart.
- "Match.Guard Per"
  Display the number of the matching guard periods for each peak

For other signals in this table, see previous table signals.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional command.

- "Reset Zoom"
  Resets the x-axis scale to 0 ms to approx. 26.5 ms.

NB-IoT scanner CIR view configuration

Right mouse click any point inside the view pops-up the context sensitive menu. Select the "Configuration" command to get the "CIR View" configuration page.

The "CIR View" option lets you customize the diagram and the contents of the table in "NB-IoT Scanner Reference Signal CIR View".

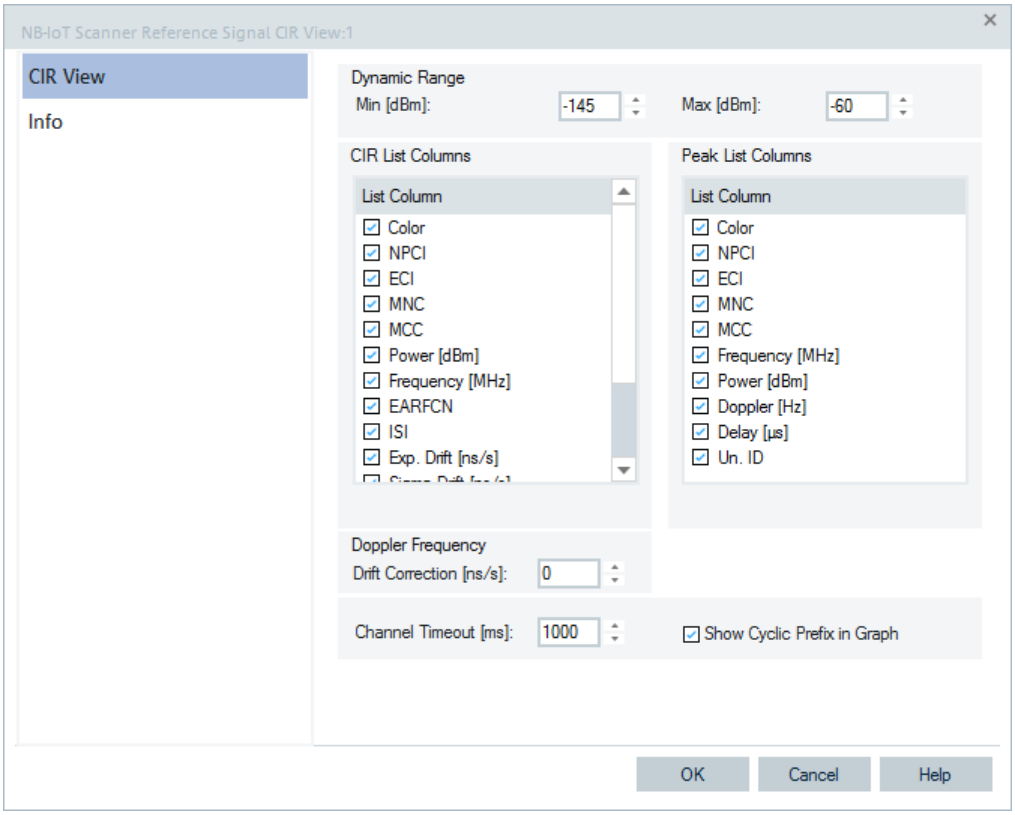


Figure 4-972: NB-IoT Scanner CIR View - configuration

Dynamic Range
The two input fields in this panel define the maximal/minimal signal level to be displayed in the "NB-IoT Scanner Reference Signal CIR View." The signal levels out of the range defined with maximal and minimal signal levels are not displayed.

CIR List Column
The CIR list selects which information to display in the left table below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Peak List Column
The peak list selects which information to display in the right table below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Doppler Frequency
The panel provides an input field for correcting the Doppler frequency displayed in the "Peak List". The purpose of the correction is to subtract frequency offsets in dependency of the measured frequency that cannot originate from the speed of the test vehicle relative to the signal source. The frequency offset is calculated as follows:

Meas. Freq. [Hz] * Drift Correction [ns/s] * 10^-9.

Example:

Frequency: 2 GHz

Drift Correction: 100 ns/s

Frequency Offset: 200 Hz

Channel Timeout
If there is no data on a channel anymore, the "CIR List" entries for this channel are removed after a timeout.

Show Cyclic Prefix in Graph
The display of the cyclic prefix in the CIR chart can be switched on or off via "Show Cyclic Prefix in Graph". If the checkbox is ticked, the Cyclic Prefix is displayed as a dotted vertical line of the cell ID color in "CIR Chart" for each "CIR List" element.

4.8.8.4 NB-IoT scanner Top N view

The "NB-IoT Scanner Top N View" shows the properties of the NB-IoT scanner signals received from the eNodeBs.

These signals are the selected elements of the "List" columns, see Figure 4-980.

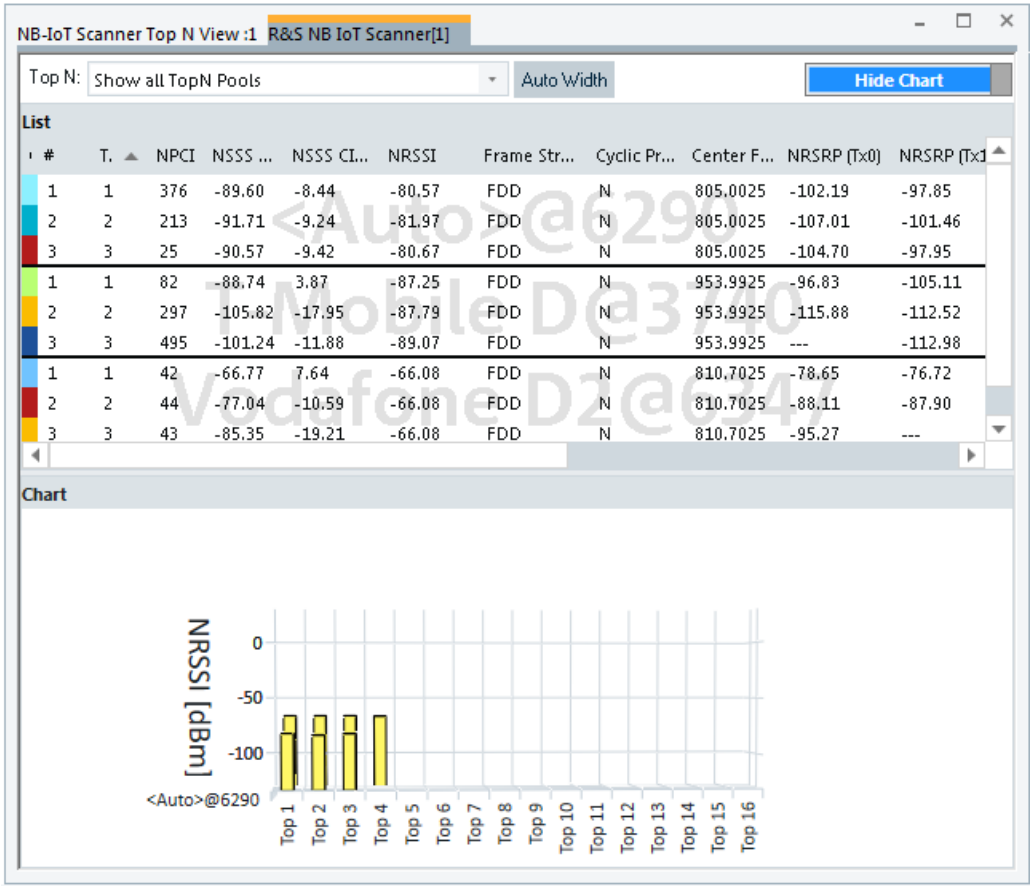


Figure 4-973: NB-IoT Scanner Top N View

The R&S TSME scanners support measurements of synchronization and reference signals.

The Top N view includes the received power and CINR on narrowband reference signals (NRS), NPSS and NSSS and the received quality (NRSRQ) of NRSs for each physical antenna port (Tx0, Tx1).

The eNodeB name is shown in the list if the transmitter database contains provider and channel, or at least EARFCN and NPCI.

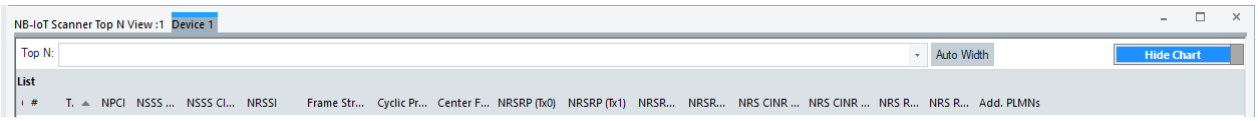
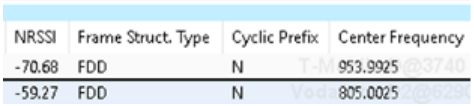


Figure 4-974: Default columns in the NB-IoT Scanner Top N View List



NRSSI	Frame Struct. Type	Cyclic Prefix	Center Frequency
-70.68	FDD	N	953.9925
-59.27	FDD	N	805.0025

Figure 4-975: Four digits after pointer for center frequency

The previous figure shows a part the "List" with emphasis on the center frequency which is shown with four digits after the pointer.

The following figures of the "Alphanumeric View" show signals related to NPSS Power, CINR and Frame Time of Arrival measurements available in the "NB-IoT Scanner Top N View". To be viewed, these signals have to be activated in the scanner configuration page, see Chapter 4.8.8.4, "NB-IoT scanner Top N view", on page 1312. The signals are available in the R&S ROMES4 "Available Signals" tree and shown by ToolTips if a mouse hovers over a signal.

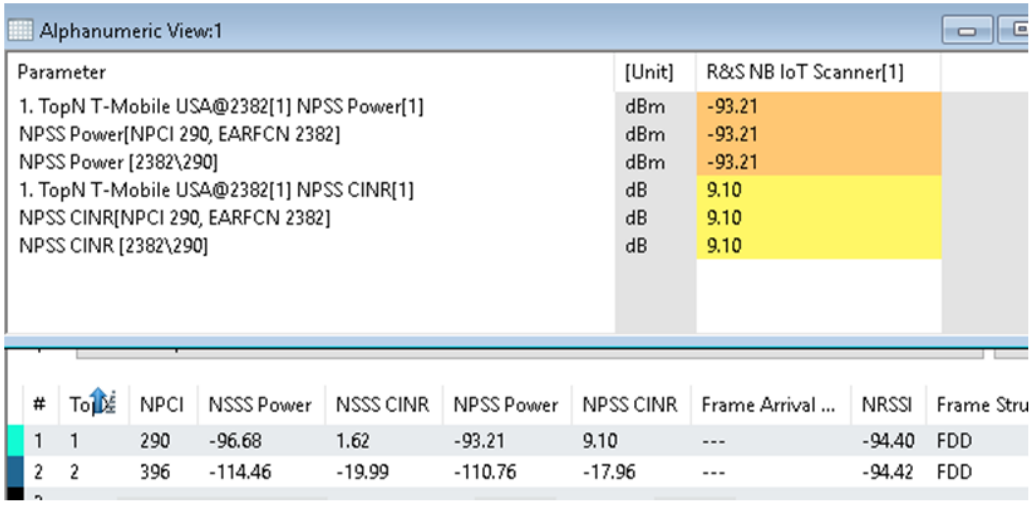


Figure 4-976: Alphanumeric view - NPSS power and CINR

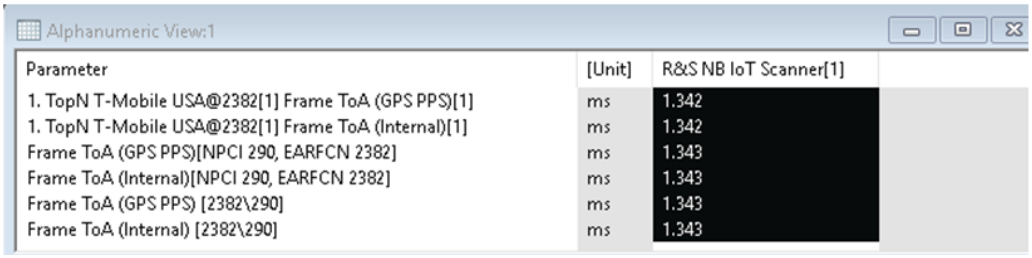


Figure 4-977: Alphanumeric view - frame ToA

The signals range and the signal events are configurable.

To configure the range of a signal:

1. Double click any point in the scanner view page.
2. In the dropped menu select the "Configure Signals"
   The "Configure Signals" > "Available Signals" page opens.
3. Select one of the mentioned signals, configure the range and click "OK".

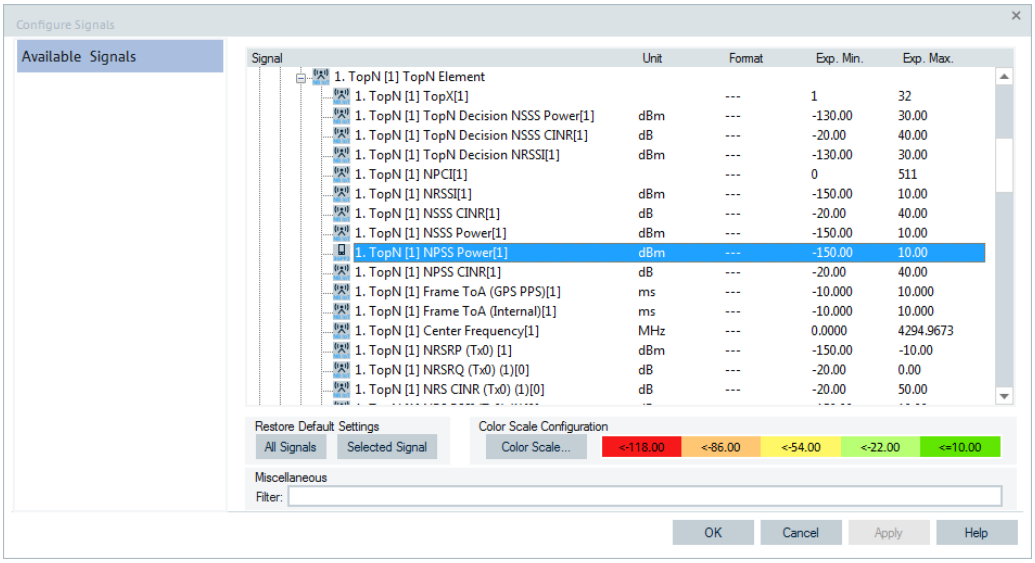


Figure 4-978: Signal range configuration

The range of signals is also configurable in "Preference" > "Available Signals".

To configure the signal event:

1. Double click any point in the scanner view page.
2. In the dropped menu select the "Configure Events"
   The "Configure Events" > "Available Events" page opens.
   Select one of the mentioned signals and configure event.

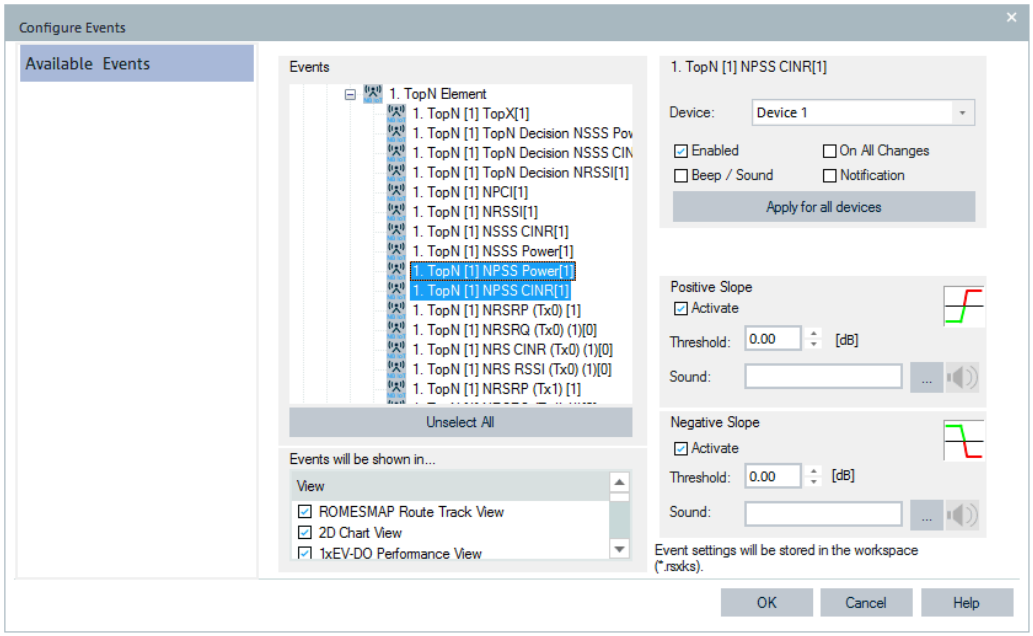


Figure 4-979: Event configuration

The event is also configurable in "Preference" > "Available Events".

For description of signals, see "Description of R&S ROMES4 Signals" > "NB-IoT Scanner".

The numbers in the brackets besides the measured signals stand for the configured antenna ports, that is, Tx antenna port 0 and Tx antenna port 1.

If you start R&S ROMES4 with an empty workspace, the initial "Top N View" column widths are initialized and scaled properly based on the current screen DPI setting.

Frame time of arrival (ToA)

Frame ToA is calculated using offset to PPS or internal block time and offset. The frame type is FDD or TDD frame.

Therefore, there are two types of Frame Time of Arrival.

- GPS PPS ToA
  If using GPS PPS, the value is a shift/drift pertaining to RF grid,. The value is always less than the frame length
- Block Time ToA
  If using Block Time and Offset, the values are generated by internal clock.

The formula to calculate ToA for FDD frame is: Frame Time = ((Internal TOA + 5 ms) modulo 10 ms) - 5 ms

The formula fto calculate ToA for TDD frame is: Frame Time = ((Internal TOA + 2.5 ms) modulo 5 ms) – 2.5 ms

In the formulas display unit is millisecond, modulo is the operation that takes the remainder of a division of two double operands. 5 ms and 10 ms stand for frame lengths of TDD and FDD frames, respectively.

- R&S ROMES4 v18.2 or higher must be used to record and show ToA time. Replaying early recorded measurement file shows empty or "--" space. The following is valid:
- Signal is available in Top N Pool and template signal trees
- GPS PPS values require GPS antenna and module and the signal values take a little bit time (probably a minute) to be available
- Frame ToA signals do not have events
- ToA signals by Block Time are always available if R&S ROMES4 v18.2 or higher is used

The automatic pool configuration feature is also supported with NB-IoT Scanner Top N View. Applied are the common functions and rules as for other 3GPP specified technologies, see "Scanner Top N view for automatic pool configuration" on page 1262.

Top N line

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.
- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

Top N list

The "Top N List" gives an overview of the all received signals in the current Top N pool together with their measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

The "Top N List" shows the following optional signals if configured.

- "TopX"
  Rank of the current cell in the Top N pool.
- "NPCI"
  Physical Layer Cell Id, range 0 to 503.
- "NSSS Power"

NSSS power of the secondary sync signal, range -150.00 to 10.00 dBm.

- "NSSS CINR"
  Carrier to Interference plus Noise Ratio of the secondary synchronisation signal, range -20 to 40.00 dB.
- "NPSS Power"
  NSSS power of the primary sync signal, range -150.00 to 10.00 dBm.
- "NPSS CINR"
  Carrier to Interference plus Noise Ratio of the primary synchronisation signal, range -20.00 to 40.00 dB.
- "Frame ToA (GPS PPs)"
  Frame Time of Arrival related to radio frequency grid in millisecond calculated by GPS Pulse Per Second (PPS) and offset to PPS, range -10.00 to 10.00 ms.
- "Frame ToA (Internal)"
  Frame Time of Arrival related to radio frequency grid in millisecond calculated by internal block time and offset to it, range -10.00 to 10.00 ms.
- "NRSSI"
  Total power received by the scanner inside the 180 kHz bandwidth of a NB-IoT channel. This power includes all possible NB-IoT signals transmitting in the channel as well as noise, range -150.00 to10.00 dBm.
- "Frame Struct. Type"
  FDD or TDD frame structure; type 1 or type 2 respectively.
- "Cyclic Prefix"
  Normal or extended length.
- "Central Frequency"
  Center frequency of the NB-IoT signal, range 0.00 to 4294967294.00 Hz
- "NRSRP (Tx0/1)"
  Average power of the power received from reference signals from Tx antenna port x, range -150.00 to 10.00 dBm.
- "NRSRQ (Tx0/1)"
  Reference Signal Received Quality (from Tx antenna port x) considering also NRSSI and the number of used Resource Blocks(N) - NRSRQ = (N * NRSRP) / NRSSI measured over the same bandwidth, range -20.00 to 0.00 dB.
- "NRS CINR (Tx0/1)"
  Reference Signal Power from Tx antenna port x divided by the sum of the interference power and the power of some background noise, range -20.00 to 50.00 dB.
- "NRS RSSI (Tx0/1)"
  Total received power of reference signals from Tx antenna port x, range -150.00 to 10.00 dBm.
- "EARFCN"
  Evolved Absolute Radio Channel Number
- "eNodeB Name"
  LTE base station's name
- "Dist.(km)"
  Distance to the eNodeB.
- "ECI(20/8), EC(28)"
  EUTRAN Cell Identifier columns

Cell Identifier: CellID*256 (or << 16) + eNodeB ID

- "MCC"
  Mobile Country Code
- "MNC"
  Mobile Network Code
- "TAC"
  Tracking Area Code
- "Add. PLMNs"
  Additional PLMNs shared with this eNodeB
- "Operation Mode"
  The operation mode of a NB-IoT cell broadcasted in the cell's MIB is included in the scanner's Top N view list and in the "Signal Tree".

For the NB-ioT scanner signals details, see "Description of R&S ROMES4 Signals" manual.

You can add or remove the optional signals by right click any point of the "NB-IoT Scanner Top N View" and choose the wanted configuration.

Select or unselected the desired rows in the "List" of the "Top N View" page, see Figure 4-980.

NB-IoT scanner Top N view configuration

The "Configuration" option lets you set the color for the selected BTS symbols in the "ROMESMAP Route Track View" and define the filter for generating a BTS list.

Open the configuration page by a right mouse click on a point inside the view or via the "Tools" > "Configuration Active View" command.

Configuration: Top N view

The "Top N View" configuration option is common for all technologies, see "LTE scanner Top N view configuration" on page 1272.

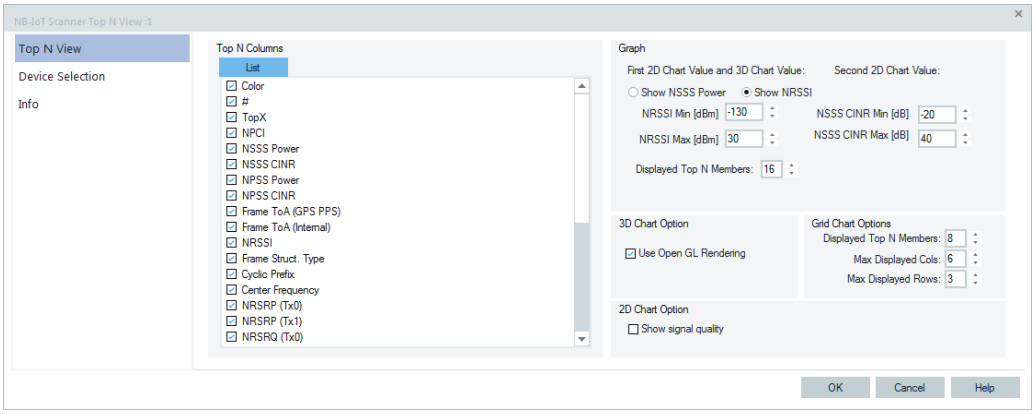


Figure 4-980: NB-IoT scanner Top N view - configuration

Configuration: Device selection

This configuration is common for all technologies.

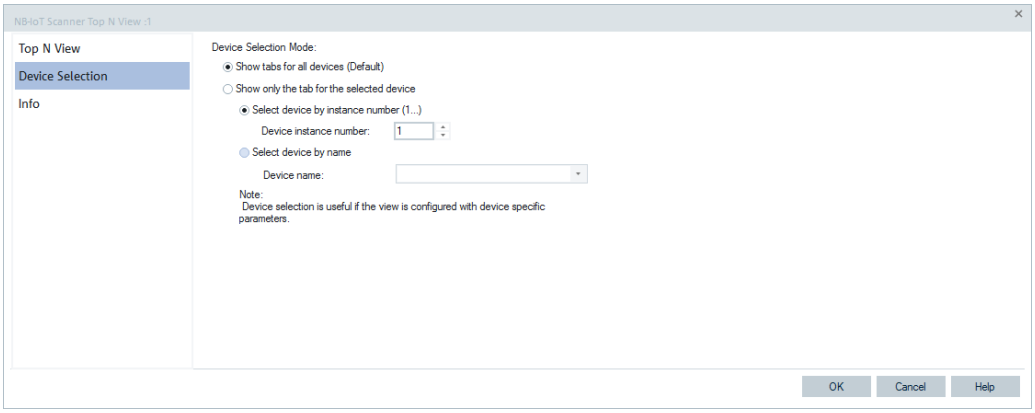


Figure 4-981: Device selection for NB-IoT scanner Top N view

4.8.9 RF power scanner views

The "RF Power Scanner Views" show the RF power information obtained in the RF power scan performed by an R&S radio network analyzer.

For the RF power scan, use the R&S TSME scanner with its hardware option R&S TSME-K27.

The RF Power Scanner available option is R&S TSME4T1E.

See Chapter 6.4.21, "RF power scanner", on page 1823.

The RF power scanner views can be selected from a submenu displayed on the right-hand side of the "View" menu if the mouse hovers over the "RF Power Scanner Views".

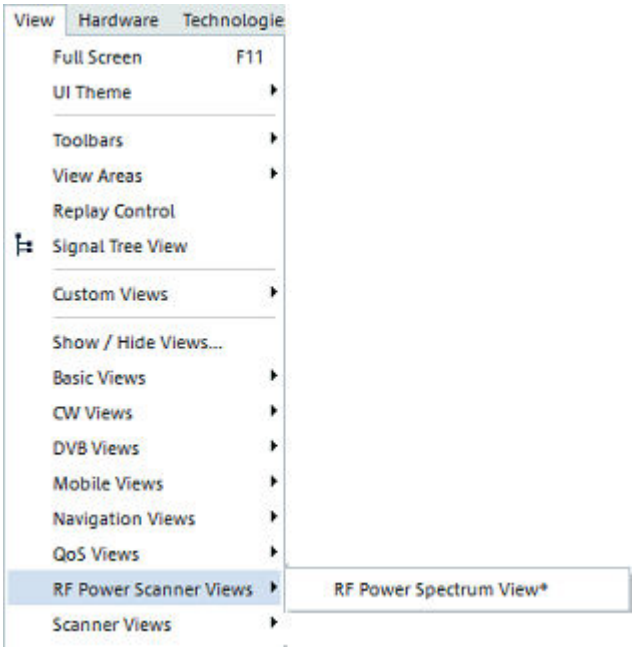


Figure 4-982: RF Power Scanner views

"RF Power Scanner View:<n>" shows the RF power information obtained in the RF scans performed by an R&S TSME radio network analyzer.

The RF power Peak of Peaks (PoP) signal list is added to the "Sweep Templates" of the RF Power Scan branch in the "Signal Tree".

An RF power scan sweep contains RF Power Scan frames. Each of the frames contains a list of peak signals. A peak is a turning point where signal power changes from going strong to going weak. Peak signals are ranked by their power values. When selecting peak signals in signal filter, sweep and rank are needed.

For the signals in the PoP list and their description, see "Description of R&S ROMES4 Signals" document.

4.8.9.1 RF power scanner sweep template

Adding signals to a generic view is done by dragging a signal from the "Signal Tree" > "RF Power Scan" branch to the view. A signal filter dialog is displayed for selecting sweep or optionally mark or channel number. If hovering mouse over the name column of the dialog, the Tooltip is displayed.

Value fields are displayed red if a valid value is entered or selected.

Check boxes in the first column are readable only if the field is required.

The "Apply for all signals" check box indicates whether to apply the same selection to all signals.

Filtering dialog is without the "Device" group, for example, in "Alphanumeric View".

Sweep names are listed in the sweep grid data column (the first row and the third column normally).

- If no measurement file is opened, the default sweep name is "Sweep x" where x is the sweep index.
- If a measurement file is opened, the sweep names are retrieved from measurement file.
- If multiple RF Power devices are available, "+" is suffixed to the end of the first sweep name.

Filter dialog without device group

The screenshot shows the filter dialog without device group, for a generic view, for example, the "Alphanumeric View".

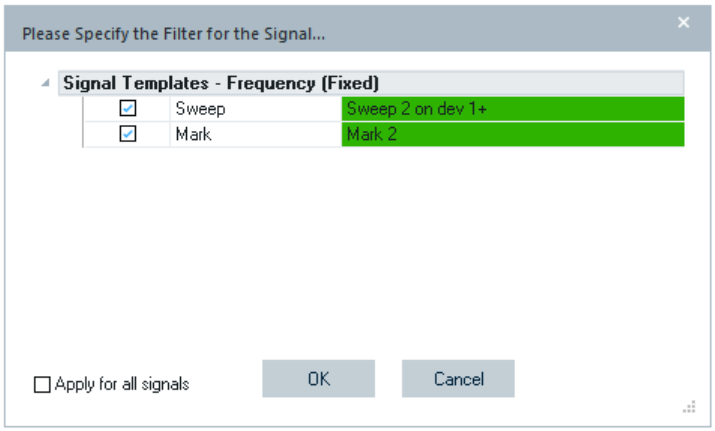


Figure 4-983: Frequency signal template without device filtering

Filter dialog with device group

The screenshot shows the filter with device group, for a generic view, for example, the "2D Chart View" or the "Grid View".

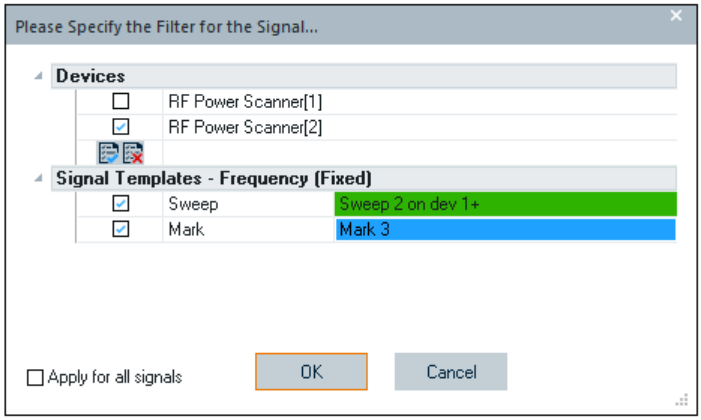


Figure 4-984: Frequency signal template with device filtering

Select sweep

The maximum number of sweeps is 40.

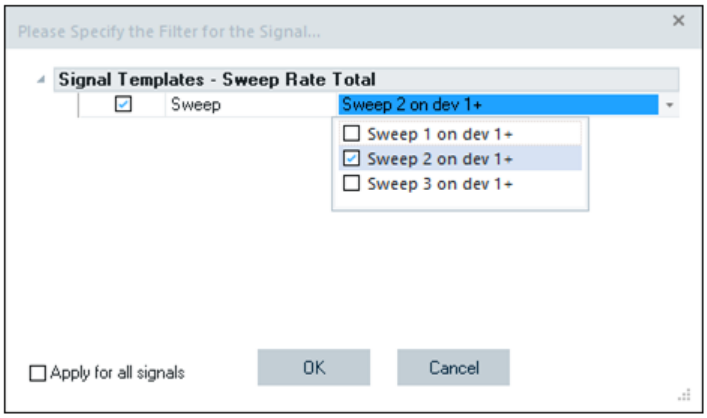


Figure 4-985: Filtering per total rate for sweep 2

Select sweeps for multiple devices

If multiple devices are configured, a sweep name of the first device is listed and suffixed with indicator "+".

If the name already ends with "+", the indicator is "(+)".

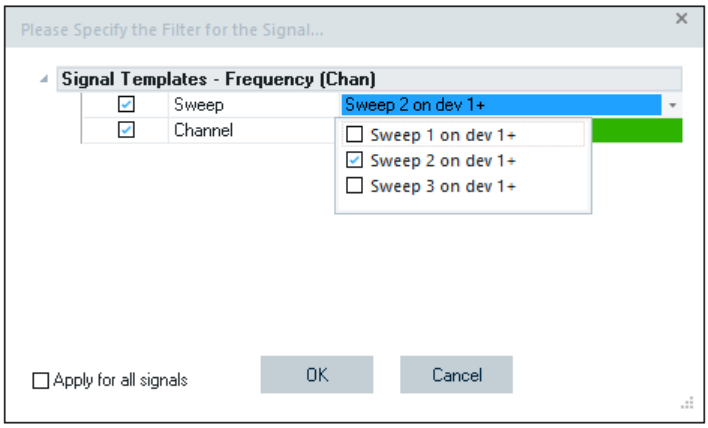


Figure 4-986: Filtering per frequency for multiple devices

Select marks for fixed mark signals

The maximum number of fixed markers is four.

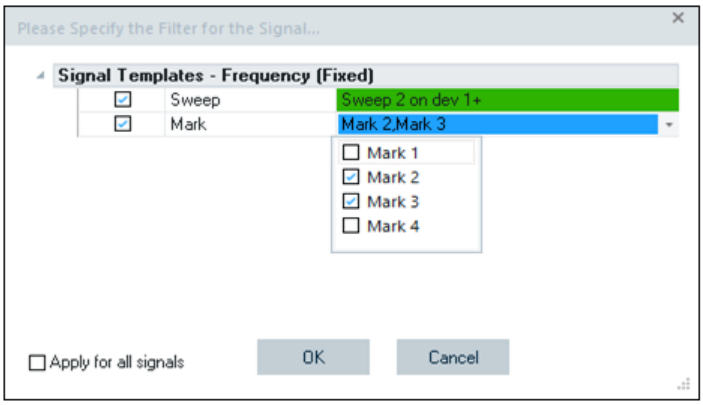


Figure 4-987: Filtering per fixed markers

Select channel number for channels

Channels can be configured when creating RF Power Scan measurement file.

Channels are associated with sweep. After a sweep is selected, the corresponding configured channels are available in the drop-down check list.

1. If there is no opened measurement file, free channels can be entered.

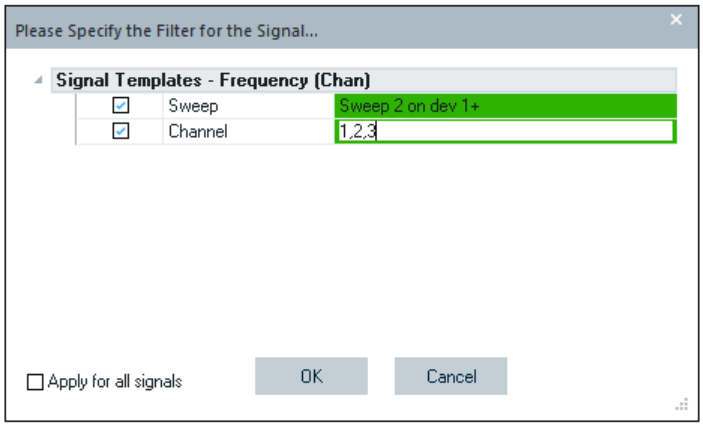


Figure 4-988: Filtering per free entered channels

2. If measurement file is opened and contains configured channels, these channels are displayed in "Channel" row for selection.

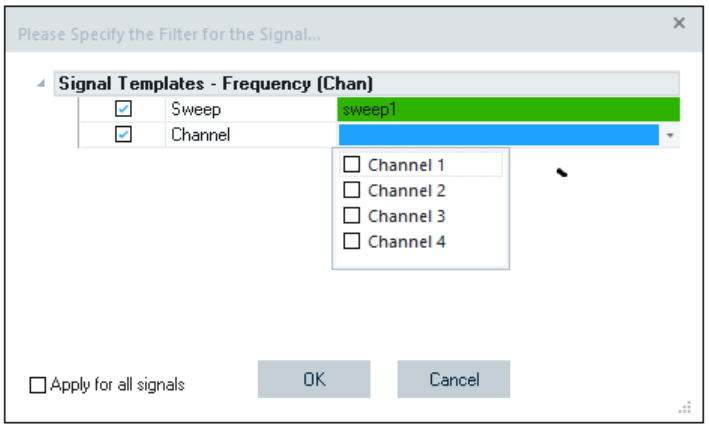


Figure 4-989: Filtering per channels from opened file

If the measurement file does not contain the configured channels, the channel row is empty, as shown in the previous figure.

Prior selected signals

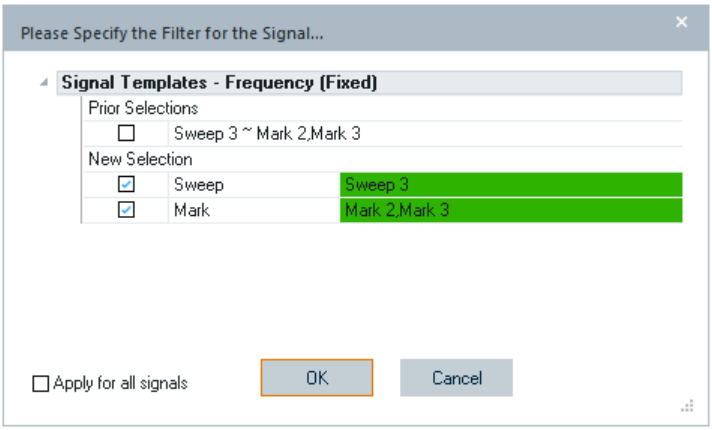


Figure 4-990: Prior selected signals

Select filter for peak of peaks signals

The RF Power Scan Peak of Peaks (PoPs) is added to the sweep template. The filtering can be done per Frequency (PoP), Channel Index (PoP) and Level (PoP). To select a PoP signal, sweep and rank are needed. Rank can be entered, but if not entered assumed is to be 0. To enter Rank, the "Rank" check-box must be checked.

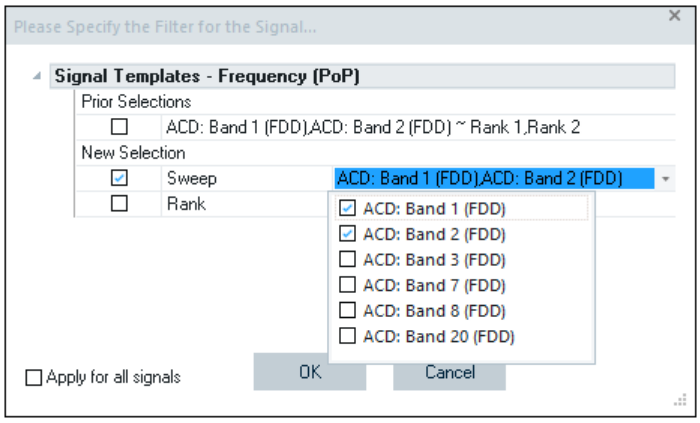


Figure 4-991: Filtering per frequency PoP

The dialogs for filtering per Channel index (PoP) and Level (PoP) are identical.

The following screenshot shows a Frequency (PoP) filter with three sweeps and two ranks selected.

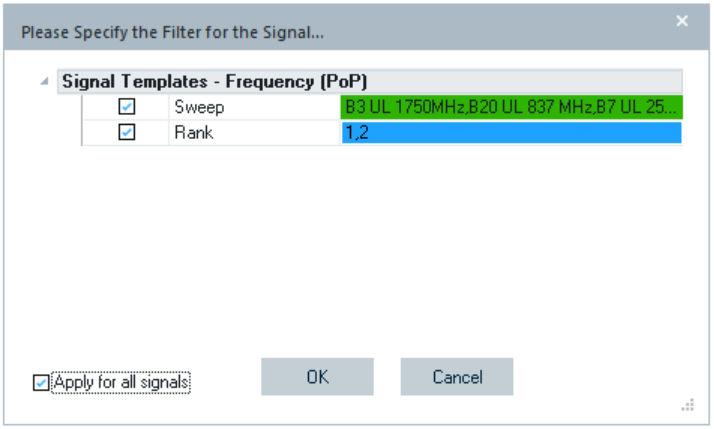


Figure 4-992: Filtering per frequency (PoP) - three sweeps and two ranks

4.8.9.2 RF power scanner signals in alphanumeric view

The sweep names in the "Alphanumeric View" are different dependent on context. The context depends on whether the sweeps are entered (no opened file), taken from the measurement file or from the configuration of multiple devices.

Sweep names without open measurement in the view

The default sweep name specified in the filter is used: sweep x, where x is the sweep number in the sweep filtering selection.

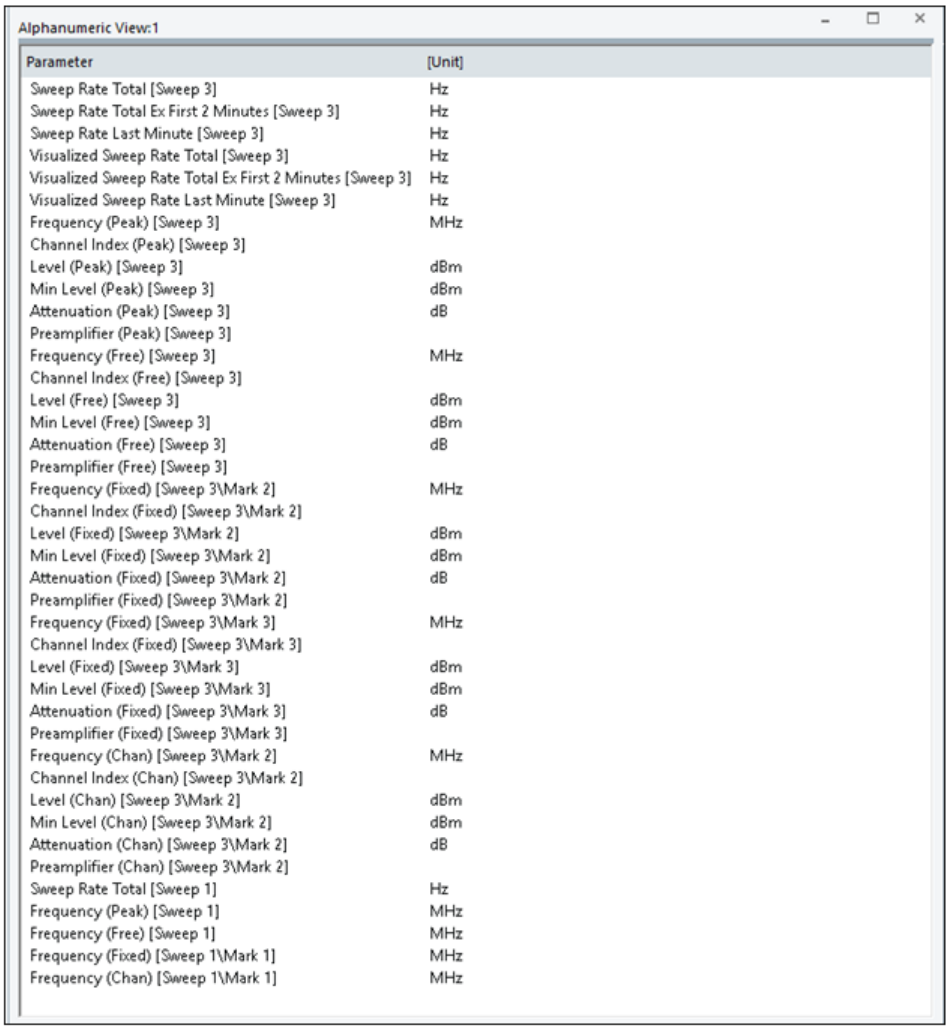
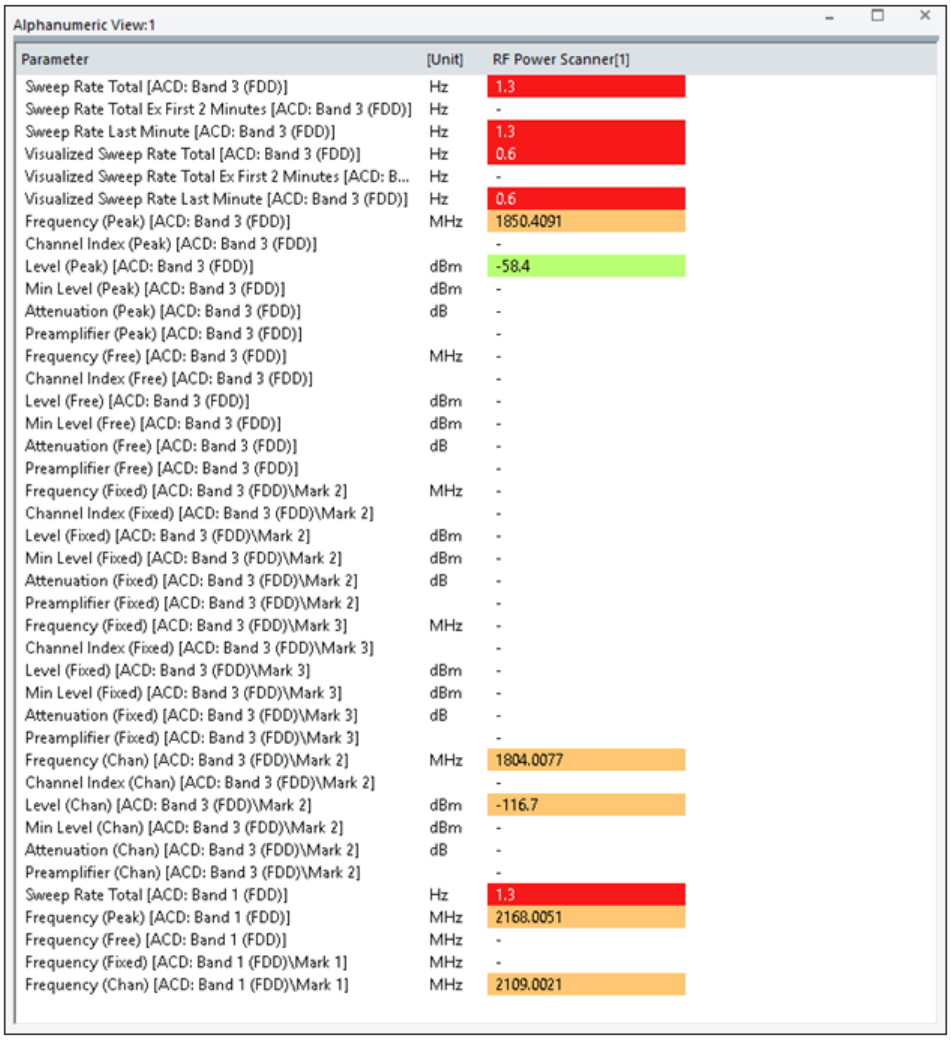


Figure 4-993: Alphanumeric view - not opened measurement file

Sweep names with open measurement in the view

The sweep names are changed accordingly to the sweep names defined in a measurement file.

If a sweep name is blank, "Sweep x" is used as default name. Values from the multiple devices are listed on different column, see the next section.



Parameter	[Unit]	RF Power Scanner[1]
Sweep Rate Total [ACD: Band 3 (FDD)]	Hz	1.3
Sweep Rate Total Ex First 2 Minutes [ACD: Band 3 (FDD)]	Hz	-
Sweep Rate Last Minute [ACD: Band 3 (FDD)]	Hz	1.3
Visualized Sweep Rate Total [ACD: Band 3 (FDD)]	Hz	0.6
Visualized Sweep Rate Total Ex First 2 Minutes [ACD: B...	Hz	-
Visualized Sweep Rate Last Minute [ACD: Band 3 (FDD)]	Hz	0.6
Frequency (Peak) [ACD: Band 3 (FDD)]	MHz	1850.4091
Channel Index (Peak) [ACD: Band 3 (FDD)]		-
Level (Peak) [ACD: Band 3 (FDD)]	dBm	-58.4
Min Level (Peak) [ACD: Band 3 (FDD)]	dBm	-
Attenuation (Peak) [ACD: Band 3 (FDD)]	dB	-
Preamplifier (Peak) [ACD: Band 3 (FDD)]		-
Frequency (Free) [ACD: Band 3 (FDD)]	MHz	-
Channel Index (Free) [ACD: Band 3 (FDD)]		-
Level (Free) [ACD: Band 3 (FDD)]	dBm	-
Min Level (Free) [ACD: Band 3 (FDD)]	dBm	-
Attenuation (Free) [ACD: Band 3 (FDD)]	dB	-
Preamplifier (Free) [ACD: Band 3 (FDD)]		-
Frequency (Fixed) [ACD: Band 3 (FDD)\Mark 2]	MHz	-
Channel Index (Fixed) [ACD: Band 3 (FDD)\Mark 2]		-
Level (Fixed) [ACD: Band 3 (FDD)\Mark 2]	dBm	-
Min Level (Fixed) [ACD: Band 3 (FDD)\Mark 2]	dBm	-
Attenuation (Fixed) [ACD: Band 3 (FDD)\Mark 2]	dB	-
Preamplifier (Fixed) [ACD: Band 3 (FDD)\Mark 2]		-
Frequency (Fixed) [ACD: Band 3 (FDD)\Mark 3]	MHz	-
Channel Index (Fixed) [ACD: Band 3 (FDD)\Mark 3]		-
Level (Fixed) [ACD: Band 3 (FDD)\Mark 3]	dBm	-
Min Level (Fixed) [ACD: Band 3 (FDD)\Mark 3]	dBm	-
Attenuation (Fixed) [ACD: Band 3 (FDD)\Mark 3]	dB	-
Preamplifier (Fixed) [ACD: Band 3 (FDD)\Mark 3]		-
Frequency (Chan) [ACD: Band 3 (FDD)\Mark 2]	MHz	1804.0077
Channel Index (Chan) [ACD: Band 3 (FDD)\Mark 2]		-
Level (Chan) [ACD: Band 3 (FDD)\Mark 2]	dBm	-116.7
Min Level (Chan) [ACD: Band 3 (FDD)\Mark 2]	dBm	-
Attenuation (Chan) [ACD: Band 3 (FDD)\Mark 2]	dB	-
Preamplifier (Chan) [ACD: Band 3 (FDD)\Mark 2]		-
Sweep Rate Total [ACD: Band 1 (FDD)]	Hz	1.3
Frequency (Peak) [ACD: Band 1 (FDD)]	MHz	2168.0051
Frequency (Free) [ACD: Band 1 (FDD)]	MHz	-
Frequency (Fixed) [ACD: Band 1 (FDD)\Mark 1]	MHz	-
Frequency (Chan) [ACD: Band 1 (FDD)\Mark 1]	MHz	2109.0021

Figure 4-994: Alphanumeric view - opened measurement file

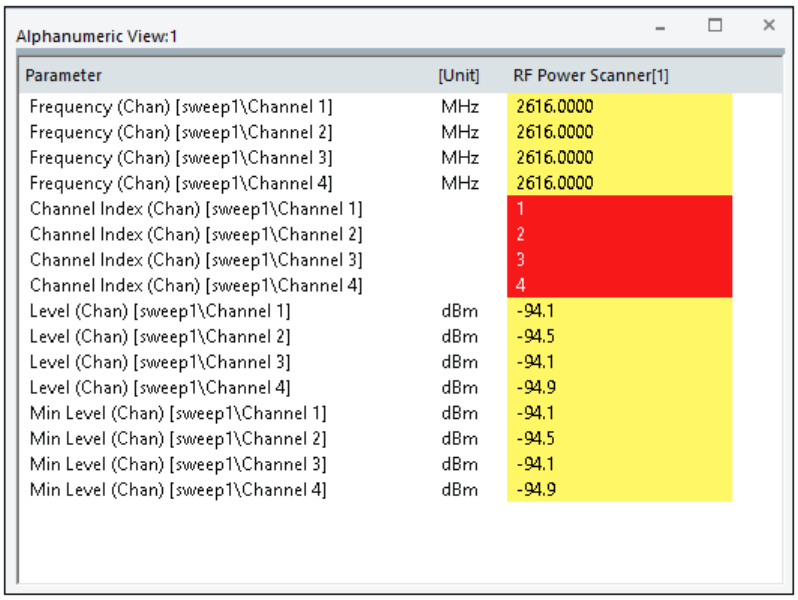
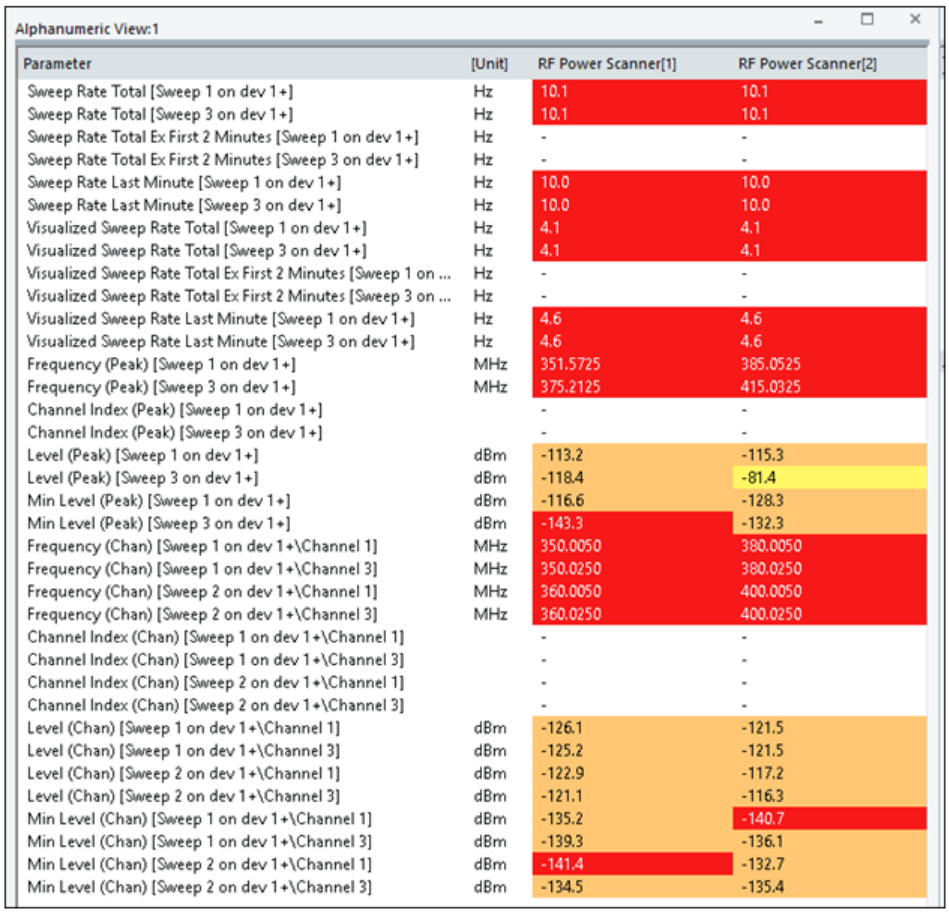


Figure 4-995: Channel signals in Alphanumeric view

Sweep names with multiple devices in the view


Alphanumeric View:1

Parameter	[Unit]	RF Power Scanner[1]	RF Power Scanner[2]
Sweep Rate Total [Sweep 1 on dev 1+]	Hz	10.1	10.1
Sweep Rate Total [Sweep 3 on dev 1+]	Hz	10.1	10.1
Sweep Rate Total Ex First 2 Minutes [Sweep 1 on dev 1+]	Hz	-	-
Sweep Rate Total Ex First 2 Minutes [Sweep 3 on dev 1+]	Hz	-	-
Sweep Rate Last Minute [Sweep 1 on dev 1+]	Hz	10.0	10.0
Sweep Rate Last Minute [Sweep 3 on dev 1+]	Hz	10.0	10.0
Visualized Sweep Rate Total [Sweep 1 on dev 1+]	Hz	4.1	4.1
Visualized Sweep Rate Total [Sweep 3 on dev 1+]	Hz	4.1	4.1
Visualized Sweep Rate Total Ex First 2 Minutes [Sweep 1 on ...	Hz	-	-
Visualized Sweep Rate Total Ex First 2 Minutes [Sweep 3 on ...	Hz	-	-
Visualized Sweep Rate Last Minute [Sweep 1 on dev 1+]	Hz	4.6	4.6
Visualized Sweep Rate Last Minute [Sweep 3 on dev 1+]	Hz	4.6	4.6
Frequency (Peak) [Sweep 1 on dev 1+]	MHz	351.5725	385.0525
Frequency (Peak) [Sweep 3 on dev 1+]	MHz	375.2125	415.0325
Channel Index (Peak) [Sweep 1 on dev 1+]		-	-
Channel Index (Peak) [Sweep 3 on dev 1+]		-	-
Level (Peak) [Sweep 1 on dev 1+]	dBm	-113.2	-115.3
Level (Peak) [Sweep 3 on dev 1+]	dBm	-118.4	-81.4
Min Level (Peak) [Sweep 1 on dev 1+]	dBm	-116.6	-128.3
Min Level (Peak) [Sweep 3 on dev 1+]	dBm	-143.3	-132.3
Frequency (Chan) [Sweep 1 on dev 1+\Channel 1]	MHz	350.0050	380.0050
Frequency (Chan) [Sweep 1 on dev 1+\Channel 3]	MHz	350.0250	380.0250
Frequency (Chan) [Sweep 2 on dev 1+\Channel 1]	MHz	360.0050	400.0050
Frequency (Chan) [Sweep 2 on dev 1+\Channel 3]	MHz	360.0250	400.0250
Channel Index (Chan) [Sweep 1 on dev 1+\Channel 1]		-	-
Channel Index (Chan) [Sweep 1 on dev 1+\Channel 3]		-	-
Channel Index (Chan) [Sweep 2 on dev 1+\Channel 1]		-	-
Channel Index (Chan) [Sweep 2 on dev 1+\Channel 3]		-	-
Level (Chan) [Sweep 1 on dev 1+\Channel 1]	dBm	-126.1	-121.5
Level (Chan) [Sweep 1 on dev 1+\Channel 3]	dBm	-125.2	-121.5
Level (Chan) [Sweep 2 on dev 1+\Channel 1]	dBm	-122.9	-117.2
Level (Chan) [Sweep 2 on dev 1+\Channel 3]	dBm	-121.1	-116.3
Min Level (Chan) [Sweep 1 on dev 1+\Channel 1]	dBm	-135.2	-140.7
Min Level (Chan) [Sweep 1 on dev 1+\Channel 3]	dBm	-139.3	-136.1
Min Level (Chan) [Sweep 2 on dev 1+\Channel 1]	dBm	-141.4	-132.7
Min Level (Chan) [Sweep 2 on dev 1+\Channel 3]	dBm	-134.5	-135.4

Figure 4-996: Alphanumeric view of RF Power Scanner - multiple devices

4.8.9.3 RF power spectrum view

"TEC for RF Power Scanner TSME" lets you create signals for each selected sweep and allows elementary spectrum measurement and analysis, see Chapter 3.8.2.16, "TEC for RF power scanner TSME", on page 369.

The analysis results are displayed in the "RF Power Spectrum View". The power spectrum is displayed in four different ways.

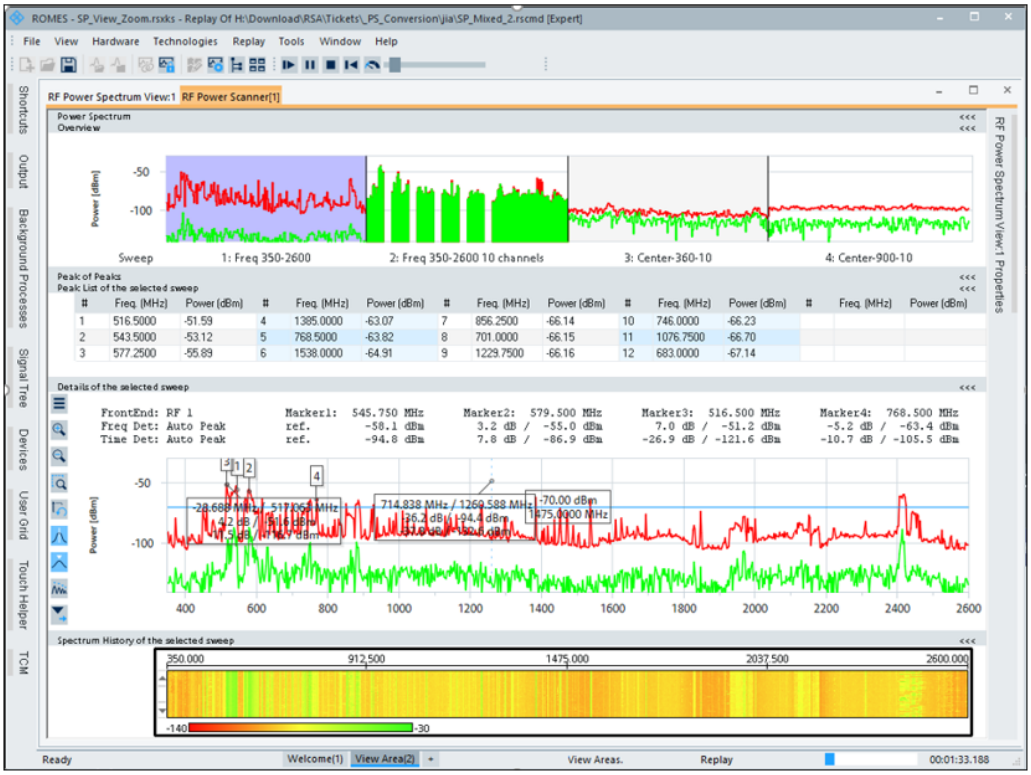


Figure 4-997: RF Power Spectrum View dialog

- "Power Spectrum Overview"
  The top section of the view displays an overview of the sweeps which were configured in the scanner.
- "Peak of Peaks"
  The section contains the peak list of the selected sweeps.
- "Details of the selected sweeps"
  This section of the view displays the spectrum of the selected sweep in detail.
- "Spectrum History of the selected sweep"
  The bottom section displays the spectrum with a time dimension ("Spectrum History"). The power values are indicated through a color scale.

The sweeps displayed in the last two sections can be chosen from the list of channels in the top section by clicking it.

Peak of peaks section

The combination of three columns in a grid, called Peak Bar, is used to describe a peak. The peak is described with the rank number, frequency and power.

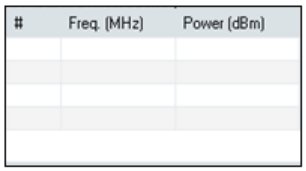


Figure 4-998: Peak bar

A PoP grid row contains multiple peak bars. The screenshot shows a grid with three peak bars in a row.

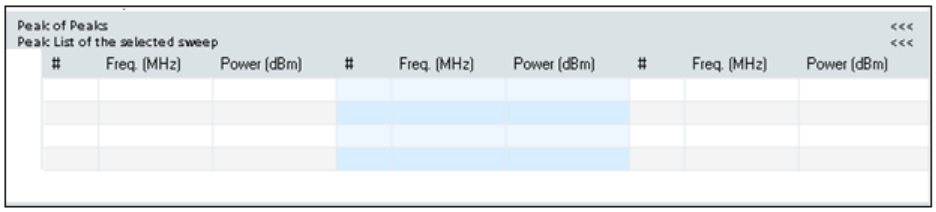


Figure 4-999: PoP grid row

Peak limit line in details chart

The peak limit line is included in the details chart. A limit line marker displays around the limit line. Power and frequency are displayed inside the marker.

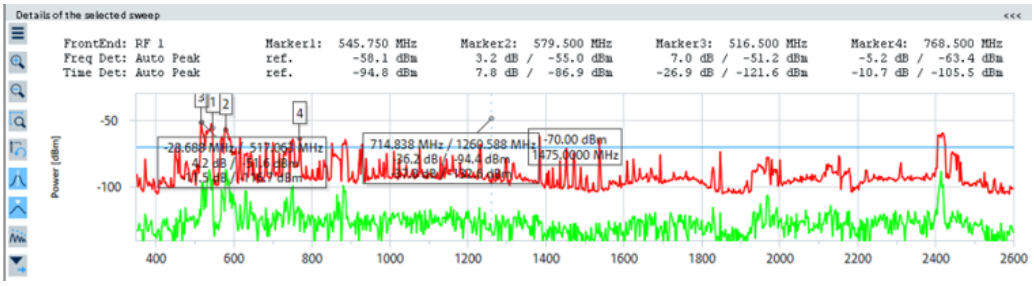


Figure 4-1000: Normal limit line in details view

If hovering mouse over the limit line, it changes to thicker line with a hand cursor and is active for dragging.

When the limit line is active, dragging the line up and down changes the limit value. The width, marker, location and orientation of the limit line can be configured. For details, open the property bar section on the right side of the view's dialog.

Peak limit line setting and peak list grid

Signals are displayed in peak list if their powers are above limit line.

Peak limit line setting and chart fixed markers

Fixed markers in the "Details for the selected sweep" chart are hidden if the power of the markers is below the limit line setting.

If the fixed markers are invisible, the corresponding text label on the header is suffixed with a star '*'. When the limit line setting is changed, the states of the fixed markers change accordingly.

Integrated view update rate service

If "Use update rate" is selected (for either measurement or replay in "Measurement" or "Replay") in "Tools" > "Preferences" > "Performance" page, GUI update rate is reduced.

The RF Power Spectrum view has integrated this service to improve the performance.

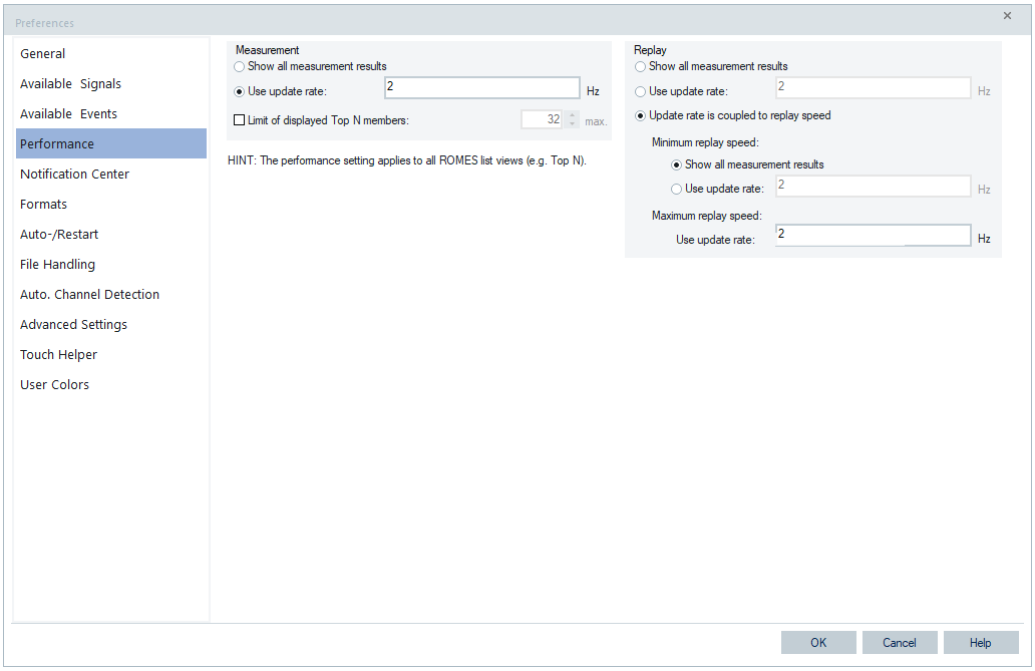


Figure 4-1001: Performance setting for RF Power Scanner

Properties bar

The "RF Power Spectrum View:1 Properties" is added on the top right-hand side of the view.

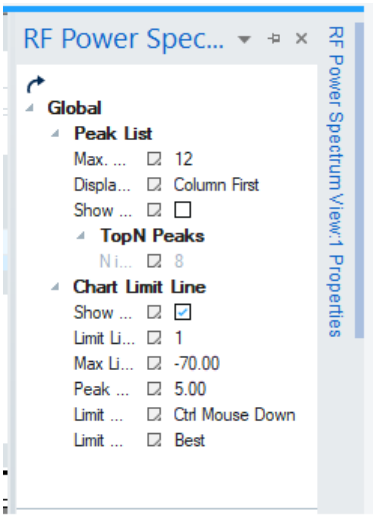


Figure 4-1002: RF Power Scanner properties bar

Under the "Global" > "Peak List", there is the possibility to select the peak list size and N Top N peaks. The "Chart Limit Line" entries let you configure the grid layout.

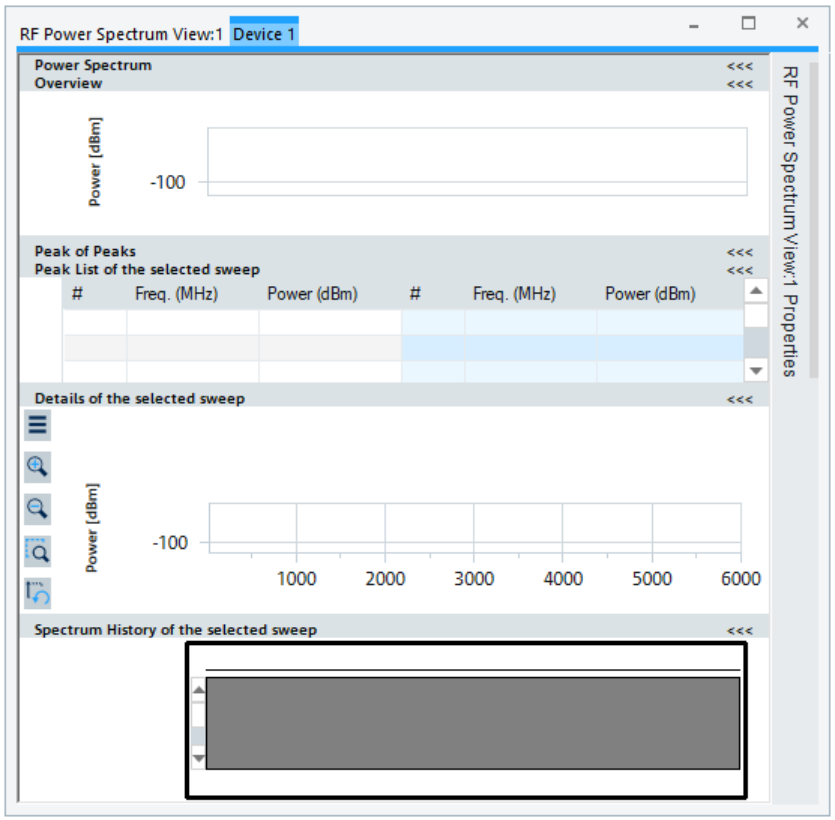


Figure 4-1003: RF Power Scanner - peak to peak (PoP) properties

You can close the property window and make the property bar invisible if clicking the "X" button in the property window. To get the property window again, right mouse but-

ton click anywhere on the "RF Power Spectrum View". The configuration menu pops-up. Select the "Properties" entry in the menu.

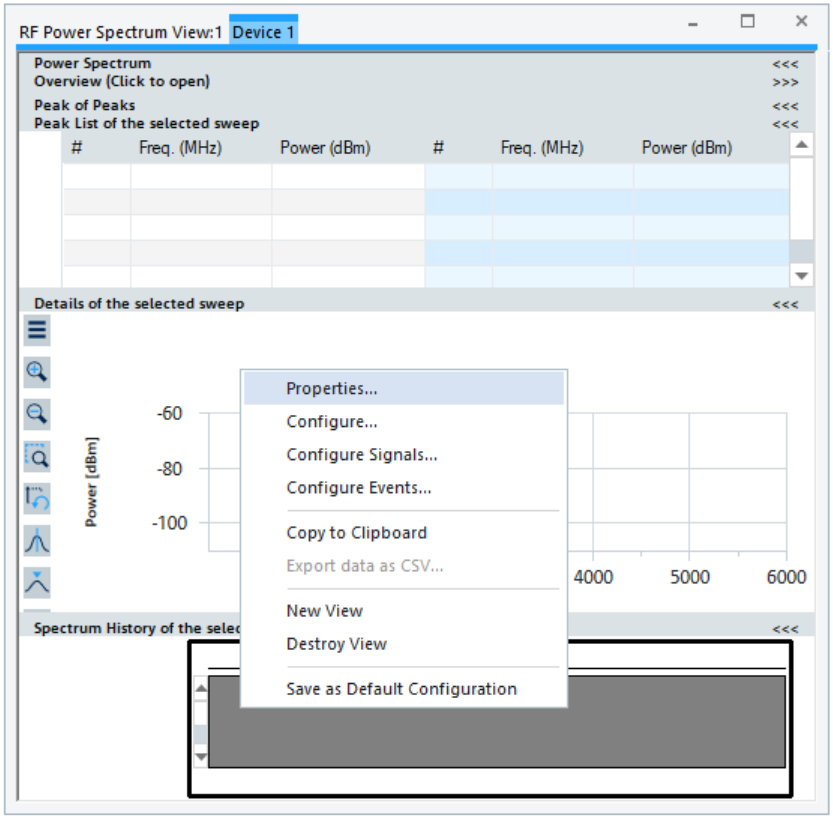


Figure 4-1004: RF Power Scanner - (PoP) properties activation

Peak list group

The following entries are configurable in the "Global" > "Peak List" of the "RF Power Spectrum View: Properties" window:

"Max Number of Peaks" - set the maximum number of peaks to be based. The value determines the number of grid rows. The maximum number of peaks to be based ranges from 4 as the minimum value up to maximum allowed value 12. The default value is 12. The number of rows in a grid is calculated dynamically to use better horizontal space.

Grid width determines the number of peak bars in a row. The wider the grid, the more peak bars are present in the chart. The minimum number of peak bars in a row is 1.The following screenshots show cases with 2 and 6 peak bars in a row.

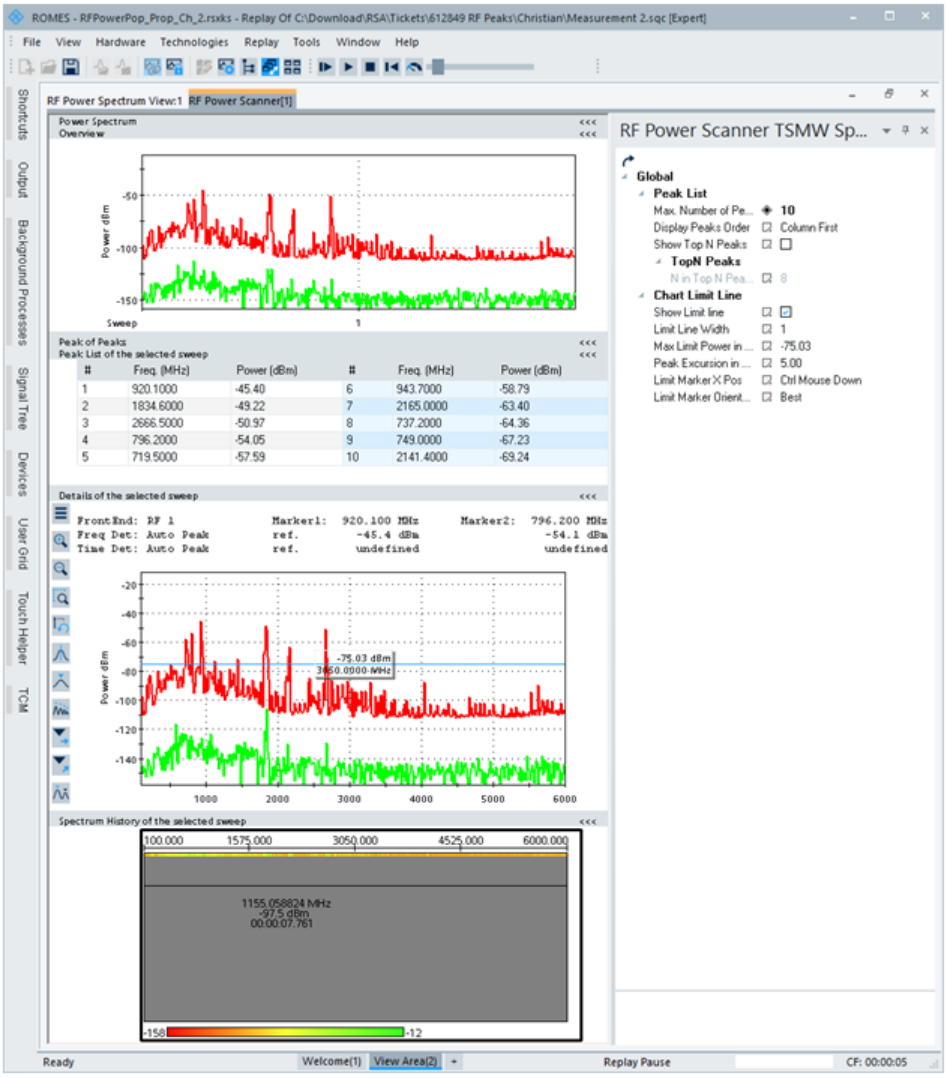


Figure 4-1005: RF Power Scanner - 2 peak bars in a row

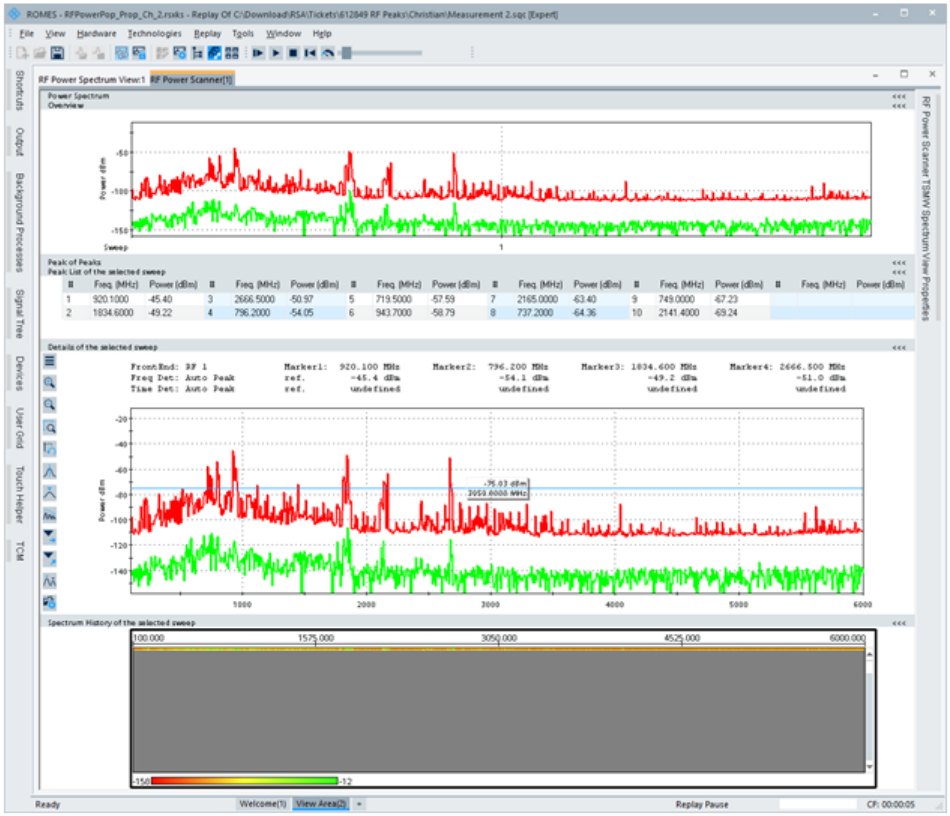


Figure 4-1006: RF Power Scanner - 6 peak bars in a row

The number of rows is then calculated by the max number of peaks and the number of peak bars in a row.

For example, max number of peaks is set to 10 and each row can hold 6 peak bars. Therefore, 2 rows are needed for showing 10 peaks.

"Display Peaks Order" - sets the way that the peaks are displayed. The order can be column first or row first. In the order column first, the first column of all rows in the grid is filled first, then the next column of all rows and so on.

"Show Top N Peaks" - shows the Top N peaks.

If "Show Top N Peaks" is checked, N in "Top N Peaks" edit box is enabled. The peak list contains only the Top N peaks if available. If Top N is different from max number of peaks, the smaller one is used.

"Top N Peaks" > "N" configure the N in Top N setting.

Chart limit line group

The following entries are configurable in the "Global" > "Chart Limit Line" of the "RF Power Spectrum View: Properties" window:

"Show Limit Line" - show limit line if checked, hide otherwise.

"Limit Line Width" - configure the limit line width. Either the value 1 or 2 can be selected in drop-down list.

"Max Limit Power in dBm" - configure the threshold of the limit line. Value change is populated to position the limit line. Dragging the limit line also changes this value. Power in dBm is shown on the top of limit marker.

"Peak Excursion in dBm" - power of the peak used for the Peak algorithm.

"Limit Marker X Pos" - configures where the limit line marker is displayed in X Axis:

1. Ctrl Mouse Down: setting the limit line marker X position by hovering mouse over limit line and CTRL-clicking on the limit line.

2. Mouse Down: set the limit line marker X position by clicking the limit line.

3. Center: position the limit line marker at the center of the line.

"Limit Marker Orientation" - configures the orientation of the limit line marker. You can choose among some available limit marker orientations. Select a limit marker orientation available in the drop-down list of the "Limit marker orientation" entry in the "Chart Limit Line".

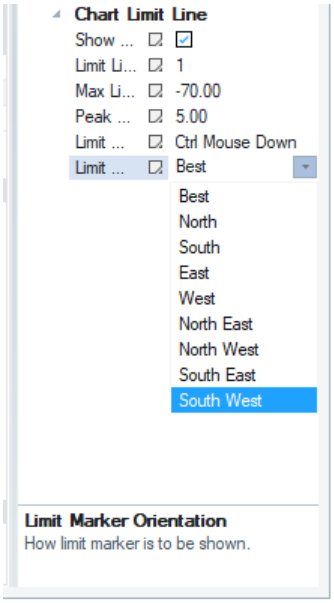


Figure 4-1007: Selection of limit marker orientation

The following figures display some possible orientations. The reference position is the "Best" orientation.

Best:

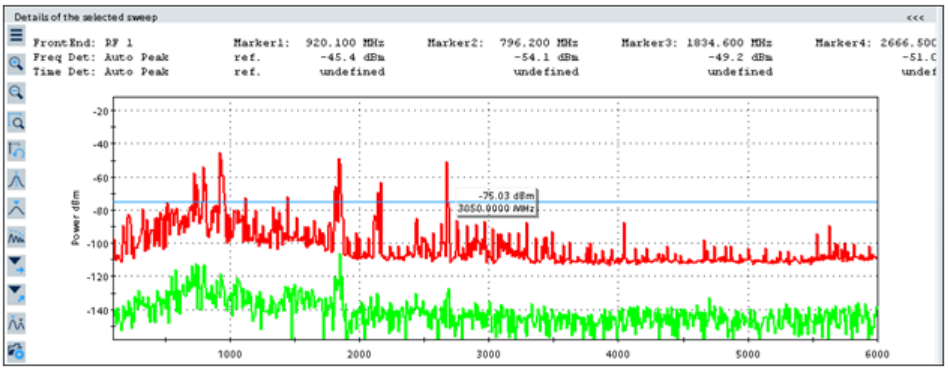


Figure 4-1008: Best orientation of limit line marker

North

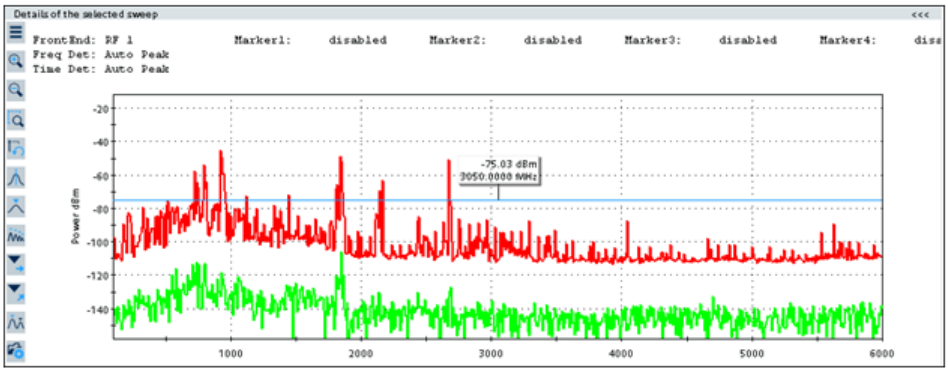


Figure 4-1009: North orientation of limit line marker

South West

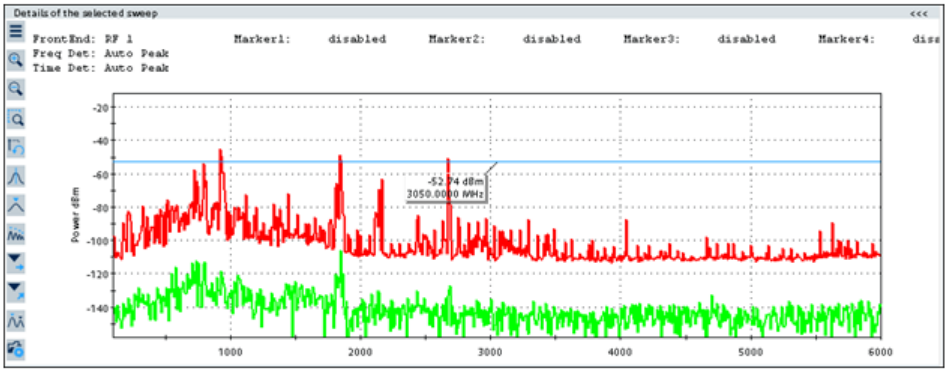


Figure 4-1010: South-West orientation of limit line marker

Default color scale for the RF power scanner view

It is possible to specify a default color scale for the "RF Power Scanner View".

Use the"Save As Default" button to store the current color scale as default. From now on, empty workspaces use this color scale.

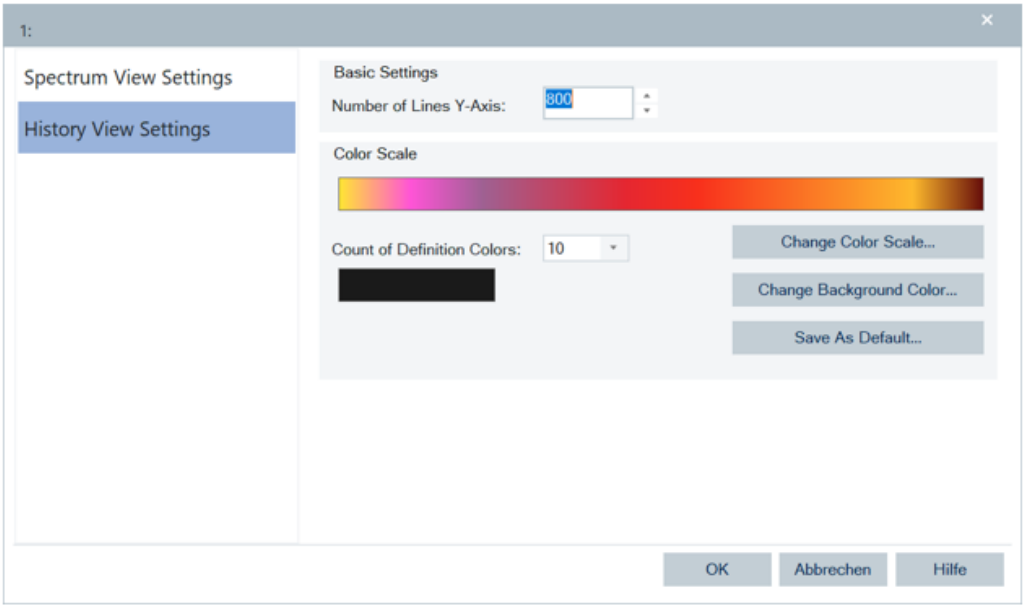


Figure 4-1011: Used default color scale for RFPS

4.8.10 TETRA scanner views

The TETRA scanner views show the information obtained in the TETRA network scan performed by an R&S radio network analyzer.

For this purpose, the R&S TSME scanner with its hardware option R&S TSME-K26 is needed.

The TETRA network scan available option for R&S TSME is R&S ROMES4T1E.

How to install and configure the TETRA network scanner, see Chapter 6.4.22, "TETRA scanner", on page 1837.

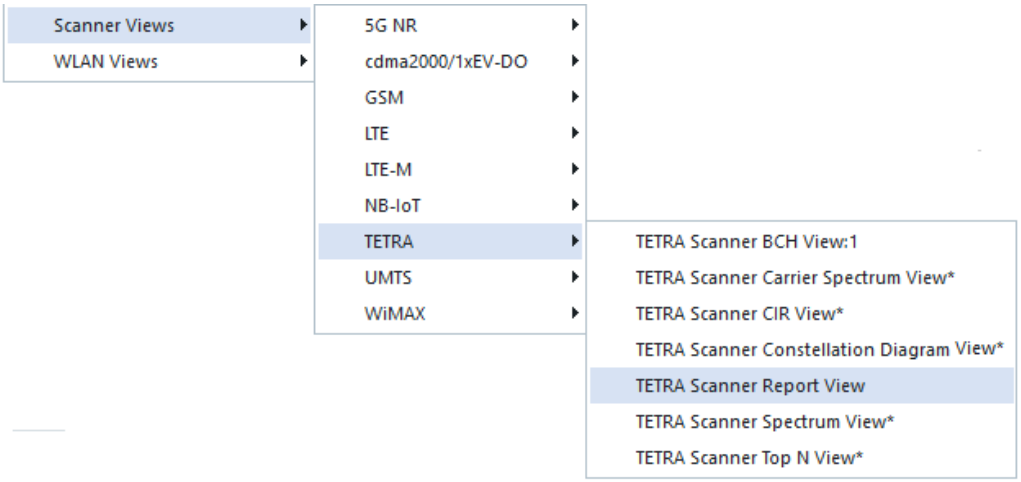


Figure 4-1012: TETRA Scanner Views

The TETRA scanner views can be selected from a submenu displayed on the right side of the "View" menu if the mouse hovers over the "TETRA" > "TETRA Scanner" entry. Different views can be chosen to visualize the results of the TETRA scanner. A TETRA carrier is always associated with the same color in all views, including the ROMESMAP Route Track (RTM) module.

Measurements from two TETRA scanners are correctly shown in the CIR, Carrier Spectrum and Constellation Diagram views.

The default TETRA carrier type is the "Fixed Carrier" with associated fixed parameters "Top N Pool" and "Top N Member". It can be used for all single scanner configurations and display in the previously mentioned views. Instead, you can configure the "Top N Member" and "Radio" type of a TETRA carrier.

The mentioned views can follow the current server of any attach TETRA radio. Select in the configuration dialog "Radio" as a TETRA carrier type and specify the appropriate connected TETRA radio. A view shows automatically the data which belongs to the TETRA channel on which the TETRA radio currently camps.

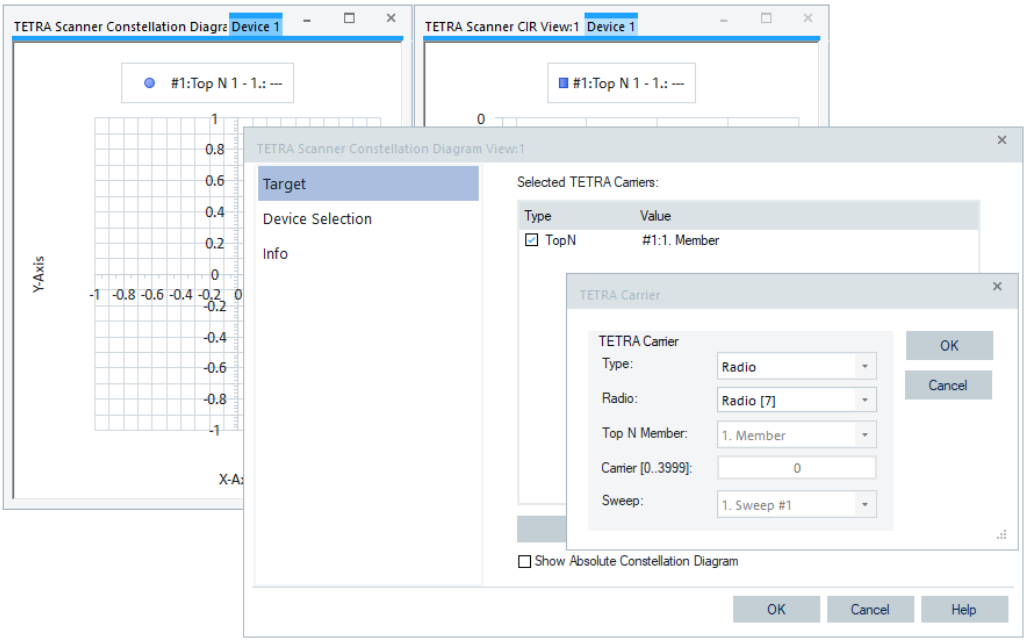


Figure 4-1013: TETRA carriers type selected for some views

The "Target" page shows the list of TETRA carriers selected for display in a few TETRA scanner views, for example, in the "TETRA Scanner CIR View" and "TETRA Scanner Constalation Diagram View".

4.8.10.1 TETRA scanner BCH view

The TETRA scanner measures TETRA signals, demodulates and decodes the content of broadcast channels of the received TETRA signal. This data is depicted as a summary of all found TETRA transmitters by the "TETRA Scanner BCH View".

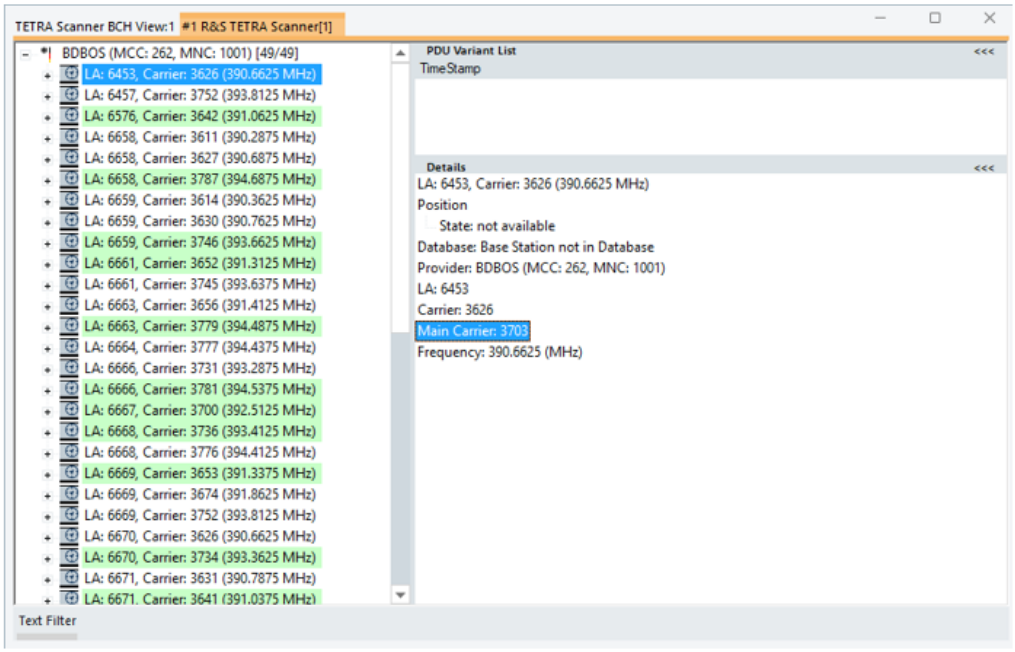


Figure 4-1014: TETRA Scanner BCH View

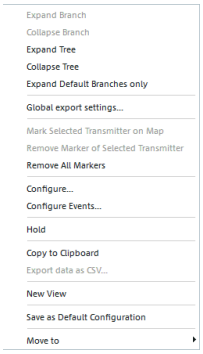
The left part of the view shows the tree of all found TETRA transmitters. The names of the transmitter sites are displayed if available in the current loaded database, it is BDBOS in the figure. The first node reflects the network, which is specified by MCC and MNC. The next hierarchy level lists TETRA transmitters identified by the carrier and location area. Select a TETRA transmitter to see the transmitter's detailed information. The information is displayed in the "Details" pane on the right part of the view. The highlighted Main Carrier in the pane identifies the main carrier given to a TCH.

Below the transmitter level, all broadcast and decoded messages in BCH signal for the corresponding transmitter are shown. This level contains, for example, decoded SYNC PDU, D-MLE-SYNC PDU and SYSINFO PDU messages of the transmitter. Select a message to get the detailed information in the right part of the view.

The MCCH stations are displayed in light green color in "TETRA Scanner BCH View". A MCCH station corresponds to an MCCH channel in the view.

To highlight a BTS in the "TETRA BCH View", double-click a column in "TETRA Scanner Top N View" or "TETRA Scanner Spectrum View". The tree of "TETRA BCH View" collapses then and only the branches of the selected BTS are selected and expanded.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

TETRA scanner BCH view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "Configuration" option lets you filter base stations according to configured state of their position and visualize them in a predefined color in "ROMESMAP Route Track View".

4.8.10.2 TETRA scanner carrier spectrum view

The "TETRA Scanner Carrier Spectrum View" shows the spectrum of the TETRA channel of a selected carrier or several selected carriers. The carrier can be fixed carrier or a Top N member. The graph color of a carrier corresponds to the color which is defined for the TETRA carrier number.

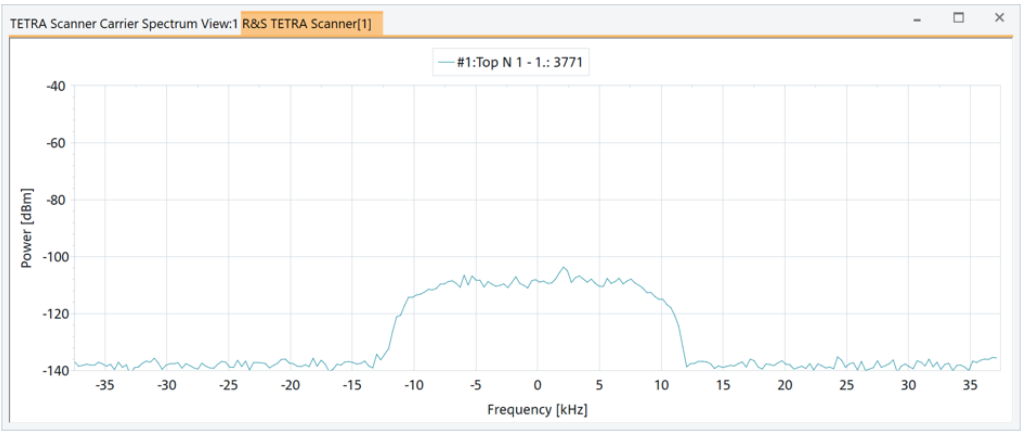
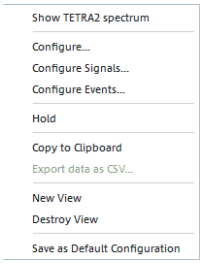


Figure 4-1015: TETRA Scanner Carrier Spectrum View

Using the context menu, the view can be switched to show the TETRA2 spectrum view. There is no difference in the view layout and configuration between TETRA and TETRA2.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu command "Show TETRA2 spectrum" switches the view to the TETRA 2 spectrum view.

TETRA scanner carrier spectrum view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Target

The "Target" option lets you specify TETRA carriers for carrier spectrum view. The carrier list can be modified in sense that new carriers can be added, the existing deleted or the values of the carriers in the list change.

A carrier for visualization can be a fixed carrier, a member of a certain Top N pool or a channel the TETRA radio currently camps on.

The page shows in the list all currently specified TETRA carriers. The "Type" column in the list indicates the selected option.

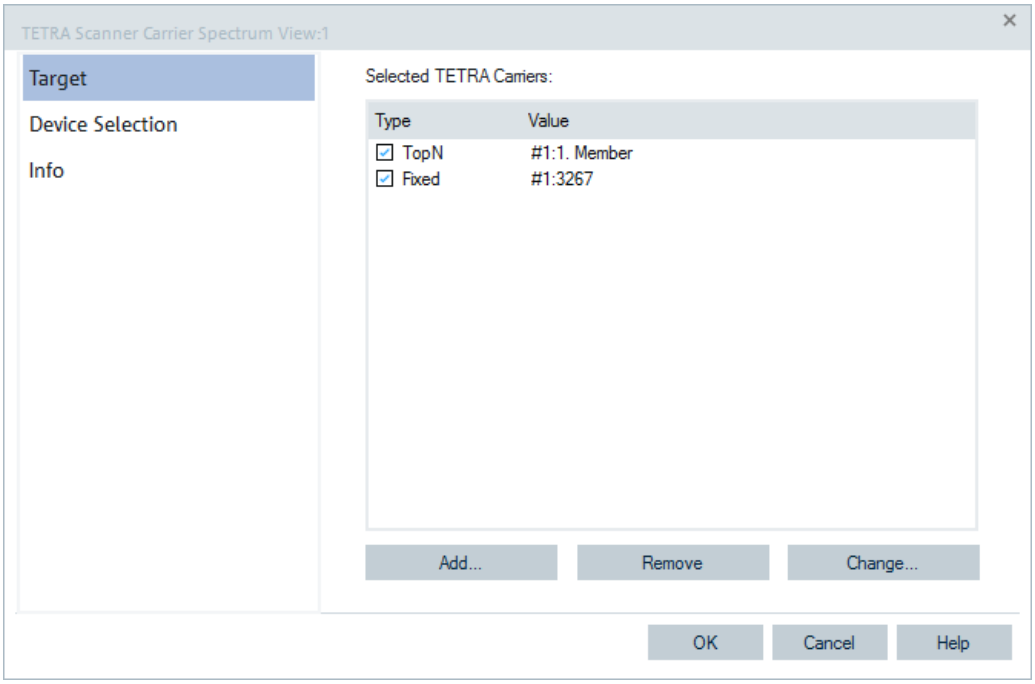


Figure 4-1016: TETRA Scanner Carrier Spectrum View - target selection

The "Target" page applies also to the TETRA CIR scanner and TETRA scanner constellation diagram views.

Add
Adds the user-defined fixed carriers, Top N pools or carriers a TETRA radio currently camps on in the list of "Available Signals", see "Add" on page 377.

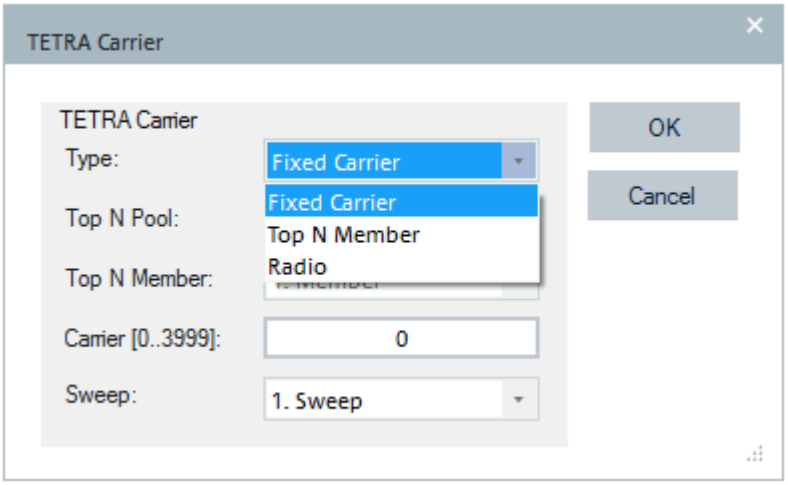


Figure 4-1017: TETRA Carrier settings for display

- **Type**
  The selection specifies which type of TETRA carriers to display in the view.
- **Top N Pool**
  (Only for Type = "Top N Member").
  Specify the corresponding Top N Pool. The default entry is Top N 1.
- **Top N Member**
  (Only for Type = "Top N Member")
  Specify the corresponding Top N Member. The default entry is 1. Member.
- **Carrier**
  (Only for Type = "Fixed Carrier")
  Specifies the carrier number (0 to 3999).
- **Sweep**
  Number of sweeps for the spectrum analysis (1 to 16).

Remove
Deletes the selected carrier from the list.

Change
Allows the modification of the properties for the selected carrier. The "Change" dialog contains the same panels as the "Add" dialog, all field descriptions are defined there.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

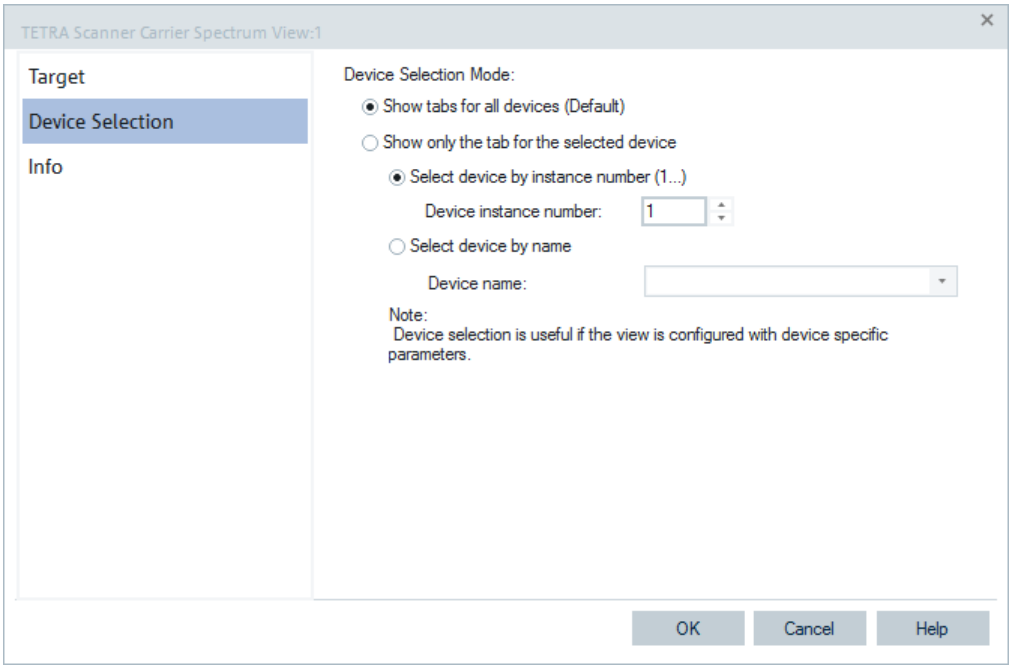


Figure 4-1018: TETRA Scanner Carrier Spectrum View - device selection

The "Device Selection" page and the previously mentioned applies also for all the TETRA scanner views.

4.8.10.3 TETRA scanner CIR view

The "TETRA Scanner CIR View" displays a carrier impulse response of the TETRA signals. Analog to the "TETRA Scanner Constellations Diagram View", the view shows the channel impulse response of the selected carriers, which can be fixed carriers or Top N members. The power first path of the carrier is always drawn at x=0, the following paths correspond to their arrival times.

The tabs with less than 40-microseconds delay spread are not displayed In the "TETRA CIR View" as the TETRA channel bandwidth is less than 25 kHz. To prove multi-path propagation if the CIR view is empty, use the numerically calculated "TETRA Delay Spread" parameter. The parameter is available as a signal in the "TETRA Scanner Top N View" and "TETRA Scanner Spectrum View".

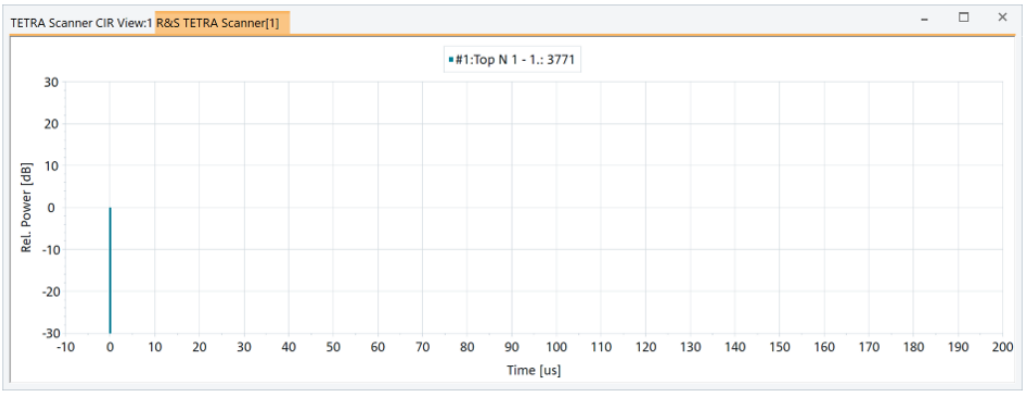
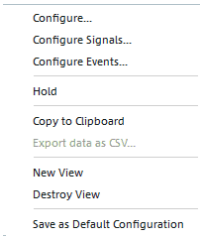


Figure 4-1019: TETRA Scanner CIR View

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

TETRA scanner CIR view configuration

Refer to "TETRA scanner carrier spectrum view configuration" on page 1343.

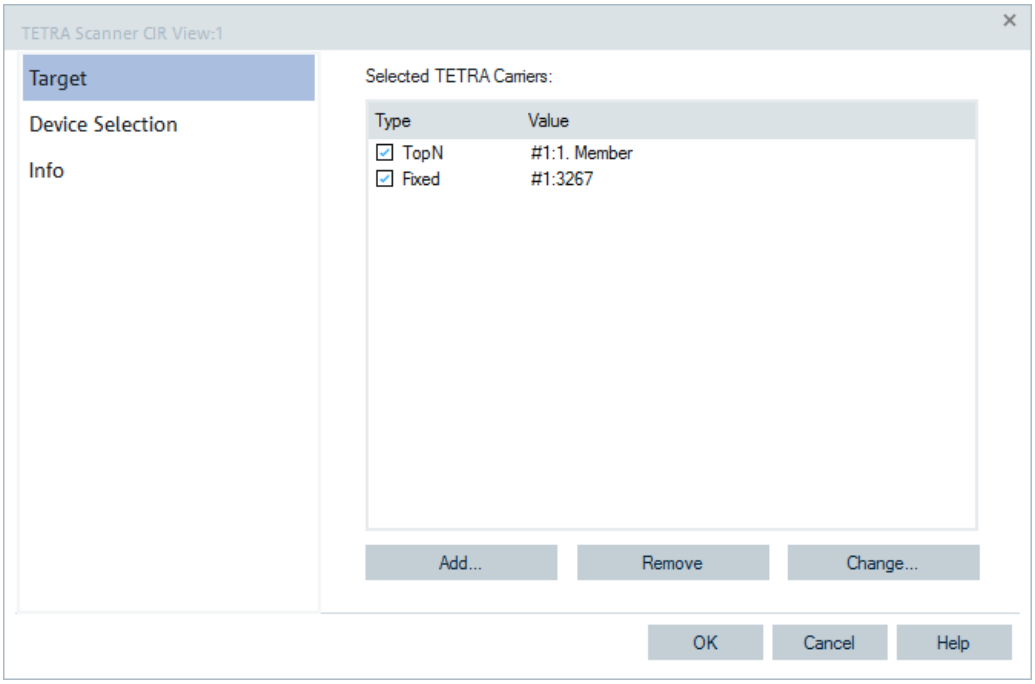


Figure 4-1020: TETRA Scanner CIR View - target selection

TETRA scanner CIR view conf.: Target

Refer to "TETRA scanner carrier spectrum view configuration" on page 1343.

4.8.10.4 TETRA scanner constellation diagram view

The "TETRA Constellation Diagram View" shows the current state of the constellation diagram of either a fixed carrier or a specified member of a Top N Pool. To specify what elements have to be shown, the open configuration page of the view or use the context menu of one of the other TETRA Scanner views.

The constellation diagram shows the phase difference between two consecutive symbols and not the absolute phase (which would result in eight spots). The Sync Burst is always analyzed. R&S ROMES4 supports the Sync Burst which uses DQPSK modulation.

If D8PSK modulation is used for the Sync Burst, R&S ROMES4 could recognize it, but the generated results are set in relation to DQPSK modulation instead of the wanted D8PSK relation. Thus, the constellation diagram does not show the preferred information.

The calculated phase error is the mean square distance from the expected phases (45°, 135°, 225° and 315°).

Figure 4-1021: TETRA scanner constellation diagram view

If the transmission is TETRA2, the "TETRA Constellation Diagram View" shows the TETRA2 QAM data.

R&S ROMES4 supports absolute TETRA scanner constellation diagram format in addition to the previously described one.

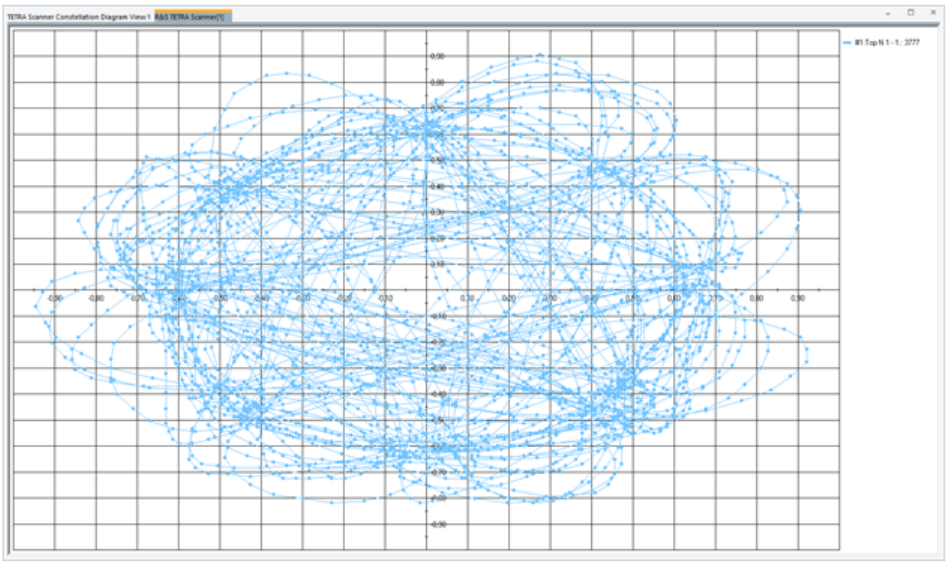
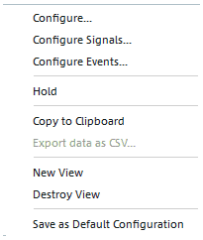


Figure 4-1022: Absolute TETRA scanner constellation diagram view

If the TETRA scanner is configured to measure the constellation diagram, the previously mentioned TETRA constellation diagram format is by default selected. To get the absolute constellation diagram format, select the "Show Absolute Constellation Diagram" option in the view's configuration page, see Figure 4-1023.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

TETRA scanner const. diagram view configuration

Refer to "TETRA scanner carrier spectrum view configuration" on page 1343.

.

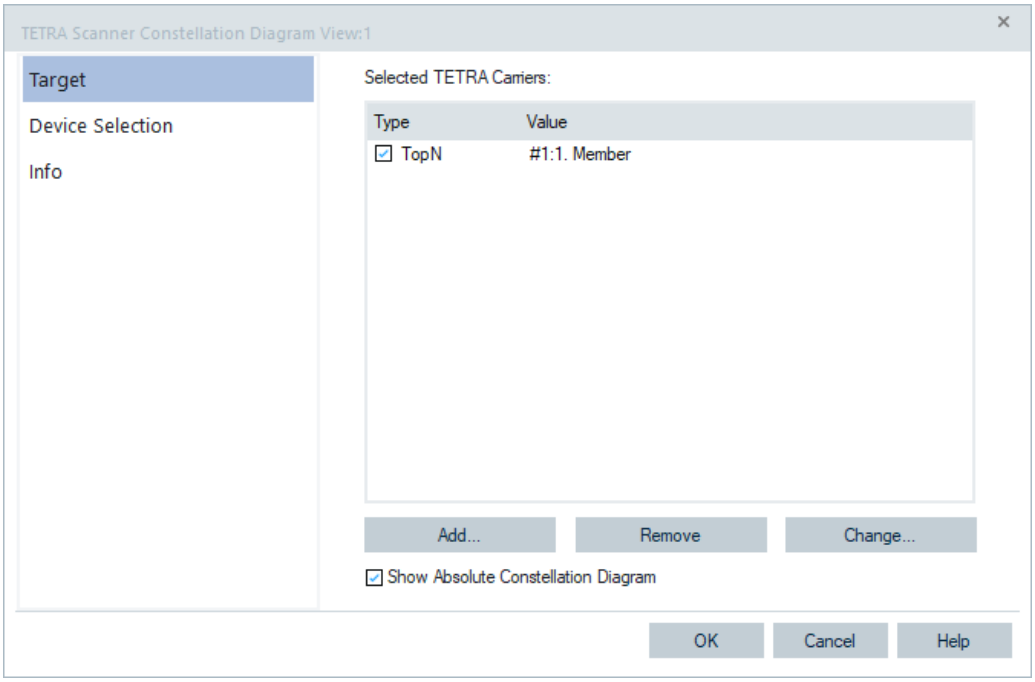


Figure 4-1023: TETRA Scanner Constellation Diagram View - target selection

If activated, the "Show Absolute Constallation Diagram" option provides the TETRA scanner absolute constellation diagram format in addition to the default one.

4.8.10.5 TETRA scanner report view

The "TETRA Scanner Report View" allows you to get reports out of the TETRA measurements in an easy and fast way.

The view is filled automatically for the following type of measurements:

- Indoor Hotspot Measurements
  - Section is a Hotspot Location
- Panorama Measurements
  - Section is an Angle

The "TETRA Scanner Report View" shows a table of all TETRA transmitters which have been measured at least once with a TETRA power above the given threshold of the TETRA Report Views configuration.

The table reports the resulting set of transmitters, its TETRA power and EVM values. Over the time of measuring a section, the incoming values are averaged. For TETRA power, several values in Watt are averaged and logarithm to dBm.

For the Panorama Measurement, the first line of the table has a combo-box which allows you to select a panorama measurement between the performed ones in the measurement file.

The data used for this report view, as a panorama measurement, an indoor measurement and outdoor measurement showing Geo Binning (see following chapters) are not based on any TopN pools. The evaluation is based on the raw measurements as delivered by the TETRA scanner.

The report format depends on the measurement type. The following screenshot shows a panorama measurement. In this case the power values are not colored.

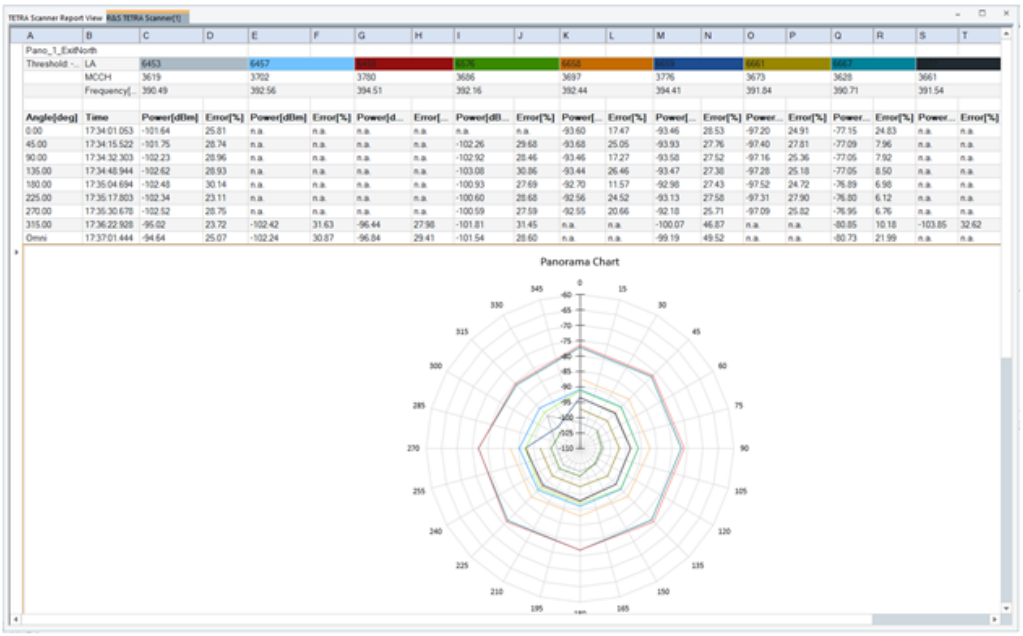


Figure 4-1024: TETRA scanner report view - power values and panorama chart

The data can be exported to CSV format (without the chart) or to XLSX format (Excel). To do so, open the views context menu and select the corresponding menu item ("Export data as CSV".

The Excel export exports all available panorama measurements (one per sheet) while the CSV export exports the currently selected measurement only.

The following screenshot shows the Omni measurement in a separated chart. The chart shows all transmitters which have been measured during the Omni measurement. The chart's x-axis range is from lowest to the highest measured frequency. The label above the transmitters shows the LA, MCCH and frequency of the transmitter.

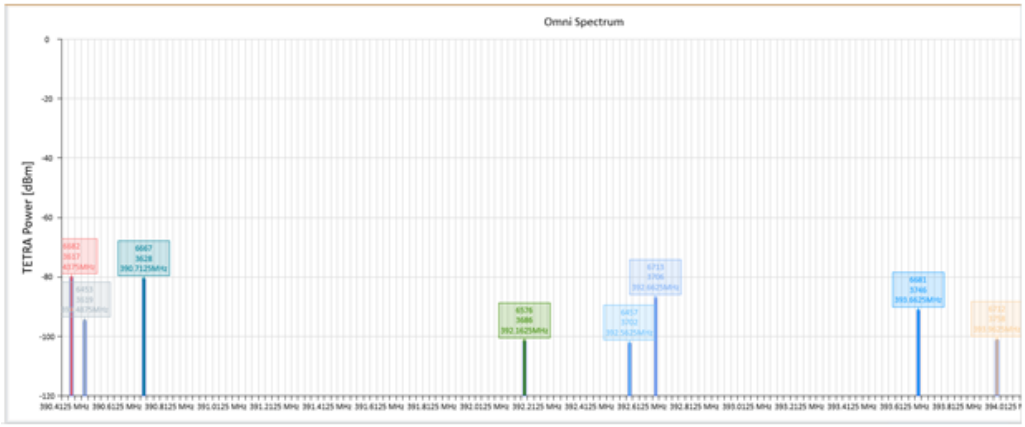


Figure 4-1025: TETRA scanner report view - omni chart

The report format depends on the measurement type. The Figure 4-1024 shows a panorama measurement. In this case, the power values are not colored.

The following screenshot shows a report of an indoor measurement.

For Indoor Hotspot Measurements, the table shows the Top1 and Top2 transmitter, and the complete set of received transmitters, ordered by LA. The power cells are colored as specified by the TETRA Top N TETRA Power signal.

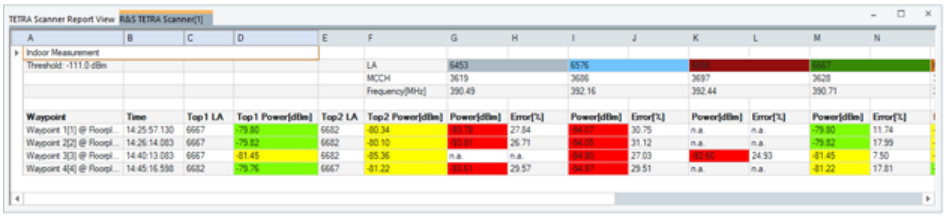


Figure 4-1026: TETRA scanner report view - indoor power values

TETRA scanner indoor measurements

If the TETRA scanner is used for Indoor Hotspot Measurements, the waypoints on the Indoor Map give additional information, which is directly linked to the "TETRA Scanner Report View". The color of each waypoint represents the TETRA power of the best server of the waypoint.

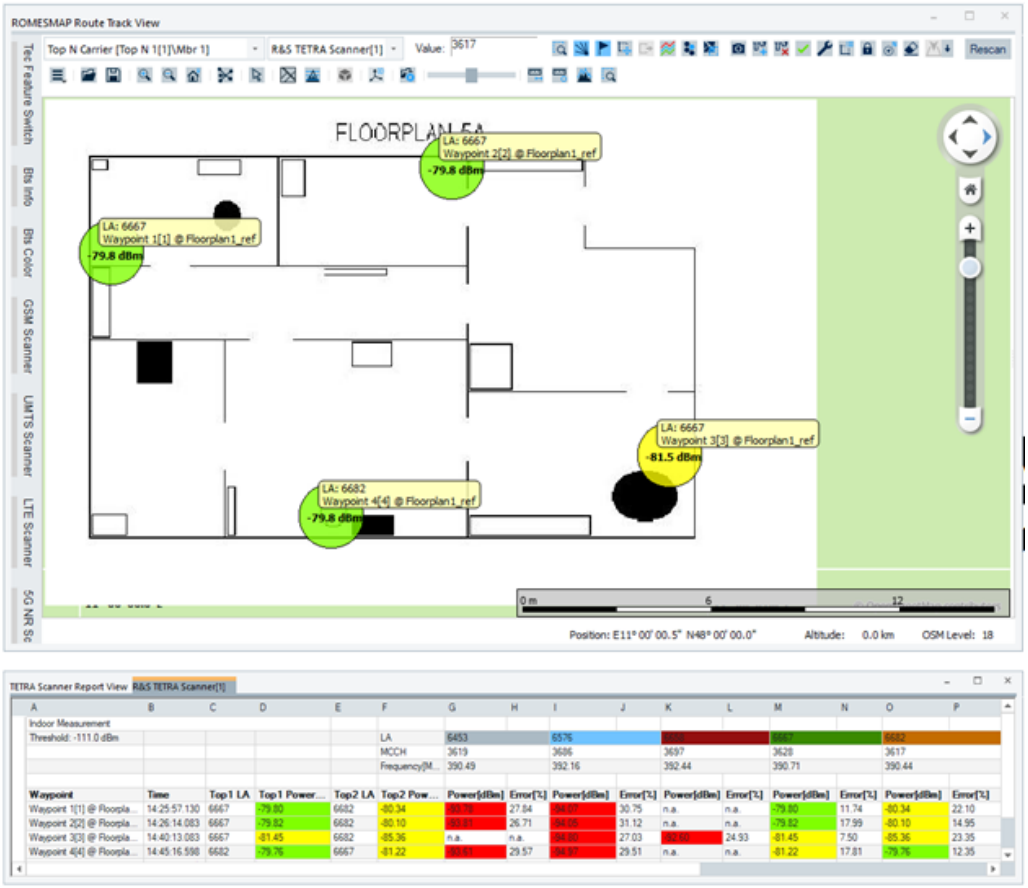


Figure 4-1027: TETRA scanner - indoor route track view and power values

Also, the waypoint gets a label, which informs about the LA of the best server and the waypoint name. The label is the link to the "TETRA Scanner Report View".

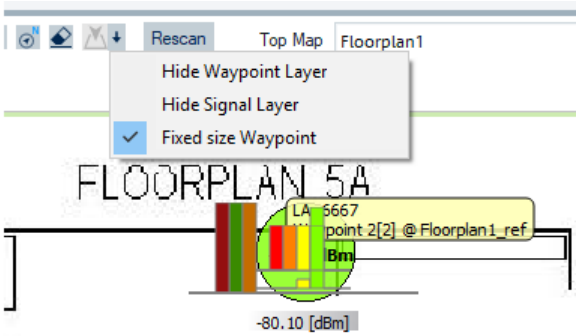


Figure 4-1028: Hiding options

If an ES4 signal is selected in the map, its histogram can overlap with the waypoints. The "Hide Signal Layer" option, on the right-hand side of the icon bar, helps in such a case to show the waypoints only, without having to remove the signals from the maps configuration.

TETRA scanner outdoor measurements

The TETRA Scanner Evaluation algorithm provides binned data. The binning is based on the received power of the TETRA transmitters.

Basically, it is the same approach as for the indoor hotspot measurement, but applied to geographic bins. The bin can be visualized in the "ROMESMAR Route Track View" and in the "TETRA Scanner Report View". The color of the bin reflects the color of the TETRA Power Signal. The frame of the bin is the color of the best LA.

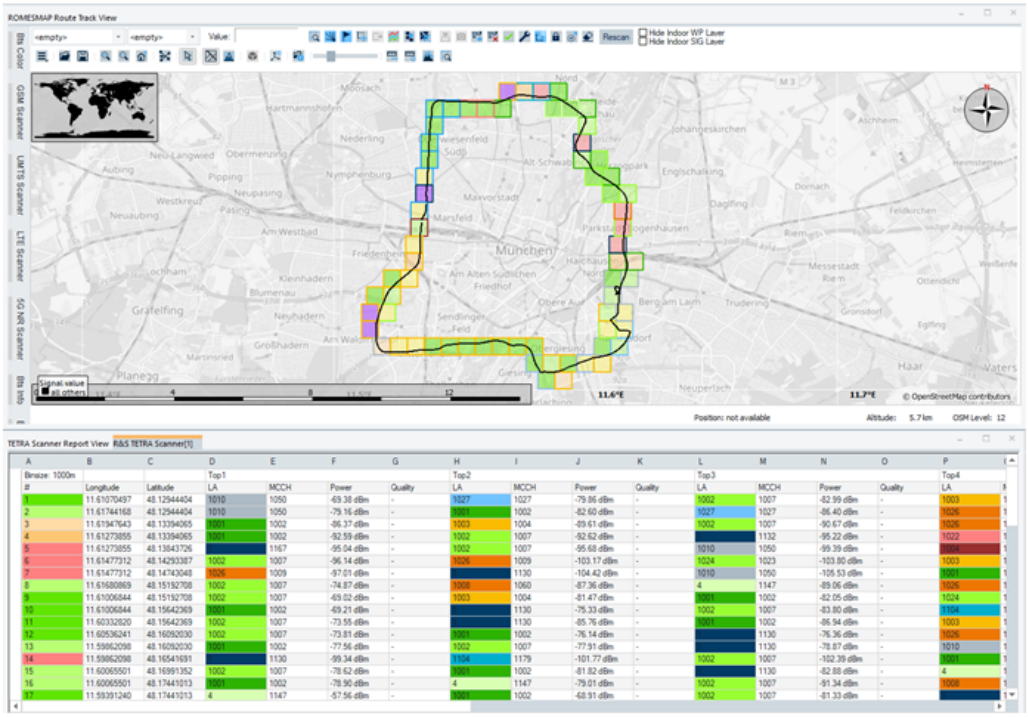


Figure 4-1029: TETRA scanner - outdoor route track view and power values

The bin size can be set manually to sizes between 5 m and 1000 m on the "Binning View" tab. For details about binning, see Chapter 4.3.3.2, "View area", on page 566.

The currently selected bin size is reflected in the "TETRA Scanner Report View" automatically.

The following screenshot shows a Tooltip of each bin. It displays the content of the bins. To disable the Tooltip, deactivate the select mode by clicking the arrow icon.

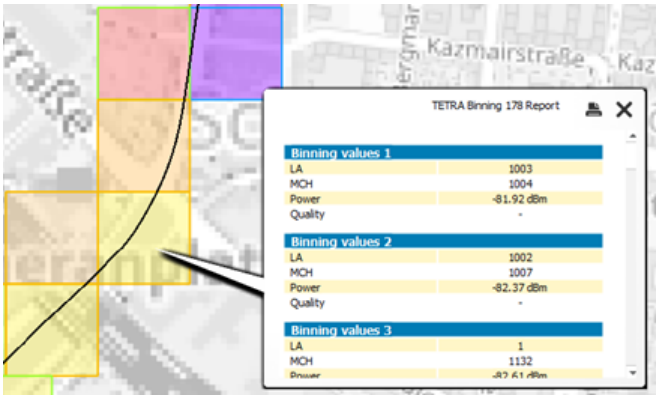


Figure 4-1030: Tooltip of bins

The previously mentioned is available during the R&S ROMES4 Replay mode only.

4.8.10.6 TETRA scanner spectrum view

To visualize the complete scan, use the "TETRA Scanner Spectrum View".

The entire area is horizontally split into "TETRA Spectrum Chart" and "TETRA Spectrum List" to accommodate a pull-down list with all defined carriers for scan.

Click the mentioned chart/list to compress or expand the chart/table, respectively. A compressed chart leaves more space for the table and vice versa. A compressed pane is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

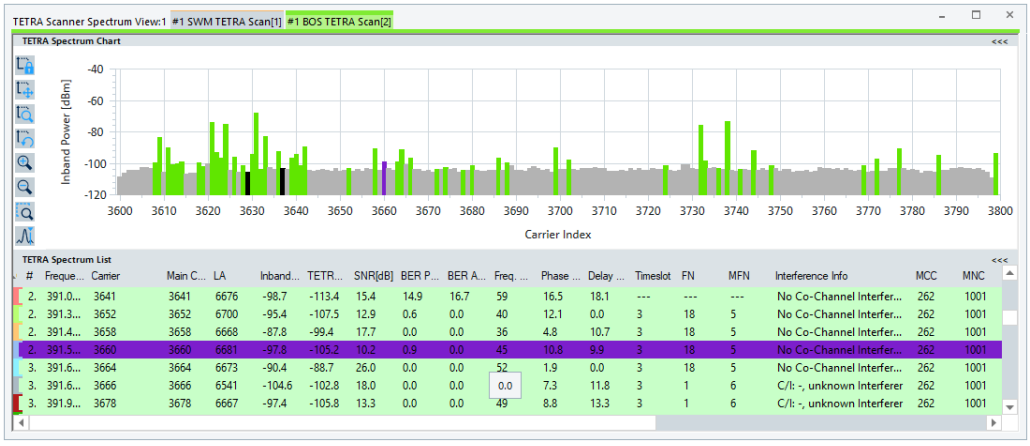


Figure 4-1031: TETRA Scanner Spectrum View

The upper part of the view shows the complete set of TETRA scans, which is specified in the scanner's settings. All carriers, on which a TETRA signal could be found according to type are colored as shown in the following table. The previous screenshot shows a case where MCCH and TCH carriers are scanned (green and black vertical bars).

Table 4-35: TETRA spectrum view: coloring of carriers by type

Carrier type	Not Demodulated	MCCH	TCH	DMO	TEDS
Color	gray	green	black	blue	red

The red bar in the spectrum chart shows the TEDS carrier if the "TETRA2 active" checkbox is checked in "TEC for TETRA Scanner" > "Scanner Top N Settings". The blue bar shows DMO channels if "DMO Channel" is checked in the same menu.

The carriers could be fixed carriers or the Top N members. The colors in the lower pane, "TETRA Spectrum List", correspond to the colors set in the "Color List for Carrier" of the "TETRA Spectrum View Configuration" window.

Some parameters remain empty if it is a TEDS carrier. Measured signals are: Carrier, Inband Power, MCC, MNC, Color code, Code rate, Modulation type, Burst Mod ER, Pilot Mod ER, Header Mod ER, Data MER, SICH Error rate, AACH Error rate, Data Error rate. Signal frequency and frequency offset are calculated from carrier.

View area

Diagram

The spectrum chart offers some tools on the left-hand side of the chart. For the explanation of these tools (icons), see Chapter 4.2.1, "2D chart view", on page 448.

Hover with the mouse over a bar, to get more information on the selected carrier.

The corresponding carrier at the "TETRA Spectrum List" is marked. To toggle the marker view, click "Show/Hide Marker" ( ) in the tool bar.

The information field of the marker line is always on the left side of the chart and not stuck to the vertical marker line.

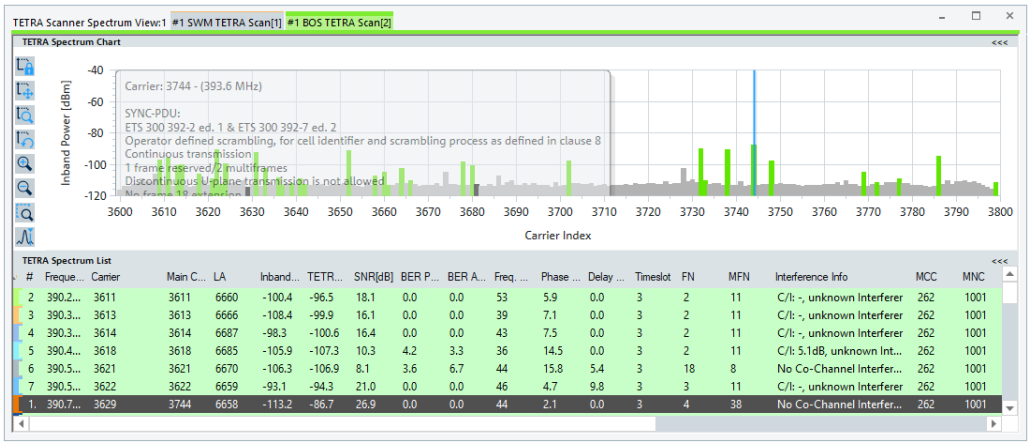


Figure 4-1032: Marker double-click to get further carrier information

TETRA spectrum list

The second part of the view shows the list of the found TETRA carriers, which are marked green in the upper chart. Double-click a carrier selects the carrier in the dia-

gram above and opens a marker with further measured information to the selected carrier.

The carrier list can be sorted by clicking the header of the corresponding column.

- "Color"
  Carrier index configured color
- "#"
  Number of measured cells
- "Frequency [MHz]"
  Frequency corresponding to the index of TETRA carrier
- "Carrier"
  Index of TETRA carrier (0 to 3999)
- "Main Carrier"
  Frequency of the MCCH extracted from the SYSINFO PDU.
  As the TETRA network can change the MCCH dynamically, this signal is not used as a TETRA BTS identifier in ROMESMAP Route Track View.
- "LA"
  Location Area is a geographical area consisting of one or more cells. The recognition of a base station in ROMEMAP Route Track View is based on this signal together with MCC.
- "Inband Power[dBm]"
  Inband power of the TETRA channel
- "TETRA Power[dBm]"
  Received Signal Strength Indicator
- "SNR[dB]"
  Signal to Noise Ratio
- "Pre-Vit BER[%]"
  Ratio of estimated number of channel errors in block 1 and block 2. It is the comparison of the received data and re-encoded data after error correction to the number of analyzed bits in block 1 and block 2 (Convolutional Code with Viterbi-Detector). For more, see "TETRA scanner Top N settings" on page 374.
- "AACH BER[%]"
  Access Assign Channel Bit Error Rate - ratio of estimated number of channel errors in the broadcast block. It is the comparison of received data and re-encoded data after error correction to number of analyzed bits in the broadcast block (Reed-Muller-Code).
- "Freq. Err[Hz]"
  Frequency error
- "Phase Error[°]"
  RMS (Root-mean-square) phase error on the information symbols
- "Delay Spread[µs]"
  Delay spread of arriving paths. Useful to prove multi-path propagation, especially if no data is shown in the TETRA Scanner CIR View, where the minimum delay spread for displaying results is 40 microseconds.
  The delay spread can be characterized through different metrics, although the most common one is the root mean square (RMS) delay spread: According to Gold-

smith, let $A_c(\tau)$ be the power delay profile of a channel. Then, the mean delay of the channel is

$$\overline{\tau} = \frac{\int_0^\infty \tau A_c(\tau) d\tau}{\int_0^\infty A_c(\tau) d\tau}$$

Thus, the RMS delay spread is

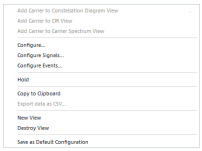
$$\tau_{rms} = \sqrt{\frac{\int_0^\infty (\tau - \overline{\tau})^2 A_c(\tau) d\tau}{\int_0^\infty A_c(\tau) d\tau}}$$

- "Timeslot"
  Timeslot number extracted from SYNC PDU
- "FN"
  Frame number extracted from SYNC PDU
- "MFN"
  Multiframe number extracted from SYNC PDU
- "Interference Info"
  Information about the interference situation on the TETRA measured channel
- "MCC"
  Mobile Country Code extracted from the D-MLE-SYNC PDU. The recognition of a base station in ROMEMAP Route Track View is based on this signal together with LA.
- "MNC"
  Mobile Network Code extracted from the D-MLE-SYNC PDU
- "Transmitter"
  Name of the TETRA transmitter
- "Colour Code"
  Color code extracted from Sync-PDU
- "MCCH BER Pre-Vit.[%]"
  Bit Error Rate on the Main Control Chanel (MCCH)
- "MER[%]"
  Number of blocks which could not be corrected by the Reed Muller Error Correction divided by the total number of blocks on the Access Assignment Channel (AACH)
- "ModER[dB]"
  Modulation error ratio
- "MCCH BER AACH [%]"
  Bit Error Rate on the AACH
- "MCCH ER Payload CRC[%]"
  Error Rate of the payload CRC
- "MCCH BLER AACH[%"]
  Block Error Rate on the AACH
- "Modulation Type"
  Used modulation in burst
- "Code Rate"
  Burst code rate
- "Burst Mod ER[dB]"

Modulation Error Ratio over all symbols in the burst

- "Pilot Mod ER[dB]"
  Modulation Error Ratio over the pilot and sync symbols
- "Header Mod ER[dB]"
  Modulation Error Ratio over the header symbols
- "Data MER[dB]"
  Modulation Error Ratio over data symbols
  MER = Modulation Error Ratio (Mod ER)
- "SICH Error Rate[%]"
  Number of errors in the received SICH bits / total number of SICH bits
- "AACH Error Rate[%]"
  Number of errors in the received AACH bits / total number of AACH bits
- "Data Error Rate[%]"
  Number of errors in the received data bits / total number of data bits
- "Source Address (DMO)"
  Direct mode of operation: address of the source terminal
- "Destination Address (DMO)"
  Direct mode of operation: address of the destination terminal
- "DMO Channel"
  DMO channel as received by the PDU in SCH/H

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu has the additional "Add Carrier to" entries.

If a line within the Top N list is selected and the other referenced view is also opened, these entries get active. It is possible with them to add the selected member of Top N pool to other view. By later closing that view, the menu entry remains loaded, active and the view can still be configured.

TETRA scanner spectrum view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "View Configuration" option lets you adapt the visualized columns to the actual needs.

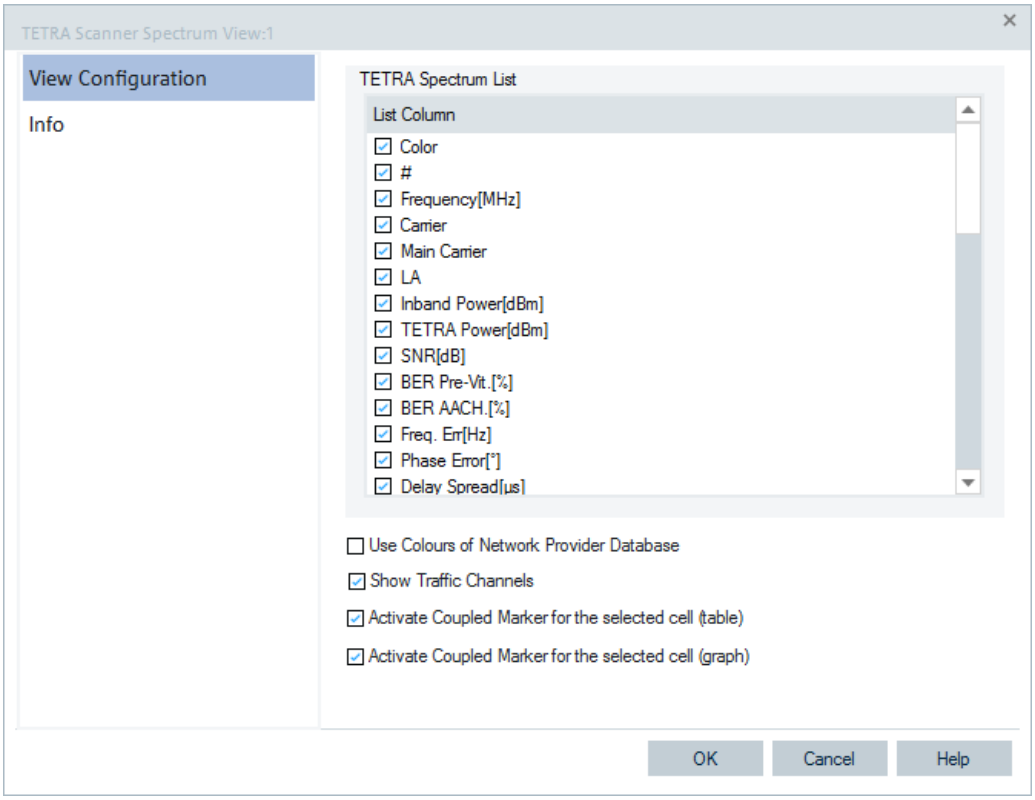


Figure 4-1033: TETRA Scanner Spectrum View - configuration

The following entries are included in the "TETRA Spectrum List" panel:

- "List Column"
  For a short description of the parameters, see "TETRA spectrum list" on page 1357.
- "Use Colours of Network Provider Database"
  Defines which color settings to use.
- "Show Traffic Channels"
  Option to remove traffic channels from the list of decoded transmitters. The condition for a traffic channel is Main Carrier does not equal Carrier.
- Activate Coupled Marker for selected cells (table / graph)
  The Coupled Marker function, which marks the same carriers in the chart and in the list, can be switched "on" and "off". The function is activated in the "Configure" button (right mouse button click the view) of "TETRA Scanner Spectrum View".

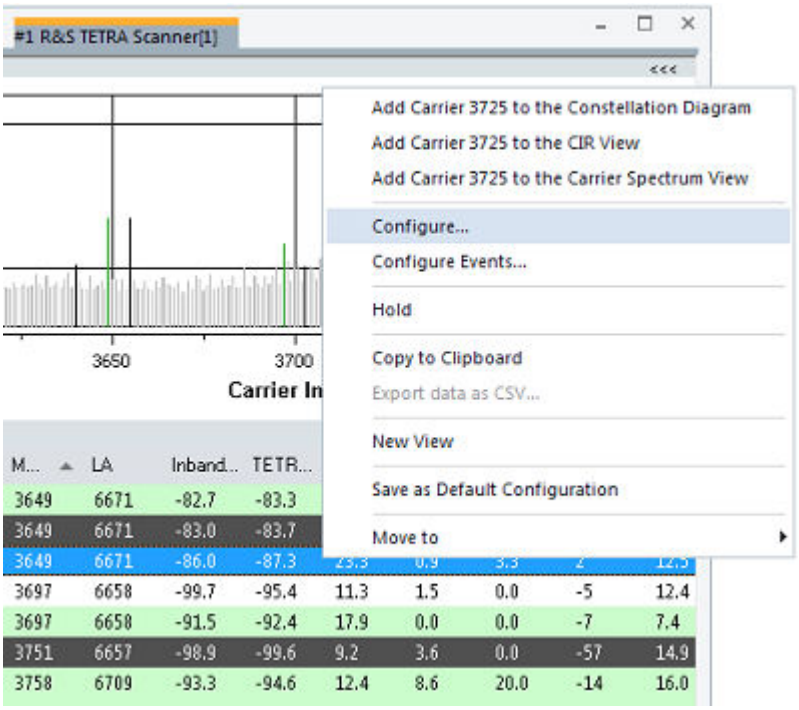


Figure 4-1034: Configure...

The table and the graph for "Activate Coupled Marker for the selected cells" of the "TETRA Scanner Spectrum View" are controlled separately.
If the option is "on", the "TETRA Scanner Spectrum View" looks like in the following figure.

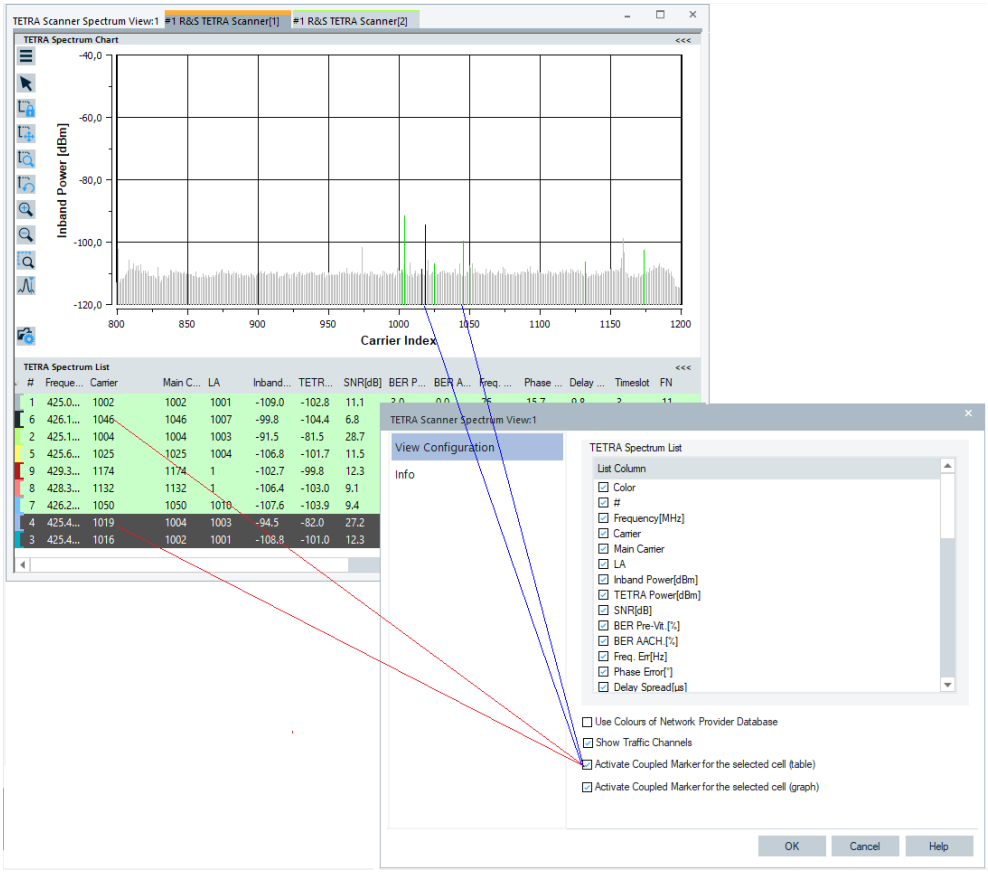


Figure 4-1035: Activate Coupled Marker for selected cells "on"

4.8.10.7 TETRA scanner Top N view

The "TETRA Scanner Top N View" visualizes the current state of the Top N calculation. Furthermore, it displays the properties of the signals from the base transceiver stations that are elements of the Top N pools defined in the technology configuration.

The upper part of the view, "List", shows the list of all Top N members of currently selected Top N pool, configured in the previously described combo box "TETRA Carrier".

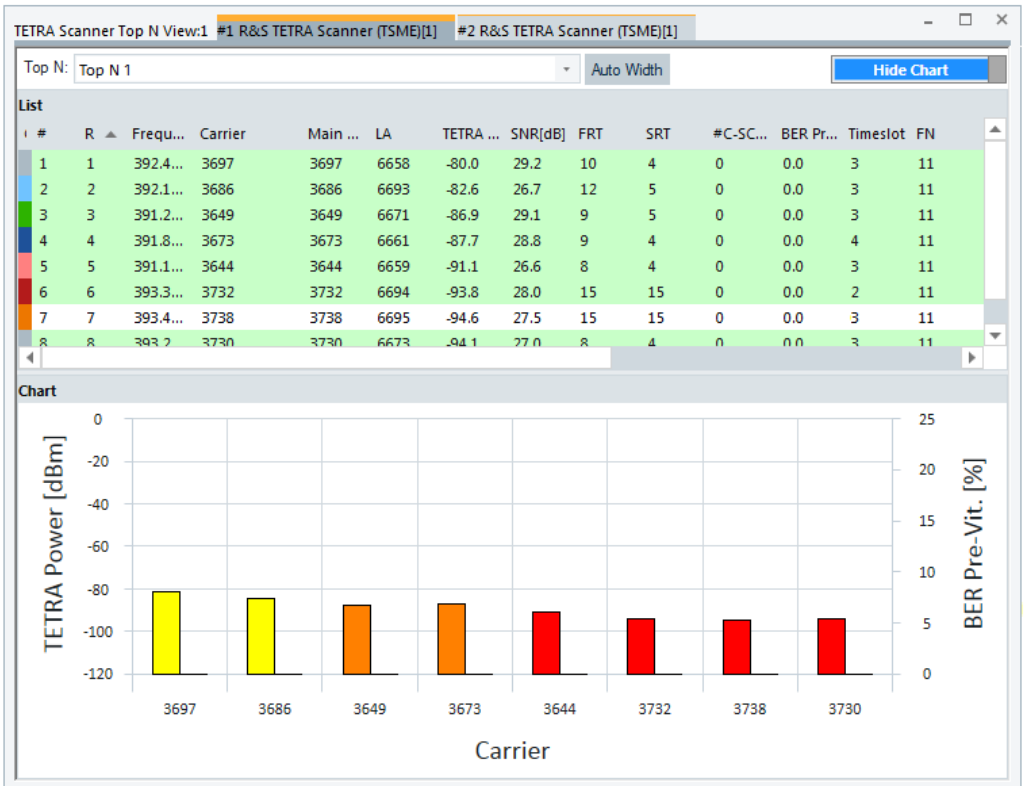


Figure 4-1036: R&S TETRA Scanner Top N View

The MCCH carriers are marked in a light green color in the "List", in a way they are colored in the "TETRA Scanner BCH View" and "TETRA Scanner Spectrum View".

"List" shows presence of the TEDS carriers, in red color. The only measured power is the inband power of the TEDS channel (Inband Power), see the "List" of the previous figure. Therefore, if TEDS carrier is considered in the Top N calculation, set the observation parameter to Inband Power. It is performed in "Top N Settings" > "Top N Pool Settings".

The lower part is a chart which shows the observed values of the selected signals. By default is shown TETRA Power and BER Pre-Viterbi (on the right side of the scale) value as a quality parameter of TETRA signals, see Figure 4-1036.

The user can configure Inband Power as observation value instead of TETRA Power, see Figure 4-1037. This configuration is necessary if the TEDS carriers are considered in "Top N Chart" and seen as the bars.

It is assumed that Pre-Vit. BER is the most appropriate parameter to valuate the quality of TETRA signals.

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

The splitter position between the upper and lower part of the scanner view area and the open or closed state of the "Top N List" and "Top N Chart" are restored from the workspaces.

Top N

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.
- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

Refer to "Tools > Overview of Settings", Chapter 3.8.2.18, "TEC for TETRA scanner", on page 374.

Top N list

The table "Top N List" gives an overview of the received signals in the current top N pool together with their measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

In the view configuration menu, it is possible to show or hide each individual table column. Up to 3 different named pools can be configured in the default setup. Each pool has several configurable parameters.

The "Top N List" contains the following columns:

- "Color"
  Carrier index-related color
- "#"
  Number of measured cells within the Top N pool
- "Rank"
  Cell current rank within the Top N Pool
- "Frequency[MHz]"
  Frequency of the TETRA carrier index

- "Carrier"
  TETRA carrier index (0 to 3999)
- "Main Carrier"
  Frequency of the MCCH extracted from SYSINFO PDU
- "LA"
  Location Area; a geographical area consists of one or more cells
- "Inband Power[dBm]"
  Inband power of TETRA channel
- "TETRA Power[dBm]"
  Code power of TETRA channel
  The default Top N pool uses TETRA Power as the observation value, see Figure 3-247.
- "SNR[dB]"
  Signal to Noise Ratio
- "C1"
  Path loss parameter C1; the calculation is based on the values of the broadcast channel and the configured maximum UE transmit power.
- "FRA"
  State of the fast reselection; the calculation is based on the values of the broadcast channel.
- "SRA"
  State of the slow reselection; the calculation is based on the values of the broadcast channel.
- "BER Pre-Vit.[%]"
  Ratio of estimated number of channel errors in block 1 and block 2 to the number of analyzed bits in block 1 and block 2. It is the comparison of received data and re-encoded data after error correction (Convolutional Code with Viterbi-Detector).
  See also "TETRA scanner Top N settings" on page 374.
- "BER AACH.[%]"
  Ratio of estimated number of channel errors in the broadcast block to the number of analyzed bits in the broadcast block. It is the comparison of received data and re-encoded data after error correction (Reed-Muller-Code).
- "MER.[%]"
  Number of blocks not corrected by the Reed Muller Correction divided by the total number of blocks on the AACH.
- "ModER[dB]"
  MER = Modulation Error Ratio
- Freq. Err[Hz]
  Frequency error
- "Phase Error[°]"
  RMS (Root-mean-square) phase error on the information symbols
- "Delay Spread[µs]"
  Delay spread of arriving paths. It is useful to prove multi-path propagation, especially if no data is shown in the TETRA Scanner CIR View, where the minimum delay spread for displaying results is 40 microseconds.

The delay spread can be characterized through different metrics, although the most common one is the root mean square (RMS) delay spread: According to Goldsmith, let $A_c(\tau)$ be the power delay profile of a channel. Then, the mean delay of the channel is

$$\overline{\tau} = \frac{\int_0^\infty \tau A_c(\tau) d\tau}{\int_0^\infty A_c(\tau) d\tau}$$

Thus, the RMS delay spread is

$$\tau_{rms} = \sqrt{\frac{\int_0^\infty (\tau - \overline{\tau})^2 A_c(\tau) d\tau}{\int_0^\infty A_c(\tau) d\tau}}$$

- "Timeslot"
  Timeslot number extracted from SYNC PDU
- "FN"
  Frame number extracted from SYNC PDU
- "MFN"
  Multiframe number extracted from SYNC PDU
- "MCC"
  Mobile Country Code extracted from the D-MLE-SYNC PDU
- "MNC"
  Mobile Network Code extracted from the D-MLE-SYNC PDU
- "Transmitter"
  Name of the TETRA transmitter
- "Dist.(km)"
  Distance to the TETRA transmitter
- "Colour Code"
  Color code extracted from Sync-PDU
- "MCCH BER Pre-Vit.[%]"
  Bit Error Rate on the Main Control Chanel
- "MCCH BER AACH [%]"
  Bit Error Rate on the Access Assignment Channel
- "MCCH ER Payload CRC[%]"
  Error Rate of the payload CRC
- "MCCH BLER AACH[%]"
  Block Error Rate on the AACH
- "Modulation Type"
  Used modulation in burst
- "Code Rate"
  Burst code rate
- "Burst Mod ER[dB]"
  Modulation Error Ratio over all symbols in a burst
- "Pilot Mod ER[dB]"
  Modulation Error Ratio over the pilot and sync symbols
- "Header Mod ER[dB]"
  Modulation Error Ratio over the header symbols

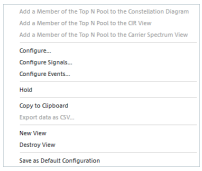
- "Data MER[dB]"
  Data Modulation Error Ratio
- "SICH Error Rate[%]"
  Number of errors in the received SICH bits / total number of SICH bits
- "AACH Error Rate[%]"
  Number of errors in the received AACH bits / total number of AACH bits
- "Data Error Rate[%]"
  Number of errors in the received data bits / total number of data bits
- "Source Address (DMO)"
  Direct mode of operation: address of the source terminal
- "Destination Address (DMO)"
  Direct mode of operation: address of the destination terminal
- "LTPxx(TETRA Power) [dBm]/LTPyy(TETRA Power) [dBm]"
  Probability of a certain TETRA power value over the LEE time. For more details, refer to "Top N Pool Signal Settings" on page 375.
  To display the LTPxx(TETRA Power)/ LTPyy(TETRA Power) signals in the "TETRA Scanner Top N View", make them active by checking the corresponding check-boxes in "Top N View". Drag & drop the lines to another order to resort the columns. The signals are then included in the "Alphanumeric View".
- "DMO Channel"
  DMO channel as received by the PDU in SCH/H
- "EVM (Peak)"/"EVM (RMS)"
  Calculated Error Vector Magnitude value, peak/root-mean square, range 0.00 to 100.00.

The export of the signals to ASCII files is supported.

Diagram

The "Top N Chart" shows Inband Power (or TETRA Power, dependent on selection) and the BER Pre-Viterbi values for all cells as bars in the current Top N measurement, refer to "Configuration: Top N view" on page 1369. Their upper and lower limits for the y-axis of the chart are configurable.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Add a Member of the Top N Pool to the ....."
  If a line within the Top N list is selected and also the referenced other view is opened, this context menu entry gets active. Then it is possible to add the selected member of the Top N Pool to another view. If the other view is later closed, the context menu entry remains loaded, active and the view can still be configured.

TETRA scanner Top N view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Top N view

The "Top N View" tab customizes the contents of the table and the chart, offering the following:

- Selection of the parameters to be included in Top N list contents
- Definition of the y-axis scale display. The definition assumes minimum/maximum level of a signal displayed as a first 2D/3D and second 2D chart value in the Top N chart
- Selection of the power type to be displayed in the Top N chart
- Selection of the 3D chart colors
- Displaying or not the signal quality in the 2D Top N chart

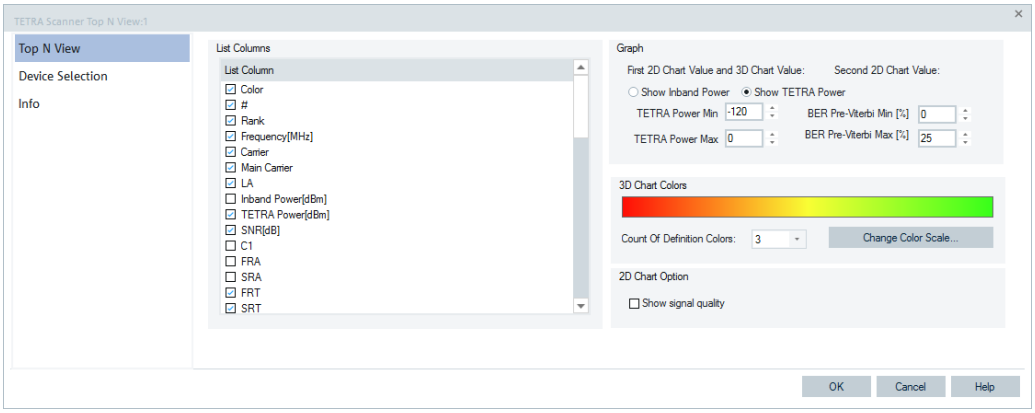


Figure 4-1037: TETRA Scanner Top N View - configuration

List Column
Lists the parameters that, if selected are included in the Top N list contents, see "Top N list" on page 1365.

Graph

- "Show Inband Power"
  If selected, shows total inband power of the TETRA channel in the "Top N Chart".
- "Show TETRA Power"

If selected, shows TETRA Power of the TETRA channel in the "Top N Chart".

- "Inband Power Min/Max [dBm]" or "TETRA Power Min/Max [dBm]"
  Sets the upper and lower Inband Power or TETRA Power levels for the left y-axis of the chart.
- "BER Pre-Viterbi Min/Max [%] "
  Sets the upper and lower BER Pre-Viterbi levels for the right y-axis of the second 2D chart.

2D Chart Option
"Show signal quality" lets you switch on or off the second y-axis on the chart and quality signal bars. Dependent on switching, the signal quality is displayed or not.

The result of the switching is visible only on the next frame as the chart must redraw at least once for it.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

4.8.11 UMTS scanner views

UMTS PNS measurements are performed using the UMTS PN scanner, see Chapter 6.4.19, "UMTS PN scanner", on page 1788. R&S ROMES4 controls an R&S scanner (radio network analyzer) to alternate between UMTS Pseudo Noise (PN) scans and a spectrum analysis. Most of the results obtained with the different test instruments are equivalent.

The scanner measures and identifies all UMTS downlink signals in the air with an UMTS PN scan. The main purpose of this measurement is to test the receiving conditions of a mobile in an UMTS network and to analyze possible interferences.

The spectrum analysis consists of a frequency sweep over a specified range to detect arbitrary UMTS downlink and uplink signals. Results of the UMTS PN scans are displayed in all UMTS scanner views except in the "UMTS Scanner Spectrum View" and the "UMTS Scanner Spectrum History View".

The R&S TSME performs the UMTS networks scans. The hardware option required for the R&S TSME scanner is R&S TSME-K21.

The UMTS PN scanner available option for R&S TSME is R&S ROMES4T1E.

Many of the UMTS PN scanner results can also be displayed in other R&S ROMES4 views, for example, in the "Alphanumeric View" and "ROMESMAP Route Track View".

Some measurement examples using the UMTS PN scanner are outlined in Chapter 2.2, "Measurement examples", on page 72.

To get wanted UMTS scanner view hover mouse over the "Views" > "Scanner Views" > "UMTS", as shown in the following figure.

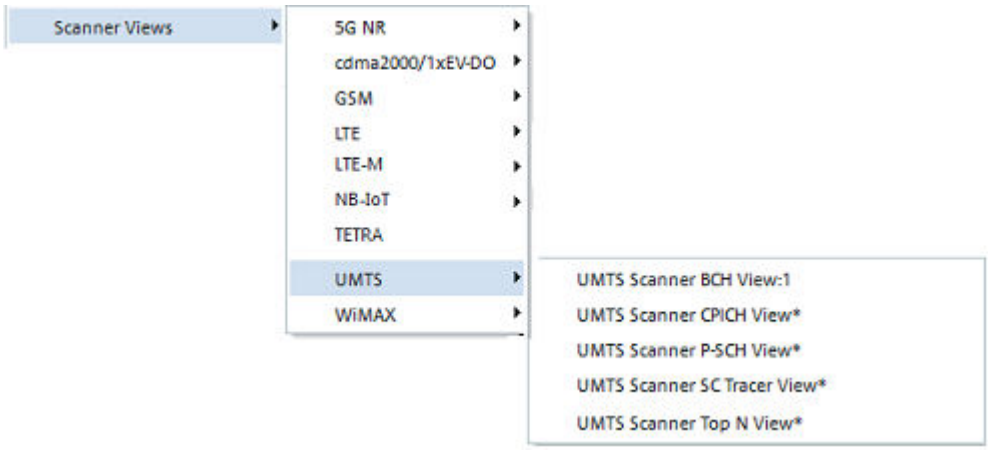


Figure 4-1038: View – UMTS scanner menu

- UMTS scanner signals templates 1371
- UMTS scanner BCH view 1377
- UMTS scanner CPICH view 1383
- UMTS scanner P-SCH view 1391
- UMTS scanner pilot view 1393
- UMTS scanner SC tracer view 1397
- UMTS scanner Top N view 1404

4.8.11.1 UMTS scanner signals templates

The UMTS scanner signals templates offer a way to get easy access to the measurement data of a specific NodeB. The access is achieved by specifying the UARFCN and the SC whose measurement data that you want to get in a basic (generic) view. That data is also displayed in the "Top N Templates" or the "CIR SC <UARFCN\SC> Template" branch of the "Signal Tree" > "UMTS PNS" tree.

Figure 4-1039: UMTS scanner signals templates

1. Select from the "Top N Templates" or the "CIR SC <UARFCN\SC> Template" branch a signal that you want to visualize in a R&S ROMES4 basic view and in the "Signal Tree" as a template signal.
2. Drag & drop the selection into the view. Instead, double click the item in the view's configuration page.
3. A dialog pops-up asking you to define the filter for the signal. For UMTS PNS, this filter asks for a combination of a NodeB UARFCN and SC.
   If you have selected several signals, check the "Apply for all signal" box. The action applies the same filter for all signals.

   The filter for the signal is entered.

   The signal appears in the R&S ROMES4 basic view and in a template branch of the "Signals Tree" > "UMTS Scan" tree.

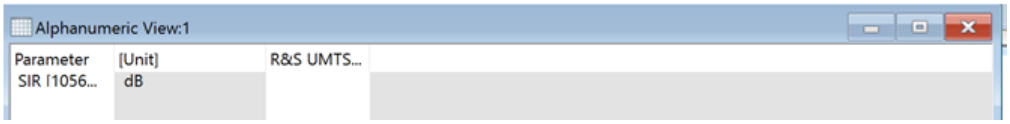


Figure 4-1040: Alphanumeric view of the template signal SIR

   The template branches are a home of all created template signals.

The filtering dialog remembers the last set values.

The template signals are part of the workspace. Being the part of the workspace, they are stored to it and restored when loading a workspace. Creating a workspace removes the template signals.

Configuration of UMTS scanner Top N templates

The Top N signals can be configured on any generic views ("Basic Views"). If a signal is configured on a generic view, a prompt for specific Top N pool and Top N member to be configured is displayed.

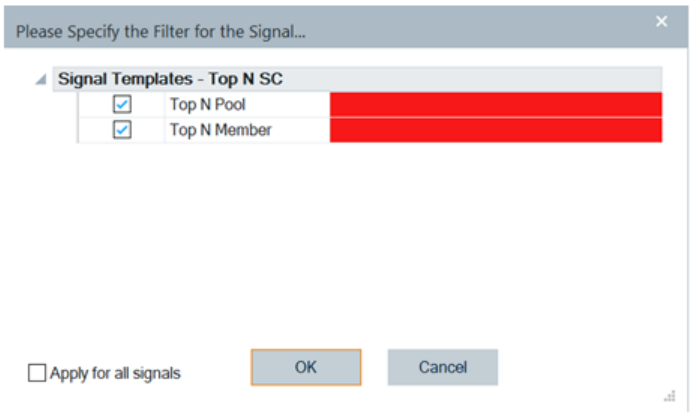


Figure 4-1041: Template to filter Top N SC

Configuration of Template Top N Pool: Enter the desired Top N pool number. A range of Top N pools can be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represents the pools 1, 2 and 4 and 1 to 4 would represent an entry of pools 1 to 4.

If measurement or measurement replay is in progress, the valid Top N pools are available for selection if you click the down arrow. Click one or more of the valid pools.

Once all selections are made, click another field or "OK" to close the selection window.

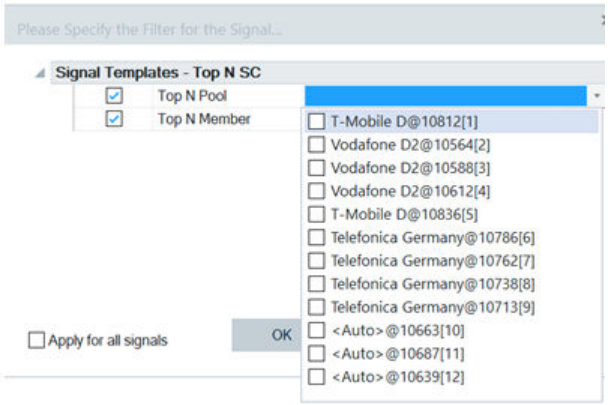


Figure 4-1042: Available Top N pools

Configuration of Template Top N Member: Enter the desired Top N member number. A range of Top N members can be entered by using a comma separator which separates individual pools or a dash to define a range of pools. For example, entered 1, 2, 4 represents the members 1, 2 and 4 and 1 to 4 would represent an entry of members 1 to 4.

Selection of Field Color Code: Once a valid selection is made, the field gets a green background color. If a selection is not valid, the background color is red.

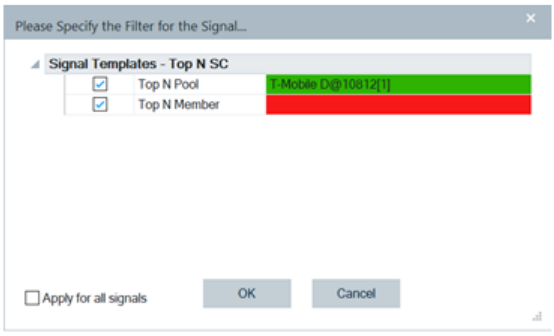


Figure 4-1043: Colored fields for Top N SC filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections". (These selections are reset each time R&S ROMES4 is restarted). To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear if all prior selection boxes have been deselected.

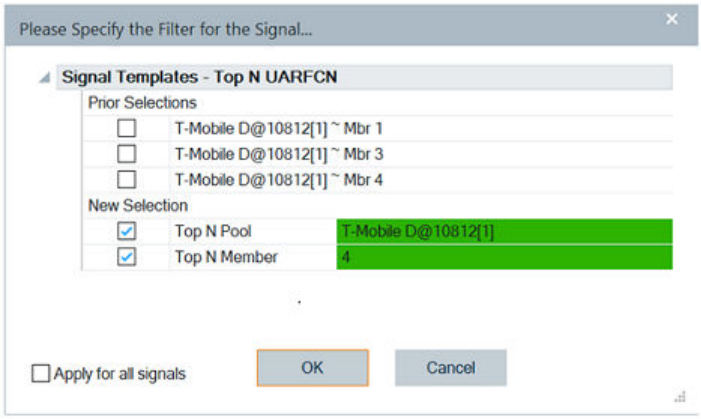


Figure 4-1044: Prior selected template signals

Configuration of UMTS CIR SC<UARFCN/SC> signals templates

If a CIR SC signal is configured for use on a generic view, a prompt to configure the signal with desired filter value is displayed.

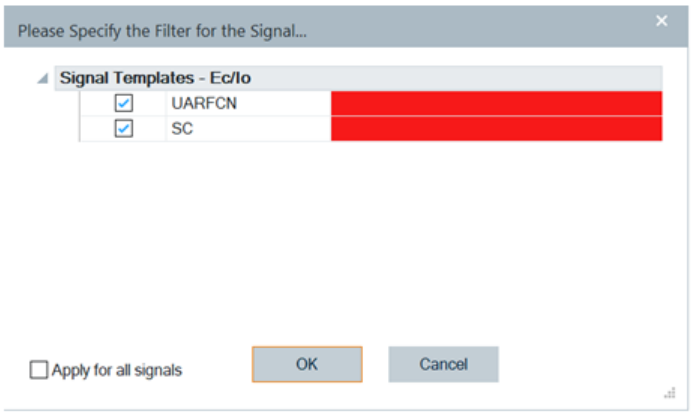


Figure 4-1045: Ec/Io template signal filtering

Configuration of UARFCN Value: An UARFCN value can be entered. Multiple UARFCN can be entered by separating the values with a “,”. For example, by entering 1300, 1444 selected are channels with UARFCN 1300 and 1444.

If a second-level or measurement replay is in progress, a list of currently valid UARFCN values is displayed if you click the down arrow. One or more of the values can be selected if you check the box next to the desired choice.

Once all selections are made, click another field or "OK" to close the selection window.

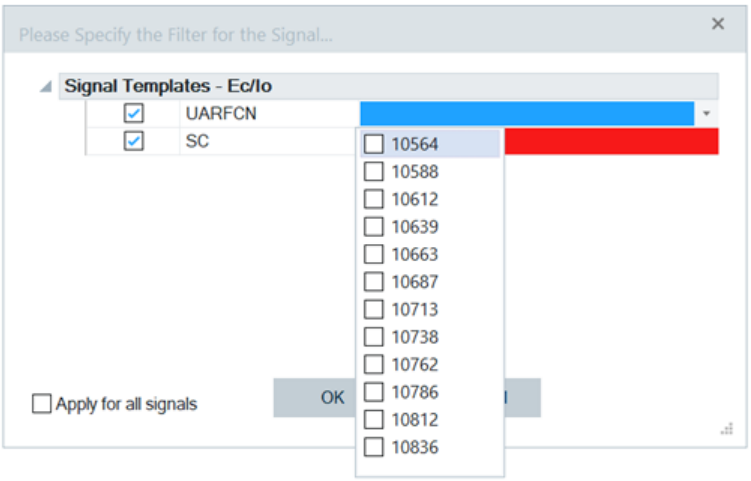


Figure 4-1046: Selection of an UARFCN value

Configuration of SC: A scrambling code (SC) value can be entered. Multiple SC values can be chosen by separating the values with a “,”. For example, entered values 32, 131 selects the SC value 32 and 131.

If a measurement or measurement replay is in progress, a list of valid PCI values for the currently selected UARFCN is displayed by clicking the down arrow. One or more of the values can be selected if you check the box next to the desired choice,

Once all selections are made, click another field or "OK" to close the selection window.

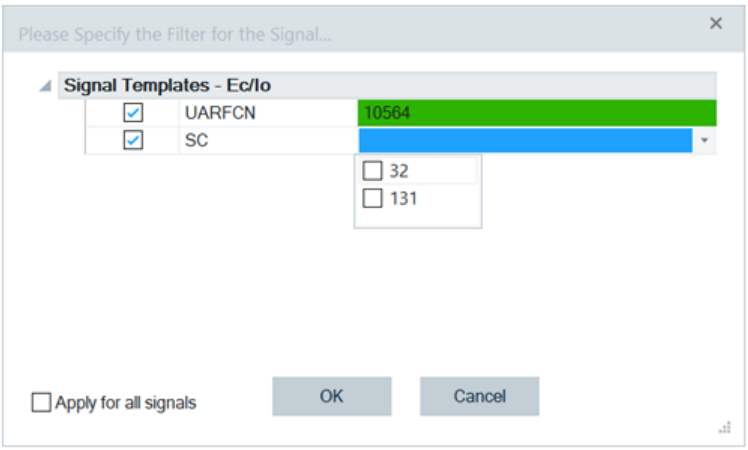


Figure 4-1047: Selecting SC values

Selection of Field Color Code: Once a valid selection is made, the field gets green background color. If a selection is not valid, the background color is red.

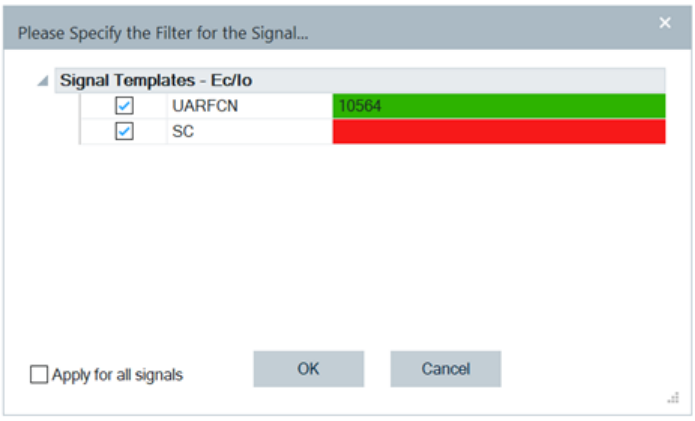


Figure 4-1048: Colored fields for Ec/Io filtering

If the entry field has focus, it is displayed as a blue background regardless of selection status.

Prior Selections Selection: The last five user selections appear under the "Prior Selections" rows. (These selections are reset each time R&S ROMES4 restarts).

To select one of the prior selections, check the box next to the desired option and press "OK". The new selection items are hidden. They reappear when all prior selection boxes are deselected.

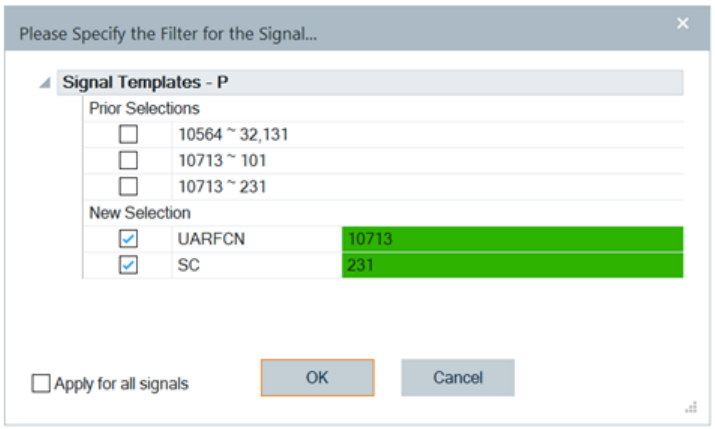


Figure 4-1049: Prior selected power template signals

4.8.11.2 UMTS scanner BCH view

The "UMTS Scanner BCH View" shows a list of all System Information Blocks (SIBs) and Master Information Block (MIB) decoded from the UMTS BCH of a certain NodeB. The contents of each block appear in a tree view of the "Details" pane when the block is selected. The SIB types and their information elements are described in standard 3GPP TS 25.331.

The view accumulates the SIBs acquired and displays them in the left part of the view, grouped by network provider, i.e. by MNC and MCC.

Each second level node of the data tree shown represents an UMTS NodeB sector identified by MCC, MNC and CI. If it can be found in the UMTS NodeB database loaded, the corresponding name is shown, e.g. MXU811A.

Otherwise, the name is composed as S<MNC>_<MCC>_<CI>; for example, S262_001_09814 with:

- **<MNC>** → decimal MNC value, 3 digits
- **<MCC>** →decimal MCC value, 3 digits
- **<CI>** → decimal CI value, 5 digits

Some parameters (SC, CI, position) are appended to the NodeB name. In the "Details" pane within the tree view the scrambling code is always displayed in the decimal format.

If the NodeB has been retrieved from the database, the position is displayed as Lon <value> Lat <value>. If the NodeB has been generated from SI3 measurement without a corresponding database entry, the position is displayed as Lon *<value> Lat *<value>. The format of the position values depends on the corresponding global R&S ROMES4 setting.

The SIB and MIB information is available only if the PN scanner data are recorded with the "BCH Demodulation" enabled. Decoding of each SIB type must be enabled explicitly in the UMTS PNS scanner configuration menu, see "Receiver settings UMTS PNS" on page 1790.

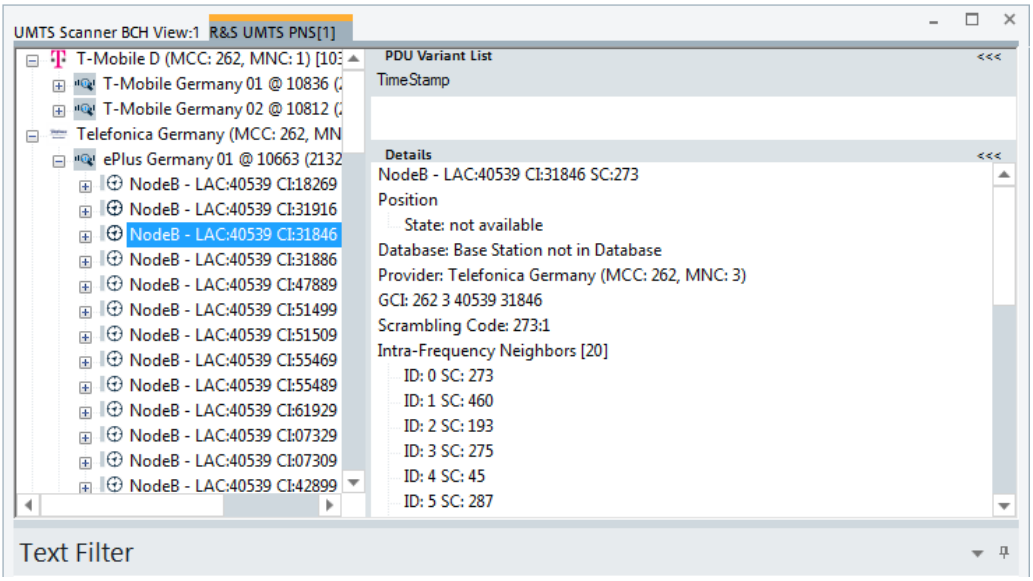


Figure 4-1050: Selected NodeB details

The data shown in the "Details" panel depend on selected item in the right-hand panel of the view.

For example, if SIB 11 and SIB 12 are selected, the contained neighbour cells information is extracted and can be seen as the neighbors of a serving NodeB in "Details".

If SIB 1 is selected, LAC is extracted and can be seen as cn_CommonGSM_MAP_NAS_SysInfo[LAC] in the "Details" of SIB 1 and as LAC in the "Details" of the NodeB.

PDU variant list

As R&S ROMES4 supports dynamic PDU handling described in "Implementation of the dynamic PDU handling" on page 284, the scanner BCH view for UMTS and other technologies is enhanced. The BCH view shows the list of PDU variants over time. The PDU variants are shown as leaves of the base station.

When a SIB is selected on the left side of the "UMTS Scanner BCH View", the list of PDU variants and the list of associated time stamps are displayed on the view's right side. The following screenshot displays PDUs carrying SIB1.

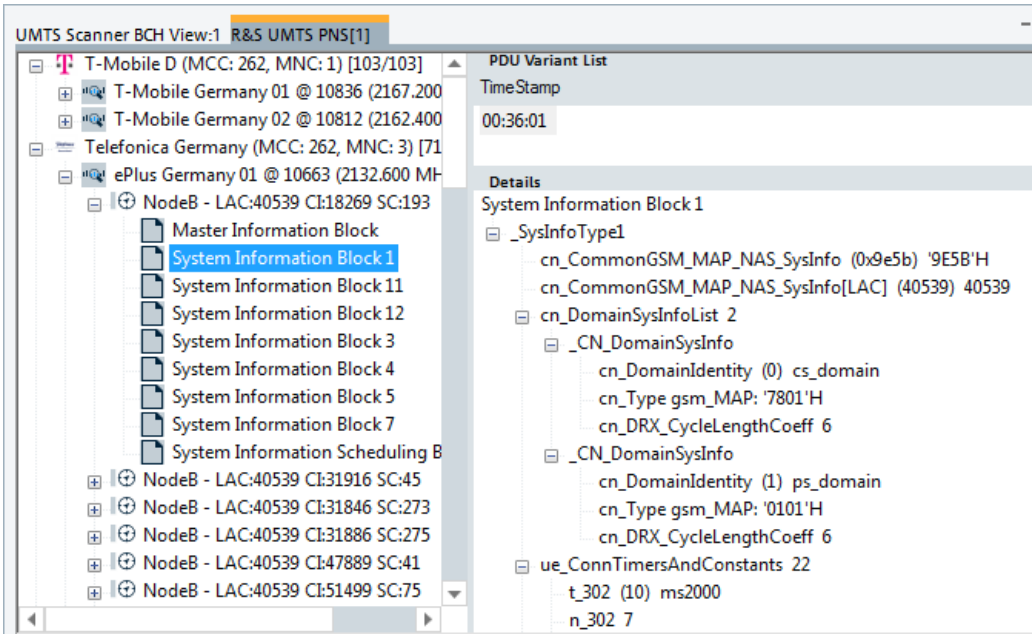


Figure 4-1051: Right panel shows details of NodeB parameters in SIB 1

The "PDU Variant List" in the upper right of the view shows a list of time stamps if there were different variants found. For SIB1 shown in the previous screenshot, only one variant is found. The "TimeStamp" shows the most recent measurement of the variant.

The following screenshot shows a list of time stamp of a PDU with variants, as UMTS SIB 7.

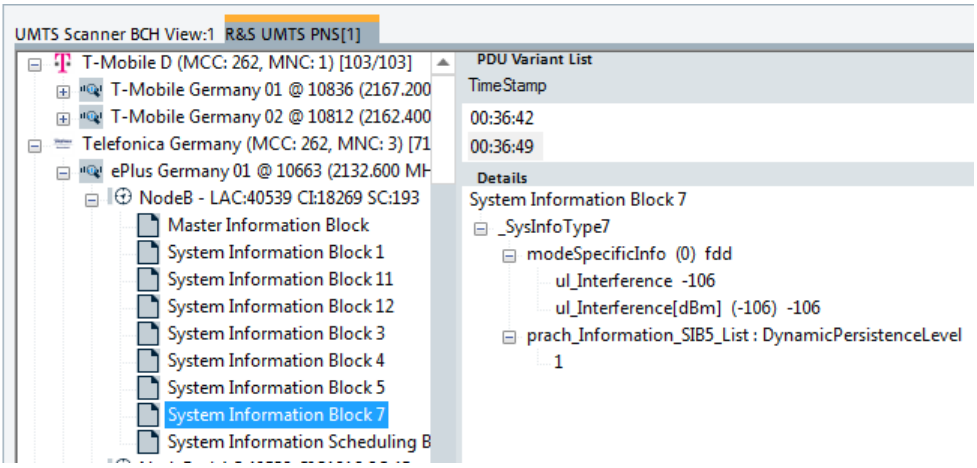


Figure 4-1052: PDU list of time stamps

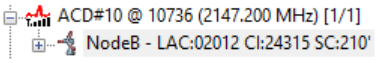
The "PDU Variant List" is common for all the RATs that support dynamic PDU handling. Therefore, the given explanations are valid for all them.

RAN sharing in BCH view

The "UMTS Scanner BCH View" displays NodeBs of all PLMNs reported in the MIB (the standard MIB for the primary PLMN and the v690ext MIB for additional PLMNs,

see Add. PLMNs). For example, the transmitters which serve the PLMN 123,1 and PLMN 123,2 are visible in the UMTS Scanner BCH view in the branch for PLMN 123,1 and PLMN123, 2 respectively.

A transmitter, which is listed below a PLMN that is not its primary PLMN is displayed with an "`" appended to its name.



The view creates branches for all PLMNs of the measured transmitters (base stations), instead of transmitters only the primary PLMN. It is possible to hide the transmitters, which are displayed as non-primary PLMNs if you check the "Text Filter" > "Show Shared Basestations" check-box in the view.

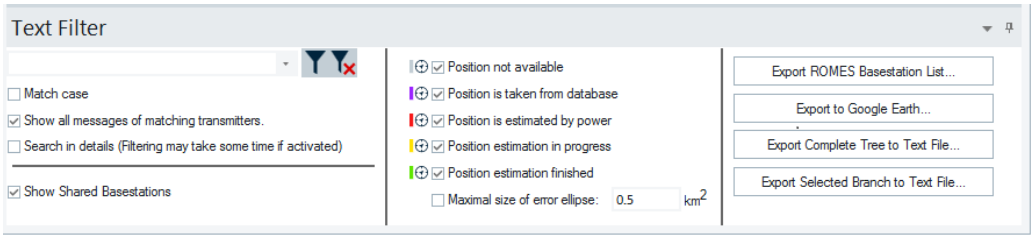
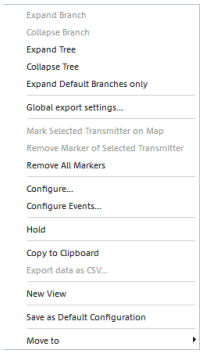


Figure 4-1053: Show or hide shared base station options

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"

Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.

- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

BTS export parameters configuration

If the export is started before measurement or replay stops, the file contains all System Information starting from the selected node in the BCH tree. All SIBs of the selected NodeB or all SIBs belonging to all NodeBs of one provider (MCC, MNC) are contained in the file then.

If the export is started after measurement or replay is stopped, the file contains all SIBs belonging to all NodeBs of the "UMTS Scanner BCH View".

The System Information can be exported to an ASCII file in the EXPORT directory of R&S ROMES4. The export file is named:

```
UMTS_SysInfo_&lt;measurement filename&gt;.txt
```

Content export file

```
Provider MNC: 2  MCC: 262
NodeB MXUW70C - SC 432 - CI 32703 - Lon 11°26'18"E - Lat 48°8'20"N
Master Information Block
value MasterInformationBlock ::=
{
  mib-ValueTag 7,
  plmn-Type gsm-MAP :
  {
    plmn-Identity
    {
      mcc
      {
        2,
        6,
        2
      },
      mnc
      {
        0,
        2
      }
    }
  },
  sibSb-ReferenceList
  {
    {
      sibSb-Type sysInfoType1 : 229,
      scheduling
```

```
    {
      scheduling
      {
        sib-Pos rep32 : 2
      }
    }
  },
  {
    sibSb-Type sysInfoType2 : 3,
    scheduling
    {
      scheduling
      {
        sib-Pos rep64 : 6
      }
    }
  },
```

Position estimation

If position estimation is active (see Position Estimation), the estimated positions are added to the NodeB entries. The estimated positions are marked by an asterisk, see Figure 4-1051.

After stopping the measurement, the view automatically generates the BTS list import files with an entry for every estimated BTS position.

Files

Two files are generated for each `*.rscmd` measurement file.

GSM_BTS_LIST<measurement filename>.ATD	Contains the database definition.
GSM_BTS_LIST<measurement filename>.TXT	Contains the BTS data.
Note: The NodeB list files are stored in the R&S ROMES4 measurement directory. After stopping replay of a measurement file, you can create the same NodeB list via the view's "Generate NodeB List" context menu option.	

Example:

Measurement file:	`zgb-muc.rscmd`
Generated files:	`UMTS_BTS_LIST_ zgb-muc.ATD`
	`UMTS_BTS_LIST_zgb-muc.txt`

Content *.ATD and *.TXT file

For a detailed example, refer to "BTS export parameters configuration" on page 1381.

UMTS scanner BCH view configuration

The "Configuration" option lets you set the color for the selected BTS symbols in the "ROMESMAP Route Track View" and define the filter for generating a BTS list.

Open the configuration page by a right mouse click on a point inside the view or via the "Tools" > "Configuration Active View" command.

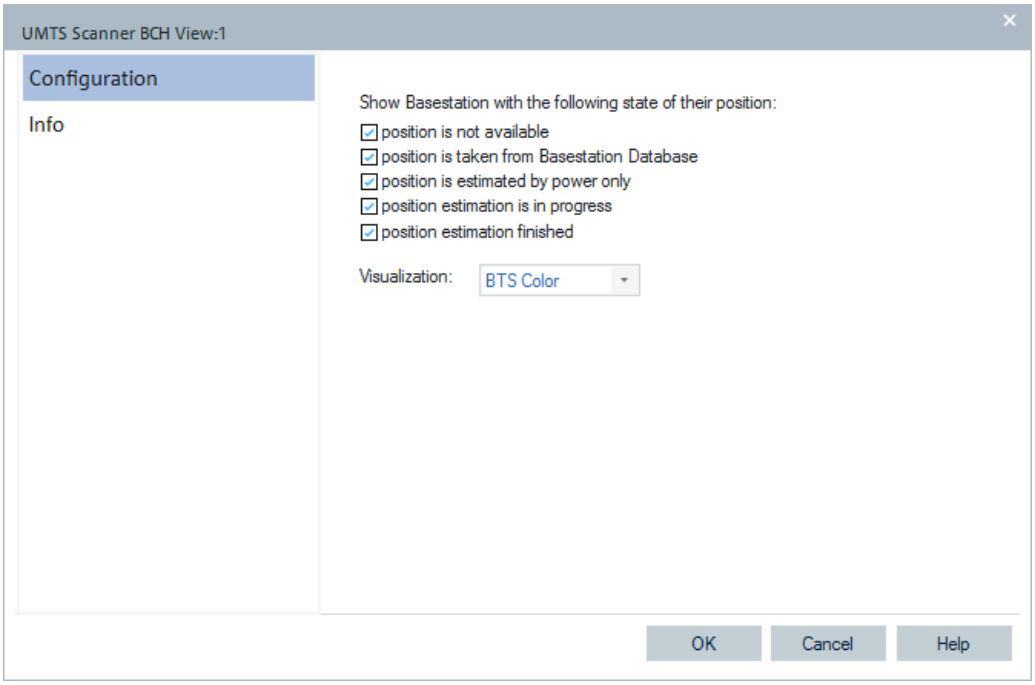


Figure 4-1054: UMTS Scanner BCH View - configuration

4.8.11.3 UMTS scanner CPICH view

The "UMTS Scanner CPICH View" shows the average signal power of the received P-CPICHs and a comprehensive analysis of the properties of all DL signals received in the UMTS PN scan.

Different signals are distinguished by their slot timing (the beginning of the slot detected by the receiver of the test instrument). Signals from different NodeBs are distinguished by their primary scrambling codes (SC), transmitted over the CPICH. Signals with different slot timing, but equal SC, originate from the same NodeB but propagate along different paths. A comparison of those signals provides important information on reflections and possible interferences.

The analysis requires synchronization to each received signal, which is performed in the 3-step process:

1. The test device searches for the Primary Synchronization Channel (P-SCH) to obtain the slot timing. The start of the P-SCH marks the beginning of the slot.
2. The Secondary Synchronization Channel (S-SCH) analysis derives the scrambling code group (CG) and the frame timing.

3. The SC within the CG is determined by correlating with the pilot bits of the CPICH.

   Steps 2 and 3 are modified if "High Speed" is selected in the "Measurements" tab of the scanner configuration menu, see Chapter 6.4.19.2, "Configuration menus UMTS PNS", on page 1790. This tab defines the "Synchronization Rate".

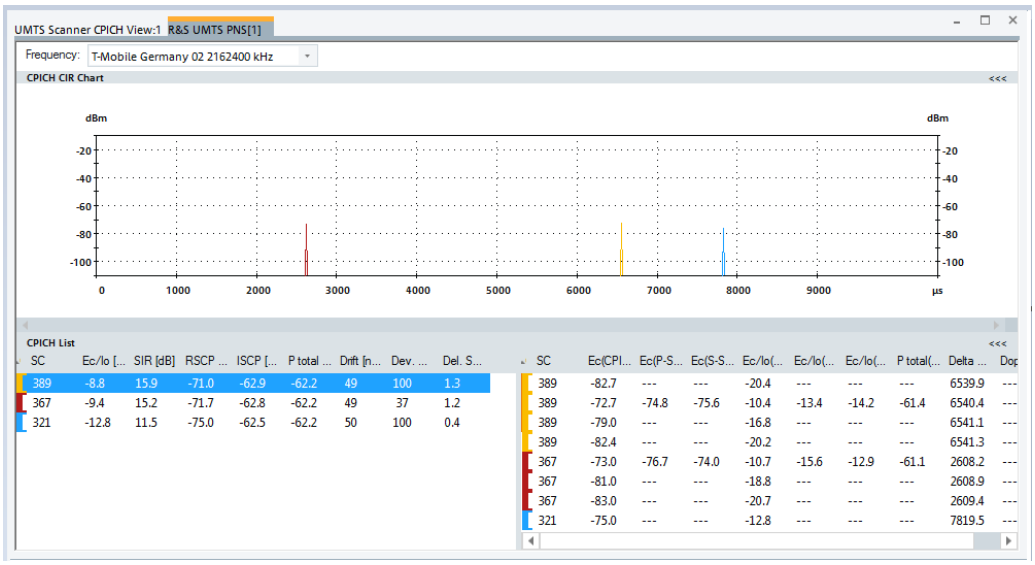


Figure 4-1055: UMTS Scanner CPICH View

Frequency

Below the view title, the "Frequency" pull-down list contains all measured frequencies selected in the "Receiver" tab of the scanner configuration menu. The list is also provided in the "UMTS Scanner P-SCH View", "UMTS Scanner Pilot View" and "UMTS Scanner SC Tracer View".

Changing the frequency in one of these views, automatically adapts the frequencies in all other views. This change provides that the views have the same current number in their title bar. For example, the view in the previous figure is the number 1. Using this feature, it is possible to generate different groups of views with the same current number and select frequencies for an entire group with a single mouse click.

View area

The entire view area is horizontally split to accommodate a chart and a table/list. The "CPICH CIR Chart" shows the average signal power of the P-CPICHs of all received signals over the time. The displayed powers and times correspond to the "Ec (CPICH) [dBm]" and "Delta T[µs]" values listed in the "Peak List" (right-hand part of the "CPICH List").

A click on the "CPICH CIR Chart" or "CPICH Lists" title bars compresses and expands the 2D-chart or table. A compressed chart leaves more space for the table and vice versa. Moreover, the tables appear in several UMTS Scanner views so that compressing them can help to avoid redundancies. A compressed sub diagram is characterized

by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Diagram scale

The diagram is opened with a default x-axis scale of little more than one UMTS frame (10 ms). If placed inside the diagram area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside). A vertical line is displayed at the cursor position.

A left mouse click magnifies the diagram in x-direction around the cursor position, "Ctrl" plus left mouse click causes the opposite. An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed. "Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

The scale of the y-axis (power in dBm) can be set in the configuration menu.

Table entries

Below the diagram, the "CPICH Lists" give an overview of the received signals together with their scrambling codes, different power parameters, frequency and timing information. On mouse hover-over, each cell in the table header provides a short explanation of the corresponding column.

The entire table is divided into the "CPICH List" and the "Peak List." In the configuration menu, it is possible to show or hide each individual table row in both lists.

CPICH list

The "CPICH List" (left-hand part of the "CPICH Lists") provides a general description of the received CPICH signals from each NodeB. Each signal is characterized by its SC, corresponding to the transmitting NodeB, and includes all possible peaks (reflections) indicated in the "Peak List" on the right-hand side. The list can contain the following CPICH-related values (see also standard 3GPP TS 25.215 and related standards.

All power results in the CPICH List and Peak List are obtained in an unbiased measurement: The contribution of the noise floor to the powers is subtracted.):

- "SC [Hex]"
- Primary scrambling code no. of the CPICH signal in the format selected in the "TEC for UMTS PNS" tab of the "Configuration of Software Modules" menu; refer to chapter Chapter 3.8.2.9, "TEC for UMTS scanner", on page 321. In decimal representation, the primary scrambling code numbers are multiples of 16: SC[dec] = 16*i where i=0 to 511, so the least significant digit of the hex numbers is always 0, see Chapter 4.8.11.6, "UMTS scanner SC tracer view", on page 1397. Sequence numbers:"1, :2" behind a code distinguish multiple reflections.
- Each SC is identified by a color, to be customized in the configuration menu. The SC color codes are also shown in the "ROMESMAP Route Track" menu.

CPICH signal power

- "Ec/Io [dB"]

Ratio of the received energy per PN chip of the CPICH and of the entire NodeB signal to the total transmit power spectral density. The value equals to the sum of the "Ec/Io (CPICH) [dB]" values of all individual peaks of the same SC displayed in the "Peak List", see CPICH peak list.

- "SIR [dB]"
  Signal-to-Interference Ratio of the CPICH, RSCP/ISCP*256 where 256 is the CPICH spreading factor.
- "RSCP [dBm]"
  CPICH Received Signal Code Power; sum of the received powers of all peaks on one code, measured on the pilot bits of the Primary CPICH.
- "ISCP [dBm]"
  Interference Signal Code Power, the interference on the received signal measured on the pilot bits. Both the orthogonal and the non-orthogonal parts of the interference are included in the measurement.
- "P total [dBm]"
  Total received wide-band power in the channel, measured within the correlation sections of the P-CPICH. The observed signal section is the same for all signals, so P total is the same for all NodeBs. "P total" is equal to Io during the CPICH chips so that the following relation holds:
  "P total + Ec/Io = RSCP"

CPICH signal timing

- "Drift [ns/s]"
  Averaged change of the time delay of the CPICH peaks of a NodeB signal over the time. A drift translates into a lateral deviation of the signal in the Chapter 4.8.11.6, "UMTS scanner SC tracer view", on page 1397. It can be due to one or several of the following effects:
  - Doppler Effect due to a relative movement of the test vehicle and the NodeB.
  - Drift of the system time compared to the nominal UMTS timing
  - Drift of the NodeB timing compared to the nominal UMTS timing

  Tip:
  A measurement at fixed position eliminates the Doppler effect and thus isolate the two other effects making the assessment possible. To disentangle system time and NodeB drift, it is sufficient to compare signals from several NodeBs. If several signals are measured with the same drift, this common drift is likely to be due to the system time. After subtraction of this common system time drift, one is left with the drift of the individual NodeBs.
- "Dev. Drift [ns/s]"
  90% confidence interval width of the average time drift. A small value indicates that the drift measurement is estimated to be relatively accurate.
  Note:
  The accuracy of the drift measurement increases with the number of measured values. Consequently, the Dev. Drift values (and often also the Drift values) typically decrease as the measurement progresses.
- "Del. Spread [Chip]"
- RMS delay spread in chip periods: Standard deviation of the time delay "Delta T (ΔT)" at all CPICH measurement points weighted with the measured powers "Ec

(CPICH)". A small delay spread indicates that the individual CPICH peaks of the NodeB signal are relatively close or that the power of peaks with different time delay is low.

The "CPICH List" is also displayed in the "UMTS Scanner Top N View".

CPICH peak list

The rows of the "Peak List" (right-hand part of the "CPICH Lists)" describe the single peaks (reflections) that contribute to the different NodeB signals.

The list can contain the following values (see also standard 3GPP TS 25.215 and related standards):

- "SC [Hex]"
  Primary scrambling code no. of the CPICH is defined in the format selected in the "TEC for UMTS PNS" tab of the "Configuration of Software Modules" menu, see Chapter 3.8.2.9, "TEC for UMTS scanner", on page 321.

Signal power

- "Ec (<Ch>) [dBm]"
  Average energy per transmitted PN (Pseudo Noise) chip for channel <Ch>, divided by the chip period and thus converted into an average received signal power (in dBm). E_c is displayed for the (Primary) CPICH, P-SCH and S-SCH.
- "E_c/I_o (<Ch>) [dB]"
  Ratio of the received energy per PN chip for channel (<Ch>) to the total transmit power spectral density. E_c/I_o is displayed for the (Primary) CPICH, P-SCH and S-SCH.
- "P total (SCH)"
  Total averaged received signal power for the duration of the SCH. "P total" contains the contributions of all channels during the observation period and is therefore always greater than "E_c (P-SCH)" or "E_c (S-SCH)". The following relations hold:
  "P total + E_c/I_o (P-SCH) = E_c (P-SCH)"
  "P total + E_c/I_o (S-SCH) = E_c (S-SCH)"

Signal timing

- "Delta T [µs]"
  Time delay of the signal's slot timing relative to the system time or GPS time (hardware-dependent). The reference time (left edge of the diagram) is of minor importance. The diagram extends over more than one frame, which is enough to display and separate all received signals.
- "Doppler Freq."
  Frequency offset of the measured P-CPICH carrier frequency compared to the nominal UMTS channel frequency. In a coverage measurement on a moving test vehicle, an important source of frequency offsets is the Doppler shift due to the speed of the receiver relative to the transmitter. Constant frequency offsets do not originate from the Doppler shift and can be corrected in the configuration menu. The "Doppler Frequency" is available only if "High Dynamic" is selected in the "Measurements" tab of the scanner configuration menu, see "Measurements UMTS PNS" on page 1801.

The "Peak List" is also displayed in the "UMTS Scanner P-SCH View".

Special table entries

Depending on the conditions of the measurement, the tables can show some particular results:

- An invalid result "---" denotes that a peak or the entire NodeB signal was too weak to be accurately measured. Selecting "High Dynamic" mode in the measurements tab of the scanner configuration menu generally reduces the number of invalid results.
- A number as ":1", ":2", etc., behind the scrambling code denotes reception of signals with the same scrambling code but with a significant difference in their time delays. Two different scenarios can cause multiple scrambling codes:
  - If several of those signals occur at the same time, they are likely to belong to different NodeBs that accidentally use the same SC.
  - Two signals with different numbers behind their scrambling codes that are received at different times can belong to the same NodeB but actually indicate a strong time drift.

Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- **Reset Zoom**
  Resets the x-axis scale to 0 ms to approx. 10.5 ms.
- **Destroy View**
  Deletes the active view with its contents.

UMTS scanner CPICH view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "UMTS Scanner CPICH View" configuration customizes the diagram in the view and the contents of the table.

The "CPICH View" option lets you set the y-axis scale of the "UMTS Scanner CPICH View", select the information to be displayed in the table and correct the Doppler frequency.

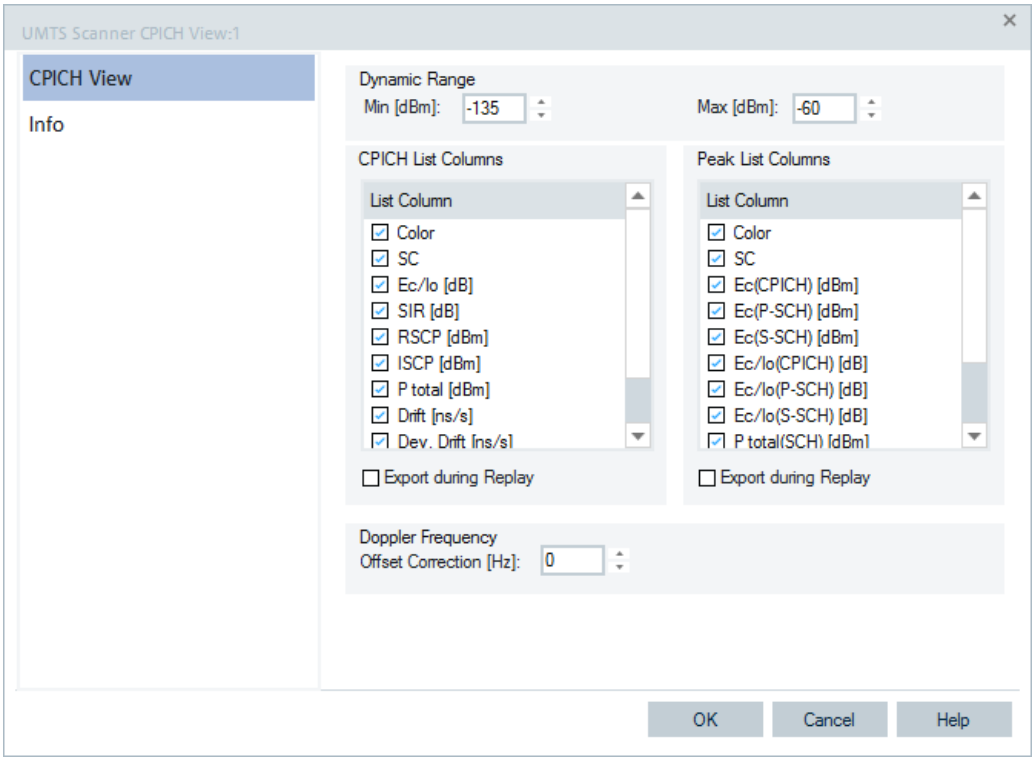


Figure 4-1056: UMTS Scanner CPICH - configuration

Dynamic Range

The two input fields in the "Dynamic Range" panel define the minimum "(Min [dBm])" and the maximum "(Max [dBm])" level to be displayed in the "UMTS Scanner CPICH View".

CPICH List/Peak List

The "CPICH List" and "Peak List" panels select, which information is displayed in the tables below the "CPICH CIR chart". Clearing a box, hides the corresponding row in the diagram.

Export During Replay

You can export the data shown during replay in two lists of the view to XML files.

Instead, export to CSV format is also possible. The export is basically like the CIR export in LTE and WiMAX. To export the data in CSV, thick the "Export during Replay" check box in the "CPICH View" configuration page.

The file names are generated from the cmd file name, the view name, the “CIR” or “Peaks” and the scanner instance, for example:

```
2012-06-21_10-09-24_mh_galaxy_3UMTS_
UMTS_Scanner_CPICH_View_1_
CIR_0.xml
```

The xml content for CIR looks like:

```
<ListContent Timestamp="3708 ms" SelectedFrequency="2112.800 MHz">
        <Longitude Value="11.744320"/>
        <Latitude Value="48.104593"/>
            <Line Value="1">
                <Color Value=" "/>
                <SC Value="475"/>
                <Ec_Io__dB_ Value="-6.6"/>
                <SIR__dB_ Value="18.6"/>
                <RSCP__dBm_ Value="-73.8"/>
                <ISCP__dBm_ Value="-68.3"/>
                <P_total__dBm_ Value="-67.2"/>
                <Drift__ns_s_ Value="  0"/>
                <Dev__Drift__ns_s_ Value="101"/>
                <Del__Spread__Chip_ Value="0.0"/>
            </Line>
```

The xml content for CIR peaks looks like:

```
<ListContent Timestamp="3708 ms" SelectedFrequency="2112.800 MHz">
            <Longitude Value="11.744320"/>
            <Latitude Value="48.104593"/>
                <Line Value="1">
                    <Color Value=" "/>
                    <SC Value="475"/>
                    <Ec_CPICH___dBm_ Value="-73.9"/>
                    <Ec_P_SCH___dBm_ Value="-76.0"/>
                    <Ec_S_SCH___dBm_ Value="-76.1"/>
                    <Ec_Io_CPICH___dB_ Value="-6.7"/>
                    <Ec_Io_P_SCH___dB_ Value="-12.3"/>
                    <Ec_Io_S_SCH___dB_ Value="-12.4"/>
                    <P_total_SCH___dBm_ Value="-63.7"/>
                    <Delta_T__us_ Value="4484.6"/>
                    <Doppler_Frequency__Hz_ Value="---"/>
                </Line>
    </ListContent>
```

Note: Position data for every <ListContent> entry is available in CIR and CIR peak export files.

Doppler Frequency
The "Doppler Frequency" panel provides an input field to correct the "Doppler Frequency" displayed in the "Peak List". The purpose of the correction is to subtract out constant frequency offsets that cannot originate from the speed of the test vehicle relative to the signal source.

Possible sources of constant frequency offsets are de-tuned NodeB transmitters and test device receivers.

Tip: A measurement at fixed position eliminates the Doppler effect and thus allows the frequency offset of the test device receiver and the different NodeBs to assess. A de-tuned receiver causes the same frequency offset on signals from different NodeBs. Therefore, if several NodeB signals are measured with the same Doppler frequency in a fixed-position measurement, the Doppler frequency measured is due to the receiver. If this common frequency offset is entered as an "Offset Correction", the CPICH View table indicates the frequency offset of the individual NodeBs.

4.8.11.4 UMTS scanner P-SCH view

The "UMTS Scanner P-SCH View" displays the signal power of the Primary Synchronization Channel of all recorded DL UMTS signals. Additional information is displayed in a table below the diagram.

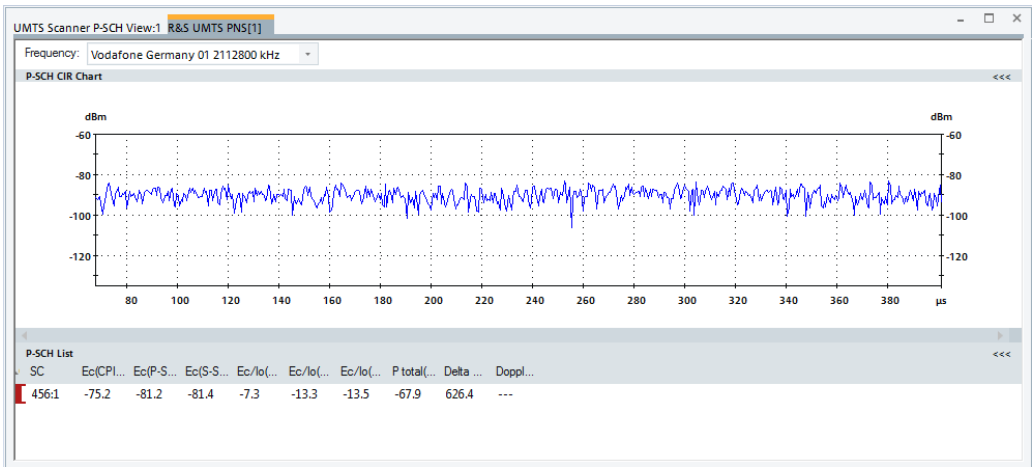


Figure 4-1057: UMTS Scanner P-SCH View

Frequency

Below the view title, the "Frequency" pull-down list contains all measured frequencies selected in the "Receiver" tab of the scanner configuration menu. The list is also provided in the "UMTS Scanner CPICH View, UMTS Scanner Pilot View", "UMTS Scanner SC Tracer View".

Changing the frequency in one of these views, automatically adapts the frequencies in all other views. The change provides that all views have the same current number in their title bar. Using this feature, it is possible to generate different groups of views with the same current number and select frequencies for an entire group with a single mouse click.

View area

The entire view area is horizontally split to accommodate a chart and a table/list. The "P-SCH CIR Chart" shows the power of the received P-SCs in all recorded DL UMTS signals over the time. This power is measured when the system correlates to the P-SCs (1st synchronization step; see "UMTS scanner CPICH view" and therefore always available. The "P-SCH List" below shows only the signals to which the system could synchronize to determine the SC. Typically the tallest peaks of the diagram correspond to the values of "Ec (P-SCH)" displayed in the table.

A click on the "P-SCH CIR Chart" or "P-SCH Lists" title bars compresses and expands the 2D-chart or table. A compressed chart leaves more space for the table and vice versa. Moreover, the tables appear in several UMTS Scanner views so that compressing them can help to avoid redundancies. A compressed sub diagram is characterized by the symbol >>>(instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Diagram scale

The diagram is opened with a default x-axis scale of one UMTS slot (2/3 ms, i.e. 666 µs). If placed inside the diagram area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside). A vertical line is displayed at the cursor position.

A left mouse click magnifies the diagram in x-direction around the cursor position, "Ctrl" plus left mouse click causes the opposite. An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed. "Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

The scale of the y-axis (power in dBm) can be set in the configuration menu.

Table

Below the diagram, the "P-SCH List" gives an overview of the received signals together with their scrambling codes, different power parameters, frequency and timing information. On mouse hover-over, each cell in the table header provides a short explanation of the corresponding column. The "P-SCH List" is identical with the "Peak List" in the "UMTS Scanner CPICH View". For a detailed explanation of the parameters, refer to Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

In the configuration menu, it is possible to show or hide each individual table row.

Context menu

A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,
- put the view on hold,
- copy the current view to the clipboard,
- create or delete views,
- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Reset Zoom"
  Resets the x-axis scale to 0 ms to 2/3 ms.
- "Destroy View"
  Deletes the active view with its contents.

UMTS scanner P-SCH view configuration

The tab sets the y-axis scale of the view and selects the information to be displayed in the table.

This configuration tab is analogous to the menu of the "CPICH View" tab of the "PNS CPICH" view.

Refer to PNS CPICH configuration menu. See chapter UMTS scanner CPICH view

The "UMTS Scanner P-SCH View" option lets you customize the diagram in the view and the contents of the table.

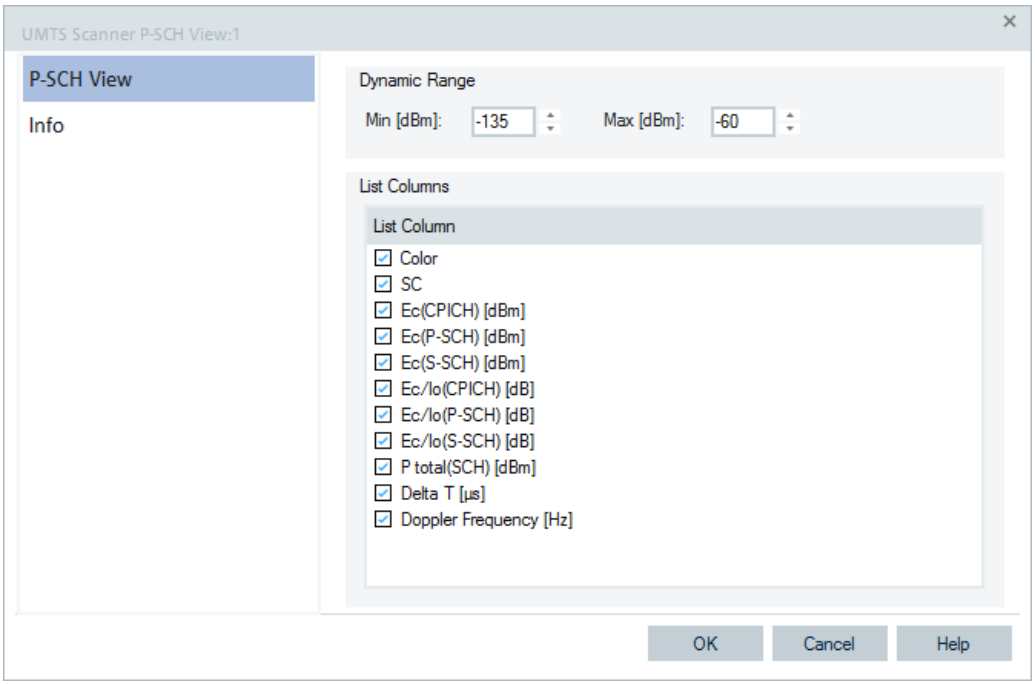


Figure 4-1058: P-SCH View - configuration

4.8.11.5 UMTS scanner pilot view

The "UMTS Scanner Pilot View" displays the the current Received Signal Code Power (RSCP) of the Common Pilot Channels (CPICHs) as a bar.

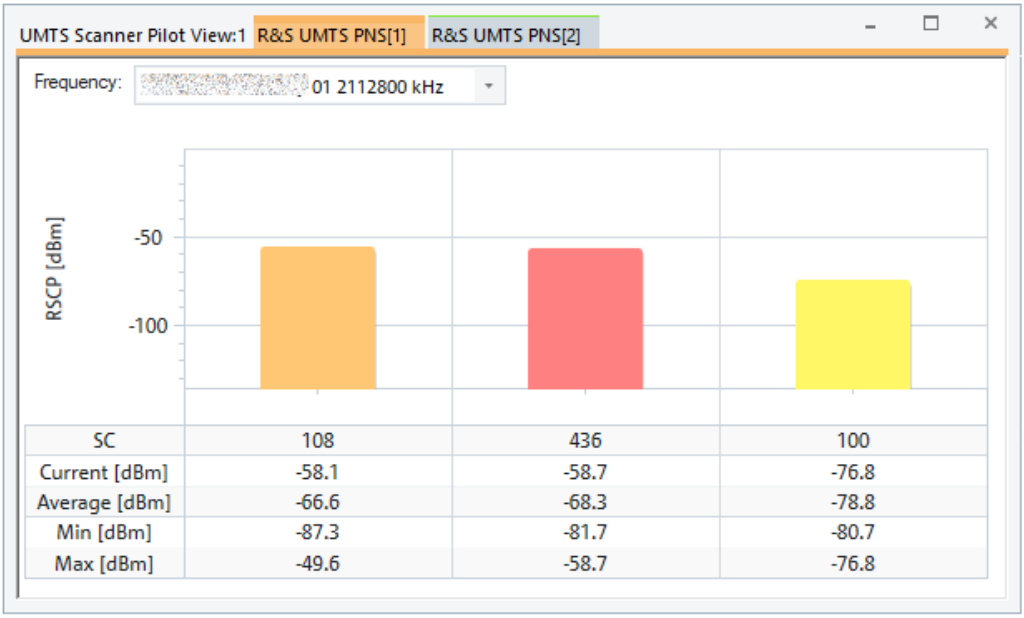


Figure 4-1059: UMTS Scanner Pilot View

View area

Below the view title, the "Frequency" pull-down list contains all measured frequencies selected in the "Receiver" tab of the scanner configuration menu. The list is also provided in the "UMTS Scanner P-SCH View", "UMTS Scanner CPICH View" and "UMTS Scanner SC Tracer View".

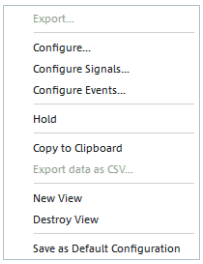
Changing the frequency in one of these views automatically adapts the frequencies in all other views. The change provides that all views have the same current number in their title bar. Using this feature, it is possible to generate different groups of views with the same current number and select frequencies for an entire group with a single mouse click.

The chart shows the CPICH Received Signal Code Power. It is the received signal power measured on the pilot bits of a Primary CPICH which is identified by its primary scrambling code.

Each signal generates a vertical bar in the view's chart. The bar visualizes the current RSCP value of the pilot. The bar color is the SC color and is also used in the "UMTS Scanner Top N View". The chart has only one mode. Remaining values of RSCP ("Min", "Max", "Average" and "SC") are displayed in the table below the chart. All four values are constantly updated while the measurement or replay is running.

The scale of the y-axis (RSCP in dBm) can be set in the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- **Export**
  Opens a "Save As" dialog to export the current RSCP values to a text file. This function is unavailable during measurement or a file replay. It can be activated after "Stop", "Stop Recording" or "Pause Replay". The export function is not affected by a change of the chart type.

Export file format

The export file is an ASCII table in CSV format that can be opened and processed by Excel. The table headings form the first line of the file. Each of the following lines corresponds to a single signal with definite SC. The values in the lines are separated by semicolons.

The file contains current measurement values as indicated in the Min.-Max.-Average-Current chart. The values form the following columns

- "SC"
  Primary scrambling code of the signal in the format selected in the "TEC for UMTS PNS" tab, see Chapter 3.8.2.9, "TEC for UMTS scanner", on page 321. Sequence numbers ":1, :2" behind a code distinguish multiple reflections.
- "RSCP"
  Minimum, maximum and average RSCP in dBm

The last four columns contain the time stamps describing the recording history of each signal.

- "Tfirst"
  Time when the signal is detected for the first time. This can coincide with the beginning of the measurement.
- "Tlast"
  Time when the signal is detected for the last time. The time can coincide with the time when recording or replay is stopped.
- "Tmin/Tmax"
  Recorded time when the minimum/maximum RSCP was measured

SC	RSCPmin[dBm]	RSCPavg[dBm]	RSCPmax[dBm]	Tfirst	Tlast	Tmin	Tmax
233:01:00	-81.3	-71.4	-63.0	214188	312740	214188	312740
190	-85.8	-74.3	-63.4	214188	312740	214188	312740
318:01:00	-82.6	-74.5	-64.0	224433	312740	224433	312740
214	-82.6	-71.8	-61.8	11437	284900	284900	174652
233	-88.6	-70.4	-61.1	11437	274645	274645	140913
73	-93.2	-69.2	-58.5	11437	274645	269859	102748

To ensure that the export file contains all signals ever recorded in the measurement, deactivate the "History" parameter in the configuration menu.

UMTS scanner pilot view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "Pilot View Configuration" option lets you define the y-axis scale. You can define the minimum and the maximum level of the RSCP to be displayed in the view and select the diagram type ("Graph").

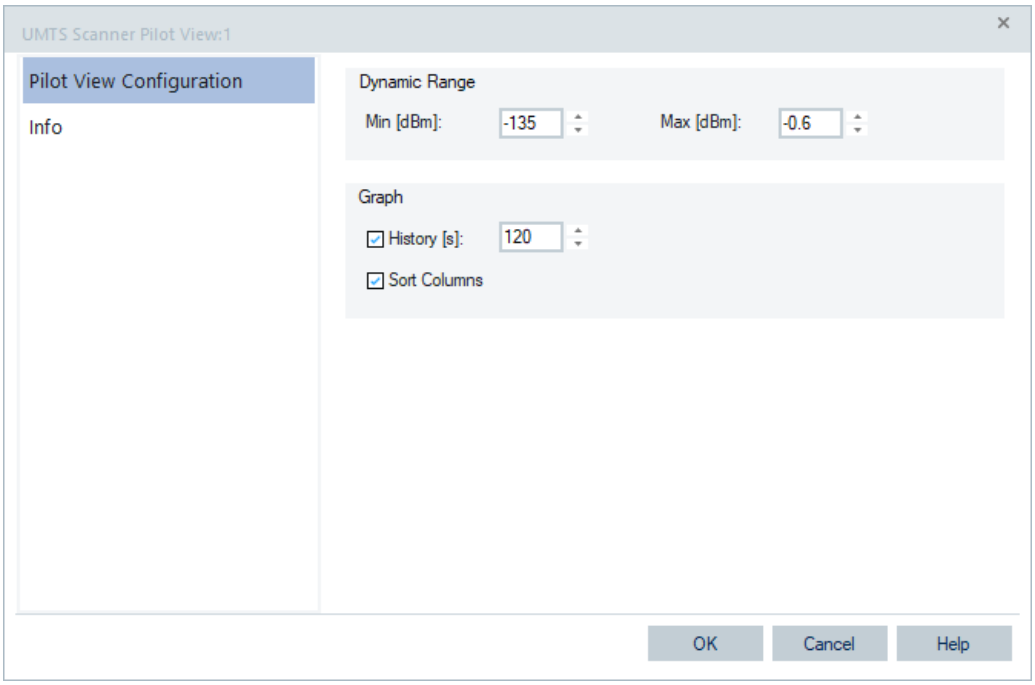


Figure 4-1060: UMTS Scanner Pilot View - configuration

Dynamic Range
The two input fields in the "Dynamic Range" pane define the minimum ("Min [dBm]") and the maximum ("Max [dBm]") level for display in the "UMTS Scanner Pilot View".

Graph
"Graph" is used to select the diagram type.

- "History [s] "
  If no further information from the frequency signal is received, the "History" value defines how long the old available values are shown until the view is cleared. Clearing this parameter corresponds to an infinite history time. This approach ensures that all signals ever recorded in the current measurement are displayed in the view and can be exported to an ASCII table.
- "Sort Columns"
  Sorts the bars/columns according to their RSCP. The strongest signal is displayed on the left side, the weakest on the right side. If the box is cleared, the signals and SC numbers keep their position irrespective of the evolution of their signal power.

4.8.11.6 UMTS scanner SC tracer view

The "UMTS Scanner SC Tracer View" shows the evolution in time of the time delay and CPICH signal power of all received UMTS peaks with a particular primary scrambling code (SC) or a particular rank in a top N pool.

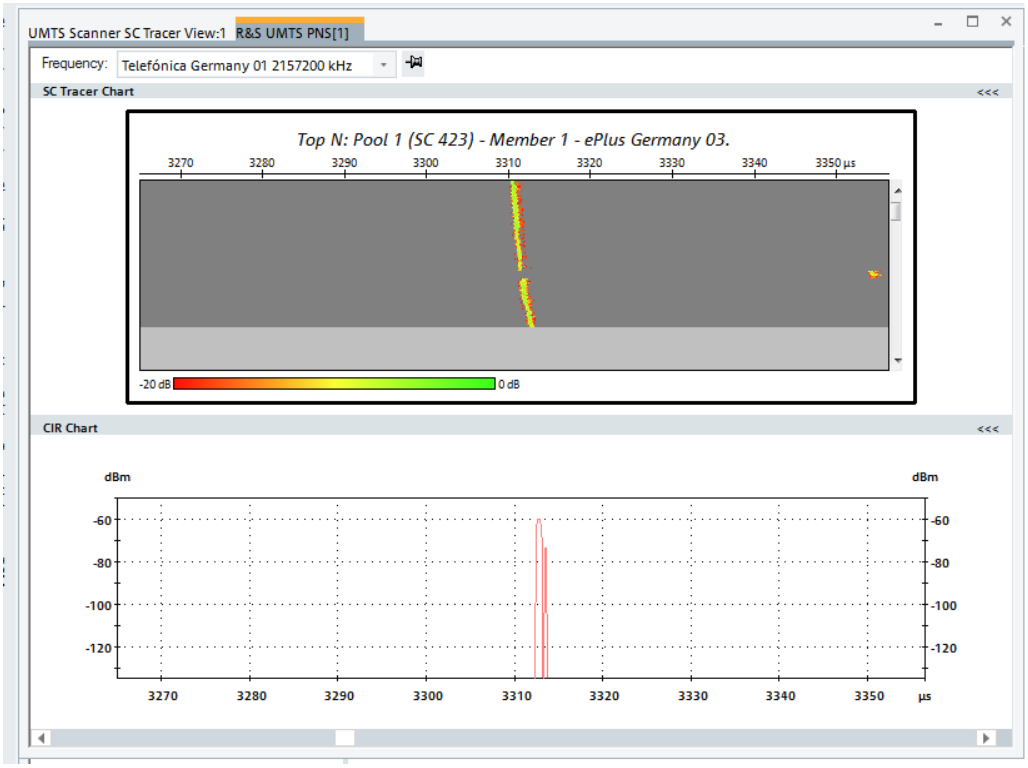


Figure 4-1061: UMTS Scanner SC Tracer View

Frequency

Below the view title, the "Frequency" pull-down list contains all measured frequencies selected in the "Receiver" tab of the scanner configuration menu. The list is also provided in the "UMTS Scanner P-SCH View", "UMTS Scanner Pilot View", "UMTS Scanner CPICH View".

Changing the frequency in one of these views automatically adapts the frequencies in all other views. The change provides that all views have the same current number in their title bar. Using this feature, it is possible to generate different groups of views with the same current number and select frequencies for an entire group with a single mouse click.

Fix current scrambling code

The pin icon to the right of the "Frequency" list forces the system to trace the current scrambling code, even if "Trace Top N Element" is selected in the configuration menu. In fixed SC mode the icon is crossed out with red color and "Fixed Top N" is indicated in the title of the "SC Trace Chart".

Clicking the crossed-out icon again releases the fixed SC: The system continues tracing the selected top N element. If "Trace a Fixed SC" is selected in the configuration menu, the pin icon has no effect.

View area

The entire view area is horizontally split to accommodate two different charts.

A click on the "SC Tracer Chart" or "CIR Chart" title bars compresses and expands the corresponding chart. A compressed chart leaves more space for the other chart. A compressed chart is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

SC tracer chart

The colored rectangular diagram shows the evolution in time of the power "E_c (CPICH) [dBm]" and the time delay "Delta T[µs]" using the color scheme defined in the configuration menu. "E_c (CPICH) [dBm]" and "Delta T[µs]" are listed in the "Peak List" in the Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383. The rectangular diagram area represents the time/delay time plane.

In this plane, the signals with the same SC form one or several traces that change their slot timing (horizontal position) and strength (color). All signals can be assumed to originate from the same NodeB, see the explanation at the beginning of Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383. Multiple traces indicate multiple signals with different timing but the same SC and thus reflections. The example of the Figure 4-1061 shows a single (direct) signal. The time delay of the signal decreases/ increases while the test vehicle approaches/goes away from the transmitting NodeB. The signal strength can be expected to reach its maximum where the distance to the NodeB is close to its minimum. The slope of the trace corresponds to the "Drift" which is also displayed in the Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

In this plane, the signals with the same SC form one or several traces that change their slot timing (horizontal position) and strength (color). All signals can be assumed to originate from the same NodeB, see explanation at the beginning of Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383. Multiple traces indicate multiple signals with different timing but the same SC and thus reflections.

- "X-axis (del. time)"
  Symmetric range centered on the first relative slot timing measured. The delay time span is fixed and equals to 90 µs (13.5% of a slot).

- "Y-axis (time)"
  Linear time scale of the measurement. The diagram consists of 100 to 800 lines, arranged from top to bottom. Each line shows the result of a single scan or sweep with a frequency range of 5 MHz. The diagram is continuously updated during the measurement or replay by adding new lines. It is scrolled and a scrollbar is added along the right border when a line reaches the bottom of the diagram.
- "Display line"
  On moving across the "SC Tracer Chart" area, the cursor displays a black, horizontal line. A left mouse click on the chart updates the "CIR Chart" which now displays the peaks at the time corresponding to the position of the display line.

CIR chart

The "CIR Chart" shows the average signal power of the P-CPICHs of all received peaks over the time. The displayed powers and times correspond to the "E_c (CPICH) [dBm]" and "Delta T[µs]" values listed in the "Peak List" in the Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

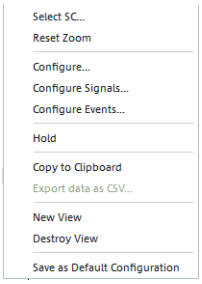
The diagram opens with a default x-axis scale of 90 µs (13.5% of a slot). If placed inside the diagram area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside). A vertical line is displayed at the cursor position.

A left mouse click magnifies the diagram in x-direction around the cursor position, the CTRL key plus left mouse click causes the opposite. An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed. "Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

The scale of the y-axis (power in dBm) can be set in the configuration menu.

By default the diagram shows current results, corresponding to the last line in the "SC Tracer Chart." To select a previous result for viewing, the display line in the "SC Tracer Chart" can be used.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Select SC"
  Opens a dialog box to select the primary scrambling code associated with the signal to be viewed.

The scrambling code is defined in the format selected in the "TEC for UMTS PNS" page, refer to chapter Chapter 3.8.2.9, "TEC for UMTS scanner", on page 321.
The "Select SC" command is unavailable if a particular Top N element is traced.

- "Reset Zoom"
  Resets the x-axis scale.

UMTS scanner SC tracer view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: SC tracer target selection

The "SC Tracer Target Selection" option lets you select the signal to be traced in "UMTS Scanner SC Tracer View".

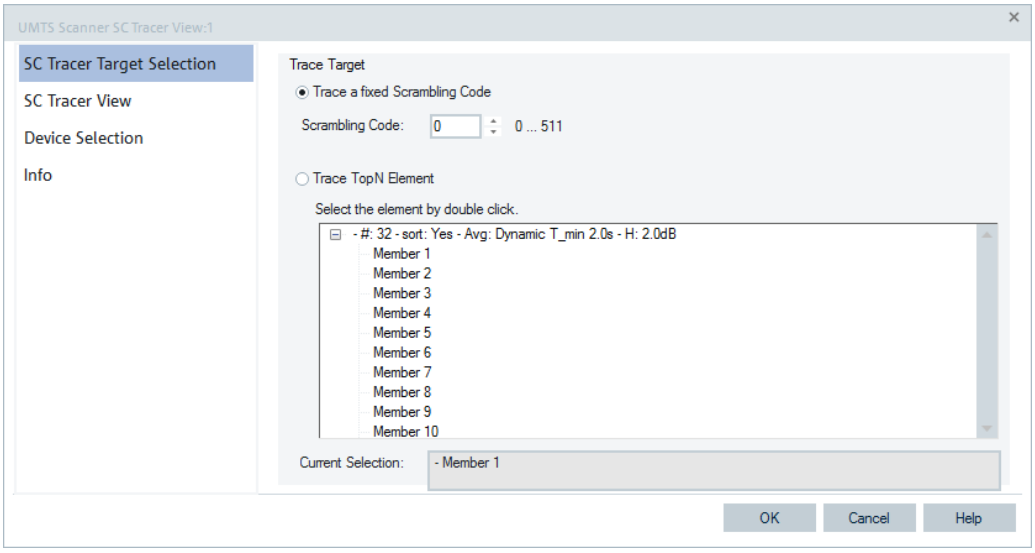


Figure 4-1062: UMTS Scanner SC Tracer View - configuration

Trace Target
The "Trace Target" option lets you select either a signal with a definite scrambling code or a particular Top N element to be traced.

- "Trace a fixed SC"

The scrambling code is defined in the format selected in the "TEC for UMTS PNS" tab, see Chapter 3.8.2.9, "TEC for UMTS scanner", on page 321. In decimal representation, the primary scrambling codes are multiples of 16: SC[dec] = 16*i where i=0 to 511, so the least significant digit of the hex numbers must be 0, preceded by a hex value between 0 and 1FF.
If a scrambling code that is not assigned to any measured signal is selected, the "UMTS Scanner SC Tracer View" remains empty.

- "Trace TopN Element"
  List of all Top N pools defined in the scanner configuration menu. The current Top N pool selection is indicated in the list of Top N pools.

Configuration: SC tracer view

The "SC Tracer View" option lets you scale the diagrams and define the colors in the view.

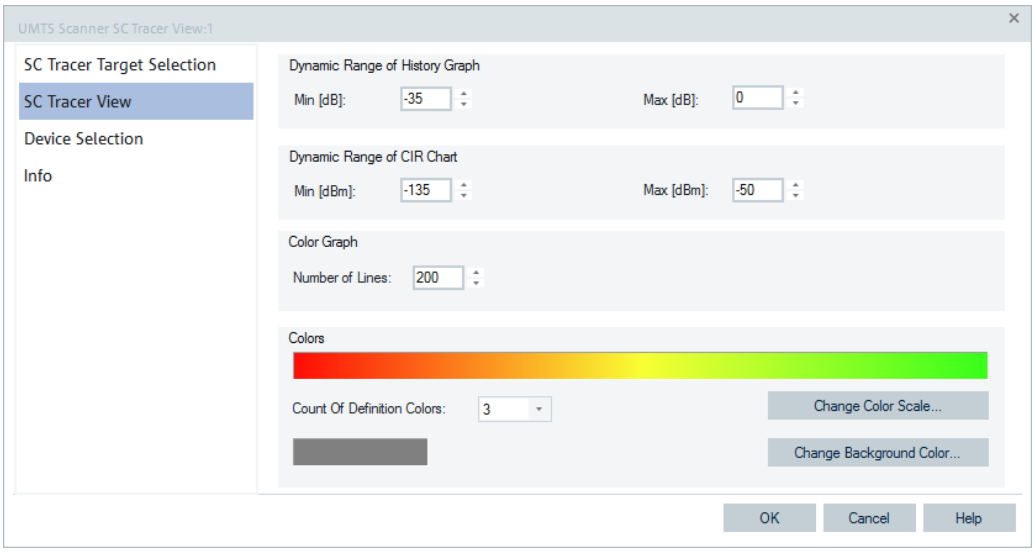


Figure 4-1063: UMTS Scanner SC Tracer View - view configuration

Dynamic Range of CIR Chart
The fields in the panel define the minimum ("Min [dBm]") and the maximum ("Max [dBm]") signal level displayed in the diagrams of the "UMTS Scanner SC Tracer View". The signals exceeding the dynamic range are not displayed.

Color Graph
The entry defines the number of lines to be displayed in the view. A line corresponds to the single frequency sweep.

Colors
The panel defines a color scale of the lines in this view and of the background. The scale is derived from 2 to 16 "definition colors". The definition colors are entered at equidistant positions on the color scale, the first and last color defining the beginning and the end of the scale. Between the definition colors, the hue changes continuously.

- "Count of Definition Colors"

Pull down list to select the number of definition colors in the range 2 to 16.

- "Change Color Scale"
  Opens the Colors dialog to select or define the definition colors.

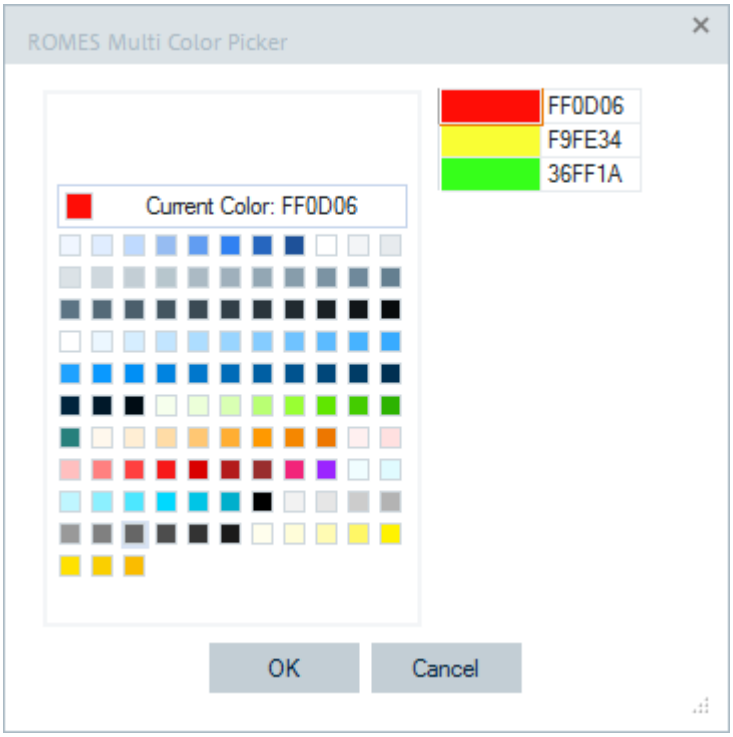


Figure 4-1064: ROMES color scale

The current definition colors are displayed in the Custom Colors section. The [F1] function key provides help about the remaining control elements in the dialog.

- "Change Background Color"
  Opens the Colors dialog to select or define a background color for the diagram, as shown in the previous figure.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

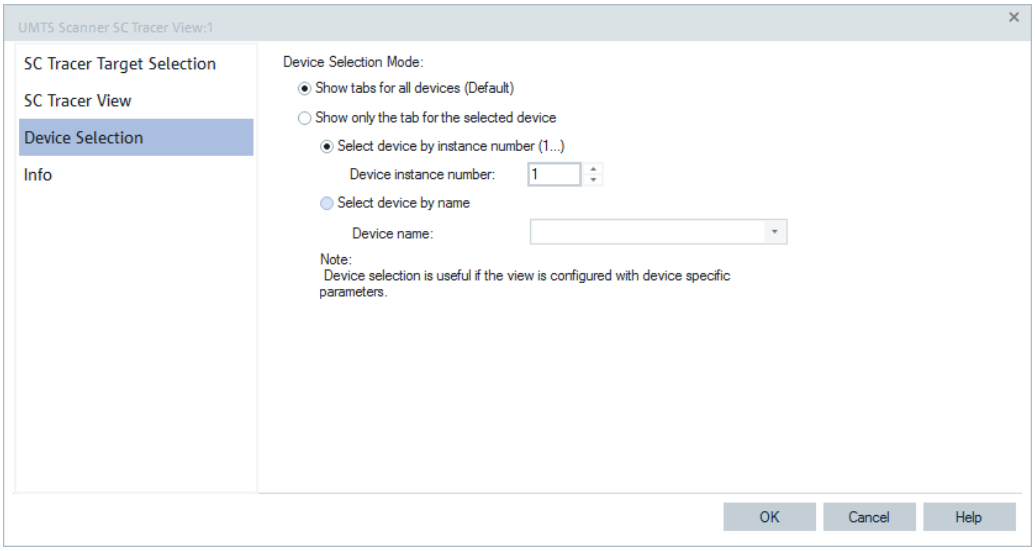


Figure 4-1065: UMTS Scanner SC Tracer View - device selection

The result of the device selection looks like shown in the following figure. "UMTS Scanner SC Tracer View" shows only the tab of the 1st scanner. If you need more than one device-specific view of a certain type, open and configure more instances of the view in "Context menu" > "New View".

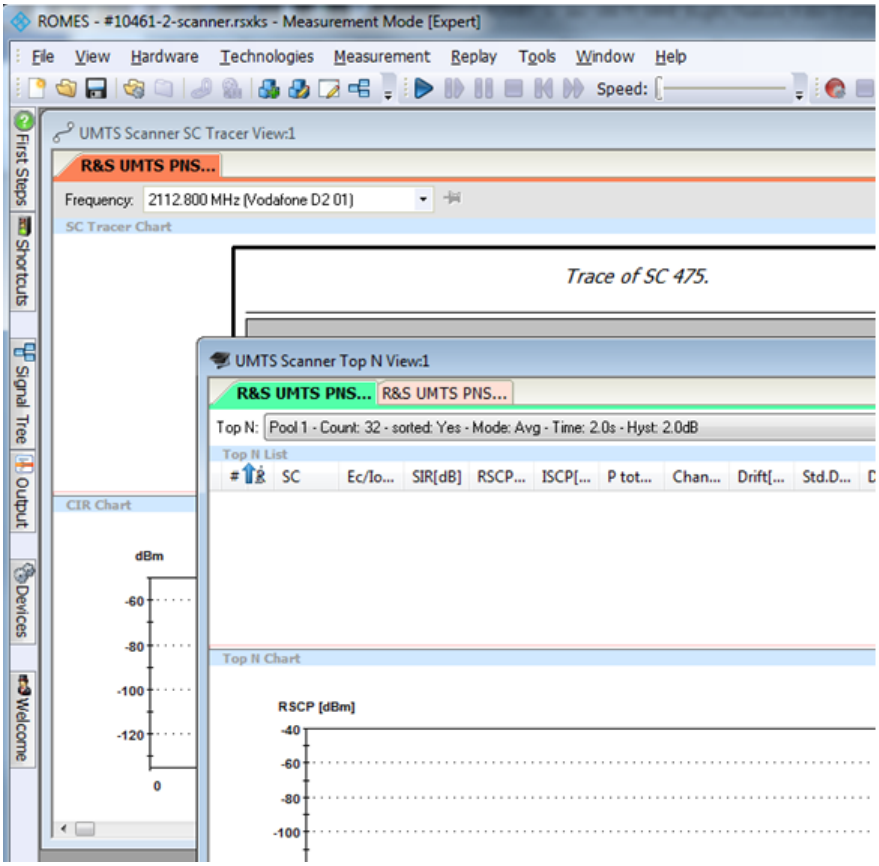


Figure 4-1066: Results of the device selection

4.8.11.7 UMTS scanner Top N view

The "UMTS Scanner Top N View" displays the properties of the signals received from the NodeBs. These signals are the selected elements of the "Top N Columts" list in the scanner's configuration menu, see Figure 4-1071. A Top N pool contains up to N NodeBs with specific characteristics providing the strongest P-CPICH level at a given position and time.

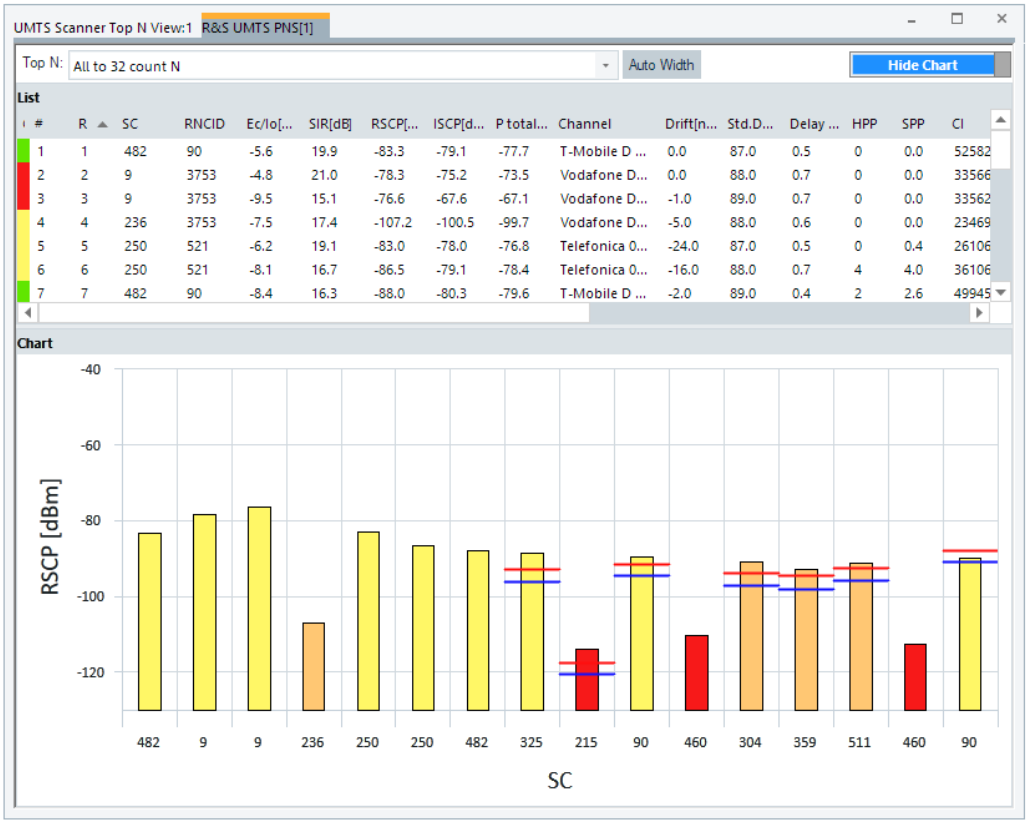


Figure 4-1067: UMTS Scanner Top N View

The Pilot Pollution markers are inserted on the top of the RSCP bars in the 2D top N "Chart" in the previous figure. The HPP marker is shown in red and the SPP marker in blue color.

If the Top N cell number is limited during measurement, the view's chart panel uses the full width for the limited number of members.

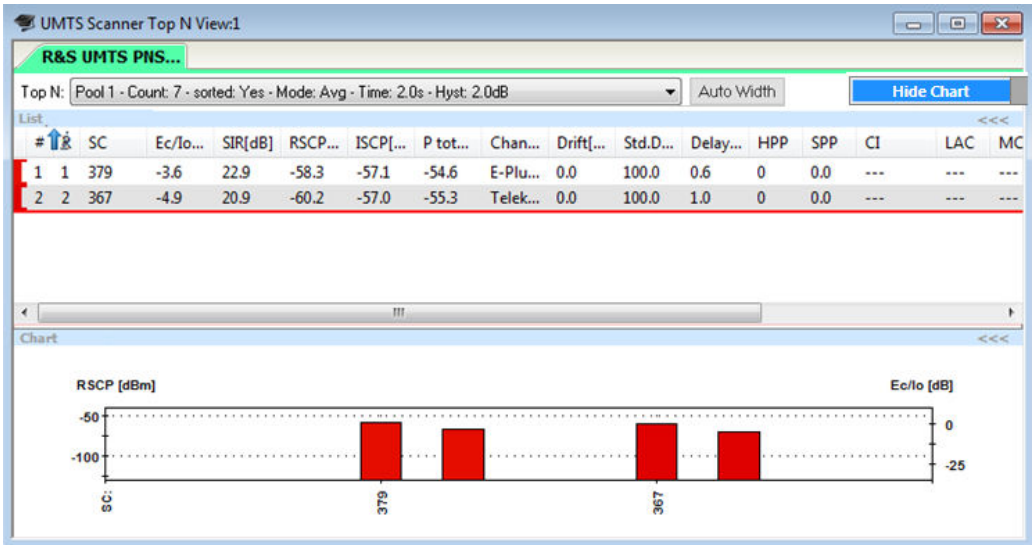


Figure 4-1068: Limited Top N list

UMTS scanner Top N view for automatic pool configuration

The scanner Top N view of the R&S ROMES 3GPP technologies displays the all “automatically configured Top N pools" on the screen.

If you select "Top N Pools" > "Automatic Pool Configuration" for a corresponding technology, the Top N selector control gets the additional entry "Show all TopN Pools" in the view.

By selecting this entry, you can see all Top N pools in the list. The number of displayed members per pool depends on the size of the window. It is calculated automatically in such a way that all Top N pools can be observed without scrolling the list (if even one member does not fit, scrollbars are added).

The signals and their decision values which users can select for ranking of the Top N pools are available in the "Available Signals" tree.

The "Chart" panel is shown in 3D in case the automatic Top N pool configuration active. The values of the selected signal used for ranking and display are shown as 3D bars.

The Top N chart can be rotated moving the mouse while pressing the left button (x-axis, y-axis and z-axis when pressing the CTRL key additionally). Press the R key to reset the 3D chart to its default orientation.

The configuration of the Top N view allows to configure the colors for the 3D chart and the minimum and maximum for the Top N values.

The color of each bar represents the state of the signal based on the signals color scale defined in the "Available Signals" configuration page. Typically this is green for high values and red for low values.

You have the option to display the Top N pools as the grid with 2D charts instead of the standard 3D bar chart.

To enable the grid with 2D bar charts, click on the "Show Grid" slider at the right top if the 3D "Chart".

You may return to the 3D chart at any time by clicking the "Show 3D" slider at the right top if the 2D "Chart".

For the Scanner Top N view the grid arrangement is dynamic to allow the best use of space to display as many pools as possible.

Note: The maximum size of the grid is to be 6 columns and 3 rows.

The following figure shows how many rows and columns to expect in the grid.

Number of Pools	Grid Cols	Grid Rows
1	1	1
2	2	1
3	3	1
4	2	2
5	3	2
6	3	2
7	3	3
8	3	3
9	3	3
10	4	3
11	4	3
12	4	3

Figure 4-1069: Allowed sizes of the grids in 2D chart

For the "Chart" layout in this case, see Figure 4-761.

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

The splitter position between the upper and lower part of the scanner view area and the open or closed state of the "Top N List" and "Top N Chart" are restored from the workspaces.

Most of the information in the table is displayed in the Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383, so that compressing it can help to avoid redundancies.

Top N

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.
- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

If you start R&S ROMES4 with an empty workspace, the initial widths of the columns in "Top N View" are initialized and scaled properly based on the current screen DPI setting.

Top N list

The "List" gives an overview of the received signals in the current Top N pool together with their scrambling codes, different power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column. Most of the results in the list are also displayed in the "Peak List" in the "UMTS Scanner CPICH View". For a detailed explanation of the parameters, refer to Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

The "List" contains the following additional columns:

- "#"
  Current number of a NodeB within the measurement. NodeBs are numbered in ascending order, according to the time when they enter the top N pool. The current numbers tend to increase as the measurement progresses.
- "Rank"
  Current rank of a NodeB within the pool, according to its average or maximum Ec/Io (see scanner configuration menu). The ranks are reassigned every time the pool is updated; they are in the range 1 ≤ Rank ≥N.
- "SC"
  Scrambling code in hex format.
- "RNC"
  Radio Network Controller identity
  The signal is also included in the "Available Signals" tree of the UMTS PNS. The data shown is taken from the highest 16 bit of the cell identity in the SIB 3.

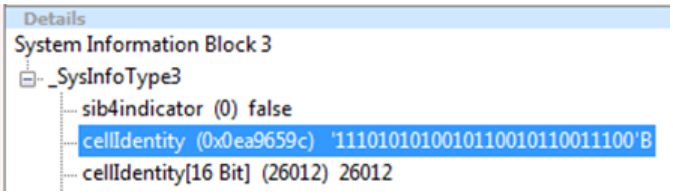


Figure 4-1070: UMTS scanner BCH view - cell identity

- "Ec/Io [dB]"
  Ratio of the received energy per P-CPICH to the total inband energy during one chip.
- "SIR [dB]"
  Signal to interference ratio, calculated as RSCP/ISCP*SF, where SF=256 for P-CPICH.
- "RSCP [dBm]"
  Integral received signal code power for all measured peaks.
- "ISCP [dBm]"
  Interference power orthogonal and non-orthogonal.
- "Ptotal [dBm]"
  Total average inband power within correlation section.
- "Channel"
  Physical channel and channel frequency of the received CPICH.
- "Drift [ns/s]"
  Mean time drift of P-CPICH regarding the internal clock which can be synchronized with the PPS of GPS.
- "Std.Dev.Drift [ns/s]"
  90% confidence interval width of the mean time drift value. A small value indicates that the drift measurement is estimated to be relatively accurate.
- "Delay Spread [Chip]"
  RMS (Root Mean Square) delay spread in chip periods: standard deviation of the time delay Delta T at all CPICH measurement points weighted with the measured power Ec (CPICH).
  A small delay spread indicates that the individual CPICH peaks of the NodeB signal are relatively close or that the power of peaks with different time delay is low.
- "HPP"
  Hard pilot pollution of the NodeB signal as defined in "TEC for UMTS PNS" > "Pilot Pollution", see the Figure 3-214.
- "SPP"
  Soft pilot pollution of the NodeB signal as defined in "TEC for UMTS PNS" > "Pilot Pollution", see Figure 3-214.
- "Cue"
  C-criterion for cell selection/re-selection emulated by the UE, based on EcNo; Srxlev (reported in parenthesis). The ranking is done by quality in this case.
- "NR"
  Neighbor relation to the other members of the Top N pool. This number is percentage of members which are listed in the BA list. It is only available if at least SIB11 and SIB12 was demodulated.

- "Add. PLMNs"
  Additional PLMNs shared on this NodeB, see "Top N pool signal settings" on page 324.
  The shown MCC and MNC signals of the eNodeB in the TopN List view are always related to the primary PLMN. However, for Top N pools, filtering of eNodeB signals takes into account all PLMNs that are in the list and the mentioned signals are shown in the "Add. PLMNs" column.

The following information is available only if the PN scanner data are recorded with "BCH Demodulation" (minimum SIB3 decoding) enabled (see "BCH demodulation UMTS PNS" on page 1804).

- "LAC"
  Location Area Code
- "CI"
  Cell Identity (16 bits)
- "MCC"
  Mobile Country Code
- "MNC"
  Mobile Network Code
- "Node B"
  Name of the closest NodeB with the corresponding SC and UARFCN.
- "ULI [dBm]"
  Interference measured in the channel uplink measured in SIB7.

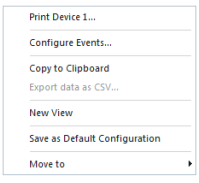
In the view configuration menu, it is possible to show or hide each individual table row.

Diagram

Below the table, the "Chart" shows the Ec/Io ratio and the Received Signal Code Power (RSCP) for all NodeB signals in the current top N measurement (see Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383).

Signals from different NodeBs are distinguished by their primary scrambling codes (SC), displayed along the x-axis. The scales for the two parameters RSCP and Ec/Io are displayed on the left and right edge of the diagram, respectively. Both y-axis scales (RSCP in dBm and in dB) can be set independently in the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

UMTS scanner Top N view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

Configuration: Top N view

The "Top N View" option lets you set the following:

- Select the Top N column list
- Select a type of power signal for display as the 2D and 3D chart value used for ranking the pools. For example, select for display the total average inband power within correlation section of P-CPICH. Also, the integral received signal code power for all measured peaks can be selected as the first 2D and 3D chart value.
- Specify the UMTS graph y-axis titles and limit displayed in the chart. Define the minimum ("Min [dBm]") and the maximum ("Max [dBm]") value to be displayed for the selected power signal in the view.
- Select if the 3D chart uses open GL (Hardware) rendering. Using open GL rendering fastens the 3D chart.
- Select signal quality for the 3D chart option display.

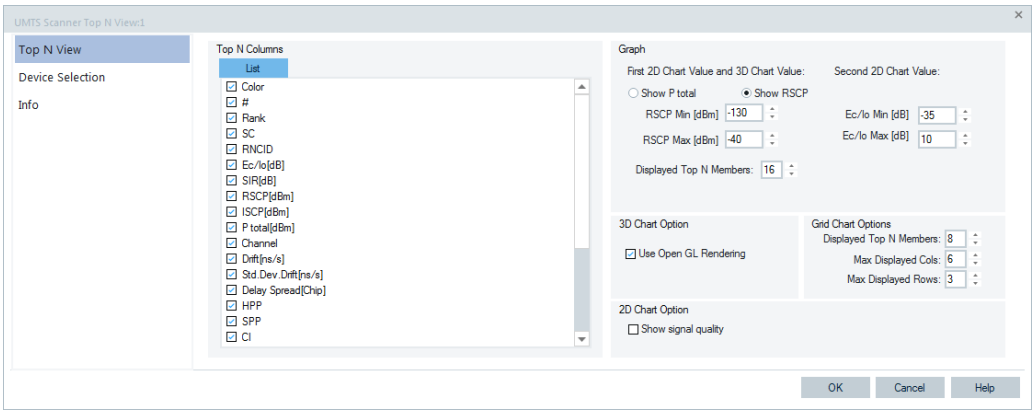


Figure 4-1071: UMTS Scanner Top N View - configuration

All RSCP settings are analogous to the settings in the "UMTS Scanner CPICH View" configuration menu, see Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

The pilot pollution limits are identical with thresholds providing the criteria for HPP and SPP (see "Pilot pollution" on page 334).

UL Interference signals and Top N values are reset, if not updated during a certain time period. For each frequency, this period is calculated as five times the time interval for UL Interference measurement, but at least 3 seconds.

Graph

"First 2D Chart Value and 3D Chart Value"

- "Show P total"

Shows total received power in the 2D/3D chart, if selected.

- "Show RSCP"
  Shows the Reference Signal Code Power in the 2D/3D chart, if selected.
  – "RSCP Min/Max [dBm]"
    Sets the upper and lower RSCP for the left y-axis of the chart.
- "Display Top N Members"
  The check box lets you select the number of Top N member for display.
- "Select 2D Chart Value"
  – "Ec/No Min/Max [dBm]"
    Sets the upper and lower SINR level for the right y-axis of the chart.

3D Chart Option ← Graph

- "Use Open GL Rendering"
  The options determine if the 3D chart is rendered open GL (hardware) rendering or software rendering. Using open GL allows faster rendering of the 3D chart.

Grid Chart Options ← Graph

- "Displayed Top N Members"
  The check box lets you select the number of Top N member that each chart in the grid will display.
- "Max Displayed Cols"
  The check box lets you select the maximum number of displayed columns in the grid. Allowed values are from 1 to 6.
- "Max Displayed Rows"
  The check box lets you select the maximum number of displayed rows in the grid. Allowed values are from 1 to 3.

2D Chart Option ← Graph

- "Show signal quality"
  If the option is selected, shows the signal quality in the Top N chart. This is the possibility to switch "on" or "off" the second y-axis on the chart and quality signal bars.

For both 2D/3D chart options, if selected, the result of the switching is visible in the next frame, as the chart must redraw at least once for it.

Configuration: Device selection

The function offers the following options for a device selection mode:

- Select that all tabs of all devices are displayed.
- Select that a single tab used by predefined device is displayed only.

In both cases you can make the selection by device instance number or its name.

NOTE: The "Device Selection" tab is not available during measurements or replay. It is available if nothing is measured or the replay is paused.

4.8.12 WiMAX scanner views

The WiMAX scanner views show the information obtained in the WiMAX network scan performed by an R&S radio network analyzer.

For this purpose, the R&S TSME scanner with its hardware R&S TSME-K28 option is needed.

The WiMAX network scan available option for R&S TSME is R&S ROMES4T1E.

How to install and configure the WiMAX network scanner, see Chapter 6.4.25, "WiMAX scanner", on page 1856.

The "WiMAX Views" can be selected from a submenu displayed on the right side of the "View" menu when the mouse hovers over "WiMAX Views".

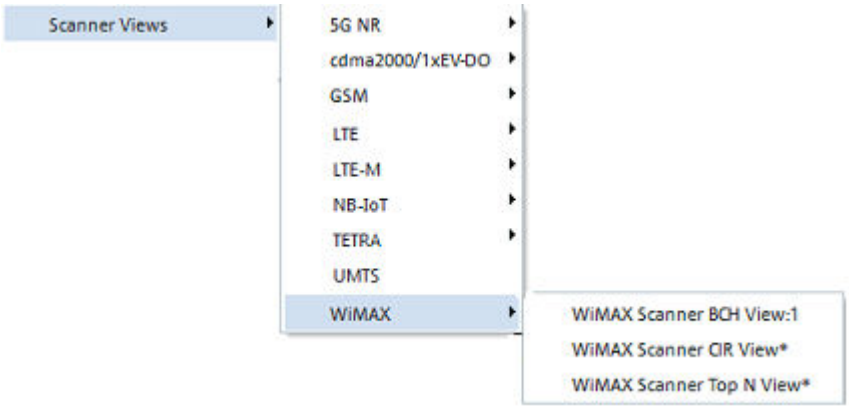


Figure 4-1072: WiMAX Scanner Views

4.8.12.1 WiMAX scanner BCH view

The WiMAX scanner measures WiMAX signals and in addition demodulates and decodes the content of received channels of the WiMAX signal. This data is depicted as a summary of all found WiMAX transmitters by the "WiMAX Scanner BCH View".

The contents of the messages appear in a tree view when a message is selected.

The information is available only if the WiMAX scanner data is recorded with "BCH Demodulation" enabled, refer to Chapter 6.4.25.2, "WiMAX scanner configuration", on page 1857.

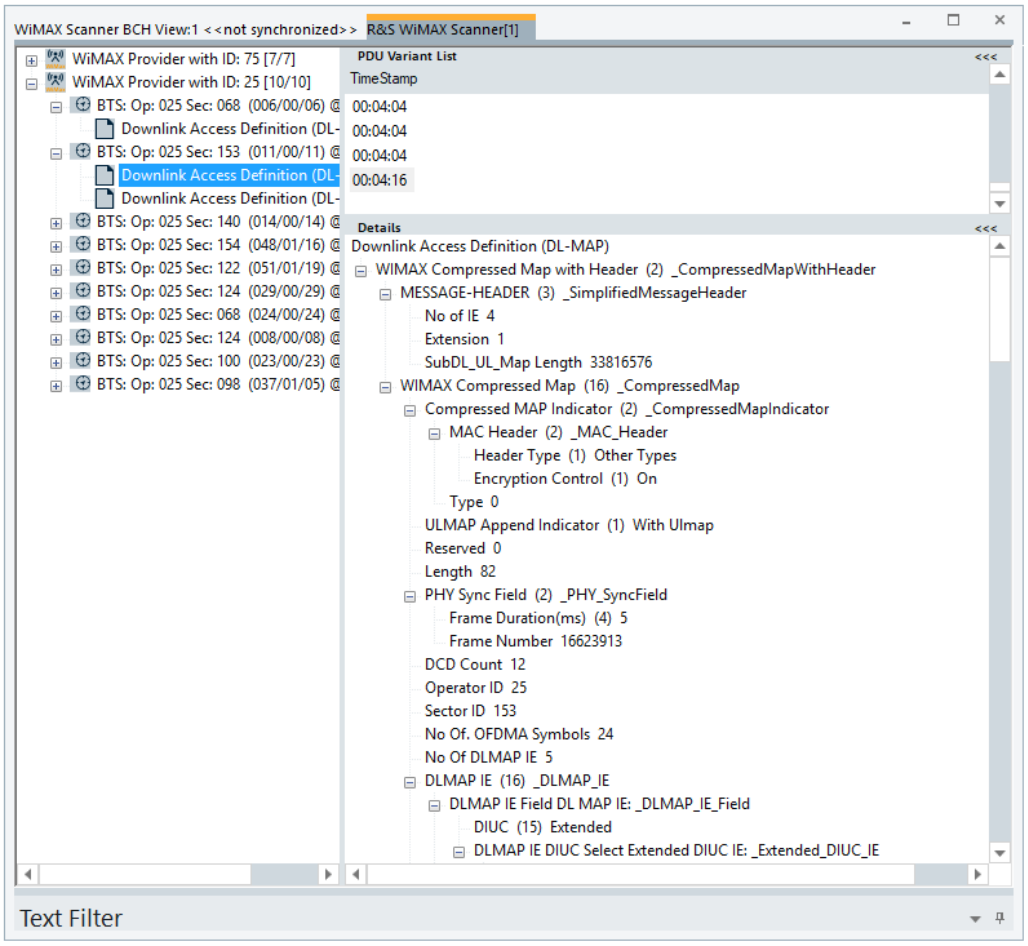


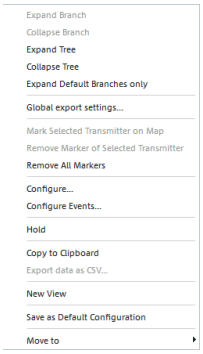
Figure 4-1073: PDU list of variants and time stamps

Referring to R&S ROMES4 support of dynamic PDU handling described in "Implementation of the dynamic PDU handling" on page 284, the "WiMAX Scanner BCH View" is enhanced. The enhancement is the list of measured PDU variants over time. The PDU variants are shown as leaves of the base station tree.

If a signal is selected on the left-hand side of the "WiMAX Scanner BCH View", the list of PDU variants and the list of associated time stamps are shown on the view's right-hand side. The "TimeStamp" shows the most recent measurement of the variants.

In the previous figure the "PDU Variant List" shows the several time stamps in the upper right of the view as there were found different PDU variants.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Expand/Collapse Branch"
  Expands or collapse the branch in the left part of the window.
- "Expand/Collapse Tree"
  Expands or collapse the additional information in the tree view.
- "Expand Default Branch only"
  Expands only the default branch. All others are collapse.
- "Global Export Settings"
  Opens the "Basestation List Export" dialog which offers to generate the base station list, see "Basestation list export" on page 1218.
- "Mark Selected Transmitter on Map"
  Base stations which are found in the data base can be marked in the ROMESMAP view via the context menu.
- "Remove Marker of Selected Transmitter"
  Base stations which are marked in the ROMESMAP view can be removed.
- "Remove All Markers"
  All base stations which are marked in the ROMESMAP view can be removed.

WiMAX BCH view configuration

The "Configuration" page is common for the scanner BCH view of all RATs.

The "Configuration" option lets you set the color for the selected BTS symbols in the "ROMESMAP Route Track View" and define the filter for generating a BTS list.

Open the configuration page by a right mouse click on a point inside the view or via the "Tools" > "Configuration Active View" command.

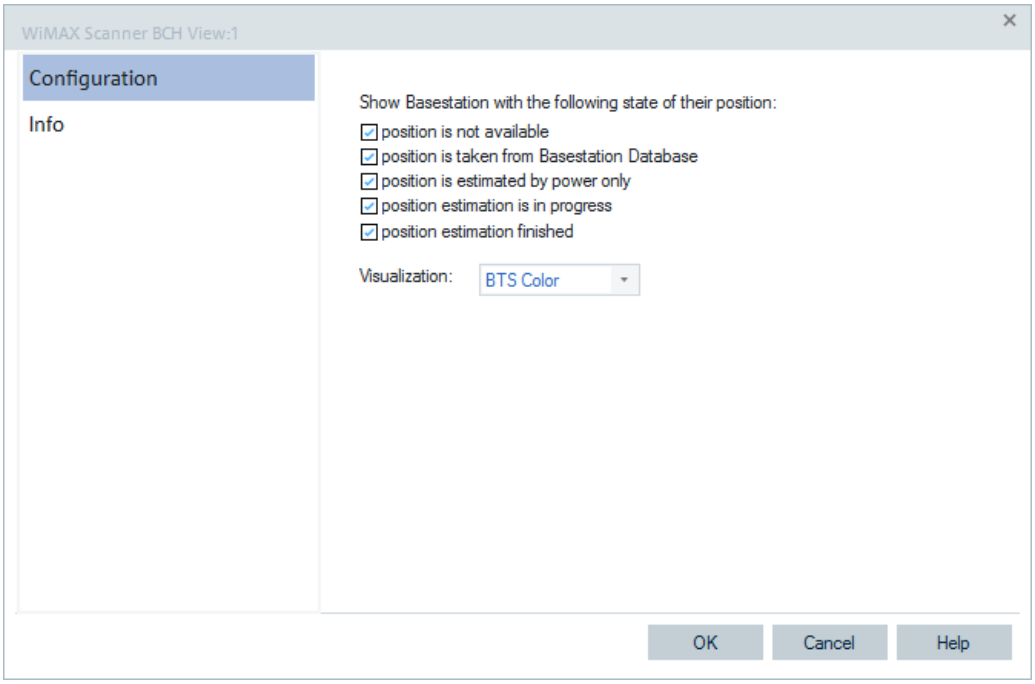


Figure 4-1074: WiMAX Scanner BCH View – configuration

4.8.12.2 WiMAX scanner CIR view

"WiMAX Scanner CIR View" displays the channel impulse response (CIR) of the WiMAX signals.

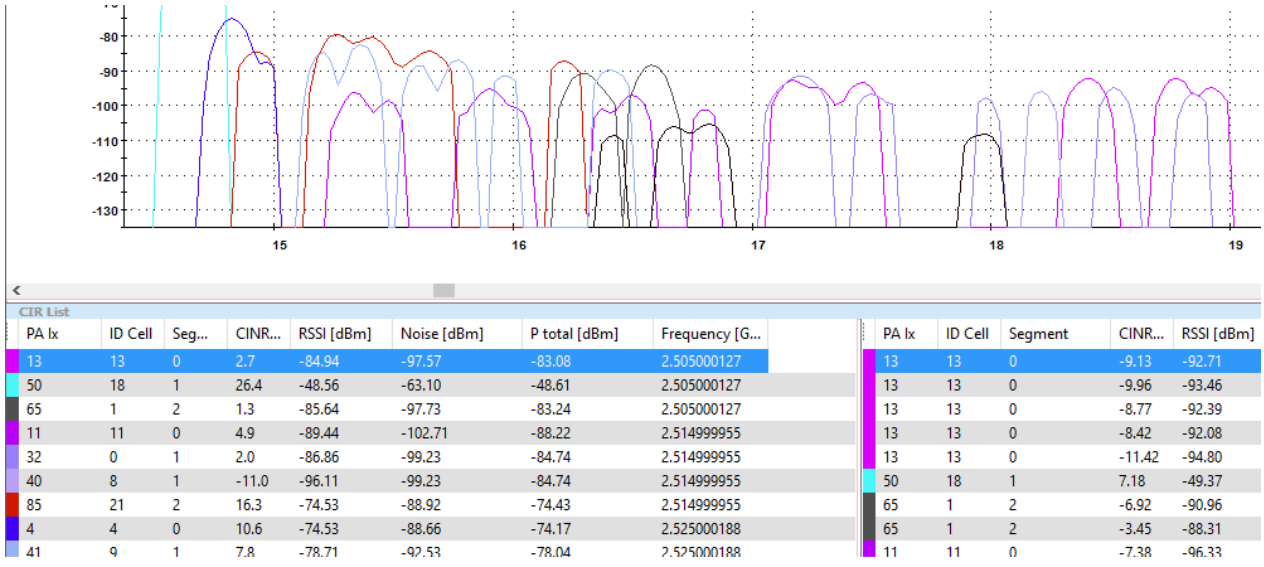


Figure 4-1075: WiMAX Scanner CIR View

View area

The entire view area is horizontally split to accommodate a chart and a table/list. The "CIR Chart" shows the CIR of the different WiMAX signals which are scanned. The graph allows zooming the chart. The small button on the right of the scroll bar reset the zoom level.

Click the "CIR Chart" or "CIR Lists" title bars to compress or expand the 2D-chart or table. A compressed chart leaves more space for the table and vice versa. Moreover, the tables appear in several views so that compressing them can help to avoid redundancies. A compressed sub diagram is characterized by the symbol >>> (instead of <<<) in its title bar. On pausing on one of the title bars, the cursor displays a compress symbol.

Diagram scale

If placed inside the diagram area, the cursor takes the shape of a zoom-in icon (a magnifying glass with a '+' inside). A vertical line is displayed at the cursor position.

A left mouse click magnifies the diagram in x-direction around the cursor position, CTRL+ left mouse click causes the opposite. An area to become the new x-axis range (e.g. the area around a peak) can be marked while the left mouse button is pressed. "Reset Zoom" in the context menu restores the default scale. A scrollbar is provided to move the magnified diagram to the right or left.

The scale of the y-axis (power in dBm) can be set in the configuration menu.

Left table

The left table lists all scanned WiMAX segments.

- "Color"
  The color configured to represent the preamble index of a segment. It is configured in views configuration page.
- "Preamble Index"
  Downlink preamble index.
- "ID Cell"
  Cell identity, if applicable. If not, written is "---" in the corresponding column.
- "Segment"
  A cell site can be divided up into three different segments. Thus, the segment is identified with ID, which can be 0, 1, or 2.
- "CINR"
  Signal to interference and noise ratio of the preamble of the WiMAX cell.
- "RSSI"
  Power of the preamble of a certain WiMAX cell characterized by ID Cell and Segment ID. It excludes noise and interference.
- "Noise"
  Noise floor [dBm].
- "Ptot"
  Total power, including noise and interference, measured at the same time and frequency as the preamble.
- "Frequency"

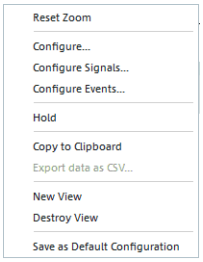
Center frequency of the used channel [GHz], according to IEEE 802.16.

Right table

The right table shows the different path of the segments. For each path, the following parameters are displayed:

- "Color"
  The color configured to represent the preamble index of a segment. It is configured in views configuration page.
- "Preamble Index"
  Downlink preamble index.
- "ID Cell"
  Cell identity, if applicable. If not, written is "---" in the corresponding column.
- "Segment"
  A cell site can be divided up into three different segments. Thus, the segment is identified with ID, which can be 0, 1, or 2.
- "CINR"
  Signal to interference and noise ratio of the preamble of the WiMAX cell.
- "RSSI"
  Power of the preamble of a certain WiMAX cell characterized by ID Cell and Segment ID. It excludes noise and interference.
- "Ptot"
  Total power, including noise and interference, measured at the same time and frequency as the preamble.
- "Delay"
  Signal delay time [µs]. The delay in the list corresponds to the delay seen in the CIR list (left list).

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

The context menu provides the following additional commands:

- "Reset Zoom"
  Resets the x-axis scale to 0 ms to approx. 26.5 ms.

WiMAX scanner CIR view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "CIR View" lets you customize the diagram and the contents of the table in the "WiMAX Scanner CIR View".

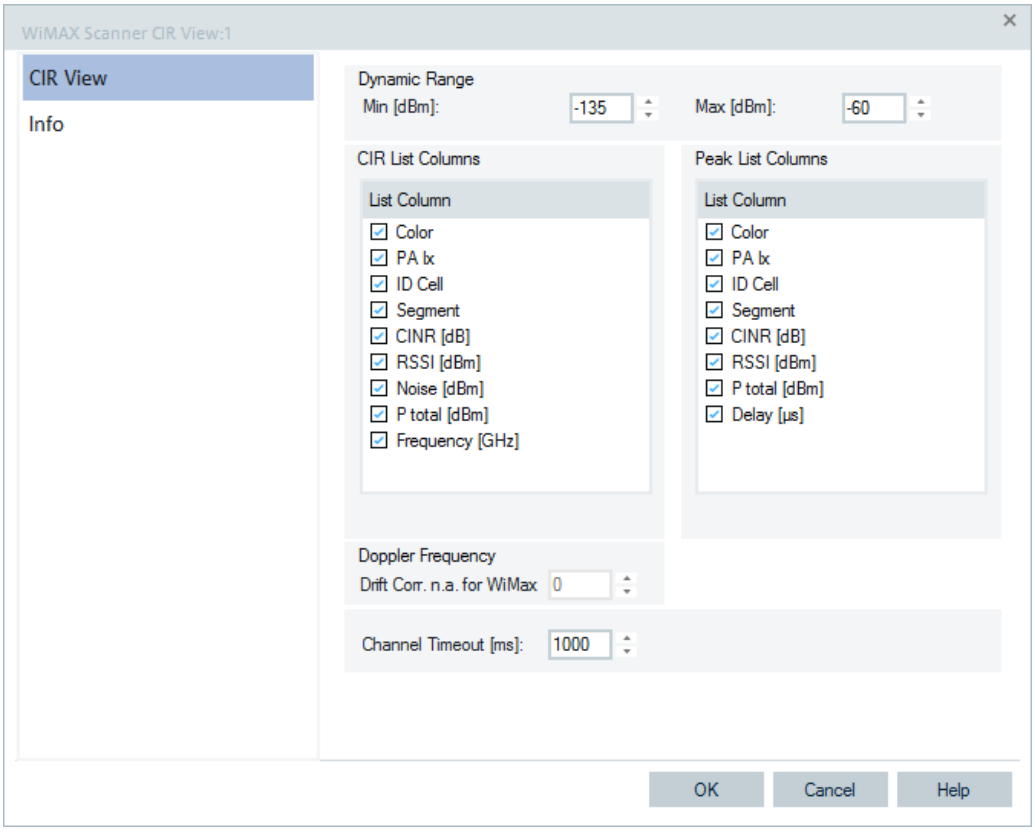


Figure 4-1076: WiMAX Scanner CIR View - configuration

The CIR view configuration includes y-axis scaling, selecting the information for display in the view and a Doppler shift correction.

Dynamic Range
The two input fields in "Dynamic Range" define the minimum ("Min [dBm]") and the maximum ("Max [dBm]") level to be displayed in the "WiMAX Scanner CIR View".

CPICH List, Peak List
"CPICH List" and "Peak List" select which information is displayed in the tables below "CIR Chart". Clearing a box hides the corresponding row in the diagram.

Doppler Frequency
The function is disabled, setting can be ignored.

Channel Timeout
If there are no data on a channel anymore, the "CIR List" entries for this channel are removed after a timeout.

4.8.12.3 WiMAX scanner Top N view

The "WIMAX Scanner Top N View" displays the properties of the signals from the BTSs that are the elements of the "Top N Pools" defined in the technology configuration. A Top N pool contains cells with specific characteristics providing the strongest RSSI or CINR level at a given position and time.

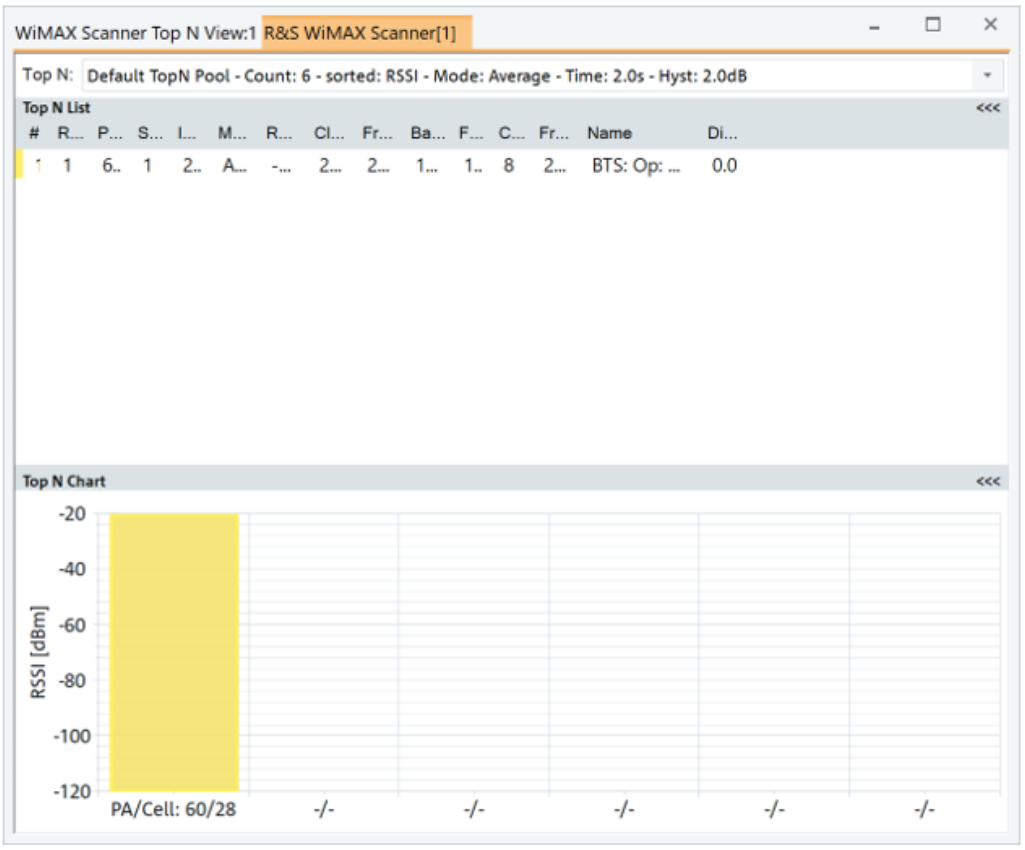


Figure 4-1077: WiMAX Scanner Top N View

View area

The entire view area is horizontally split into three parts. On the top, the view accommodates a pull-down list with all defined "Top N" measurements of the technology. The "Top N List" below shows in tabular way the values of the parameters configured for the measurement. The lowest part is the bar chart.

Click the ">>>"/"<<<" button to hide/expand the tables or chart pane. The hidden chart leaves more space for the table and vice versa.

The splitter position between the upper and lower part of the scanner view area and the open or closed state of the "Top N List" and "Top N Chart" are restored from the workspaces.

Top N

Below the view title bar there is the "Top N" line with the pull-down box which contains all the Top N pools defined in the "Top N Settings" configuration page of technology. The results in the "List" and "Chart" refer to the Top N pool selected in the list.

The "Top N" line contains in addition the "Auto Width" button. If clicked, the button automatically adjusts the widths of all columns. If clicked CTRL + "Auto Width", adjusted are the column widths to fit both column contents and titles.

If mouse hovers over the "Auto Width"" button, the related message is shown as a Tooltip.

- Double-click the column divider auto-adjusts the width of a single column on its left.
- CTRL double-click a column divider auto adjusts all column widths.
- Double-click or CTRL double-click the column header only toggles the sort order, does not adjust a column width.

The column widths adjustment is based on the cell content, not on the column title widths.

Saving the workspace with adjusted Top N view column widths saves also the changed column widths. Loading the workspace next time, restores the changed column widths.

Refer to "Tools" > "Overview of Settings" > "TEC for WiMAX Scanner" in Chapter 3.8.2.11, "TEC for WiMAX scanner", on page 337.

Top N list

The "Top N List" gives an overview of the received signals in the current Top N pool together with their measured power parameters, frequency and timing information. On mouse rollover, each cell in the table header provides a short explanation of the corresponding column.

In the view configuration menu, it is possible to show or hide each individual table column. Up to three differently named pools can be configured in the default setup. Each pool has several configurable parameters.

The "Top N List" contains the following columns:

- "Color"
  Automatically selected color code of the preamble index.
- "#"
  Number of a measured cell and its preamble index within the Top N pool.
- "Rank"
  Current rank within the Top N pool.
- "PA Ix"
  Downlink preamble Index.
- "Segment"

A cell site can be divided up into three different segments. Thus, the segment is identified with ID, which can be 0, 1, or 2.

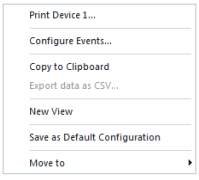
- "ID Cell"
  Cell identity, if applicable. If not, "---" written is in the corresponding column.
- "Mode"
  Valuation method (Average/Max/Min).
- "RSSI"
  Power of the preamble of a certain WiMAX cell characterized by ID Cell and Segment ID. It excludes noise and interference.
- "CINR"
  Signal to interference and noise ratio of the preamble of the WiMAX cell.
- "Frequency[GHz]"
  Center frequency of the used channel according to IEEE 802.16.
- "Bandwidth[kHz]"
  For WiMAX, different bandwidths are possible according to IEEE 802.16.
- "FFT Size"
  Fast Fourier Transformation size
- "CP Ratio"
  Cyclic Prefix ratio.
- "Frame Rate"
  Frame rate.
- "BTS Name"
  Name of the WiMAX base station
- "Distance (to BTS)"
  Distance to the BTS.

Diagram

Below the table, the "Top N Chart" shows the RSSI and CINR for all cells in the current Top N measurement as a bar chart.

It is possible to select the upper and lower RSSI and CINR levels for the y-axis of the chart in the configuration menu.

Context menu



A right mouse button click at any point in the view opens the context menu.

The menu contains the following commands:

- access the configuration page,

- put the view on hold,

- copy the current view to the clipboard,

- create or delete views,

- save the current configuration as default, or move to another view area.

Refer to Chapter 4.1.3, "Context menu", on page 429.

WiMAX scanner Top N view configuration

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

The "Top N View" option lets you define y-axis scaling, specify the thresholds (minimum/maximum) for RSSI/CINR for display in the chart view and the contents of the Top N list.

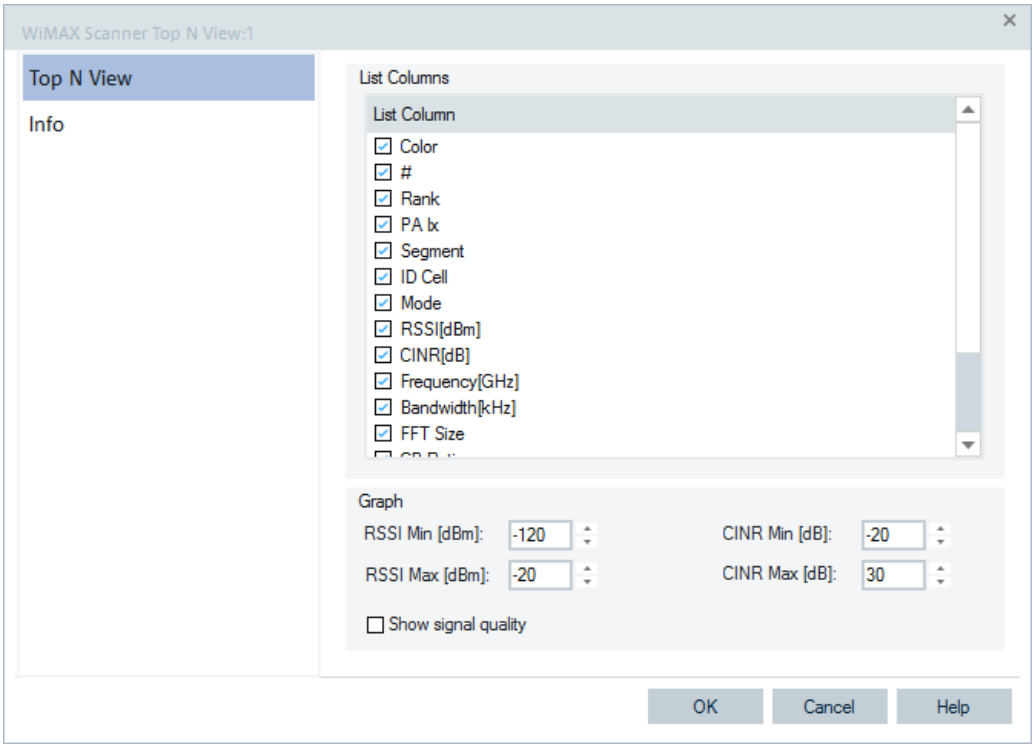


Figure 4-1078: WiMAX Scanner Top N View - configuration

Graph

- "RSSI Min/Max [dBm]"
  Sets the upper and lower RSSI levels for the left y-axis of the chart.
- "CINR Min/Max [dBm]"
  Sets the upper and lower CINR levels for the right y-axis of the chart.
- "Show signal quality"
  Shows the signal quality in the "Scanner Top N View" when the option is activated. The option is the possibility to switch on/off the second y-axis on the chart and quality signal bars.
  If the option is selected, you see the result of the switching in the next frame, as the chart must redraw at least once for it.

5 R&S ROMES4 tools

Together with the main application, R&S ROMES4 installs additional useful software tools. The tools are accessible in the MS Windows "Start" pane. The QualiPoc Update Tool is accessible also via the "Tools" menu of the R&S ROMES4.

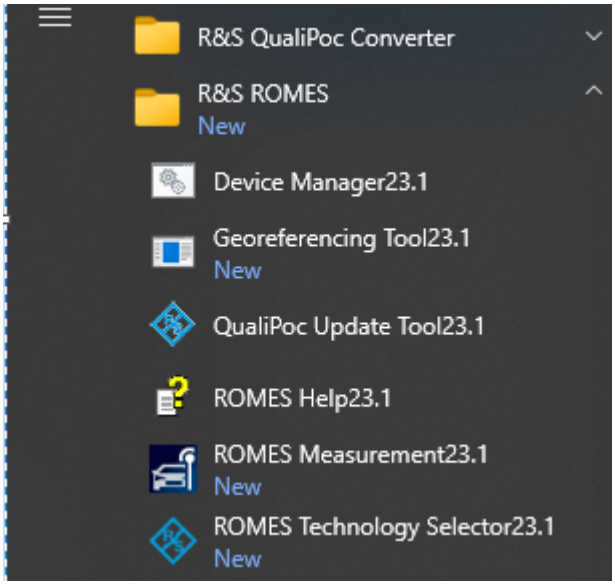


Figure 5-1: R&S ROMES4 tools

- Device manager....1424
- Georeferencing tool....1426
- QualiPoc converter....1430
- QualiPoc update tool....1436
- R&S ROMES4 technology selector....1440
- R&S TSME diagnosis and updates....1443

5.1 Device manager

The Device Manager helps to remove redundant USB devices (mainly test mobile devices and GPS devices) that R&S ROMES4 used in previous measurement sessions. A USB device has to be assigned to several virtual COM ports whenever it is connected.

The operating system does not delete unused virtual COM ports if USB devices are connected and disconnected repeatedly. As a result, the virtual COM port numbers for new devices ("Assign Serial Ports" dialog) tend to increase, which in the end can cause connection problems.

If the assigned port numbers exceed values of 30, or the holes in the sequence of the COM port numbers are noticed, delete the redundant USB ports using Device Manager.

The Device Manager is the standard device manager from Microsoft with the environment variable `SET DEVMGR_SHOW_NONPRESENT_DEVICES` set to 1.

5.1.1 Installation

The special Device Manager is automatically installed together with the test system. The executable file `DeviceManager.bat` is stored in the C:\Program Files (x86)\Rohde-Schwarz\ROMES<version>\Tools\DeviceManager program directory.

5.1.2 Removing unused devices

To remove unused device:

1. Select the "Start" > "R&S ROMES" > "Device Manager<version>" entry in Windows GUI.

   The "Device Manager" page opens.

2. Select "View" > "Show hidden devices".

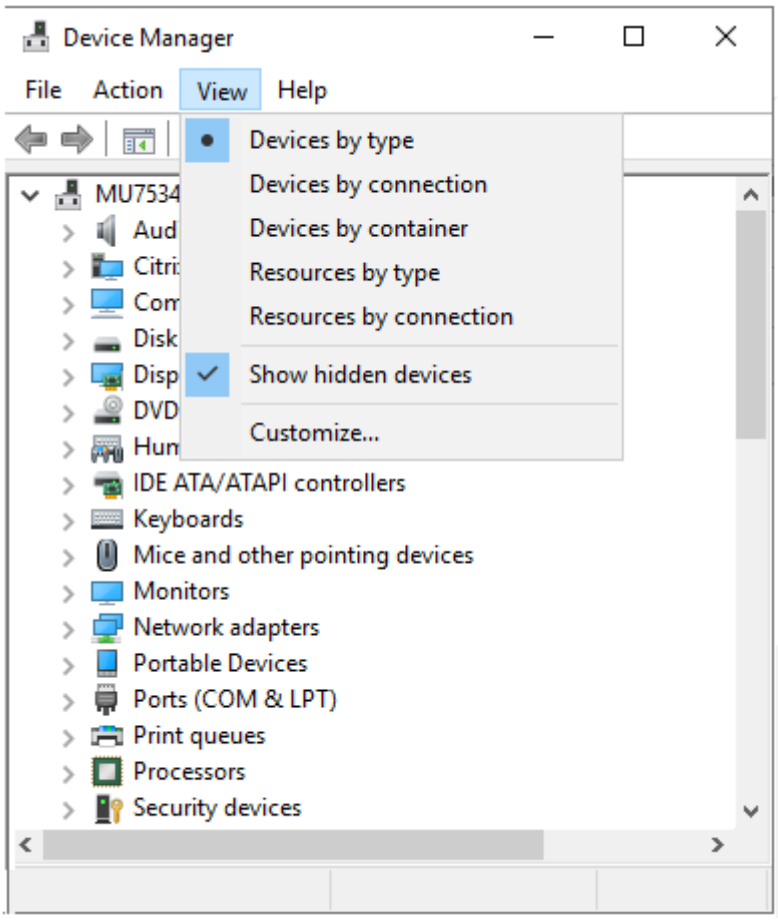


Figure 5-2: Device manager view

Note: The entry must be ticked after each program start.

3. Expand the "Modems" and "Wireless Communication Devices" nodes in the "Device Manager" page.
4. Gray icons display unused devices and port assignments.
5. Delete redundant entries, for example, the "Qualcomm" entries, all Qualcomm COM ports and “compound devices”, and all other devices that appear several times and you no longer need them.
6. Close the "Device Manager" page.

   The lower virtual COM port numbers are available once again. You can use them for the connection of new USB devices.

5.2 Georeferencing tool

Start the Georeferencing map referencing tool from the Windows "Start" > "R&S ROMES" > "Georeferencing Tool<version>" entry.

How to use the tool, see `GeoRefWizard_Manual_en.pdf` which is located in the C:\Program Files (x86)\Rohde-Schwarz\ROMES20.1\GeoRefWizard directory.

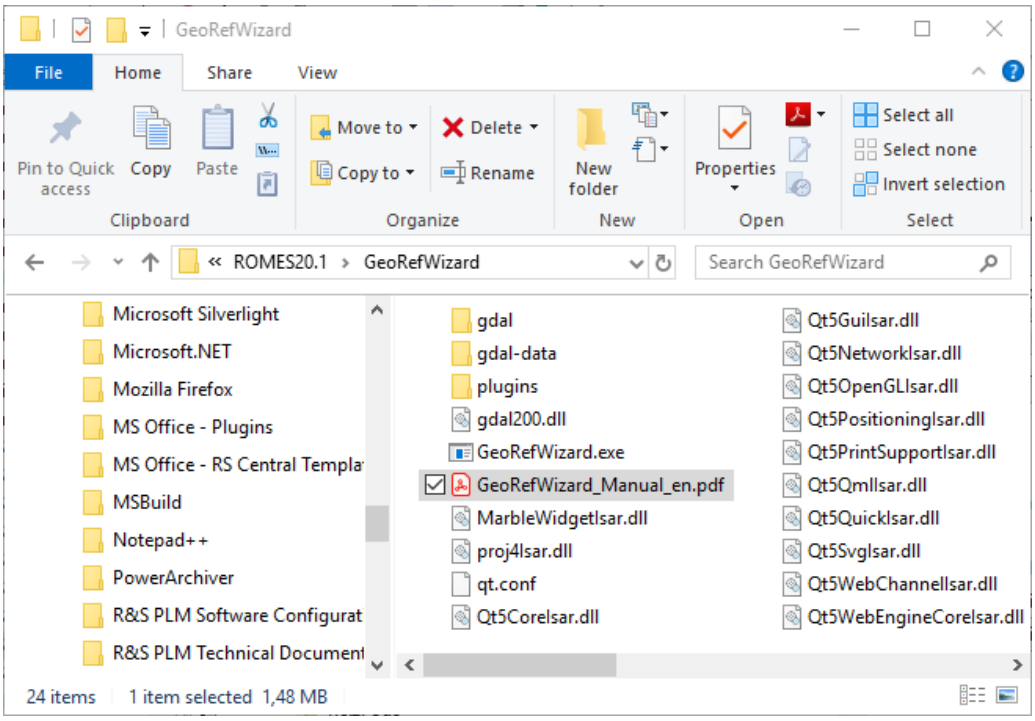


Figure 5-3: Location of GeoRefWizard_Manual

5.2.1 Referencing and patching indoor measurements

You can start the GeoReferencing Wizard from R&S ROMES4 to reference not referenced maps of an indoor measurement. When started, the GeoReferencing Wizard also patches the geographical coordinates of the measurement with the result of the referencing.

Perform the following:

1. Click the "File > Reference/Patch Indoor Measurement" entry in the R&S ROMES4 window.

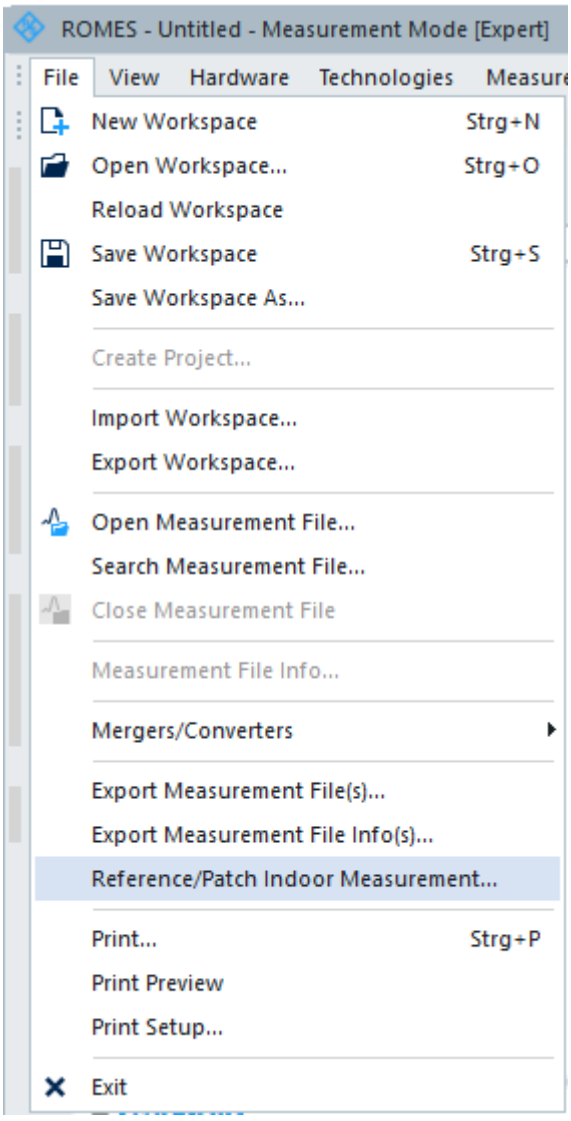


Figure 5-4: Reference/Patch Indoor Measurement command

2. Select a measurement file containing an Indoor measurement.

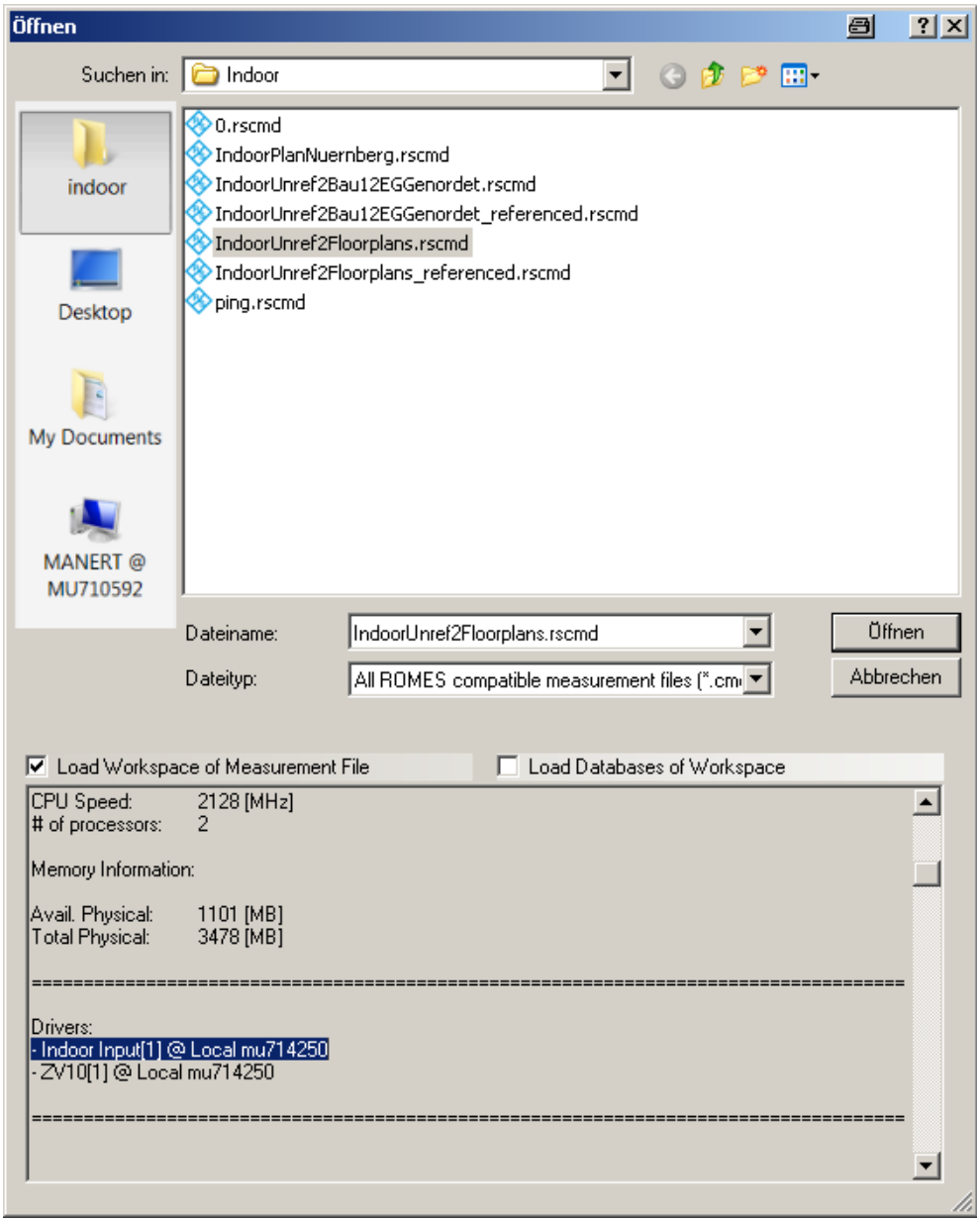


Figure 5-5: Indoor measurement file selected

If selected, the function searches for an indoor measurement file that contains maps and measured geographical coordinates.

3. At the end of the searching, the following dialog appears.

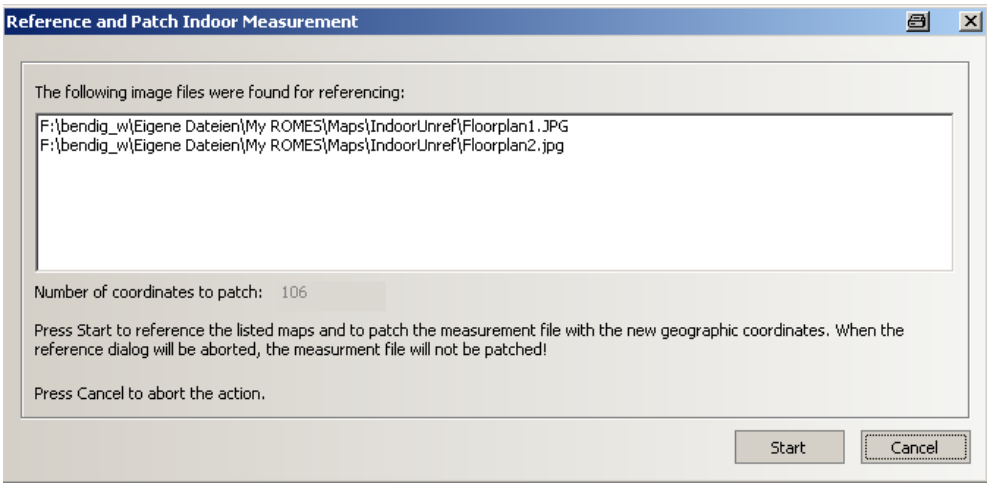


Figure 5-6: Indoor files found

The dialog displays contained maps and the number of coordinates to patch.

4. Press "Start" to start the GeoReferencing Wizard. The "GeoReferencing" page shows the first image of the list and the image can be referenced (you need to adjust the zoom level first).

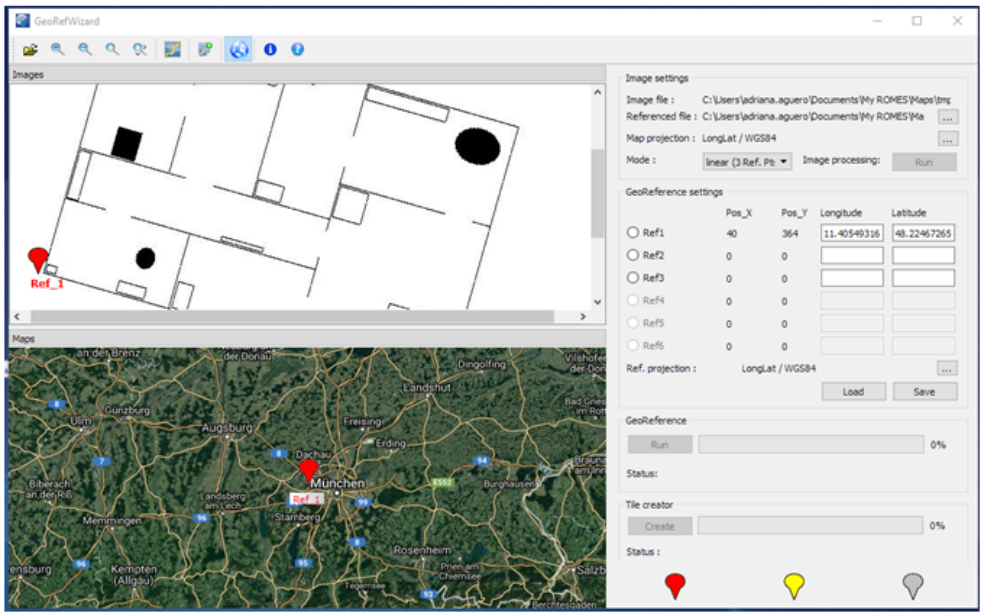
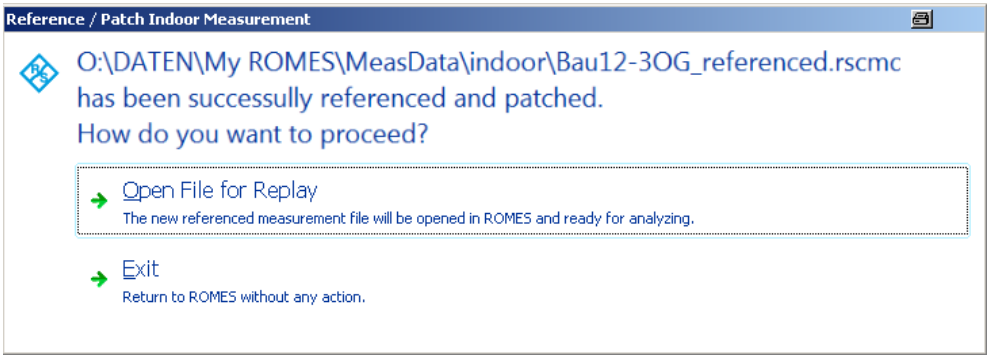


Figure 5-7: Image shown in the GeoRefWizard

5. Select the desired map projection.
6. Put the coordinates in "Longitude" and"Latitude".
7. Press "Run" to reference image. When done, it appears as the next image of the list. By referencing the last image in the list, the application closes and writes the new coordinates to the measurement file. This new measurement file has the suffix "_referenced" appended to the original file name.

8. At the successful completion of the procedure, the following dialog appears.



9. Click "Open File for Replay" to open the referenced measurement file in R&S ROMES4 or "Exit" to proceed with any other action.
Note: It is only possible to display georeferenced images together with MapInfo maps in the "ROMES Route Track View". Displaying the images together with other formats like "OpenStreetMap" is not supported.

5.3 QualiPoc converter

The QualiPoc Converter is a separate tool included in R&S ROMES4 installation which provides the conversion of measurements performed with the QualiPoc app on a mobile.

5.3.1 Supported technologies

QualiPoc Converter supports the following technologies:

- GSM
- UMTS
- LTE
- NB-IoT
- 5G NR

5.3.2 Supported DQA jobs

QualiPoc Converter supports the following DQA jobs:

- QualiPoc Session Start/End
- HTTP Download/HTTP Browsing
- HTTP Upload
- FTP Download/Upload
- Ping
- Email Send/Receive

The conversion of Email jobs works only with the QualiPoc Version 14.0.0 or later.

- Capacity DL/UL
- Call2AnyNumber
  Voice calls, no matter if the POLQA speech quality measurements or simple voice calls measurements are done, fill the "ETSI QoS View".
- YouTube Streaming
- QP Ookla ® Test
- Facebook
- Dropbox
- QP WhatsApp
- SMS Send

DQA views show the results of the conversion in the same way the same DQA jobs performed with the Android smartphones with SQ interface show.

QualiPoc text markers are converted and shown in the "QualiPoc Message View".

5.3.3 Prerequisites for QualiPoc converter

The following prerequisites apply for the QualiPoc Converter:

- Pcap recording is activated in the QualiPoc application.
- If you open a `*.mf` measurement file, the recorded PCAP files have to be in a sub directory with the same name as the `*.mf` file.
- If you do not enable Pcap recording or the QualiPoc Converter cannot find the file, the TCP/IP trigger points and the related KPIs are not available.
- If you open a `*.sqz` measurement file, the PCAP files are extracted automatically to the correct directory.
- It is not allowed to rename a `*.sqz` measurement file, as the unzipping and handling of the contained files can fail.
- It is not allowed to rename the created PCAP files because they are referenced in the measurement.
- Activate the RSCMD logging in the QualiPoc application. For how to activate the RSCMD logging, see QualiPoc OneTraceDecoder/Converter.

5.3.4 Missing files info provided by QualiPoc converter

The QualiPoc Converter has a column for information during the conversion progress. In this column the user is informed about missing files, for example, PCAP files or TAB files. The case of missing PCAP file is shown in the following figure.

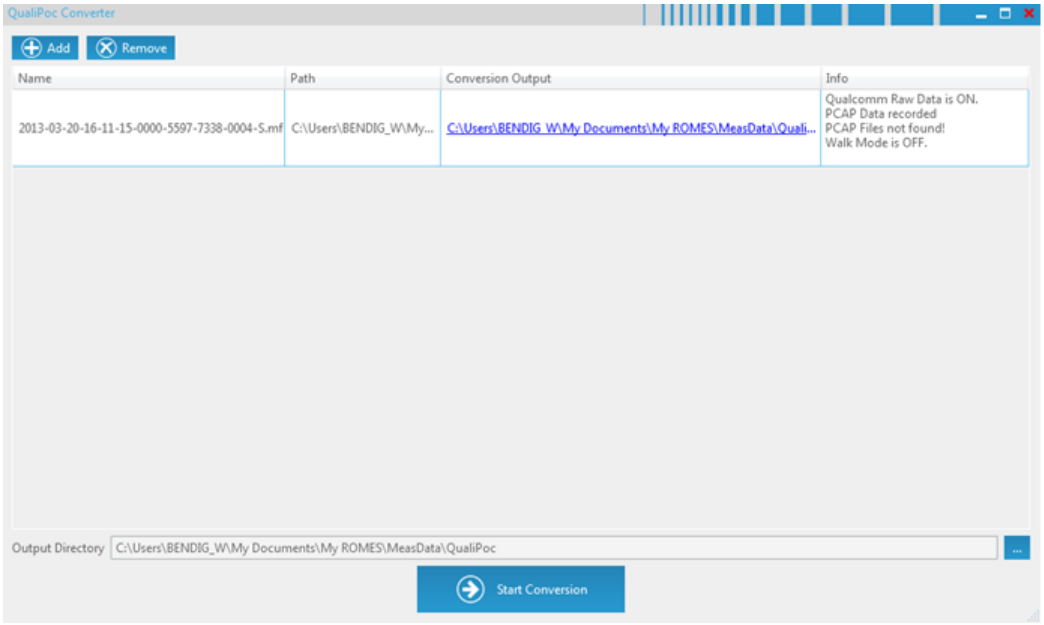


Figure 5-8: QualiPoc Converter info column

5.3.5 QualiPoc converter execution from the command line

`QualiPocConverter.exe` command-line options:

- -h [--help] Produce help message
- -v [--version] Print version
- -i [--input] arg Input file (`*.mf` or `*.sqz`)
- -o [--output] arg Output file (`*.rscmd`) [Optional]
- -l [--qclogs] Produce QC Log Code Statistics

5.3.6 Converted measurement file

In R&S ROMES4 the DQA has a relation to mobile devices. The relation is fixed by the modem port of the device and the modem port of the used modem in the Connect Job. The QualiPoc measurement does not have a special Connect Job. To create the relationship between DQA and mobile device, the converter simulates a pseudo Connect job for each QualiPoc session start and Disconnect job for each session end.

All from R&S ROMES4 provided trigger points for session start and session end are described in the "Trigger Point Definitions" document.

"File Info", which is a part of the "Open" page when you select a measurement file, shows always COM3 for the name of Data Port and for Modem Port in the "Connect Job" section.

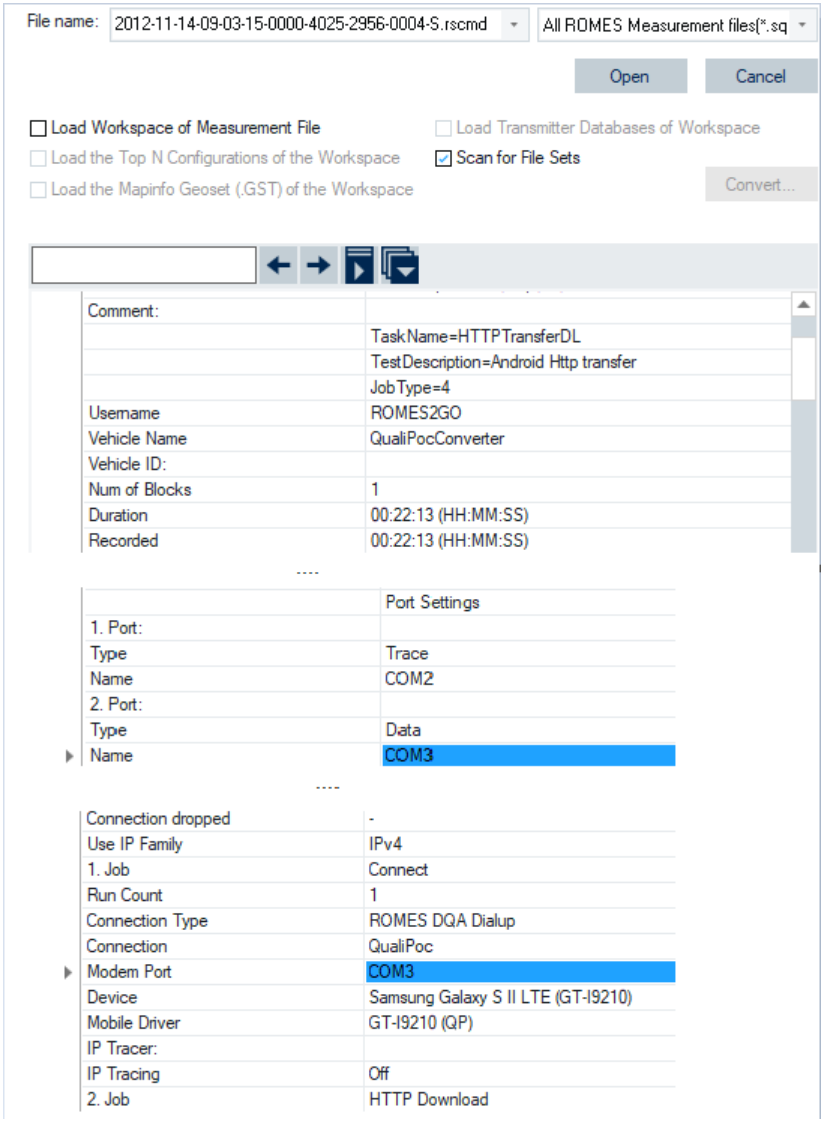


Figure 5-9: QualiPoc - File Info layout

The session report has invalid values for Connection Dialup Time, HTTP Time and Setup Time, see the following figure.

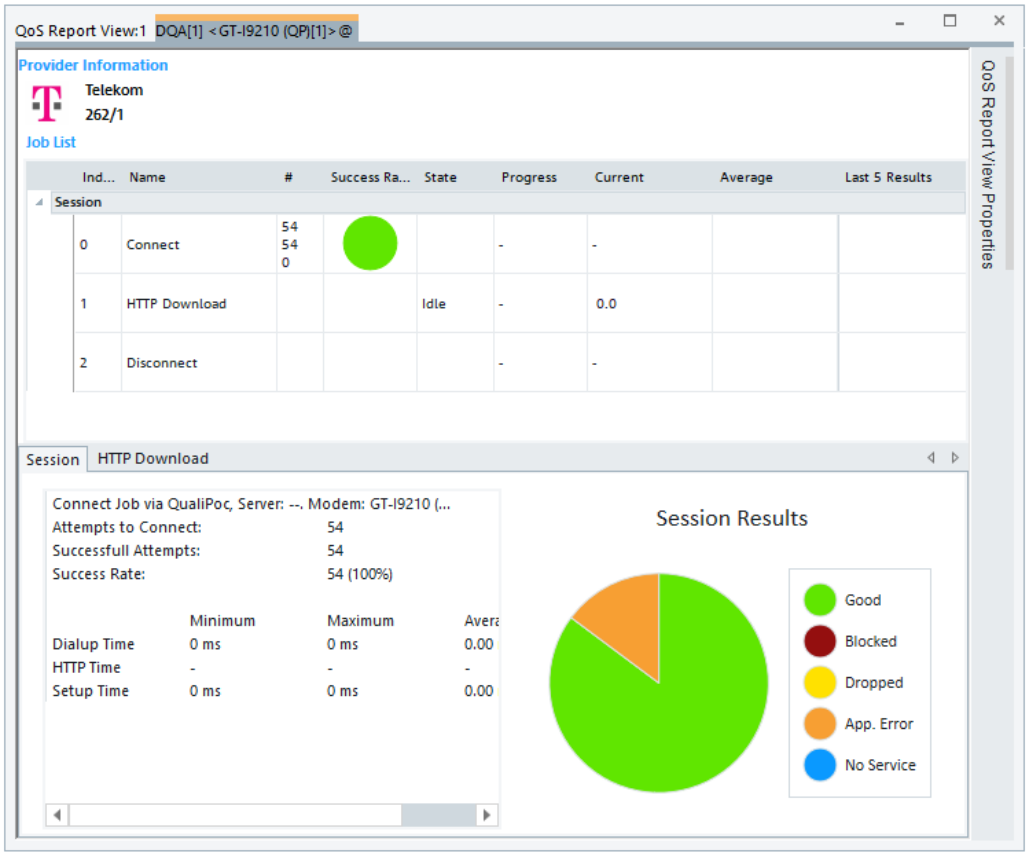


Figure 5-10: DQA Session Report - via QualiPoc Converter

5.3.7 Support of SQC container files

The QualiPoc SQC container files are available for conversion. They can be converted when opening the QualiPoc file from the R&S ROMES4 "File" menu.

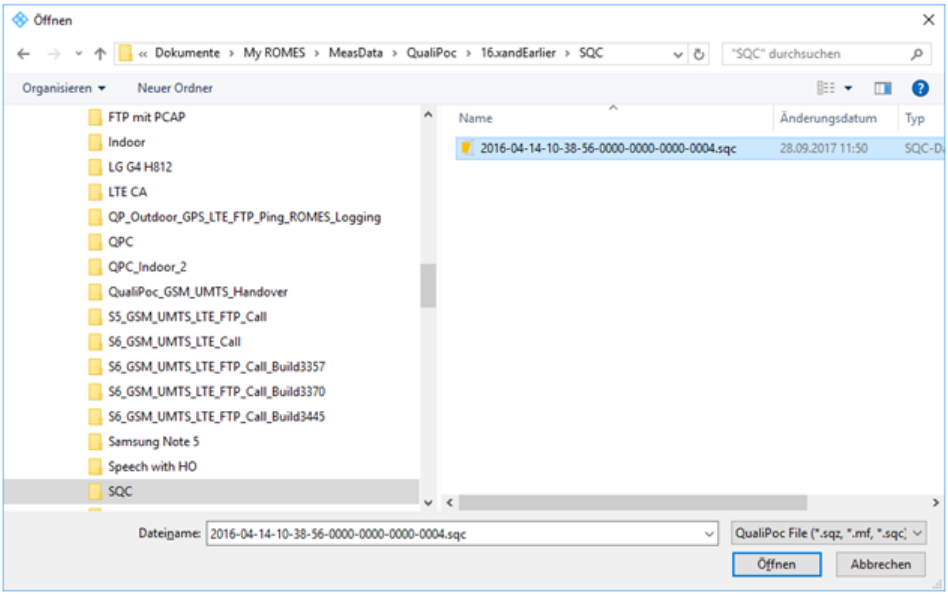


Figure 5-11: SQC container content

It is not possible to convert these files with the QualiPoc Converter GUI executable.

5.3.8 Replay of measurement files created by the SwissQual collection tools

R&S ROMES4 converts measurement files created by the SQ collection tools QualiPoc, STS, Freerider and Smart Benchmarker during the file open dialog.

- All QualiPoc created `*.sqz` measurement files can be converted to RSCMD-based `*.sqc` files and replayed in R&S ROMES4 for detailed analysis. This conversion and replay comprises measurements using the UE GPS position, indoor floorplans and the combination of floorplan and GPS positions.

Speech quality measurements and all data jobs available in R&S ROMES4 are transferred too.

- Site Testing Solution (STS) created measurements use an indoor floorplan and can be converted based on the scanner measurement files.

- Freerider created `*.sqc` measurement files usually contain multiple UEs. All UE measurements are merged to one RSCMD-based measurement file. GPS, floorplans or the combination of floorplan and GPS positions can be used. Speech quality and data jobs are transferred.

- Smart Benchmarker created `*.sqc` measurement files usually contain a scanner measurement file and one or multiple UEs measurements. The scanner measurement file contains all scanner measurements (already in RSCMD format) and is used during conversion as basis. (Only during the longer measurements a set of files is created named 001, 002 ...). Scanner measurements can comprise the 5G NR, LTE, NB-IoT, UMTS and GSM technologies (however, only one instance of GSM scanner is present). The UE measurements are merged into the scanner RSCMD measurement file. If

there are RSCMD file sets (for example, generated due to long measurement duration), choose one scanner RSCMD measurement file as a basis. UE files can be selected individually for the merge process. GPS, floorplans or the combination of floorplan and GPS positions can be used. Speech quality and data jobs are transferred.

Filenames (floorplan `*.ibwc` files and measurement files previously mentioned) can contain country-specific characters, blanks, underscores and hyphens.

5.4 QualiPoc update tool

Update of the fully integrated devices, if needed, is not performed inside R&S ROMES4. Instead, it informs you which devices need an update. You get a dialog like one shown in the following screenshot.

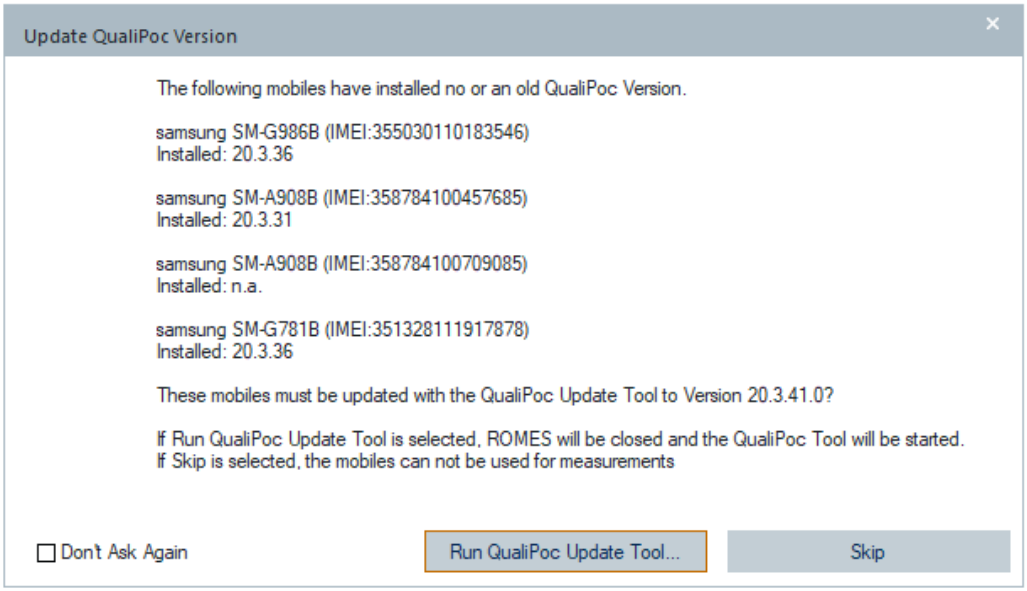


Figure 5-12: Fully integrated devices to be updated

If you press the "Skip" button, the mobiles cannot be used for measurements. They are shown as greyed out in the "Available Devices" list on the "Welcome" page.

If you press the "Run QualiPoc Update Tool" button, the QualiPoc (QP also in the text) Tool starts and R&S ROMES4 is closed. It can take a while (up to 60 seconds) until R&S ROMES4 is terminated. The QualiPoc Update Tool displays currently connected fully integrated devices.

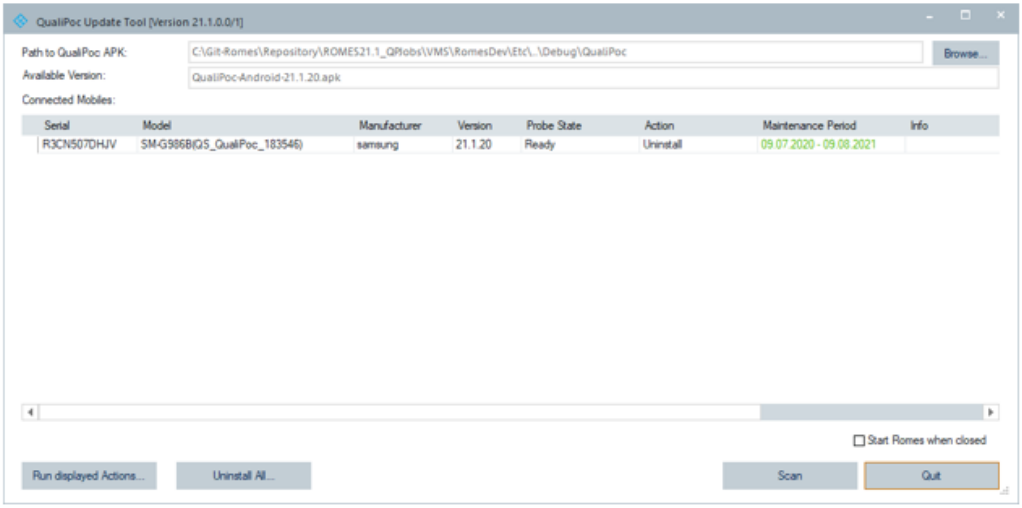


Figure 5-13: QP update tool screenshot

Entries in the QP Update Tool page

The following entries are shown in the "QualiPoc Update Tool <version>" page:

- "Path to QualiPoc APK"
  Folder where the QualiPoc APK file is located. The folder can be changed with "Browse".
- "Available Version"
  Newest QualiPoc version available in the display folder.
- "Connected Mobiles"
  Table showing the details of the connected fully integrated devices.
  - "Serial"
    Serial number of the mobile
  - "Model"
    The model name including the QualiPoc unit name. The unit name is available when its probe state is READY.
  - "Manufacturer"
    Manufacturer of the mobile device
  - "Version"
    Current version of QualiPoc
  - "Probe State"
    Current state of QualiPoc probe - it can change during the startup and update process.
  - "Action"
    Necessary action to execute for a mobile device. Some examples are shown in the next section.
  - "Maintenance Period"
    The tool checks a mobile device's release maintenance period. If the maintenance period has been expired, the update of the current installed main release is only available - for example, from 21.1.20 to 21.1.xx. The maintenance

period is available in R&S ROMES4 versions 21.1 and higher when the UE has become the probe state READY. Older versions display "n.a." in this column.

– "Info"
Reported info messages

- "Start Romes when closed"
If checked, R&S ROMES4 is started after the application has been closed.

R&S ROMES4 is only started again, when the mobiles are ready again after they have been updated. If not started after 4 to 5 minutes, perform scanning or check the mobile devices manually.

The following screenshot shows that two mobile devices are in the "RF Trace Missing" probe state. These devices with external diagnostic trace are in this state because the message only disappears when the mobile devices are loaded. For QualiPoc Update Tool, it is correct when the devices with external diagnostic trace stay in this state.

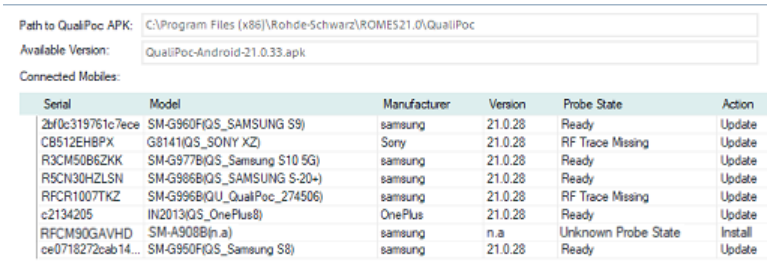


Figure 5-14: Display of connected fully integrated devices

The devices with external diagnostic trace can stay in the "RF Trace Missing" probe state.

Buttons in the QP Update Tool page

The buttons present in the "QualiPoc Update Tool <version>" page perform the following functions:

- "Browse"
Selects directory where a QualiPoc `*.apk` file is located.
- "Run displayed Actions"
Executes displayed actions.
- "Uninstall All"
Uninstalls QualiPoc on the mobiles.
- "Scan"
Executes rescan of the mobiles. Rescan is necessary if other mobiles have been connected after the start of application. The scan of mobile devices is automatically done on start of the application but not when they are plugged in to USB afterwards.
- "Quit"
Closes the application.

QP Update Tool maintenance license concept

For the QualiPoc license concept, see Chapter 3.10.4.3, "QualiPoc licenses", on page 423.

5.4.1 Actions with the QualiPoc update tool

The "Action" function includes the following possible necessary actions for the fully integrated devices:

- "Update" if the device's version is lower than the available version.
- "Install" if QualiPoc is not installed on the device.
- "Uninstall" if the device's version is greater than the available version.
- "No Action" if the device's version equals the available version.
- If "Check for QP Maintenance Update" selected, update maintenance license is allowed as previously mentioned.

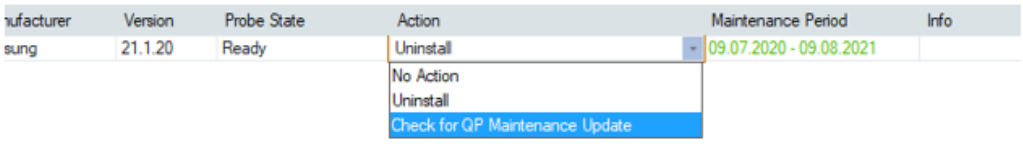


Figure 5-15: Action entries

The action can be changed depending on the detected state. The modified selection of the action is reset with a new scan.

Installing / updating

The following screenshot shows the probe states installing/updating of the fully integrated devices and the corresponding update/install actions.

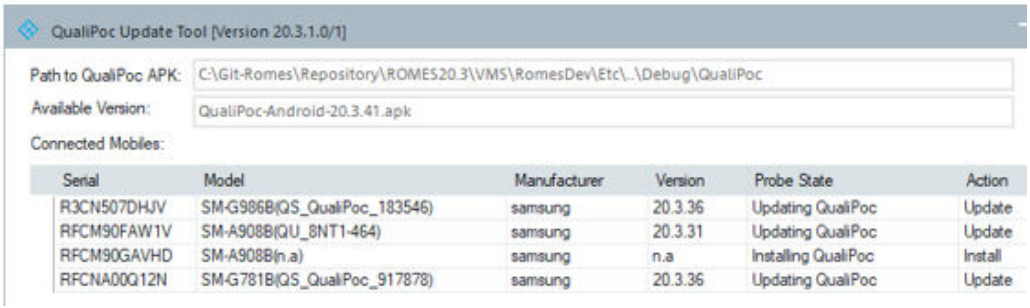


Figure 5-16: Install/update

Shutdown during update

The following screenshot shows for three devices the shutdown probe state during the update process.

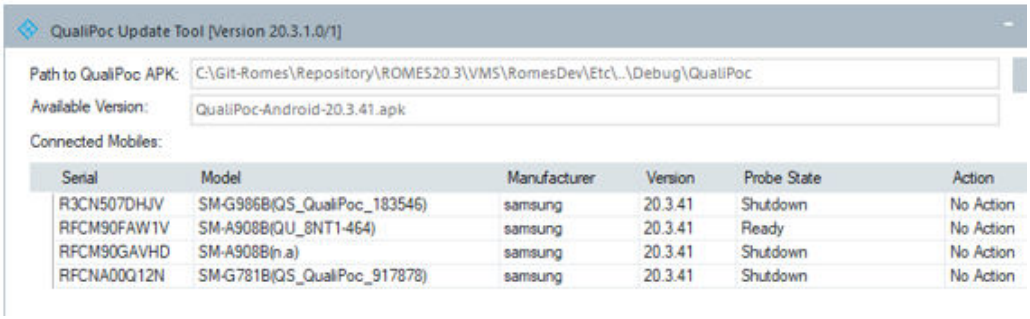


Figure 5-17: Shutdown during update process

5.4.2 Starting the QualiPoc update tool

The QualiPoc Update Tool is started from the MS Windows "Start" > "R&S Romes" menu, see Figure 5-1.

It can also be started from the "Tools" > "Run QualiPoc Update Tool" menu.

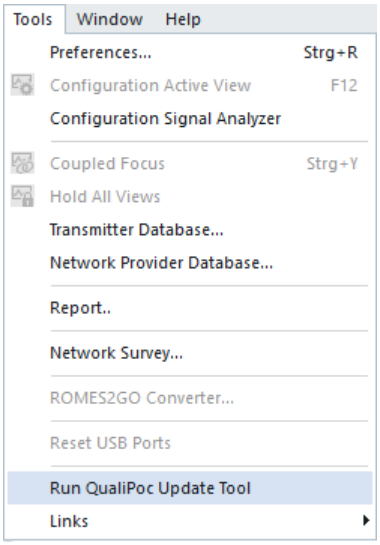


Figure 5-18: Option to run the update tool

5.5 R&S ROMES4 technology selector

There is a possibility to select RAN technologies out of the R&S ROMES4 supported ones. Users have to have administrator rights to do such selection.

To select some technologies from the list of available ones:

1. Click "Start" > "R&S ROMES" > "ROMES Technology Selector<version>". Choose the target version of R&S ROMES4 (if there is more than one version available).

2. Expand the "Tools" subfolder.
3. Launch the application, as shown in the following figure.

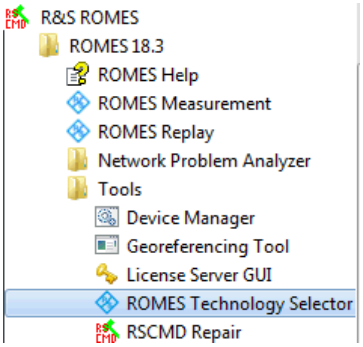
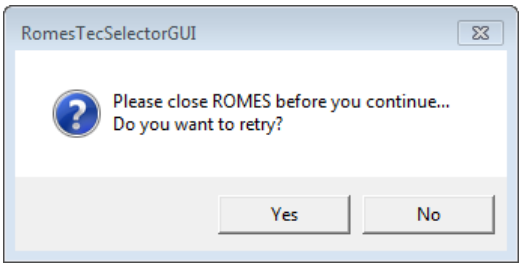


Figure 5-19: ROMES Technology Selector

If the main application (R&S ROMES <version>) is active currently, you get the message.



In this case, you have to close the R&S ROMES4 application and restart the tool.

4. The "ROMES Technology Selector<version>" page looks by default as shown in the following figure.

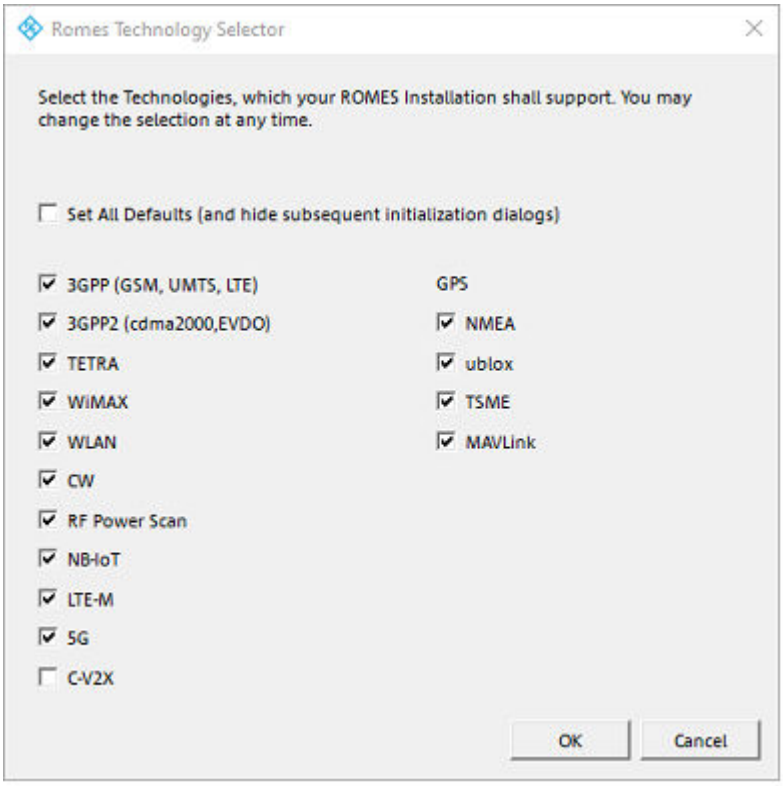


Figure 5-20: Technology selection dialog

You can select/deselect technologies which you want to be loaded/not loaded when launching the R&S ROMES4 next time.

If the "Set All Defaults (and hide...)" flag is checked and you close the dialog by pressing "OK", you skip all the initialization dialogs by default settings at the first R&S ROMES4 start after its installation.

If there is no interaction from you within 1 minute, this flag is set and auto-close is started giving you another minute to interact.

If you do not react in this next minute, e.g. on an unattended system like TSMA6, the dialog is closed, inputs are accepted and all subsequent initialization dialogs are skipped. Default settings are used.

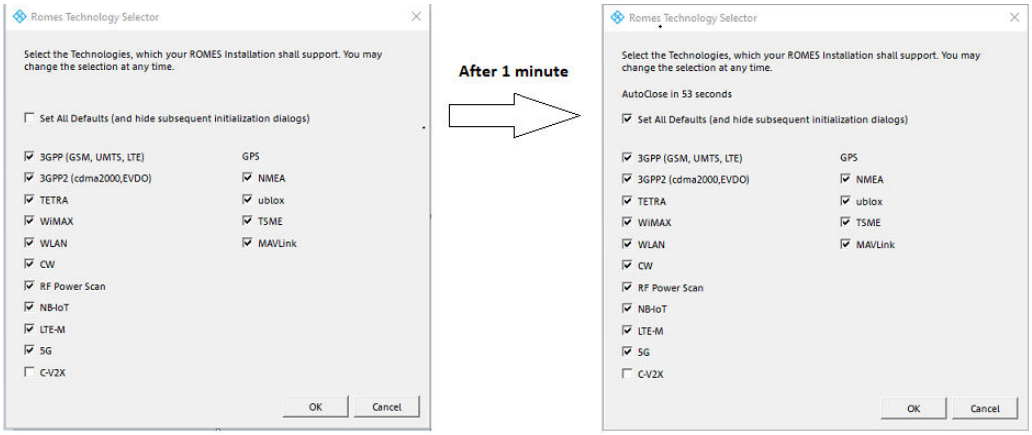


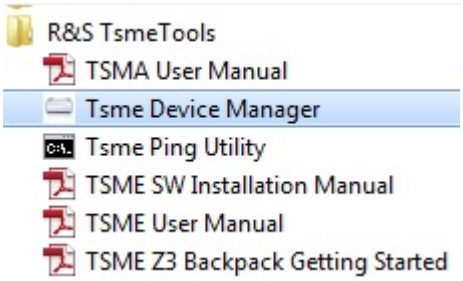
Figure 5-21: Settings all initialization dialogs as default

5.6 R&S TSME diagnosis and updates

The R&S TSME Device Manager allows you to do a complete diagnosis of the R&S TSME device and to perform updates, if necessary.

The R&S TSME Device Manager is available for downloading from the R&S homepage https://www.rohde-schwarz.com/en/software/tsme/.

After installation, you can run the R&S TSME Device Manager from the Windows "Start" menu under "R&S TsmeTools".



All new devices are preconfigured and specified technology and band options are already installed. Only if you obtain additional software options later you have to enable the options with the corresponding software license keys.

The R&S TSME scanner option R&S ROMES4T1 supports the following R&S ROMES4 scanners:

- Chapter 6.4.19, "UMTS PN scanner", on page 1788
- Chapter 6.4.18, "GSM network scanner", on page 1775
- Chapter 6.4.20, "CDMA2000 1xEVDO pseudo noise scanner (PNS)", on page 1806
- Chapter 6.4.21, "RF power scanner", on page 1823
- Chapter 6.4.25, "WiMAX scanner", on page 1856
- Chapter 6.4.15, "LTE scanner", on page 1726
- Chapter 6.4.22, "TETRA scanner", on page 1837

Software license keys are installed using the R&S TSME Device Manager, in the "Options" tab. Another tabs provide information on device, network and band configuration and the possibility to update the basic FPGA or the correction data on your R&S TSME.

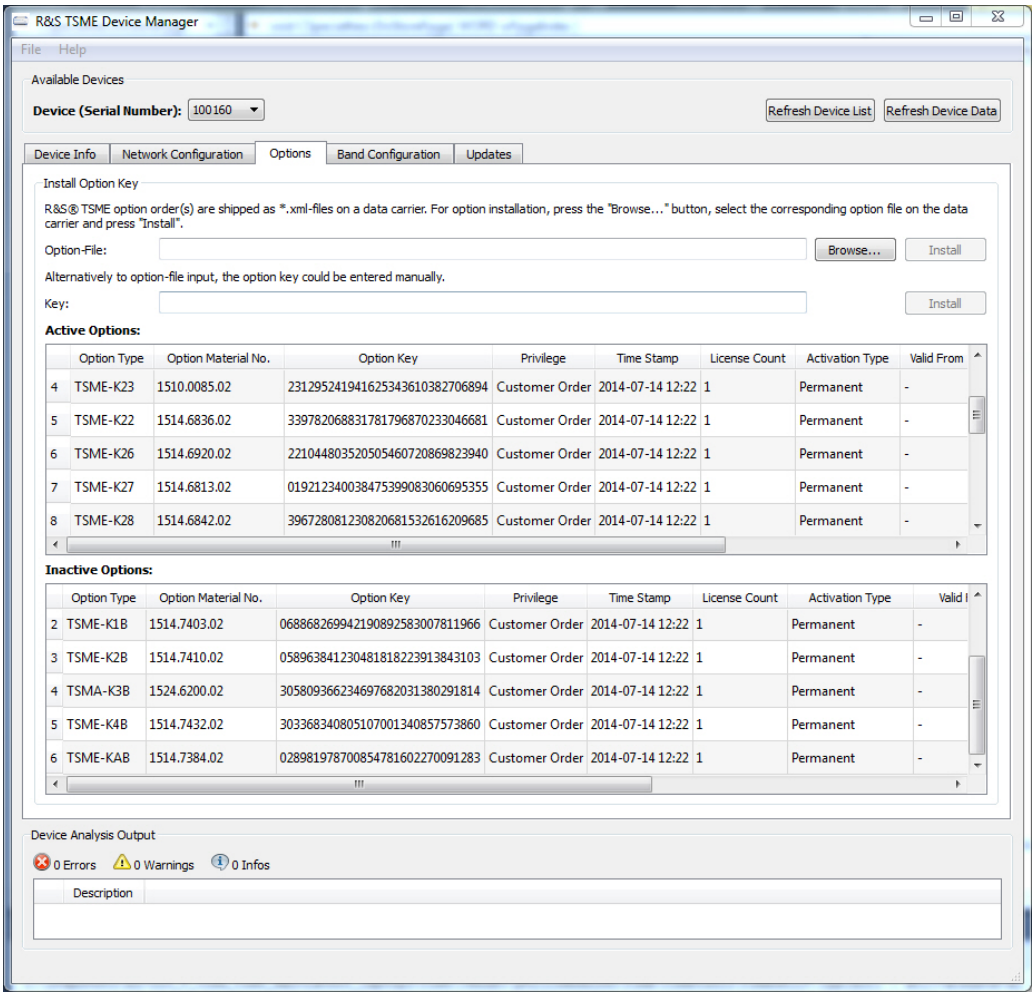


Figure 5-22: R&S TSME Device Manager window

The lower part of the R&S TSME Device Manager window shows the current errors, warnings and info.

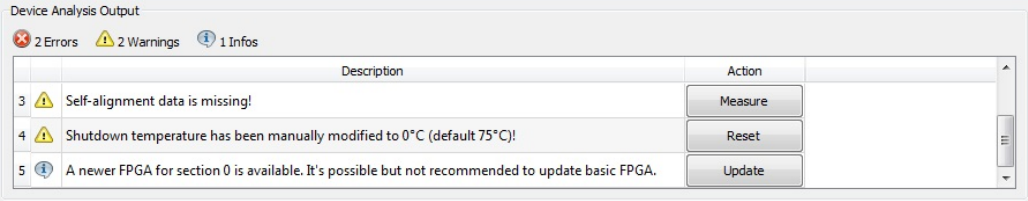


Figure 5-23: Device analysis output

For the complete information on the tool, see the "R&S TSME User Manual".

5.6.1 Obtaining firmware and correction data updates

The R&S ROMES TSME Device Manager is always provided with the most recent basic FPGA. If a newer one becomes available due to security or functional issues, a message is indicated in the "Device Analysis Output" at the bottom of the R&S ROMES TSME Device Manager window. In this case, and only in this case, it is recommended that you install this update on your R&S ROMES TSME.

The correction data on your R&S TSME has always to be kept up to date. Available updates are also indicated in the "Device Analysis Output" and it is recommended that you install them.

NOTICE

Risk of inoperability of device due to FPGA update

Before performing an update, make sure you have a stable power supply and the LAN connection is not interrupted. Both updates take a few minutes.

If the LAN connection is interrupted during an FPGA update, the device can become inoperable. Thus, only install such an update if it is explicitly recommended by a message in the "Device Analysis Output" of the R&S TSME Device Manager or by the Rohde & Schwarz support center.

You can update the basic FPGA or the correction data on your R&S TSME directly from the R&S TSME Device Manager, in the "Update" tab. The currently installed versions and the newest supported version (of the FPGA) or the minimum recommended version (of the correction data) are indicated.

5.6.2 Automatic firmware updates

Each time R&S ROMES4 is started, the software automatically compares the firmware version of the connected R&S TSME with the version currently available on the host PC. If a newer version is available, it is copied to and installed on the R&S TSME. Up to two previously installed firmware versions are stored as backups and maintained on

the R&S TSME. Thus, it is not necessary to perform firmware updates on the R&S TSME manually.

For more details, see the "R&S TSME User Manual", chapter 4.

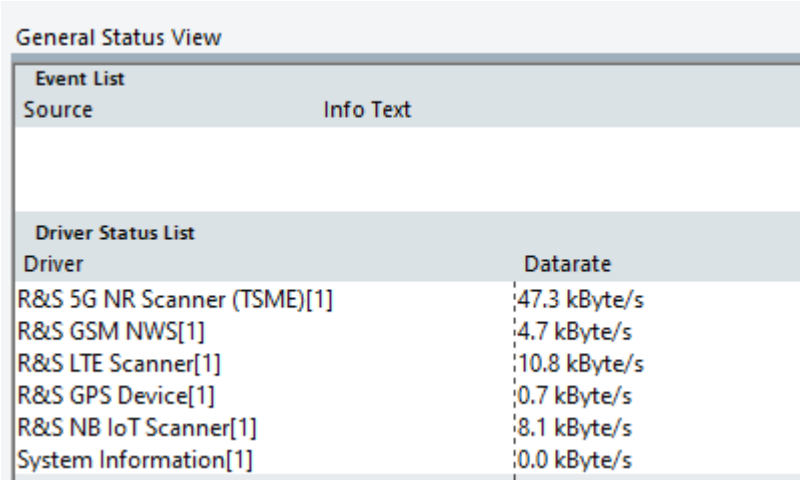
6 Hardware Components

This chapter is dedicated to hardware devices, how to connect them and configure to perform network measurements and analyze provided measurement results.

For all USB devices (most test mobiles and GPS receiversa devices) an additional Windows driver on host PC has to be installed first.

Device Status

The status of the hardware devices can be observed in the "Views" > "Basic Views" > "General Status View". The list shows all hardware devices and the amount of currently produced data. Each hardware device is expected to deliver a certain amount of data as long as its device is in a good condition. If the currently delivered amount of data drops below that amount, an error box pops-up, see Chapter 6.3, "Devices observation", on page 1510. A wave file is available to be played additionally.



- Devices 1447
- Automatic reload of mobile devices 1509
- Devices observation 1510
- Test devices 1511
- Quality of service 1880
- Navigation 2061

6.1 Devices

The chapter intends to explain how to load hardware devices, how to assign them to a physical or virtual COM port (e.g. emulated port created by USB adapter). Also is included the possibility of a device removal.

These actions are common for all devices with the following exceptions:

- Loading the R&S indoor device and the QoS tester does not require any hardware or port assignments.

- A PCMCIA slot is used for WLAN cards or/and the UMTS data cards.

The R&S ROMES4 drivers can be loaded into a device which is used for measurement and analysis in the following ways:

- Using R&S ROMES4 "Devices Manager"
- Using the "Hardware" > "Connect/Disconnect" menu
- Loading the desired configuration file

Loading devices is not necessary if the measurement data is replayed from a measurement file.

Default device template

The Default Device Templateis feature is intended for R&S ROMES4 system administrators, not for daily users.

Loading a device starts by loading a default template.

The default template loading allows an administrator to populate default settings for the R&S ROMES4 drivers. Locate the template in the device's template folder (Current Users and Application Folder is supported) and name it `~default.xtemplate`.

R&S ROMES4 loads the default template if available automatically. Then it checks if the settings can be used with the actual connected device.

The creator of the default template is responsible for the compatibility of the settings with the actual used hardware.

This template is not visible in the template page of a device, but can be saved as a normal template from this page.

6.1.1 Devices manager

R&S ROMES4 offers the "Devices" bar for managing test devices docked to the left side of the R&S ROMES4 window.

Following test devices are supported:

- Virtual COM Port devices (USB), (most test mobiles and GPS receivers)
- Network scanner devices of TSMX family (R&S TSME/TSME6/TSME6B)

R&S ROMES4 automatically detects those test devices which are detected automatically by the PC operating system. However, the R&S ROMES4 capability automatically to detect test devices is not applicable to test devices connected via LAN interface. The R&S TSME family is using LAN interface to connect to the PC.

When a test device is connected to the PC and R&S ROMES4 is running, the R&S ROMES4 Device Manager automatically performs a rescan and detects the newly connected device.

The R&S ROMES4 Device Manager list is updated automatically.

To detect the R&S TSME scanners:

1. Connect an R&S scanner to the computer having installed R&S ROMES4 SW.
2. Start R&S ROMES4.

   During startup, R&S ROMES4 scans for connected R&S TSMEs. The connected R&S scanners are recognized and added to the Device Manager list.
   Note: If R&S ROMES4 is already running, click the "Rescan..." button to detect the connected R&S TSME manually.

To load and activate a detected test device:

1. Select the device in the "Type" combo box.

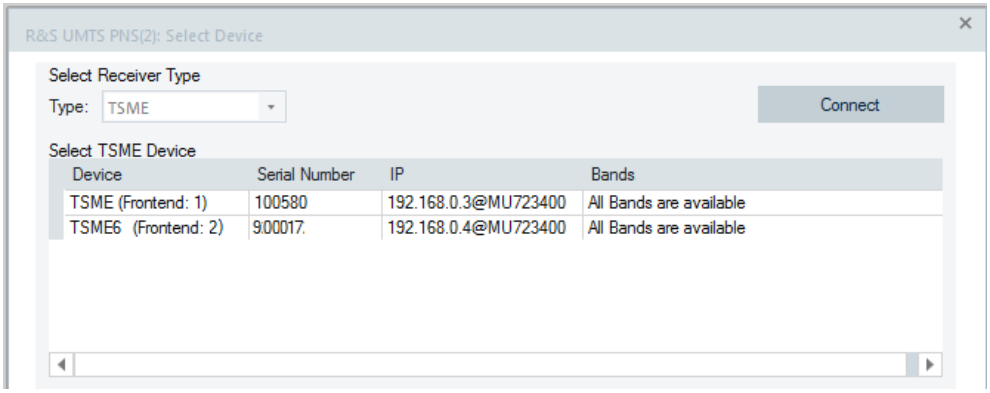


Figure 6-1: Loaded scanners

2. Click the "Connect" button.

   The corresponding R&S ROMES4 driver is loaded into the connected device. Once the test device is loaded in R&S ROMES4 it becomes active and can be configured according to wanted measurements.

The activated test devices are shown in the upper part of the Device Manager window and ready for further configurations.

It is also possible to activate test device by right mouse click the selected device. The context menu opens offering some possibilities, like test device activation with a pre-configured template, wizard, or a ready-to-use profile (i.e. FTP download).

R&S ROMES4 adapts to the number of devices automatically. The maximum number of devices is 16, which is an internal limit.

6.1.2 Hardware dialog for loading devices

To load a device, select the "Hardware" > "Connect/Disconnect" menu entry, or simply load the desired configuration file.

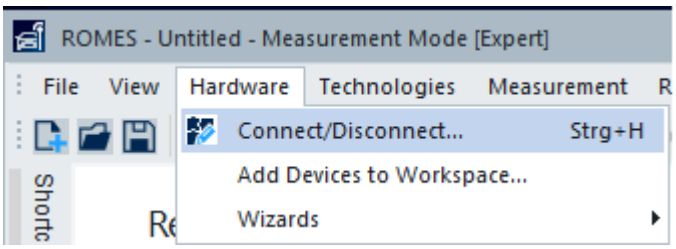


Figure 6-2: Hardware menu - connect/disconnect devices

Available devices supported by R&S ROMES4 are displayed in the "Hardware Configuration" window.

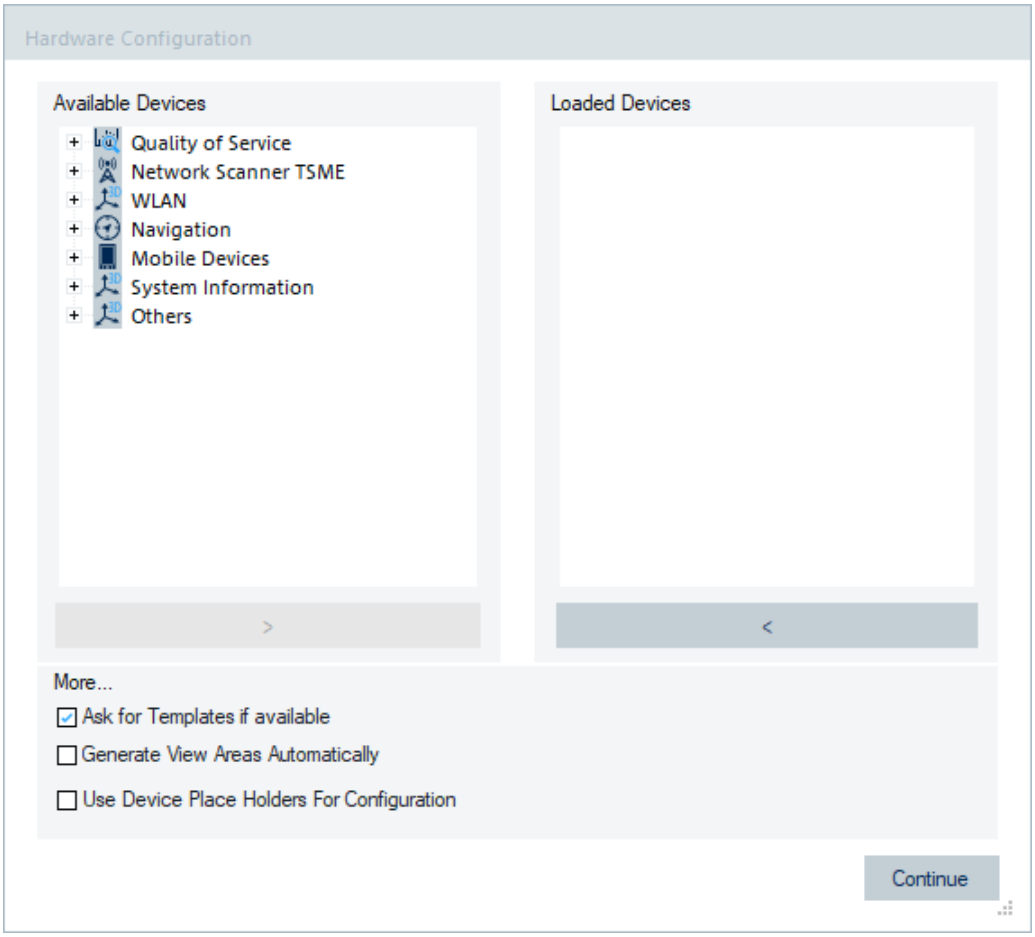


Figure 6-3: Hardware configuration window

The devices are grouped according to their functions.

The order of the groups and devices in a group changes dynamically. The group with the most accesses is listed on the top. The group of the devices with the most accesses is visible on the first level in the "Available Devices" pane.

The following table shows devices groups and devices, available at the time of writing.

Table 6-1: Available device groups and devices

Device group	Device
Navigation (GPS and indoor devices - only one can be loaded at a time)	Indoor Input MAVLink NMEA GPS (most GPS devices) HE 300 GPS Compass Simulator GPS (formerly: Dummy device) R&S TSME GPS U-Blox (R&S TSMX-PPS) GPS
Mobile Devices (chipset-based mobiles, WiMAX cards etc.)	Generic Mobile GSM / WCDMA Samsung Chipset (Phone, 3GPP) Qualcomm Chipset (3GPP/3GPP2) Neul Chipset Sepura Radio TETRA Mobile via PEI
Quality of Service	Data Quality Analyzer Speech Quality Analyzer
Others	BTS Position Estimator
System Information	System Information
Network Scanner R&S TSME family	R&S TSME 5G NR Scanner R&S TSME6 LTE C-V2X R&S TSME LTE R&S TSME WiMAX R&S TSME GSM R&S TSME CW R&S TSME cdma2000® 1xEVDO R&S TSME NB-IoT R&S TSME RF Power Scanner R&S TSME TETRA R&S TSME WCDMA
WLAN	WinWLAN

The ">" button click or double-click the selected device in the "Available Devices" list opens the "Assign Ports to <variable>." window. If the ports are assigned to device, it is loaded and is shown in the "Loaded Devices" pane. The ☐ checkbox in front of the loaded device indicates that the loaded device is not active. Click the checkbox to activate it.

The applications "Quality of Service", "System Information", "Others" and the "Navigation" > "Simulator GPS" available in the "Available Devices" branches are automatically active when selected for loading.

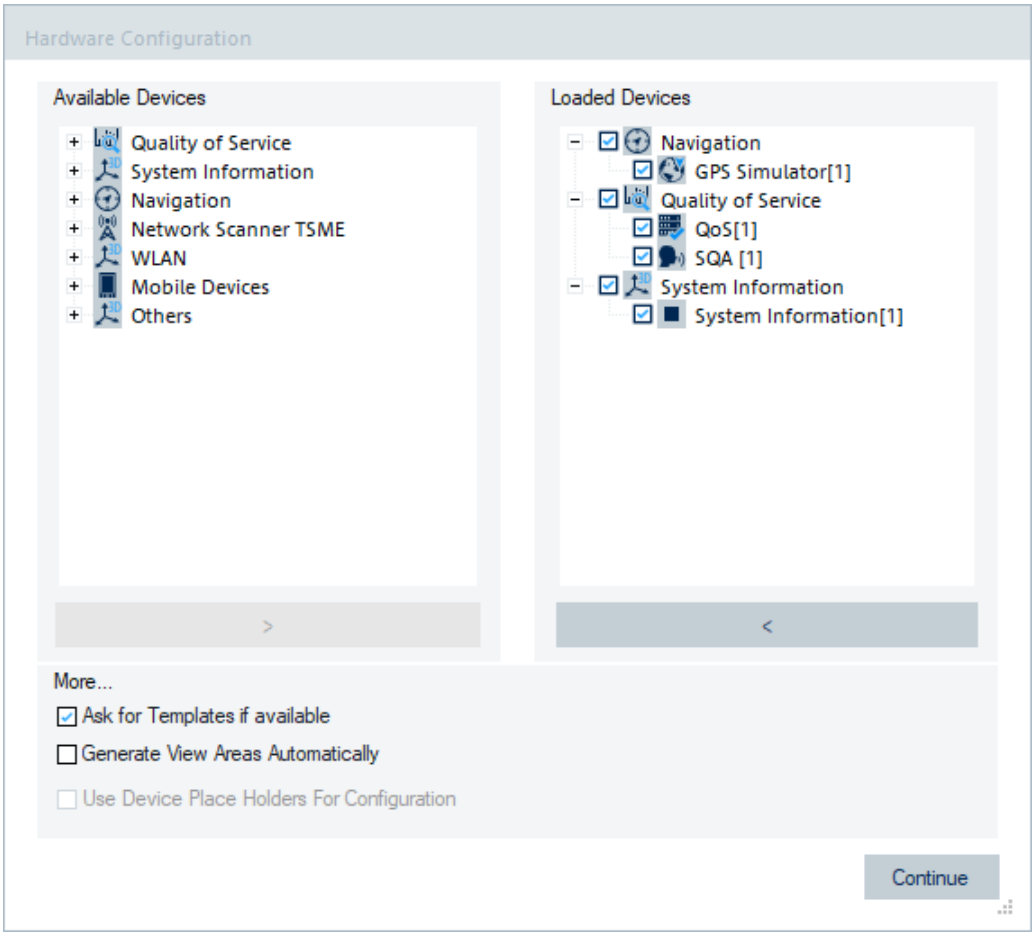


Figure 6-4: Loaded and active devices

Click the "Continue" button to let system accept and save the configuration of devices. The command also closes the "Hardware Configuration" window.

The all loaded devices are then displayed in the "Hardware" menu, which indicates if a device is in inactive state. Only the loaded and activated devices are displayed in the "Devices" window which pops-up if you click the "Device" bar on the left-side of the R&S ROMES4 main window.

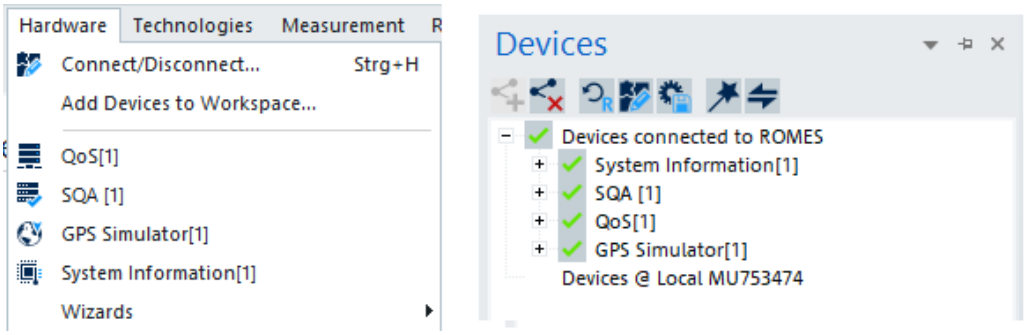


Figure 6-5: Windows to see loaded devices

Now we deactivate the loaded SQA device, for example.

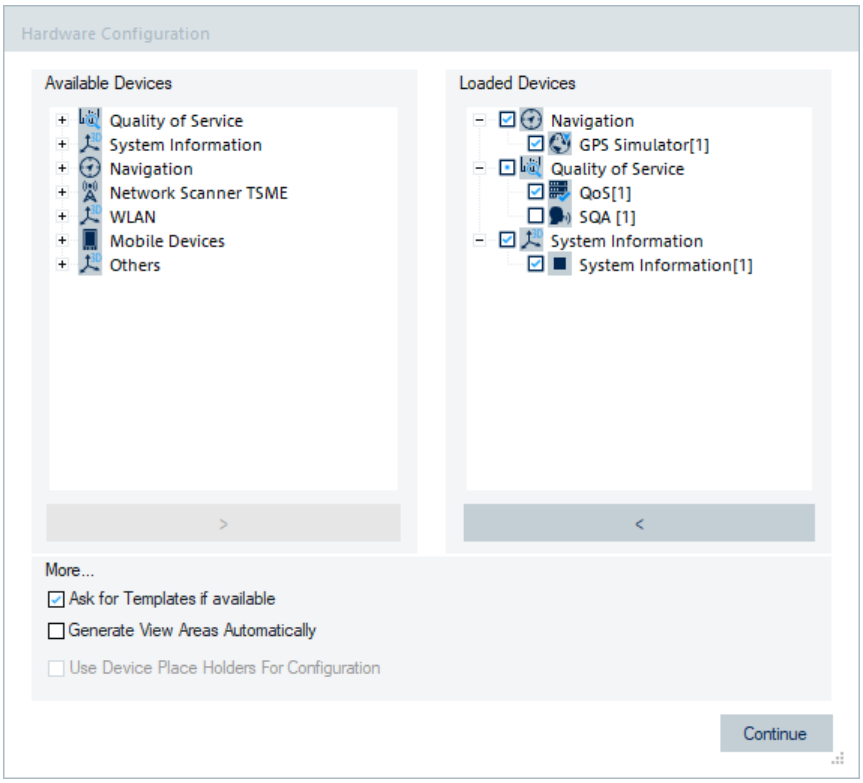


Figure 6-6: SQA is not active

The state of a device is always stored within the workspace file. The following figure displays the difference of the content of loaded devices in mentioned menu and window. Inactive drivers are marked in the "Hardware" menu.

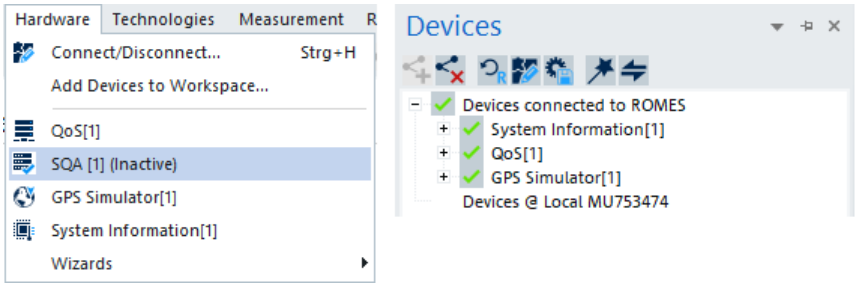


Figure 6-7: Windows to see loaded devices and states

For understanding of how devices are connected and interdependent with other devices we mentiondata quality testers. They are displayed as children of their corresponding mobile devices. If a mobile is removed, its dependent tester is removed as well. Activating or deactivating a mobile or DQA automatically does the same to its child or parent, respectively.

The "<" button removes a selected loaded device from the "Loaded Devices" pane and accordingly from the previously mentioned menu and window.

More
The loading options for the available devices/drivers are controlled with the functions contained in lower, the "More" pane of the window.

- "Ask for Templates if available"
  If the driver is loaded and this option is checked, R&S ROMES4 looks for related device templates stored in the driver directory of R&S ROMES4 and displays a list of the found ones. The device can be loaded with default settings or with the settings stored in any of the templates found.
- "Generate View Areas Automatically"
  If checked, R&S ROMES4 automatically generates a view area depending on the loaded device. After loading one or more devices, R&S ROMES4 displays automatically some view areas with the most important views concerning the loaded device.
- "Use Device Place Holder for Configuration"
  If checked, configures R&S ROMES4 measurement workspaces and mobile devices, scanners and GPS devices without actual devices attached to a PC on which R&S ROMES4 is running. See for details Chapter 6.1.13, "Place holder", on page 1503.

Continue
Confirms the port assignments, loads the device with the configuration settings suitable for the connected device type and closes the "Hardware Configuration" window.

6.1.3 Connection via COM port

Click "Hardware" > "Connect/Disconnect" to open the "Hardware Configuration" window. It shows available and loaded drivers.

The left-hand field shows a list of all available devices drivers.

Click ">" button to get the "Assign Ports to <variable>" dialog for assigning a COM port to the selected device driver, as shown in the following screenshot for generic mobile.

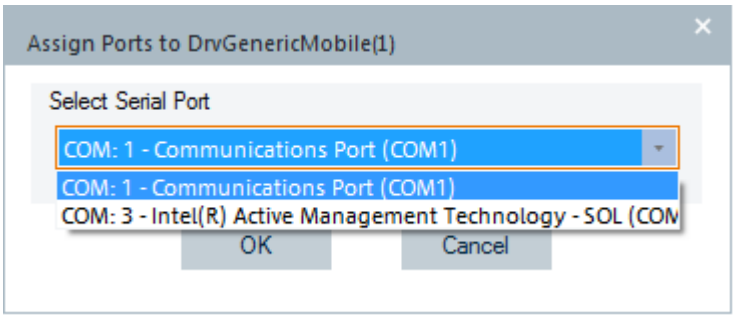


Figure 6-8: Assign ports to generic mobile driver

There is an automatic verification if the COM ports are available. Only free ports are offered in the pull-down list.

Assigning COM ports to several drivers can be done by repeating the process via the "Assign Ports to <variable>" dialog.

The dialog provides the following entries.

Serial Port	Assigns a port to the driver to be loaded. Select a port from the pull-down list if the current assignment is to be changed.
OK	Confirms the port assignment and closes the window. The driver previously selected in the "Available Drivers" list is initialized (loaded) and finally entered in the "Loaded Drivers" list. The progress of the procedure is monitored in a displayed window.
Cancel	Discards the made changes and closes the window.

If the initialization of the mobile driver fails (e.g. because no mobile of appropriate type is available at the serial port), R&S ROMES4 displays the following message.

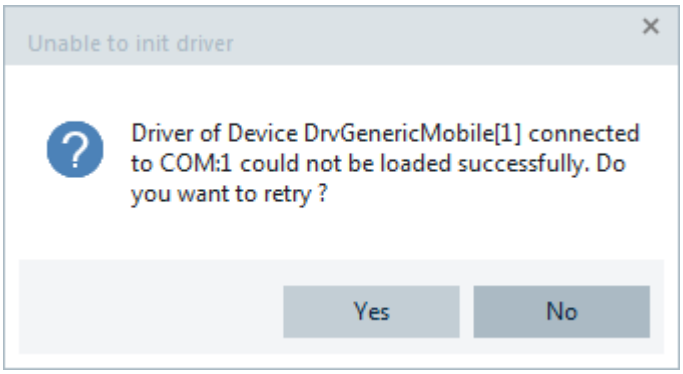


Figure 6-9: Unsuccessful loading of the driver

In this case, check the connection and verify if the correct port has been selected.

It can be necessary to add one driver type several times, for example, if several mobiles of the same type are used. A number in brackets displayed behind the device type denotes the number of allowed drivers. Several different ports can be assigned to a same mobile driver.

6.1.3.1 NMEA GPS

R&S ROMES4 drivers check the COM port name during the automatic driver detection.

The NMEA GPS device supports by default the most common GPS names. However, some special system setups can result in different COM port names.

These port names can now be specified in an XML file which is read by R&S ROMES4. The content of the file is then added to the internal list of COM port names.

Locate the XML file in the My Documents\My ROMES\Configuration `\NMEA_COM_Ports.xml` folder.

The content is a list of port names,

```
<?xml version="1.0"?>
<COMPorts>
```

```
<COMPort Name="serial port emulator" />
</COMPorts>
```

6.1.3.2 Splitter box (mobiles supporting GPRS)

The test mobile devices which support GPRS measurements must use a splitter box. This additional device is connected to the mobile and to the power supply.

The splitter box separates the trace and data interface of a mobile. The trace interface corresponds to the normal GSM test mobile mode except GPRS. The data interface represents an extension that is used for GPRS data transfer. Three different modes can be set at the mobile.

Table 6-2: Trace interface modes

Trace	Route the trace interface to "SL1"
Data	Route the data interface to "SL1"
Trace/Data	Route the data interface to "SL1", the trace interface to "SL2"

The two outputs "SL 1" and "SL 2" of the splitter box can then be connected to two separate COM ports. The COM ports can be assigned in the "Assign Ports to ..." after the "Use Splitter box ..." option is checked.

GPRS test mobiles from Qualcomm can be connected via USB interface, see Chapter 6.1.4, "Connection via USB interface", on page 1456.

These special COM ports are only available as long as the mobile is connected to the PC and powered on.

6.1.4 Connection via USB interface

Most of the test mobile devices are connected to a host PC via USB port/cable using an appropriate driver. Physical COM ports are not needed. The USB drivers are already pre-installed on controllers from Rohde & Schwarz.

Support of Rich Communications Service (RCS)

To boot a test mobile device if connected to the USB port, the following setting has to be configured on the device:

- `adb shell`
- `su`
- `setprop persist.sq.autoboot 1`

6.1.4.1 Installing the USB drivers

The USB drivers are mobile-specific and located in the subdirectory on the R&S SmartONE installation data package.

To install the driver for your test mobile device:

1. Go to the relevant subdirectory related to your test mobile type.
2. Follow the instructions in the `Readme.txt` files or in the `Readme.pdf` installation instructions.

   During the installation, MS Windows creates the necessary number of virtual COM ports and attaches them to the test mobile devices.

Many mobile devices require more than one virtual COM port (Qualcomm chipset-based test devices).
Do not run R&S ROMES4 while installing drivers for such devices. R&S ROMES4 automatically detects device after installing the first virtual COM port, but the device cannot be used by R&S ROMES4 until all ports are available. To avoid the confusion, the driver must be fully installed before starting R&S ROMES4.

6.1.4.2 Loading the USB drivers

Once the USB drivers are installed on the system, they can be loaded to mobile device following the procedure outlined in Chapter 6.1.3, "Connection via COM port", on page 1454.

One of the virtual COM ports created during the USB driver installation can be assigned to the 1st port (data interface), the 2nd port (AT interface) and the "Modem Port" (data interface). The three virtual COM port numbers must be different.

The second port is optional but is required for autodialing. Assign always all three ports.

The operating system does not reliably delete unused virtual COM ports if USB devices are connected and disconnected repeatedly. Delete redundant USB ports using the Device Manager if a large number (30 or more) of ports has been created. To access the Device Manager, choose the Windows "Start" > "R&S ROMES" > "Device Manager<version>" option.

6.1.4.3 NDIS interface

To use the NDIS interface, select the "NDIS Interface" option in the "Assign Ports to <variable>" dialog. R&S ROMES4 searches for available NDIS interfaces on the host PC. If at least one NDIS interface is found, the NDIS option gets active. You can select the desired NDIS interface in the "NDIS" combo box.

If there is no NDIS interface available, the message that NDIS interface is unavailable is displayed and the options for the NDIS interface is grayed out.

Connect mobile from the device tree

A mobile is loaded without an available NDIS driver if the loading is made from the device tree via "Connect" or "Connect with Wizard".

Option data cards

Qualcomm option data cards

The R&S ROMES4 driver for Qualcomm chipset-based devices supports the NDIS interface called GTNDIS.

The DQA "Connect to Network" job offers this interface using the DQA Dialup option. For the job, refer to Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891.

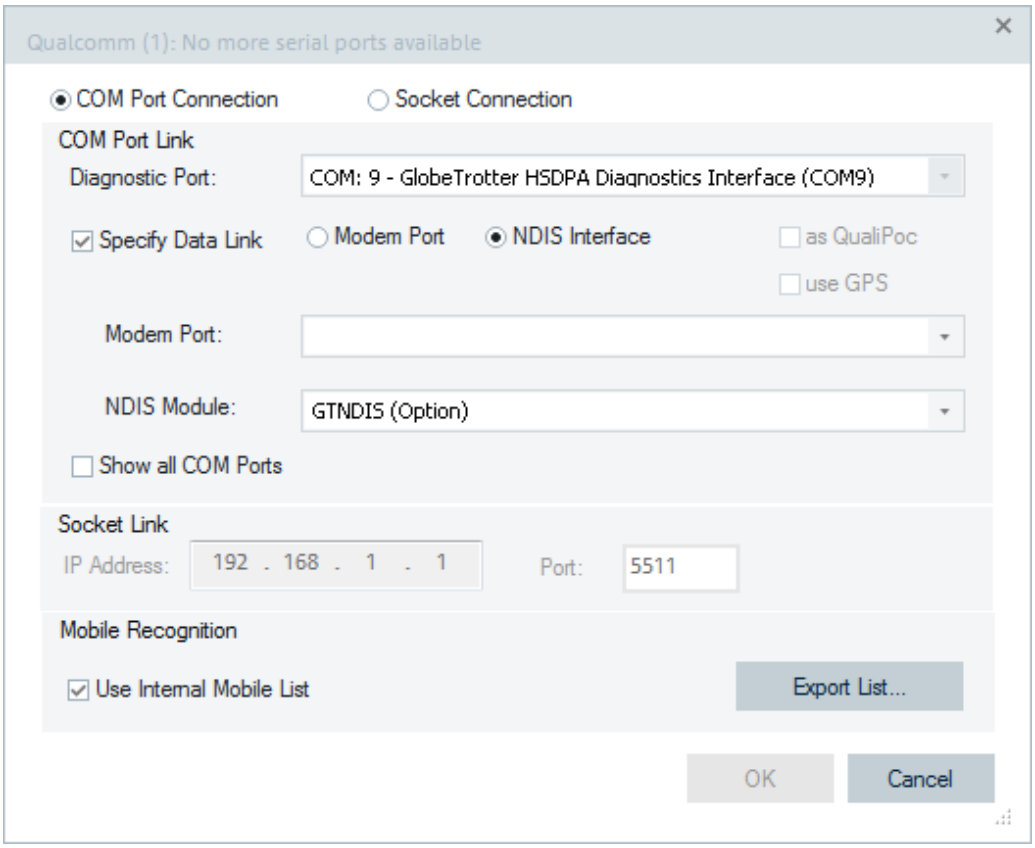


Figure 6-10: Assign ports to Qualcomm chipset-based device

Samsung option data cards

The R&S ROMES4 driver for Samsung chipset-based devices does not support NDIS interface.

Sierra Wireless AC875 PC card

The NDIS interface supports the Sierra Wireless AC875 Edge/UMTS PC card. Unlike the Option Card, the Sierra Wireless NDIS interface does not support AT Commands. For this card, specify a modem port to be able to communicate with the card, see the previous figure.

Select "Sierra Wireless DM Port" and "Sierra Wireless AT Command Port" if using NDIS. Ensure that the Watcher is not running during the R&S ROMES4 session.

Sierra Wireless NDIS update

The R&S ROMES4 supports Sierra Wireless devices drivers for the latest NDIS version. It is highly recommended to update the drivers for the device at least to version 6.20.0.18. The version is displayed by the Sierra Wireless Watcher in the "Info" dialog.

6.1.5 Network cards with MS Windows

If a network data card is connected to a measurement device (laptop or PC) running on MS Windows operating systems, the mobile drivers can recognize the network card as device. After recognizing the device, the drivers provide this information to R&S ROMES4.

The information is necessary for the use of Windows Mobile Broadband with DQA.

If connected, the network card is then displayed in the "Devices" window docked on the left side of the R&S ROMES4 window. If the device appears, it can be loaded via "Hardware" > "Connect/Disconnect" and is available in the DQA Connect job.

The major advantage is that R&S ROMES4 checks for NDIS support apart from detecting modems. R&S ROMES4 shows the capabilities of all detected devices under the "Settings" of the "DQA Connect" job. You do not need to click the NDIS radio button to find out whether NDIS is supported by the card.

NOTICE

Device assignment

The assignment of devices such as modems, serial ports and network cards depends on MS Windows Registry entries. The algorithm is complex and is based on undocumented key properties. Possibly, it does not work with all devices which are currently available. If the network card is not assigned correctly to the mobile device, contact the Rohde & Schwarz customer support.

Successful tests were made with several devices from Huawei and Sierra Wireless.

MS Windows can support multiple cards

Systems using MS Windows and R&S ROMES4 version 4.63 (or later), can use several network cards.

Furthermore, the MS Windows Mobile Broadband function automatically checks for NDIS functionality and offers it in the "Settings" dialog of the "DQA Connect Job".

6.1.6 Improvements of mobiles handling

6.1.6.1 Mobile device connection

The ADB ID and IMEI are stored to the workspace together with the used COM ports. Their port numbers are only used to reconnect to the mobile device when the workspace is loading.

While loading a mobile device, R&S ROMES4 checks first if the ADB ID is available, then checks the IMEI availability. If the driver finds the ADB ID or IMEI in the set of available devices, it takes the COM port numbers of those devices to connect.

Only if both are not found, the driver tries to connect to the COM port number of the workspace.

6.1.6.2 Mobile device connection to DQA

If available, the ADB ID is used instead of IMEI to identify the connection between the Qualcomm chipset-based devices and a Data Quality Analyzer (DQA). The same identification applies for the smartphones using Samsung chipset-based devices connection to DQA.

6.1.6.3 Using multiple mobiles

If the measurement setup requires more than four mobile devices, open the "Overview Views" automatically. Check the "Generate View Area Automatically" and "Overview Views only" checkboxes in the "Tools" > "Preferences" page.

6.1.6.4 Loading fully integrated devices

By launching the SmartONE, R&S ROMES4 connects the fully integrated mobile devices (UE in further text) without the necessity for external diagnostic ports. The approach matches the one in Smart Benchmarker. It means that the trace information from diagnostic ports is internally routed through the UE and transferred to R&S ROMES4 via ADB Interface.

This approach has lots of benefits, such as:

- Only ADB (classic Qualcomm/Samsung) drivers are needed to connect the fully integrated devices to R&S ROMES4.

- Operation approach as in Smart Benchmarker.

- Faster and easier setup time for the SwissQual (SQ) fully integrated devices.

- More operation stability without need for the stable diagnostic ports (especially for 5G UEs with two diagnostic ports).

- Devices with external diagnostic trace need open diagnostic ports.

- On PC testing (Classic mode) use mode is not available for SQ fully integrated devices.

- Fully integrated device + GPS use mode is only available if "Offer GPS for QualiPoc Devices" is activated in "Performance" > "Advanced Settings".

R&S ROMES4 checks the installed QualiPoc (QP) version of a fully integrated device like it is done for a device with external diagnostic trace. If R&S ROMES4 SW brings the newer QualiPoc version compared to the one installed on the device, R&S ROMES4 outputs the question if the device has to be updated.

After having loaded a mobile device as fully integrated device via the "Welcome" page, the configuration page of the associated QoS tester opens automatically (default). All the device's configuration tests are integrated in the QoS tester.

The SQA section added to a device's welcome page shows if the device makes MOC or MTC and the current MOS value.

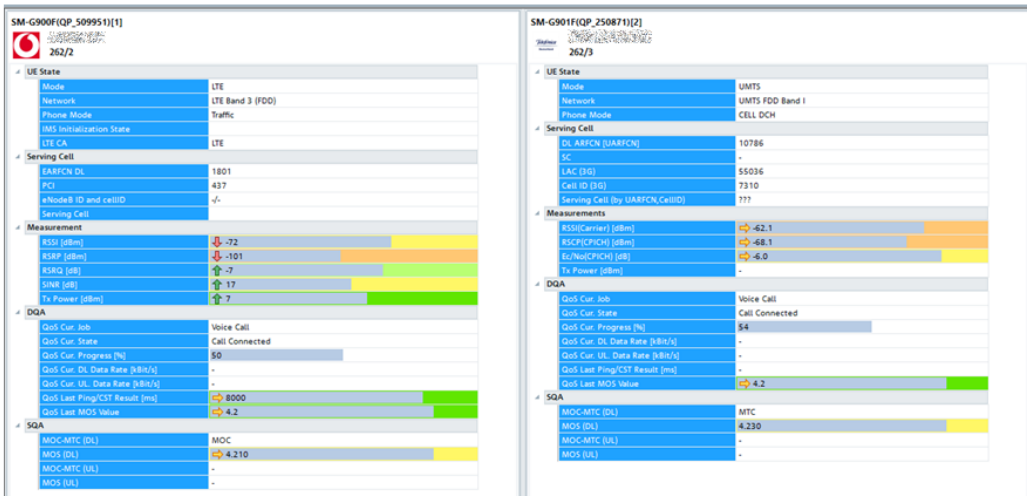


Figure 6-11: Layout of the SQA section added to QoS tester

An SQ fully integrated device can be loaded via the "Hardware" > "Connect/Disconnect" dialog if you for any reason do not want to load it from the "Welcome" page. Both Qualcomm and Samsung Exynos chipset-based mobile devices support this possibility.

By default, the already detected devices are loading directly from the opening "Welcome" page.

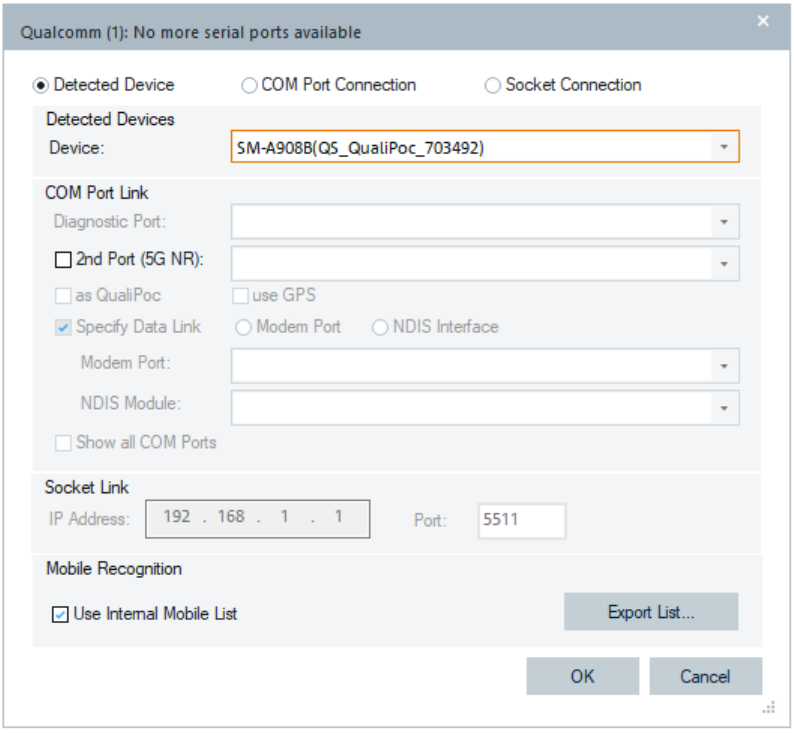


Figure 6-12: Connect device dialog for Qualcomm UE

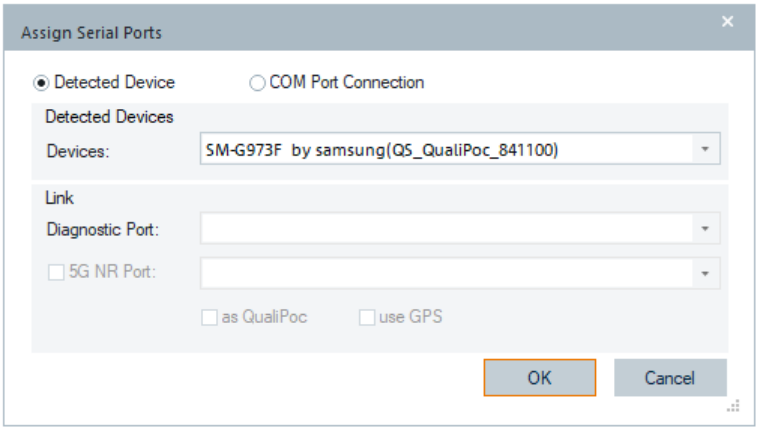


Figure 6-13: Connect device dialog for Samsung UE

If the connection via COM port is required, choose the "COM Port Connection" port assignment.

6.1.6.5 Identification of fully integrated devices

R&S ROMES4 displays the connected and loaded fully integrated mobile devices (QualiPoc) with a dedicated symbol in the "Available Devices" part of the "Welcome" page.

The following screenshot displays the QualiPoc devices connected to R&S ROMES4 in the list of available devices after their loading. The symbols associated with the available devices indicate their maintenance status, see "Handling a maintenance period of fully integrated mobile devices" on page 1464.

Figure 6-14: Available fully integrated mobile devices

The symbol of the QualiPoc devices changes when they become available in comparison to the symbol when they are connected but not yet loaded.

The configuration page of a fully integrated device contains the "QualiPoc Settings" tab to identify it.

Click the tab to open the dialog. The device's name is displayed for one second in the "Unit Name" box. The displayed names help handling more devices connected to R&S ROMES4.

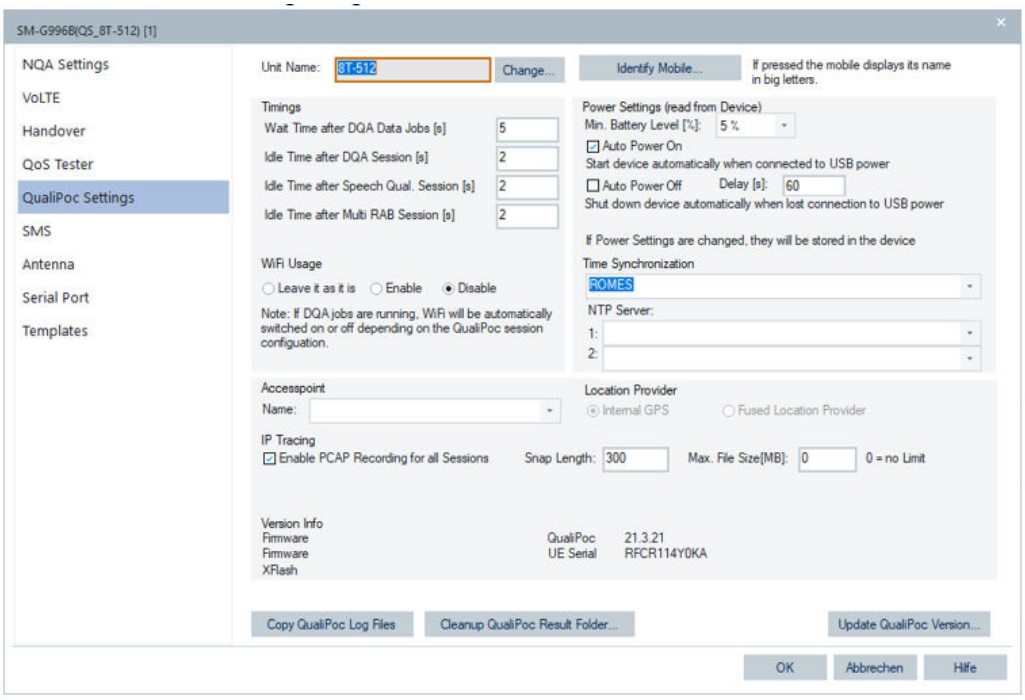


Figure 6-15: Mobile identification

Handling a maintenance period of fully integrated mobile devices

R&S ROMES4 implements the strict enforcing which prevents the application to run on fully integrated mobile devices (QualiPoc) when out of maintenance period. R&S ROMES4 warns you on time about a maintenance period expiry.

R&S ROMES4 detects the maintenance period of a QualiPoc device and provides an indication in the "Welcome" page using the device's symbol.

The symbol of the available QualiPoc fully integrated mobile device changes when its license of maintenance period is going to expire or has already expired. These symbol changes serve as warning and error messages, respectively. The warning symbol is shown the first time 90 days before the expiration date. The three possible maintenance states of the QualiPoc fully integrated mobile devices and the associated symbols are displayed in the following figure.

Figure 6-16: Symbols displaying the status of the maintenance period

6.1.7 Qualcomm mobile wizard

If a device is connected via Qualcomm device driver, R&S ROMES4 requires some basic information about it. R&S ROMES4 has a large database which holds this infor-

mation for many different mobile devices. However, new devices are introduced more and more frequently.

It is possible to add new mobile devices to the R&S ROMES4 database with the Qualcomm wizard.

A mobile device information can be added to an external database which is an XML file. To enter the information, it is necessary to edit the XML file and add the data manually. The information about new Qualcomm chipset-based devices is entered automatically with the Qualcomm wizard.

Whenever you connect a Qualcomm chipset based mobile device which cannot be recognized by R&S ROMES4, the wizard pops up.

Follow these steps to integrate a new Qualcomm chipset based mobile device into R&S ROMES4.

1. Ensure that all necessary COM ports (diagnostics and modem port) are available. Usually, the ports are opened for data cards but some mobiles need a special code for the cards.
2. Connect your device to the computer.
3. Start R&S ROMES4.
4. Open the "Load Hardware" dialog ("Hardware" > "Connect/Disconnect").
5. If R&S ROMES4 cannot find the COM ports associated with the device, check the "Show all COM Ports" box.
6. Select the diagnostic and modem ports of the device.
   For diagnostic port configuration, see "Device Configuration" on page 271. The handling of the diagnostic port per IP connection is so that R&S ROMES4 reconnects to the device, if for any reason the IP connection is disconnected during the measurement.
7. Click "OK".
8. If the connected device cannot be found in the database, as mentioned, the wizard pops up.
9. The first appeared dialog provides some basic information which the device read. Click "Next".
10. The next dialog requests information on technologies that the device supports. Select the appropriate entries from the "3GPP" and "3GPP2" sections.

    Note: R&S ROMES4 automatically reads out the HSDPA category from the RRC connection setup message during a measurement. This information is used by default. If RRC connection setup is not available, the HSPDA category specified here is taken.

11. The next dialog requests the information about the setup of the circuit switched calls. If you do not intend to initiate the circuit switched calls with the device, select "CS not supported".
    The option "Keyboard Emulation" means that R&S ROMES4 sends commands for pressing the keys on the keypad to the device. The devices which have real key-pad usually do not support these commands. If you select this option, you see the dialed number in the display of the mobile device.

    Using this option you can specify two additional parameters:
    - Increase the pause between by pressing the keys if the device does not dial the given number correctly.
    - Increase the Interface
      Pause before answering if the device does not answer incoming calls correctly. This case can happen in devices which have to change the user interface before making possible to press the answer button.

    The option "AT Commands" is suitable for data cards, which allows you to initiate circuit-switched calls.
    Click "Next" to continue.

12. Now R&S ROMES4 tries to detect automatically:
    - NDIS interface, if available.
    - Extended AT command set, if available. To force the device to a specific RAT, you need the command set.
    - Information how to handle the PIN.

    After the auto-detection has finished, a dialog window appears. It shows the results of this process.

13. In the dialog window, decide if to use the detected features. For example, if you do not want to use the NDIS interface, select "none (use Dialup Network)".
    Click "Next" to continue.

14. The next dialog displays the name that R&S ROMES4 assigned to that device. It is still possible to adapt the proposed name.
    The other two edit fields show the names of the diagnostic and modem ports. It is still possible to change these names, but usually it is not necessary.
    Click "Next" to continue.

15. A summary window opens and displays the configuration that is stored into the external database. Click "Finish" to finalize the setup of the new device.

    R&S ROMES4 tries to load the device using the information that was added to the external database.

    If the new device is configured well and the information is successfully added to the external database, the added Qualcomm chipset-based device is loaded successfully in R&S ROMES4.

6.1.8 Qualcomm chipset based mobile devices

It is possible to install some updates which allow R&S ROMES4 to recognize Qualcomm chipsets-based mobile devices.

If integration of a new device into R&S ROMES4 is required, the procedure is performed in the following steps:

1. MS Windows drivers offering access to the Qualcomm diagnostic and modem ports have to be available.
2. Send the device to Rohde & Schwarz.
3. The Rohde & Schwarz personal tests the device with the latest released R&S ROMES4 version.
4. If no technical problems occur, an installation setup is created within a short time frame. This setup is published to all customers.
5. In the rare case when the device reports new log versions, the R&S ROMES4 has to be adapted and tested carefully. In this case the device is integrated with the next R&S ROMES4 version.
6. All integrated devices are automatically the part of the next R&S ROMES4 version.

   The list of the supported Qualcomm chipset based devices is created.

The list of supported devices based on Qualcomm chipsets is composed of three parts:

- Internal hard-coded list of the R&S ROMES4 Qualcomm driver
- Users list, created by the Qualcomm wizard, see Chapter 6.1.7, "Qualcomm mobile wizard", on page 1464 for the wizard
- List of also installed UEs

To get the actual composed list of supported UE, click "Help" > "Loaded Modules" in the R&S ROMES4 toolbar. The "Available Options" window displays all the loaded modules and associated information as well as the found licenses and sales options.

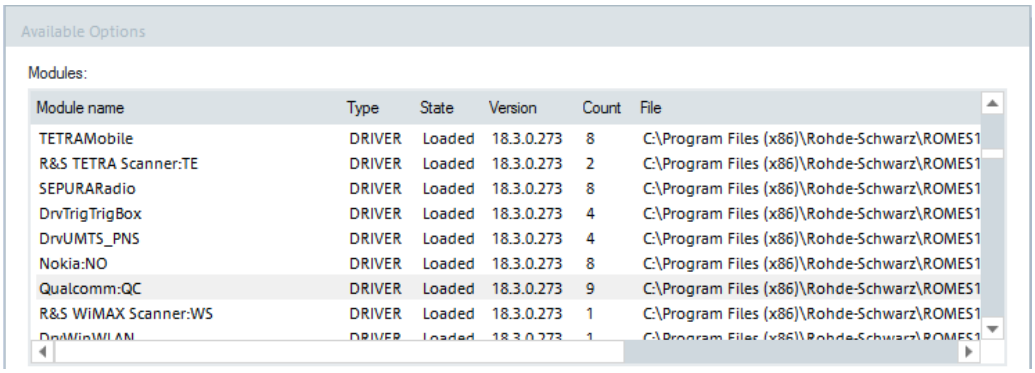


Figure 6-17: Loaded modules

Select the "Qualcomm:QC" line and press the "Detailed Information" button. The pop-up dialog displays the list of the supported Qualcomm chipset based devices.

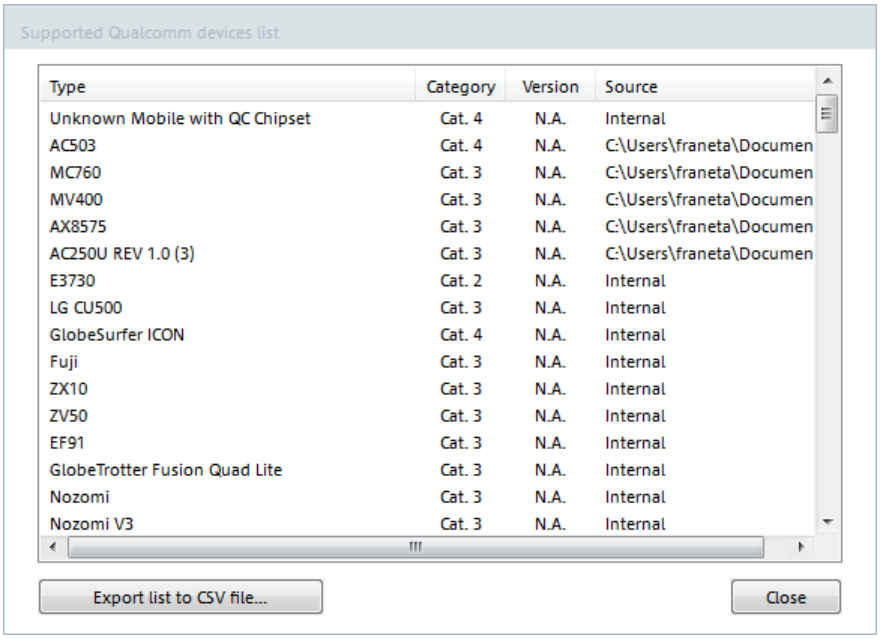


Figure 6-18: List of supported Qualcomm devices

The "Export list to CSV file" button lets you save the list of supported mobiles to a `*.csv` file.

6.1.8.1 Connecting Qualcomm chipset based mobiles

The supported Qualcomm chipset-based devices are the composite mobile devices which require two virtual COM ports.

Connect the test mobile device to the USB port of the PC to load it. Once the USB drivers are installed on the system, they can be loaded to mobile device following the procedure outlined in Chapter 6.1.3, "Connection via COM port", on page 1454. If one of the Qualcomm chip-set based device is loaded, R&S ROMES4 opens the page shown in Figure 6-10.

During loading, the MS Windows enumerates the device which is necessary to add it to the USB mobile device internal list.

Certain mobile device types cannot be numerated during loading. The previously referred page contains the "Use Internal Mobile List" combo-box and the "Expot List" button in the "Mobile Recognition" pane.

These two options in the pane are function as following:

- "Use Internal Mobile List"
  If unchecked, the internal mobile list is ignored while assigning the COM ports to Qualcomm chipset-based mobile devices.
  The option is used to force opening of the mobile wizard to integrate a new mobile type. This integration is necessary if the internal mobile recognizes a wrong type. Once the wizard integrates the new mobile successfully, it is not necessary to ignore the internal mobile list anymore. The list created by the wizard is always checked before the internal list.

- "Export List"
  Press the button to export the list of supported mobiles to a `*.csv` file.
  (*) Category 1 means that the mobile is permanently used for tests, Category 2 means that the mobile was tested successfully at least once.

Parallel loading of Qualcomm chip-set mobile devices

The Qualcomm chip-set mobile devices can be initialized and loaded in parallel if you add the registry key `HKEY_CURRENT_USER\Software\Rohde & Schwarz\Romes<version>\General\AllowParallelQCInit` and set its value to 1. This setting decreases significantly the loading time of a workspace with many Qualcomm chipset-based mobile devices,

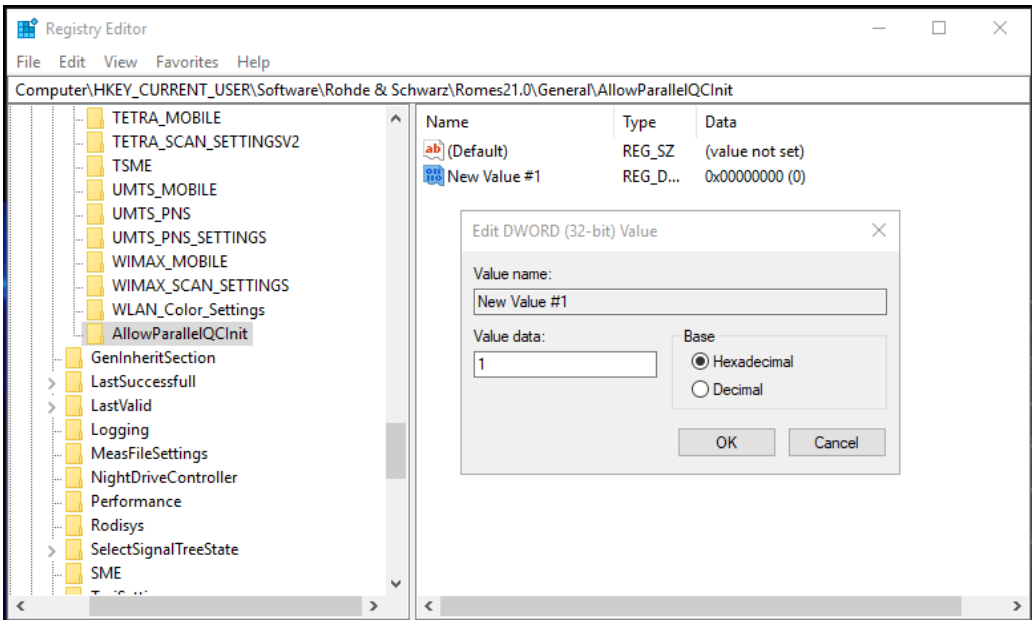


Figure 6-19: Adding QC registry key

If you load a device from scratch, you still have to do it one by one.

The feature is intended for experienced users only.

6.1.8.2 MAC CE UL analysis support

R&S ROMES4 supports display of the evaluated MAC control elements (CEs) in uplink direction of Qualcomm chipset based mobile devices. Displayed is the current uplink buffer status per logical cell groups and the power headroom for LTE and 5G NR UEs.

The signals which visualize the MAC CE uplink data are included in the "Signal Tree" >"LTE UE" > "MAC CE UL" branch for LTE UEs and in the "Signal Tree" > "5G NR UE" > "BSR Buffer Status"/"Power Headroom" branches for 5G NR.

For the signals description, see the "Description of R&S ROMES4 Supported Signals" document.

6.1.8.3 Qualcomm MTP 5G NR mobile support

R&S ROMES4 supports the Qualcomm form-factor Mobile Test Platform (MTP) for 5G NR.

The MTP allows the 5G test user insight to standards-compliant 5G NR testing before the commercial devices are ready for testing. The R&S ROMES4 support lets you achieve test data from a 5G NR network.

Use the three installed widget templates as a starting point for setting up a 5G NR grid view, see "Templates" on page 512.

Connecting the Qualcomm MTP 5G NR mobile

The Qualcomm chipset-based devices offer two diagnostic ports. The MSM port is the port for LTE chip, the MDM port is the port for the 5G NR chip. As the R&S ROMES4 supports dual port recording, the SW logs in parallel the trace output of both chips.

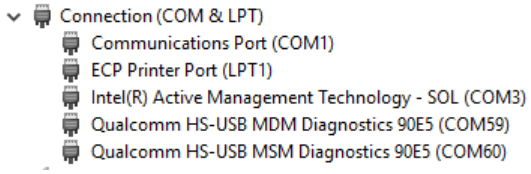


Figure 6-20: Available COM &LPT connections

The MTP 5G NR mobile is recognized automatically by R&S ROMES4. It can be connected to R&S ROMES4 either by a double-click the "Welcome" screen or using the "Hardware" > "Connect/Disconnect" dialog.

If using the dialog, be sure to select the MSM port as the main diagnostic port, and the MDM port as the secondary one. The secondary port supports 5G NR logs only.

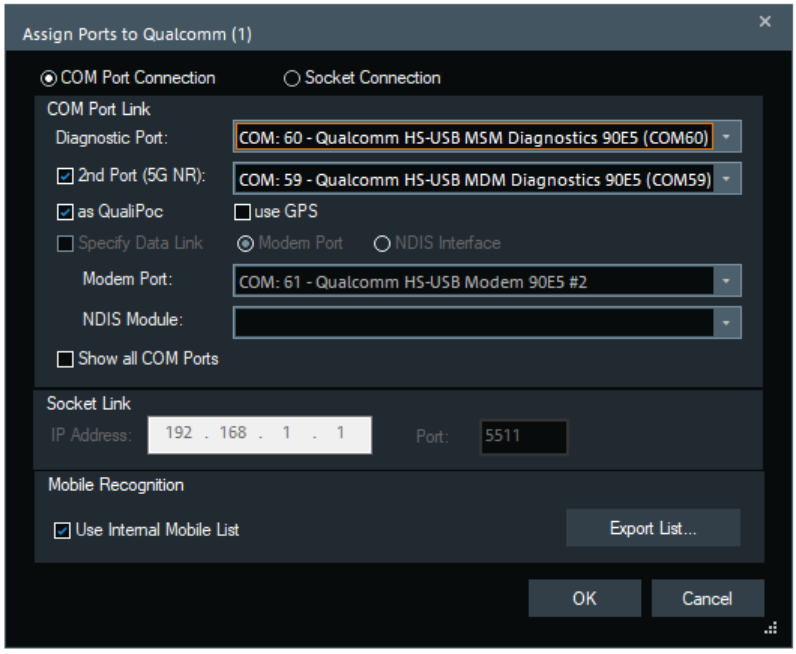


Figure 6-21: Selection of the ports for MTP

The MTP mobile devices can be used as fully integrated devices and On PC testing (Classic mode) devices.

The diagnostic ports can get unstable. In this case, reboot the MTP.

6.1.8.4 PMI evaluation support

Qualcomm chipset-based UE reports PMI to BTS. With the PMI feedback, the UE can report its preferred codebook configuration.

The PMI reports are used in 5G NR by gNB for beamforming and MIMO management when larger antenna configuration, e.g. 64 transceiver active antenna, is used. The gNB is, according to 3GPP specifications not obliged to apply the UE preferred precoding to PDSCH. However, the PMI can be an important input to the beamforming algorithms.

Dependent on the content of gNB RRC configuration message, the UE can include PMI in the CSI reports sent on PUSCH/PUCCH. The PMI values represent a beam and phase shift selection of a virtual antenna that has a layout described in the CSI report configuration Layer 3 IE.

For the Qualcomm chipset-based mobile devices, R&S ROMES4 derives the reported PMI values for Type I Single Panel codebook (i11, i12, i13 and i2) and implements them. The values are visible in the "5G NR TTI View" and are available as R&S ROMES4 signals. For details, see "Evaluated PMI displayed in the view" on page 872.

The Type I Single Panel codebook is configured using the CodebookConfig within the CSI-reportConfig. The "codebookType" must be set to ‘Type1’, while the subtype must be set to ‘TypeI-SinglePanel’.

This R&S ROMES4 feature is rated as an expert feature. It requires some insights into the 3GPP specifications. Refer to 3GPP 38.214 or https://www.sharetechnote.com/html/5G/5G_CSI_RS_Codebook.html for more details and information about precoding, codebooks and PMI reporting in 5G NR.

6.1.8.5 Mobile devices use mode

The following modes to use a mobile device with R&S ROMES4 are available:

- Fully integrated device / fully integrated device plus GPS use mode
  Devices with SwissQual (SQ) Flash (QP mode), loaded as QualiPoc. Such device is used in R&S ROMES4 DQA tests in QP mode.
- Device with external diagnostic trace
  Fully integrated device with the external diagnostic trace, loaded as QualiPoc. Such device is used in R&S ROMES4 DQA tests in QP mode.
- On PC testing use mode
  - Classic mode
    Device loaded without QualiPoc. Such device can execute R&S ROMES4 DQA tests.
  - Classic mode 2
    Classic mobile / IoT device Qualcomm chipset-based and loaded without QualiPoc. Such device can be used for DQA tests only in Classic mode 2, meaning that network adapter needed.

The "Select Mobile Use Mode" dialog lets you select among the supported use modes.

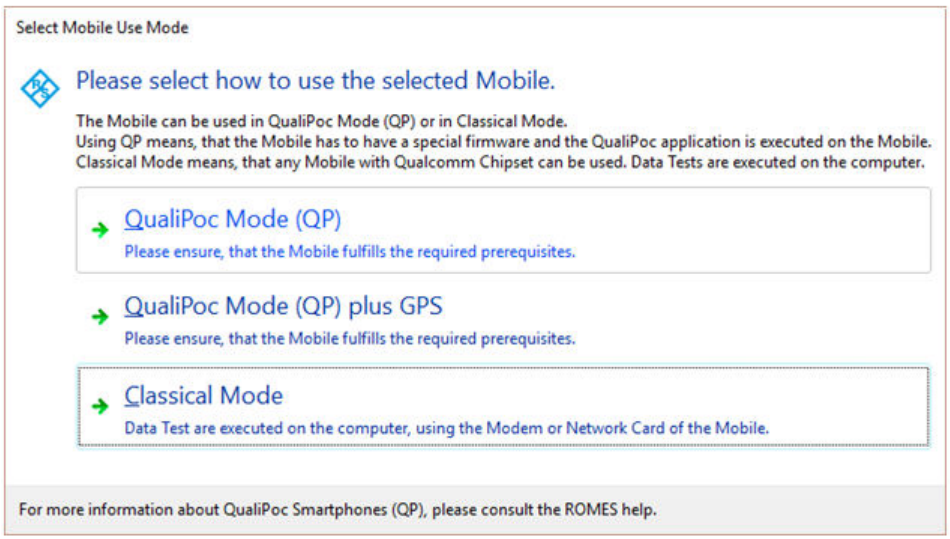


Figure 6-22: Mobile use modes

The following screenshot displays the hardware configuration dialog of the Qualcomm chipset-based mobile devices configured in fully integrated use mode.

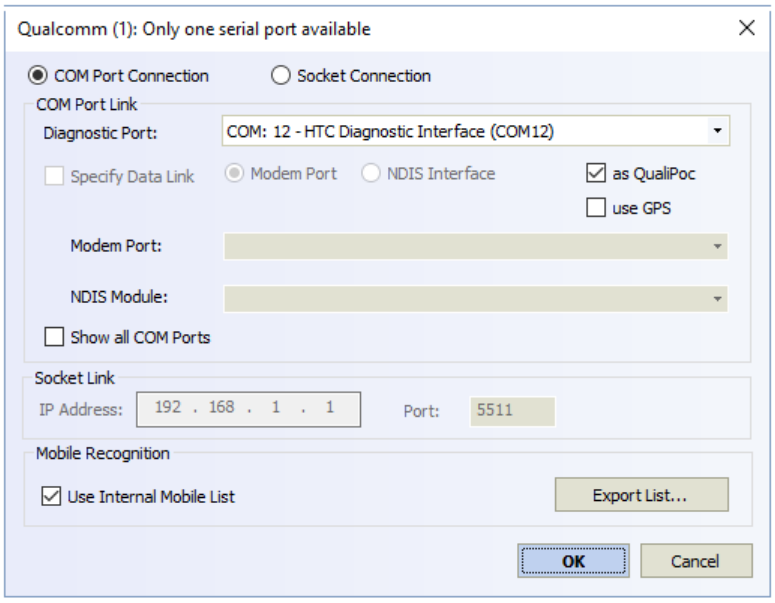


Figure 6-23: HW settings of Qualcomm mobile

If Qualcomm chipset based mobile device is loaded in On PC testing (Classic mode) use mode, the device configuration dialog contains the "IP logging" tab. This tab and its configuration page are not available if a device is configured in fully integrated device mode.

Fully integrated device use mode with or without GPS makes the MOS speech quality measurements with POLQA and SQUAD possible. For the available DQA jobs in this mode, see Chapter 6.5.2, "DQA jobs with Android OS-based smartphones", on page 1961.

To use Samsung chipset based mobile devices in On PC testing (Classic mode) use mode, you need a license per system and a device license per connection.

6.1.8.6 Mobile devices without QualiPoc

The Classic mode 2 is available for selection as the use mode of non-QualiPoc supporting mobiles.

The Classic mode 2 is used to load the non-QualiPoc mobiles. This use mode offers a special set of QualiPoc tests performed on computer.

If loading such a mobile, select the wanted use mode in the "Select Mobile Use Mode" dialog.

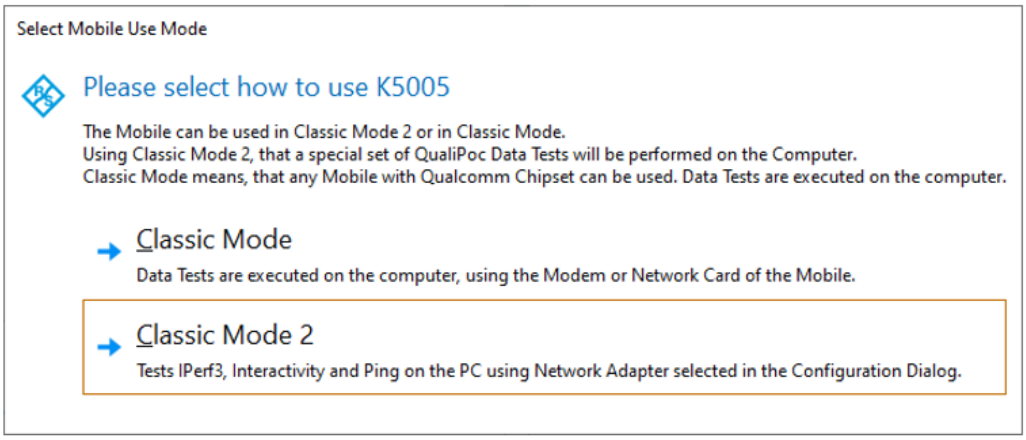


Figure 6-24: Dialog to select use mode of non-QualiPoc mobiles

The Classic mode 2 is supported only by devices with Qualcomm chipset.

For supported DQA jobs, see "DQA jobs in classic mode 2" on page 1969.

6.1.8.7 Data and speech quality test on fully integrated devices

To run data and speech quality tests needed is a fully integrated device.

If data or speech quality tests are defined, a QualiPoc measurement starts on the device. The results of the tests are transferred at once to R&S ROMES4 and stored in the measurement file.

Running data and speech quality test on a mentioned device type prevents configuration of other DQA jobs. If configured, those jobs fail.

Prerequisites

- A smartphone must have installed Android version 7 or higher to work in fully integrated device use mode (QualiPoc application installed). The smartphones with an Android version 6 or lower can be used as On PC testing (Classic mode) devices only.
- The version of QualiPoc application must be the same as the R&S ROMES4 version with a valid license.
- Do not install mobile tools like Samsung Kies or HTC Sync Manage on PC. Otherwise, the problems with the ADB connection occur.
- DV-SMP-RF and DV-SMP-QA are not supported anymore, corresponding DV-RF or DV-QA are required.

OTA update of QualiPoc versions

A QualiPoc OTA update can be started by R&S ROMES4.

The R&S ROMES4 software checks if a QualiPoc version on a loadable mobile is supported by R&S ROMES4. If the version is not supported, the icon of the mobile on the Welcome page has a warning marker.

After loading such a mobile, an update dialog appears letting you select a version to be installed.

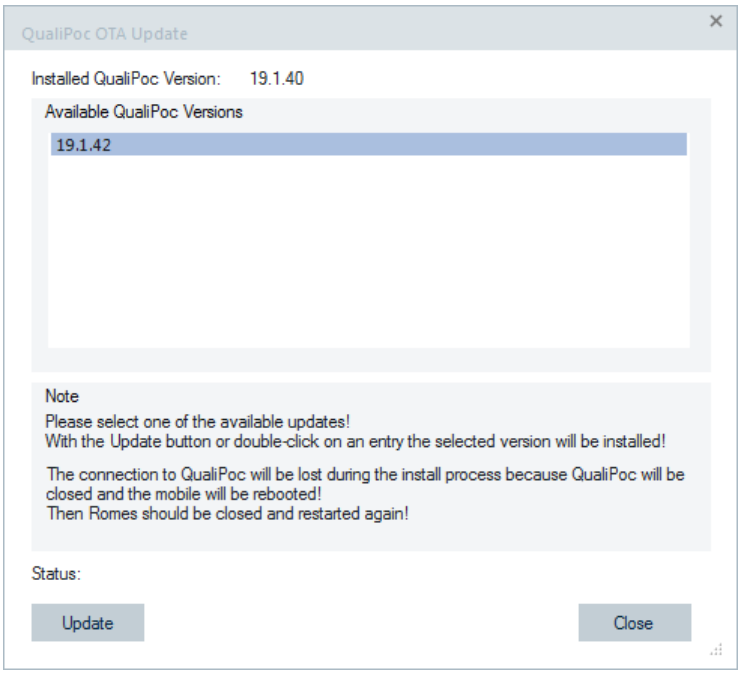


Figure 6-25: QualiPoc OTA update dialog

To install the selected QualiPoc version:

► Double-click the selection or click the "Update" button.

The progress of the installation process is displayed in the status line of the dialog.

The "QualiPoc OTA Update" dialog disappears, meaning that the installation was successful.
The connection to a mobile having QualiPoc app installed is lost now, because QualiPoc is closed and the mobile is rebooting.

R&S ROMES4 closes and restarts.

It is possible to look for updates in the "QualiPoc Settings" > "Version Info" pane, see Figure 6-29.

Click the "QualiPoc Settings" > "Update QualiPoc Version" button to get the updated dialog for QualiPoc versions.

Test call to any number by fully integrated device

R&S ROMES4 supports the QualiPoc test call to any number.

If a mobile device is loaded in fully integrated device use mode and "Action" > "Dialing" in the "Auto Dialing" page is checked, the QualiPoc performs autodial function.

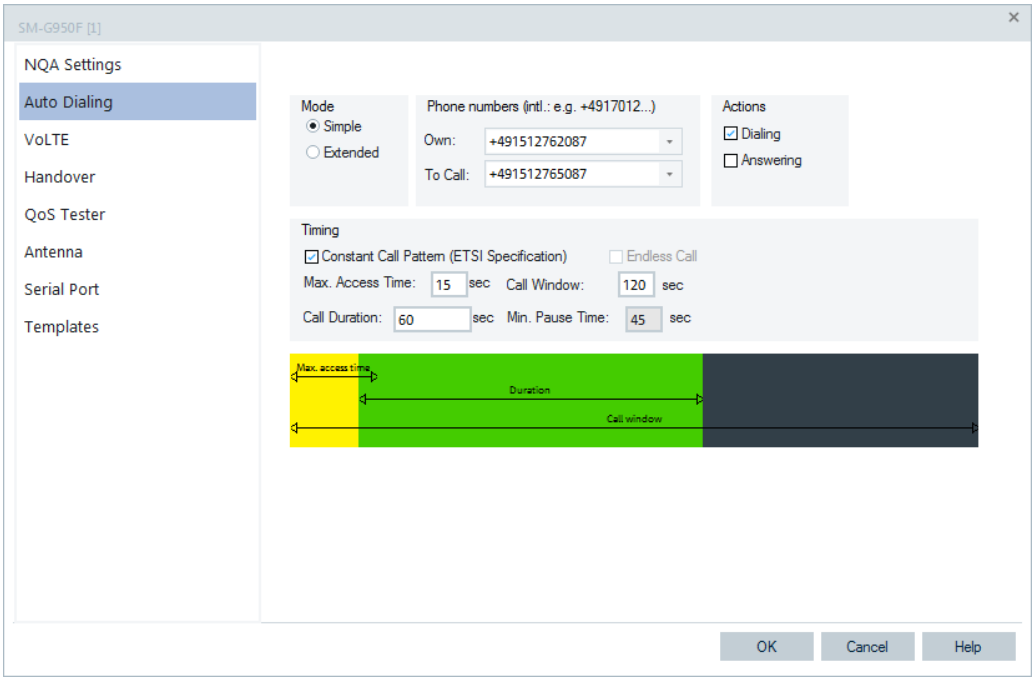


Figure 6-26: Dialing activated in simple mode

If the auto dialing function is set to "External", the "Constant call pattern" and "Endless call" options are unavailable in the "Auto Dialing" page. The test call to any number has always a constant call pattern.

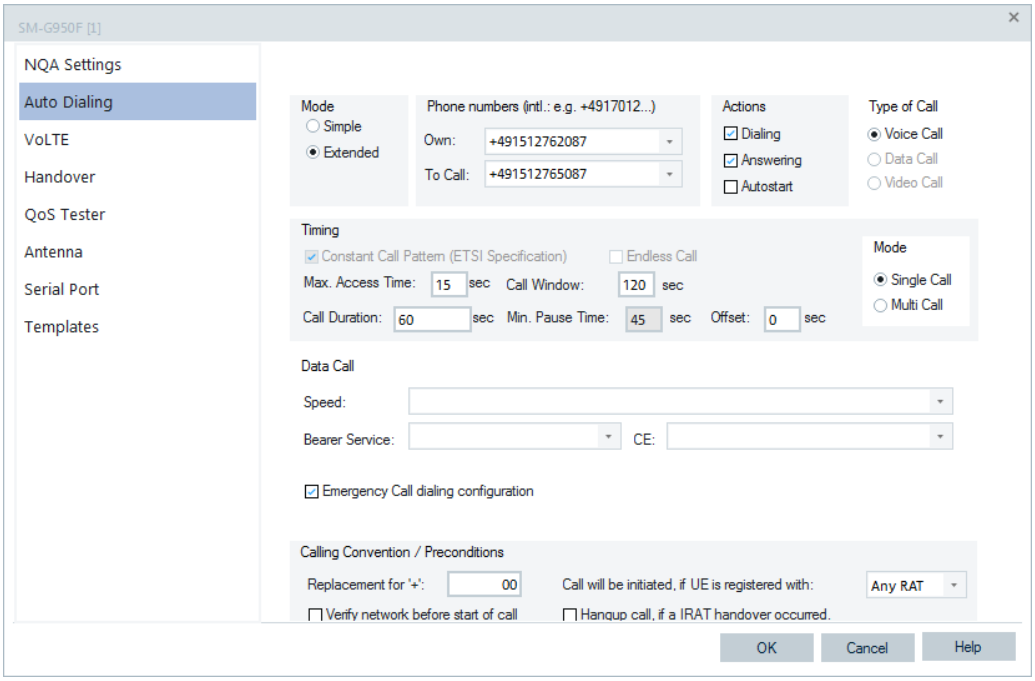


Figure 6-27: Dialing activated in extended mode

Network forcing in fully integrated device mode

The mobile devices in fully integrated device use mode support network forcing for 3GPP defined RATs. R&S ROMES4 takes care of forcing states. The settings in the "Network Forcing" dialog are loaded to device when the dialog closes.

R&S ROMES4 supports advanced cell forcing for 4G and 5G mobile devices,

A cell EARFCN and PCI parameters for 4G mobiles advanced forcing is mandatory.

If the 5G forcing is selected, the following parameters for 5G mobiles advanced cell forcing can be defined:

- "NARFCN" - 5G NR ARFCN
- "PCI" - Physical Cell ID
- "Band" - a list of 5G bands available for this device
- "SCS" - subcarrier spacing in kHz

The 5G NR network forcing on fully integrated devices with SwissQual flash is supported by R&S ROMES4 if forcing is supported by a mobile itself.

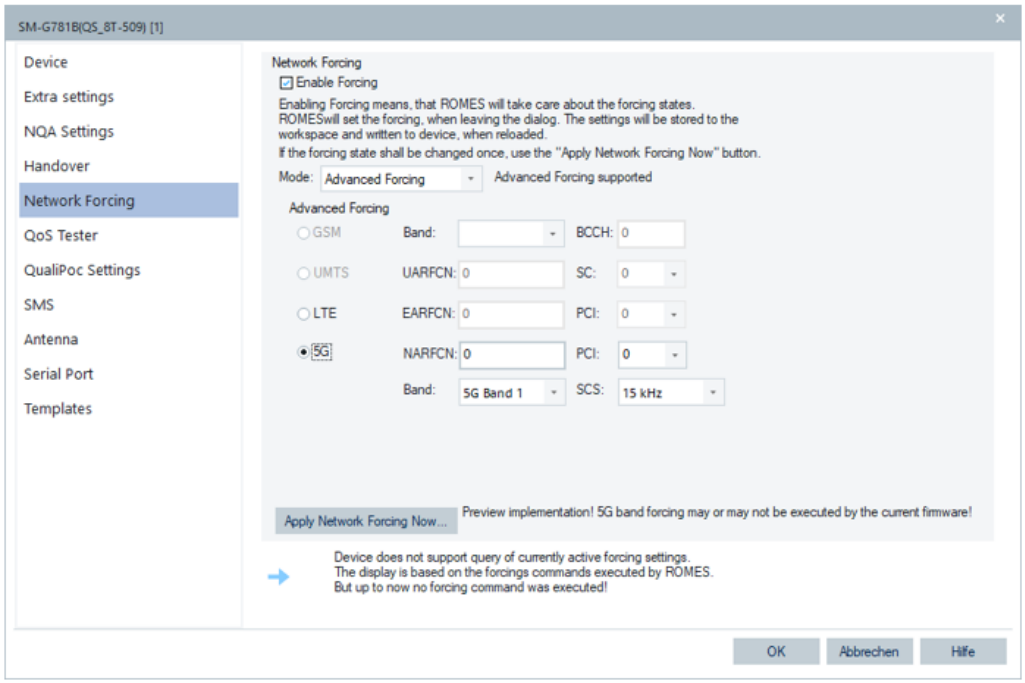


Figure 6-28: QualiPoc forcing dialog

The R&S ROMES4 5G network forcing function supports bands that are available in "Band" drop-down box.

Common QualiPoc settings

A device in fully integrated device use mode is set in the "QualiPoc Settings" dialog.

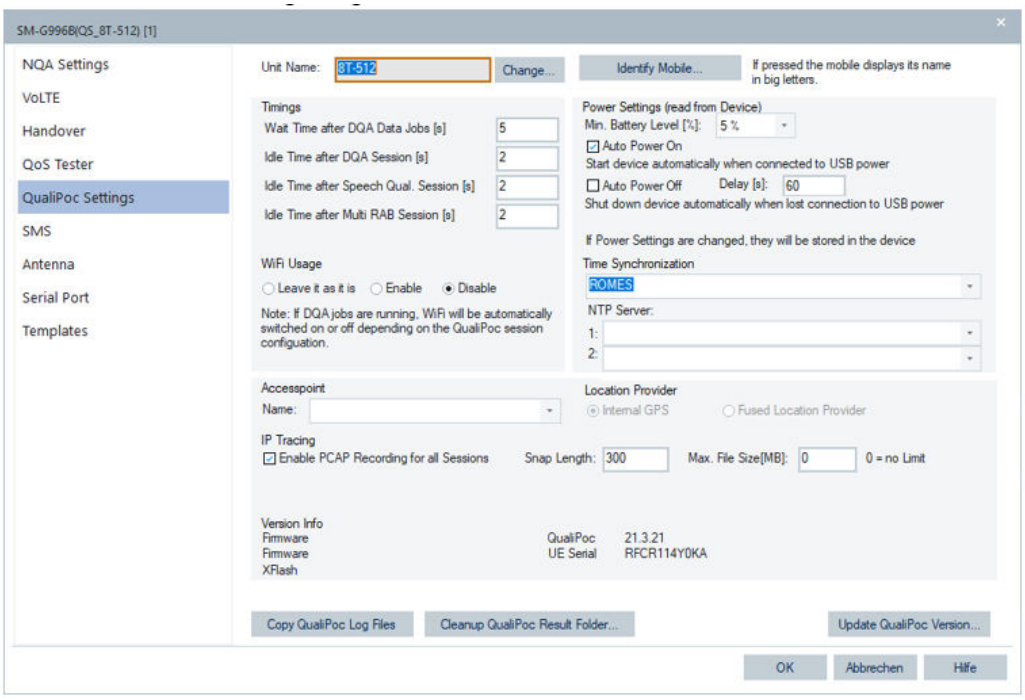


Figure 6-29: QualiPoc settings dialog

Unit Name
A name assigned to a device configured in fully integrated device use mode used for its identification.

Power Settings
Power setting is read from a device.

Min. Battery Level [%] ← Power Settings
The minimum battery level a QualiPoc campaign starts with.

Auto Power On ← Power Settings
If check, starts device automatically if connected to USB power.

Auto Power Off / Delay ← Power Settings
If checked, a device automatically shuts down within the "Delay" defined time if the connection to USB power is lost.

Wait time after DQA Data Jobs [s]
The time to wait after a QualiPoc data test. A wait time after the test is necessary to catch all IP data relating to this test.

Idle Time after a DQA Session [s]
The idle time the execution of a DQA job list.

Idle Time a Voice Call Session [s]
The idle time after the execution of a voice call session (speech quality measurement).

Idle Time after Multi RAB Session [s]
The idle time after the execution of a Multi RAB session (combined speech quality and data test).

WiFi Usage
Sets the WiFi usage at the start of measurement.

Time Synchronization
If the "ROMES" option is selected, a time synchronization is done between R&S ROMES4 and a mobile device operating in fully integrated device use mode.

If NTP is selected, at least one NTP server must be specified. A data connection must be activated at the mobile.

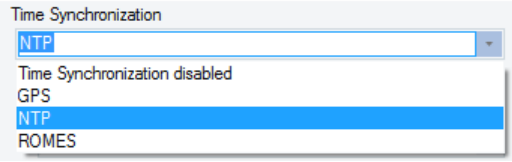


Figure 6-30: Time synchronization with NTP

By default, the time synchronization is disabled.

Accesspoint
As mobile devices in fully integrated device use mode do not allow the write access to the access points, there is only the possibility to select an existing access point. The selection is done in the "QualiPoc Settings" > "Accesspoint" pane.

Select an existing access point for your fully integrated device from the "Name" combo-box out of all defined access points.

The access points must be created/modified in the device's Android settings.

Location Provider
There are two modes available to locate mobile device position:

- Internal GPS
- Fused Location Provider
  If "Fused Location Provider" is selected, the Android interface provides the best available location out of all available providers, that is, WiFi, GPS and mobile networks. Prerequisite is that the mobile device is loaded as fully integrated with active GPS.

IP Tracing
The configuration for PCAP logging, which includes enabling and defining the snap length, is available on a session level. The PCAP logging on the session level makes it possible to distinguish between data tests. There are tests for which PCAP recording is important (for example, browsing, single file DL/UL). However there are tests which are irrelevant and produce too much data (for example, capacity test).

Check the "Enable PCAP Recording for all Sessions" box to activate IP tracing, see Figure 6-29.

If the "Enable PCAP Recording for all Sessions" is selected, PCAP files are created for each session in the measurement.

- "Snap Length": Length of the packet snap-shot in Bytes.
- "Max File Size [MB]": The maximum files size of PCAP file. A file size is unlimited if the value is set to 0.

The "Enable PCAP Recording" option is grayed out if a device with external diagnostic trace is used as fully integrated device.

Copy QualiPoc Log Files
The button to copy QualiPoc log files. The files are copied to a subfolder of MyROMES \Logfiles.

If the QualiPoc installation crashes, the coped log file can help to analyze the cause of crashes. By finishing the copy operation, a message box appears providing information on where the files are copied to.

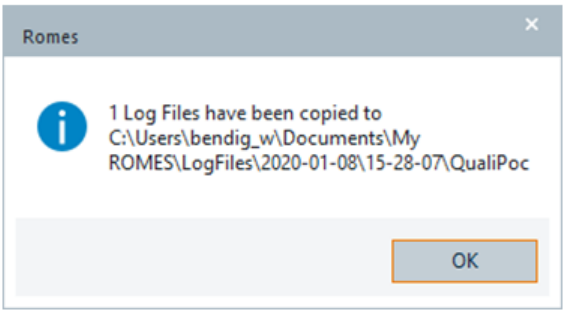


Figure 6-31: Location of the copied QP log file

Cleanup QualiPoc Result Folder
If clicked, the "Cleanup QualiPoc Result Folder" tab deletes the files of the result folder in a mobile phone. The action is recommended if there is not enough disk space on the phone.

Update QualiPoc Version
Click the "Update QualiPoc Version" button to update the dialog of QualiPoc versions, see Figure 6-29.

6.1.8.8 QualiPoc on devices with external diagnostic trace w/o SQ flash optimizer

Mobile devices with Android operating system (OS) can be loaded as fully integrated devices even if they do not have the SQ Flash Optimizer. The supported operating system has to be Android version 7 or higher.

If such a mobile device is loaded for the first time, you are asked if to install the QualiPoc application on it.

If you select the "Install QualiPoc" option, the QualiPoc application is installed on the device, but the device's driver is not loaded, as the installation requires a reboot of the device.

The mobile device is operational as fully integrated device after next R&S ROMES4 restart.

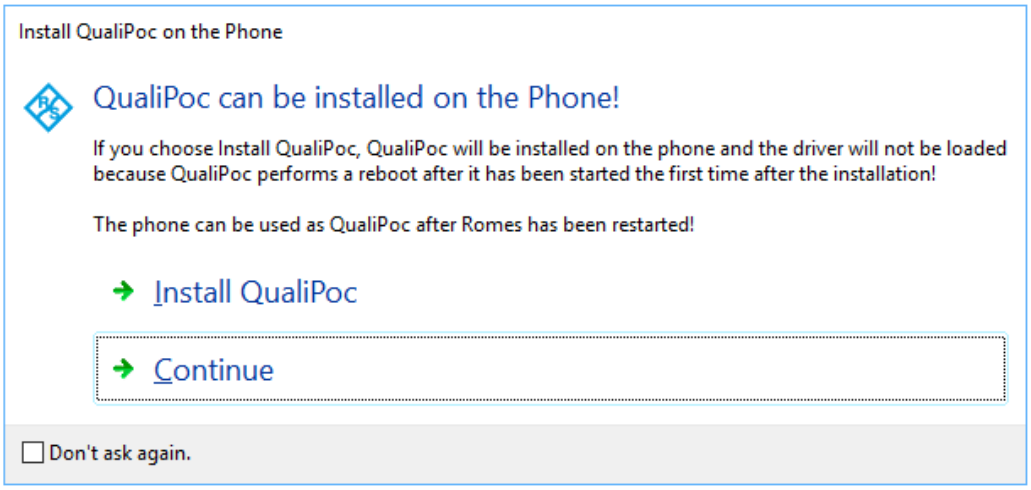


Figure 6-32: Support of QP for devices with external diagnostic trace

The devices with external diagnostic trace support some basic QualiPoc jobs, for example, FTP Up-/Download, HTTP Transfer, Ping and Capacity Test.

Performing MOS speech quality tests with POLQA or SQUAD requires license.

During the QualiPoc chipset-based mobile device loading with an external diagnostic trace in R&S ROMES4, the SQUAD drivers and libraries are installed along the device loading process. The driver installation together with the availability of the SQUAD license is necessary to perform the speech quality tests with MOS based on SQUAD.

6.1.8.9 IP socket connection with Qualcomm chipset based mobile devices

The R&S ROMES4 supports IP sockets for connecting the Qualcomm chipset-based devices (cards, mobile hotspots, for example the Netgear Aircard AC810) to it. The IP address and the port number depend on the device type.

To connect such a device to R&S ROMES4 via IP socket, proceed as follows:

1. Click "Hardware" > "Connect/Disconnect".

   The "Hardware Configuration" page pops-up.

2. Click the "Qualcomm Chipset" option in the "Available Devices" > "Mobile Devices".

   The page to connect Qualcomm chipset-based devices pops-up.

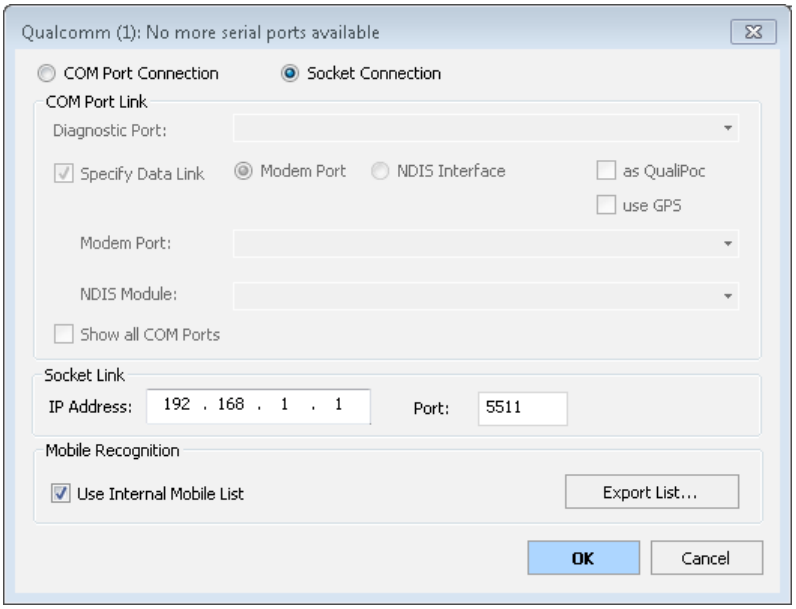


Figure 6-33: IP socket connection

3. Check the "Socket Connection" option.
4. Specify the IP address and port number of the device in the active "Socket Link" pane of the page.
5. Click "OK" to complete the procedure

   The device is connected to R&S ROMES4 via IP socket.

6.1.8.10 IP logging with Qualcomm chipset based mobiles

The R&S ROMES4 "Qualcomm Chipset" option supports direct IP data logging with a device using On PC testing (Classic mode) operation mode.

The "IP Logging" tab of a device configuration page lets you switch on this function. The configuration page is visible only if the mobile is connected in On PC testing (Classic mode) operation mode.

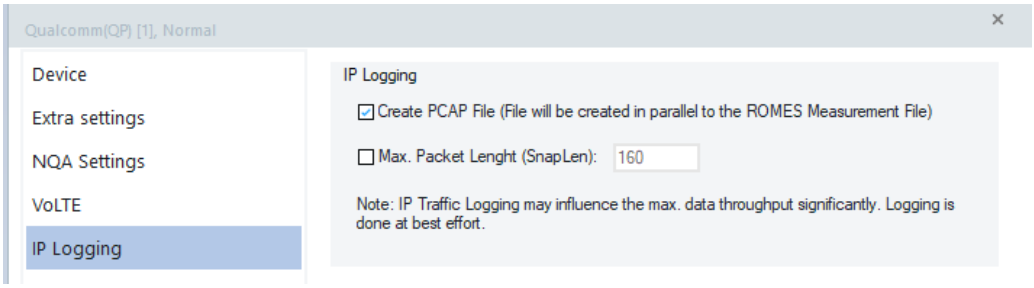


Figure 6-34: IP logging configuration

The whole IP traffic of a phone is logged without need of some additional tool. Check the "Max. Packet Length (SnapLen)" box if you want to limit the maximum size of the IP traffic to be logged.

The IP traffic is logged as a `*.pcap` file into the same folder where the measurement file is written. The file name has the following format `<measurementname>.rscmd<devicename>_Date.pcap`.

The file can be opened by Wireshark already during the measurement.

Example:

The VoLTE tracing is logged as `Measurement.rscmd.SM-G900F[1]_VoLTE.pcap`.

The eMBMS tracing is logged as `Measurement.rscmd.SM-G900F[1]_eMBMS.pcap`.

The IP logging can influence significantly the maximum achievable data throughput. Therefore, it is highly recommended to switch off the logging when KPI measurements are running.

The IP logging is done at best effort. It can happen, that not all packets are logged.

6.1.9 Samsung Exynos 5G chipset-based mobile devices

Starting from the version R&S ROMES4 19.0 SP1, R&S ROMES4 supports the Samsung Exynos 5G chipset-based mobiles devices.

Since EN-DC relies on both LTE and 5G operating in NSA mode, two diagnostic ports are needed.

The Samsung Exynos 5G mobile devices have two diagnostic ports like the Qualcomm based devices.

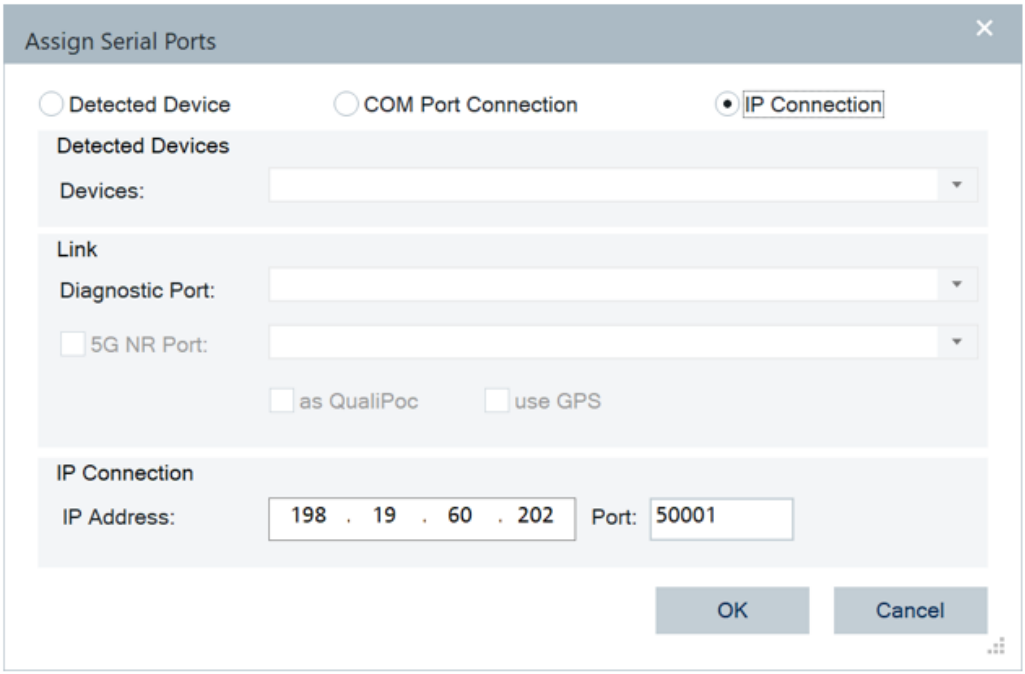


Figure 6-35: Exynos chipset-based devices - assign ports dialog

It is possible to connect the Samsung Exynos chip-set based mobile devices per IP socket.

1. Click the "Hardware" > "Connect/Disconnect" command in the R&S ROMES4 page.
2. Select the "Mobile Devices" > "Samsung Chip Set (Phone)" branch in the "Hardware Configuration" dialog.

   The "Assign Serial Port" dialog pops-up where you can select the diagnostic ports.
3. Select the "IP Connection" in the "Assign Serial Port".
4. Define the IP address and the port number in the "IP Connection" pane.
5. Click "OK" to complete the connection procedure

If you select "Com Port Connection" instead, check the "5G NR Port" box to activate the second port.

The Samsung Exynos 5G chipset-based mobile devices provide statistics on:

- Serving cell
- PRACH/RACH
- PDSCH/PUSCH
- Layer3
- RLC/MAC layer information, for example, the throughput values

There is a difference between the 5G available signals provided by the Qualcomm and the Samsung Exynos chipset-based mobile devices. For a detailed overview of the dif-

ference between them related to supported signals, a comparison is provided and documented on R&S Sales Web. Also, see the "Qualcomm v.s. Samsung chipset-based terminals" document.

6.1.9.1 Exynos SIP analysis

The R&S ROMES4 "Samsung Chipset" driver allows you to force SIP tracing using the R&S ROMES4 SIP Analyzer for devices with external diagnostic trace.

Any IP port can be used for the SIP analyses if the "Use all IP Ports for SIP Message Tracing" option is checked. A port setup of VoLTE and VoNR becomes easier in this way.

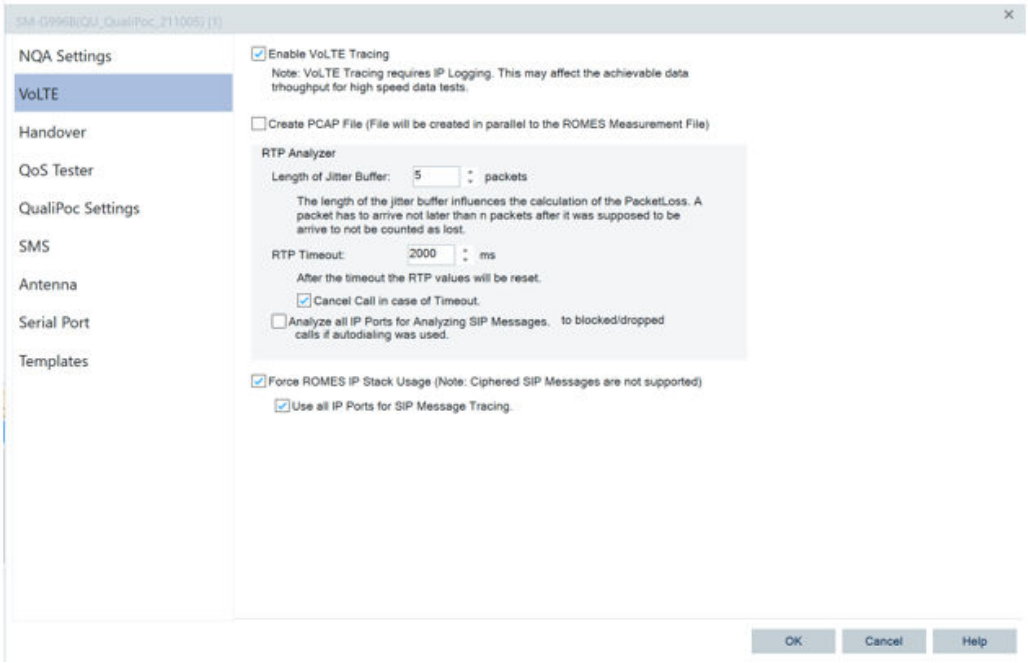


Figure 6-36: Activating SIP analysis

Do not use the R&S ROMES4 SIP analyzer in parallel with high-speed data measurements.

The SIP analyzer can analyze not-ciphered streams only.

6.1.9.2 SMS test with Exynos chipset-based mobile devices

The Samsung Exynos chipset-based mobiles loaded as fully integrated devices support the SMS test.

6.1.10 Neul chipset based devices

R&S ROMES4 supports the Neul chipset-based devices for NB-IoT.

Load the Neul chipset-based devices by using common the "Hardware" > "Connect/ Disconnect" command. In the "Hardware Configuration" dialog, select the "Neul Chipset" option in the "Mobile Devices" branch.

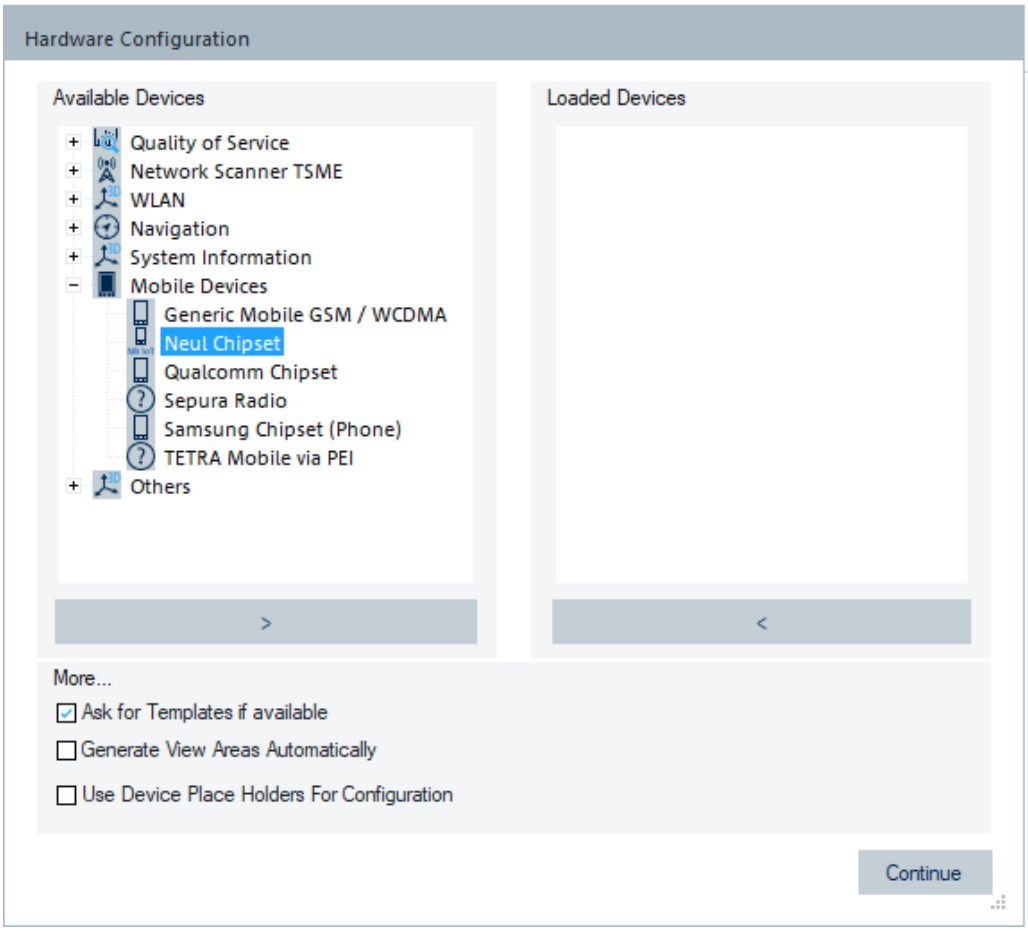


Figure 6-37: Load Neul chipset-based device

The user has to specify the AT command port and the diagnostic port of the connected Neul chipset-based device.

After having successfully loaded the module, it appears on the right side of the dialog as loaded device.

The Neul chipset-based devices currently cannot be detected automatically.

R&S ROMES4 automatically tries to connect to module with exchanged ports, if the given assignment does not work.

6.1.11 Test devices

When loading a test device (R&S TSME, R&S TSME6, R&S TSM6B, also called the R&S TSMX family), R&S ROMES4 checks whether the driver configuration settings

comply with the connected device. If they do not comply, "Receiver settings" of the test device configuration menu opens to adjust the settings.

To be identified by the R&S ROMES4 drivers, a test device connected to the host PC has to be switched on.

6.1.11.1 R&S TSME network scanner

R&S ROMES4 supports the R&S TSME/TSME6/TSM6B variants of the device. Supported is also the R&S TSMA6.

The devices can be used in parallel as a GSM network scanner, UMTS PN scanner, CDMA2000 1x EV-DO PN scanner, RF Power Scanner, WiMAX scanner, LTE scanner, TETRA scanner, CW scanner and a GPS receiver. The 5G NR scan needs the R&S TSM6/TSM6B network scanners.

If the R&S ROMES4 TSME/TSME6/TSM6B/TSMA6 driver loader for mentioned technologies is available, the selected device is loaded.

The Device Manager shows all the R&S ROMES4 drivers available for loading in the TSME/TSME6/TSM6B/TSMA6 scanners. For a certain device, available are those drivers for which the device has the corresponding scanning option and supports at least one of the needed RF bands.

The "Device Manager" page and the "Devices" bar display the connected devices' name supporting certain R&S ROMES4 driver, as shown in the following figure.

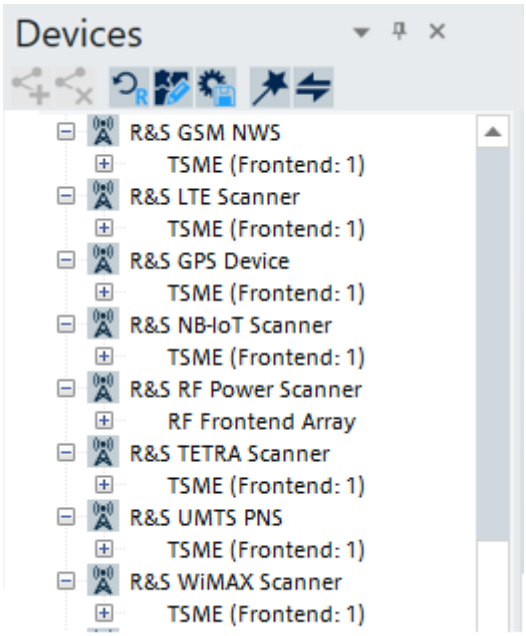


Figure 6-38: Loaded devices

All devices are listed, but only the devices that have the necessary RF bands for the specific scanners can be selected. The others are displayed in gray color.

Click a connected device name in "Devices" to extend the view and get information on its serial number, IP address and the currently available RF bands. This information for loaded and connected devices is also shown in "R&S <scanner variable>: Select Device", see Figure 6-41.

The R&S ROMES4T1E (R&S No. 1117.6885.82) option is required for this driver.

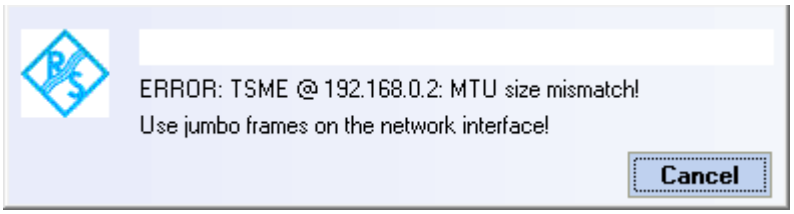
R&S TSME jumbo frames use - inform user

The R&S TSME driver connection to the R&S ROMES4 needs to enable the "jumbo frames" on the network interface.

The R&S TSME device scanning process is automatically done during the R&S ROMES4 startup. The process checks for the error code "MTU size mismatch".

In the case an error is detected, the following happens:

- The connection is not established
- Error message is issued in the dialog window



- Error message is added to the "Output" > "ROMES Messages" list.

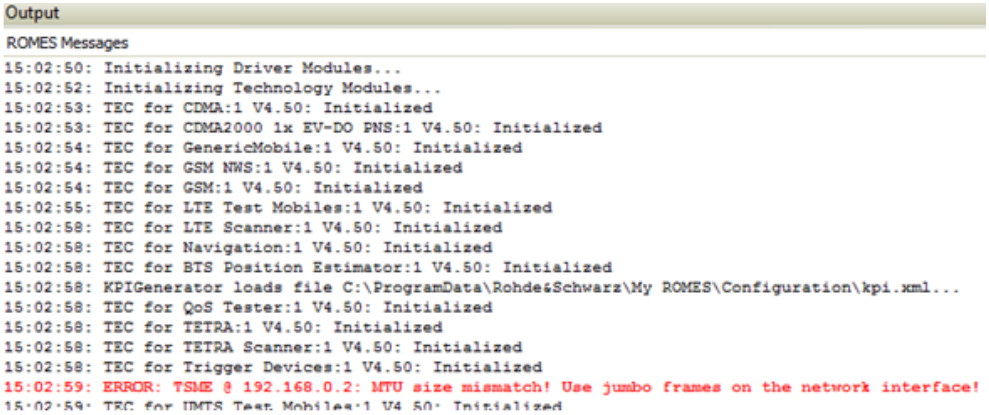


Figure 6-39: Mismatch error message in the Output window

Install R&S TSME drivers

To load the R&S TSME driver, perform the following steps:

1. Click "Hardware" > "Connect/Disconnect".
   The "Hardware Configuration" window opens.

   All device loader, which can be used by the R&S TSME/TSME6/TSMA6 device are shown in the "Network Scanner TSME" branch.

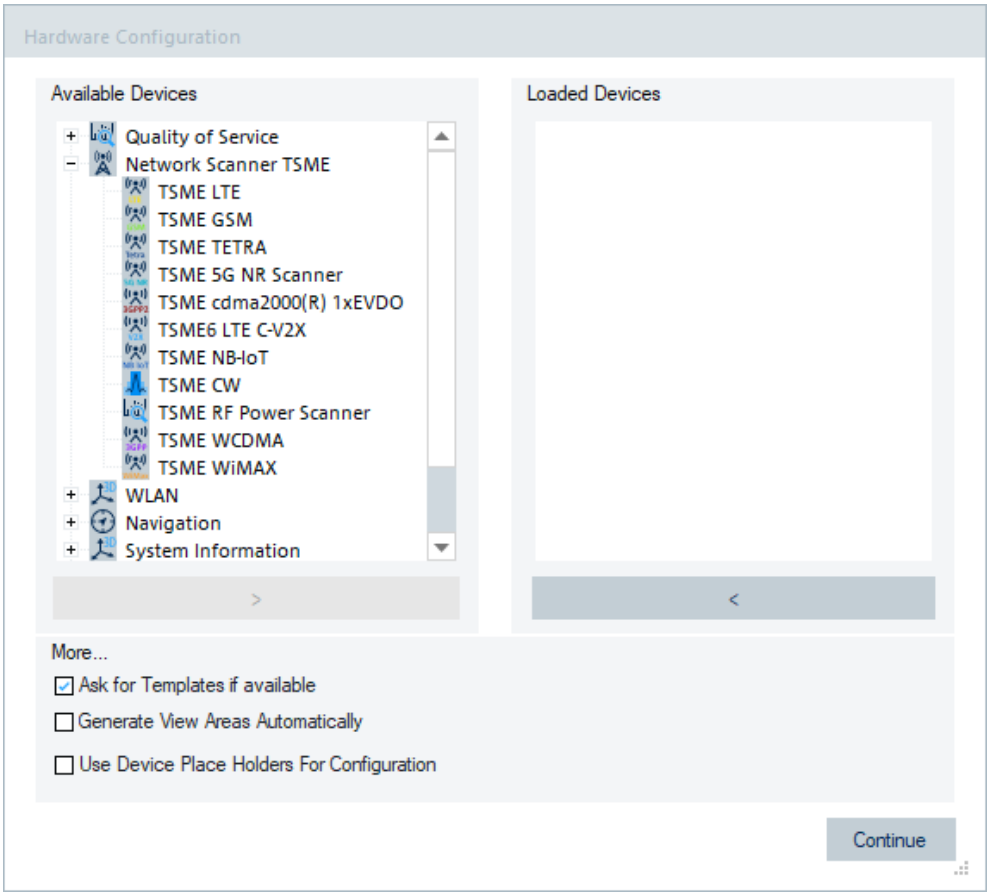


Figure 6-40: R&S ROMES4 TSME drivers

2. Double-click the selected device or press ">".

   The device loader starts and tries to reach the R&S TSME/TSME6/TSMA6 at the default IP address.
   The "R&S <scanner variable>: Select Device" page opens showing the R&S TSMEs attached to R&S ROMES4.

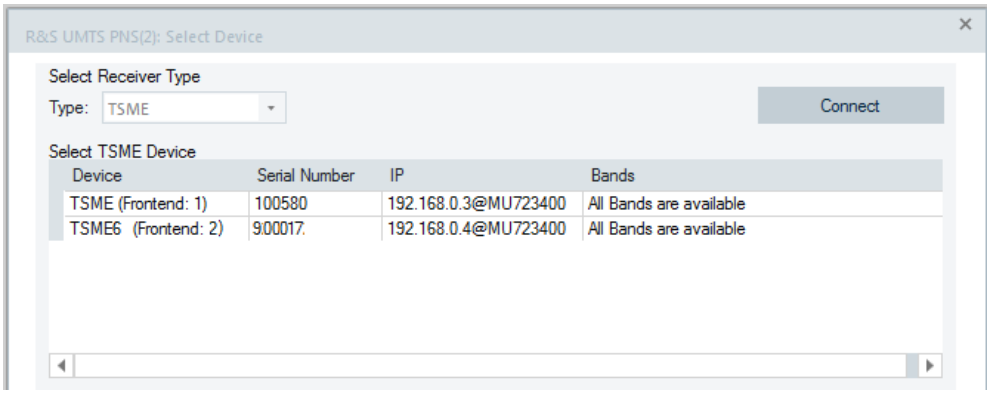


Figure 6-41: Attached R&S TSME devices

The dialog shows the serial numbers, IP addresses and available RF bands of the devices.

3. Select an attached R&S TSME.
4. Click "Connect" to activate it.

   The R&S TSME is active now.

Switch on and physically connect the all R&S TSMEs to the system before you start R&S ROMES4.

Configuration check

The configuration is checked concerning the specified frequencies.

This check is useful if the available RF bands of a device are covered by the technology bands.

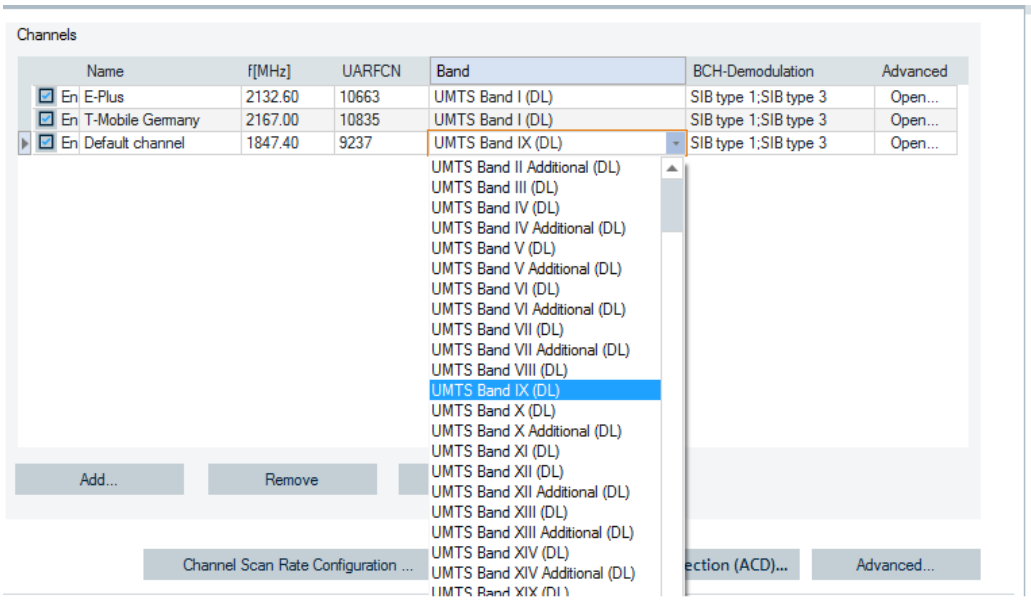
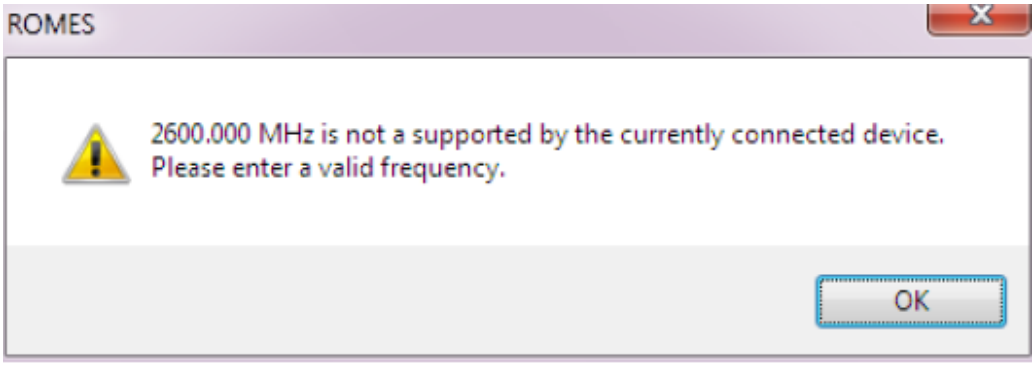


Figure 6-42: Available scanning bands

If you specify a not supported frequency or load a template/workspace which contains not supported frequencies, you are warned about that. You are requested to adapt the frequencies or remove the affected measurement channels.



Using wizards

The wizards also check the specified configuration with the actual available RF bands.

License check

The R&S TSME license can be verified in "Help" > "Loaded Modules".

Handling the connection to the R&S TSME

The R&S TSME connection to R&S ROMES4 has three states.

Once the scanner has been loaded successfully, the R&S TSME is connected.

Figure 6-43: R&S TSME connected to R&S ROMES4

If the network cable is removed, the R&S TSME tries to reconnect for about 20 seconds.

If the R&S TSME connection is reestablished successfully within this time frame, the state changes to connected again.

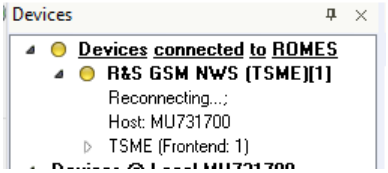


Figure 6-44: R&S TSME reconnects to R&S ROMES4

If the reconnection time frame expires, the state changes to disconnected.

Figure 6-45: R&S TSME lost connection to R&S ROMES4

Stop the currently running R&S ROMES4 measurements to reconnect the R&S TSME.

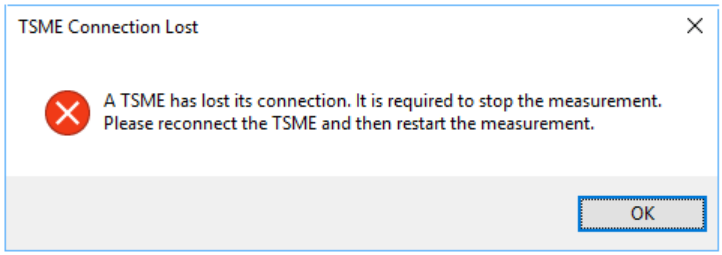


Figure 6-46: Warning message

Once the user stops the measurements and reestablishes the cable connection, R&S ROMES4 is able to reconnect the R&S TSME. R&S ROMES4 starts the next measurement.

Stop the currently running R&S ROMES4 measurements even if the R&S TSME is not actively used during the reconnection.

R&S TSME GPS frontend selection

The option provides the R&S TSME6 automatic frontend selection for R&S TSME.

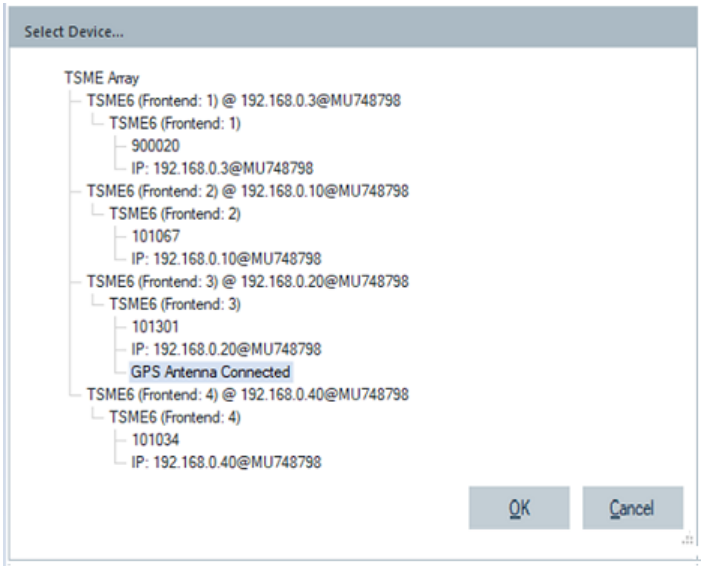


Figure 6-47: Automatic GPS frontend selection

If several R&S TSME6s are connected to the system and the GPS tile on the welcome screen is used to load the GPS device the following cases are possible:

- The frontend is used automatically if only one R&S TSME6 has a GPS antenna connected.
- The user has to select the fronted if several R&S TSME6s have a GPS antenna connected, or none of them.

R&S TSME synchronization source

The synchronization source is selected automatically for this scanner type.

If GPS is available, the scanner normally uses PPS.

If no PPS is available, it uses a mobile network, GSM, UMTS or some other for synchronization.

For the interpretation of measurement results, it is helpful to know which synchronization method the scanner has used.

You can load the driver "System information", see Chapter 6.1.12, "System information and performance counters", on page 1498. For each scanner you have then the "PPS Synchronization" signal, so that you can see if PPS was used for synchronization or not.

R&S TSME device information

Detailed information on the R&S TSME device can be found in the "Scanner" page of the device.

The pane "Scanner Properties" of the page shows the installed device hardware and software details, the available options and all the installed RF band options.

For example, the pane contains the production index, the currently active R&S TSME SW including the FPGA version and the FW version of the default SW, the R&S TSME scanner calibration date and the self-alignment date.

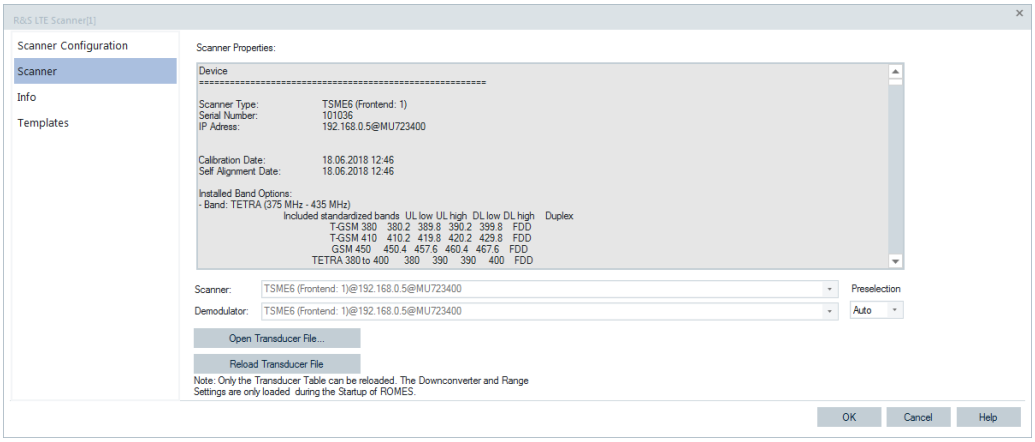


Figure 6-48: Installed R&S TSME scanner properties

The previously mentioned details are also included in the measurement file opening page, see Figure 3-15.

The R&S TSME Device Manager tool lets users do a complete diagnosis and perform updates if necessary, refer to Chapter 5.6, "R&S TSME diagnosis and updates", on page 1443.

6.1.11.2 Channel scan rates configuration for R&S TSME

R&S ROMES4 supports the configuration of the channel scanning rate for the R&S TSME network scanner in a single configuration page and in a unified manner.

This R&S ROMES4 function applies to all three 3GPP technologies when using the R&S TSME scanner.

The use of the same R&S TSME scanner is based on usage of the same IP address.

To configure the Channel Scan Rate function, use the "Channel Scan Rate Configuration" button.

The button is available in the UMTS and LTE scanner configuration page at the bottom of the page, see the following figure.

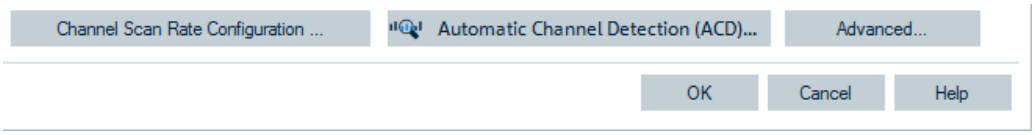


Figure 6-49: Channel scan rate configuration button - UMTS and LTE

In GSM technology, the button is located in the "Setup GSM NWS" > "Scan Parameters" pane.

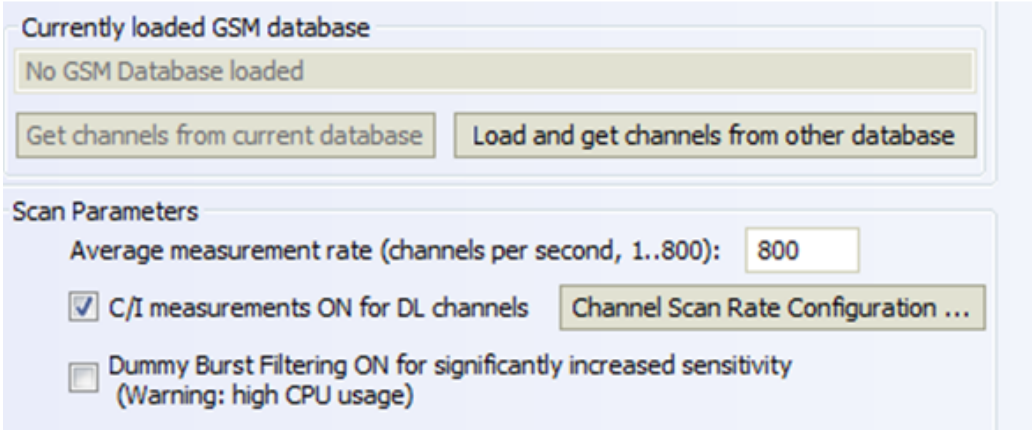


Figure 6-50: Channel scan rate configuration button - GSM

Press the button to open the function's configuration page.

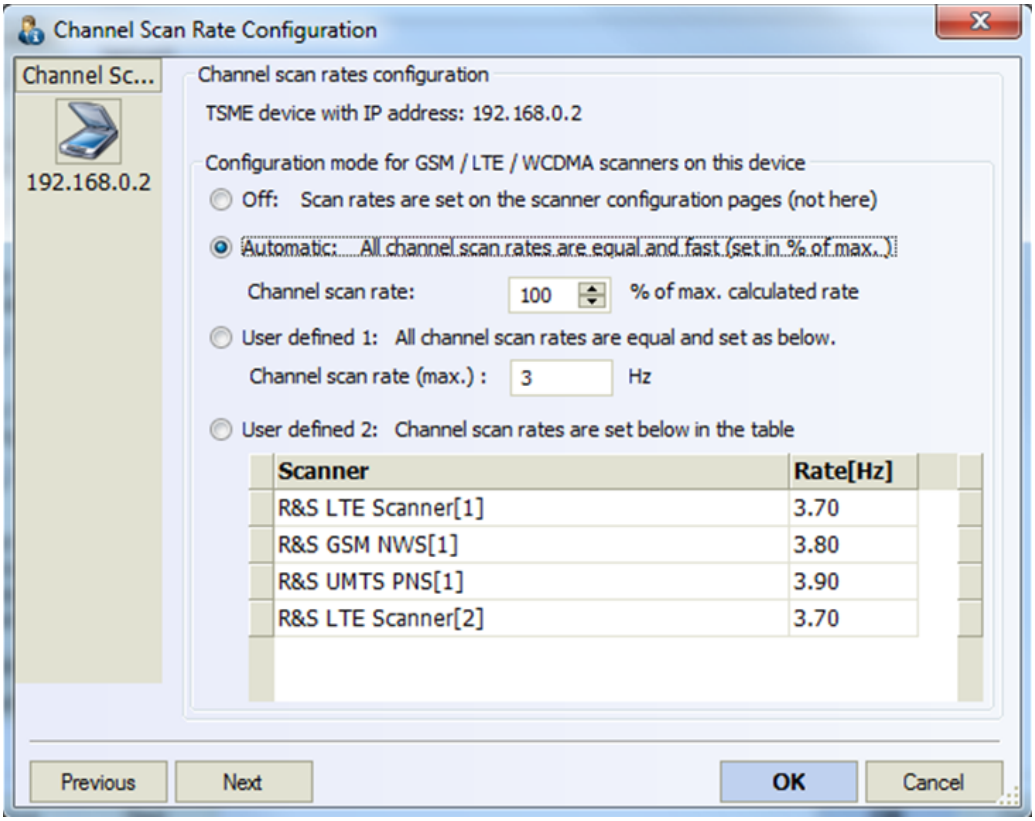


Figure 6-51: Channel scan rate configuration

The function has four operational modes.

- "Off"
  The scan rates are set on the scanner configuration pages (default).
- "Automatic"
  The optimization target is the highest possible channel scan rate, which is nearly equal for all involved technologies (GSM, UMTS and LTE). Typically, the highest possible channel scan rate is determined by the technology with the most measured channels.
  This mode has the parameter "% of max. calculated rate", which allows reducing the rate to lower levels. Reducing the rate level is useful for less load or smaller measurement files.
  The calculated measurement rates are target rates. The effective rates can be lower depending on other factors, like additional technologies assigned to the same scanner or network, or the CPU load.
- "User Defined 1"
  Channel scan rate is set to a given value for all involved technologies. This value can be used to set a specific rate like 1 Hz or to set low rates like 0.01 Hz.
  The given rate is a target rate. If the max. possible rate for the involved technologies is lower than the target rate, the scanners adapt them to use the max. possible rate. A ROMES message is issued in the "Output" window; see the following figure.

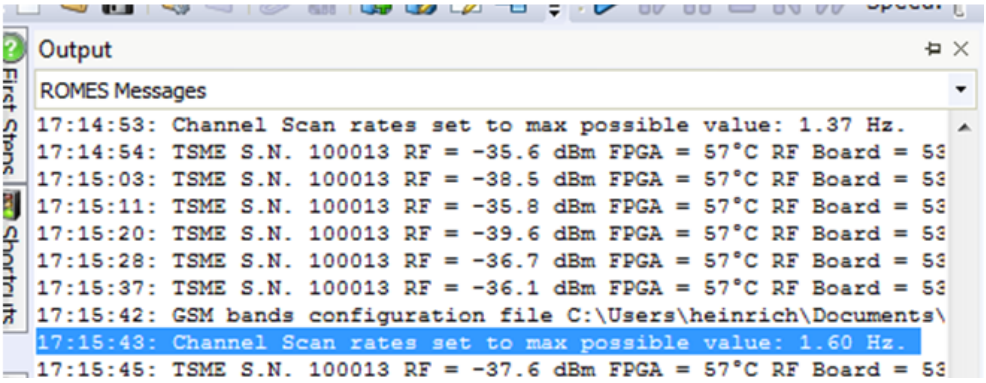


Figure 6-52: Channel scan rate-related message

The effective measurement rates can be lower depending on other factors like additional technologies assigned to the same scanner or network, or the CPU load.

- "User Defined 2"
  Channel scan rate is set to a given value for each involved technology. This value can be used to set a specific rate for different technologies.
  The given rate is a target rate for the technology. If the max. possible rate for the involved technology is lower than the target rate, then the technology is configured to use the max. possible rate and a ROMES message with details is issued in the "Output" window.
  The effective measurement rates can be lower depending on other factors like additional technologies assigned to the same scanner or network, or the CPU load.

The channel scan rate setting is applied on any configuration change of the involved scanners.

The results of the optimization are visible in the GSM, UMTS and LTE scanner configuration dialogs.

By choosing any function mode other than "Off", the channel scan rate controls of the scanner configuration dialog are read-only.

Example: Scan cycle times

The scan cycle times of all three technologies with similar values, shown in the following figure are result of the optimization. The time is defined as the time in which every configured channel has been measured at least once.

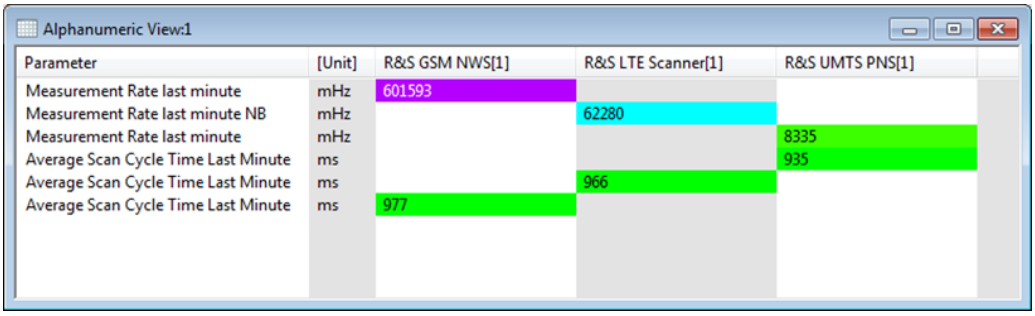


Figure 6-53: Average scan cycle times of all 3GPP technologies

6.1.12 System information and performance counters

The System Information device is a hardware-independent function that stores the values of the Windows performance counters to the measurement file. Monitoring of this information during the measurement can be helpful for assessing the validity of the measurement results.

The device is automatically loaded which makes it easier to access a scanner state.

Example:

Suppose that a DQA job involving an FTP download from a remote server fails. Monitoring the local processor time together with the measurement data helps to decide whether the failure is due to local performance problems rather than to an unstable data connection.

The System Information is loaded like any other device. The configuration menu is accessible via the "Hardware" > "Connect/Disconnect" dialog.

1. Select "System Information" from the "Available Devices" list.
2. Use the ">" button to load the device.

   The device is loaded and you can see it in the "Loaded Devices" list and in the "Hardware" menu.

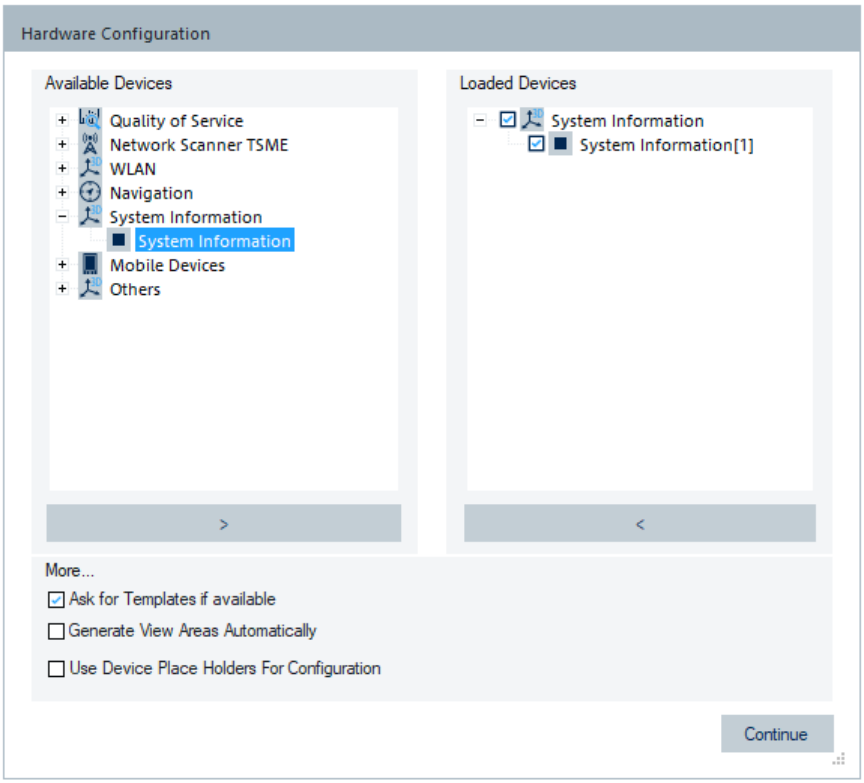


Figure 6-54: Loaded System Information

Click "Continue". The icon appears in the R&S ROMES4 icon bar. Click the icon to get the system information "System Monitor" opening page.

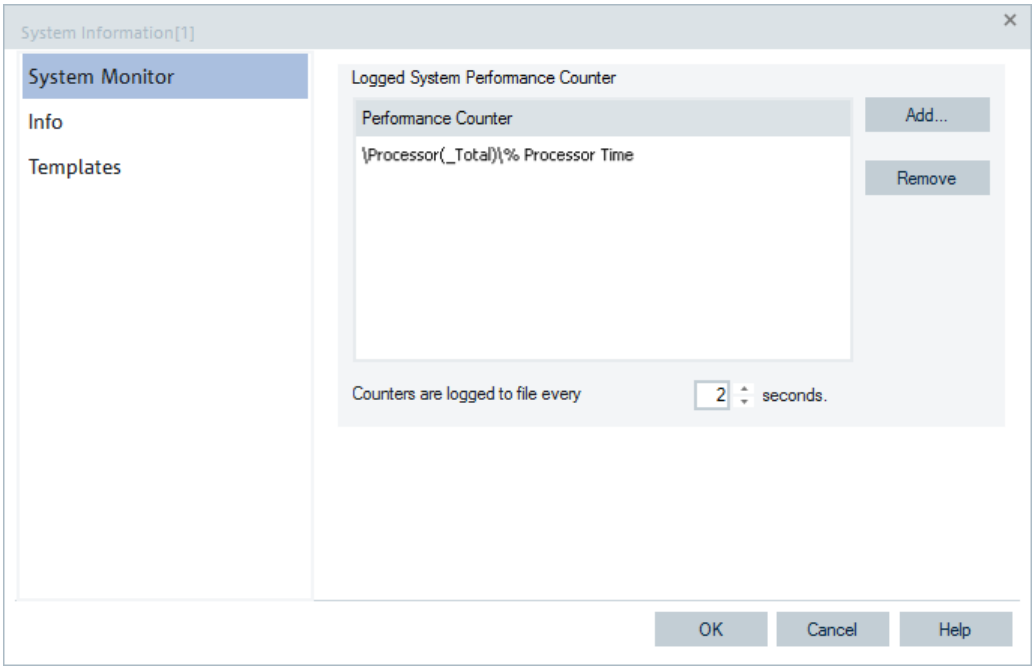


Figure 6-55: System Information page

In "Performance Counter" you can select the performance counters you want to store to the measurement file and the time interval between two consecutive loggings.

Click "Add" to open the browser to select computer counters. The selected local computer counters are directly written into the "Performance Counter" pane.

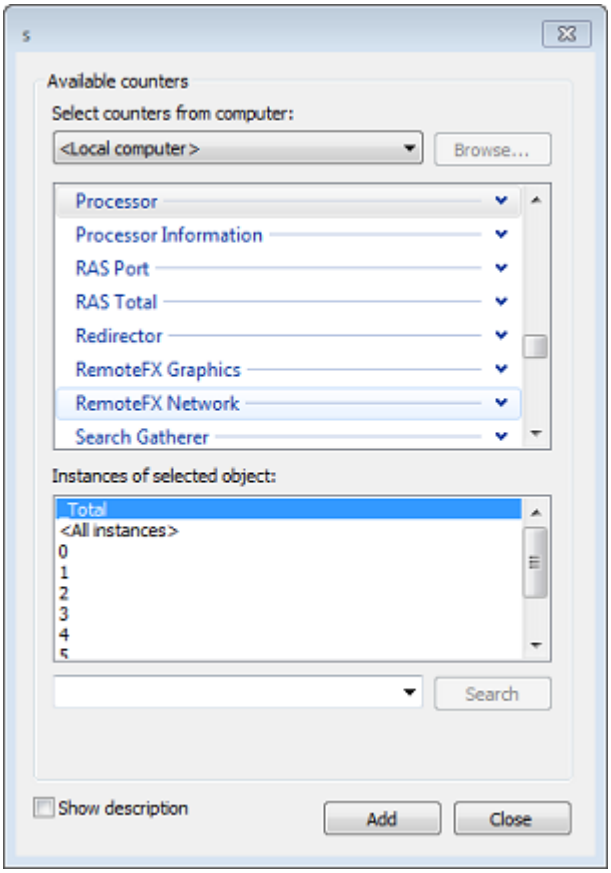


Figure 6-56: Dialog to select computer's counters

R&S ROMES4 generates a signal for each selected computer counter in the "Signal Tree" > "System Info" > "Performance Counter" branch. For the selected scanners-generated, the signals are stored in the "Scanner" branch.

The signals are configured for display in the "Tools" > "Preferences" > "Available Signals" page.

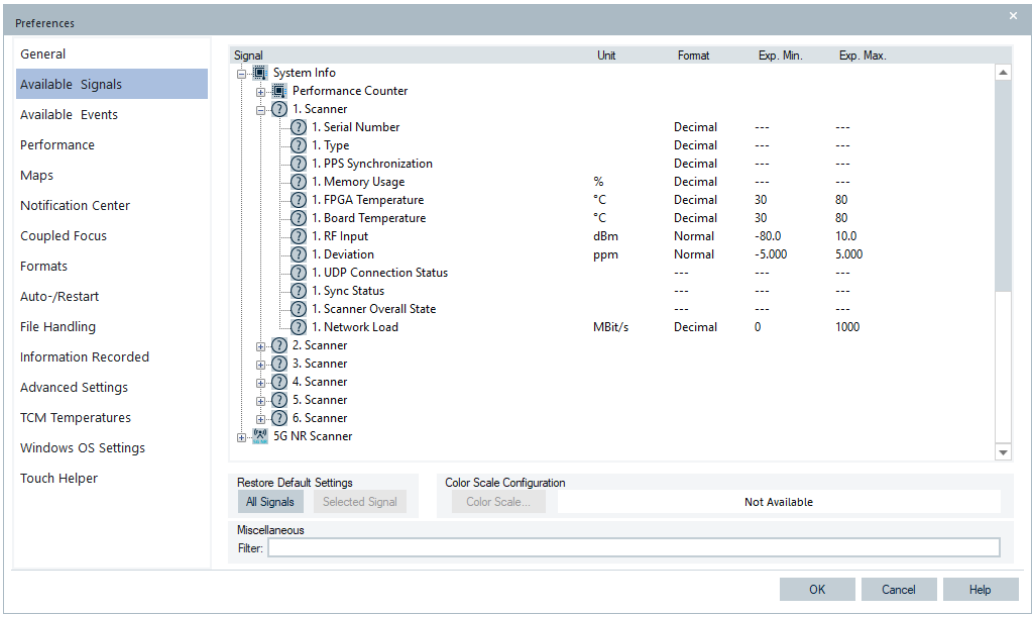


Figure 6-57: System Info available signals

For the signals description, see the "Description of R&S ROMES4 Signals" document.

The signals can be viewed in correlation with other signals by using an appropriate view, for example, the "2D Chart View" or the "Alphanumeric View".

An example of the supported views is given in the following figure.

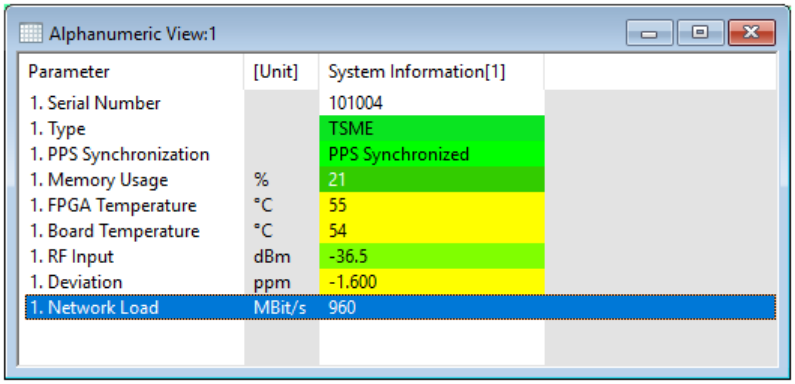


Figure 6-58: Alphanumeric view of the System Information signals

6.1.12.1 System information support of scanner status signals

The System Information makes it possible to log and visualize the R&S scanners status.

The R&S TSME supports the all signals shown in the Figure 6-57.

The following figure shows the System Information of the supported scanner signals for which an enhanced visualization is available.

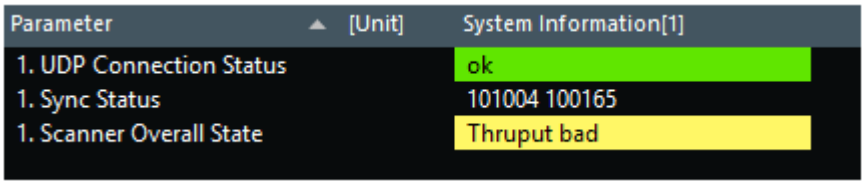


Figure 6-59: System information scanner signals

The meaning of the colors in the table is as following.

Red	RF input > -10 dBm or Thruput < 300 Mbit or UDP Packages dropped
Yellow	RF input Y -20 dBm or Thruput < 700 MBit
Green	otherwise

Figure 6-60: Explanation of colors

6.1.12.2 System information support of events and alarms for scanner status

The System Info device stores a scanner status in the measurement file. The stored status helps to evaluate the RF conditions of the scanner during the measurement but also to identify the system errors, for example, loose cable connections.

The information about error is available as a signal and as an event on some signals.

Also, a system alarm is activated if one of the connected scanners' overall state is erroneous. A scanner's state alarm is triggered by the condition listed in the following figure.

What	Condition	Alarm
UDP Dropped	YES	Error
RF Input	>-10dBm	Error
	>-20dBm	Warning
Network Load	< 700 Mbit/s	Warning
	< 300 Mbit/s	Error

Figure 6-61: Conditions to trigger an alarm

The alarms are logged in the general status view, in the "Basic Views".

The General Status View function allows you to specify an audio file, which replays at an alarm activation. A file is configured in the "Tools" > "Preferences" > "Available Events" page.

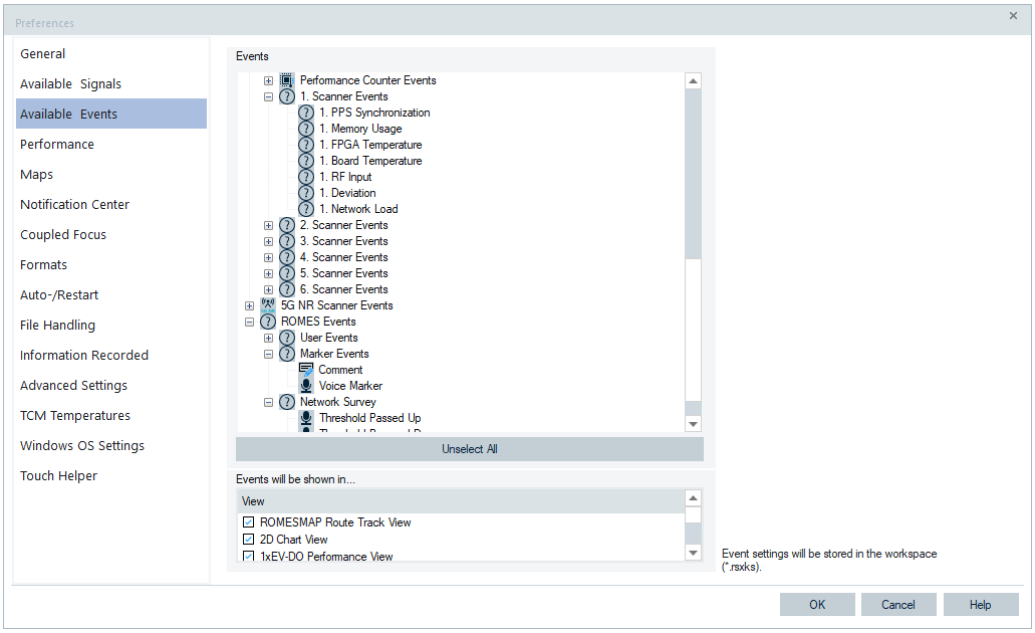


Figure 6-62: System Information available events

To get the scanner event status information and the alarms, it is necessary to load the System Information device manually.

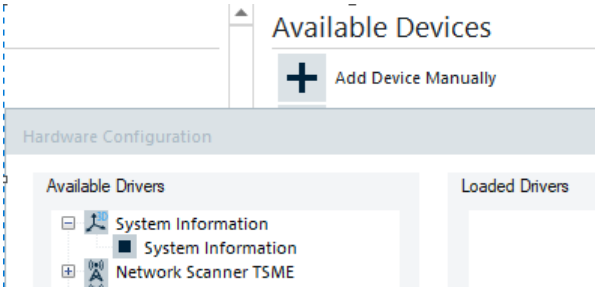


Figure 6-63: Add System Information device manually

6.1.13 Place holder

R&S ROMES4 allows the configuration of measurement workspaces and mobile/scanner/GPS devices without the actual devices attached to a PC R&S ROMES4 runs on.

The workspace can be saved with place holder devices and then R&S ROMES4 prompts to replace the place holder devices with actual attached hardware when the workspace is reloaded.

The benefit of the feature is the possibility to configure measurement at the home office. At measurements configured from the home office, you get the workspace that contains the place holder device. You only need to open the workspace and point to the actual hardware. Then start the measurement.

The feature currently supports only the R&S TSME scanner out of the R&S ROMES4 supported R&S scanners.

Click the "Available Devices" > "Add Device Manually" to initiate place holder configuration from the "Welcome" page.

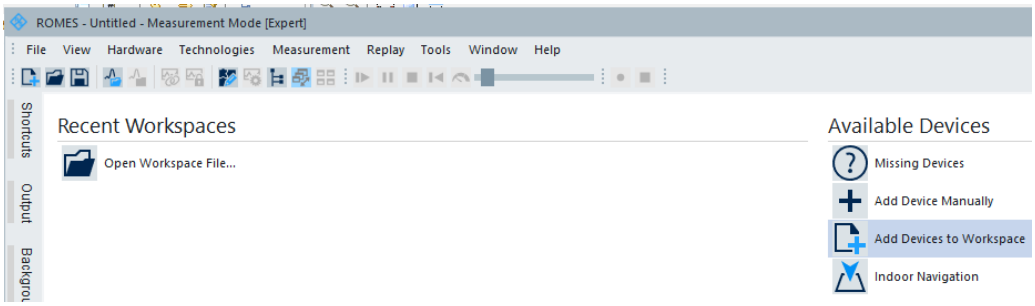


Figure 6-64: Option to initiate place holder

Alternatively, check the "Use Device Place Holders for Configuration" check-box in the "Hardware Configuration" > "More" pane, see Figure 6-3. The action modifies the "Available Devices" filed to show only devices that support place holder configuration. WinWLAN and Position Estimator are excluded from the list.

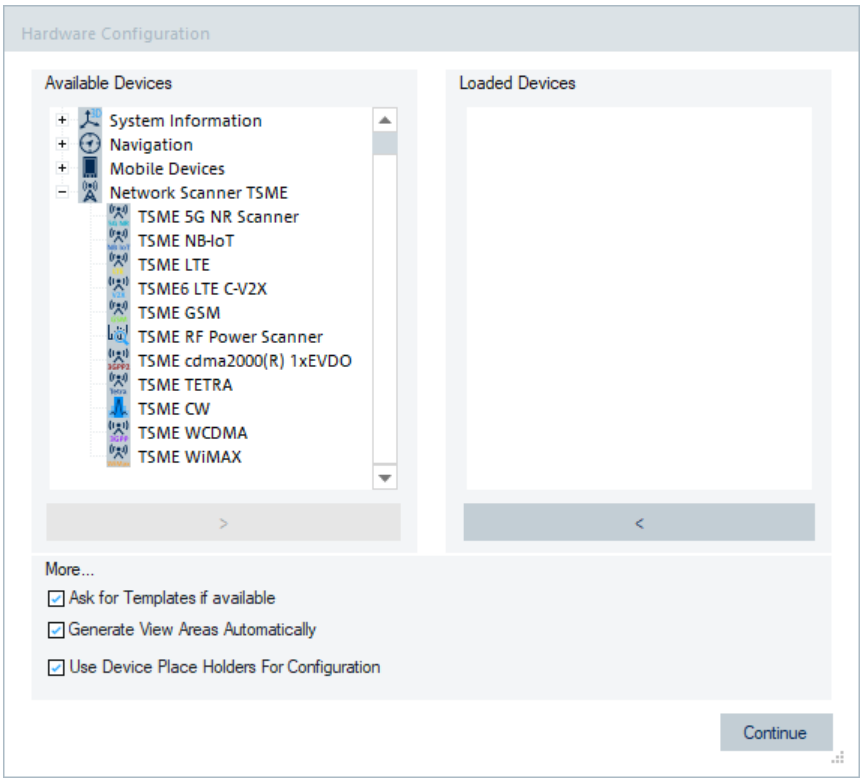


Figure 6-65: Devices supporting place holders

6.1.13.1 Scanner place holder configuration

Select the desired scanner technology from the list of available devices. The selection brings up the configuration screen to configure the R&S TSME place holder devices.

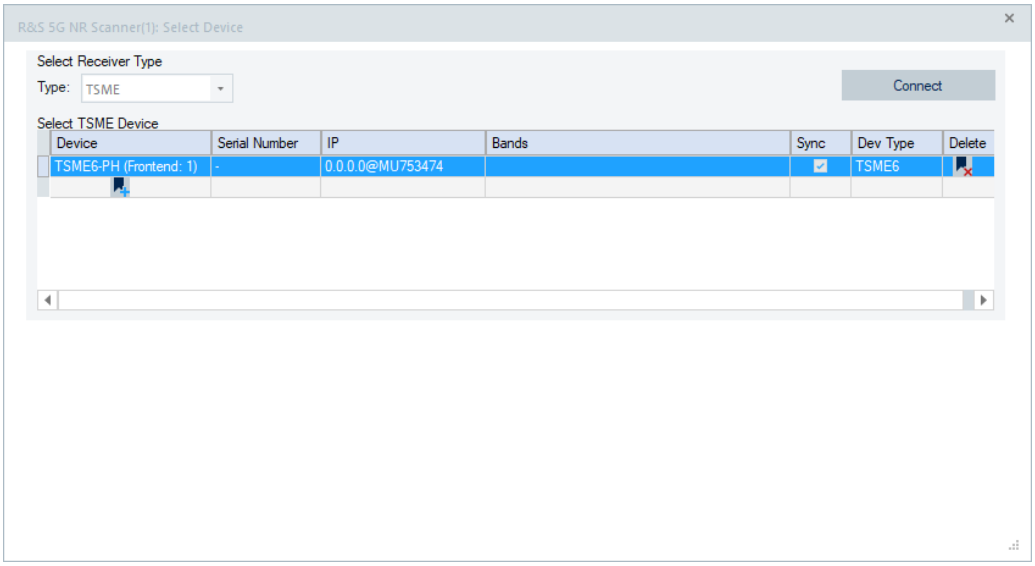


Figure 6-66: Selected R&S TSME6 device

Click the icon to add additional device. Clicking icon removes the selected device from the list. The type of the R&S TSME can be configured by choosing either "TSME" or "TSME6" from the "Dev Type" drop-down menu. By default, all "TSME" place holders are synced to one another. A "TSME" place holder device can be unsynced from other "TSME" place holder devices by unchecking the check box in the "Sync" column.

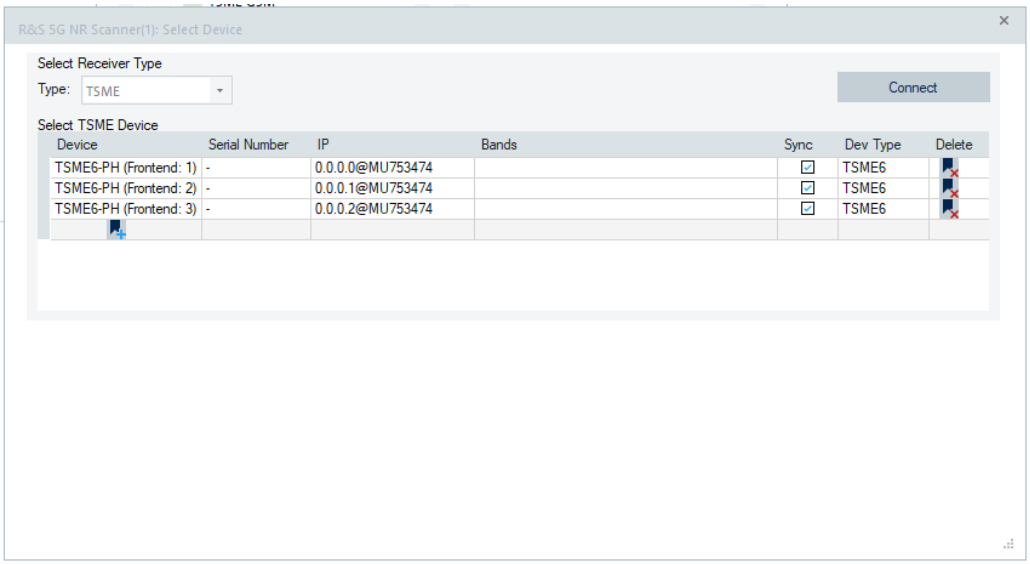


Figure 6-67: Additional place holder devices added

If the desired number of the "TSME" place holders is configured, click "Connect" to attach the R&S TSME to wanted technology.

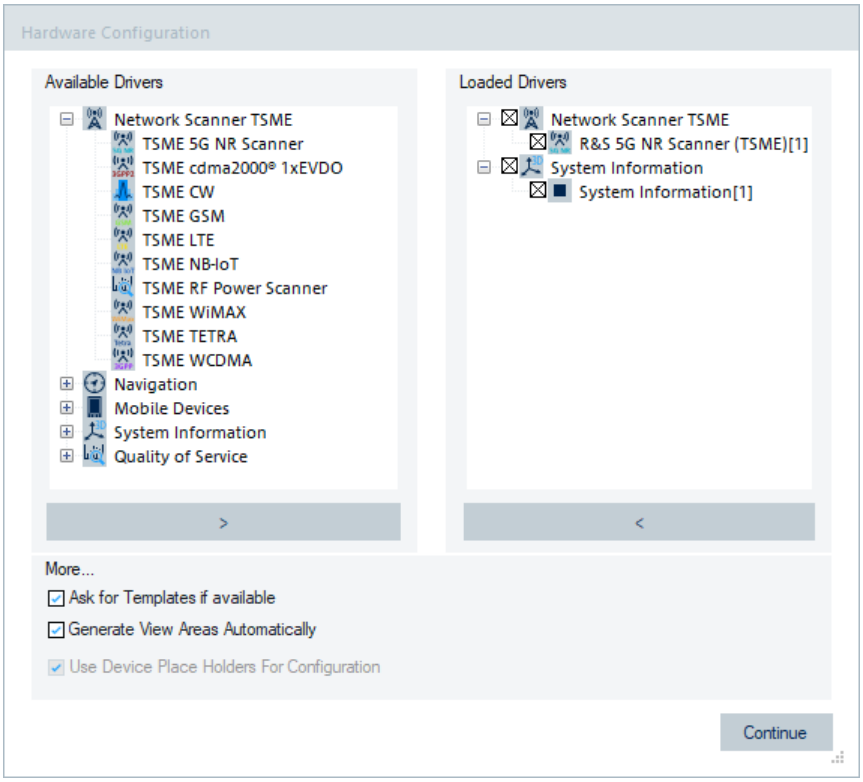


Figure 6-68: Attached scanner

If a second scanner is chosen, then the previously configured "TSME" place holder is removed and displayed in the place holder device selection dialog.

If all desired devices are loaded, clicking "Continue" completes the loading process. R&S ROMES4 configures as normal. You can now also save the workspace from the "File" menu as normal.

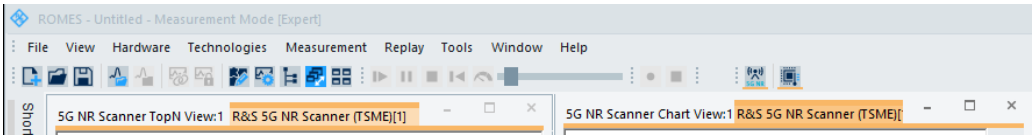


Figure 6-69: Several devices attached

If a place holder device is used, then "Start Measurement" button in R&S ROMES4 is grayed out and a measurement cannot be started.

6.1.13.2 Mobile device place holder configuration

The configuration of mobile device place holder is the same as the scanner place holder configuration, with one exception. As there is one to one relationship between mobile devices and R&S ROMES4, there is no need to define place holder devices.

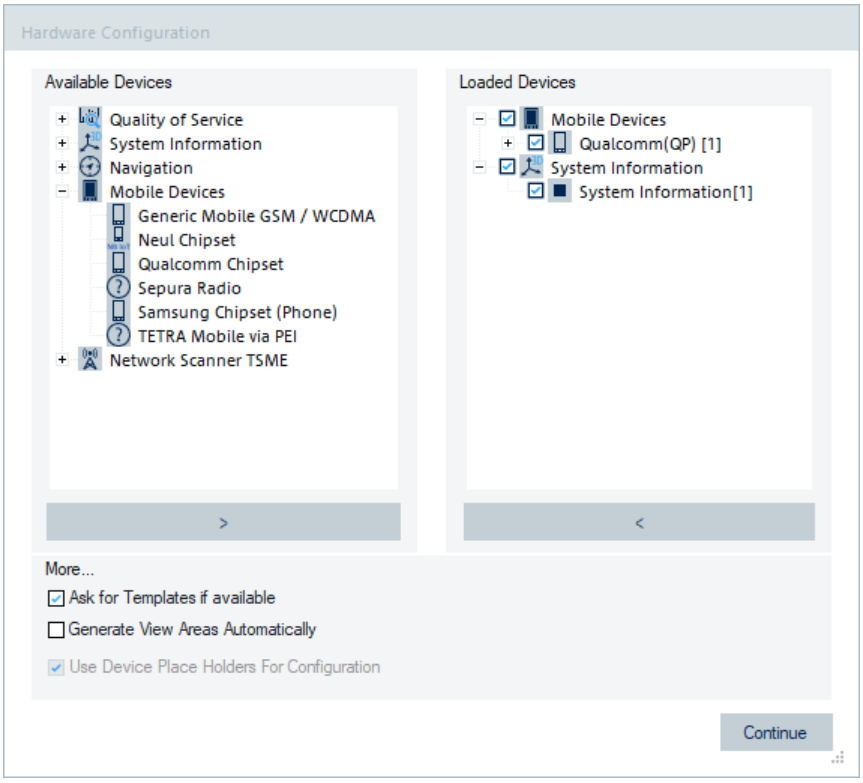


Figure 6-70: Attached Qualcomm mobile device

Limitation for mobiles: Forcing, QualiPoc and QoS testing is not supported.

6.1.13.3 Other actions with place holder

Reload workspace for additional configuration

To reload the saved workspace to allow additional place holder configuration, perform the following:

1. Open the workspace in R&S ROMES4.
2. When it prompts to identify the actual hardware, select the place holder as device option for reload.

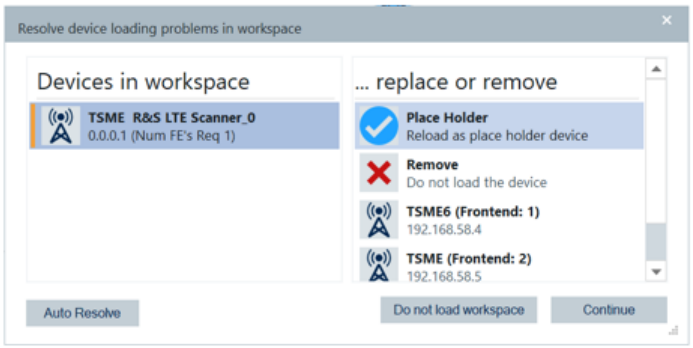


Figure 6-71: Place holder as device option to reload

Place holder is loaded as a device.

Place holder replacement

1. Reload the workspace again to replace the place holder devices with the actual hardware.
2. Start the measurement.
3. Attach all needed hardware to R&S ROMES4 first.
4. Open the workspace in R&S ROMES4.
5. When it prompts, replace each place holder device with the actual hardware needed in the measurement.

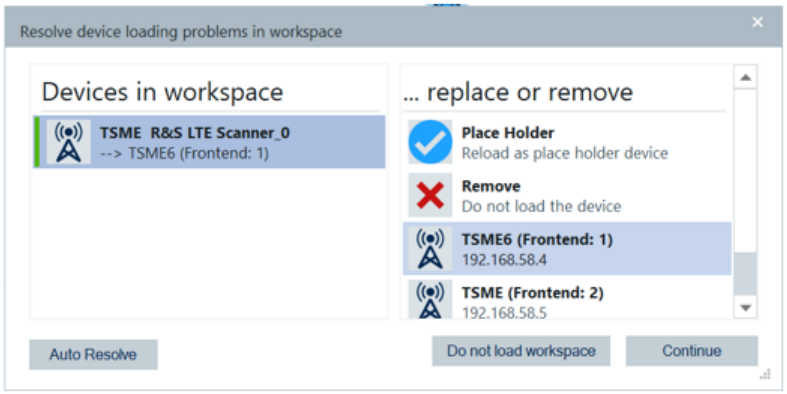


Figure 6-72: Place holder device repaced with actual one

6. Click "Continue".

   The R&S ROMES4 measurement can now be started.

7. To start the measurement, click the "Measurement" > "Start" command in the R&S ROMES4.

   The workspace is now opened with a modified file name.

The original workspace with the place holder devices is not modified.

Example:

Assume the workspace file that contains place holder devices, called `2_TSME_LTE_PH.rsxks`, is opened. Assume further that place holder devices are replaced with actual hardware. A new workspace called `2_TSME_LTE_PH_modified.rsxks` is now created and loaded so that the original workspace is not modified.

6.2 Automatic reload of mobile devices

R&S ROMES4 reconnects 3GPP test devices automatically to the correct COM ports. Therefore, the mobile drivers check the IMEI and IMSI of the test mobile device during R&S ROMES4 connect process.

Only the COM ports specified in the workspace are accounted for connection to a mobile. If the mobile is connected to a different COM port, you have to reallocate it by selecting "Assign New Link".

If the original IMEI or the IMSI is found, the test device is installed automatically.

If the IMEI of the currently connected mobile is not equal to the IMEI stored in the workspace, R&S ROMES4 searches the workspaces for the appropriate setting for the current IMEI. If such setting exists in the workspace file, it is loaded for the mobile. Otherwise, a window appears indicating that the workspace setting does not match the currently connected mobile.

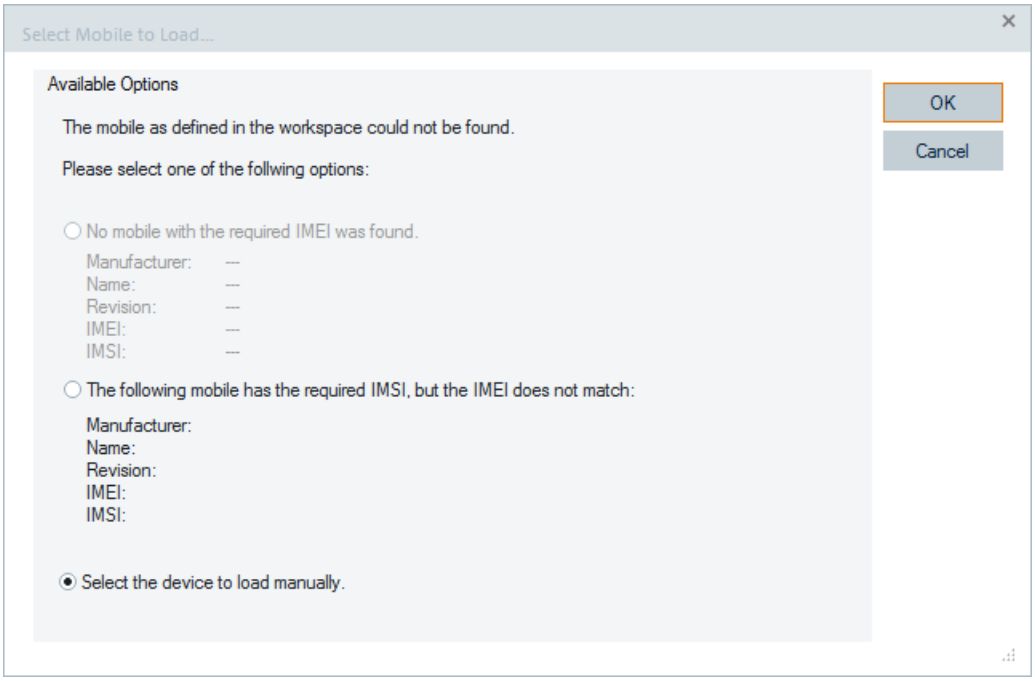


Figure 6-73: Automatic reload of devices

Depending on the mobile device, the "Select Mobile to load" window offers single or multiple selection possibilities.

- Select another test device that has the required IMEI, but another IMSI.
- Select another test device that has the required IMSI, but another IMEI.
- Load the device manually
  Cancel the reconnect process and select the device manually. The 3GPP Qualcomm drivers support this functionality.

If the COM port has to be changed the DQA and the SQA reconfigure automatically.

6.3 Devices observation

6.3.1 Expected data rate

R&S ROMES4 observes the amount of produced data per time unit of each R&S ROMES4 connected device. This value is taken as indicator for a proper function of the device connected to the R&S ROMES4. By default it is expected, that a R&S ROMES4 connected device produces and sends 100 Bytes per second. This value can be adapted if necessary. To do so, open the configuration dialog of the corresponding device and navigate to the "Information" section. Click the "Info" tab. At the top of the opened page, this value can be changed.

Figure 6-74: Info tab - Module Properties

The Chapter 4.2.7, "General status view", on page 501 reports the current data rate for each R&S ROMES4 connected device involved in the current measurement. The right column indicates the set threshold for alarms. Reporting of the current values does not start earlier than 10 seconds after the start of measurement. The refresh rate is about five seconds. If the current rate of data is below the given threshold, the corresponding cell in the list gets a red background. An alarm dialog is shown and plays a wave file (optionally).

6.3.2 Raw data logging

Some test devices, for example Qualcomm chipset-based mobiles, offer raw data logging. Raw data offers more information, which can be useful for the interpretation of network problems discovered during drive testing. By default the function is not active. To activate it, click "Info" and check the "Module Properties" > "Raw Data Logging" checkbox.

The log files are saved to the `LogFiles` directory of `My ROMES`.

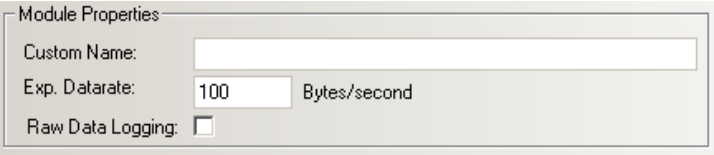


Figure 6-75: Raw data logging checkbox included

Enable raw data logging only when required for investigating a specific problem. Otherwise, the measurement files are larger than normal and the hard drive of the measurement PC is quickly filled.

6.4 Test devices

The drivers needed for the test devices and their configuration are described in the following sections.

The measurement system supports a wide range of devices that can be used to perform measurements and provide the desired results:

- Mobile phones of various types and for usage in various networks
- Test receivers and analyzers, named here scanners

- NB-IoT UE

About mobile devices

R&S ROMES4 supports NB-IoT measurement data collected by Qualcomm or Neul chipset-based test UE, see Chapter 6.1, "Devices", on page 1447. The UE can be loaded as any other test devices.

ADB phones not authorized for the R&S ROMES4 PCs do not appear on the "Welcome" screen. If R&S ROMES4 detects such a mobile phone, an error message is issued in the "Output View". You are asked to authorize the ADB access on the phone.

An unauthorized mobile phone is a mobile phone with Android operation system not authorized for the used PC. Authorization can be done on the mobile.

About scanners

The ACD function acts in a way that all detected channels are automatically added to the actual scanners. This automatic behavior of any scanner can be suppressed by deactivating the "Auto Start of Scan" option in the "Automatic Channel Detection" page.

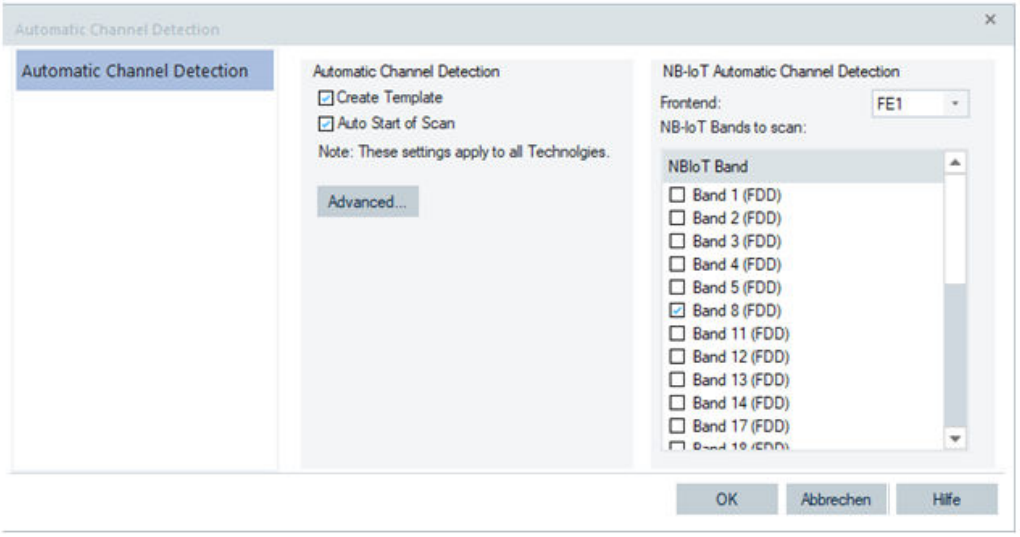


Figure 6-76: ACD page - auto start of scan

The option is useful if not all channels are of interest and the important ones should be scanned with a maximum rate. Enabling only specific channels helps to save resources and to focus on the actually required channel measurements, seeChapter 4.2.2, "ACD status view", on page 461.

GSM does not support this feature, as it does not use the ACD algorithm. if you enable GSM in the ACD wizard, GSM is scanned always.

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6.4.1 Support of SwissQual TCM

R&S ROMES supports the SwissQual device Test Containment Module (TCM).

Network optimization and troubleshooting suppose use of unmodified phones in a controlled environment to achieve reliable results. The TCM ensures maximum data quality for large-scale benchmarking campaigns.

In particular, if MIMO is used with increased number of build-in antennas, the TCM allows assessing the real RF performance of the device.

The temperature control of the test devices is improved with the TCM. Temperature control of the device is important to avoid that measurement results are impacted by reduced phone performance due to overheating. The module enables stable thermal environments and uniform conditions for all test devices, making measurement results comparable.

6.4.1.1 Prerequisites

After installing the R&S ROMES4 application, the following steps have to be performed to obtain the TCM functionality.

- TCM driver installation
- TCM firmware version check and update

TCM driver installation

Two device types can be connected to R&S ROMES4. One Remote Power Controller (RPC) and up to 16 Test device Containment Modules (TCM) can be connected.

Connect the RPC board for temperature control to avoid overheating of its components. Also, this connection is necessary to switch the 4 auxiliary ports of the RPC controller on and off.

1. Plugin the RPC device.
2. Look for the device named USB API with an exclamation mark at its icon in "Other device" or "Unknown devices" of the Device Manager. Ignore any devices there with the name SwissQual ASC.
3. Right-click the USB API device.
4. Select "Update Driver Software" and then "Browse my computer for driver software".
5. Browse to the folder containing the RPC driver.
6. Click "Next".
7. The "Windows Security" dialog pops-up. Choose "Install this driver software anyway".

   The installation finishes.

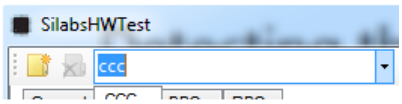
Now plug in a TCM device and install the driver in the same way that you installed the RPC device.

TCM firmware check and update

The SwissQual TCM firmware version must be 2.35 or higher to work with R&S ROMES4. If the firmware is older, an error is shown in the "Output" window and the device is ignored.

Check the TCM firmware version using the SiLabsHWTest tool.

1. Stop R&S ROMES
2. Start the SiLabsHWTest.
3. Select "ccc" at the top.



4. Click the folder symbol to connect to this device.
5. Open the "General" tab.

6. Select "FW Version".

   The firmware version is shown.

If the shown version is not 2.35 or higher, you have to update the firmware.

To update the firmware version, perform the following steps:

1. Select "Bootload" and ccc as "Device Serial String". Click "Open".
2. In the "Select Hex File" section, click "Browse". Select the hex file (`*.hex`) to load.
3. Click "Download".
   Reset device after previously performed steps. Click "Reset Device".
4. Press "Exit" and connect to the ccc device again (folder symbol).
5. Click "Read" in the "TCM Flash option" group.

   The radio button group below the "Read" button shows now "Romes".

If it is not a case, change the TCM and click "Set". Disconnect from the device.

6.4.1.2 TCM and RPC-related controls in R&S ROMES4

R&S ROMES4 automatically detects the connected RPC and TCM devices, USB ports and the phones and starts temperature checking of the devices.

Press the "Stop" button in the TCM dialog to disconnect the mobile phone in the TCM from the USB port. The mobile phone is no longer seen by R&S ROMES, but as the TCM remains connected, the temperature can be seen. The button changes its name into "Start". Press the button to reconnect the phone.

To reboot a phone, select the "Reset" button. It takes some time (around 30 seconds) until the device is detected again by R&S ROMES4.

Unplugging and plugging the TCM again can cause that a R&S ROMES4 scanner cannot find the mobile device although you see the TCM and the mobile in the TCM toolbar. In this case, switch the mobile's USB power off using the "Stop" button on the TCM toolbar and switch it on again. Now the R&S ROMES4 scanner starts and looks for the mobile again.

Restarting a mobile device with the "Reset" button can cause that the device cannot be found again. (See <ABSENT> in the "Device" column and <Timeout error> in the "State" column of the TCM toolbar). If this case occurs, switch the mobile's USB power off by clicking "Stop" and then switch it again on. Now the R&S ROMES scanner starts and looks for the mobile again.

Messages related to RPC/TMC devices are shown in the "Output" window, as the "TCM" entry.

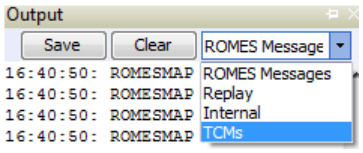


Figure 6-77: Output - TCM messages

The TCM specification includes a value of 25 °C for the ambient temperature that it tries to keep.

In addition to the warnings shown in the "Output", you can see a temperature problem in the TCM toolbar. Temperatures out of the given range are shown yellow.

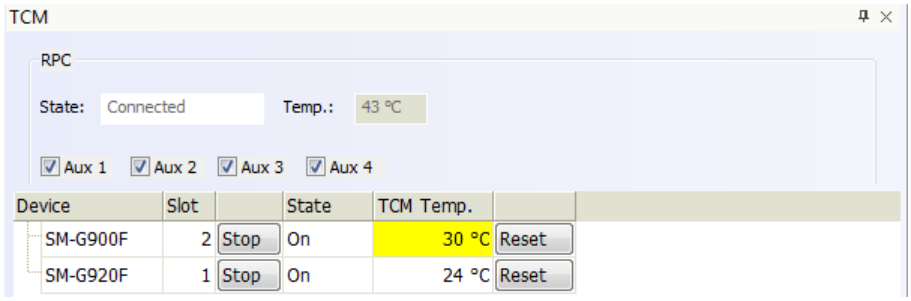


Figure 6-78: TCM temperature out of range

R&S ROMES supports TCM temperature range setting. R&S ROMES4 uses the configured temperature values to decide if warnings are issued in the "Output Bar" of the TCM page when the TCM temperature is not in the given range.

To set the temperature values for issuing a warning message, see Chapter 3.8.1, "System configuration (preferences)", on page 223.

Allowed range for the lower temperature value is 23 °C to 25 °C and for the higher 25 °C to 27 °C.

6.4.1.3 Single driver mode

If R&S ROMES4 is running under a Remote Desktop, a dongle with the CVD_EXPORT_OPTION is in use, an RPC device is plugged in and a measurement starts. R&S ROMES4 switches to the Single Driver Mode, what means that many controls are disabled to avoid accidents.

6.4.1.4 Overheat alerts

The SwissQual TCM and the RPC devices show alerts in the TCM toolbar if the temperature goes ahead 80° C. In this case, it is highly recommended to switch off the involved devices to avoid hardware damage.

6.4.2 Downconverters supported by R&S ROMES4 scanners

R&S ROMES4 supports the R&S TSME44DC and R&S 30DC.

6.4.2.1 R&S 30DC downconverter

The following R&S ROMES4 scanners support the R&S 30DC downconverter.

- 5G NR Scanner
- RF Power Scanner
- CW Scanner

The listed scanners accept frequencies in any of the supported frequency ranges of the downconverter. The supported ranges are:

- 350 MHz – 6000 GHz (only primary R&S TSME connected to RF1)
- 24 GHz – 27.5 GHz
- 27 GHz – 30 GHz

In the overlapping range 27 GHz to 27.5 GHz R&S ROMES4 uses the antenna port of the range 24 GHz – 27.5 GHz.

The "Output" view shows messages about connecting a downconverter or related warnings and/or errors.

```
16:12:30: Synchronizing User Directory...
16:12:31: Updating Folders
16:12:37: TSMW Query: 0 found.
16:12:37: TSMx Device Scanner TSME scanning....
16:12:40: Connect TSME succeeded
16:12:40: TSME S.N. 1451654784 is connected to a downconverter
16:12:40: TSMx Device Scanner scanning done.
16:12:40: TSMx Device Scanner scanning...finished.
```

Figure 6-79: R&S TSME connected to the RS& 30DC

The R&S ROMES4 "Available Devices" field of the "Welcome" page displays the connected downconverters of the scanners and the available frequency ranges per scanner. An asterisk at the end of the TSME6-DC30* name marks the primary R&S TSME6.

The R&S TSME6 which is connected via the AUX cable to the downconverter and via the RF cable to the input IF1 of the downconverter is called Primary.

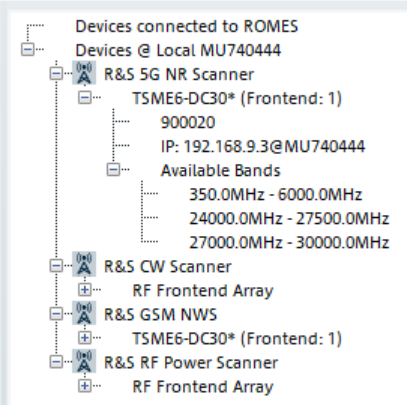


Figure 6-80: Connected devices - available devices view

It is mandatory to set up the primary R&S TSME6 with the R&S TSME Device Manager version 1.6 or higher according to the hardware setup. R&S ROMES4 reads out this information and handles the downconverter and scanners accordingly. Without the box, an R&S TSME6-30DC set-up does not work. All the R&S TSME6s connected to the downconverter require an all-band option.

Overlapping region of R&S TSME30DC

The R&S TSME30DC has an overlapping region from 27 GHz to 27.5 GHz. R&S ROMES4 supports this region as it takes antenna region for each R&S TSME as specified in the `TSMxTranducerTables.xml`.

1. Add a section TSME30DC with the attribute "Overlapping" to the Frontend selection.
2. Specify "High", if you want to take the high range antenna (27 GHz to 30 GHz). By default a legacy solution applies, which is the lower range antenna.

   The ACD wizard now starts with the current configuration.

```
<Frontends>
<Frontend Identnumber="4900.0004K02" Serialnumber="101035" Active="true">
  <TSME30DC Overlapping="High"></TSME30DC>
  <Node GainInDB="20.0" FrequencyInHz="2700000000" Type="Low"/>
  <Node GainInDB="20.5" FrequencyInHz="2800000000" Type="Mid"/>
  <Node GainInDB="20.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>
</Frontends>
```

6.4.2.2 External downconverters

The previously listed R&S ROMES4 scanners support the usage of external (third party) downconverters with R&S TSME/A6 in addition to R&S DC30 downconverter.

The `TSMxTransducerTables.xml` file allows you to specify the properties of an external downconverter.

R&S ROMES4 reads this information analogue to the R&S TSME6-DC30 information, which is stored in the primary R&S TSME6.

The file R&S ROMES4 reads is located in the C:\ User\<username-variable>\MyDocuments\MyROMES\Configuration folder.

Specify several transducer tables, downconverters and ranges for an R&S TSME/TSMA6 device in the `*.xml` file and activate one of these tables.

Refer to the following sample in the file for details:

- *Device Section*
  Includes the following frontend settings:
  – Frontend *Identnumber* - has to be in the format *aaaa.bbbbKcc*
  – Frontend *Serialnumber* - serial number of R&S TSME/TSME6
  – Frontend status *Active* - can be *true* or *false*
- *Downconverter (only TSME6)*
  Includes the following settings:
  – Downconverter *Type*
  – *LO frequency in MHz*
  – *Multiplier for LO frequency*
- *Range*
  Range is mandatory setting if downconverter is specified. Required is to specify the minimal and maximal input frequency of downconverter or device in MHz.

R&S ROMES4 reads the downconverter setup of the XML file only once during the startup, while the Transducer Table itself can be changed and reloaded during a R&S ROMES4 session.

The XML file warnings and errors are reported in the R&S ROMES4 "Output" bar.

Perform the following steps to get an external downconverter into your R&S ROMES4 system:

1. Open the `TSMxTransducerTables.xml`.
2. Read the comments at the top of the file.
3. Add a new frontend section:
   a. Set the correct Ident number of your device.
   b. Set the correct Serial number of your device.
   c. Set `Active` to true, if you want to use the section or set it to false otherwise.
4. Define the downconverter properties:
   a. Add a section downconverter.
   b. Set its attributes accordingly.
   c. Add a section Range.
   d. Set the minimal and maximal input frequency of the downconverter.

5. Specify the transducer nodes if desired.

The following figures show the layout of the `TSMxTransducerTables.xml`.

The first one shows the upper, explanatory part of the file. The second one is the lower part of the file, an example for the transducer configuration.

```
<?xml version="1.0" encoding="iso-8859-1"?>
<!--
Transducer Tables for TSMW/TSME/TSME6 receivers
This file specifies the transducer tables for all frontends.
The frontends are identified by the serialnumber of the scannerand
the frontend number.
For each frontend a set of nodes can be specified. This set can specify several
sections in the frequency spectrum.
The first node of a section has to have the type "Low". The section is closed with
a node of the type "High".
In between several nodes with the type "Mid" can be specified.
The frequencies of the all nodes of a frontend have to be ascending.
if Acitve is not present true is used


===== Device Section =====
Frontend:
Identnumber: Identnumber of Device in the format aaaa.bbbbKcc
Serialnumber: Serialnumber of TSMW/TSME/TSME6 (integer)
Active: only one Frontend per serialnumber shall be Active. Only the first active
Fronted will be taken into account.Possible values are true or false

===== Downconverter (Only TSME6) =======
Downconverter Types:
LOInMHz: LO Frequency in MHz (integer)
Multiplier: Multiplier for LO Frequency. (integer)
The DC shifts the input frequency to f(out) = f(in) - f(LO)*Multiplier
Type: Type of DC:
200     TP-5GDC - White
201     TP-5GDC - Green
202     TP-5GDC - Blue

==== Range ====
Range (mandatory if Downconverter is specified):
Allows to shrink the devices' input RF ranges, e.g. due to connected antennas
MinFInMHz: minimal input frequency of DC or device in MHz (integer)
MaxFInMHz: maximal input frequency of DC or device in MHz (integer)

Example:
-->
```

Figure 6-81: Explanatory part of the file

```
Example:
-->
<!--
<Frontends>
<Frontend Identnumber="4900.0004K02" Serialnumber="101067"  Active="false" >
<Downconverter LOInMHz="11400" Multiplier="2" Type="200"/>
<Range MinFInMHz = "24250" MaxFInMHz = "27500"/>
<Node GainInDB="10.0" FrequencyInHz="100000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="1500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="1800000000" Type="High"/>
<Node GainInDB="10.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>
<Frontend Identnumber="4900.0004K02" Serialnumber="101067"  Active="false" >
<Downconverter LOInMHz="12400" Multiplier="2" Type="201"/>
<Range MinFInMHz = "26500" MaxFInMHz = "29500"/>
<Node GainInDB="10.0" FrequencyInHz="100000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="1500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="1800000000" Type="High"/>
<Node GainInDB="10.0" FrequencyInHz="2000000000" Type="Low"/>
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<Node GainInDB="10.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>
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<Node GainInDB="10.5" FrequencyInHz="1500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="1800000000" Type="High"/>
<Node GainInDB="10.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>
<Frontend Identnumber="4900.0004K02" Serialnumber="101067" Active="false" >
<Node GainInDB="20.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="20.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="20.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>


<Frontend Identnumber="4900.0004K02" Serialnumber="101034"  Active="false" >
<Downconverter LOInMHz="11400" Multiplier="2" Type="200"/>
<Range MinFInMHz = "24250" MaxFInMHz = "27500"/>
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<Node GainInDB="10.5" FrequencyInHz="1500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="1800000000" Type="High"/>
<Node GainInDB="10.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="3000000000" Type="High"/>
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<Range MinFInMHz = "26500" MaxFInMHz = "29500"/>
<Node GainInDB="10.0" FrequencyInHz="100000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="1500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="1800000000" Type="High"/>
<Node GainInDB="10.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>
<Frontend Identnumber="4900.0004K02" Serialnumber="101034"  Active="true" >
<Downconverter LOInMHz="17800" Multiplier="2" Type="202"/>
<Range MinFInMHz = "37000" MaxFInMHz = "40000"/>
<Node GainInDB="10.0" FrequencyInHz="100000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="1500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="1800000000" Type="High"/>
<Node GainInDB="10.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="10.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="10.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>
<Frontend Identnumber="4900.0004K02" Serialnumber="101034" Active="false" >
<Node GainInDB="20.0" FrequencyInHz="2000000000" Type="Low"/>
<Node GainInDB="20.5" FrequencyInHz="2500000000" Type="Mid"/>
<Node GainInDB="20.6" FrequencyInHz="3000000000" Type="High"/>
</Frontend>

</Frontends>

-->
<Frontends/>
```

Figure 6-82: Configuration example, the lower part of the file

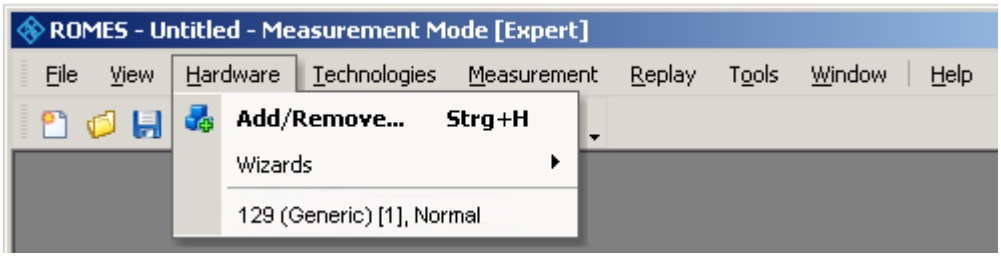
It is not allowed to use the third-party downconverter settings together with the R&S DC30 downconverter in the system.

6.4.3 Generic mobile devices

The driver for generic mobile test devices is based on AT commands, so that most common mobile phones can be used for testing with a reduced functionality. The generic mobile is no longer a fully enabled test mobile. Instead, it is limited to return data like the measurement report (RxLev, RxQual) or the phone mode. Nevertheless, the generic mobile can be used for e.g. speech quality measurements, where the AT commands and responses are shown in the "Layer 3 View" instead of the L3 messages.

The selection of generic mobile test devices is performed in the "Hardware" > "Connect/Disconnect" > "Hardware Configuration" configuration window. Select the "Generic Mobile GSM / WCDMA" entry and click the ">" button. After you define the device's serial port, the driver is loaded and added to the "Loaded Driver" list.

The measurement system provides a generic mobile driver for the test mobiles not covered by the GSM or UMTS drivers.



6.4.3.1 Configuration menu

The "Generic Mobile GSM / WCDMA" driver configuration menu contains various tabs to perform different tasks.

- "GM Settings", "Communication Item List Editor", "Mobile Options" to select the measurement and message types evaluated by the test system
- "Autodialing" to configure the autodialing and autoanswer call mode
- "SQA" to set up the speech quality
- "Serial Port Driver Info" to display information on the driver and the assigned serial port

Click the "Hardware" > "<Driver>" command line which is available when a mobile driver is loaded.

- Generic mobile (GM) settings 1523
- Communication item list editor 1523
- Autodialing generic mobile 1524
- SQA settings generic mobile 1525

- NQA settings....1525
- Templates generic mobile....1526
- Serial port driver info generic mobile....1527

Generic mobile (GM) settings

The "GM Settings" tab lets you handle the PIN number, if applicable.

PIN handling
If "Use PIN" is checked, the PIN number for identification after switching on the test mobile can be entered in the "GM Settings" panel of the configuration dialog. If nothing is entered, the SIM must be entered manually at the mobile each time it is started.

Communication item list editor

The "Communication Item List Editor" tab shows the message commands, requests, and responses to be recorded to the measurement file.

Communication Item List Editor
- **ID**
  Internal list number of the communication item.
- **Use**
  Toggles the use of the selected list item.
- **Item**
  Communication item descriptor (or AT command).
- **Type**
  Qualifies the list item to be a command, request, or result.
- **Text**
  Additional optional description of the list item.
- **Check**
  Sets whether the communication item is supported by the mobile. Setting "Yes" indicates that there is active feedback from the mobile.
- **Get Par.**
  List item parameter is requested by the generic mobile.
- **Set Par.**
  List item parameter is sent to the mobile (e.g. PIN).
- **Term.**
  Termination of the mobile response, i.e. the item defines the end of the mobile response.
- **Delim.**
  Sets the delimiter for parts of multi-part responses from the mobile.
- **Time [ms]**
  Defines the time to wait for the response from the mobile.
- **Response**
  Represents the value of the response, for example, 0 means that "Response is a valid value", 1 usually means "OK".

Load List
Calls the "Load List" dialog to select a previously saved list for loading.

Save List
Calls the "Save" dialog to store the current list.

Initialize List
Loads the default list (unsaved manual changes are lost).

Autodialing generic mobile

The "Autodialing" tab configures the mode where a definite phone number is dialed periodically, and a call is set up to the mobile phone.

This mode is relevant for the network quality analysis described in "NQA settings" on page 1547.

The autodialing mechanism of the mobile drivers allows the IRAT handovers automatically to test, see the following figure and "Preconditions" on page 1541.

All settings are analogous to the GSM driver settings described in "Autodialing" on page 1536.

If a 2nd virtual COM port is needed to be operated in autodial mode, refer to Chapter 6.1.4.2, "Loading the USB drivers", on page 1457.

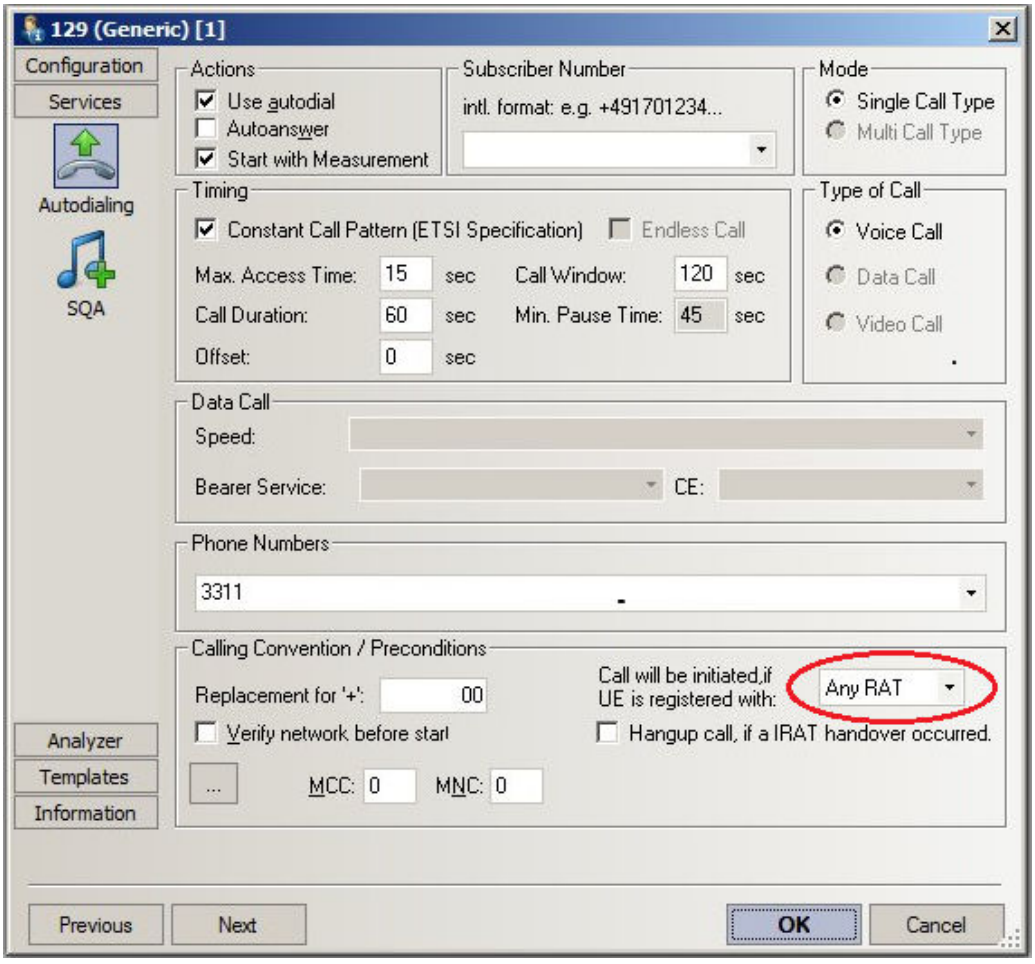


Figure 6-83: Generic Mobile driver configuration – Autodialing tab

Autodialing can be limited for the mobiles to initiate a call in "Only LTE", see Figure 6-97.

SQA settings generic mobile

The SQA tab enables and configures the speech quality (SQA) with the R&S ROMES4SQA, "Voice Quality PESQ" option. The SQA results are displayed in chapter Chapter 4.6.1, "QoS SQA view", on page 1060.

All settings are analogous to the GSM driver settings described in "GPS health monitoring" on page 2064.

NQA settings

The "NQA Settings" tab provides the parameters for network quality analysis. The NQA settings are prerequisite for drawing up a call statistic, where the calls are classified and the classes are visualized separately.

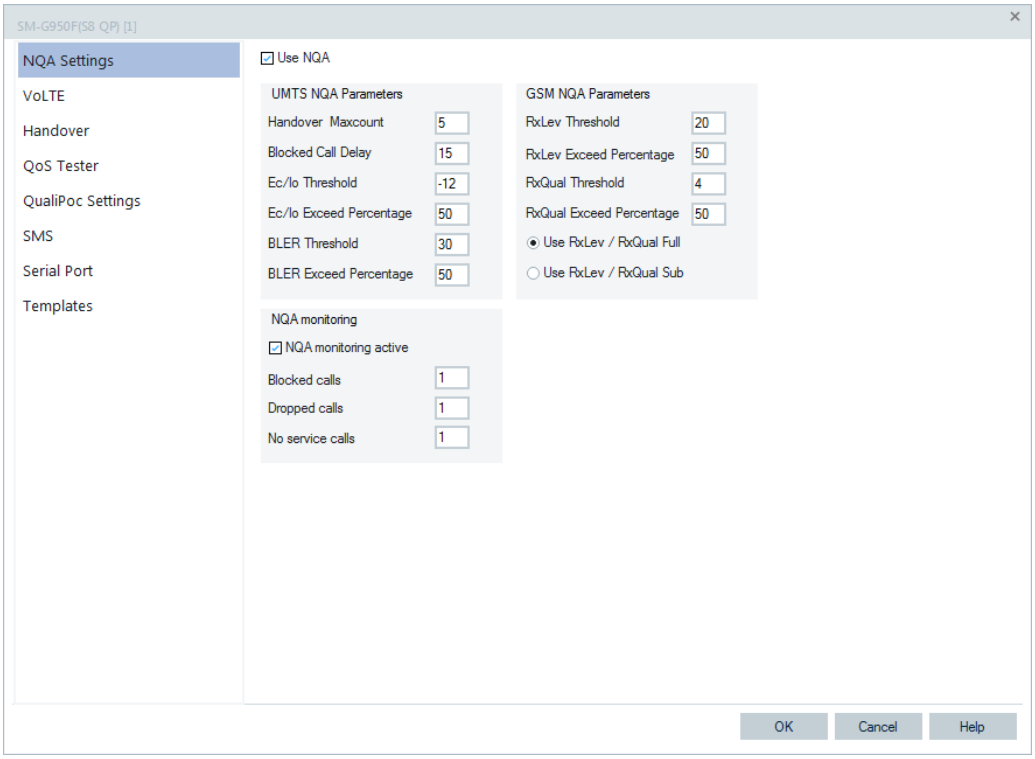


Figure 6-84: Generic Mobile driver configuration – NQA Settings

The parameters in the "GSM NQA Parameters" and "NQA Monitoring" sections are identical to the NQA parameters for GSM, see "NQA settings" on page 1547.

Use NQA
If checked, activates the network quality analysis (default).

UMTS NQA Parameters
The following numeric parameters configure the UMTS NQA by defining conditions and limits for the different call classes (we quote the ranges for all parameters; default values are underscored).

- "Handover Maxcount"
  Maximum number of handover procedures during a call in the range 1 to 100. Default is 5. If the defined value is exceeded, the call is classified as EXCESSIVE HO.
- "Blocked Call Delay"
  Maximum delay (in seconds) between CM_SERV_REQ and ASSIGNMENT_COMMAND in the range 1 (s) to 63 (s). Default is 15 (s). If the defined delay is exceeded, the call is classified as DELAYED CALL.
- "Ec/Io Threshold"
  Minimum Ec/Io value included in measurement.
- "Ec/Io Exceed Percentage"
  Minimum ratio of reported RxLev values in percentage falling below the RxLev threshold. Default is 50 %. If the actual ratio falls below the specified percentage, the call is classified as NOISY.
- "BLER Threshold"
  Maximum Block Error Rate in percentage. Default is 30 %. BLER values above this threshold contribute to NOISY.
- "BLER Exceed Percentage"
  Minimum ratio (in percent) of reported BLER values exceeding the BLER threshold in the range. Default is 50 %. If the actual ratio exceeds the specified percentage, the call is classified as NOISY.

GSM NQA Parameters
Configures the GSM NQA, see "NQA settings" on page 1547.

NQA Monitoring
Activates NQA monitoring and displays the number of Blocked Calls, Dropped Calls and No Service Calls, see "NQA settings" on page 1547.

Templates generic mobile

The "Templates" tab stores the current driver configuration as a template, lists, loads or deletes driver templates. All settings and buttons are analogous to the GSM driver settings described in "Templates" on page 1558.

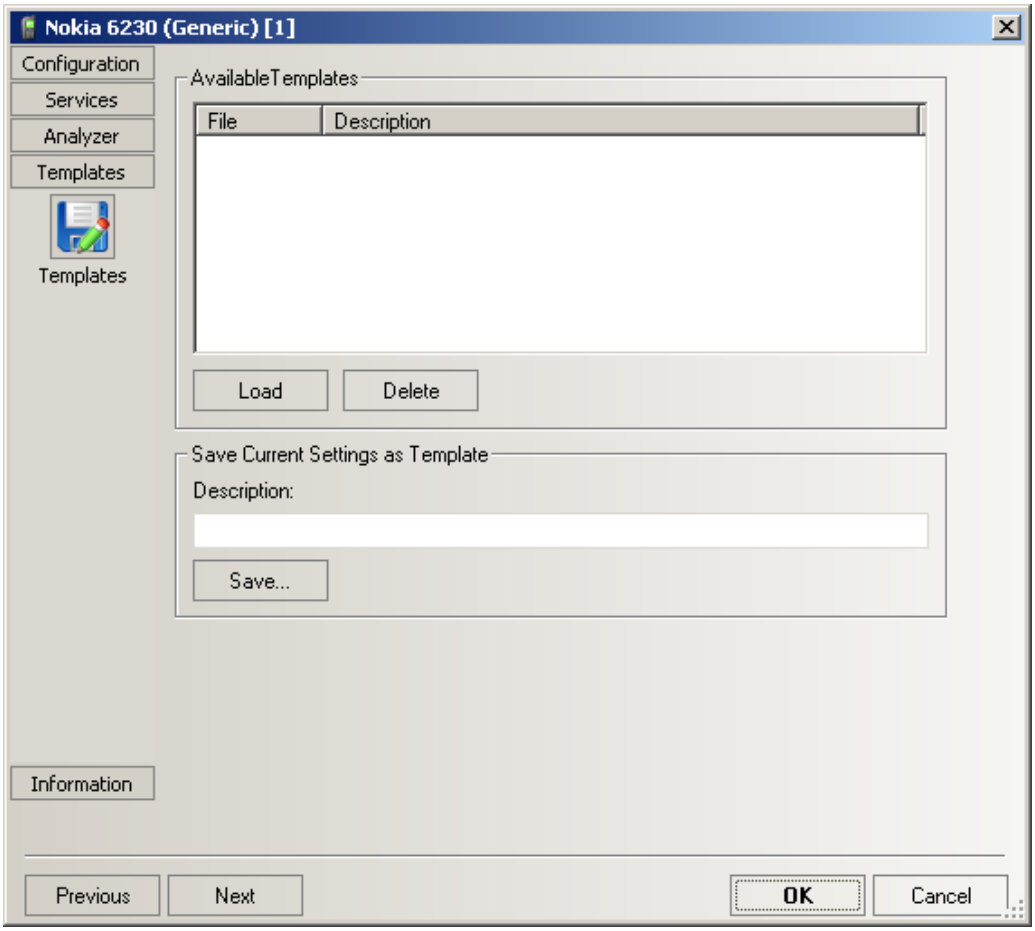


Figure 6-85: Driver Configuration – Templates tab

Serial port driver info generic mobile

The "Serial Port Driver" tab displays the custom name of the device, information on the file version of the technology driver, the serial port assigned to it and the transfer parameters. The "Custom Name" is used to assign a name to a test device, e.g. to make a quick association of a test device to its designated test network provider.

Also the expected amount of produced driver data per time unit can be set. See also Chapter 6.3, "Devices observation", on page 1510.

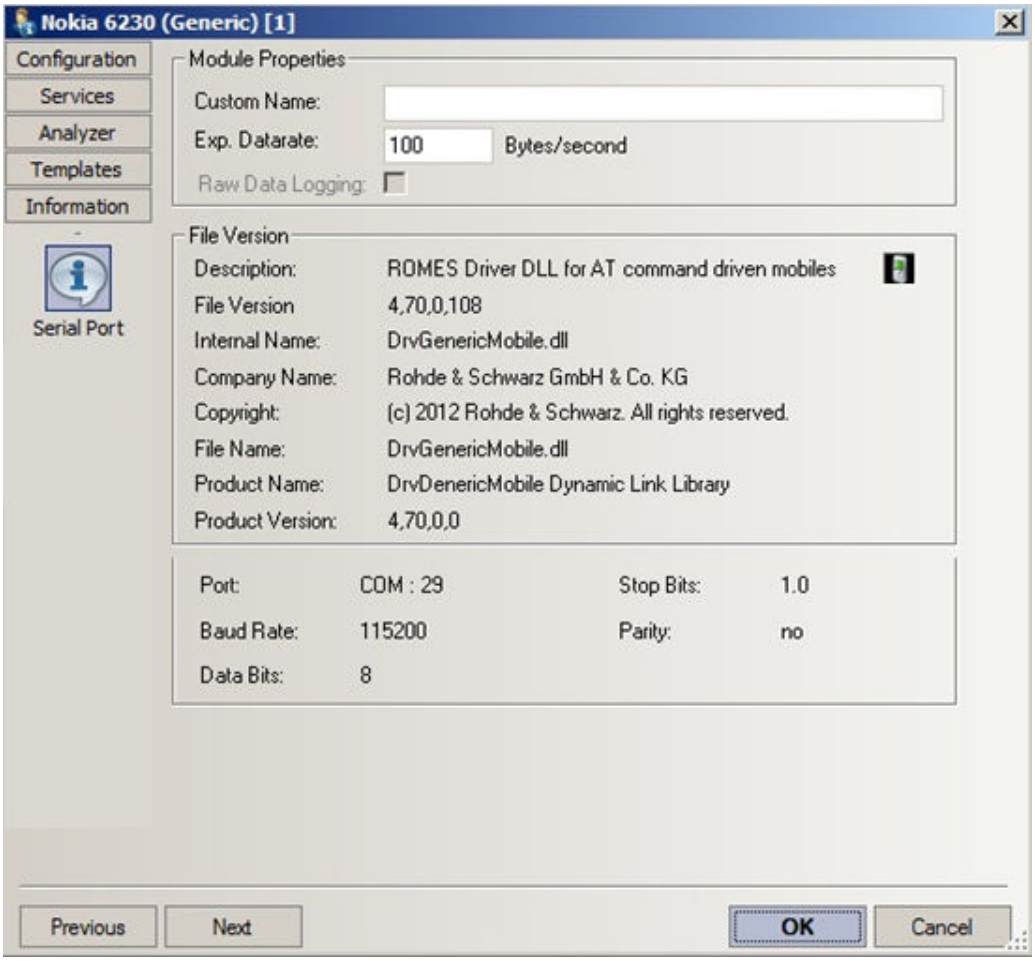


Figure 6-86: Driver Configuration – Serial Port Driver Info tab

Raw Data Logging is not available for Generic mobile driver.

6.4.3.2 Action menu generic mobile

The "Action" menu opens pop-up boxes used to set up a call or show the contents of the mobile display. It is added to the menu bar when a mobile driver has been successfully installed (see "Devices"). If several mobiles are connected, separate command lines are displayed for each of them.

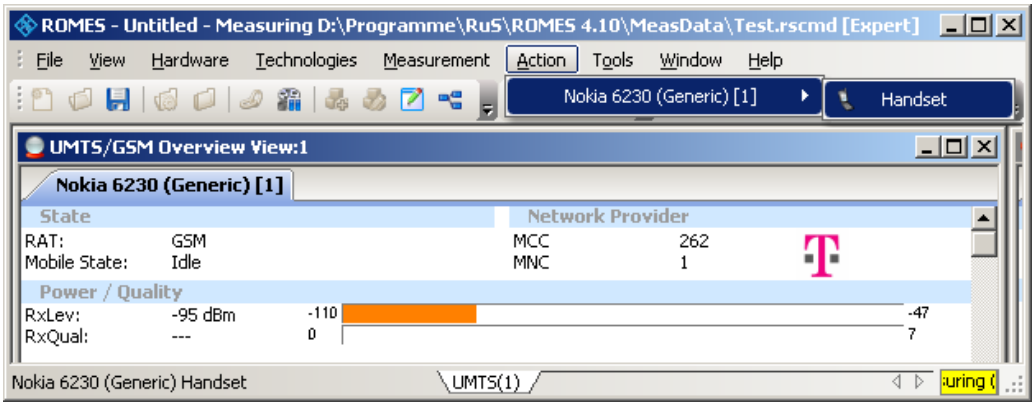


Figure 6-87: Action menu for different driver types

Handset generic mobile

Activates the entry of a number to dial, set up and terminate a call.

- **Handset**
  The "Handset" command opens a window (equal for all drivers) which have two possible statuses:
  – Not selected
  – Selected, marked with "- *" and shown in the following figure as connected mobile [2].

If there is only one "Handset" window, it always has selected status.
If there is more than one "Handset" window, the selected status can be set to any "Handset" window in one of two listed ways:
1) Click to the window using a mouse.
2) Choose selected window using the "N" key. In this case selection changed like this: Window[1] > press "N"> Window[2] > press "N"> ...Window[n] > press "N"> Window[1] (cycling choose like "Alt+Tab" between open windows in MS Windows).

Only selected windows accepts hotkeys “D” ("Dial"), “A”("Answer"), “H”("Hangup").
Note: The previously mentioned keys have only effect, if the focus is not set to an input control, example-given edit field or combo box.
Example: if you select the phone number by selecting the corresponding entry of the combo box, the keys do not work afterwards. Set the focus to another window, for example to the main R&S ROMES4 window.

- **>>**
  The ">>" button enlarges the dialog box, giving access to the Key pad and the "Autodialing" option.

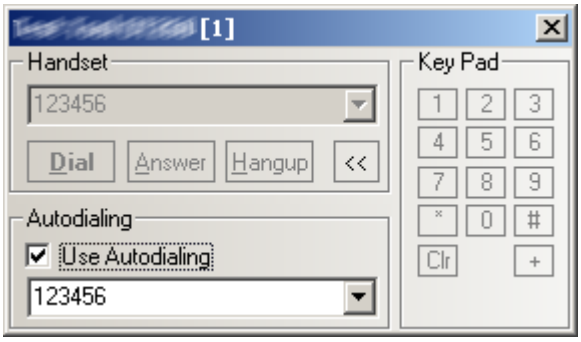


Figure 6-88: Use Autodialing

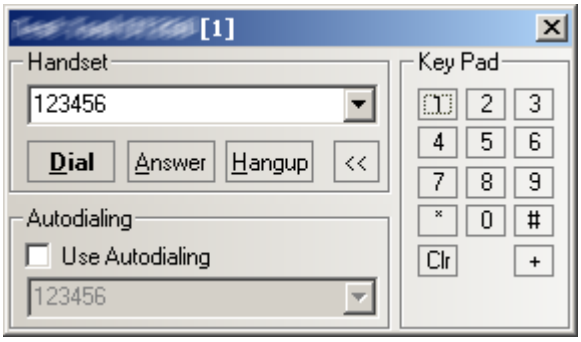


Figure 6-89: No Autodialing

- **Dialed number**
  The number to be dialed can be entered either via the keyboard and the input field or by clicking the on-screen keypad.
- "Close window ☒"
  Closes the window without any further action.
- "Dial"
  Starts dialing the number entered before.
- "Answer"
  Instructs the phone to accept the call.
- "Hangup"
  Drops the line.
- "Autodialing"
  If the box is checked, the phone number entered below is called periodically, the "Dial", "Answer", and "Hangup" buttons are disabled (grayed). The autodialing mode can be set even during the measurement, but only in "Idle mode".

This item starts "Autodialing" if the "Start with Measurement option" was not checked in the driver configuration-autodialing tab panel.

6.4.4 GSM mobile devices

This section is related to R&S ROMES4 support of the GSM mobile devices.

The drivers and mobile devices are grouped into the R&S supported classes 1 and 2. The introduction of the R&S supported classes is necessary due to the sheer number of supported mobiles.

The drivers and mobile devices of the R&S supported class 1 are continuously tested with new R&S ROMES4 release and service packs. They are permanently available to our testing staff.

The drivers and mobile devices of R&S supported class 2 are not always available for testing. They have been tested successfully at least once with the current R&S ROMES4 software release.

The mobile devices with the R&S supported class 1 are listed with the normal title typeface. Mobile devices with R&S supported class 2 are marked with italic title typeface.

The GSM test devices are either hand-portable or vehicle-mounted mobile phones or modules for system integration.

To see test mobile devices that are supported by R&S ROMES refer to `Supported Test Mobiles ROMES.pdf` file which is found in the `..\Documents\ReleaseNotes\` of the delivered R&S ROMES DVD.

All GSM channels and frequencies are listed in appendix Chapter 12.8.1, "GSM channel bands and power classes", on page 2395.

6.4.4.1 GSM mobile signals - Android performance data

The GSM signal tree in "Available Signals" contains a set of signals for Android performance data. For more, see "R&S ROMES4 Description of Signals".

6.4.4.2 Configuration menu GSM

The GSM test mobiles configuration page contains various tabs providing basic settings in the "Configuration" page and some advanced settings, like secondary receiver control, in the "Advanced" page. Depending on the mobile type, some special menus can be included also.

Many mobile drivers support template files. These files store a complete driver configuration, which can be reused independent of the workspace. See Chapter 6.5.1.5, "Templates DQA", on page 1959.

To open a view configuration window, right mouse click any point inside the view. The context-sensitive menu pops-up. Select the "Configure" command.

A view can be opened also via "Tools" > "Configuration Active View", see Chapter 3.8.2, "Overview of settings (configuration of software modules)", on page 279.

- General settings....1532
- Layer 3 uplink frames....1535
- Autodialing....1536
- GSM/GPRS forcing....1544
- NQA configuration....1547
- Handover analyzer....1551
- Receiver....1551
- QoS tests....1554
- QoS statistics....1557
- Templates....1558
- Serial port driver info....1559

General settings

The "Basic" tab configures the measurement mode, channels to scan, a call broadcast and RxLev correction.

The "Basic" configuration window offers the possibility to change audio auto-routing via the "Hardware Settings" panel. Audio is routed either to speaker and microphone or through a USB cable.

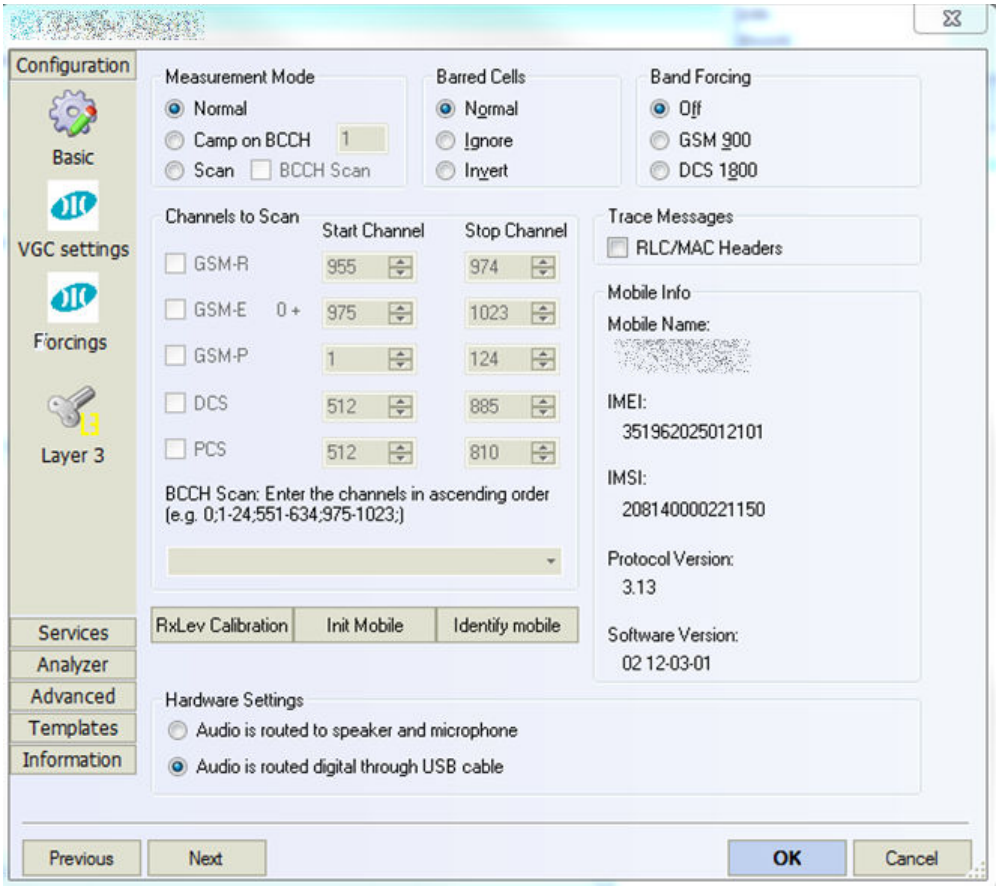


Figure 6-90: GSM test device settings with audio routed digital

Measurement Mode

GSM drivers support three measurement modes.

- "Normal"
- "Camp on BCCH"
- "Scan"

Some test mobiles do not support all them.

- "Normal"
  The measurements are performed in the selected network.
  During the measurement and a call (dedicated mode), it is possible to switch over to one out of configured neighbor cells by forcing handover. This switchover is possible if the conditions in the desired cell are appropriate. If several mobiles are installed, switching can be performed separately for each one. See "Handover" command in Chapter 6.4.4.3, "Action menu GSM", on page 1560).
- "Camp on BCCH"
  In this mode, the access to all cells except the one with a particular BCCH is denied for the mobile. Handover attempts are thus suppressed. Therefore the "Camp on BCCH" mode is recommended for cell boarder determinations.
  If the measurement is started, the mobile initiates a cell reselect process. It tries to register to the BCCH and BSIC that are set in the entry field behind the "Camp on

BCCH" radio button for the GSM driver. This action is successful only when the BCCH number and BSIC are available.

- "Scan"
  This mode allows the complete frequency band or a part of it to scan. In this measurement mode the operator can get a quick overview on the current activities of the channels within the used frequency band. By default, only the signal strength of each channel in [dB] is measured.
  For this mode, it is necessary to select the desired channel range in the "Channels to Scan" panel. Typically, "Start Channel" and "Stop Channel" define the scan range, which must be completely within the used frequency band.
  The R&S ROMES4 supports also the railway GSM channels (EGSM-R). If the "Scan" measurement mode is selected, you can set for the GSM-R start channel value one out of the range 940 to 954, which is the EGSM-R range. The channels are scanned, saved and displayed in the GSM scan view.
- "BCCH Scan"
  In this mode the mobile also decodes the BSIC in a specified channel range entered in "Channels to Scan".
  If entering the channels in an ascending order, for example, enter the range 940 to 954 into the "Enter the channels in an ascending order" combo box, all EGSM-R channels are scanned.
  As long as BCCH scan is active, the mobile measures each channel until the BSIC is successfully decoded. This measurement can cause a considerable extension of the measurement time.

Note: Test transmitter measurements can be performed in regions with operational GSM networks without influences on those networks - select an available channel. To avoid any conflicts, the channels on the left and right of the used channel (adjacent channels) must also be available. So first use the "Scan" mode to look for a gap you can use.

If a test mobile is synchronized to the test transmitter signal, the program flow is similar to the "Camp" mode, however, only the downlink is performed.

Channels to Scan
The channel numbers entered in the "Start BCCH" and "Stop BCCH" determine the measurement range in the "Scan(ning)" mode. This range must be within the supported channel range (e.g. 1 to 124 for GSM900).

The GSM drivers provide an overview of channel ranges that can be set depending on the GSM band used. Moreover, they support the "BCCH Scan" with BSIC decoding over an arbitrary combination of single BCCH channels and channel ranges.

The "Samples" parameter defines the number of measured values to be acquired in each channel, see the section "General settings" on page 1532.

Barred Cells / Cell Barring / Cell Bar Flag
This function allows the GSM devices to ignore or even invert the cell bar flag.

- "Normal"
  Only cells that are not barred are accessible for the mobile
- "Ignore"
  Cell bar flag ignored – all cells are accessible
- "Invert"

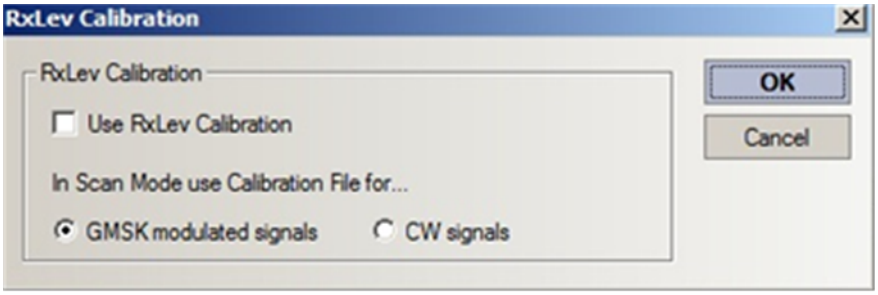
Cell bar flag inverted – only barred cells are accessible

Trace Messages
The function is available for GSM (GPRS/EDGE) devices. If the function "RLC/MAC Headers" is active, the information contained in the RLC/MAC headers of the transmitted radio blocks is included in the measurement data and can be displayed in the "GSM RLC/MAC Header View".

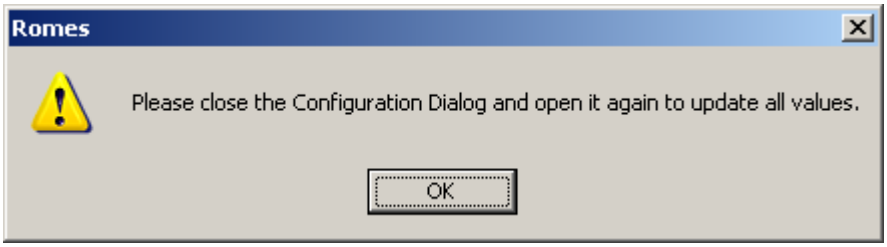
The R&S ROMES4 RSCMD file size increases quickly if this parameter is on and packet data transfer is performed.

Mobile Info
The function is available for all GSM test devices. It displays information on the current test device in the hardware configuration dialog.

RxLev Calibration
The function is available for GSM test devices. The "RxLEV Calibration" button opens a dialog to activate the calibration of the received signal level reported by the mobile.



Init Mobile
The "Init Mobile" button starts the initialization if a GSM mobile device (even of the same type) is changed.



Identify mobile
The "Identify mobile" button opens a message box and displays the IMEI.

Layer 3 uplink frames

The layout of the "Layer 3" dialog depends on the mobile type, however, the functions are equivalent. The dialog allows you to modify Layer 3 messages.

The following figure shows an example of possible modification of up to four Layer 3 messages that an MS sends to the network.

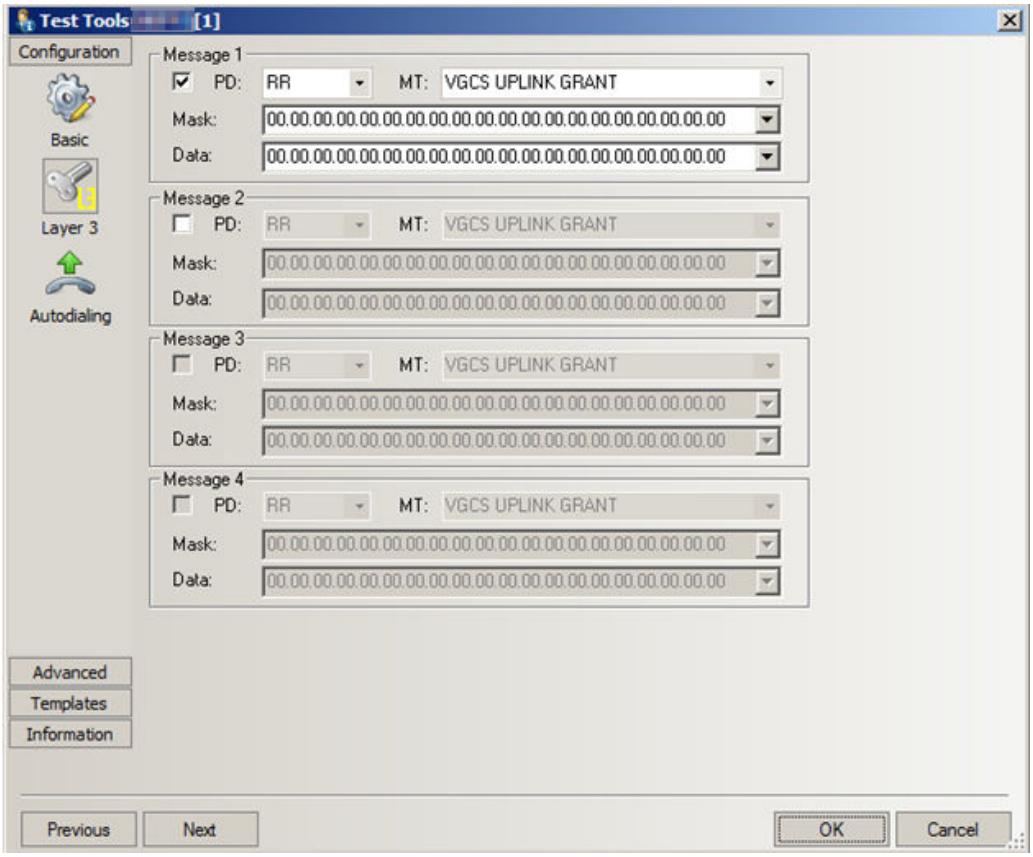


Figure 6-91: GSM driver configuration – layer 3 uplink frames

The rows "Message x" in the "Layer 3" page contain the following parameters:

- "PD and MT"
  Indicates the protocol discriminator (PD, first two characters) and the message type (MT) of the GSM or GPRS layer 3 message that is modified. See Figure 6-109.
- "Mask [Hex]"
  Mask to be applied on the GSM or GPRS Layer 3 messages for the modification.
- "Data [Hex]"
  Data to be used for modification.

Autodialing

Autodialing function provides the mode where a mobile periodically attempts call to a network by dialing a definite phone number. This mode is relevant for the network quality analysis described in "NQA settings" on page 1547.

The autodialing mechanism of the mobile drivers supports the IRAT handover test automatically with the "Call will be initiated if the UE is registered with option", see "Preconditions" on page 1541.

The "Autodialing" configuration dialog is shown in the following figure.

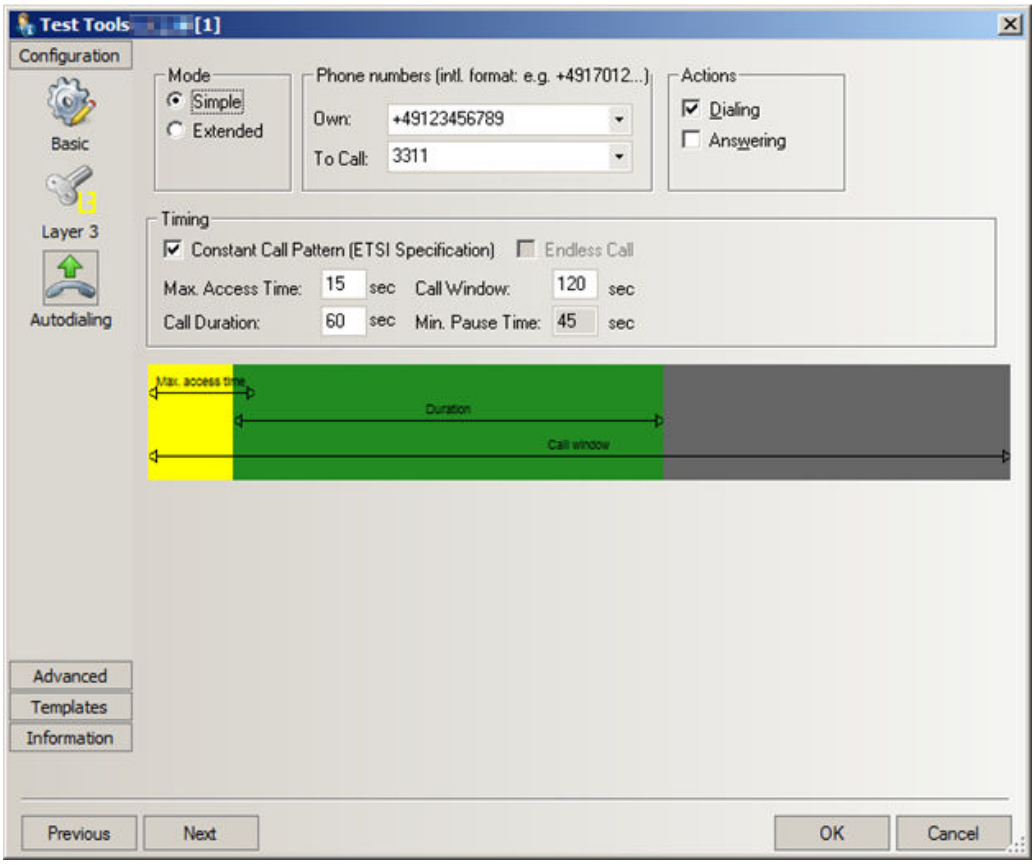
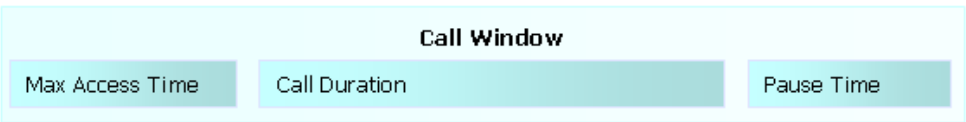


Figure 6-92: Driver configuration – autodialing (single mode)

Actions

The check boxes in "Actions" activate automatically the following call options:

- "Dialing"
  If the box is checked, the mobile sets up the periodic calls using the parameters in the remaining panels of the "Autodialing" dialog. The autodial function is useful for many applications, in particular for the Network Quality Analysis (NQA).
  Sometimes, the NQA state machine has difficulties if a new call is started when the previous one was not finished (DISCONNECT message was sent, but RELEASE was not yet received). This case happens, for example, if one call lasts longer than specified in "Call Window".
  The mobile autodialer algorithm inserts a pause after a call has terminated to prevent a new dial attempt during radio resource cleanup. The pause is to be set in "Autodialing" on page 1536.
  The autodialing mechanism works as follows:
  The pause time is calculated from the settings made in the "Timing" pane of the autodialer configuration page. Therefore, the sum of the maximum access time and the call duration is subtracted from the overall call window duration.



The mobile and the network are given a chance to clean up a call properly even in case the call takes longer than the overall call window.

The minimum value for a pause time is 5 seconds. Even if a shorter pause is defined in the configuration dialog, the autodialer will append such a delay to each call after a hang up has been triggered.

- "Answering"
  If the box is selected, the mobile automatically accepts all incoming calls after a certain number of ring tones.
- "Autostart"
  If the box is selected, autodialing starts automatically with the measurement.

Subscriber number
Selects the subscriber number. Usually the subscriber number is received automatically by the driver.

Mode
Two option buttons switch between single call and multi call mode.

- A single call is set up according to the settings in the remaining panels of the "Autodialing" tab, see Figure 6-92. The call is periodically repeated if "Use autodial" is activated.
- A multi call is a sequence of calls with individual call settings, to be configured in the multi call version of the "Autodialing" dialog, see the following figure.

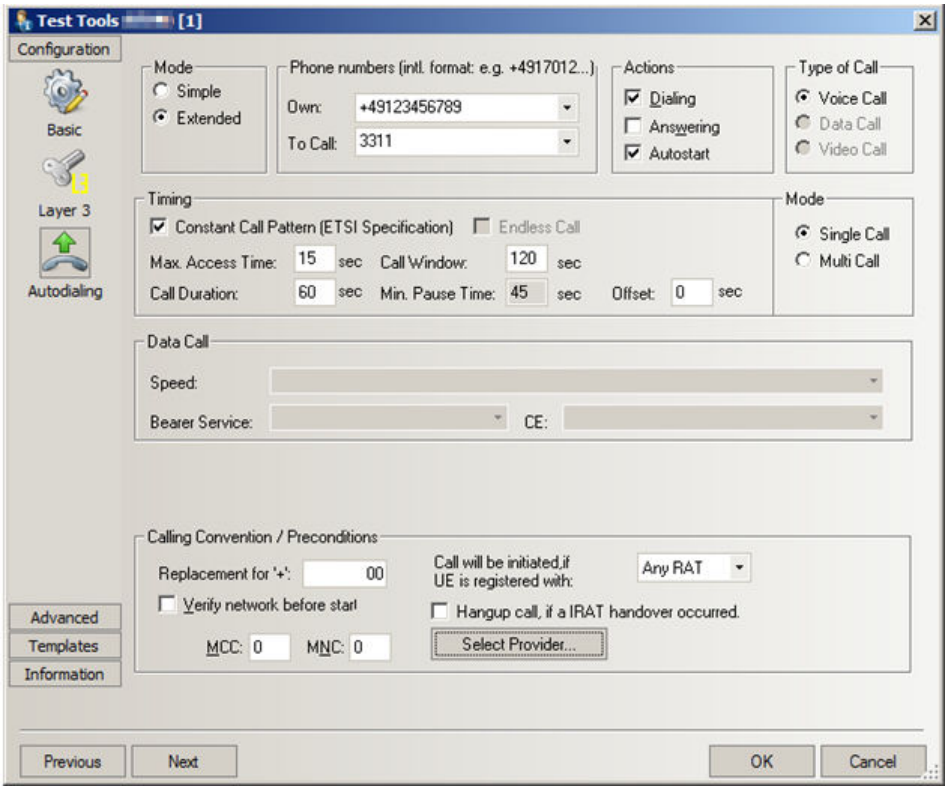


Figure 6-93: Driver configuration – autodialing (extended mode)

If "Use autodial" is activated, the call sequence periodically repeats.

Note: Autodialing can be limited for the mobiles to initiate a call in "Only LTE", see Figure 6-97.

Type of Call

Several drivers display the "Type of Call" panel.

- "Voice Call"
  All GSM test mobiles support voice calls.
- "Data Call"
  If the driver is loaded, the R&S ROMES4 automatically initializes the data call service using an appropriate AT command.
- "Video Call"
  Video calls are not possible with GSM mobiles.

Timing

Defines the periodicity of the autodial process.

- "Constant Call Pattern (ETSI Specification)"
  If this option is checked, the calls are repeated in the fixed Call duration/Call Window pattern. It is irrelevant if a connection is released or lost before the end of the call duration. This setting is in accordance with IREG specifications and ensures that several connected test mobiles operate synchronously.
  In the alternative setting, the call duration ends and the next Min. Pause Time start at the moment when a call is lost. This setting ensures that a maximum number of calls per unit of time can be set up at fixed call duration and idle time.

- "Max. Access Time"
  Maximum time allowed for cell access. If no call can be established within this time, the call is classified as a blocked call.
- "Call Duration"
  Time between start and release of a call in the range between 15 s and 86400 s. For some mobiles, it can be necessary to set the call duration higher than 15 s, e.g. to 25 s. Such setting provides a Good Call.
- "Min. Pause Time"
  The minimum pause time is automatically calculated as
  "Call Window – (Max. Access Time + Call Duration)"
  An example:

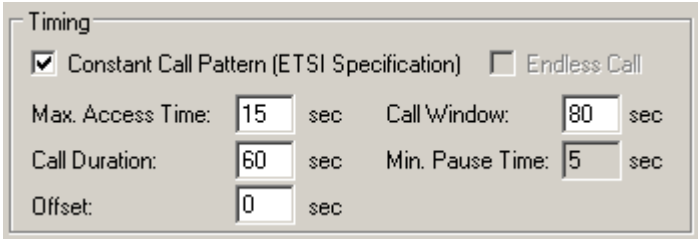


Figure 6-94: Wrong setting in Timing

If the resulting pause time is less than 10 seconds, an error message is issued and the Call Window is increased correspondingly:

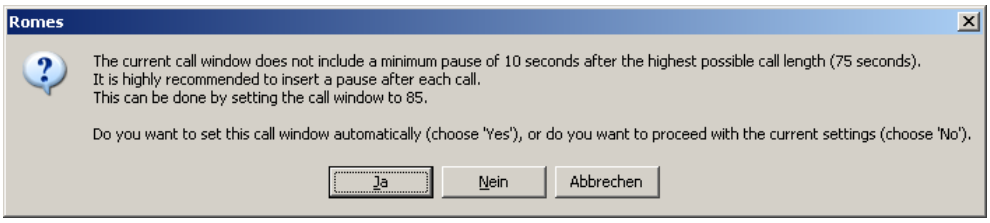


Figure 6-95: Warning about the setting

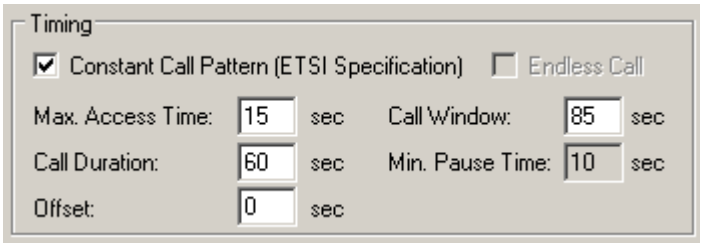


Figure 6-96: Correct setting in Timing

- "Call Window"
  Time between two subsequent call attempts, including the access time, the call duration and a possible idle time until the next call is initiated. The Call Window is available while "Constant Call Pattern" is enabled.
- "Offset"
  Time offset for dialing. Different offset times for different test mobiles (for example, 0 s for the first, 20 s for the second mobile) ensure that the test mobiles do not dial simultaneously. Possible problems in the connection setup are avoided.
- "Endless call"

For an endless call (box checked), the call duration is set to infinity; the Call duration input field is disabled. "Endless call" is disabled while Constant Call Pattern (ETSI Specification) is selected.

Data Call
If a data call is selected, then the input fields in the "Data Call" panel are enabled. They provide a subset of the possible parameters for the +CBST call control command described in standard 3GPP TS 07.07. The values depend on the test mobile type.

- "Speed"
  Baud rate of the data connection. The test mobile provides automatic baud rate selection according to the quality of the radio link.
- "Bearer Service"
  The value "data circuit asynchronous (UDI or 3.1 kHz modem)" cannot be changed.
- "CE"
  Connection Element; the value "non-transparent" cannot be changed.

Subscriber Number
The Subscriber Number, which is mandatory for SQA, is entered or selected in this list field.

The number must be entered using the international format, e.g. (089) 12345678 would be entered as "+498912345678" without fillers (such as blanks or hyphens).

Phone Numbers
One or more phone numbers can be entered via the keyboard and the input field.

Calling Conversion
R&S ROMES4 requires phone numbers in international format, including the '+'. However, on some mobiles the '+' cannot be emulated. Thus, replace it by the national numbers to access the international network. Former this replacement was done with '00'. But several regions use other numbers. Now this number can be defined here. The default value is '00', which reflects the former behavior.

Preconditions
The "Preconditions" panel sets home network-related parameters:

- "Call will be initiated if UE is registered with:"
  The initiation of a call can be set to depend on the activation of the technology. Possible options are: "Any RAT", "Only UMTS", "Only GSM" or "Only LTE".
  The option "Call will be initiated, if UE is registered with:" allows you to specify the RAT in which the UE has to camp before a call is initiated. If the UE does not camp on this RAT at the point in time when the call is initiated, the trigger for the call is ignored. No NQA message is generated in this case.

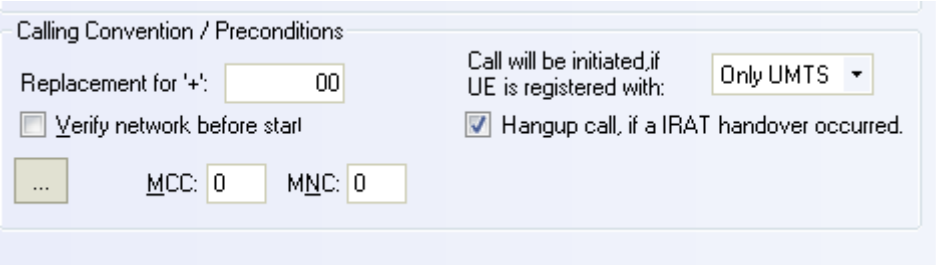
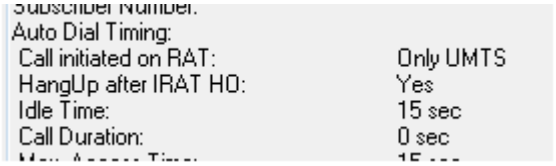


Figure 6-97: Calling convention and preconditions

NOTE: In older version, R&S ROMES4 generated a NO_SERVICE message in this case.

- "Hangup call, if an IRAT handover occurred"
  The "Hangup call, if a IRAT handover occurred." option lets users end a call when the IRAT handover took place. A new NQA event Call Canceled will be reported after the UE returned to the idle mode. If the option is not activated, the call proceeds in the new RAT until the point in time defined in the autodialer.
  The setting is reported in the measurement file information.



Canceled Calls are reported in the following Views:

– "Layer 3 View"

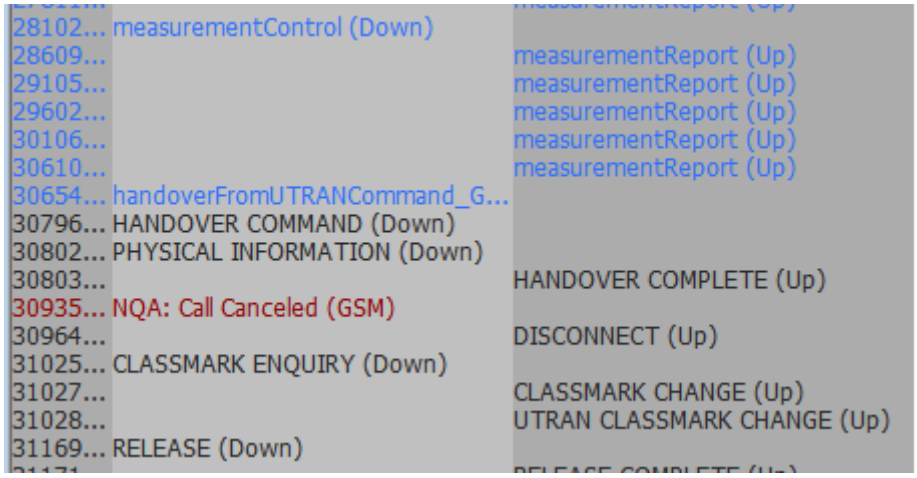


Figure 6-98: NQA: Call Canceled

– "ETSI QoS View"

Figure 6-99: Result: Call Canceled

- "Verify network before start"
  If "Verify network before start" is checked, the mobile is out of service if a call is attempted from a foreign network (e.g. during a measurement tour near the border of a network where roaming is possible). This verification ensures that calls from foreign networks will not impair the network quality analysis; see next section.
  By default, the "verify before start of call" function is not active.
- "MCC/MNC"
  Mobile country code (MCC) and mobile network code (MNC) together identifies the home network.
-

  Tap the button to open the home network selection dialog.

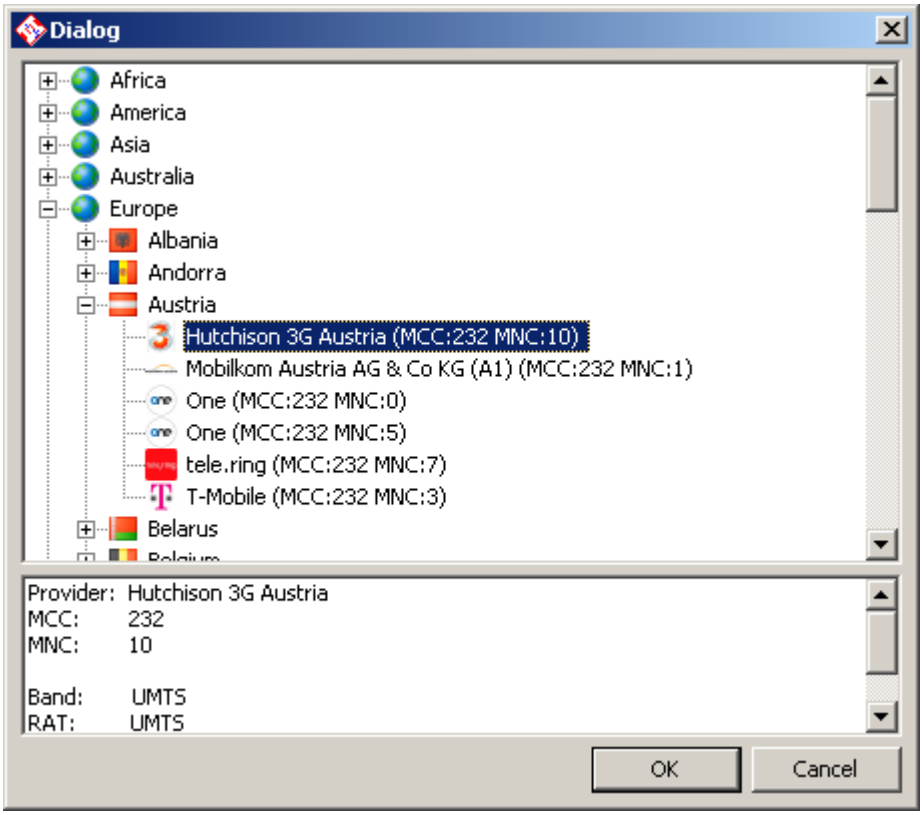


Figure 6-100: Selection of the PLMN

The "Autodialing" configuration menu changes if the "Mode" > "Extended" is selected, see Figure 6-92 and Figure 6-93.

A multi call is a sequence of single calls with independent call settings. The settings for each call are identical to the single call settings described previously. The individual calls are listed in the center of "Call Generator". If "Constant Call Pattern" is activated, the timing settings in this panel are valid for all calls in the list.

The buttons to the right of the list add or remove calls from the list and edit or modify a selected call, respectively. "Add Call" or "Edit Call" opens the following "Call Settings" dialog.

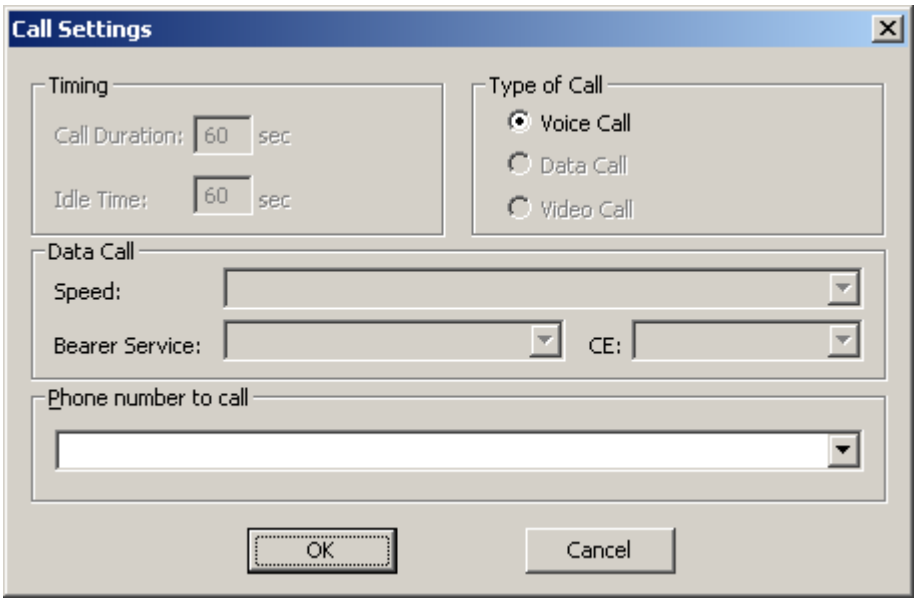


Figure 6-101: Call Settings (multi call type)

If "Constant Call Pattern" is activated, the "Call Settings" > "Timing" setting is dimmed.

GSM/GPRS forcing

The "GSM/GPRS Forcing" dialog lets you select the GPRS/GSM related parameters of the mobile phones supporting GPRS.

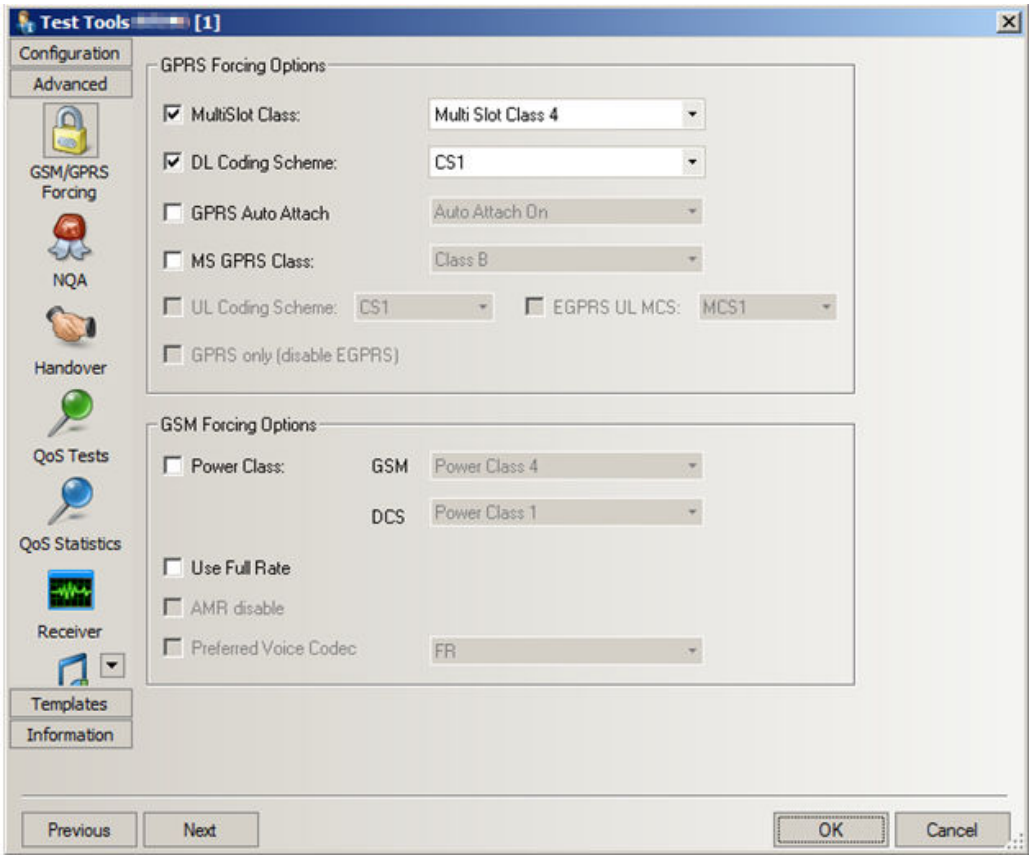


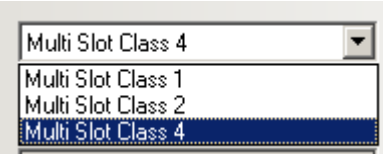
Figure 6-102: Driver configuration – GSM/GPRS forcing

GPRS Forcing Options

The GPRS parameters to be forced at the mobile phone can be selected in the "GPRS Forcing Options" panel from several pull-down lists. Each of the lists is activated by checking the box associated to the parameter. Otherwise, the parameter is not enforced and the mobile uses its default value.

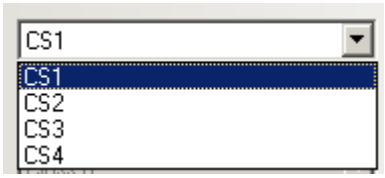
Multislot Class ← GPRS Forcing Options

Select the GPRS multislot class according to GSM 05.02. The list indicates the MS class no. (1, 2, 4) plus (in brackets) the maximum number of receive and transmit time-slots that the MS can use per TDMA frame.

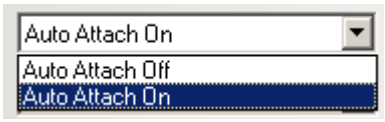


DL Coding Scheme ← GPRS Forcing Options

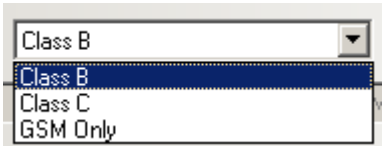
Select the coding scheme (CS1 to CS4) for downlink data transfer.



GPRS Auto Attach ← GPRS Forcing Options
Select whether the mobile device is automatically attached to the GPRS network at power-up ("On") or not ("Off"). If it is set to "Off", the MS only attaches upon PDP Context Activation.



MS GPRS Class ← GPRS Forcing Options
Select the GPRS class of the MS ("Class B" or "Class C").



UL Coding Scheme ← GPRS Forcing Options
Select the coding scheme (CS1 to CS4) for uplink data transfer. Disabling this item gives the MS/network the decision.

EGPRS UL MCS ← GPRS Forcing Options
If the checkbox is activated, the related list allows the selection of the EGPRS uplink coding scheme (MCS1 to MCS9, MCS5–7, and MCS6–9). Disabling this item gives the MS/network the decision.

GPRS only (disable EGPRS) ← GPRS Forcing Options
The activation of this checkbox forces the use of GPRS. Disabling this item gives the MS/network the decision.

GSM Forcing Options
General GSM parameters can be set in the "GSM Forcing Options" panel.

Power Class ← GSM Forcing Options
Power class of the MS while in GSM900 or GSM1800 mode. The GSM standard defines power classes 1 to 5.

Table 6-3: Power classes of GSM mobiles

Power class	GSM900	GSM/GSM1800	GSM/GSM1900
1	-	1 W / 30 dBm	1 W / 30 dBm
2	8 W / 39 dBm	0.25 W / 24 dBm	0.25 W / 24 dBm
3	5 W / 37 dBm	4 W / 36 dBm	2 W / 33 dBm

Power class	GSM900	GSM/GSM1800	GSM/GSM1900
4	2 W / 33 dBm	-	-
5	0.8 W / 29 dBm	-	-

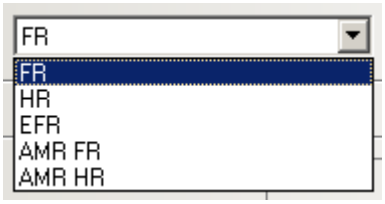
The power class can be decreased. However, it is not possible to go beyond the highest supported power class of the selected mobile type. See the overview of power classes and power control levels in Table 12-16.

Use Full Rate ← GSM Forcing Options
If checked, the MS is forced to use either Full Rate or Half Rate but not Enhanced Full Rate (EFR) data transfer mode. "Use Full Rate" becomes unavailable if an EFR codec is selected explicitly.

AMR Disable ← GSM Forcing Options
If checked, prevents the test mobile from activating an Adaptive Multi Rate (AMR FR or AMR HR) codec. The test mobile uses its Full Rate (FR), Half Rate (HR), or Enhanced Full Rate (EFR) codec.

"AMR Disable" becomes unavailable if an AMR codec is selected explicitly.

Preferred Voice Codec ← GSM Forcing Options
Explicit selection of a voice codec for the test mobile to use. The explicit voice codec selection can possibly overwrite the "AMR Disable" and "Use Full Rate" settings.



The voice codec selection ensures that a test mobile does not change its voice codec, which can have an undesired impact on the measurement results.

NQA configuration

The Network Quality Analyzer (NQA) configuration dialog, "NQA Settings", lets your set the parameters for a network quality analysis. NQA is a prerequisite for drawing up a call statistic where the calls are classified and the classes are visualized separately.

NQA settings

The "NQA Settings" configuration dialog is identical for all GSM mobile drivers.

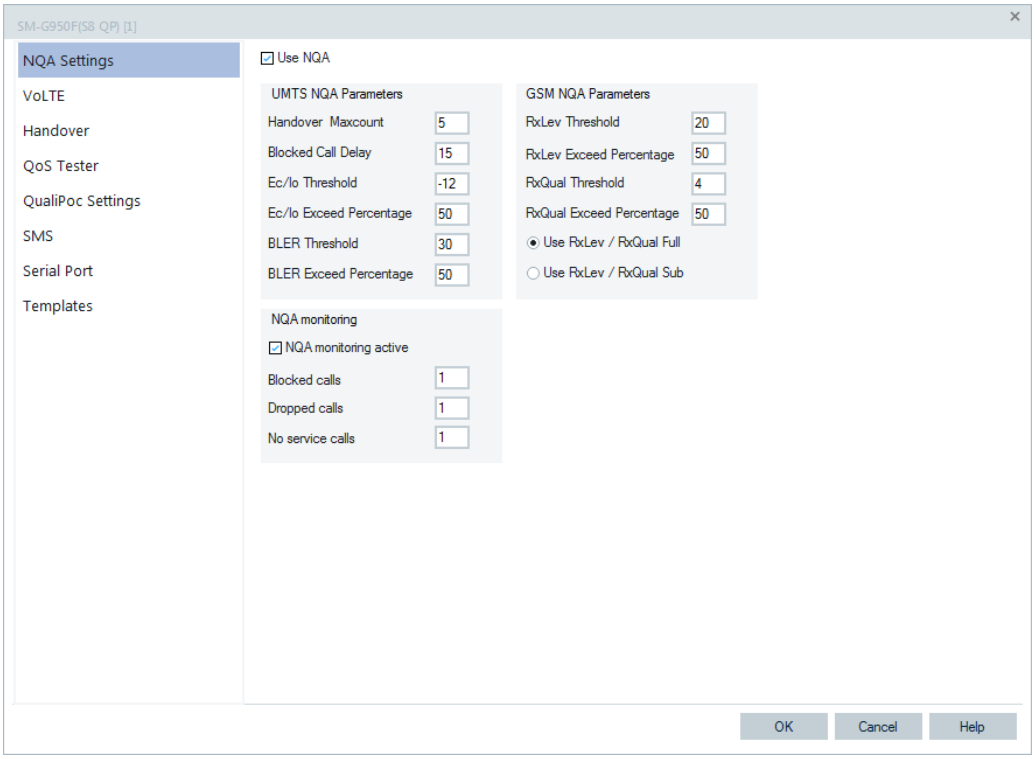


Figure 6-103: GSM driver configuration – NQA settings (all drivers)

Use NQA
If checked, the network quality analysis is active (default).

NQA Parameters
The following numeric parameters configure the NQA by defining conditions and limits for the different call classes (the ranges for all parameters are quoted; default values are underscored):

- "Handover Maxcount"
  Maximum number of handover procedures during a call in the range 1 to 100. Default value is 5. If the defined value is exceeded, the call is classified as EXCESSIVE HO.
- "Blocked Call Delay"
  Maximum delay (in seconds) between CM_SERV_REQ and ASSIGNMENT_COMMAND in the range 1 (s) to 63 (s). Default value is 15 (s). If the defined delay is exceeded, the call is classified as DELAYED CALL.
- "RxLev Threshold"
  Minimum received signal input level in the range 1 to 63. Default value is 20. RxLev values which fall below this threshold contribute to NOISY.
- "RxLev Exceed Perc."
  Minimum ratio (in percent) of reported RxLev values falling below the RxLev Threshold in the range 1 (%) to 99 (%). Default value is 50 (%). If the actual ratio falls below the specified percentage, the call is classified as NOISY.
- "RxQual Threshold"
  Maximum value of RxQual (i.e. minimum received signal quality) in the range 1 to 7. Default value is 4. RxQual values above this threshold contribute to NOISY.

- "RxQual Exceed Perc."
  Minimum ratio (in percent) of reported RxQual values exceeding the RxQual Threshold in the range 1 (%) to 99 (%). Default value is 50 (%). If the actual ratio exceeds the specified percentage, the call is classified as NOISY.

RxLev/RxQual Source ← NQA Parameters
The buttons in the "RxLev/RxQual Source" pane determine the type of values used for the NQA:

- "Use RxLev/RxQual Full"
  Both parameters are assessed over the full range of TDMA frames within a SACCH block
- "Use RxLev/RxQual Sub"
  Both parameters are assessed over a subset of 12 TDMA frames

The full and sub-values are displayed separately in the Chapter 4.4.18, "Serving cell view", on page 999.

Note: Important note on NQA in downlink DTX mode. If the BTS uses discontinuous transmission (DTX), the BTS transmitter is switched off during time periods where no information needs to be transferred. The BTS (downlink) signal shows strong variations in time resulting in a large difference between the measured "RXLev/RXQual Full"and "RXLev/RXQual Sub" values. The NQA must be performed with the "Use RxLev/ RxQual Sub" option, otherwise it generally underestimates the network quality.

NQA Monitoring
If checked, "NQA monitoring active" activates the network quality (NQA) monitoring. In this mode, a message is displayed in the Chapter 4.2.7, "General status view", on page 501 when the number of blocked calls, dropped calls, or no service calls reaches the entered value in the related input field of the NQA monitoring panel.

An example for the "General Status View", the messages are shown in the following figure.

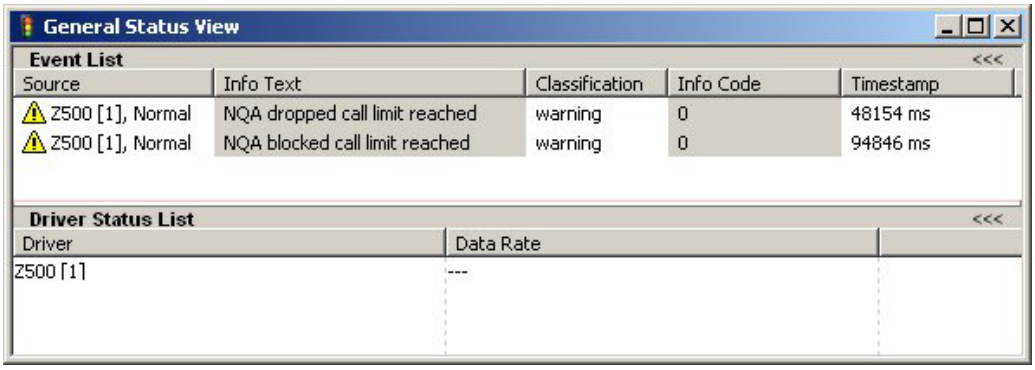


Figure 6-104: NQA reports in General Status View

Display of results

The displayed statistic related to NQA monitoring, classifies voice calls as following:

- "Good"
  Good is every call successfully established and terminated by the system within the time set in "Autodialing" > "Call duration".

- "Blocked"
  A call is qualified as blocked if one of the following applies:
  – An idle message was detected during call setup but the call was not canceled. This happens in all cases where a call setup was performed at least up to the SERVICE REQUEST Layer 3 message . The idle message does not appear up to message ALERTING / CONNECT and where no DISCONNECT, RELEASE or CHANNEL RELEASE was executed, or
  – The call was canceled, call setup was not performed up to ALERTING and/or CONNECT.
  – A dial command has been sent to the mobile at a moment with sufficient coverage, but because of temporarily insufficient coverage no call could be established. The NQA state machine remains IDLE. On the next dialing, the system recognizes that no call could be established and one blocked call is added.
- "Dropped"
  A call is qualified as dropped if one of the following applies:
  – An established call is canceled before the "Call duration" set in the "Autodialing" tab has passed, or
  – An established call is terminated. An NQA data package is generated when an "Idle" or "Error (No Service)" state is detected after a call was established and the "Call duration" has not passed yet.
- "No Service"
  A "No service" call is added every time the system wants to dial but the mobile is out of service. If the mobile remains out of service the time interval between two subsequent "No service" calls is equal to the "Call duration" plus the "Idle time", both set in the "Autodialing" tab.
- "Call Cancelled"
  A call is canceled if one of the following applies:
  – Manual hang up by user
  – Stop measurement during a call
  – Called party did a hang up
  – Call starts in a certain RAT, for example, in UMTS and during the call the RAT changes, for example, to GSM and the "Hangup call, if a RAT handover occurred" is checked. See "Calling Convention / Preconditions" in the Figure 6-93 and refer to "Preconditions" on page 1541.

Voice Call Table

Result	Start Time	End Time	RAT	Network Provider	Device ID	Start CI/LA	End CI/LA	Setup Time [s]
Good	3/19/13 12:30 PM	3/19/13 12:31 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	4.681
Good	3/19/13 12:32 PM	3/19/13 12:33 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	5.365
Good	3/19/13 12:34 PM	3/19/13 12:35 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	6.22
Call Cancelled	3/19/13 12:36 PM	3/19/13 12:36 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	
Call Cancelled	3/19/13 12:36 PM	3/19/13 12:37 PM	GSM	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	
Good	3/19/13 12:37 PM	3/19/13 12:37 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26012	
Call Cancelled	3/19/13 12:38 PM	3/19/13 12:38 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26016	
Call Cancelled	3/19/13 12:38 PM	3/19/13 12:39 PM	UMTS	Vodafone D2 (262; 2)	Galaxy LTE(SMP) [2]	26012	26016	

Figure 6-105: Voice call canceled

A single call can fit into more than one class and can therefore contribute to several bars. The percentages do not necessarily sum up to 100 %.

Handover analyzer

The "Handover" configuration dialog lets user enable or disable the GSM handover analyzer (the R&S R&S ROMES4HOA option) and set the timeout for the HO analysis.

The HO analysis and the meaning of the timeout is described in Chapter 4.4.10, "3GPP handover analyzer view", on page 898. The dialog is identical for all GSM mobile drivers.

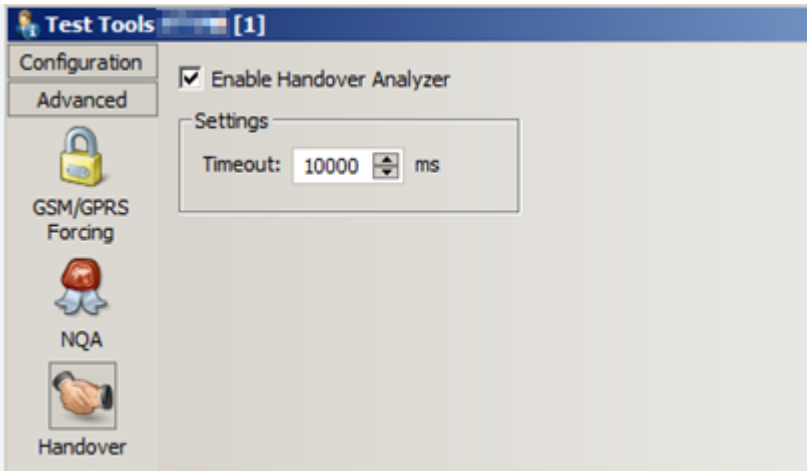


Figure 6-106: GSM driver configuration – Handover Analyzer

Receiver

The "Receiver" configuration dialog lets the user set the tracking mode where the mobile phone controls a CW test receiver (the R&S TSME CW) and set its receive frequency. In tracking mode, the measurement must be performed on a single frequency channel although the test receiver is able to measure at several frequencies simultaneously.

The "Receiver" dialog is identical for all GSM and UMTS mobile drivers.

Remarks about the tracking mode

The selected tracking mode has an impact on layout of some device's configuration menus and views.

- In the tree views for data selection, for example, in the "2D Chart View" > "Values" configuration menu, the main channel instead of the measurement frequency is displayed for the mobile phone which controls the test receiver.
- The settings of the test receiver channels controlled by previously mentioned mobile phone cannot be changed in the "Measurement Settings" of the test receiver driver configuration menus, see Figure 6-416.
- Each channel change and each used receiver generate an event in the measurement data. These events can be viewed together with all other events in the "Event

View", the "ROMESMAP Route Track View" and the "2D Chart View". Also, each channel change is indicated in the "General Status View".

Connected Receivers
List of test available receivers. To connect an additional test receiver, click the "Connect Receiver" button. To remove a test receiver from the list, select the receiver and click the "Disconnect Receiver" button.

Available RF Rx Paths
List of receiver signal paths, receiver, and receiver jobs assigned to each path. To select an additional job to be done, click the "Job Management" button.

Activate Rem. Rec. Jobs
If the box is checked, the jobs that are shown in the "Available RF Rx Paths" table will be done after "OK" is clicked and the configuration menu is closed.

Connect Receiver
The "Connect Receiver" button opens a selection dialog showing all test receivers available as secondary.

Test receivers are not shown in the pull-down list before the test receiver drivers are loaded. Click the "Load Secondary" button to call up the "Load Secondary" window and select a test receiver to be loaded and shown in the pull-down list.

Use the R&S TSME receiver drivers for tracking.

- "OK"
  Connect the selected test receiver, add it to the list of "Connected Receivers" in the "Remote Receiver" tab and close the "Load Secondary" window.
- "Cancel"
  Close the "Load Secondary" window without connecting a test receiver.

Disconnect Receiver
The "Disconnect Receiver" button disconnects the receiver selected in the list of "Connected Receivers".

Job Management
The "Job Management" button opens the "Assign Job to Remote Receiver" dialog to create or select a job and assign it to a remote test receiver.

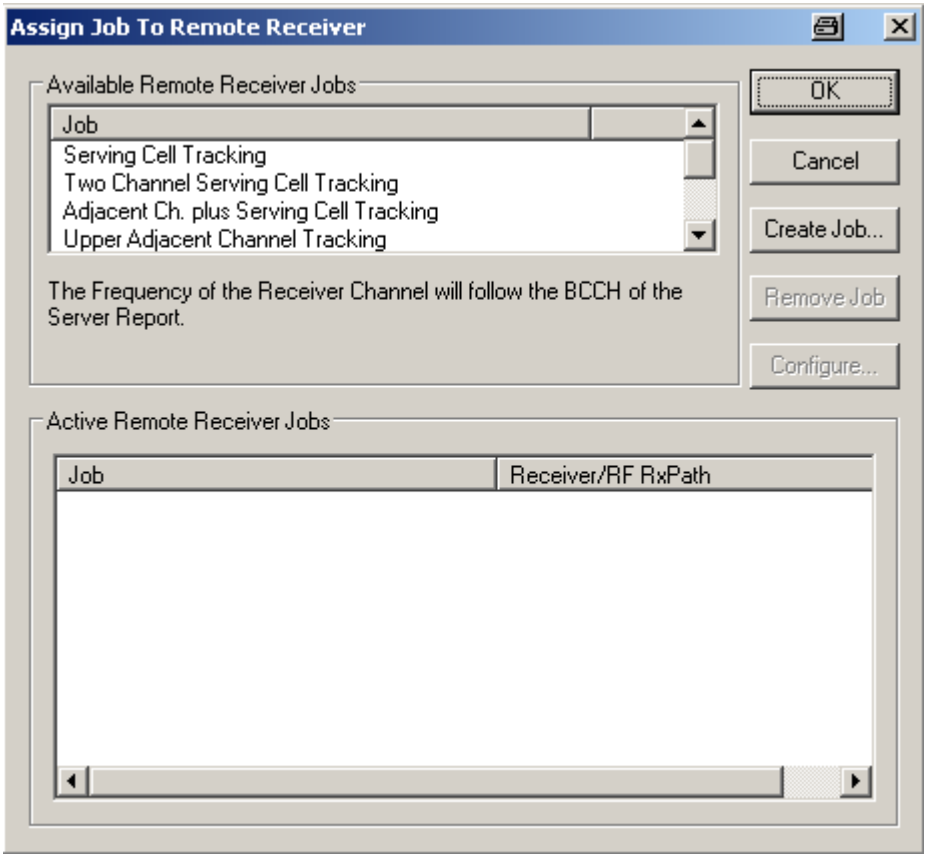


Figure 6-107: Job assignment to remote receiver

The job to be assigned to the remote receiver can be selected from the "Available Remote Receiver Jobs" list. A description of each job is displayed below the list when the job is selected.

- **Serving Cell Tracking**
  The frequency of the receiver channel follows the BCCH of the server report.
- **Two Channel Serving Cell Tracking**
  Channel A follows the strongest NC, one channel B the SC. After the SC changed, the channel A tracks the SC which was supposed to be the strongest NC, and channel B now tracks the new NC.
- **Adjacent Ch. plus Serving Cell Tracking**
  One frequency of the receiver follows the BCCH of the server report. Two other frequencies follow both adjacent channels of the BCCH.
- **Upper Adjacent Channel Tracking**
  The receiver channel follows the upper adjacent channel of the C0 carrier.
- **Lower Adjacent Channel Tracking**
  The receiver channel follows the lower adjacent channel of the C0 carrier.
- **Uplink Serving Cell Tracking**
  The frequency of the receiver channel follows the uplink channel of the SC.
- **OK**
  Assign the selected job to the receiver selected in the "Remote Receiver > Connected Receivers" list and close the current dialog.

- **Cancel**
  Discard the current selection and close the dialog.
- **Create Job**
  Activate the selected job and add it to the "Active Remote Receiver Jobs" list.
- **Remove Job**
  Remove the selected job from the "Active Remote Receiver Jobs" list. This soft key is disabled if the list is empty or if no job is selected in the list.
- **Configure**
  Open the "Select Channel" dialog to assign one or several receiver channels (RF Rx Paths) to the job selected in the "Active Remote Receiver Jobs" list. The "Configure" soft key is disabled if the list is empty or if no job is selected in the list.
  Some jobs require several channels which can be provided by one or several test receivers.
  The "Select Channel" dialog displays all channels that are available but not yet assigned ("Available RF Rx Paths") and the channels that are already assigned to the current job ("Current Job Settings"). Double-click on a channel in one of the tables to move it to the other table.

QoS tests

The "QoS Tests" configuration dialog lets the user periodically initiate the number of procedures in the GPRS mobiles being in dedicated mode, for example:

- GPRS mobility management actions ("GPRS Attach/Detach")
- Routing Area Update
- GPRS packet routing actions ("Activate/Deactivate PDP Context")
- GSM layer 3 actions ("Location Area Update")
- Cyclic Handover

A statistical evaluation of the actions provides an overview of the Quality of Service (QoS), e.g. the amount of network resources given to the mobile. It can be displayed in the "GSM QoS View".

To be recorded and evaluated, the actions must be enabled in the "QoS Statistics" dialog of the driver configuration menu. See "QoS statistics" on page 1557.

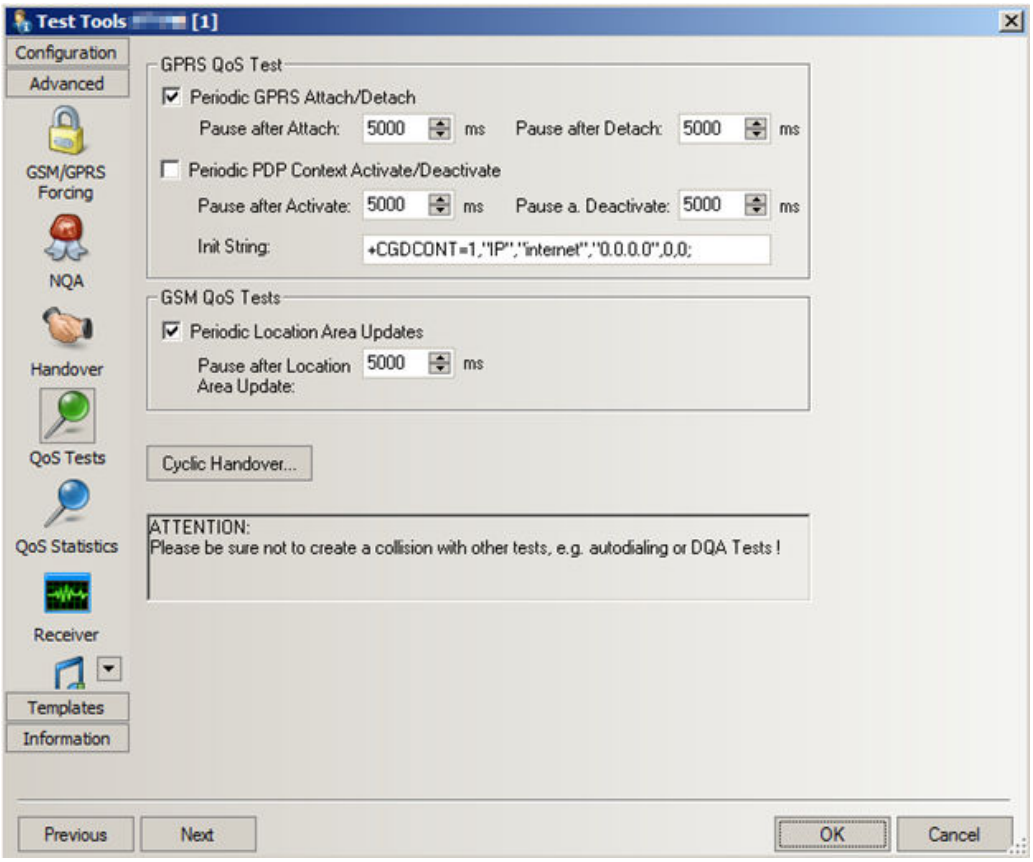


Figure 6-108: GSM driver configuration – QoS tests

The entries "Periodic GPRS Attach/Detach", "Periodic PDP Context Activate/Deactivate" and "Periodic Location Update" are analogous.

- **Enable/Disable**
  The three types of periodic actions mentioned in the previous sentence can be activated independently. They are compatible with each other.
  GSM test devices can be used for various automatically controlled, periodic tests, for example, Autodialing and DQA analysis. Some of the periodic tests cause conflicts when activated simultaneously. For example, the QoS test functions cannot be performed after a call releasing with autodialing function.
- **Pause after Location**

  Defines the periodicity of the following actions:
  - The GPRS Attach/Detach cycle consists of an attach, followed by the pause after attach, detach, and pause after detach.
  - The PDP Context Activate/Deactivate cycle consists of a PDP context activate, followed by the pause after activate, PDP context deactivate, pause after deactivate.
  - The Location Area Update cycle consists of the location update procedure followed by the pause after Location Update.
- **Init String**

`PDP Context +CGDCONT` command specifies PDP context parameter values for a PDP context identified by the (local) context identification parameter (first numeric parameter after “=”). The command is described in standard 3GPP TS 07.07 and is preset as shown in Figure 6-108.
`PDP Context +CGDCONT` command specifies PDP context parameter values for a PDP context identified by the (local) context identification parameter (first numeric parameter after “=”). The command is described in standard 3GPP TS 07.07.
In most networks, adjusting the third string parameter ("Access Point Name (APN)", preset as "internet") is sufficient to activate a PDP context.

Cyclic handover

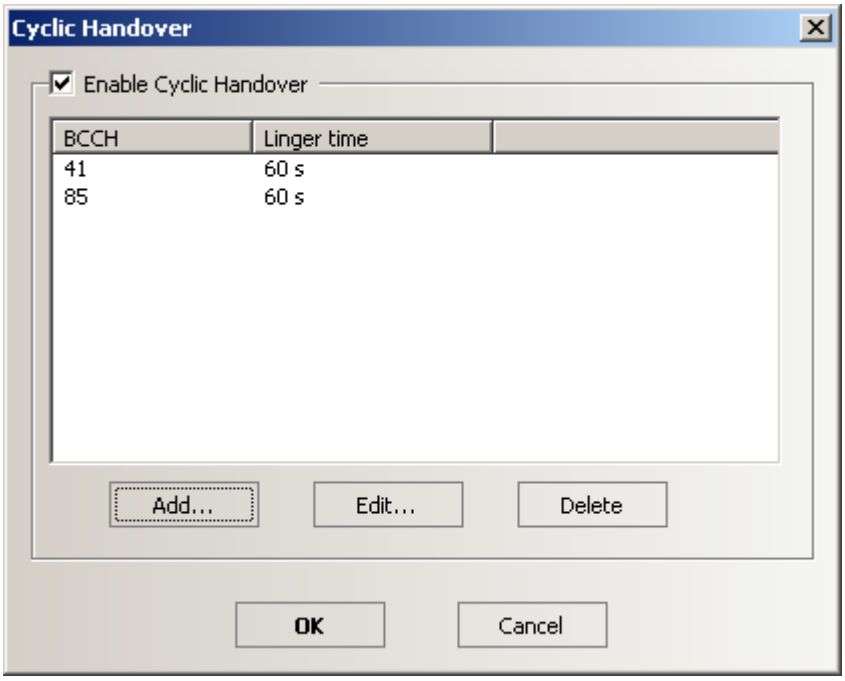
Configures the neighbor cell BCCH and timing parameters necessary for cyclic hand-over that a GPRS mobile can initiate while it is in dedicated mode (during a call).

For cyclic handover, the mobile manipulates the received signal strengths in its receiver reports. The manupulationis in such a way that the network periodically initiates a handover to a given neighbor cell. The cells are arranged in a BA list. The mobile cycles through the list, lingering in each cell for a definite amount of time.

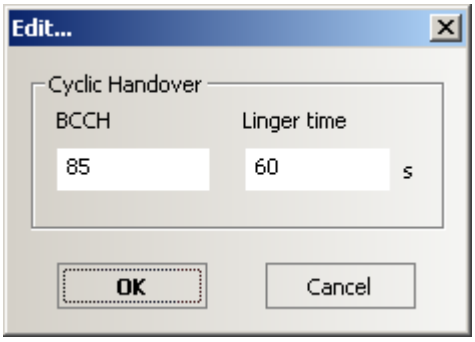
The process is stopped if one of the cells is no longer detected, so cyclic hand-over is typically tested on a fixed location. Cyclic handover and manual handover exclude each other. Perform cyclic handover tests in autodial mode and with endless call duration, see "Autodialing" on page 1536.

If the network fails to initiate a handover, the "General Status View" displays a timeout warning. Other warnings and error messages (for example, "Autodial switched off", "Telephone number is empty", "No endless call selected", "BA list empty") are also displayed in the "General Status View".

The "Cyclic Handover" button opens the following dialog.



Cyclic handover must be enabled explicitly by checking the "Enable Cyclic Handover" checkbox. The BA list contains the BCCH channel numbers of all cells to be allocated during the cyclic handover process. The mobile dwells in each cell for a definite "Linger time". The "Add", "Edit", and "Delete" buttons are used to modify the BA list and its entries.



QoS statistics

Statistical evaluation of the actions initiated by the previously mentioned actions like `Attach Request` or `Handover Command` provides an overview of the quality of service, e.g. the amount of network resources given to the mobile. The "GSM QoS View" shows the amount of resources given to the mobile.

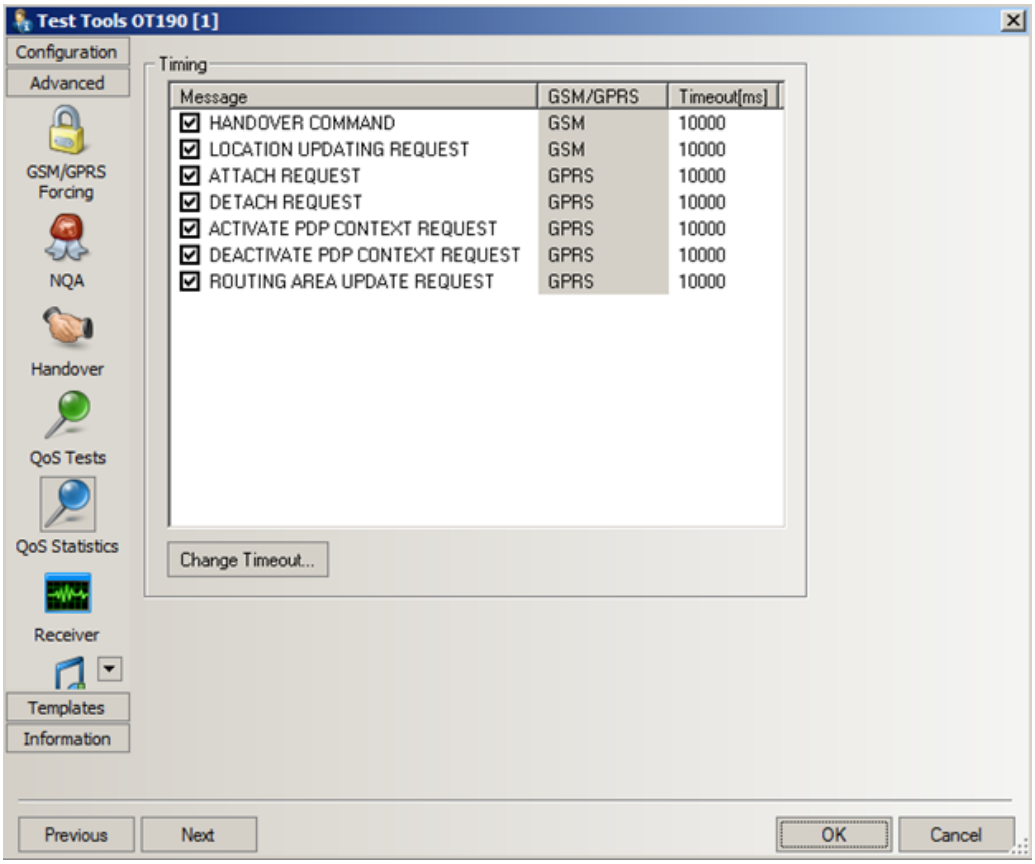
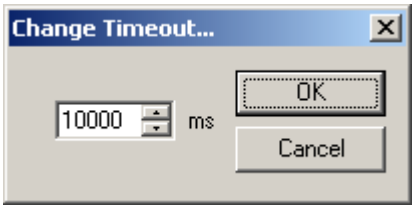


Figure 6-109: GSM driver configuration – QoS statistics

Message / GSM/GPRS
List of layer 3 and RLC/MAC control messages generated or received by the mobile. The actions initiated by the checked messages are included in the measurement file. The messages are related to either GSM or GPRS service.

Timeout
Maximum time that the selected actions can take until they are classified as "No Response" actions. For mobile-initiated actions, the time is measured from the time the mobile transmits the REQUEST message to the time it receives the response from the network.



An individual timeout can be set for each selected action.

Templates

The "Templates" dialog lets the user store the current driver configuration as a template, lists, load or delete the driver templates. It is identical for all GSM mobile drivers.

When a driver is loaded using the "Hardware > Connect/Disconnectd/Remove" command, see Chapter 6.1, "Devices", on page 1447, the R&S ROMES4 checks whether a driver template is stored in the Driver Templates directory and its subdirectories. The driver can be loaded with default settings or with the settings stored in any of the templates found.

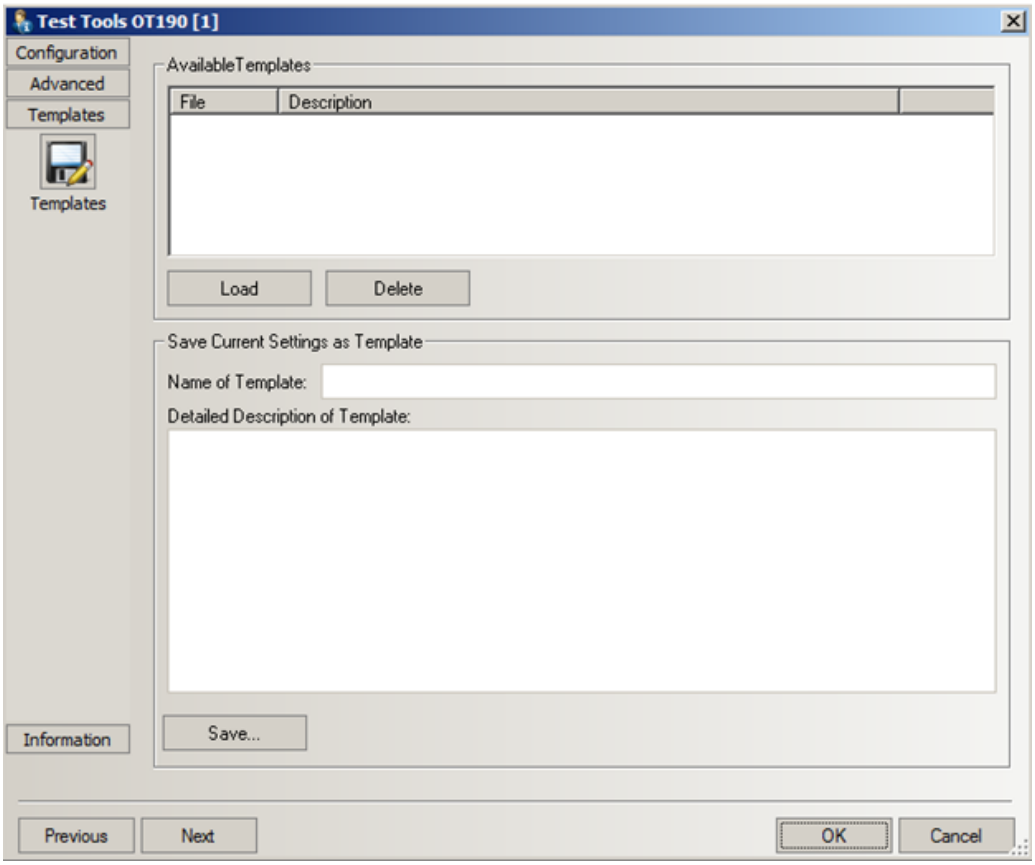


Figure 6-110: GSM driver configuration – templates

Load/Delete
The buttons load, delete respectively a driver template or delete a template displayed in the "Available Templates" list. Template files are ASCII files with the extension `*.template`. The template definition is independent from the workspace. A selection of template files for different drivers is supplied with the R&S ROMES4 installation.

Save
Saves the current driver settings together with the "Description" to a selected template file.

Serial port driver info

The "Serial Port Driver" tab displays the custom name of the device, information on the file version of the technology driver, the serial port assigned to it and the transfer parameters. The "Custom Name" is used to assign a name to a test device, e.g. to make a quick association of a test device to its designated test network provider.

Also the expected amount of produced driver data per time unit can be set. See also Chapter 6.3, "Devices observation", on page 1510.

The configuration dialog identical for all GSM mobile drivers.

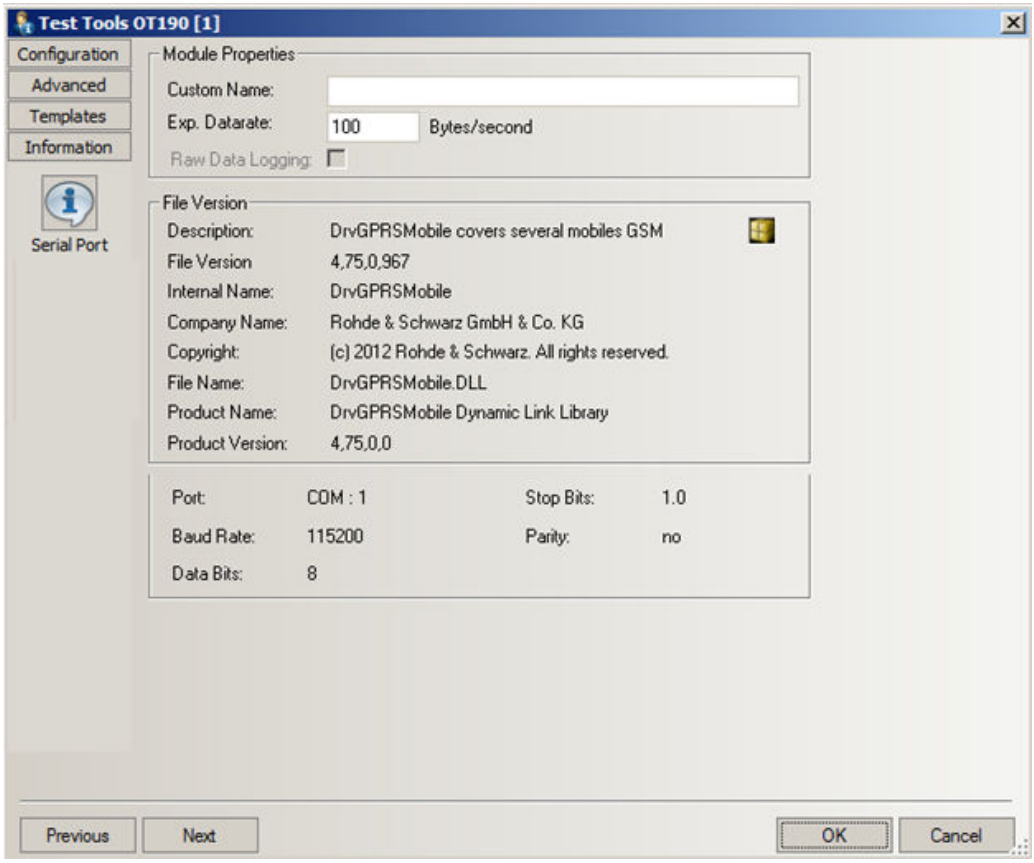


Figure 6-111: GSM driver configuration – serial port

Raw data logging is not available for GSM mobile driver.

Custom Name
Used to assign a name to a mobile, e.g. to make a quick association of a test mobile to its designated test network provider.

OK
Confirms all settings made in the "Driver Configuration" menu and closes the menu.

If any of the settings made are wrong (i.e. not compatible with the connected device), an error message box pops up.

Cancel
Discards all changes made and closes the "Driver Configuration" menu.

6.4.4.3 Action menu GSM

The "Action" menu opens commands used to perform various actions at the mobile phone, for example, to set up a call, force a handover to a neighbor cell, perform a location update. The menu is added to the menu bar when a mobile driver is successfully installed, see the chapter Chapter 6.1, "Devices", on page 1447. The "Action"

menu and its functionality depend on the driver and mobile type. If several mobiles are connected, separate command lines are displayed for each of them.

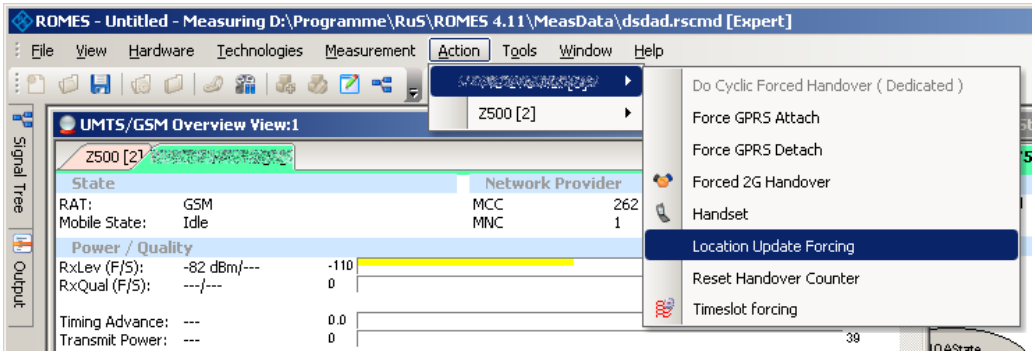


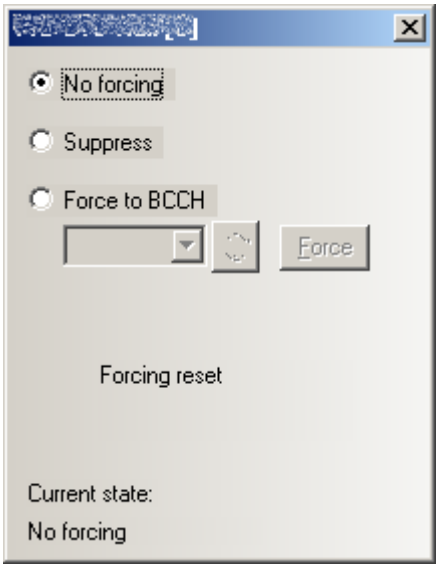
Figure 6-112: Action menu of a GSM mobile device

Handover

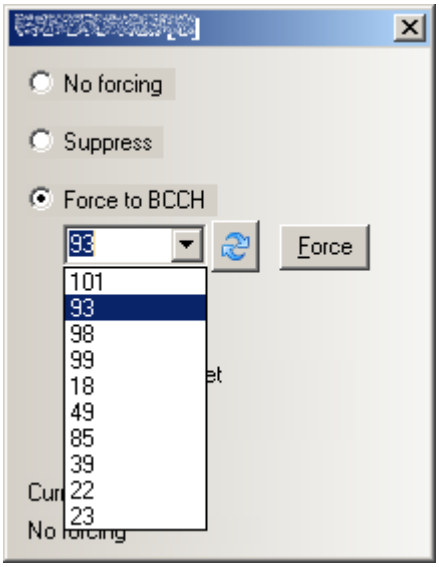
Switches over to one of the six neighbor cells if possible.

Handover is possible in dedicated mode (during a call) only. The "Handover" command opens a dialog box (equal for all drivers). On the bottom of the dialog, the current forcing state is displayed.

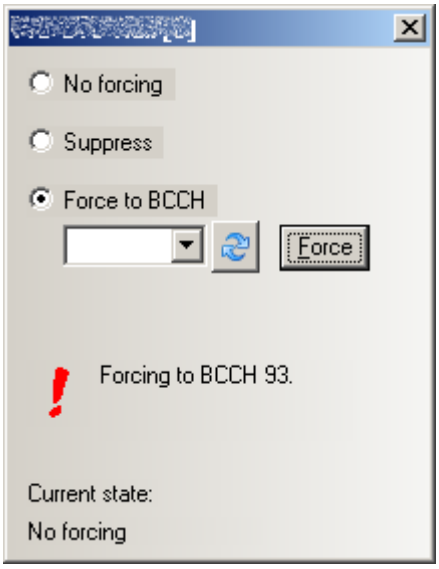
1



2


No forcing
Suppress
Force to BCCH
93
Force
101
93
98
99
18
49
85
39
22
23

3


No forcing
Suppress
Force to BCCH
Force
Forcing to BCCH 93.
Current state:
No forcing

4

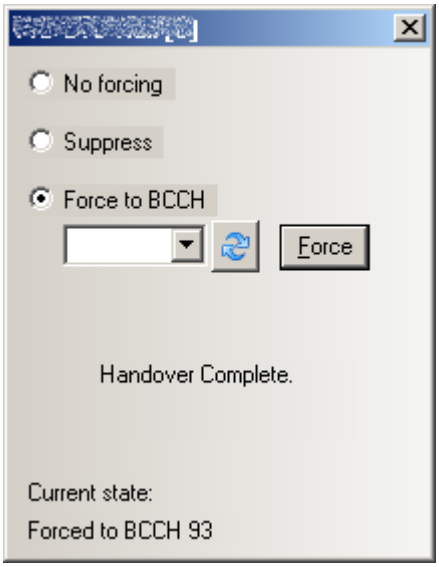


Figure 6-113: The four screenshots show the steps of a handover

- **No Forcing**
  Cancel all forced handover procedures and return to normal measurement mode.
- **Suppress**
  Suppress a handover. Only possible if the mobile supports this functionality.
- **Force to BCCH**
  An editable drop-down list lets you enter any neighbor cell or to select one from a list of all visible neighbor cells. In case the mobile station can measure more than six, they are also in the list. Every time the dialog is opened the list is updated. Or by clicking the refresh button.
-

  Refresh button. Updates the list of the neighbor cells.
- **Force**
  Initiates a forced handover to the selected neighbor cell. This forcing can be done several times in succession. After a forced handover, the mobile is locked on the former neighbor cell which is now the serving cell.

The current action is indicated in the two output fields below the buttons.

This function is only possible in NORMAL measurement mode.

Handset (GSM)

Activates the entry of a number to dial, set up and terminate a call.

- **Handset**
  The "Handset" command opens a window (equal for all drivers) which have two possible statuses:
  – Not selected

– Selected, marked with "- *" and shown in the following figure as connected mobile [2].

If there is only one "Handset" window, it always has selected status.
If there is more than one "Handset" window, the selected status can be set to any "Handset" window in one of two listed ways:
1) Click to the window using a mouse.
2) Choose selected window using the "N" key. In this case selection changed like this: Window[1] > press "N"> Window[2] > press "N"> ...Window[n] > press "N"> Window[1] (cycling choose like "Alt+Tab" between open windows in MS Windows).
Only selected windows accepts hotkeys “D” ("Dial"), “A”("Answer"), “H”("Hangup").
Note: The previously mentioned keys have only effect, if the focus is not set to an input control, example-given edit field or combo box.
Example: if you select the phone number by selecting the corresponding entry of the combo box, the keys do not work afterwards. Set the focus to another window, for example to the main R&S ROMES4 window.

- **>>**
The ">>" button enlarges the dialog box, giving access to the Key pad and the "Autodialing" option.

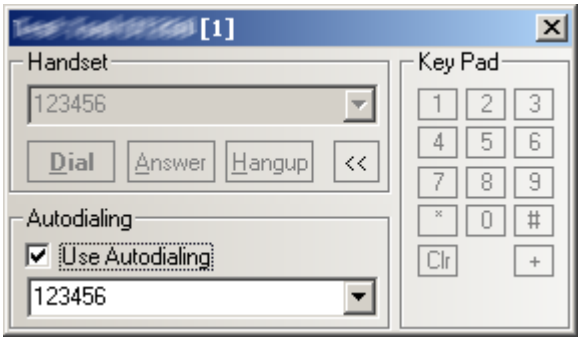


Figure 6-114: Use Autodialing

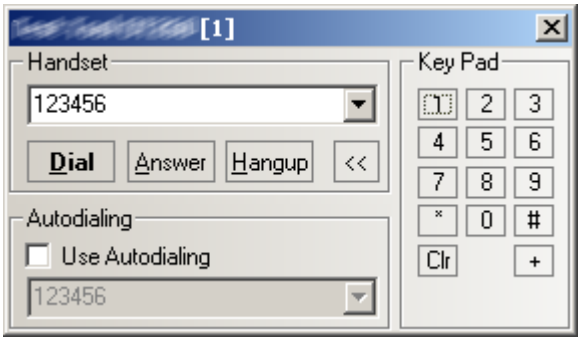


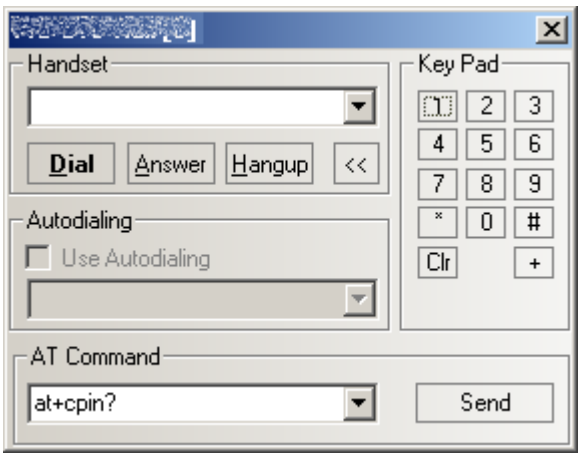
Figure 6-115: No Autodialing

- **Dialed number**
  The number to be dialed can be entered either via the keyboard and the input field or by clicking the on-screen keypad.
- "Close window ☒"
  Closes the window without any further action.
- "Dial"
  Starts dialing the number entered before.
- "Answer"
  Instructs the phone to accept the call.
- "Hangup"
  Drops the line.
- "Autodialing"
  If the box is checked, the phone number entered below is called periodically, the "Dial", "Answer", and "Hangup" buttons are disabled (grayed). The autodialing mode can be set even during the measurement, but only in "Idle mode".
  This item starts "Autodialing" if the "Start with Measurement option" was not checked in the driver configuration-autodialing tab panel.

AT Command

- Enter the command to send.
- Click "Send".

The command is directly sent to the test device. This functionality is provided by the Qualcomm drivers.



AT commands are logged into the RSCMD file and visualized in the "2G/3G Layer 3 View".

Do cyclic forced handover

Forces the mobile cyclically to attempt a handover procedure, see "Cyclic handover" on page 1556. It is grayed unless the mobile is in dedicated mode (during a call).

Force GPRS attach

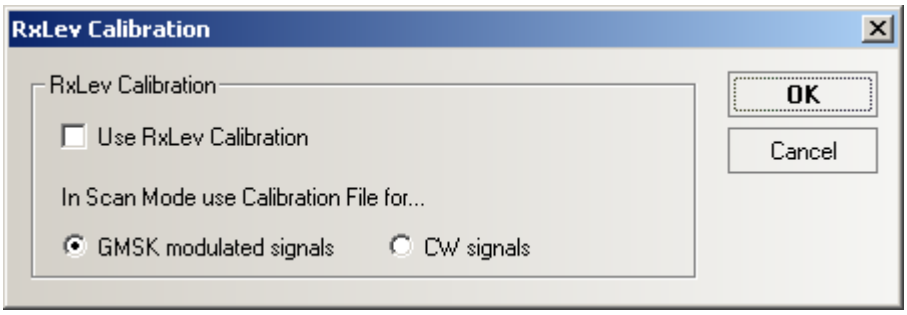
Forces the mobile phone to attempt a GPRS attach.

Force GPRS detach

Forces the mobile phone to attempt a GPRS detach.

RxLev calibration

The "RxLev Calibration" button opens a dialog to activate the calibration of the received signal level reported by the mobile devices.



The RxLev calibration is based on a comparison between the RX level values reported by the mobile and the actual RX levels applied to the mobile receiver. This comparison can be drawn with a CMD Digital Radio Communication Tester and the R&S MobCal software tool.

Presently, RxLev calibration is implemented only with GSM900 and GSM1800. The calibration can be used for single-band and for GSM900/1800 dual-band mobiles. For GSM-E or GSM-R calibration, the values of BCCH 1 are used.

For dual-band mobiles, two separate correction table files have to be created for the two GSM bands, and they must be stored in the `\driver\` subdirectory of the R&S ROMES4 program directory.

To be recognized as two files belonging to the same mobile, the two correction tables must be named as follows:

- For GSM900: <IMEI 8 last significant digits> <exit> (e.g. 12345678.cm)
- For GSM1800: <IMEI 8 last significant digits>_D <exit> (e.g. 12345678_D.cm)

If the file name does not follow this convention, a file open dialog prompts for the wanted `*.<ext>` file at start of measurement.

Table 6-4: The file extensions are used as follows:

<ext>	is used for...
.CM	Normal and Camp measurements

Important notes

- A correction table file (ASCII) contains a maximum of 50 different channels.
- Channels others than 1 to 124 in the first file and 512 to 855 in the second file are not allowed and could lead to crashes
- Level lines are between -110 dB and -35 dB in 1 dB steps in a 3-dimensional matrix.
- Between the channels, the calibration value is linearly interpolated. Outside, the last valid value is extrapolated. Between two level lines, the calibration value is linearly interpolated.

Example: A simple .CM file

The following file is an example with 3 channels (Ch 1, 40, and 124) and 9 level lines. The shown calibration values change linearly from 1.0dB to 1.2dB.

```
{[D]};15.09.104;12:05:55;11:16:52
{[T]}25;25;25
{[M]}GSM; 350639.07.031008.0; 206.10.2000005178;4
{[F]}CM;GMSK;0.00
{[O]}1;-110;10
{[O]}1;-101;10
{[O]}1;-77;10
{[O]}1;-57;10
{[O]}1;-53;10
{[O]}1;-51;10
{[O]}1;-50;10
{[O]}1;-49;10
{[O]}1;-48;10
{[ ]}
{[O]}40;-110;11
{[O]}40;-101;11
{[O]}40;-77;11
{[O]}40;-57;11
{[O]}40;-53;11
```

```
{[O]}40;-51;11
{[O]}40;-50;11
{[O]}40;-49;11
{[O]}40;-48;11
{[ ]}
{[O]}124;-110;12
{[O]}124;-101;12
{[O]}124;-77;12
{[O]}124;-57;12
{[O]}124;-53;12
{[O]}124;-51;12
{[O]}124;-50;12
{[O]}124;-49;12
{[O]}124;-48;12
{[ ]}
```

Table 6-5: Explanation of the line identifiers

Identifier	Meaning of succeeding parameters
{[D]}	User*);Date*);Time*);Duration of creation*)
{[T]}	Room temp*);Mobile temp. (start)*);Mobile temp. (end)*)
{[B]}	CMD TxPower (start)*);TCH (start)*);Tslot (start)*);used Tslot(dBm)*);unused Tslot (offset dB)*)
{[M]}	Network type*);IMEI*);IMSI*);power class*)
{[F]}	CM;GMSK;0.00 // Type of corr.file CM; GMSK|CW*); FreqOffset in KHZ*)
{[O]}	Channel; Level line RxLev in dB; calibration offset in 1/10 dB
{[ ]}	Separator

*) not used so far

6.4.5 UMTS mobile devices

The R&S ROMES4 measurement system provides UMTS mobile drivers for the UMTS test mobile devices based on the Qualcomm chipsets 6200, 6250, 6275, 6280, 7200, 7201 and 8200.

A driver is installed as described in Chapter 6.1, "Devices", on page 1447.

How to configure the UMTS mobile devices is described in the following sections. The maximum number of test mobiles to be used simultaneously is limited by the option file, by the number of interfaces and the performance of the controller. The test mobiles must be connected via USB interface, see Chapter 6.1.4, "Connection via USB interface", on page 1456.

CAUTION

USB interface for power supply of Samsung mobiles

The Samsung mobiles rely on the USB interface for their power supply. A supply current of approx. 0.5 A is required.

Check the specification of your USB interface, especially when connecting several Samsung mobiles or other power-consuming devices in parallel. If necessary, use a self-powered USB hub.

All UMTS channels and frequencies are listed in Chapter 12.9, "UMTS channels", on page 2405.

The Qualcomm chipset-based test mobiles can be used to acquire data for most of the UMTS and UMTS/GSM views, see Chapter 4.4.3, "UMTS views", on page 742 and Chapter 4.4.12, "3GPP overview view", on page 923. Limitations are listed in the following table.

Table 6-6: Supported Views of Qualcomm test mobiles (excerpt)

View	Qualcomm MSM 6200-/6250-based	Qualcomm MSM 6275-/6280-/ 7200-/7201-based	Qualcomm MSM 8200-based
UMTS Finger Data View	Yes	Yes	Yes
UMTS Cell Set View	Yes, active set and neighbor set	Yes, active set and neighbor set	Yes, active set and neighbor set
UMTS NAS Status View	Yes	Yes	Yes
UMTS TrCH View	Yes	Yes	Yes
UMTS Physical Channel View	Yes	Yes	Yes
UMTS SIB View	Yes	Yes	Yes
UMTS RLC/MAC View	Yes	Yes	Yes
UMTS Measurement Report View	Yes	Yes	Yes
UMTS Reselection View	Yes	Yes	Yes
UMTS Power Control View	Yes	Yes	Yes
UMTS Layer 1 Graph View	Yes	Yes	Yes
All UMTS HSDPA Views	No	Yes	Yes
All UMTS HSUPA Views	No	Only 72xx	Yes
UMTS HSPA L2 Statistic	No	No	Yes
2G/3G Layer 3 View	Yes	Yes	Yes
2G/3G ETSI QoS View	Yes	Yes	Yes
UMTS/GSM Overview	Yes	Yes	Yes

Analogous to GSM, the UMTS test mobiles and drivers are grouped into the R&S support classes 1 and 2. The mobiles of R&S support class 1 are continuously tested with new R&S ROMES4 versions and service packs. They are permanently available to our testing staff. The mobiles of R&S support class 2 are not always available for testing, but they have been tested successfully at least once with the current R&S ROMES4 software release. The introduction of the R&S support classes is necessary due to the sheer number of supported mobiles. The mobile types with R&S support class 1 are listed with normal title typeface in the table below. The mobiles with R&S support class 2 are marked with italic title typeface.

To see test mobile devices that are supported by R&S ROMES refer to `Supported Test Mobiles ROMES.pdf` file which is found in the `..\Documents\ReleaseNotes\` of the delivered R&S ROMES DVD.

UMTS services are available for PCMCIA slot-based data cards. The following cards (based on the Qualcomm chipset) are supported.

Table 6-7: UMTS properties of UMTS test data cards

Manufacturer: Novatel Wireless	Manufacturer: Option	Manufacturer: Sierra Wireless
• **Merlin U740** UMTS 2100 MHz + HSDPA 1.8 MBit GSM850/900/1800/1900 + GPRS + EDGE • **Merlin U870** UMTS 2100 MHz + HSDPA 7.2 MBit GSM850/900/1800/1900 + GPRS + EDGE	• **Globetrotter GT 3G + EMEA** UMTS 2100 MHz + HSDPA 1.8 MBit GSM 900/1800 + GPRS	• **A850/A875** UMTS 2100 MHz GSM 900/1800 + GPRS

6.4.5.1 UMTS devices configuration menu

The "Qualcomm" based devices' configuration menu contains various tabs with the following functions:

- "Configuration" and "Expert Mode" to select the message types evaluated by the test system
- "NQA" to configure the network quality analysis
- "Autodialing" for autodialing and autoanswer call mode
- "Serial Port Driver Info" to display information on the driver and the assigned serial port

To open the configuration menu, click "Hardware" > "Driver" line of the menu which is available when a mobile driver is loaded.

- UMTS devices configuration 1571
- Extra settings UMTS 1573
- NQA settings 1583
- Handover analyzer 1584
- Speech quality 1585
- Autodialing 1586
- Serial port info 1589

- Templates.....1589
- Data tester.....1590
- Tracking of SMS.....1591

UMTS devices configuration

The PIN number can be entered in "Device" in case a data card is used. For most test mobiles, the card has to be entered directly into the mobile. The tab allows a rough preselection of the evaluated message type.

The message type selection can be refined in the "Extra settings" tab, see "Extra settings UMTS" on page 1573.

The UMTS test mobiles provide information that the test system is able to store and evaluate. In many applications, only a subset of this information is needed. Restricting the recorded data saves system resources and reduces the size of the measurement files.

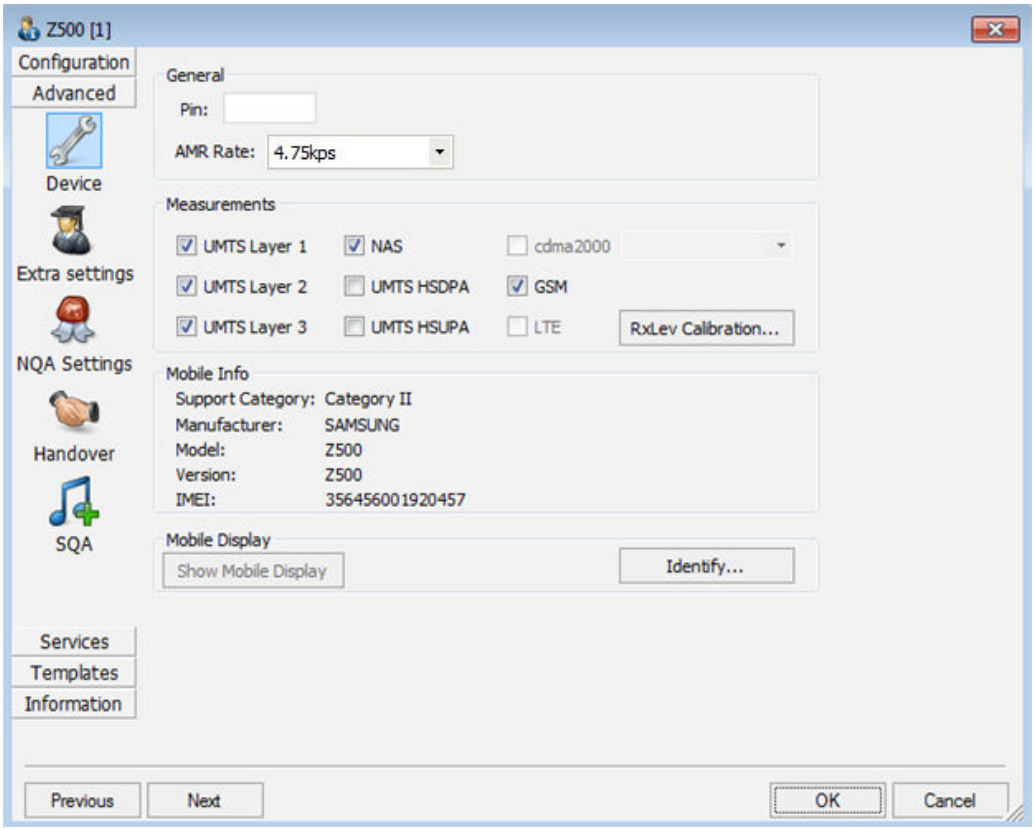


Figure 6-116: UMTS driver - device configuration

Click "Identify". The following message box appears.

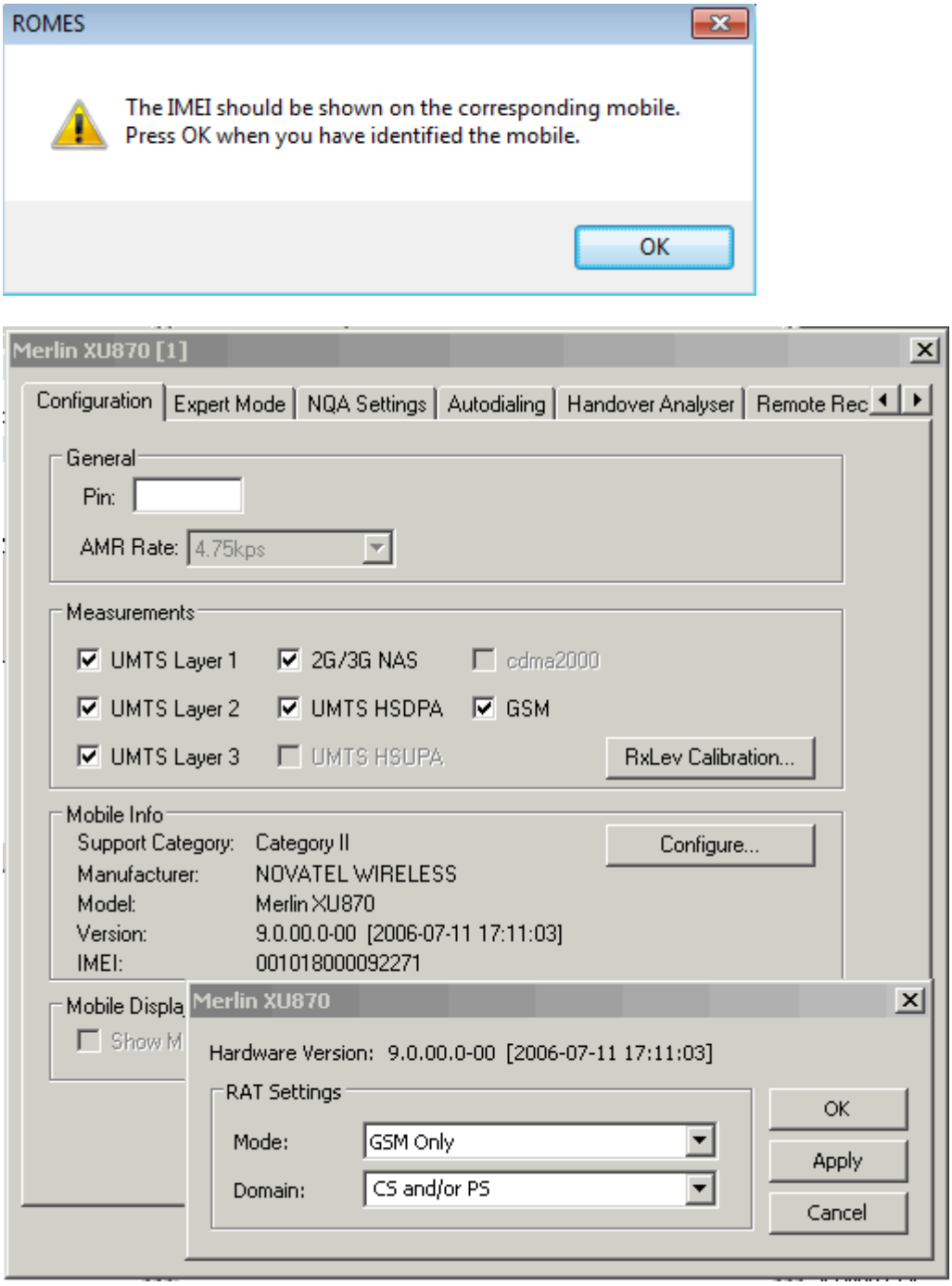


Figure 6-117: UMTS driver configuration – data card

General

The PIN number for identification after switching on the test mobile can be entered in the "General" panel of the configuration dialog (not supported by most test mobiles). If nothing is entered or the PIN is ignored, the SIM must be entered manually at the mobile each time it is started.

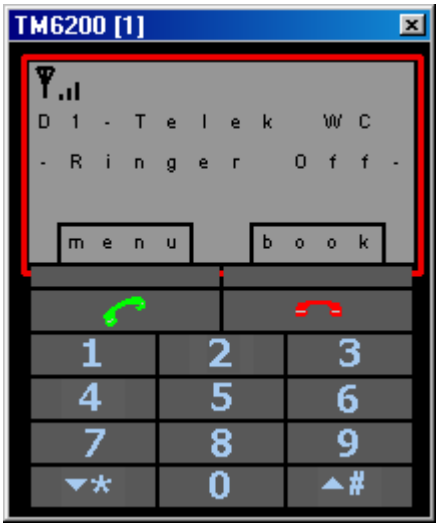
Select an AMR codec in the "AMR Rate" list box.

Note:
The option "Make Diagnostic Calls" is removed from the Qualcomm driver configuration page, as the current mobiles with Qualcomm chipset do not support this specific call type.

Measurements
The six UMTS/GSM-related check boxes in the "Measurements" group are used for a rough preselection of the messages and information types to be recorded and written to the measurement (`*.rscmd`) file. The selection can be refined in the "Expert Mode" tab. For an overview of available messages, views and signals, see Table 6-8.

Mobile Info
In the "Mobile Info" field information about the mobile is displayed. The button "Configure" is used to force a Qualcomm data card to GSM.

Mobile Display
"Show Mobile Display" opens a view of the test mobile so that it is possible to observe the display, dial numbers and browse the menu from the controller while a measurement is performed. This function is also provided in the "Action" menu; see Chapter 6.4.5.2, "Action menu UMTS", on page 1593.



Extra settings UMTS

The "Extra settings" tab selects the message types to be recorded to the measurement file. A Layer 1, Layer 2, Layer 3, or UMTS message type can be selected only if the driver has been configured to do "Layer 1", "Layer 2", "Layer 3" or "UMTS" measurement. See description of "Hardware".

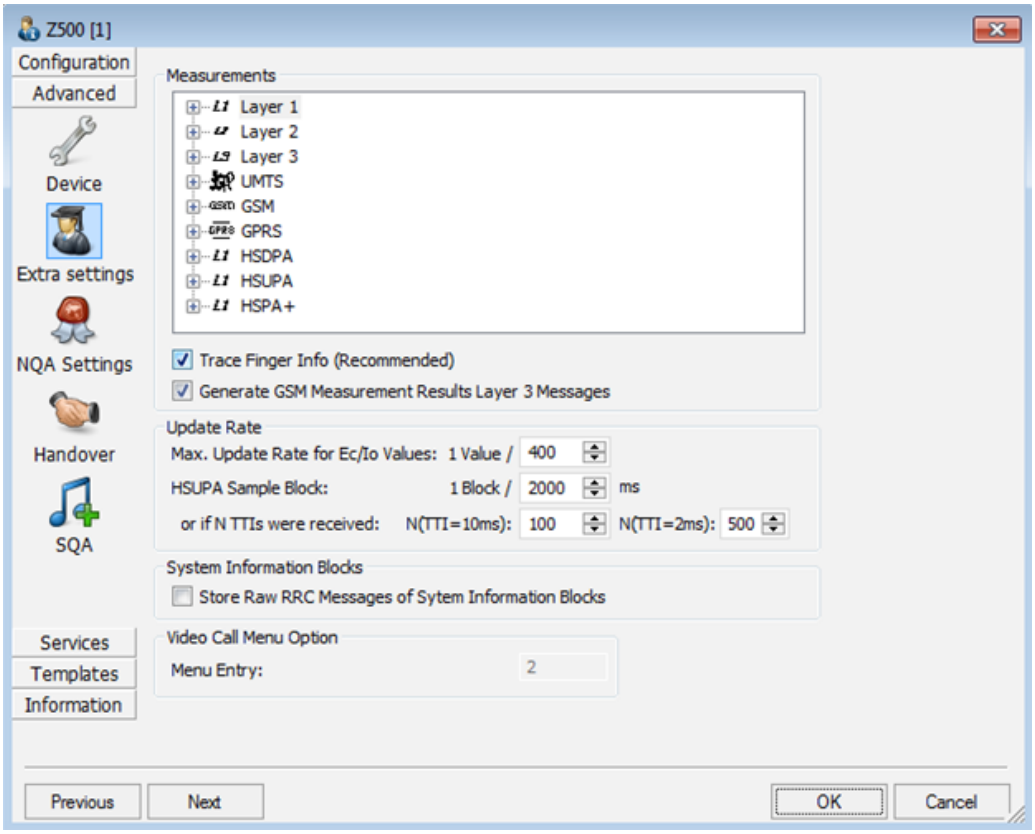


Figure 6-118: UMTS driver configuration - extra settings

The available message types are listed in the following table. The names of the corresponding views and data structures/signals in the data tree are included in the table. For an explanation of the recorded parameters, refer to the description of the UMTS and UMTS/GSM views in Chapter 4.4.3, "UMTS views", on page 742 and Chapter 4.4.12, "3GPP overview view", on page 923.

Table 6-8: UMTS message types, views and signals

Message type	R&S ROMES4 view	Data structure/signal
Layer 1 Messages		
WCDMA AGC	UMTS Layer 1	Layer 1
WCDMA RACH Parameters	Only general-purpose views (e.g. Alphanumeric View)	RACH Parameters
WCDMA DRX Mode	Only general-purpose views (e.g. Alphanumeric View)	DRX Mode
WCDMA TrCH Downlink	UMTS TrCH	
WCDMA TrCH Uplink	UMTS TrCH	
WCDMA Common Physical Channels Downlink	UMTS Physical Channels	
WCDMA Dedicated Physical Channels Downlink	UMTS Physical Channels	

Message type	R&S ROMES4 view	Data structure/signal
WCDMA Physical Channels Uplink	UMTS Physical Channels	
WCDMA PRACH	UMTS Physical Channels	
WCDMA Active Set	UMTS CellSet, UMTS Network Analyzer	Active Set
WCDMA Neighbour Set		
WCDMA BLER		
WCDMA SIR Estimation		SIR
WCDMA Cell Reselection	UMTS Reselection View	
WCDMA List Searcher		
WCDMA compressed mode interfrequency Step 1 search		
WCDMA compressed mode interfrequency list search		
Layer 2 Messages		
WCDMA Radio Bearer States	HSDPA Performance View	
WCDMA MAC UL Logical Channel Parameters	HSDPA Performance View	
WCDMA MAC DL Logical Channel Parameters	HSDPA Performance View	
WCDMA MAC UL Traffic Volume Measurement Report	HSDPA Performance View	
WCDMA MAC Ciphering Configuration		
WCDMA RLC UL State	HSDPA Performance View	
WCDMA RLC UL Ciphering	HSDPA Performance View	
WCDMA RLC UL Ciphering V1	HSDPA Performance View	
WCDMA RLC DL Ciphering	HSDPA Performance View	
WCDMA RLC DL Ciphering V1		
WCDMA RLC DL Cipher PDU Combination V1		
WCDMA RLC UL Cipher PDU Combination V1		
WCDMA RLC UL AM Configuration	HSDPA Performance View	
WCDMA RLC UL AM User Plane PDU		
WCDMA RLC UL AM Signaling Plane PDU		
WCDMA RLC DL AM User Plane PDU		
WCDMA RLC DL AM Signaling Plane PDU		
WCDMA RLC UL TM	HSDPA Performance View	

Message type	R&S ROMES4 view	Data structure/signal
WCDMA RLC UL UM	HSDPA Performance View	
WCDMA RLC UL AM	HSDPA Performance View	
WCDMA RLC UL AM Statistics	HSDPA Performance View	
WCDMA RLC UL AM PDU		
WCDMA RLC UL AM NAK PDU		
WCDMA RLC DL State	HSDPA Performance View	
WCDMA RLC DL TM	HSDPA Performance View	
WCDMA RLC DL UM	HSDPA Performance View	
WCDMA RLC DL AM	HSDPA Performance View	
WCDMA RLC DL AM V1	HSDPA Performance View	RLC Throughput
WCDMA RLC DL AM Statistics **Note:** This message type uses numerous cpu time and therefore could stress the whole measurement system.	HSDPA Performance View	RLC Throughput
WCDMA RLC DL AM PDU		
WCDMA RLC DL AM NAK PDU		
WCDMA RACH Control Parameters		
WCDMA Uplink TFC		
Layer 3 Messages		
WCDMA RRC Signaling Messages	UMTS SIB, UMTS Layer 3, UMTS Measurement Report, all	Layer 3, RRC Message
UMTS		
UMTS NAS GMM State	UMTS NAS Status	NAS State
UMTS NAS MM State	UMTS NAS Status	NAS State
UMTS NAS REG State	UMTS NAS Status	NAS State
UMTS NAS CS Connection Management		CS Call Management
UMTS NAS MM Characteristics	UMTS NAS Status	MM Info
UMTS NAS OTA Messages		NAS Message
UMTS NAS QoS		NAS QoS
UMTS NAS Connection Bearer Capability		Connection Bearer Capability
UMTS Vocoder UL		
UMTS Vocoder DL		

Message type	R&S ROMES4 view	Data structure/signal
UMTS NAS AMR Uplink (only older firmware versions)		AMR Uplink
UMTS NAS AMR Downlink (only older firmware versions)		AMR Downlink

The Layer 3 Decoder now decodes the following UMTS PDUs according to 3GPP TS 36.331 V12.7.0: Any of these PDUs provided by the test Mobile is displayed in the Layer 3 View.

The following UMTS PDUs provided by test mobiles are also decoded by the Layer 3 decoder.

Table 6-9: UMTS Layer 3 messages according to 3GPP TS 36.331 V12.7.0 Spec

Message type	R&S ROMES4 view	Data structure/ signal
SIB3	Layer 3 View	Layer 3 message
SIB11ter	Layer 3 View *UMTS Scanner BCH View	Layer 3 message
SIB23	Layer 3 View /*UMTS Scanner BCH View	Layer 3 message
SIB24	Layer 3 View / *UMTS Scanner BCH View	Layer 3 message
Measurement Report	Layer 3 View	Layer 3 message
UE_Positioning_Measurement	Layer 3 View	Layer 3 message
UE_Positioning_Measurement_r4	Layer 3 View	Layer 3 message
UE_Positioning_Measurement_r7	Layer 3 View	Layer 3 message
UE_Positioning_Measurement_r8	Layer 3 View	Layer 3 message
UE_Positioning_Measurement_r9	Layer 3 View	Layer 3 message
UE_Positioning_Measurement_r10	Layer 3 View	Layer 3 message

* R&S ROMES4 UMTS scanner driver allows SIB11ter, SIB23 and SIB24 to select for demodulation. If a PDU has been demodulated, it is shown in the UMTS BCH View.

Currently, the UMTS Demodulator does not support SB3 (UMTS Scheduling Block Type 3) and SIB23 (UMTS System Information Block Type 23). They use a Secondary Broadcast Channel, which is not demodulated. Based on MIB (Master Information Block) enhancement, a Secondary Broadcast Channel can be indicated, if present.

The "NQA State Machine" signals require several layer 3 and Layer 1 messages. They are available in the default configuration of the driver configuration menu and are listed in the following table.

Table 6-10: GSM/GPRS/UMTS/HSDPA/HSUPA/HSPA+ message types, views and signals

Message type	R&S ROMES4 view	Data structure/ signal
GSM Messages		
GSM Burst Metrics		
GSM surround cell BA list	MMR	MMR, SVR
GSM serving cell info	MMR	MMR, SVR
GSM TxLev Timing Advance		SVR
GSM L3 RR state		SVR
GSM L3 RR protocol error		
GSM L3 RR signaling message	GSM/UMTS Layer 3	Layer 3
GSM L3 RR cell selection and reselection parameters	GSM Layer 1	Layer 1 ext.
GSM L3 RR RACH control parameters		SVR
GSM L3 RR control channel description parameters		MM Info
GSM L3 RR cell options		SVR
MMR GSM L3 RR cell information	MMR	MMR, SVR
GSM L3 RR channel configuration		SVR, MM Info
GSM L3 RR ciphering mode		MM Info
GSM L3 RR cell selection and reselection measurements	MMR	MMR, SVR
GSM L3 RR downlink signaling counter		SVR
GSM L3 RR radio link timeout counter		SVR
GSM L3 RR SACCH report	MMR	MMR, SVR
GSM L3 RR 3G rejected cells	Rejected 3G Cells	RR 3G Rejected Cells
Idle 3G Cell List GSM L3 idle WCDMA known list	Idle 3G Cell List	Idle Mode WCDMA Known List
GSM L3 dedicated WCDMA cell list	Dedicated 3G Cell List	3G Dedicated Measurements
GSM 3G dedicated measurements	Dedicated 3G Cell List	3G Dedicated Measurements
GPRS Messages		
GPRS indicators	GSM Layer 1	Layer 1 ext.
GPRS general parameters	RLC/MAC	MAC Info
GPRS cell options	RLC/MAC	MAC Info
GPRS power control parameters	RLC/MAC	MAC Info
GPRS mobile allocation		
GPRS PBCCH description		

Message type	R&S ROMES4 view	Data structure/ signal
GPRS GRR State		
GPRS RR cell reselection parameters	GSM Layer 1	Layer 1 ext.
GPRS RR cell reselection measurements	GSM Layer 1	Layer 1 ext.
GPRS RR packet system information 1	RLC/MAC	GPRS RR Info
GPRS RR packet system information 2	RLC/MAC	GPSR MM Info
GPRS RLC-UL statistics	RLC/MAC	QoS Info
GPRS RLC-DL statistics	RLC/MAC	QoS Info
GPRS RLC-UL Release Indicators		
GPRS RLC-DL Release Indicators		
GPRS LLC ME information	RLC/MAC	QoS Info
GPRS LLC PDU statistics	RLC/MAC	QoS Info
GPRS LLC XID Information		
GPRS SNDCP PDP context information		SNDCP Info
GPRS MAC signaling message	GSM/UMTS Layer 3	GPRS RLC Msg.
GPRS MAC UL TBF establish	RLC/MAC	MAC Info, RLC Info
GPRS MAC UL TBF release	RLC/MAC	MAC Info, RLC Info
GPRS MAC DL TBF establish	RLC/MAC	MAC Info, RLC Info
GPRS MAC DL TBF release	RLC/MAC	MAC Info, RLC Info
GPRS SM/GMM OTA signaling message	GSM/UMTS Layer 3	GPRS GMM Msg.
RLC/MAC GPRS air interface summary		RAT Info
GPRS timing advance		SVR
GPRS power control	RLC/MAC	RLC Info
GPRS transfer summary	RLC/MAC	MAC Info, RLC Info
GPRS Uplink TBF Data Block Count		
GPRS L1 Message Metrics A	RLC/MAC	MAC Info, RLC Info
GPRS L1 Message Metrics B	RLC/MAC	MAC Info, RLC Info
GPRS L1 Message Metrics C	RLC/MAC	MAC Info, RLC Info
GPRS L1 Message Metrics D	RLC/MAC	MAC Info, RLC Info
GPRS L1 Burst Metrics A		
GPRS L1 Burst Metrics B		
GPRS L1 Burst Metrics C		
GPRS L1 Burst Metrics D		
GPRS L1 Hopping ARFCN		

Message type	R&S ROMES4 view	Data structure/ signal
GPRS RR 3G reselection measurements parameter	RR 3G Reselection Measurements Parameters	GRR 3G Reselection Measurements Parameters
GPRS RR 3G reselection measurements	RR 3G Reselection Measurements	GRR 3G Reselection Measurements
GPRS/EGPRS RLC Uplink Header	GPRS/EGPRS	EGPRS Info
GPRS/EGPRS RLC Downlink	GPRS/EGPRS	EGPRS Info
GPRS/EGPRS RLC Uplink	GPRS/EGPRS	EGPRS Info
HSDPA Messages (only 6275, 6280, and 7200 chipsets)		
HSDPA Configuration	UMTS HSDPA Configuration	HSDPA DL Configuration HSDPA DL Configuration Disable HSDPA UL Configuration HSDPA UIL Configuration Disable HSDPA Finger Configuration
HSDPA UL Beta Gain Table		
HSDPA Demodulator Control Table		
HSDPA Modulator Control Table		HSDPA Modulator Control Table
HSDPA Decode Status	UMTS HSDPA Decode Status	HSDPA Decode Summary
HSDPA HS-SCCH Statistics		HSDPA SCCH Statistics
HSDPA HS-DSCH HARQ Statistics	UMTS HSDPA HARQ Statistic	HSDPA DSCH HARQ Statistics HSDPA DSCH HARQ
HSDPA UL HS DPCCH Information	UMTS HSDPA UL HS DPCCH	
HSDPA MAC HS Configuration	UMTS HSDPA MAC Configuration	
HSDPA MAC HS Headers	UMTS HSDPA MAC Header	
HSDPA MAC HS Status	UMTS HSDPA MAC Status	
HSUPA Messages (7200 chipset only)		
HSUPA EUL DL Channel Configuration	UMTS HSUPA DL Channel Configuration	HSUPA DL Channel Configuration
HSUPA EUL UL Channel Configuration	UMTS HSUPA UL Channel Configuration	HSUPA UL Channel Configuration
HSUPA EUL UL E-DPCH	UMTS HSUPA HARQ	HSUPA E-DPCH Summary

Message type	R&S ROMES4 view	Data structure/ signal
HSUPA EUL combined L1/MAC	UMTS HSUPA ACK/ NACK U MTS HSUPA Cell Status	HSUPA Statistics
HSUPA EUL L1/MAC statistics	UMTS HSUPA L1/MAC Statistic	HSUPA Statistics
HSUPA EUL MAC-e/es Configuration	UMTS HSUPA DL Channel Configuration	HSUPA MAC-e Configuration
HSUPA EUL MAC-e/es Header	UMTS HSUPA L1/MAC Statistic	HSUPA MAC-e/es Summary
HSUPA EUL UL UM PDU		
HSUPA EUL DL UM PDU		
HSUPA EUL Ciphering		
HSPA+ Messages (8200 chipset only)		
HSUP+ MAC-ehs reassembly	HSDPA Performance View	
HSPA+ Flexible DL RLC AM PDU sizes	HSPA L2 Statistic View	

Trace Finger Info (Recommended)
The WCDMA finger info is necessary for the "UMTS Layer 1 View", "UMTS Finger View", and the "UMTS Network Analyzer View". It must be selected as well to obtain the "Finger Info" signals.

Generate GSM Measurement Results Layer 3 Messages
The GSM L3 measurement report messages are not reported by a phone with Qualcomm chipset, although that the message is defined in the Qualcomm message list (see driver configuration). However, the phone sends the "GSM RR SACCH Report" messages, which basically contain the same information.

If this option is activated, the Qualcomm reports the "GSM surround cell BA list" and the "GSM L3 RR SACCH report" (see GSM message tree in "Measurements"). Activate both reports to create GSM Measurement Layer 3 Messages. These reports can be analyzed in the "Layer 3 View".

If this option is deactivated, no GSM measurement Layer 3 messages are created.

Update Rate
The high amount of trace data for HSUPA needs to be stored into HSUPA Sample Blocks. The size of these blocks can be defined. A block is sent if either the specified time (default 2s) is reached, or the specified number of TTIs were logged (default 1s (10ms*100 or 2ms*500)).

Max. Update Rate for Ec/Io Values

Sets the maximum update rate for Ec/Io values. A lower update rate decreases the size of the measurement file.

HSUPA Sample Block

Sets the Max. UpQualiPocdate Rate for Ec/Io Values for HSUPA samples. Additional option fields are provided for the case when N samples are logged for a TTI of 10 ms or 2 ms.

Note: The HSUPA views show always one block at one point in time. Thus the specified number of TTIs is responsible for the size of the HSUPA graphs.

System Information Blocks

Layer 3 Radio Resource Control (RRC) messages are broadcast in system information blocks of various types (see standard 3GPP TS 25.331). If the box "Store Raw RRC Messages…" is checked, the complete information transmitted in the layer 3 RRC signaling messages is stored to the measurement file.

If only the system information blocks are needed, the default configuration (box unchecked) is sufficient. This configuration reduces the size of the measurement file.

Video Call Menu Option

To perform a video call, it is necessary that on the test device a specific video call menu option is invoked. R&S ROMES4 automatically sets the correct value. Only if a test device is used that is not officially supported by R&S ROMES4, the field "Menu Entry" is accessible. Then the user has to set the correct value so that the video call is possible.

Example: For the field "Menu Entry", the number 2 is set and grayed out. That means that the required menu entry is at second position in the test device menu. Furthermore the R&S ROMES4 system knows the correct setting therefore it is not possible and necessary to edit this entry by the user.

HSPA+ and HSPA

The section applies to the R&S ROMES4QP/R&S ROMES4QC/ROMES4SAM option for the testing the DQA jobs performed in Fully integrated device operation mode/On PC testing operation mode, respectively.

HSPA+ supports 64QAM and MIMO mode. The "HSDPA Performance View" shows the percentage of TTIs, which used 64QAM.

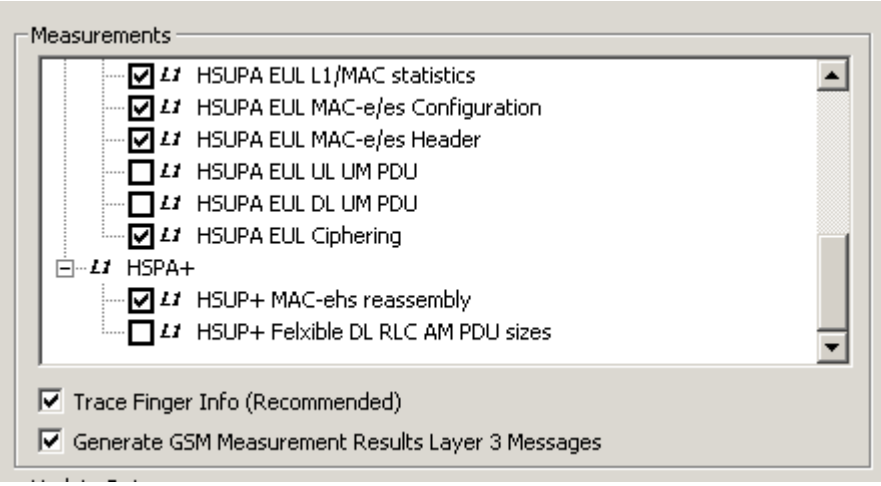


Figure 6-119: HSPA+ driver - extra settings

- **HSPA+ MAC-ehs reassembly**
  Activate this function as it provides basic information about the HSPA+ feature in the network.
- **HSPA+ Flexible DL RLC AM PDU sizes**
  It is optional, and would provide information about the flexible PDU sizes on Layer 2. However, activate the log only if needed, as it stresses mobile and measurement system. The results of this log are reported to the "UMTS HSPA L2 Statistic Views".

NQA settings

The "NQA Settings" dialog is used to set the parameters for the UMTS and GSM network quality analysis (NQA). The NQA is a prerequisite for drawing up a call statistic where the calls are classified and the classes are visualized separately.

The driver settings for one Qualcomm chipset-based mobile are shown in the following figure.

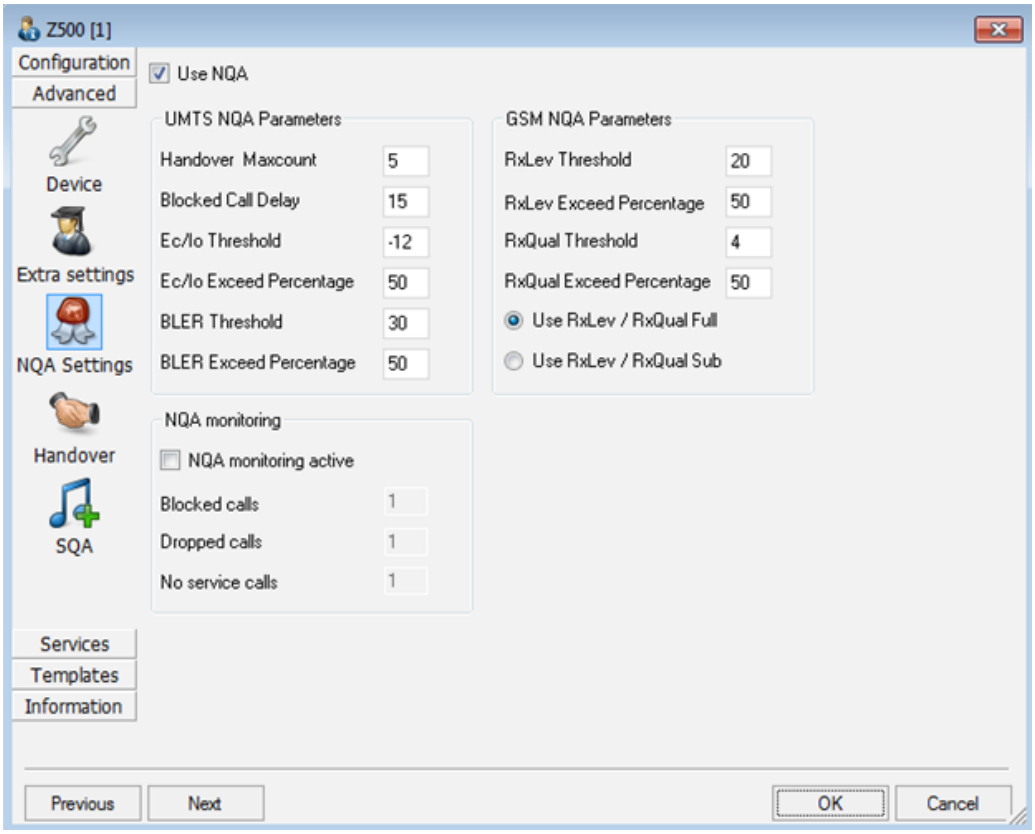


Figure 6-120: UMTS driver configuration - NQA

The parameters in the "GSM NQA Parameters" and "NQA Monitoring" sections are identical to the NQA parameters for GSM. See "NQA configuration" on page 1547.

Use NQA
If checked, the box activates the network quality analysis (default).

UMTS NQA Parameters
The following numeric parameters configure the UMTS NQA by defining conditions and limits for the different call classes (we quote the ranges for all parameters; default values are underscored).

- "Handover Maxcount"
  Maximum number of handover procedures during a call in the range 1 to 100 (default 5). If the defined value is exceeded, the call is classified as EXCESSIVE HO.
- "Blocked Call Delay"
  Maximum delay (in seconds) between CM_SERV_REQ and ASSIGNMENT_COMMAND in the range 1 (s) to 15 (s). If the defined delay is exceeded, the call is classified as DELAYED CALL.
- "Ec/Io Threshold"
  Minimum signal to noise ratio in dB and in the range –20 (dB) to 0 (dB). Default is -12 (dB). Ec/Io values which fall below this threshold contribute to NOISY.
- "Ec/Io Exceed Perc."
  Minimum ratio (in percent) of reported RxLev values falling below the RxLev Threshold in the range 0 (%) to 100 (%). Default is 50 (%). If the actual ratio falls below the specified percentage, the call is classified as NOISY.
- "BLER Threshold"
  Maximum Block Error Rate in percent in the range 0 (%) to 100 (%). Default is 30 (%). BLER values above this threshold contribute to NOISY.
- "BLER Exceed Perc."
  Minimum ratio (in percent) of reported BLER values exceeding the BLER Threshold in the range 0 (%) to 100 (%). Default is 50 (%). If the actual ratio exceeds the specified percentage, the call is classified as NOISY.

GSM NQA Parameters
Configures the GSM NQA, see "NQA configuration" on page 1547.

NQA Monitoring
Activates NQA monitoring and displays the number of blocked, dropped and "no service" calls, see "NQA configuration" on page 1547.

Handover analyzer

The "Handover" tab enables or disables the handover analyzer (option R&S ROMES4HOA) and sets the timeout for the HO analysis. The HO analysis and the meaning of the timeout is described in Chapter 4.4.10, "3GPP handover analyzer view", on page 898.

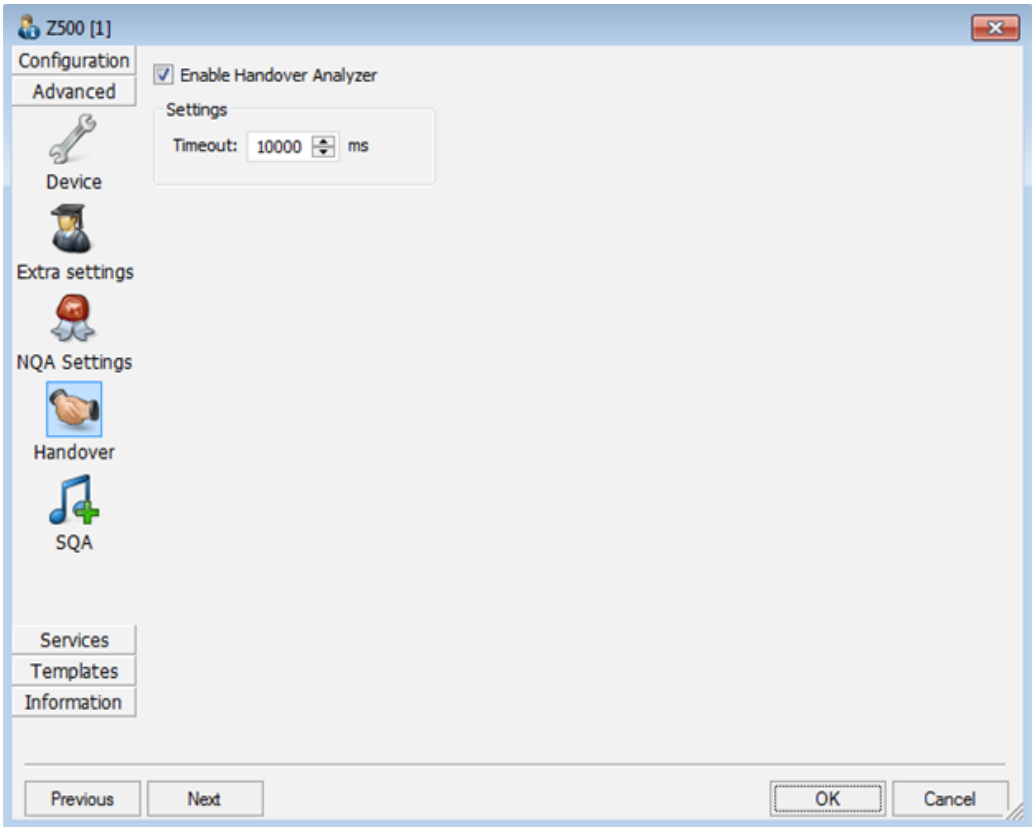


Figure 6-121: UMTS driver configuration - handover

Speech quality

The "SQA" tab enables and configures the Speech Quality Analysis (SQA, with option R&S ROMES4SQA, "Voice Quality PESQ)", as described in Chapter 6.4.12.3, "Configuration – speech quality", on page 1689.

SQA results can be displayed in the "SQA Message" view (see chapter "Display and Evaluation of Results"). All settings are analogous to the GSM driver settings described in "GPS health monitoring" on page 2064.

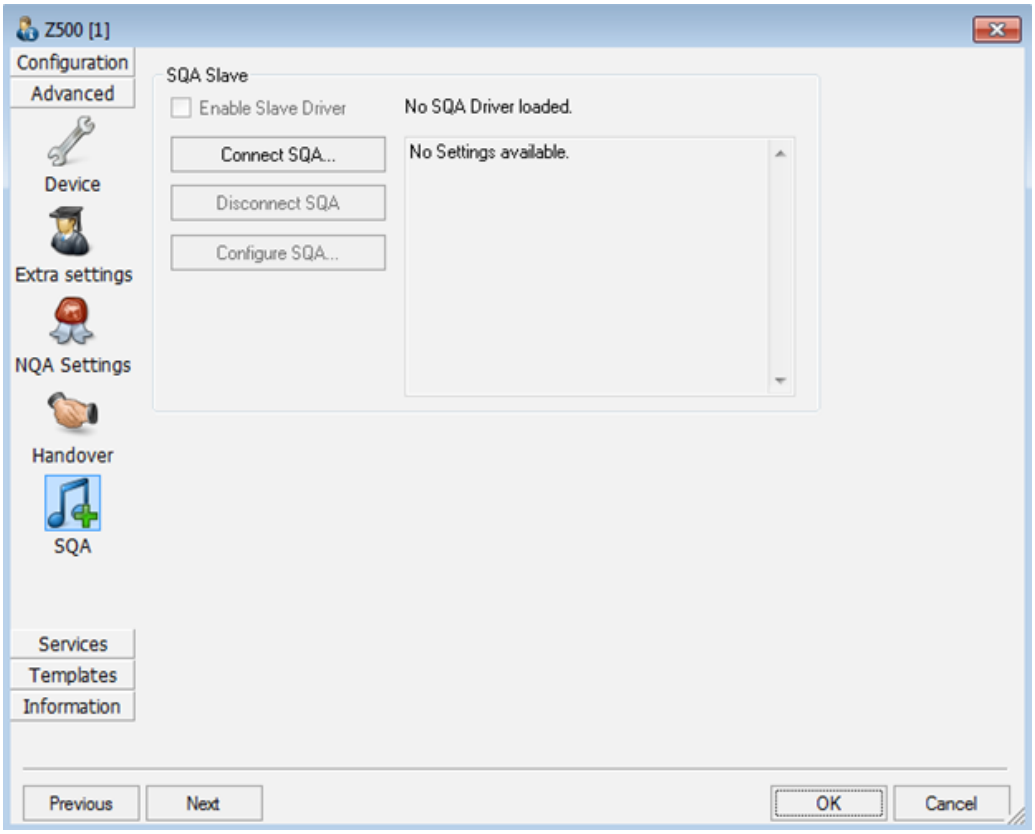


Figure 6-122: UMTS driver configuration – Qualcomm mobile SQA window

Autodialing

The "Autodialing (MOC)" provides two autodialing modes, simple and extended, where a definite phone number is dialed periodically and a call is set up by the mobile phone.

If the extended mode is selected, the configuration page contains additional options, like to choose a call type, single or multi call, calling conventions and preconditions.

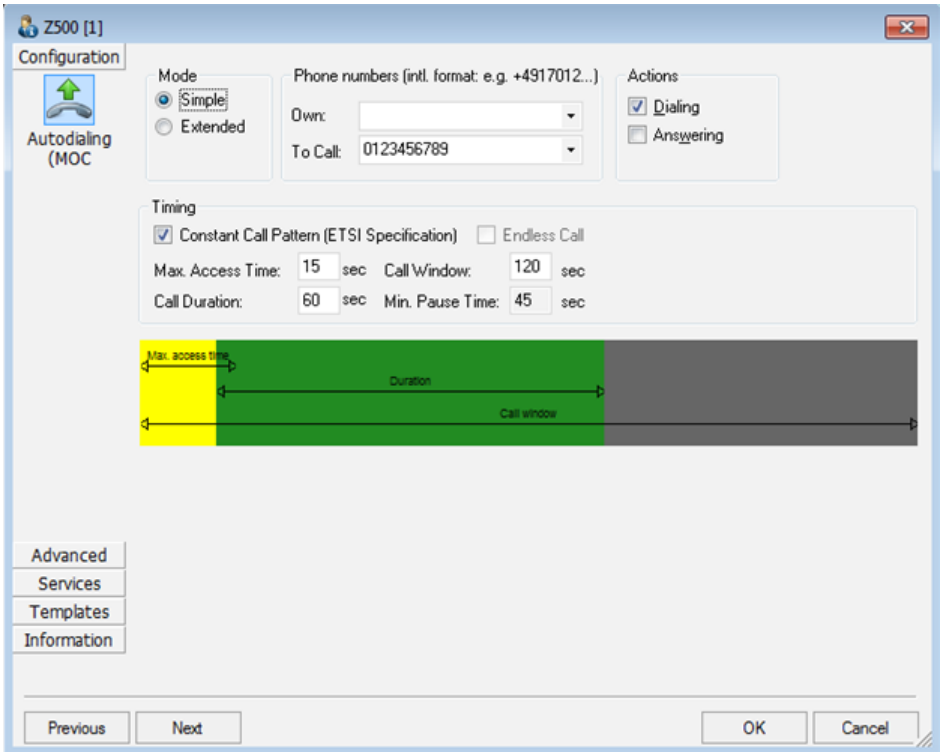


Figure 6-123: UMTS driver configuration - autodialing simple mode

The modes are relevant for the network quality analysis described in "NQA configuration" on page 1547. All settings are analogous to the GSM driver settings described on "Autodialing" on page 1536.

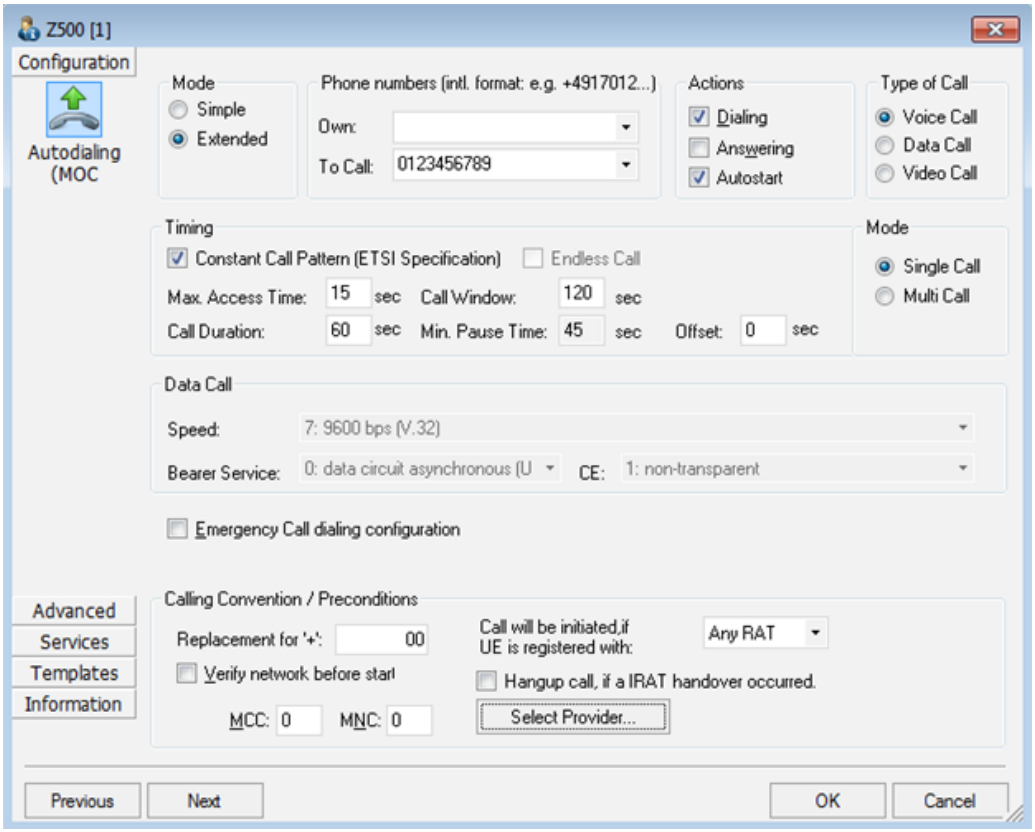


Figure 6-124: UMTS driver configuration - autodialing extended mode

Autodialing an emergency call

There is the additional option "Emergency Call dialing configuration" in the "Autodialing" page.

This setting is visible only under the following conditions:

- "Mode" panels are set to "Extended" and "Single Call"

Autodialing an emergency call leads to a short-time UNCONNECTED state to allow the mobile to scan for the best serving cell independent from its home network. The scanning drops the call immediately. This behavior is avoided by activating the "Emergency Call dialing configuration" function.

An emergency call is only performed with certain phone numbers like 112 in Europe or 911 in USA.

It is not possible to test an emergency call using an UE as a smartphone. Configure the smartphone as a modem in this case.

Samsung S3 is the only smartphone that supports emergency call, if configured as a modem.

Serial port info

The "Serial Port Driver" tab displays the custom name of the device, information on the file version of the technology driver, the serial port assigned to it and the transfer parameters. The "Custom Name" is used to assign a name to a test device, e.g. to make a quick association of a test device to its designated test network provider.

Also the expected amount of produced driver data per time unit can be set. See also Chapter 6.3, "Devices observation", on page 1510.

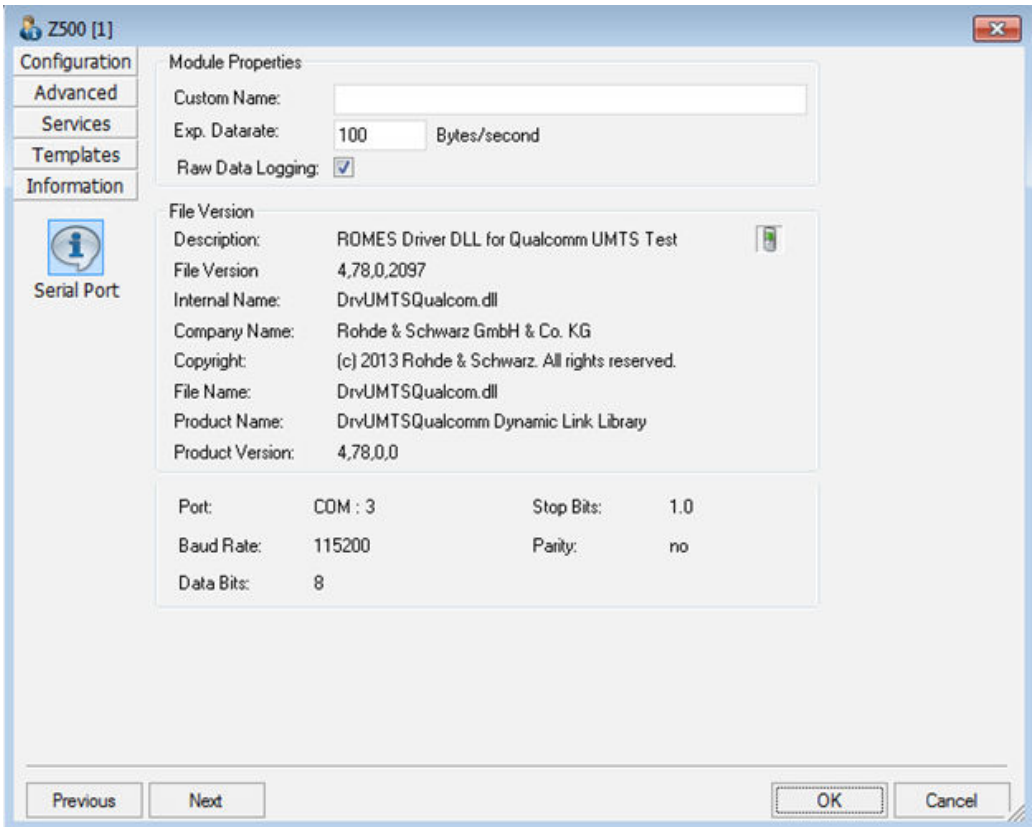


Figure 6-125: UMTS driver configuration – serial port driver Info

Templates

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

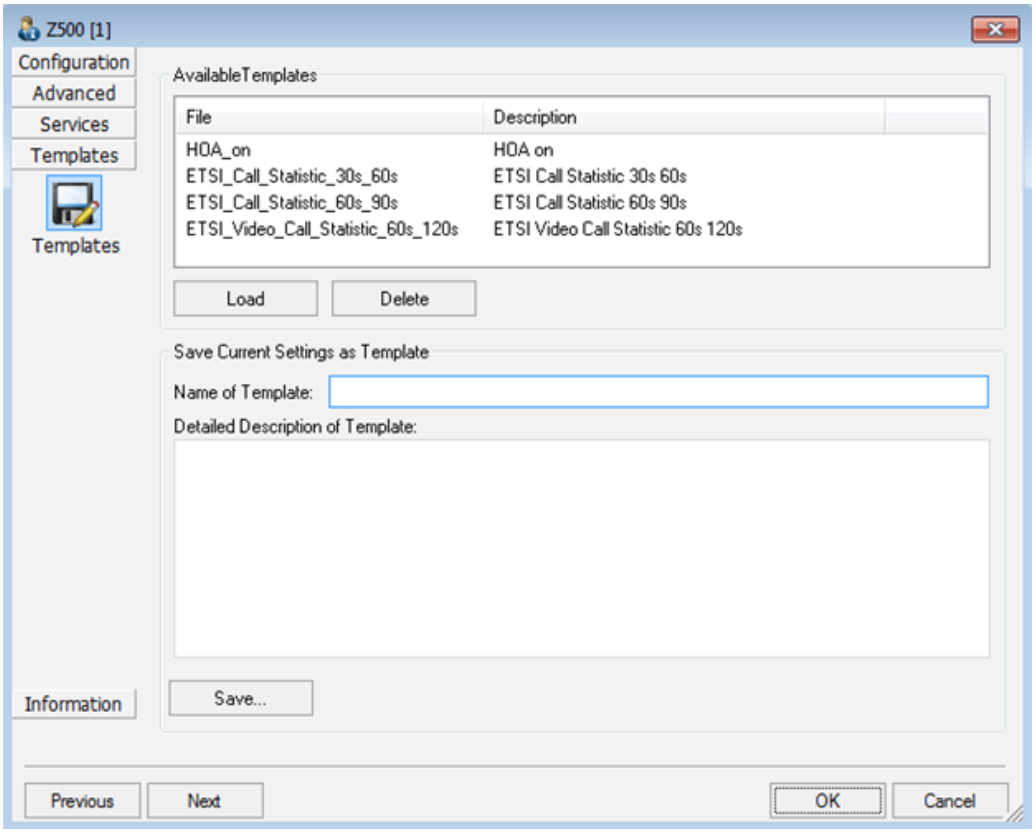


Figure 6-126: UMTS driver configuration – templates

Data tester

The R&S ROMES4 Data Tester function allows direct connection of a mobile driver to a Data Quality Analyzer. The configuration page as shown in the following figure.

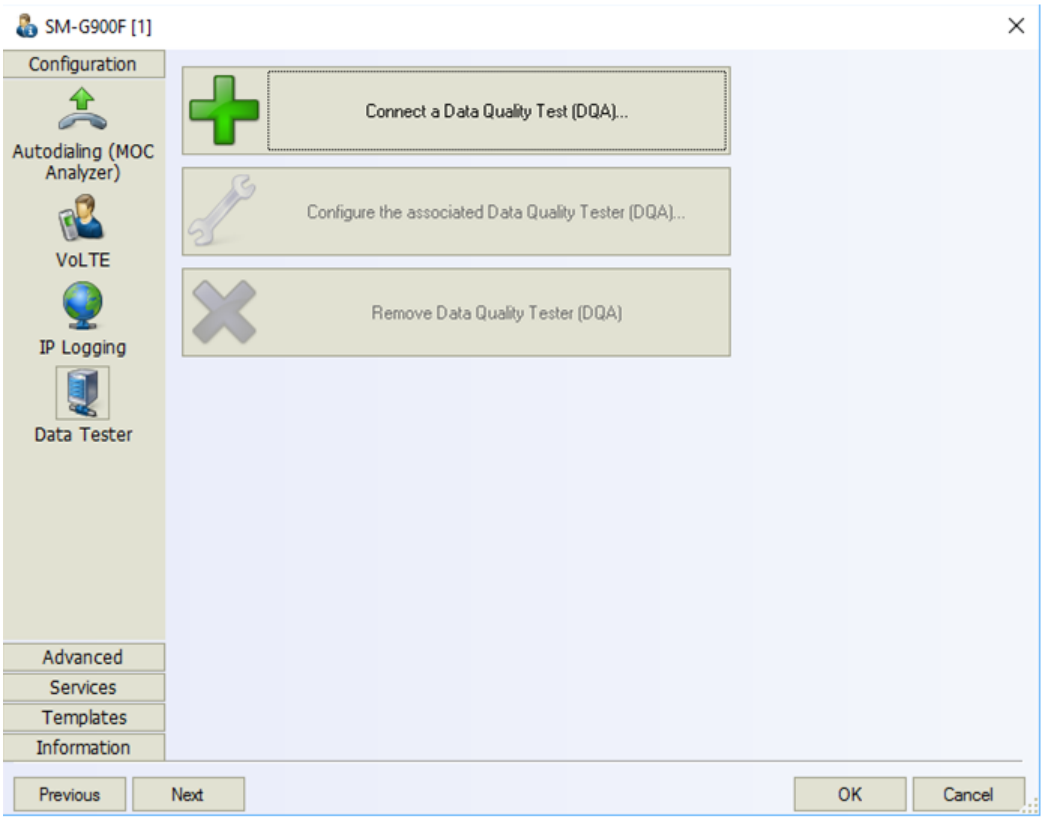


Figure 6-127: Connect a DQA

Connecting the DQA jobs with a mobile device is possible by using the "Wizard" or when loading a driver, see Chapter 3.4.2.2, "Capacity test wizard", on page 199.

The function applies to all mobile drivers.

If a DQA is connected to a specific device, the linked device cannot be changed anymore.

Tracking of SMS

SMS can be sent using the corresponding DQA job for the test UE, see Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891.

In the "Alphanumeric View" > "Values" the user can select available signals for sent and received SMS during the measurement to visualize the corresponding count. A sent SMS is marked as failed if the corresponding AT command returns with an error.

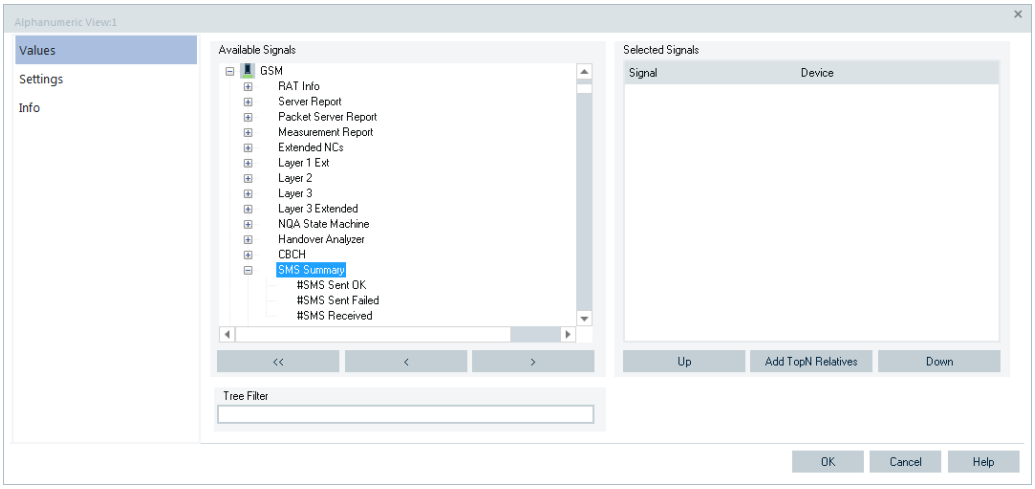


Figure 6-128: Select SMS signals for tracking

The "Service" tab opens the window for tracking of incoming SMSs. Tracking of incoming SMSs work only if the assigned modem port is available. It is not recommended to activate (check the "Tracking of Incoming SMSs" check box) this feature, if a DQA driver uses the modem port for a data connection, see the following figure.

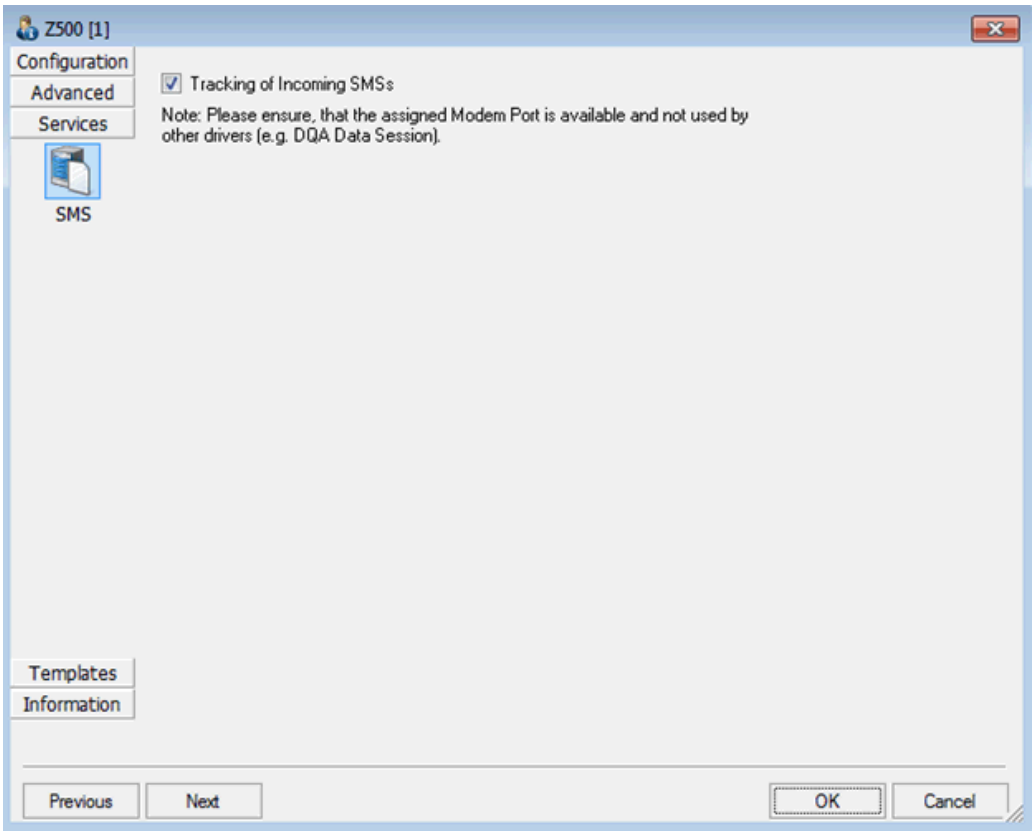


Figure 6-129: Activating the tracking of SMS function

All incoming SMSs from any sender are counted.

If the incoming SMS has been sent by the DQA "Send SMS" job with the automatically created text from the same computer, the transfer time is calculated.

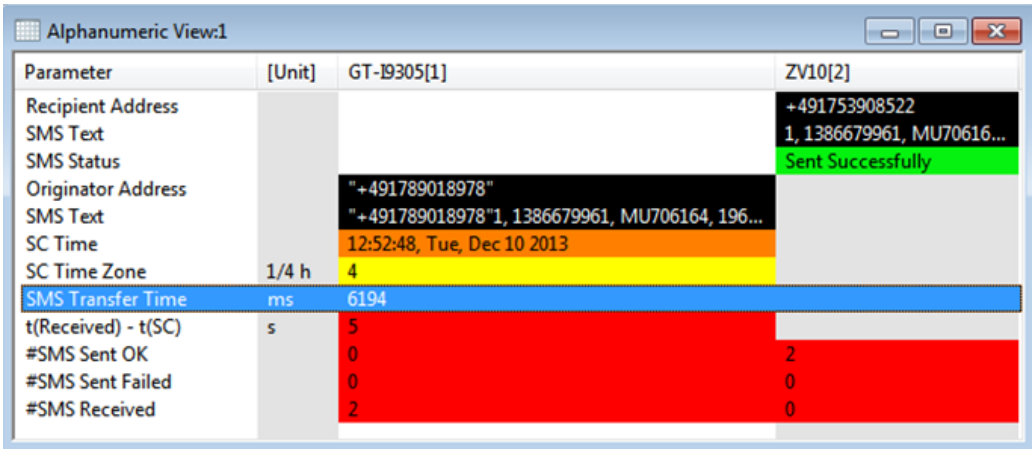


Figure 6-130: Tracked signals of sent SMSs

In the "Event View" there is the possibility to get information on events like SMS send event OK or failed and SMS received event if these events are activated in the "Available Events" > "GSM Events" branch, see Figure 4-105.

This SMS Tester does not create any entry to the ETSI QoS View. Its result is available through the R&S ROMES4 signals only, shown in Figure 6-128.

The UE has to support the following AT commands:

- AT+CPMS,
- AT+CMGL
- AT+CNMI
- AT+CMGD

6.4.5.2 Action menu UMTS

The "Action" menu opens popup boxes used to set up a call or show the contents of the mobile display. It is added to the menu bar when a mobile driver has been successfully installed (see Chapter 6.1, "Devices", on page 1447). If several mobiles are connected, separate command lines are displayed for each of them.

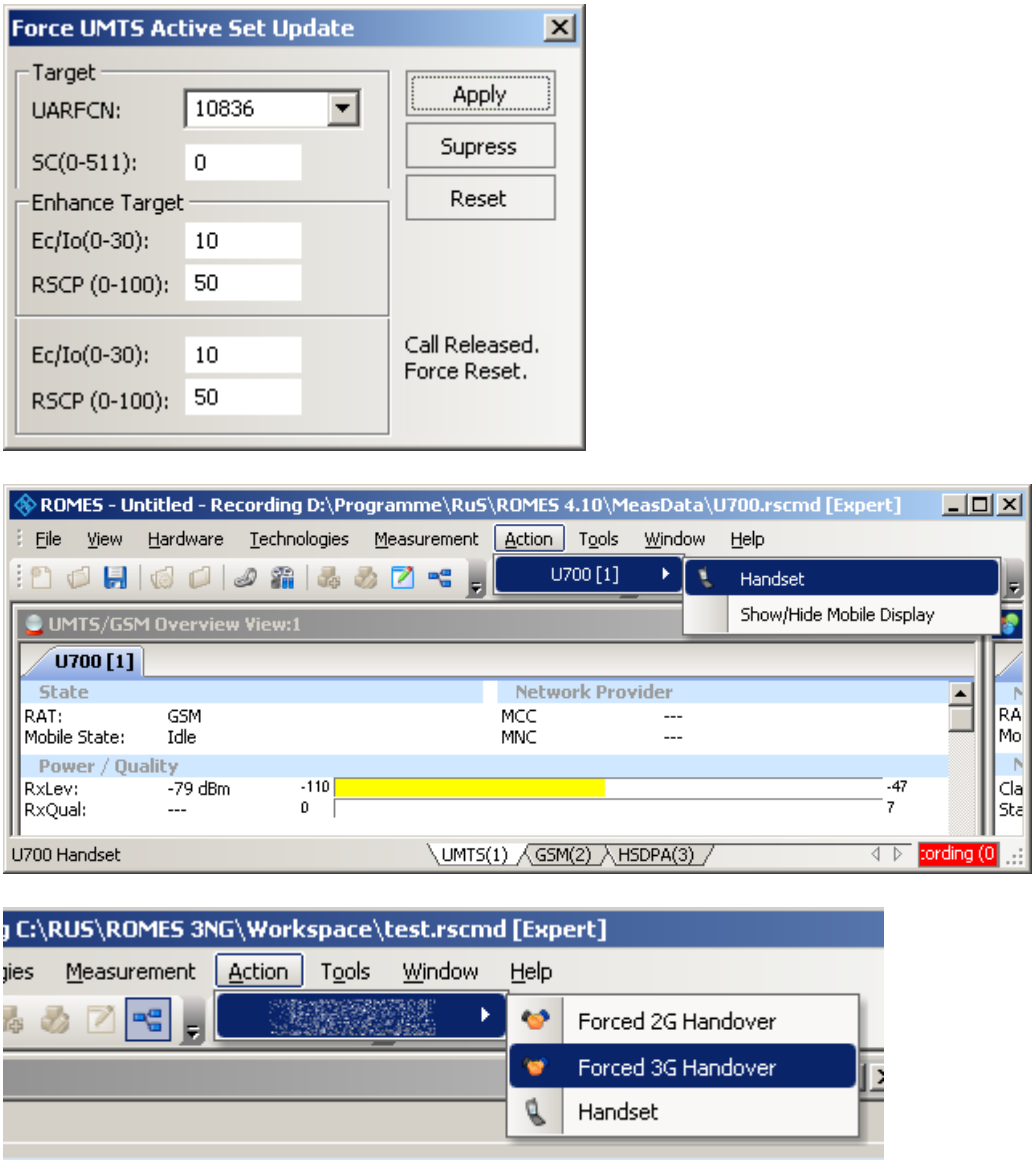


Figure 6-131: Action menu commands

Handset UMTS

Activates the entry of a number to dial, set up and terminate a call.

- **Handset**
  The "Handset" command opens a window (equal for all drivers) which have two possible statuses:
  - Not selected
  - Selected, marked with "- *" and shown in the following figure as connected mobile [2].

If there is only one "Handset" window, it always has selected status.
If there is more than one "Handset" window, the selected status can be set to any "Handset" window in one of two listed ways:
1) Click to the window using a mouse.
2) Choose selected window using the "N" key. In this case selection changed like this: Window[1] > press "N"> Window[2] > press "N"> ...Window[n] > press "N"> Window[1] (cycling choose like "Alt+Tab" between open windows in MS Windows).
Only selected windows accepts hotkeys “D” ("Dial"), “A”("Answer"), “H”("Hangup").
Note: The previously mentioned keys have only effect, if the focus is not set to an input control, example-given edit field or combo box.
Example: if you select the phone number by selecting the corresponding entry of the combo box, the keys do not work afterwards. Set the focus to another window, for example to the main R&S ROMES4 window.

- **>>**
The ">>" button enlarges the dialog box, giving access to the Key pad and the "Autodialing" option.

Figure 6-132: Use Autodialing

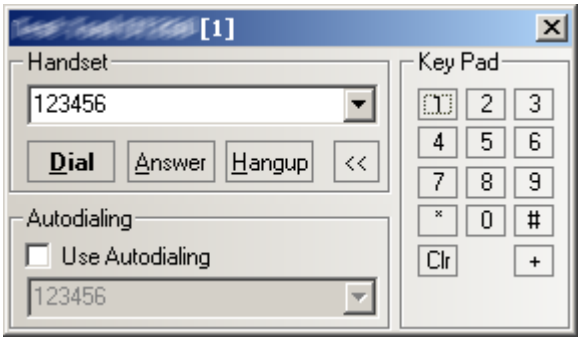


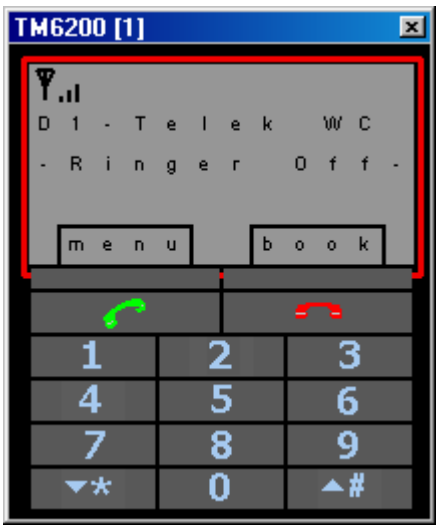
Figure 6-133: No Autodialing

- **Dialed number**
  The number to be dialed can be entered either via the keyboard and the input field or by clicking the on-screen keypad.
- "Close window ☒"
  Closes the window without any further action.
- "Dial"
  Starts dialing the number entered before.
- "Answer"
  Instructs the phone to accept the call.
- "Hangup"
  Drops the line.
- "Autodialing"
  If the box is checked, the phone number entered below is called periodically, the "Dial", "Answer", and "Hangup" buttons are disabled (grayed). The autodialing mode can be set even during the measurement, but only in "Idle mode".
  This item starts "Autodialing" if the "Start with Measurement option" was not checked in the driver configuration-autodialing tab panel.

Show/hide mobile display UMTS

Shows or hides a view of the test mobile.

With the view it is possible to observe the display, dial numbers and browse the menu from the controller while a measurement is performed (for Qualcomm mobiles only).



6.4.6 TETRA radios

6.4.6.1 Loading TETRA radios

R&S ROMES4 offers two different drivers for TETRA radios:

- PEI - based on AT commands, supports Sepura, Motorola and EADS Radio THR9 radios
- Sepura - digital interface, supports Sepura radios only

The Sepura radios allow the continuous radios usage with the existing workspaces. So, you can continue to use the TETRA Mobile via PEI driver despite the supported Sepura driver.

However, as the R&S ROMES4 supports the Sepura driver for the Sepura radios, including the Layer 3 messages traces, recommended is to reconfigure existing workspaces and use the Sepura driver.

R&S ROMES4 fully supports the following Sepura radios and the associated firmware versions.

- **SC2020**
  `<version name="176400108525,176400108522,,,440150806883,"/>`
- **STP8000**
  `<version name="166702002931, 166702302937,,, 440117302249, 440117302250,"/>`
  `<version name="166702002931, 166702302937,,, 440148903083, 440117302250,"/>`
- **STP3900**
  `<version name="169700602931, 169701402937,,, 440149703083, 440149704553,"/>`

- **SRG3900**
  `<version name="166702003579, 166702303577, 000000000000, 450701204063, 440149603083, 440117302250,"/>`
- **STP9000**
  `<version name="169700602931,169701402937,,,440149703083,440149704553, "/>`

There are no restrictions if one of the listed Sepura radios uses listed firm-wares other than ones associated to it.

All other Sepura radios can work as well but with the reduced functions (voice and group calls only, SDS is not supported). However, only the listed radios and firmware versions have been tested. In any other cases, problems can occur.

Sepura SC2020

Sepura SC2020 can be used for TETRA measurements of group and individual calls. Sending SDS works but it is limited. If Sepura SC2020 radio is used, sending SDS is controlled by macros and it is important to verify the firmware and the configuration of the radio. Namely, the associated firmware versions are used to develop the macros which control sending of SDS.

NOTICE

The SC2020 radio has different buttons in comparison to STP8000. The middle context button does not work as wanted at the macros. That is, the actual macros concerning SC2020 at `tetra_sds.xml` is not working when generating an SDS and deleting it. Enter and store an SDS manually at the SC2020. Such the SDS is used for the test.

Sepura SC2020 has a different bottom connector in comparison to STP8000. Use a different data cable or a different cradle (WeTech WTC1902USB).

Sepura SC2020 needs a specific USB driver.

Install the USB drivers on MS Windows 10 version, use the `SepuraTETRA_USB_Serial_Port_Driver_Win10.exe` file.

Sepura SC202x

Sepura introduced a purchasable option for SC202x to send certain AT commands. This option is called PEI option. Without the PEI option, R&S ROMES4 shows several missing L1 values like MCC, MNC, LA and missing connection state.

After stimulating the mobile (e.g. push PTT button), some values appear.

NOTICE

PEI option is necessary for Sepura SC202x.

Sepura radios use a private copy of users tetra_sds.xm

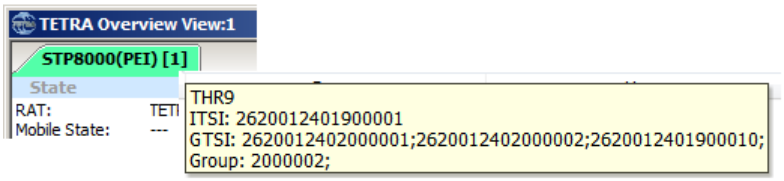
As the R&S ROMES4 installation can overwrite the user's personal data in `tetra_sds.xml` file, it is convenient to make a copy of the file in a file named `tetra_sds_user.xml`. This `tetra_sds_user.xml` file is preferably taken at a run time and is not overwritten at installation.

Driver - TETRA mobiles via PEI

The "TETRA Mobile via PEI" driver can be used with the supported TETRA radios that have the PEI interface. Such are Sepura, Motorola and EADS Radio THR9 radios.

A name of TETRA radios loaded via PEI driver has attached the appendix (PEI) to distinguish between the PEI and SAIL SW.

In addition, the Tooltip of the radios' tab shows the ITSI, GTSI and the current group.



Motorola TETRA radios

Motorola radios only work with the serial cable. The PEI interface is not supported via the USB cable.

Motorola radios do not show TEI or GSSI.

Driver - Sepura radio

The "Sepura Radio" driver can be used with a Sepura mobile only.

Sepura radios do not show TEI.

A TETRA driver loading and configuring is described in the following sections.

6.4.6.2 Loading TETRA radios general

The prerequisite for the loading is that TETRA mobile device is connected to the host PC which has installed R&S ROMES4. Perform the following steps to load a TETRA mobile driver.

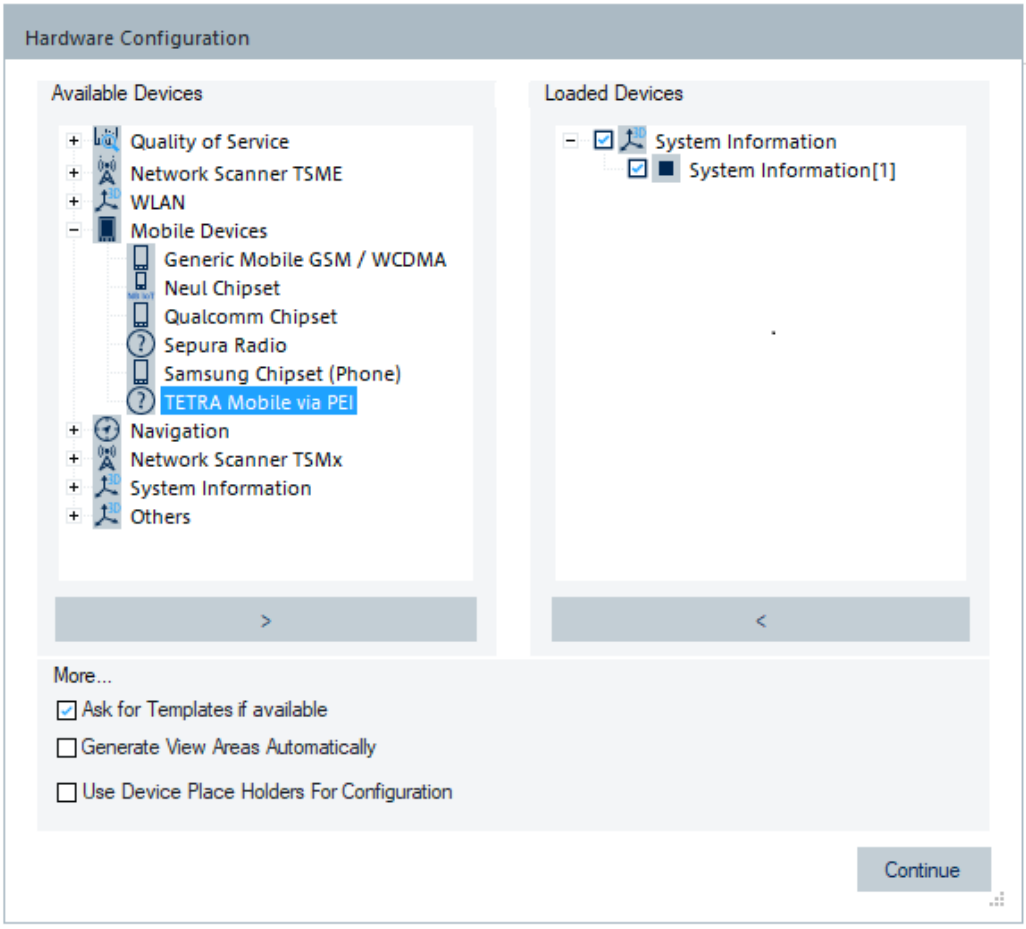


Figure 6-134: Hardware Configuration window – load TETRA device

1. Click "Hardware" > "Connect/Disconnect" entry.
   The "Hardware Configuration" window opens.
2. Double-click one of the available TETRA drivers in the "Available Drivers" > "Mobile Devices" pane.

   The "Assign Ports to TETRA Radio (1)" or "Assign Ports to Sepura Radio (1)" window shows the default COM port number assigned to the mobile driver.

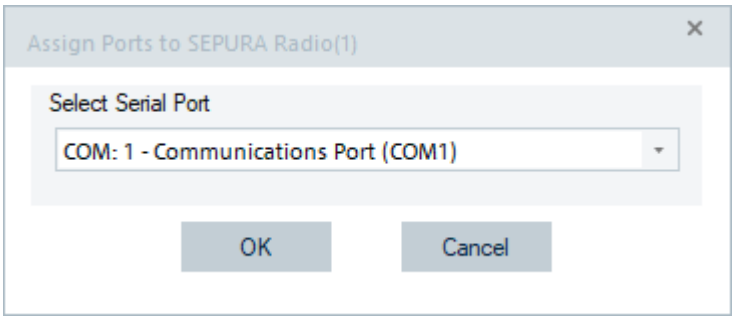


Figure 6-135: Hardware Configuration dialog – COM port selection

The same output is obtained if you select wanted TETRA driver and click ">".

3. If the device is not set to COM port 1, choose the relevant port from the pull-down list.
4. Click "OK".

   A progress bar shows the initialization of the mobile.

   After initialization, the driver is loaded and shown in the "Hardware Configuration" > "Loaded Devices" pane.

For more details about devices installation, see Chapter 6.1.3, "Connection via COM port", on page 1454.

6.4.6.3 TETRA radios configuration menu

This section describes the configuration of TETRA radios - PEI and Sepura.

In most respects, the configuration of PEI and Sepura radios is identical. The only difference is the autodialing configuration.

- PEI radios can only perform voice call and group call (no data call).

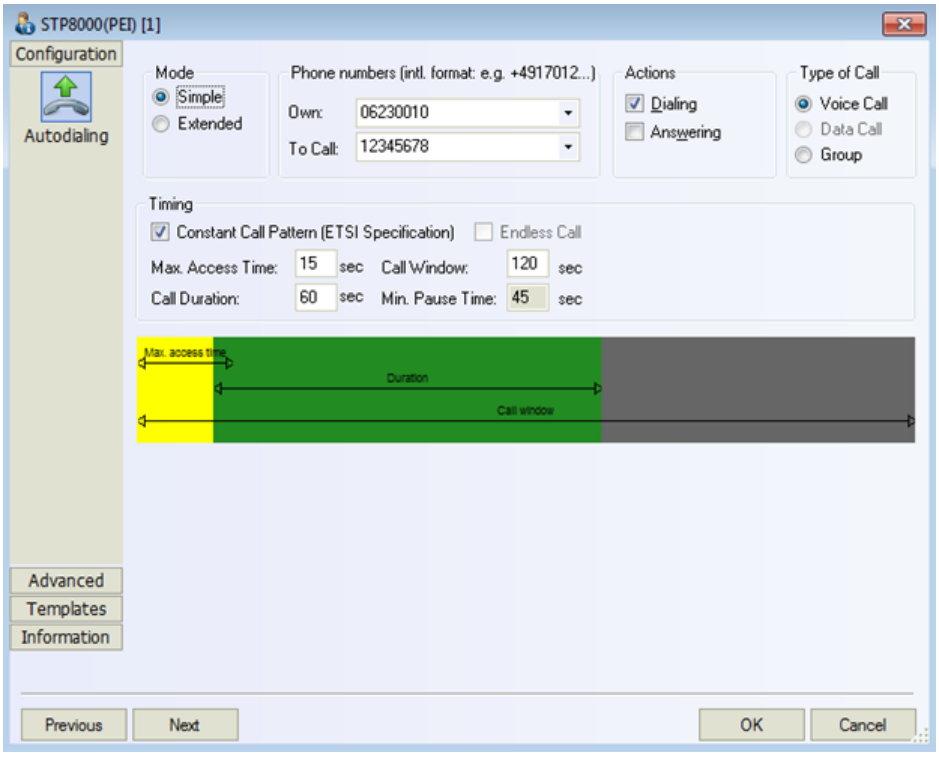


Figure 6-136: TETRA PEI driver - configuration page

- Sepura radios perform voice call, group call and send SDS messages (Short Data Service is similar to the SMS text service in GSM).
  Sepura radios support DMO.

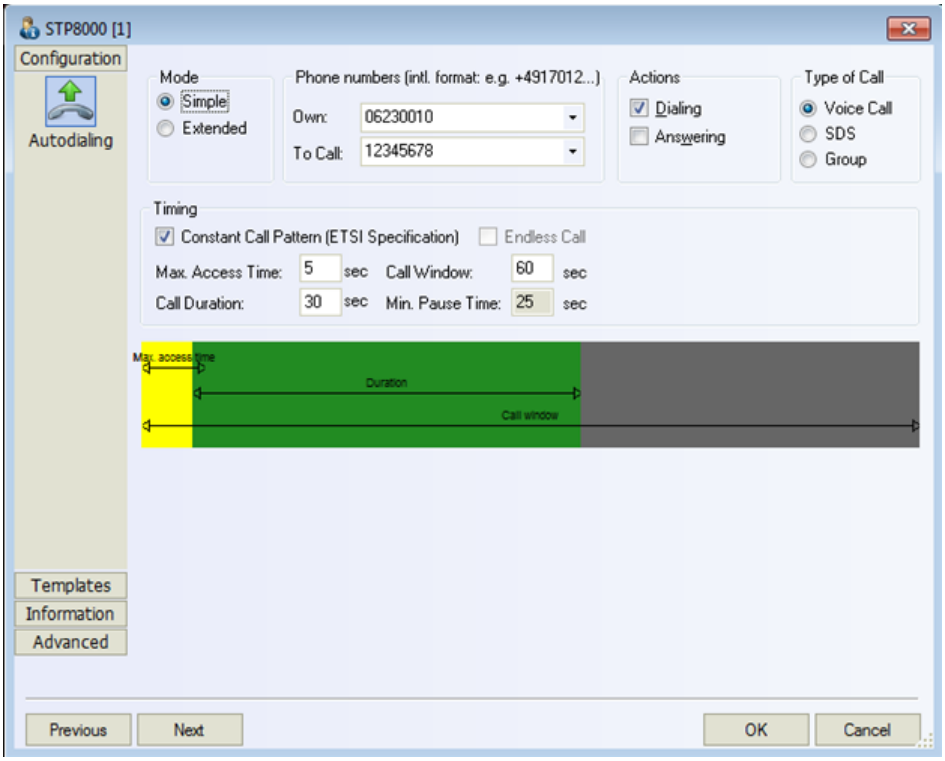


Figure 6-137: TETRA Sepura driver - configuration page

It is highly recommended to use the Sepura driver instead of the PEI driver.

Reason: Sepura radios are used as a calling party in group calls. If the PEI driver is used as a calling party in a group call, illegal additional messages are produced by the mobile. It can lead to a multiple of good or dropped calls.

Autodialing TETRA

The "Autodialing" tab lets you configure the mode where a defined phone number is dialed periodically and a call is set up to the MS.

This mode is relevant for the network quality analysis described in "NQA settings" on page 1547.

All settings are analogous to the GSM driver settings, see "Autodialing" on page 1536.

Call to PSTN

To call a number in the PSTN, put "$" in front of the "To Call" number in the "Autodialing" page.

Autodialing PEI radios

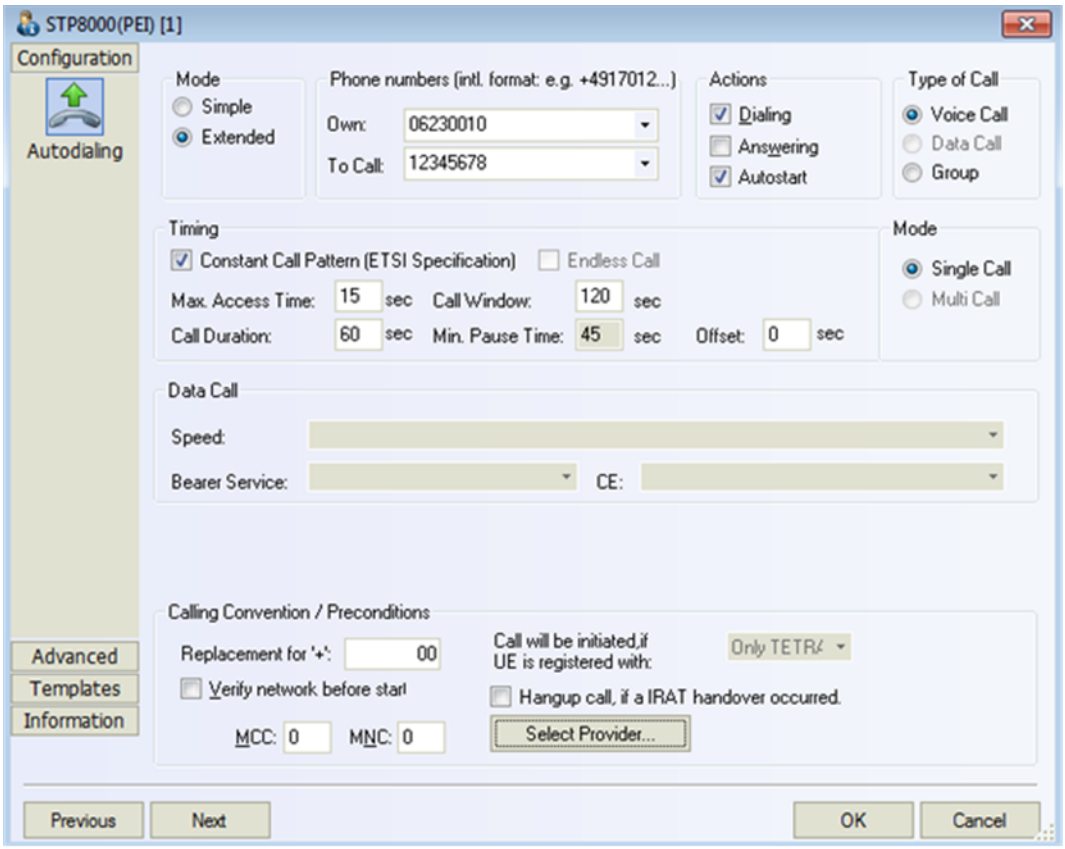


Figure 6-138: TETRA PEI radio driver – Autodialing page

For PEI mobile devices, the KPIs cannot be calculated with the required accuracy.

Activating "Autoanswer" at the configuration omits all the L1 signals as long as the TETRA mobile is in idle mode because of lack of timing accuracy.

However, a change to dedicate mode (by an incoming call) starts the periodic request of the L1 parameters.

If the mobile is not configured to autoanswer, the L1 is requested in all modes (idle, dedicated).

Table 6-11: TETRA radio (PEI) L1 signals

TETRA radio type	L1 signals		
Motorola MTP850	Vegetate, MCC, MNC, TETRA Power (old name RSSI), LA		
Sepura (PEI)	RegState, MCC, MNC, TETRA Power (old name RSSI), LA, Frequency, Carrier, C1	Best NC (Frequency, Carrier, TETRA Power (old name RSSI), LA, C2)	NCx (Frequency, Carrier, TETRA Power (old name RSSI), LA, C2)

Test setup for call testing

Prerequisite: At least two mobile devices have to be connected to R&S ROMES4. For details, see Chapter 6.4.6.1, "Loading TETRA radios", on page 1597.

The following setup steps are recommended when testing a call:

- 1. Load the mobiles
- 2. Configure one mobile for autodialing
- 3. Configure one mobile for autoanswer (if PEI mobiles are used, keep their limitations in mind)

The following setup steps are recommended when testing a group call:

- 1. Connect more mobiles to R&S ROMES4
- 2. Configure them for auto answering

Data calls are always deactivated

The call type "Data Call" is deactivated by TETRA PEI driver, as this driver has no SDS functionality. The "Data Call" button and configuration fields are grayed out.

Autodialing Sepura radios

The "Autodialing" configuration of the Sepura radios is almost identical to that of the PEI radios.

The only difference is that Sepura supports the SDS service - in all other cases the configurations described for PEI radios is applicable, see the following figure.

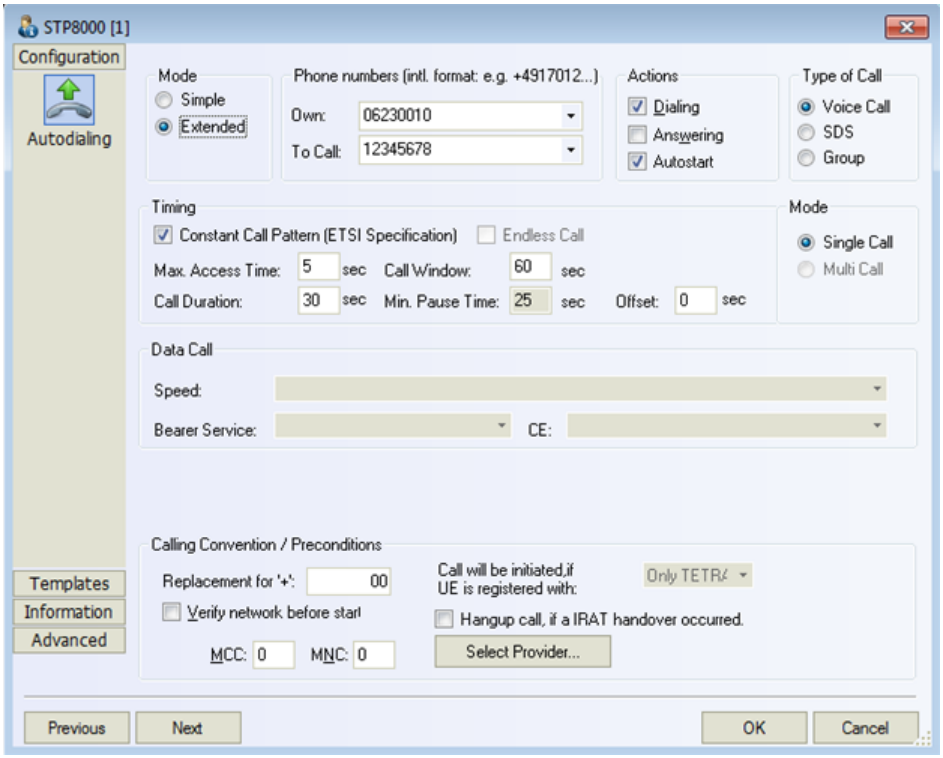


Figure 6-139: TETRA SEPURA radio driver – Autodialing page

Autodialing - SDS

If the Sepura radio is configured for autodialing and the SDS button is selected, R&S ROMES4 generates a dummy text (50 characters) then. It sends the text via SDS to the phone number configured by the user.

Figure 6-140: Call type selected - SDS

Generating the SDS takes longer, up to 10 seconds. Due to that fact, the SDS is generated only once – at the start of the first measurement. To ensure that a message is available, a new SDS is added always to the messages. The first message is deleted and rewritten with the test content. The first message is always used for sending. By closing R&S ROMES4 the message, if generated, is deleted from the radio.

It is not possible to do an individual call with one radio and a group call with a second radio to a group which the first radio belongs to. This measurement setup results in a wrong call statistic for the first radio.

Due to a bug in the SRG3900, the group call does not work as expected. The PPT button cannot be held by the software and results in a release of the call after some seconds. The Sepura SAIL software shows the same effect.

Creating and sending the test SDS messages

Creating and sending the test SDS messages using TETRA devices is based on xml-script. The script has name `tetra_sds.xml` and is stored in the R&S ROMES4 configuration directory. All tags and names of attributes and attributes values are case-sensitive.

In the following the minimal script structure is shown.

```
<manufacturers>
    <family_collection name="SEPURA">
        <configurations>
            <configuration name="STP800" default="true">
                <firmware>
                    <version name="166702002931,66702302937,,,440148903083,440117302250"/>
                    ...
                </firmware>
                <specific_control_key_definition>
                    <ckey name="VK_PTT"                    value="222" />
                    ...
                </specific_control_key_definition>
                <scenarios>
                    <scenario name="ResetScreen">
                        <execute action="KEY_PRESS_RELEASE" key="VK_HANGUP"/>
                        ...
                    </scenario>
                    <scenario name="Answer">
                        <execute action="KEY_PRESS_RELEASE" key="VK_SEND"/>
                        ...
                    </scenario>
                    <scenario name="SendSDS">
                        <execute scenario="ResetScreen"/>
                        <execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN"/>
                        ...
                        ...
                        <execute action="KEY_PRESS_RELEASE" key="VK_NUMBER_TO_DAIL" pause_ between_keypress="U" pause="100"/>
                        ...
                        ...
                    </scenario>
                    <scenario name="GenerateTestSDS">
                        <execute scenario="ResetScreen"/>
                        <execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN"/>
                        ...
                        ...
                        <loop steps="20">
                            <execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN" pause="20"/>
                        </loop>
                        ...
                        ...
                    </scenario>
                    <scenario name="DeleteTestSDS">
                        <execute scenario="ResetScreen"/>
                        <execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN"/>
                        ...
                        ...
                    </scenario>
                </scenarios>
            </configuration>
            <configuration name="STP800" default="false">
            ...
            ...
            ...
            </configuration>
            <configuration name="CSRG3900" default="false">
            ...
            ...
            ...
            </configuration>
        <configurations>
    </family_collection>
</manufacturers>
```

Tags description

- **<manufacturers>**
  Root tag of the file; contains all other tags. Only one tag of this type is allowed.

- **<family_collection name="…">**
  Describes device of concrete manufacturer. The attribute "name" is not mandatory, it is used only for clear file structure. The file can contain more than one tag of this type.
  Example:
  ```
  <family_collection name="SEPURA">
  ...
  <family_collection name="SEPURA">
  ```
- **<configurations>**
  Child tag of <family_collection> tag. The tag is mandatory and contains set of device configurations.
- **<configuration name="…"default="…">**
  At least one tag <configuration> must exist under the tag <configurations>. This tag has the following attributes:
  - "name" - Name of device which is described in the configuration. It is important to write the device right name.
  - "default" - Initially ROMES searches appropriate configuration of a device using firmware ID string, see tag **<firmware>**. If ROMES cannot find configuration with exactly matched firmware ID, it tries to use default configuration for the device with the same name. Only one configuration per device, identified by "name", can be defined as default="true". If more than one configuration of the device is defined with attribute default="true" or there is no configuration defined as default="true", ROMES generates an error message.

  Number of tags <configuration> is not limited. If the same firmware description is found in more than one configuration, R&S ROMES4 uses the first one found.
  Example:
  ```
  <configuration name="STP8000" default="true">
  </configuration>
  ```
  In this example STP8000 is the name of the SEPURA device.
- **<firmware>**
  Mandatory tag; collects the list of the firmware that describes parent configuration. The tag must contain at least one child tag **<version>**.
  Example:
  ```
  <version
  name="166702002931,66702302937,,,440148903083,440117302250"/>
  <version
  name="166702002931,66702302937,,,440148903083,440117302251"/>
  <version
  name="166702002931,66702302937,,,440148903083,440117302252"/>
  </firmware>
  ```
- **<version>**
  Every tag of this type contains the firmware ID in the attribute "name". The tag is used by ROMES for initial search for appropriate configuration of any attached TETRA device.
- **<specific_control_key_definition>**
  Mandatory tag; contains codes of device keys, excluding the keys "0 - 9". Every key is described in the nested tag **<ckey>**.
- **<ckey>**

Describes the collection of device keys. Every tag has attributes "name" and "value". The first attribute contains the name of a key, the second one contains the code of the key.
Example:

```
<specific_control_key_definition>
 <ckey name="VK_PTT" value="222"/>
 <ckey name="VK_SEND" value="223"/>
 <ckey name="VK_HANGUP" value="224"/>
 <ckey name="VK_MENU_UP" value="225"/>
 <ckey name="VK_MENU_DOWN" value="226"/>
 <ckey name="VK_MENU_LEFT" value="227"/>
 <ckey name="VK_MENU_RIGHT" value="228"/>
 <ckey name="VK_STP8000_LEFT_KEY" value="229"/>
 <ckey name="VK_STP8000_RIGHT_KEY" value="230"/>
</specific_control_key_definition>
```

All keys which are used in the tag **<execute>** must be described in the tag **<ckey>**. For keys "0 - 9", you can use tags "VK_0 - VK_9". This name is predefined in the code of R&S ROMES4. Special key with the name "VK_NUMBER_TO_DIAL" is also predefined and means "dial the phone number". The phone number for executing this action is defined in the ROMES user interface.

- **<scenarios>**
  The tag contains unlimited number of the **<scenario>** tag.
- **<scenario name="...">**
  The tag contains nested tags, which describe sequence of pressed device's buttons same as executing scripts.
  Example:

```
<scenario name="GenerateTestSDS">
 <execute scenario="ResetScreen"/>
  <execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN"/>
  <execute action="KEY_PRESS_RELEASE" key="VK_5"/>
  <execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN
pause="100"/>
  ...
</scenario>
```

  The example shows the steps made in the scenario named "GenerateTestSDS".
  The steps are:
  – Execute scenario with the name "ResetScreen".
  – The button "VK_MENU_DOWN" is pressed and released with the code 226 (see the tags **<specific_control_key_definition>** and **<ckey>**).
  – The button "5" is pressed and released.
  – The button "VK_MENU_DOWN" is pressed and released with the code 226.
  – After the button "VK_MENU_DOWN" is released, there is a pause 100 ms.
  – ... and so on.

  Every tag **<scenario>** must have attribute "name". Scenarios with the following names must exist in the configuration:
  – "ResetScreen"

– "Answer"
– "GenerateTestSDS"
– "SendSDS"
– "DeleteTestSDS"

Also user can define own scenarios. For example, for replacing in the scenarios sequence:

```
<execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
<execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
<execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
<execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
<execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP"/>
```

The user can create own scenario:

```
<scenario name="MenuUpRepeater">
 <execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
 <execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
 <execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
 <execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP
pause="10"/>
 <execute action="KEY_PRESS_RELEASE" key="VK_MENU_UP"/>
</scenario>
```

Use the following command in the scripts:

```
<execute scenario="MenuUpRepeater"/>
```

Tags **<scenario>** have the following restrictions: tags **<execute>** and **<loop>** are only allowed as a child tags, while recursive calls are not allowed.
Example:
The following construction is illegal.

```
<scenario name="Muster">
 ...
 <execute scenario="Muster"/>
 ...
</scenario>
```

- **</execute>**

  The tag can contain following attributes:

  – "scenario" - Name of executing scenario.
  Example:
  `<execute scenario="ResetScreen">`

  – "action" - Name of pressing buttons. If attribute "action" exists, non-empty attribute "key" also must exist.
  Example:
  `<execute action="KEY_PRESS_RELEASE" key="VK_MENU_DOWN"/>`

or
```
<execute action="KEY_PRESS_RELEASE" key="VK_5"/>
```

– "pause" - Defines pause after releasing the key. This attribute is using only with attribute "action".
Example:
```
<execute action="KEY_PRESS_RELEASE" key="VK_MENU_RIGHT"
pause="1000"/>
```

– "pause_between_keypress" - Defines pauses between pressing the keys when attribute "action" has value "VK_NUMBER_TO_DIAL".
Example:
```
<execute action="KEY_PRESS_RELEASE"
key="VK_NUMBER_TO_DIAL" pause_between_keypress"10"
pause="100"/>
```
The meaning of this example is: "Dial the phone number entered in interface, make pauses of 10 ms between releasing one and pushing the next button. After the end of call dialing, make pause of 100 ms."
If the key name is not "VK_NUMBER_TO_DIAL", the attribute "pause_between_keypress" is ignored.

- **<loop>**
The tag is used for loop execution of the nested tags. Attribute "steps" defines number of repeatings. This tag can contain only nested tags **<loop>** and **<execute>**.
Example:
```
<loop steps="49">
 <execute action="KEY_PRESS_RELEASE" key="VK_1" pause="100"/>
 <execute action="KEY_PRESS_RELEASE"
key="VK_STP8000_LEFT_KEY" pause="200"/>
</loop>
```
The meaning of this example is: "Make 49 times the following commands: "press 1", make pause 100 ms after releasing the button, then push the button "VK_STP8000_LEFT_KEY" and make pause 200 ms after releasing it."

Templates TETRA

The "Templates" configuration page is identical for both TETRA radios.

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

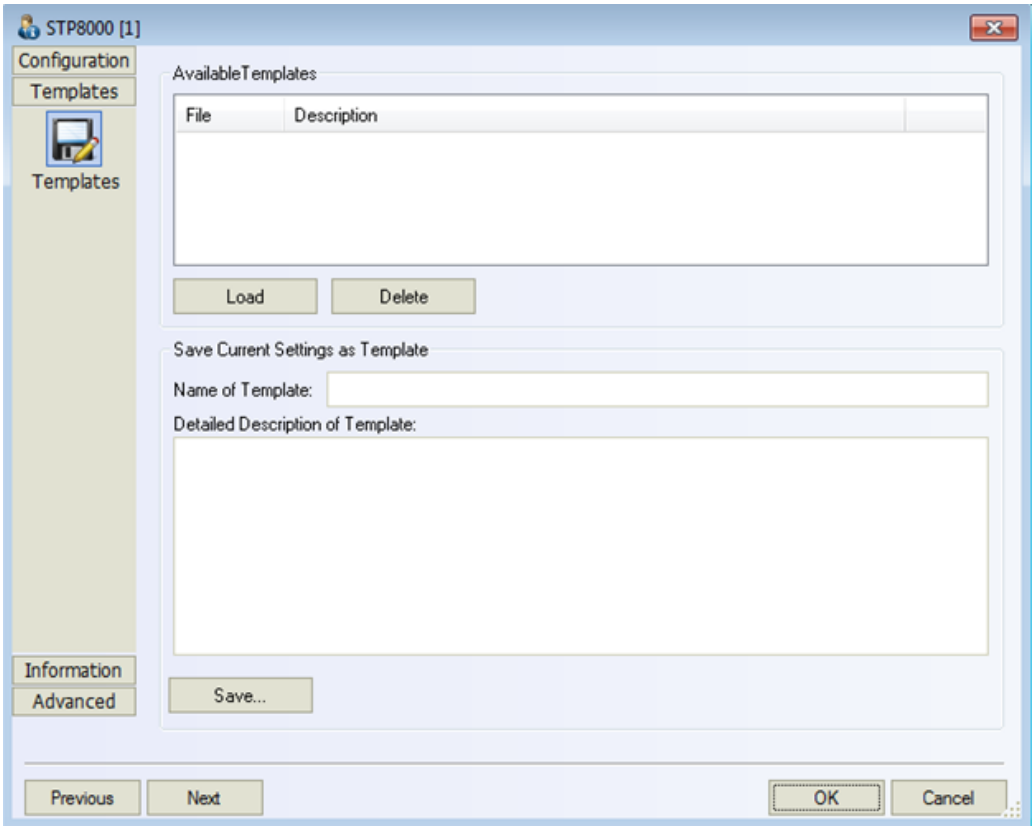


Figure 6-141: TETRA Sepura radio driver – Templates page

Serial port info TETRA

The "Serial Port" configuration page is identical for both TETRA radios.

The "Serial Port Driver" tab displays the custom name of the device, information on the file version of the technology driver, the serial port assigned to it and the transfer parameters. The "Custom Name" is used to assign a name to a test device, e.g. to make a quick association of a test device to its designated test network provider.

Also the expected amount of produced driver data per time unit can be set. See also Chapter 6.3, "Devices observation", on page 1510.

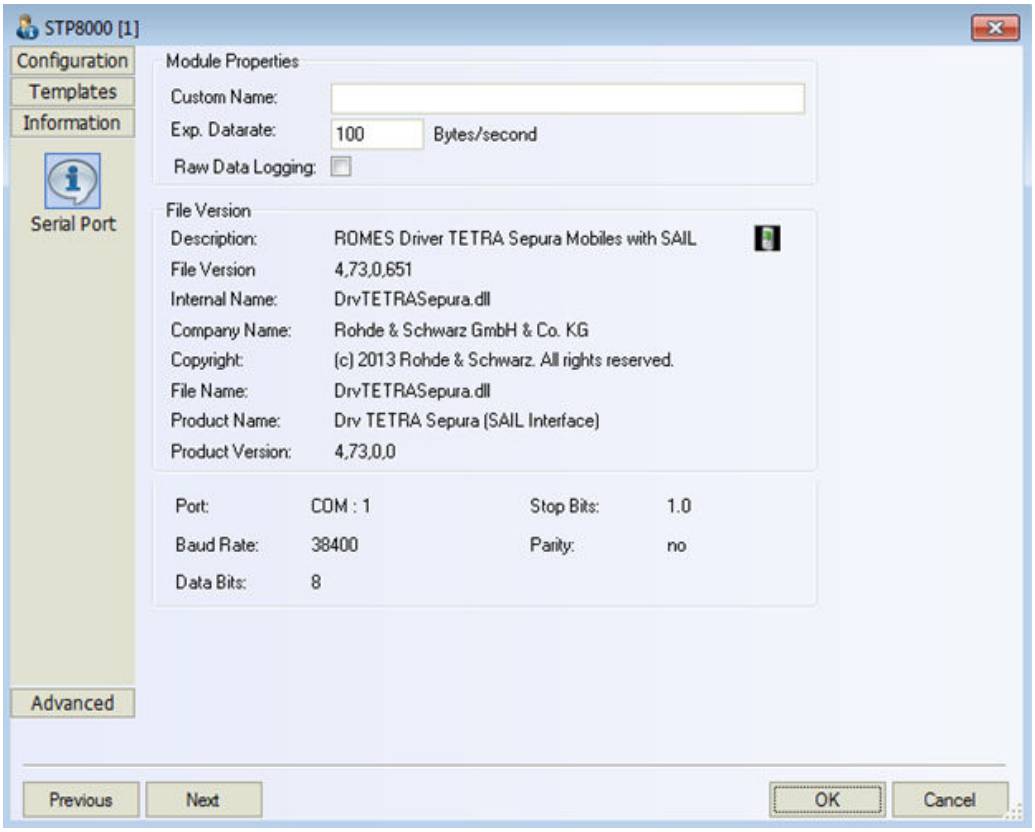


Figure 6-142: TETRA Sepura radio driver – Serial Port page

Advanced TETRA

The "Advanced" tab opens the pages to configure the SQA measurements of TETRA radios and the "SEPURA Radio" page.

Sepura radio

"Transformation SEPURA Channel to Frequency" offers to specify two inputs:

- "Frequency Base [MHz]"
- "Frequency Step [MHz]"

The inputs provide R&S ROMES4 information how to transform the channel number from Sepura radios to a frequency plan.

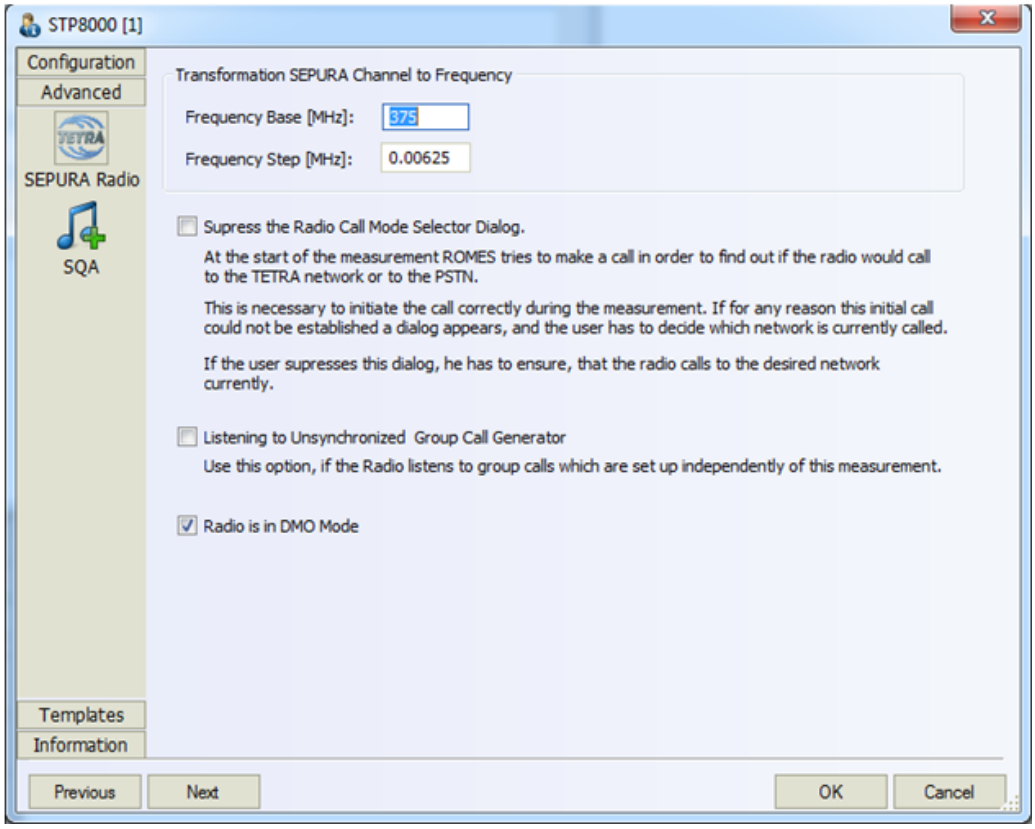


Figure 6-143: TETRA SEPURA Radio page

At the start of the measurement, R&S ROMES4 tries to make a test call to find out whether the radio would call to the TETRA network or to the PSTN.

Activated "Suppress the Radio Call Mode Selector Dialog"" suppresses the appearance of a dialog that asks user to decide which network one is calling if this initial call fails to be established for any reason. If the dialog suppression is chosen, the user has to ensure that the radio calls the desired network.

If the test call fails, R&S ROMES4 assumes that the correct mode is set to the radio.

Activated "Listening to Unsynchronized Group Call Generator" enables the radio to synchronize to a Group Call Generator for speech quality measurements.

The option suppresses the start of the Speech Quality Analyzer until one `RELEASE` message has been received. This suppression ensures that the radio synchronizes to the Group Call Generator by detecting the end of a group call. From now on, the Speech Quality Analyzer starts at the correct point in time.

R&S ROMES4 supports the Sepura TETRA radios DMO mode with the appropriate R&S ROMES4TET option. To run the Sepura radios in DMO mode, check "Radio is in DMO Mode".

The autodialer of the radio supports only group calls, once set to DMO mode. The radio can either set up a group call or stay in idle mode. In idle mode, the radio accepts incoming group calls and shows them in the ETSI QoS View.

All parameters that are available from the radio are shown in "TETRA Graph View" and "TETRA Overview View".

Figure 6-144: TETRA Graph View

The mobile radio's chipset is responsible for the unreliable TETRA Power signal measurements during a call (down to -127 dBm).

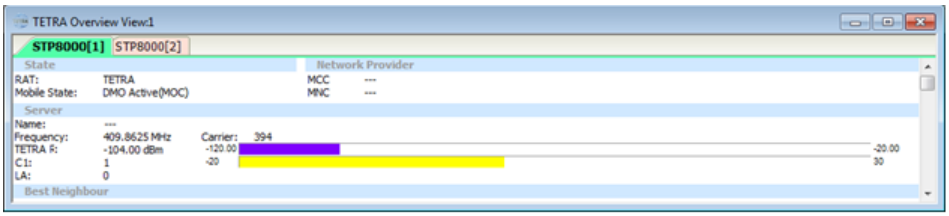


Figure 6-145: TETRA Overview View with DMO active

The DMO messages are displayed in the "Layer 3 View".

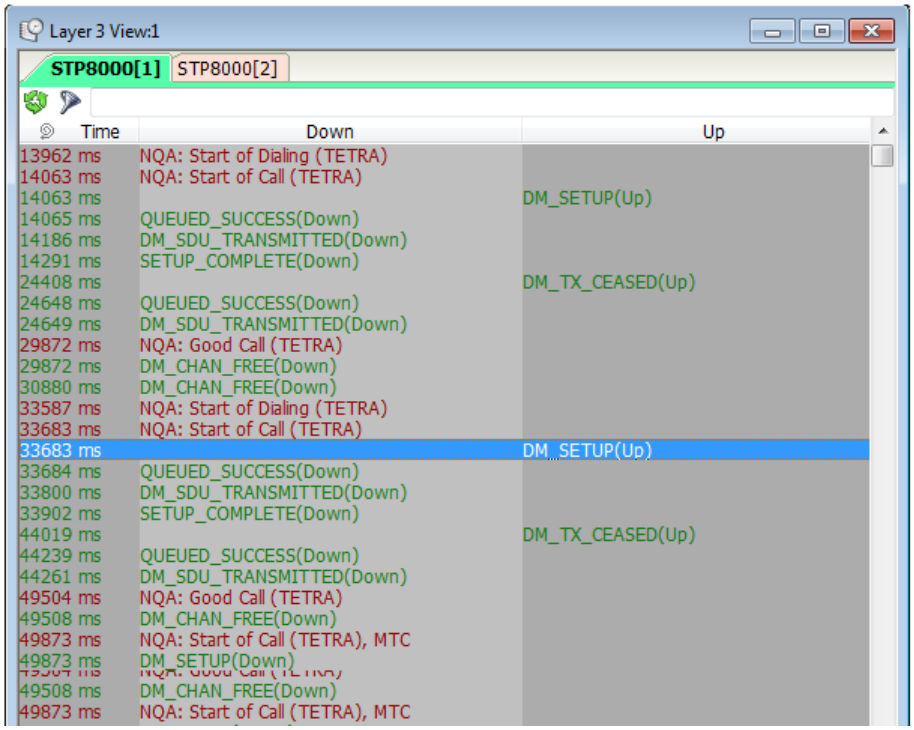


Figure 6-146: TETRA Layer 3 DMO messages

SQA TETRA

The "SQA" tab lets you configure and enable the Speech Quality Analysis. The R&S ROMES4SQA option is needed ("Voice Quality PESQ)") as described in Chapter 6.4.12.3, "Configuration – speech quality", on page 1689.

SQA results are shown in the "SQA Message View".

The configuration pages are identical for both TETRA radios.

SQA TETRA PEI radios

- For general introduction on SQA, refer to Chapter 6.4.12.1, "SQA – principle and test setup", on page 1683
- For how to configure the SQA driver, refer to Chapter 6.4.12.3, "Configuration – speech quality", on page 1689

The following figure shows the SQA configuration page for TETRA PEI radios.

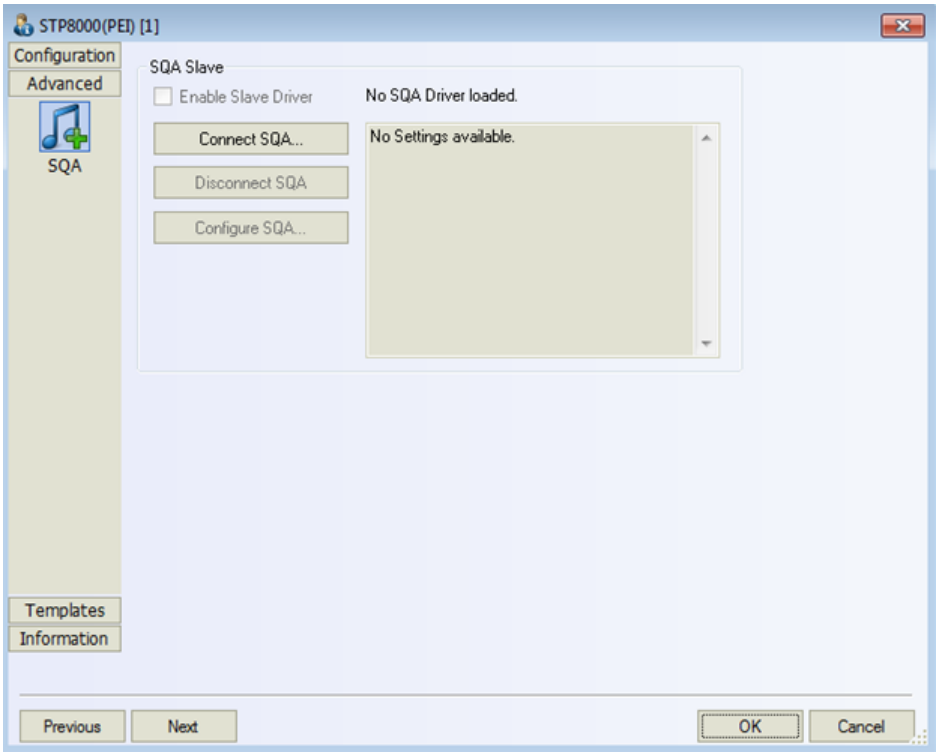


Figure 6-147: TETRA PEI radio driver – SQA page

SQA TETRA Sepura Radios

The following figure shows the SQA configuration page of TETRA Sepura radios.

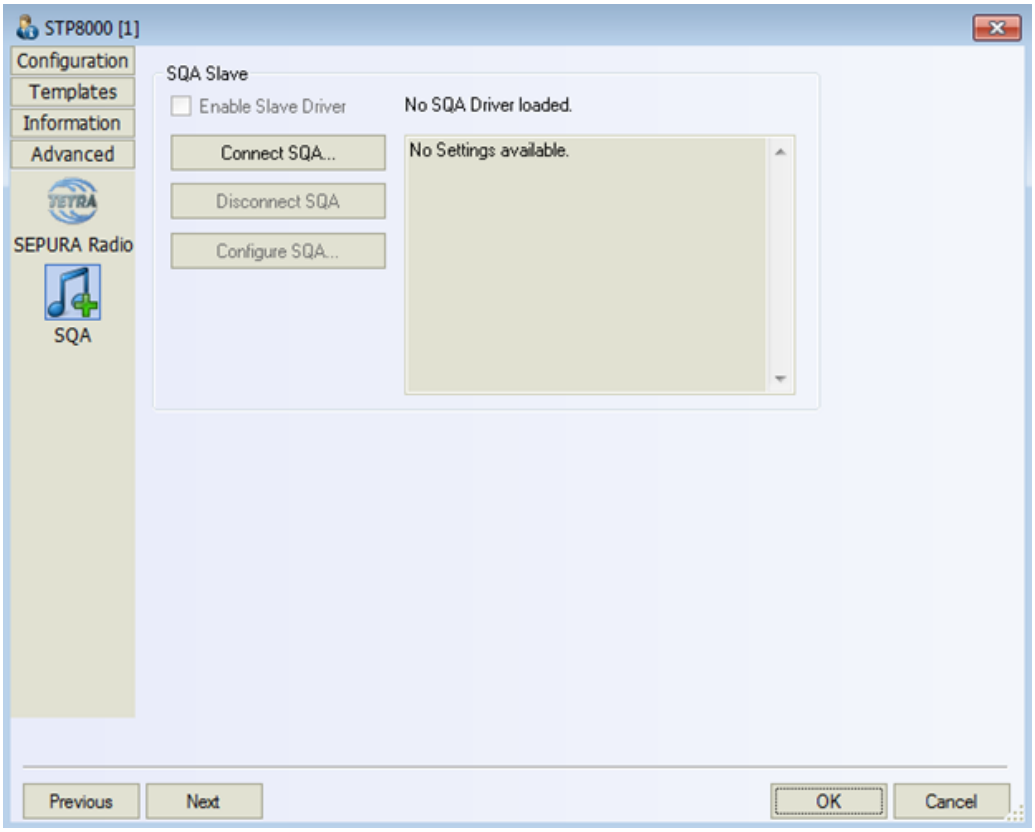


Figure 6-148: TETRA Sepura radio driver – SQA page

- For general introduction on SQA, refer to Chapter 6.4.12, "Speech quality analysis", on page 1683.
- For how to configure the SQA driver, refer to Chapter 6.4.12, "Speech quality analysis", on page 1683.

6.4.6.4 Alternating TETRA group calls

The feature activates measurements of alternating TETRA group calls.

The Sepura Sail drivers support the feature.

TETRA mobiles with PEI interface cannot be used, as the necessary configuration for dialing and auto-answering results in malfunction. They also give reduced information, for example, no L3 messages.

Having two TETRA mobiles which are in the same group, the mobile A calls the mobile B and afterwards, the mobile B calls the mobile A.

First, the mobile A sets up a group call. The mobile B listens to.

After a while, the mobile B sets up a group call and mobile A listens to. To avoid conflicting calls, set both sides to the identical call timings but one side has to have a shift of half duration.

Testing mobile to mobile voice group call needs many configurations. These configurations are described in the following chapters.

Alternating TETRA group call measurements show correct calls, timings and MOS in ETSI view.

In addition, each group call is used to transfer speech samples by the SQA driver. The opposite side does a PESQ calculation. As a group call is a simplex direction call, the SQA has to consider which direction is suitable and which is not.

Sending a `*.wav` file and performing a PESQ calculation on SQA is omitted in the wrong direction.

Alternating TETRA group calls on one PC

The assumption is that two TETRA mobiles are running on the same R&S ROMES4, on one PC. If two PCs are used, there is no guarantee that the call timing does not conflict.

Hardware configuration

Two TETRA Sepura mobiles run on the same R&S ROMES4, on one PC.

Each TETRA mobile is connected with antenna, power, audio cable and RS232 to the PC.

An audio sound card is installed. For how to set up the audio chain, see "M-Audio transit" on page 1626.

In this example TETRA Sepura Sail is used.

Using TETRA mobiles with PEI interface in this configuration does not work.

Software configuration

The following figures show how to configure mobile and SQA drivers in R&S ROMES4.

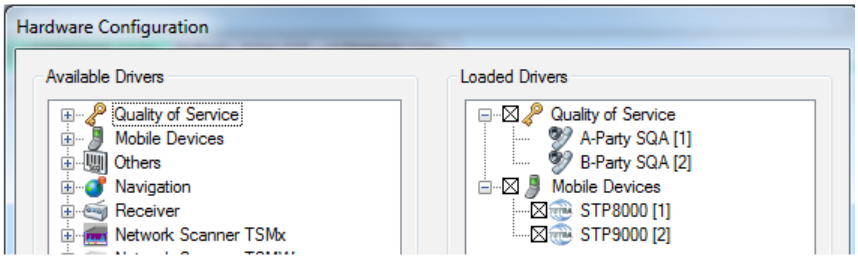


Figure 6-149: Configuration of TETRA drivers

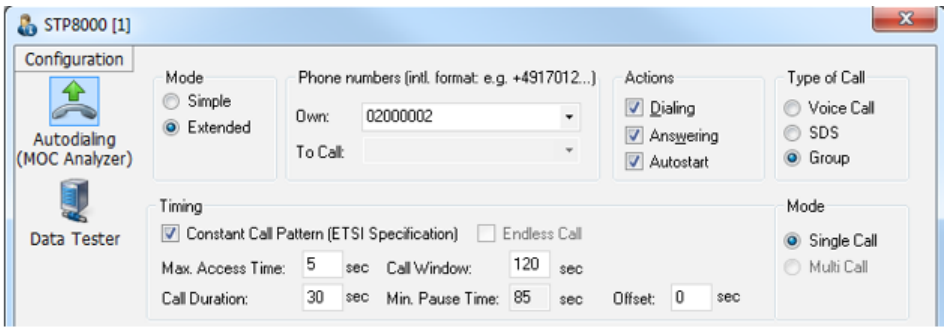


Figure 6-150: Autodialing configuration for A-Party

The call pattern of both TETRA mobiles is the same, except the shift of half of call window. Both are intended to dial and answer.

There is a call window of 120 s In this example, where a 30 s call is performed. A long pause then ensures that the opposite mobile can do its call.

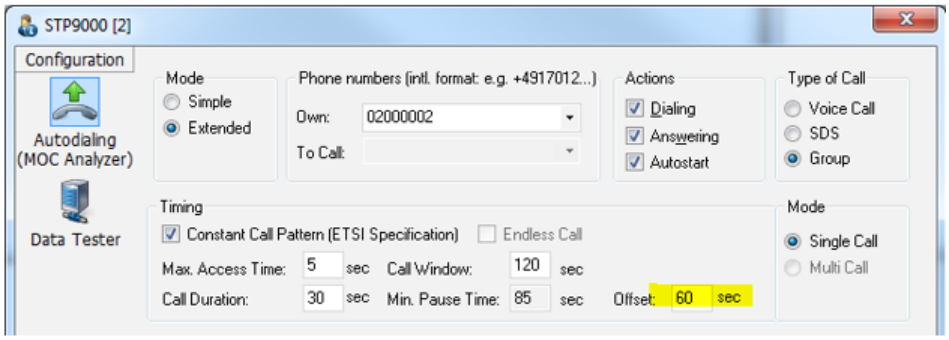


Figure 6-151: Autodialing configuration for B-Party

Notice that 2nd call setup has a delay of half of call window.

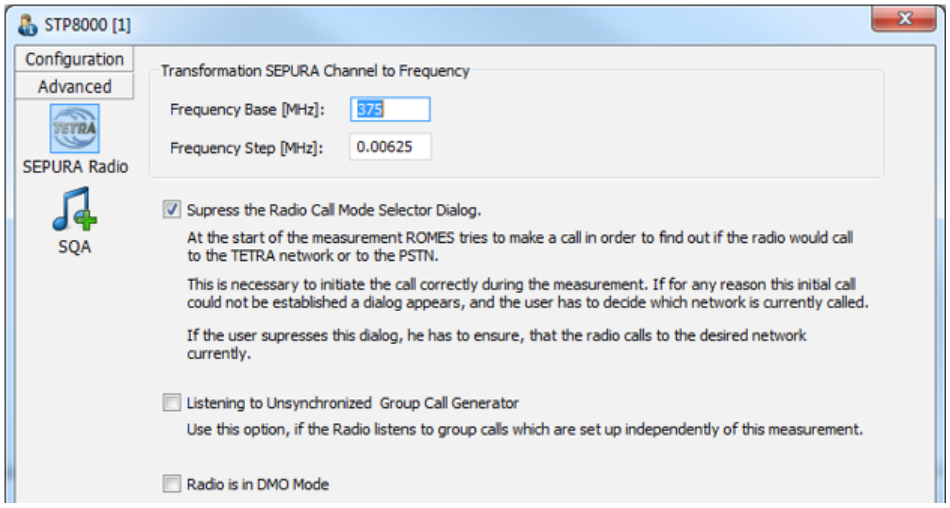


Figure 6-152: Transformation for Sepura Radio

Set both mobiles on Sepura Radio configurations as shown in the following figures.

A-Party SQA[1] is linked to STP8000[1].

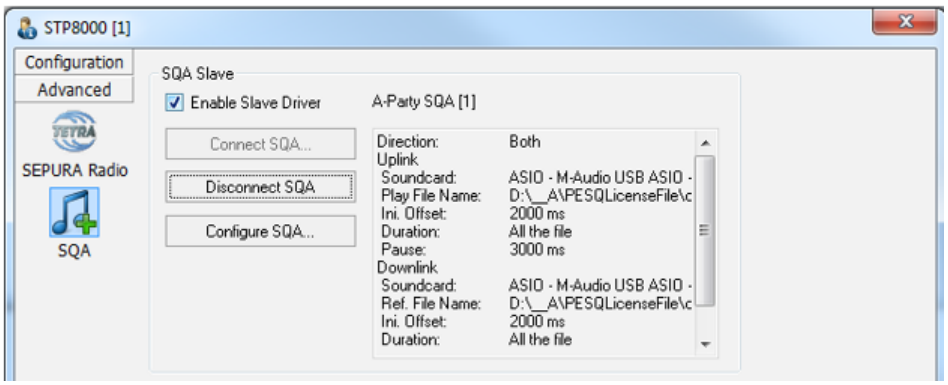


Figure 6-153: SQA page for A-Party

B-Party SQA[2] is linked to STP8000[2].

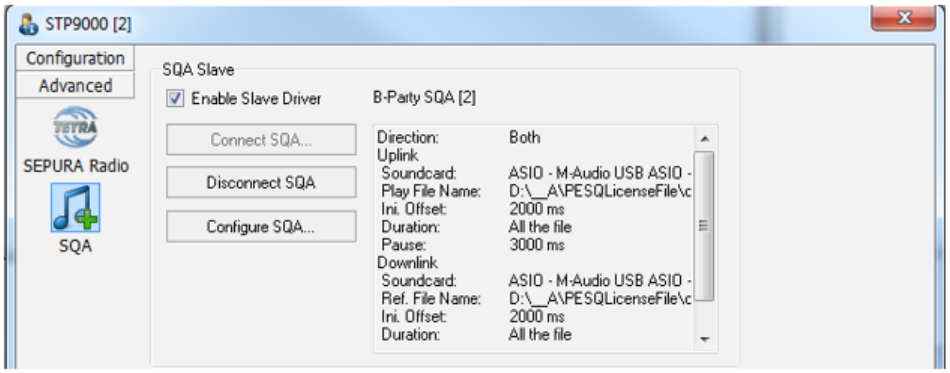
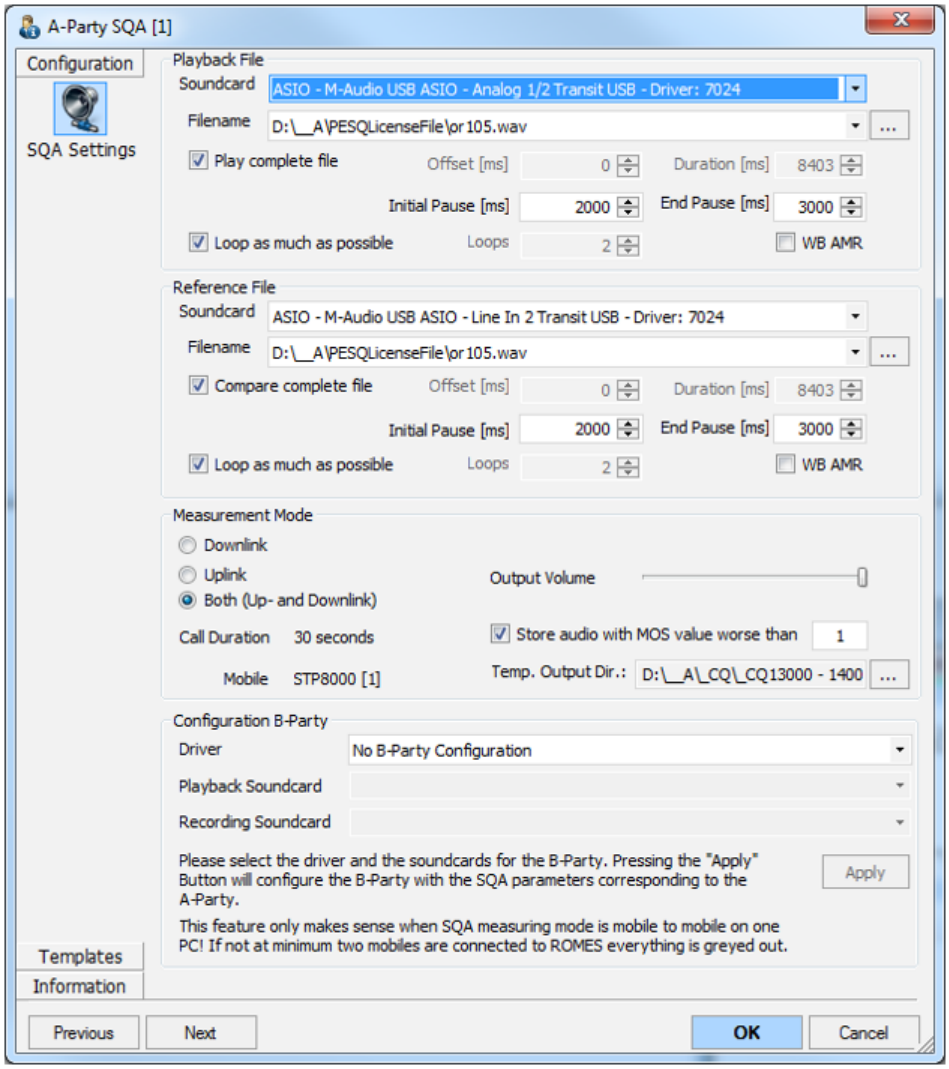


Figure 6-154: SQA page for B-Party



SQA settings for both party are identical.

There is no need of tricky pause timings for playback file and reference file, as there is no overlapping at the calls.

The only difficulty is to find out the correct in/out audio lines.

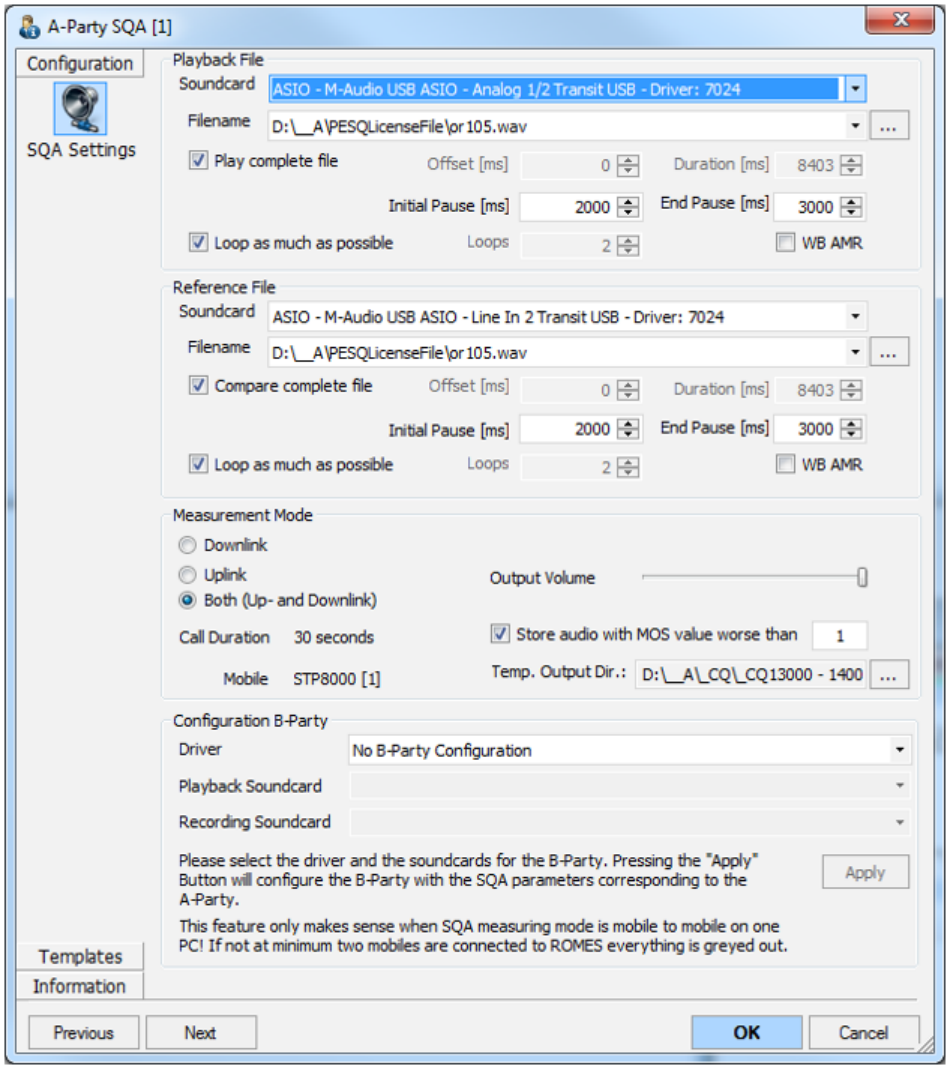


Figure 6-155: SQA settings for A-Party

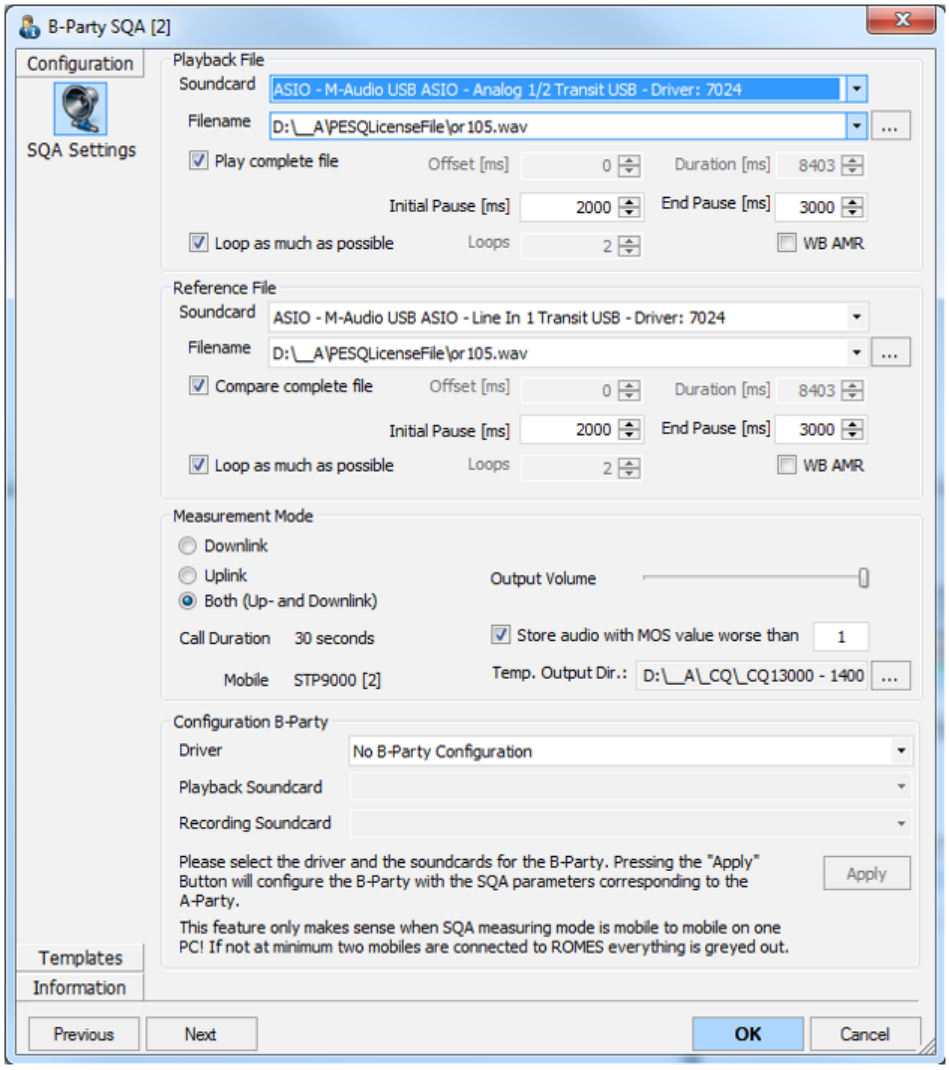


Figure 6-156: SQA settings for B-Party

In this example there is a 30 s call.

With an initial pause set to 2000 ms, the set WAV file duration and the end pause set to 3000 ms, two loops are possible.

2000ms + (8403ms +3000ms) + (8403ms +3000ms) = ~24,8s

For each loop, a PESQ calculation is done.

Alternating TETRA group calls on two PCs

The further improvement is to support TETRA group call with two PCs, each with R&S ROMES4 and one TETRA mobile.

There is a feature to align the start of a call to the clock.

Normally, calls are set up periodically according to the call window settings. With this feature, the start of a call is postponed to the next full minute. The synchronization is ensured by having both system times set correct.

It is recommended to have a GPS for setting the system time.

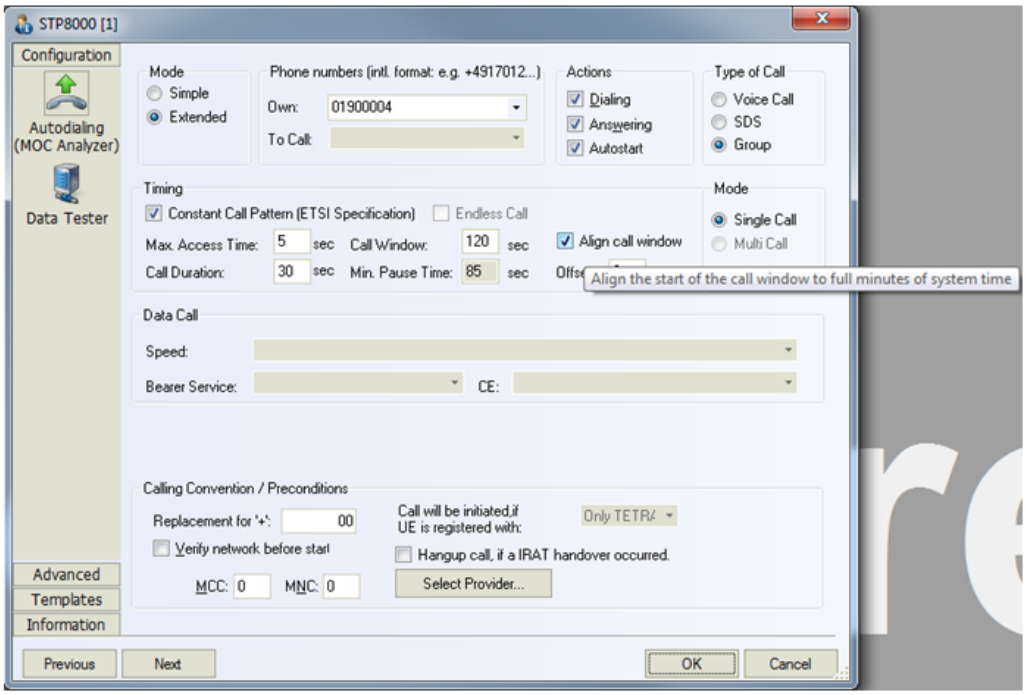


Figure 6-157: Aligning the start of the call window

By activating the "Align call window", the start of a next call is postponed to the next full minute.

This feature applies only to TETRA and is therefore only visible at configuration of TETRA mobiles.

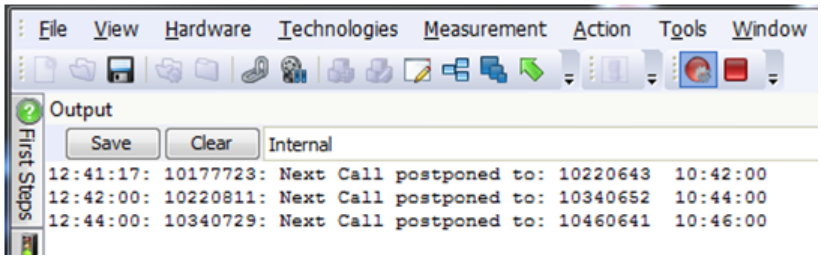


Figure 6-158: Call postpone message written in Output

The Measurement File Info reports "Call window is aligned to Clock (next full minute)" if this feature is enabled.

Measurement

The following figure shows the measurement with Sepura SAIL.

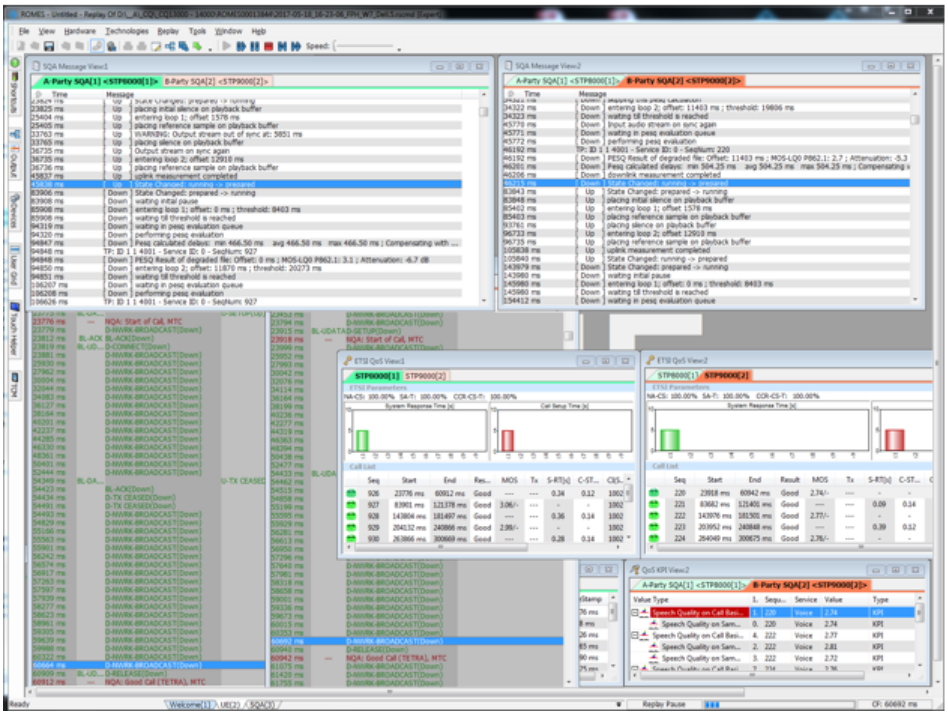


Figure 6-159: SQA Message view

According to the call timing, an alternating group call is set up.

M-Audio transit

The following figures show the actual settings of the M-Audio Transit.

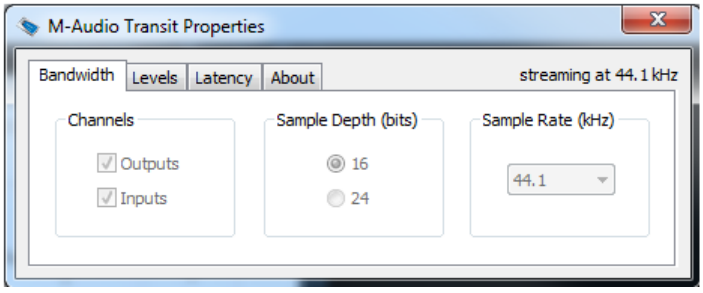


Figure 6-160: M-Audio Transit bandwidth button

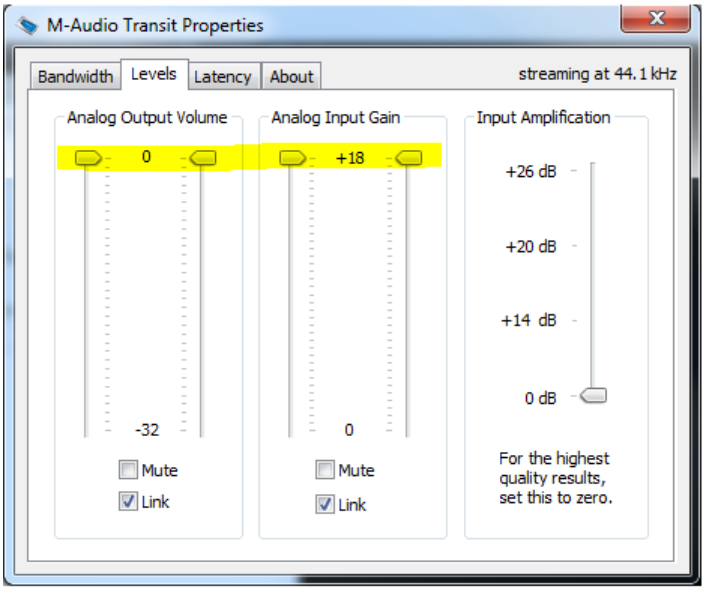


Figure 6-161: M-Audio Transit level setting

Analog Output Volume is set to 0, Analog Input Gain is set to +18.

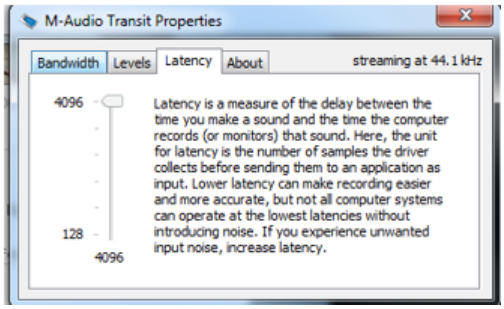


Figure 6-162: M-Audio Transit latency setting

Figure 6-163: M-Audio Transit product info

Voice level on both Sepura ~75%.

PESQ result attenuation has to be near by 0dB (+-10 dB).

6.4.6.5 Action menu TETRA

The "Action" menu opens a popup box used to set up a call. It is added to the menu bar when a mobile driver has been successfully installed, see Chapter 6.1, "Devices", on page 1447.

If several mobiles are connected, separate command lines are displayed for each of them.

Handset TETRA

Activates the entry of a number to dial, set up and terminate a call.

- **Handset**
  The "Handset" command opens a window (equal for all drivers) which have two possible statuses:
  – Not selected
  – Selected, marked with "- *" and shown in the following figure as connected mobile [2].

If there is only one "Handset" window, it always has selected status.
If there is more than one "Handset" window, the selected status can be set to any "Handset" window in one of two listed ways:
1) Click to the window using a mouse.
2) Choose selected window using the "N" key. In this case selection changed like this: Window[1] > press "N"> Window[2] > press "N"> ...Window[n] > press "N"> Window[1] (cycling choose like "Alt+Tab" between open windows in MS Windows).
Only selected windows accepts hotkeys “D” ("Dial"), “A”("Answer"), “H”("Hangup").
Note: The previously mentioned keys have only effect, if the focus is not set to an input control, example-given edit field or combo box.
Example: if you select the phone number by selecting the corresponding entry of the combo box, the keys do not work afterwards. Set the focus to another window, for example to the main R&S ROMES4 window.

- **>>**
  The ">>" button enlarges the dialog box, giving access to the Key pad and the "Autodialing" option.

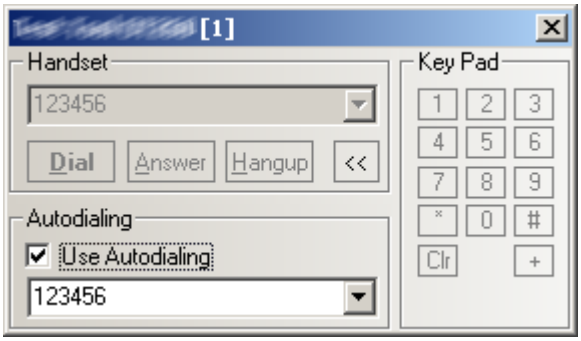


Figure 6-164: Use Autodialing

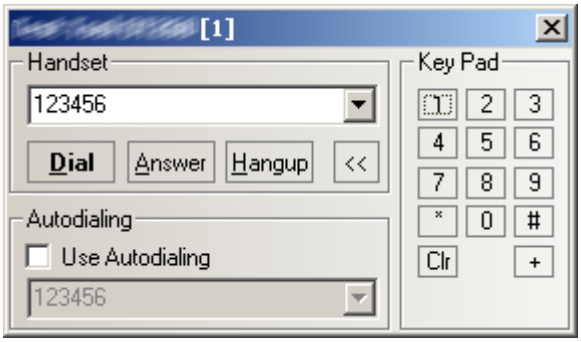


Figure 6-165: No Autodialing

- **Dialed number**
  The number to be dialed can be entered either via the keyboard and the input field or by clicking the on-screen keypad.
- "Close window ☒"
  Closes the window without any further action.
- "Dial"
  Starts dialing the number entered before.
- "Answer"
  Instructs the phone to accept the call.
- "Hangup"
  Drops the line.
- "Autodialing"
  If the box is checked, the phone number entered below is called periodically, the "Dial", "Answer", and "Hangup" buttons are disabled (grayed). The autodialing mode can be set even during the measurement, but only in "Idle mode".
  This item starts "Autodialing" if the "Start with Measurement option" was not checked in the driver configuration-autodialing tab panel.

6.4.6.6 Signals

Not all TETRA mobiles provide the same information to R&S ROMES4.

The following table gives an overview of the signals provided by different TETRA mobiles.

Signal	Sepura	Motorola	EADS Radio THR9
Transmitter	Yes	No	No
Reg.State	Yes	Yes	No
MCC	Yes	No	No
MNC	Yes	No	No
TETRA Power	Yes	No	Yes
BER	No	No	No
LA	Yes	Yes	Yes
Frequency	Yes	No	Yes
C1	Yes	No	No
Best NC LA	Yes	No	Yes
Best NC C2	Yes	No	No
NC x TETRA Power	Yes	No	Yes
NC x Frequency	Yes	No	Yes
NC x C2	Yes	No	No

KPI Values

Use SEPURA radios to obtain the most accurate KPI values.

Layer 3 messages

If the Sepura mobile is loaded using the Sepura driver (not the PEI driver), R&S ROMES4 can also decode and provide L3 messages.

To generate events for most of the TETRA Layer 3 messages:

1. Open the preferences dialog.
2. -Select the "Available Events" section.
3. Double-click the events which you would like to have shown.

Handling handover time with Sepura mobiles

The SEPURA driver shipped with R&S ROMES4 version 4.71 supports the measurement of handover time in TETRA networks, using Mobile Link Entity (MLE) indications.

Support for the following indications is added to the SEPURA driver:

- **MLE-OPEN-IND**
  The primitive used by the MLE to notify higher sublayers that they have access to communication resources.
- **MLE-CLOSE-IND**
  The primitive used by the MLE to notify higher sublayers that they no longer have access to communication resources.
- **MLE-BREAK-IND**
  The primitive used by the MLE to indicate to higher sublayers that communication resources are temporarily unavailable.
- **MLE-RESUME-IND**
  The primitive used by the MLE to indicate to higher sublayers that communication resources are available again.
- **MLE-RESTORE-REQ**
  The primitive used by higher CMCE sublayer to request the MLE to send a restore request to the new serving switching and management infrastructure (SwMI) to continue a previous call.

The TETRA MLE sublayer is responsible of providing communication resource services to the upper Layer 3 sublayers. When lower Layer 2 services become available to higher layers, the MLE sublayer issues an MLE-OPEN-IND indication to the upper layers. It notifies them that communication services are now available for transmission. Equivalently, the MLE-CLOSE-IND indication is sent when lower layer services can no longer be used.

Handover signaling

During a handover, the radio terminal (RT) must switch between cells. All radio links have to be transferred from one cell to the next one. The MAC layer of the RT must switch to a new channel in the target location area (LA). All lower layer 2 services become unavailable for layer 3 entities while a handover is in progress. To notify that communication services are temporarily unavailable, the MLE sublayer sends an MLE-BREAK-IND indication to higher layer 3 sublayers. These sublayers, in response, suspend their activity and wait for services to become available again. Upon handover completion, the MLE notifies the higher sublayers that the communication resources are available once again by issuing an MLE-RESUME_IND indication.

In case a connection has to be restored (i.e. an ongoing call has to be continued), a MLE-RESTORE_REQ request is sent from higher layers to the MLE. MLE then asks the SwMI to restore the connection at the new LA. If the connection is lost and communication services can no longer be accessed, the MLE notifies higher sublayers by issuing an MLE-CLOSE-IND indication. All higher-level services are halted until communication is established again, which is notified by the MLE by sending an MLE-OPEN-IND indication.

If the connection is lost and communication services can no longer be accessed, the MLE notifies higher sublayers by issuing an MLE-CLOSE-IND indication. All higher-level services are halted until communication is established again, which is notified by the MLE by sending an MLE-OPEN-IND indication.

Determining handover time

The handover time is defined as the time span, during which lower layer services cannot be used by higher layer 3 entities. This time can thus be estimated, by calculating the length of the interval between an MLE-BREAK-IND indication and the corresponding MLE-RESUME-IND indication.

$$t_{handover} = t_{RESUME} - t_{BREAK}$$

MLE signaling in the R&S ROMES4 layer 3 view

The introduced MLE indications can be found inside the "Layer 3 View" when measuring with Sepura radios, as shown in the following figures.

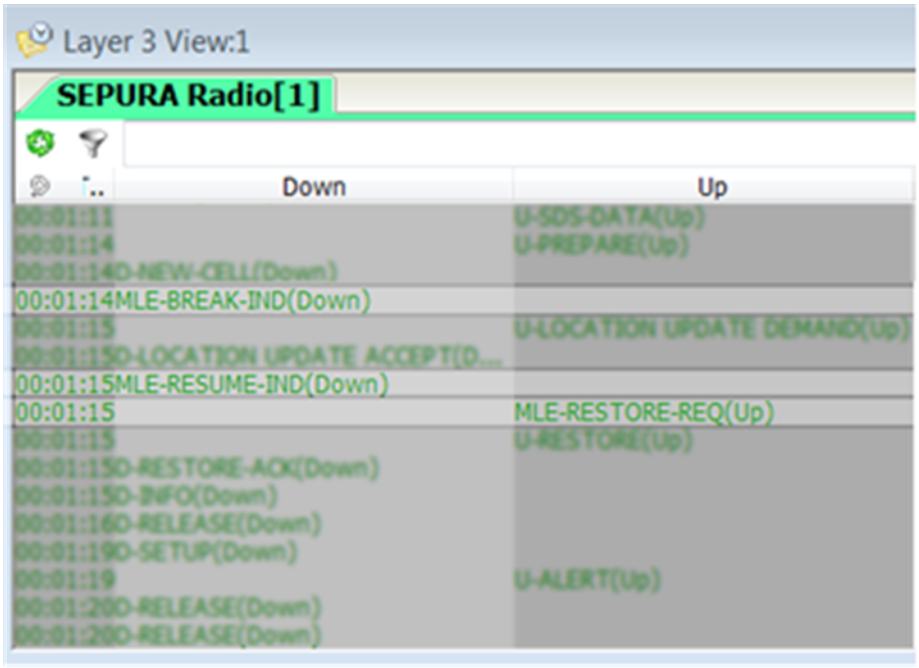
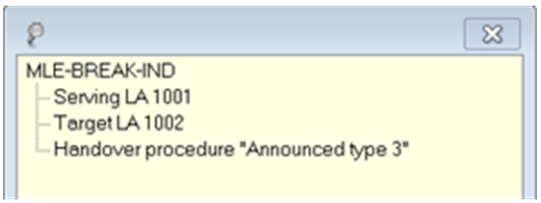


Figure 6-166: MLE signaling during successful handover procedure

In addition, the MLE-BREAK-IND and MLE-RESUME-IND indications hold additional useful information about the handover process, which can be accessed by double-clicking the messages inside the Layer 3 View.

The MLE-BREAK-IND details show the current location area, the location area of the target cell and the type of handover procedure that has been started by the device.



After handover has been completed, the location area of the new serving cell can also be inspected inside the MLE-RESUME indication details, as shown in the following figure.

6.4.7 LTE mobile devices

To see test mobile devices that are supported by R&S ROMES refer to `Supported Test Mobiles ROMES.pdf` file which is found in the `..\Documents\ReleaseNotes\` of the delivered R&S ROMES DVD.

- LTE Samsung chipset-based devices 1633
- LTE Qualcomm chipset-based devices 1636
- Support of Android debug interface 1648
- Action menu LTE 1650

6.4.7.1 LTE Samsung chipset-based devices

R&S ROMES4 fully supports the Samsung chipset based mobile devices.

The requested Samsung chipset version has to be at least ICD 4.80 and the R&S driver option R&S ROMES4SAM.

To load the Samsung chipset-based mobile device, select the "Samsung Chipset (Phone)" entry in the "Hardware" > "Connect/Disconnecte" > "Available Devices" pane.

The Samsung chipset-based mobile devices do not support all available R&S ROMES4 signals and views. The following mobile views are supported:

- **3GPP**
  - "3GPP Overview View"
  - "Layer 3 View"
  - "3GPP Handover Analyzer View"
  - "3GPP Neighbor Set View"
  - "ETSI QoS View"
  - "UE Capabilities View"
- **LTE Views**
  - "Cell Set View"
- **UMTS Views**
  - "Cell Set View"
  - "UMTS Layer 1 Graph View"
  - "UMTS Neighbourhood Analyser"
  - "UMTS RLC/MAC View"

  - "UMTS SIB View"
- **GSM Views**
  - "Cell Set View"
  - "GSM Chart View (no FER)"
  - "GSM Neighbourhood Analyser"
  - "GSM System Information View"
  - "GSM GPRS TS/CS View"
  - "Partly GSM GPRS/EGPRS"
  - "Partly GSM GPRS RLC/MAC View"

The Samsung chipset-based devices can operate in DQA fully integrated trace mode and in On PC testing (Classic) mode.

Configuration menu LTE (Samsung)

The configuration page for Samsung chipset-based mobile devices has the following tabs opening the associated configuration pages:

- "Autodialing"
- "VoLTE"
- "Advanced"

The following figures show the "Autodialing (MOC Analysis)" and "VoLTE" pages for the SM-G925F phone.

The autodialing settings are the same as for all other test UEs.

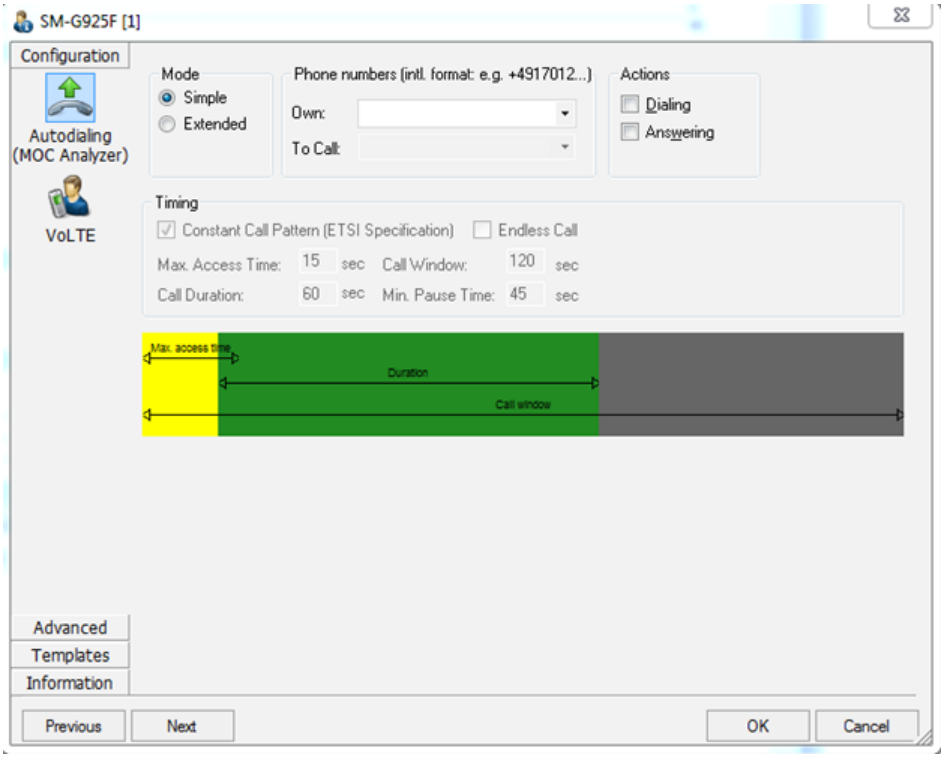


Figure 6-167: Simple mode autodialing with SM -G295F

VoLTE test needs the R&S ROMES4VO option and the activated VoLTE Tracing feature.

Deactivate the VoLTE tracing option if the higher data throughput is requested. The tracing of VoLTE consumes much device's processing capability.

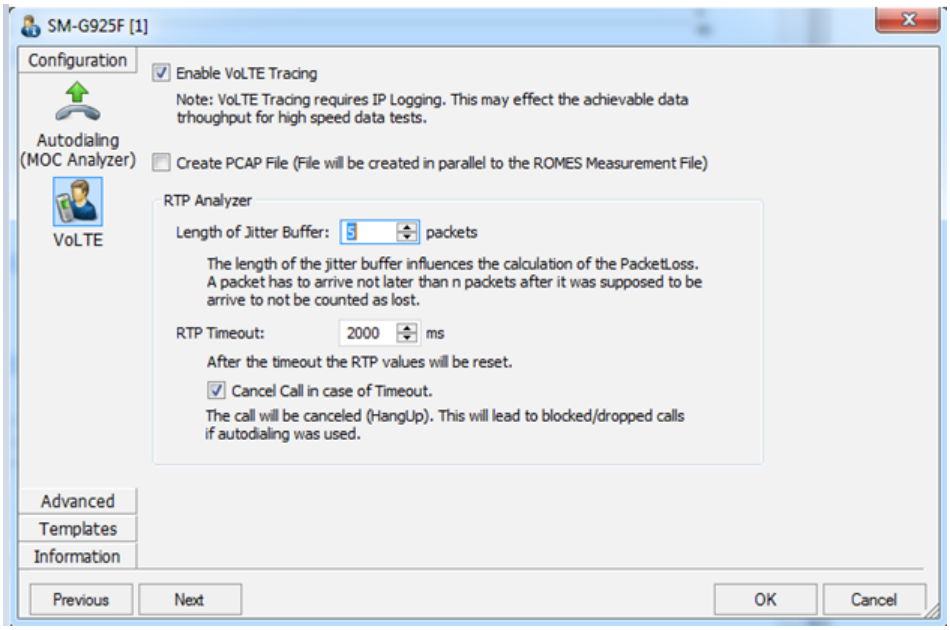


Figure 6-168: VoLTE tracing

Support of emergency call test

Samsung chipset based mobile devices support the emergency call test if set in On PC testing (Classic) mode.

Emergency numbers are registered on a certain SIM card field. Calling one of these emergency numbers results in a special signaling (L3 EMERGENCY SETUP) in opposite to call of normal phone numbers.

Disabled lock screen is the prerequisite for emergency call on smartphone.

For example, on Samsung Galaxy S6 perform the following:

"Settings" > "Lock screen and security", "Screen lock type" > "NONE"

Otherwise, the call does not start.

6.4.7.2 LTE Qualcomm chipset-based devices

The R&S ROMES4 Qualcomm driver offers a common user interface for the supported devices.

Disable third-party connection programs

It is highly not recommended to use third-party tools for device configuration during the time the device is connected to R&S ROMES4.

Disable the connection programs delivered with the test devices.

To use the LTE Qualcomm chipset-based mobile devices, the R&S ROMES4QP (LTE extension) or R&S ROMES4QC/ROMES4SAM option is required, dependent on DQA operation mode.

- For DQA measurements, most of test devices with Qualcomm chipset must be loaded by using the NDIS Interface. For details, see Chapter 6.1.8.1, "Connecting Qualcomm chipset based mobiles", on page 1468 and Chapter 6.1.4.3, "NDIS interface", on page 1457.
- Use the R&S ROMES4 DQA Dialup method for DQA Connect job. Bind it to the NDIS interface of the test device.

To measure the performance and behavior of specific bands and RATs of heterogeneous networks, it is required to force the UE to a specific band.

Some Qualcomm chipset-based test mobiles devices, for example, Huawei LTE USB sticks and several Sierra LTE UEs, allow setting a specific combination of supported bands for different RATs.

Configuration menu LTE (Qualcomm)

The configuration page of Qualcomm chipset-based mobile devices contains tabs having different functions.

- "Configuration" > "Extra setting" evaluates the message types by the test system.

- "NQA Settings" runs network quality analysis.
- "Autodialing" configures autodialing and auto-answer call mode
- "Serial Port Driver Info" displays information on the driver and assigned serial port

Click the "Hardware" >"Connect/Disconnect" command.

In the "Hardware Configuration" > "Available Devices" window, under the Mobile Devices, double-click the "Qualcomm Chipset" option. The connected Qualcomm chipset-based device is loaded, activated and the device configuration page opens.

- Configuration LTE (Qualcomm)....1637
- Extra settings LTE (Qualcomm)....1639
- Network forcing LTE (Qualcomm)....1640
- Qualcomm mobile wizard support of Android smartphones and VoLTE....1644
- Extended VoLTE support....1644

Configuration LTE (Qualcomm)

The opening "Advanced" > "Device" page allows a rough preselection of the message types to evaluate. Here the PIN number can be entered in case a data card. For most test mobile devices, PIN has to be entered.

The LTE test devices provide much information that the test system is able to store and evaluate. In many applications, only a subset of this information is needed. Restricting the recorded data saves system resources and reduces the size of the measurement files.

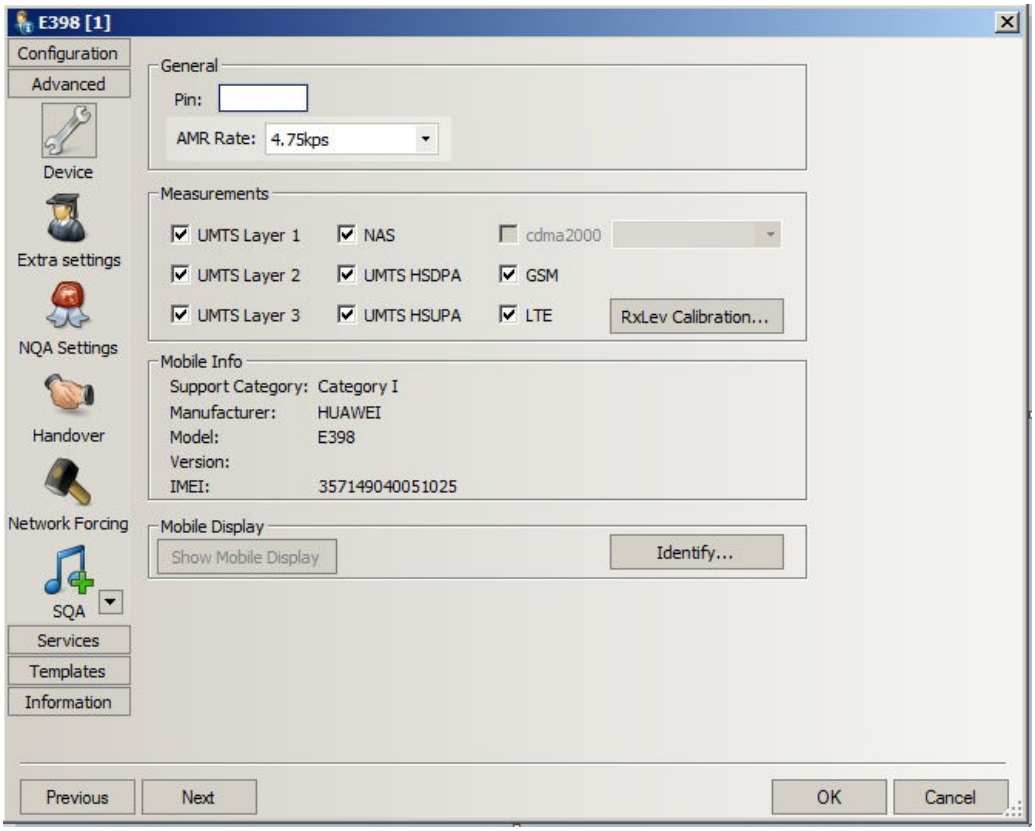


Figure 6-169: LTE driver configuration – Device

General
Enter the PIN number for identification after switching on the test mobile in the "General" pane of the configuration opening page (not supported by most test mobiles). If nothing is entered or the PIN is ignored, the SIM must be entered manually at the mobile each time it is started.

Select an AMR codec in the "AMR Rate" drop-down box.

Note:
The option "Make Diagnostic Calls" is removed from the Qualcomm driver configuration page, as the current mobiles with Qualcomm chipset do not support this specific call type.

Measurements
The technology-related checkboxes in the "Measurements" pane are used for a rough preselection of the messages and information types to be recorded and written to the measurement file.

The selection can be refined in the "Extra settings" page. For an overview of available messages, views and signals, see "Extra settings LTE (Qualcomm)" on page 1639.

Mobile Info
Gives the information about the test device.

Mobile Display
"Show Mobile Display" is not provided.

To identify the IMEI of a test mobile device, click the "Identify" button. If the test device has a display, the corresponding number appears on it.

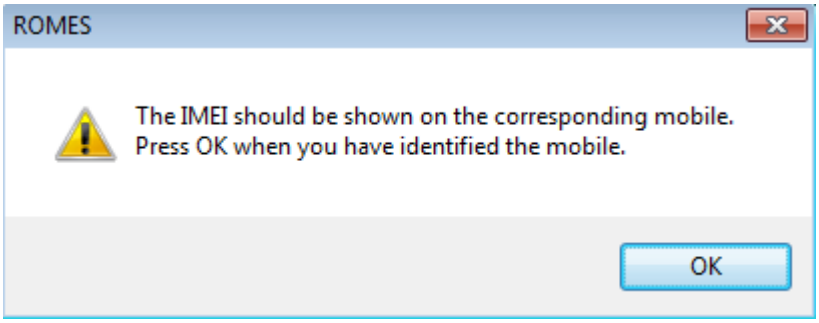


Figure 6-170: Message window

Extra settings LTE (Qualcomm)

The "Extra settings" page allows selecting the message types for recording to the measurement file.

Configure the LTE driver for making LTE measurements, see the previously mentioned "Device" page, "Configuration LTE (Qualcomm)" on page 1637.

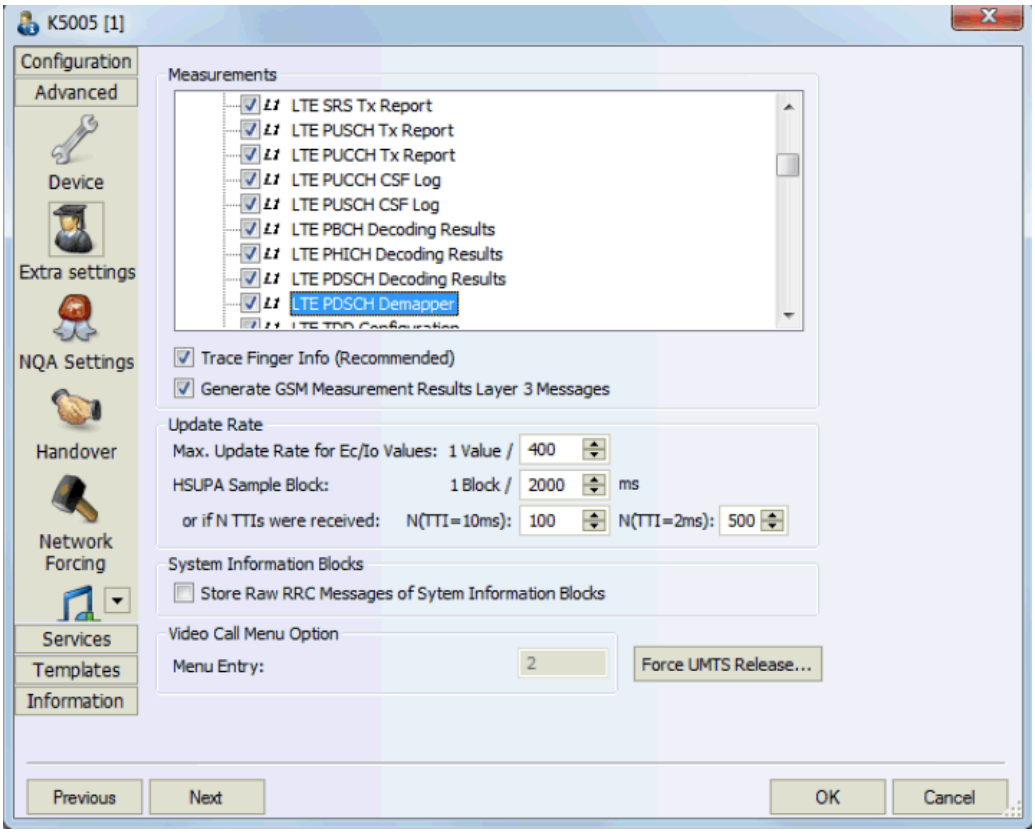


Figure 6-171: LTE driver configuration – Extra settings

Select the LTE messages which you want to be included in measurement report and evaluated from the list in the upper pane of the page. For an explanation of the recorded parameters, see the description in the Chapter 4.4.6, "LTE views", on page 810.

Parameter description

For the meaning of the checkboxes in the page, see "Extra settings UMTS" on page 1573.

For the parameters in the "NQA Settings", "Handover" and "SQA" pages, see "NQA settings" on page 1583"Handover analyzer" on page 1584 and "Speech quality" on page 1585, respectively.

Network forcing LTE (Qualcomm)

This option is stored in the registry and can be exported/imported via the system configurations export of R&S ROMES4. The forcing settings are part of the workspace/ template settings. If a workspace is loaded with forcing settings which is not or only partially supported by the currently connected device, a message pops-up. It informs that the forcing settings are not applied at all (applying partially settings is not supported).

The "Network Forcing" configuration page of the Qualcomm driver offers the actual supported bands and its state of selection for currently connected device, see the following figure.

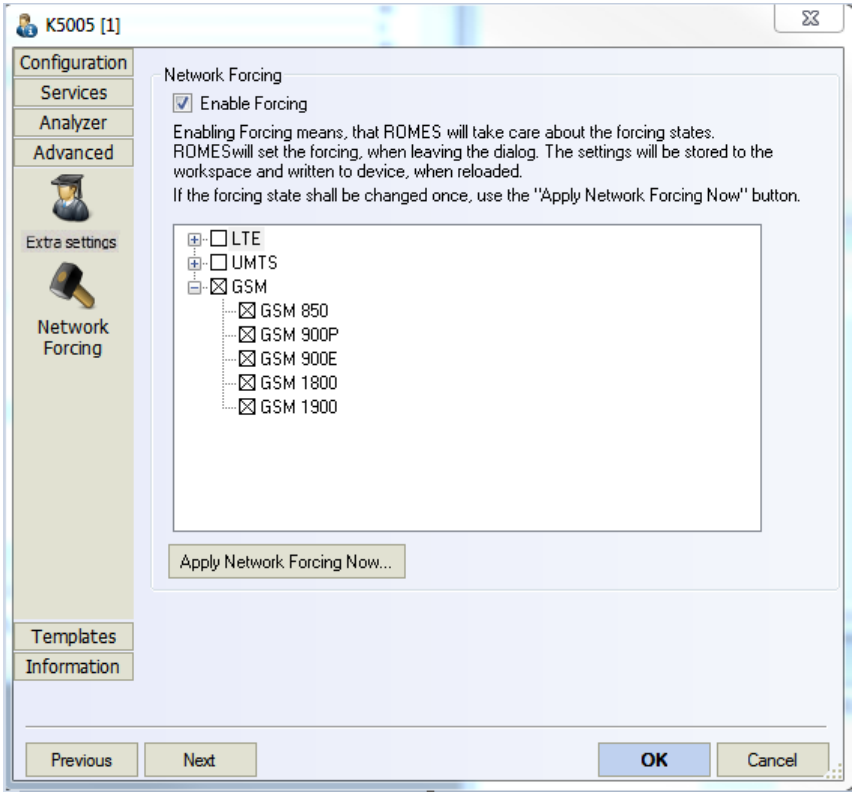


Figure 6-172: Network Forcing page

Actually, the current state is read only once from the device. From that point in time, the software traces all state changes, which are performed by R&S ROMES4. The state is not displayed correctly, if it was changed by using another program during a R&S ROMES4 session.

You can change the selected bands and after click the "Apply Network Forcing Now" button the new configuration is written to the device.

If the "Enable Forcing" option is inactive, R&S ROMES4 does not write any settings automatically to the device. Thus, activate the option to store the forcing settings to the workspace, restore and write them to the device automatically.

"Bandforcing: Off" is the report for the combination of all supported bands.

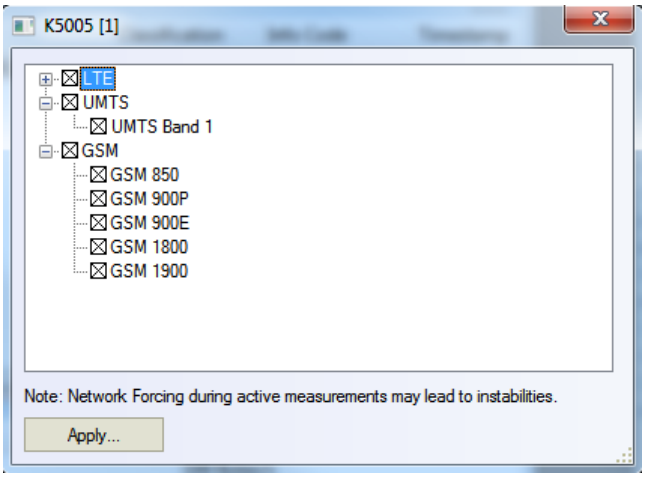


Figure 6-173: Forcing settings - all bands enabled

Some devices cannot support the all possible band combinations. For example, some Huawei sticks do not allow you to select only UMTS/GSM without LTE.

The Qualcomm chipset-based mobile device support to change the forcing during the measurement by using the "Network Forcing" action menu.

Note that the access to certain interfaces of the device is required when changing the forcing. If these interfaces are blocked by other tasks, for example by DQA or Auto-dialer, the forcing command fails. The forcing settings which were applied during the measurement do not change the workspace settings. Thus after a restart of the measurement, the device will be set to the initial forcing settings which are part of the current device configuration. If you change the forcing settings but deactivate the forcing and do not apply these settings, a warning is issued when leaving the network forcing page. The figure shows the warning.

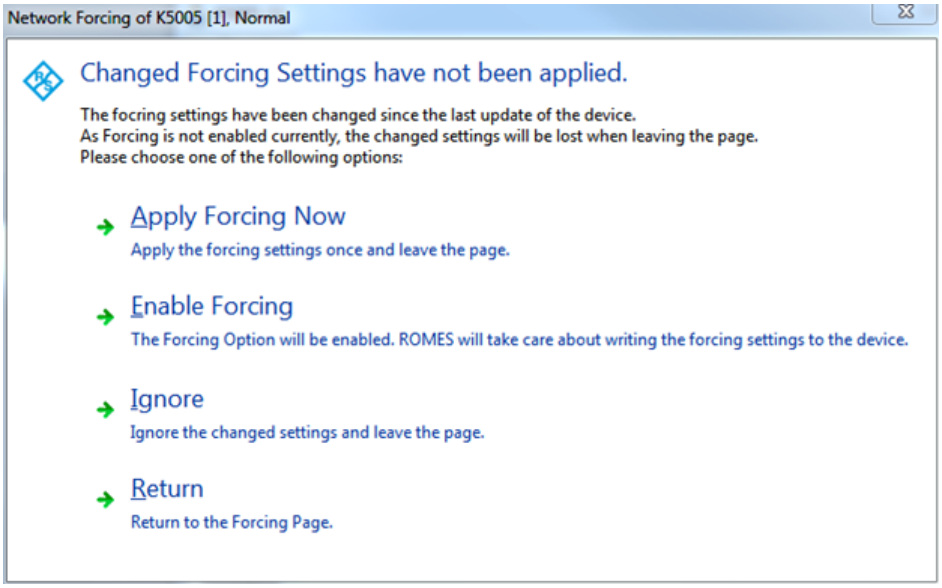
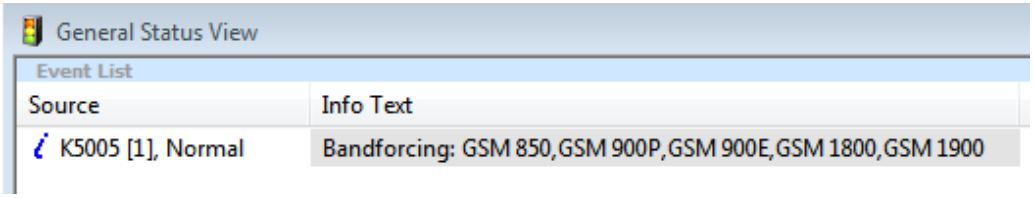


Figure 6-174: Options offered when changing forcing settings

Band forcing visualization

The forcing settings are written into the device at the start of measurement. A message which notes the forced bands is written to the "General Status View".



A R&S ROMES4 signal also displays the current state of the device concerning forcing.

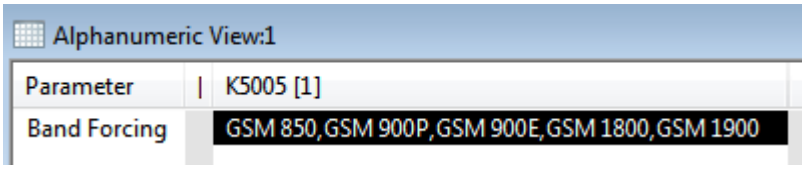


Figure 6-175: Forced bands

An icon in the "3GPP Overview View" informs on forcing of the UE which was actively set by R&S ROMES4. A Tooltip on the icon shows the actual forced bands.

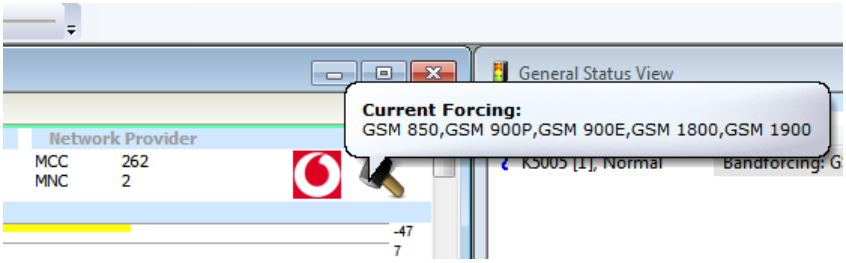


Figure 6-176: Current forcing indication in 3GPP Overview View

Applied forcing settings are stored in the "File Info" page, see the following figure.

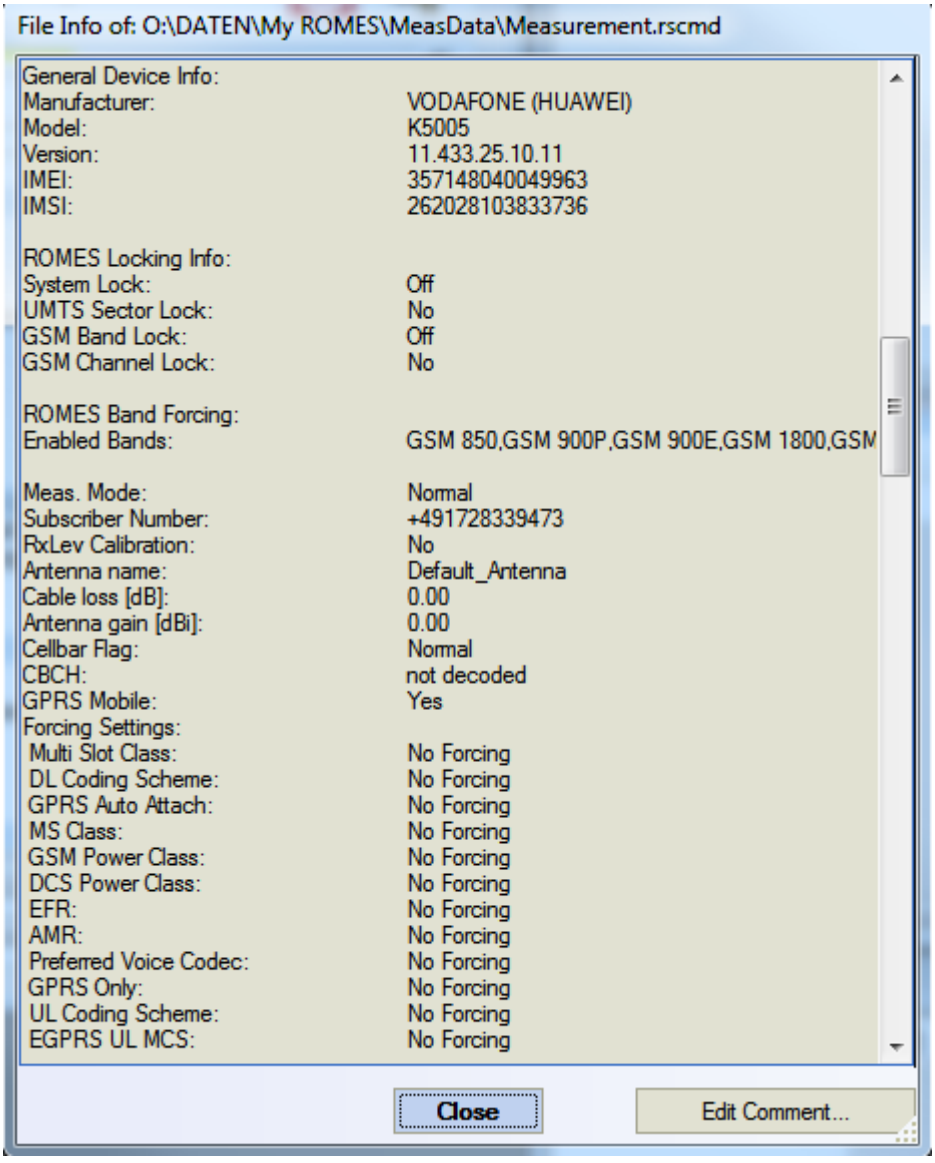


Figure 6-177: Measurement file info

Qualcomm mobile wizard support of Android smartphones and VoLTE

The Qualcomm Mobile Wizard has additional settings for supporting Android smartphones and VoLTE.

The Android debug interface is supported as dial method, see the following figure.

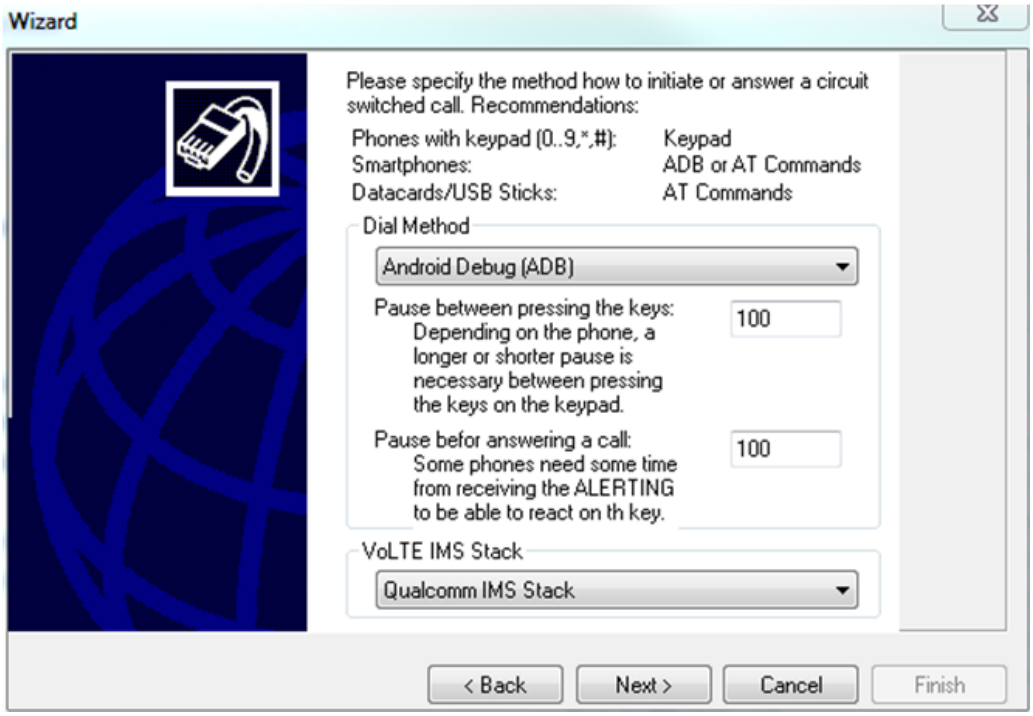


Figure 6-178: Dialing method for CS calls

To use this interface, a mobile phone has to have an Android operating system. Switch on the USB debugging at that mobile device. The availability of the ADB interface for the phone is checked when pressing the "Next" button. If the interface is not available, another dialing method has to be selected.

The IMS stack to be installed on the phone is selected in the lower part of the Wizard dialog. The dialog is active only if the phone supports LTE (RAT page).

The following stack options can be selected:

- VoLTE not supported
- Qualcomm IMS Stack
- Samsung IMS Stack
- Other IMS Stack

Extended VoLTE support

VoLTE is supported independently of the implemented IMS stack. During the integration of a phone with the Qualcomm Mobile Wizard, the phone has to be properly configured to perform VoLTE measurements. The actual kind of IMS stack has to be activated.

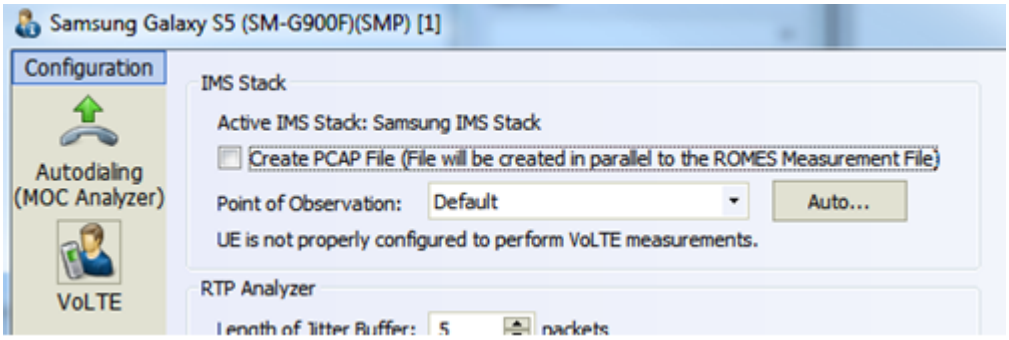


Figure 6-179: IMS stack activation

Selection of proper point of observation

The Qualcomm devices have two different points of observation concerning VoLTE.

Although most of the UEs use point 1 as a point of observation, some use point 2. If no IMS messages are show in the Layer 3 View while setting up a VoLTE call, most probably the wrong point of observation is selected. In this case open the UEs "VoLTE" configuration page and press the "Auto" button, see the previous figure.

The driver is now trying to detect the correct point of observation automatically.

While doing the autoconfiguration, the driver tries to register to the VoLTE network. R&S ROMES4 notifies that registration try. This registration period takes up to 30 seconds.

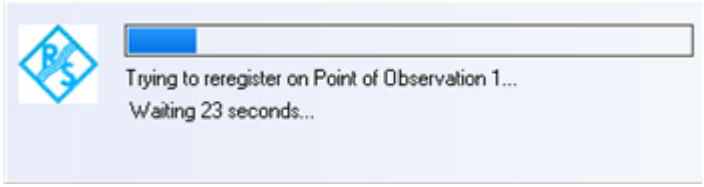


Figure 6-180: Driver tries register to VoLTE network

If a valid registration has been notified, the process stops, the correct point of observation is set and the controls are disabled.

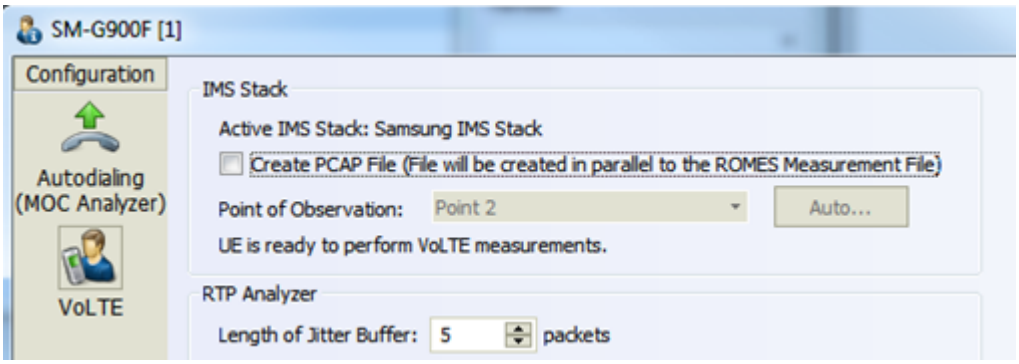


Figure 6-181: UE ready for VoLTE measurements

Creation of PCAP file

R&S ROMES4 allows PCAP file for VoLTE calls in parallel to write to the R&S ROMES4 measurement file. The file name is `<ROMESMeasurementFileName>.rscmd<DeviceName>.pcap`.

By default, writing a PCAP file is disabled. Writing is activated by selecting the "Create PCAP File (File will be created...)" option, see Figure 6-179.

The timestamps of the `*.pcap` file are set intentionally to the R&S ROMES4 measurement file's timestamp, not to the UTC time. This setting allows the timestamps of the R&S ROMES4 display to match with the Wireshark timestamps.

By default Wireshark displays the relative timestamps in second column only. To make times comparable, add new column "UTC Time" in Wireshark using the "Column Preferences" option, as shown in the following figure.

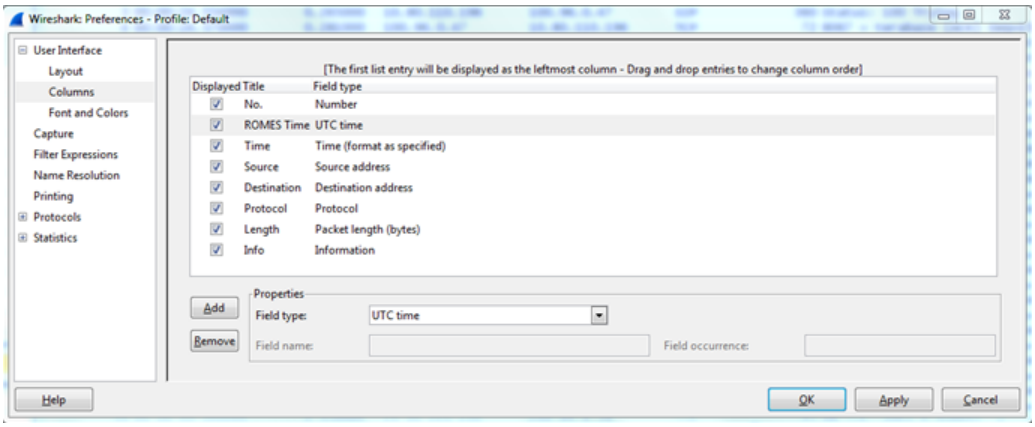


Figure 6-182: Adjusting timestamp in Wireshark

The displayed timestamps in the new column correspond to the R&S ROMES4 timestamp in “Relative Timestamp” format (xxx ms).

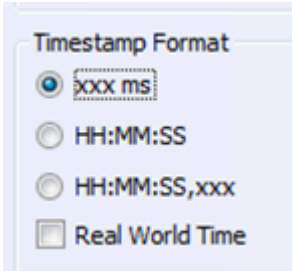


Figure 6-183: ROMES timestamp formats

The following figure shows message views obtained by the R&S ROMES4 and Wireshark.

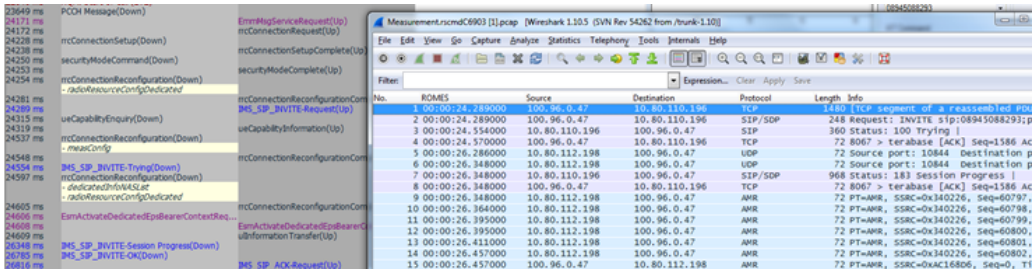


Figure 6-184: Message views comparison

The PCAP file can be opened in Wireshark already during the running measurement.

RTP analyzer

The RTP analyzer calculates the RTP Packet Loss during the VoLTE call. The algorithm uses a jitter buffer whose length you can configure between 1 to 20 packets.

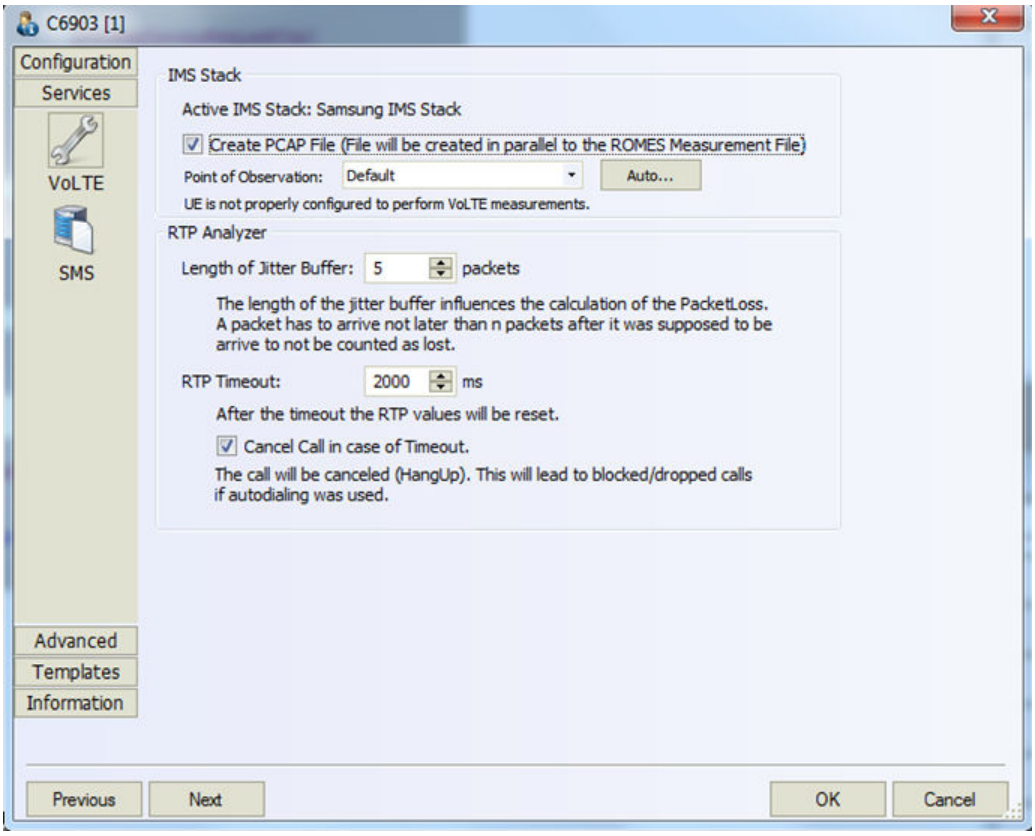


Figure 6-185: Services - VoLTE dialog

A timeout value specifies when R&S ROMES4 resets the analyzer and its values. This timeout is used also to cancel active calls. If the calls are set up by the R&S ROMES4 autodialer, the call is marked as BLOCKED/DROPPED CALL.

The settings are stored in the measurement file and are part of the measurement file info, see the following figure.

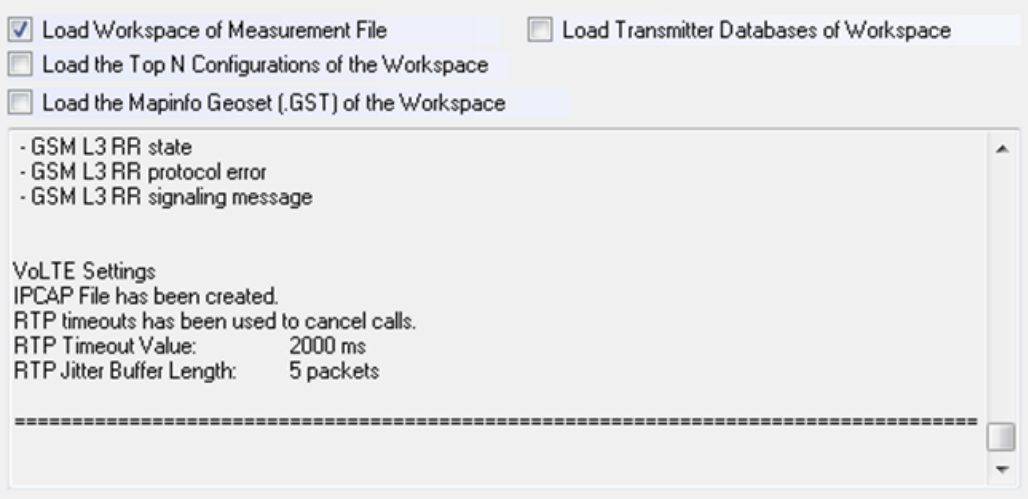


Figure 6-186: VoLTE settings shown in file info

VoLTE POLQA measurements

Using the SMP option with the SM-G900F, R&S ROMES4 is able to do the POLQA measurement on VoLTE networks.

Possible problems check during VoLTE call

The Qualcomm driver checks the possible problems during a VoLTE call.

If the autodialer starts and the `SIP Invite` message is received although a dedicated bearer is requested, the driver cancels the call without marking it as blocked. After canceling the call, the driver tries to re-register to the IMS server.

Figure 6-187: Call canceled due to detected problem

6.4.7.3 Support of Android debug interface

While using smartphones, it can happen that AT commands are not supported as expected. R&S ROMES4 offers the possibility to use the `adb` commands instead of `AT`

commands. The Adb commands are device-specific. Define them for each device separately.

Another advantage of using the adb commands is that the multi RAB session can be initiated without the need of using tethering.

A device is defined by its VID and PID (vendor and product ID). While loading the Qualcomm driver of the UE, R&S ROMES4 prints the "Output" window where it looks for the device specific adb commands.

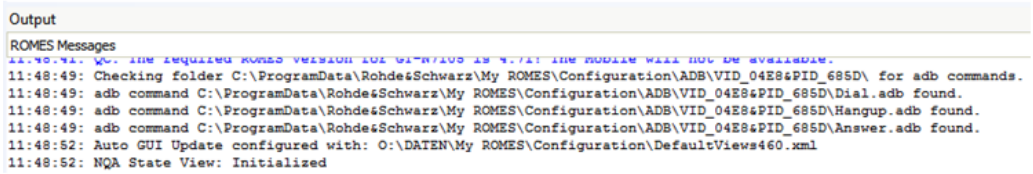


Figure 6-188: ROMES Output window

R&S ROMES4 scans for *.adb files for each supported command.

Whenever a command is executed the output view shows the exact command, which was sent to the device.

A precondition for using the adb commands is that USB Debugging is switched on at the UE. This switch can be found usually in the "Developer Options" > "Options" > "Settings" application.

Supported commands

The supported adb commands are listed in the following sections.

The content of the files is used as an argument for the adb.exe.

Dial

The file name of the command is dial.adb.

Use the place holder %%TELNUMBER%% in the file. This place holder is replaced by the actual phone number which is called.

Example:

shell am start -a android.intent.action.CALL tel:%%TELNUMBER%%

Hangup

The file name of the command is hangup.adb.

Example:

shell input keyevent 6

Answer

The file name of the command is answer.adb.

Example:

shell input keyevent 5

Switch to airplane mode

The file name of the command is `AirplaneModeOn.adb`.

Use the following place holders in the file:

- %%TELNUMBER%%
- %%SMSBODY%%

These place holders are replaced by the actual phone number and SMS Text.

Example:

shell settings put global airplane_mode_on 1

shell am broadcast -a android.intent.action.AIRPLANE_MODE --ez state true

Switch off airplane mode

The file name of the command is `AirplaneModeOff.adb`.

Example:

shell settings put global airplane_mode_on 0

shell am broadcast -a android.intent.action.AIRPLANE_MODE --ez state false

Send SMS

The file name of the command is "SendSMS.adb".

Example:

shell am start -a android.intent.action.SENDTO -d sms:%%TELNUMBER%% --es sms_body "%%SMSBODY%%" --ez exit_on_sent true

shell am broadcast -a android.intent.action.AIRPLANE_MODE --ez state false

shell input keyevent 22

shell input keyevent 26

6.4.7.4 Action menu LTE

Click the "Action" menu to get the box in the tool bar used to set up a call. The "Action" is added to the menu bar when mobile device has been successfully installed (see Chapter 6.1, "Devices", on page 1447).

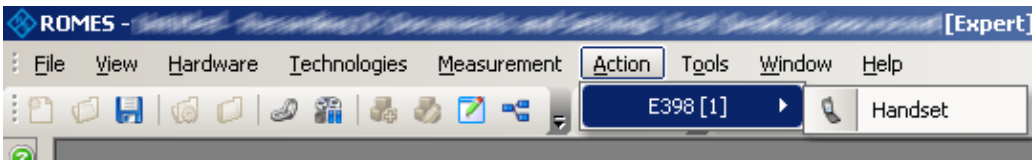


Figure 6-189: Action menu for LTE driver

If several mobiles are connected, separate command lines are displayed for each of them.

Handset LTE

Activates the entry of a number to dial, set up and terminate a call.

- **Handset**
  The "Handset" command opens a window (equal for all drivers) which have two possible statuses:
  – Not selected
  – Selected, marked with "- *" and shown in the following figure as connected mobile [2].

  If there is only one "Handset" window, it always has selected status.
  If there is more than one "Handset" window, the selected status can be set to any "Handset" window in one of two listed ways:
  1) Click to the window using a mouse.
  2) Choose selected window using the "N" key. In this case selection changed like this: Window[1] > press "N"> Window[2] > press "N"> ...Window[n] > press "N"> Window[1] (cycling choose like "Alt+Tab" between open windows in MS Windows).
  Only selected windows accepts hotkeys “D” ("Dial"), “A”("Answer"), “H”("Hangup").
  Note: The previously mentioned keys have only effect, if the focus is not set to an input control, example-given edit field or combo box.
  Example: if you select the phone number by selecting the corresponding entry of the combo box, the keys do not work afterwards. Set the focus to another window, for example to the main R&S ROMES4 window.

- **>>**
  The ">>" button enlarges the dialog box, giving access to the Key pad and the "Autodialing" option.

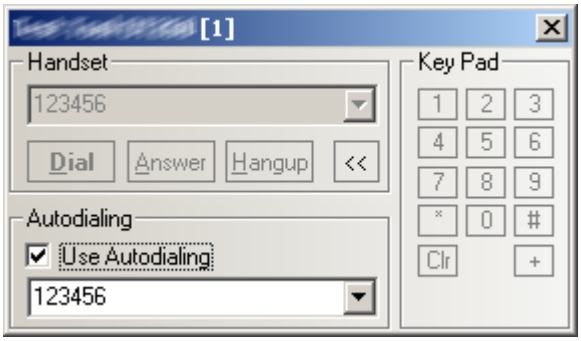


Figure 6-190: Use Autodialing

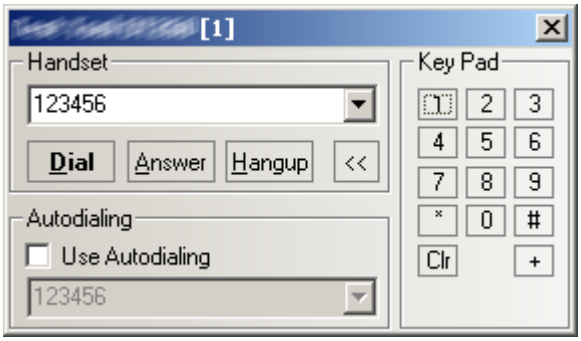


Figure 6-191: No Autodialing

- **Dialed number**
  The number to be dialed can be entered either via the keyboard and the input field or by clicking the on-screen keypad.
- "Close window ☒"
  Closes the window without any further action.
- "Dial"
  Starts dialing the number entered before.
- "Answer"
  Instructs the phone to accept the call.
- "Hangup"
  Drops the line.
- "Autodialing"
  If the box is checked, the phone number entered below is called periodically, the "Dial", "Answer", and "Hangup" buttons are disabled (grayed). The autodialing mode can be set even during the measurement, but only in "Idle mode".
  This item starts "Autodialing" if the "Start with Measurement option" was not checked in the driver configuration-autodialing tab panel.

6.4.8 NB-IoT devices

R&S ROMES4 supports the Exelonix NB-IoT development/evaluation modules. Their full integration in R&S ROMES4 makes required NT-IoT performance testing more comfortable.

Currently supported Exelonix NB-IoT modules use the following devices:

- SARA-R410M device (Qualcomm chipset based)
- SARA-N211 device (Neul chipset based)

6.4.8.1 Support of Exelonix NB-IoT modules

These modules offer band forcing in their "Network Forcing" configuration dialog.

R&S ROMES4 supports the Exelonix NB-IoT stick based on Quectel BG77. This module supports the on-device tests Ping and FTP jobs.

Note: Band forcing requires a reboot of the module. It is recommended to force the module before doing the measurement, and not as a part of the measurements configuration.

Note: If the Qualcomm R410M device is added to R&S ROMES4 by using the Qualcomm Wizard, remove the corresponding entry from the file `My ROMES\Configuration\QualcommMobilesV462.xml`. In that way, you get the access to the new features.

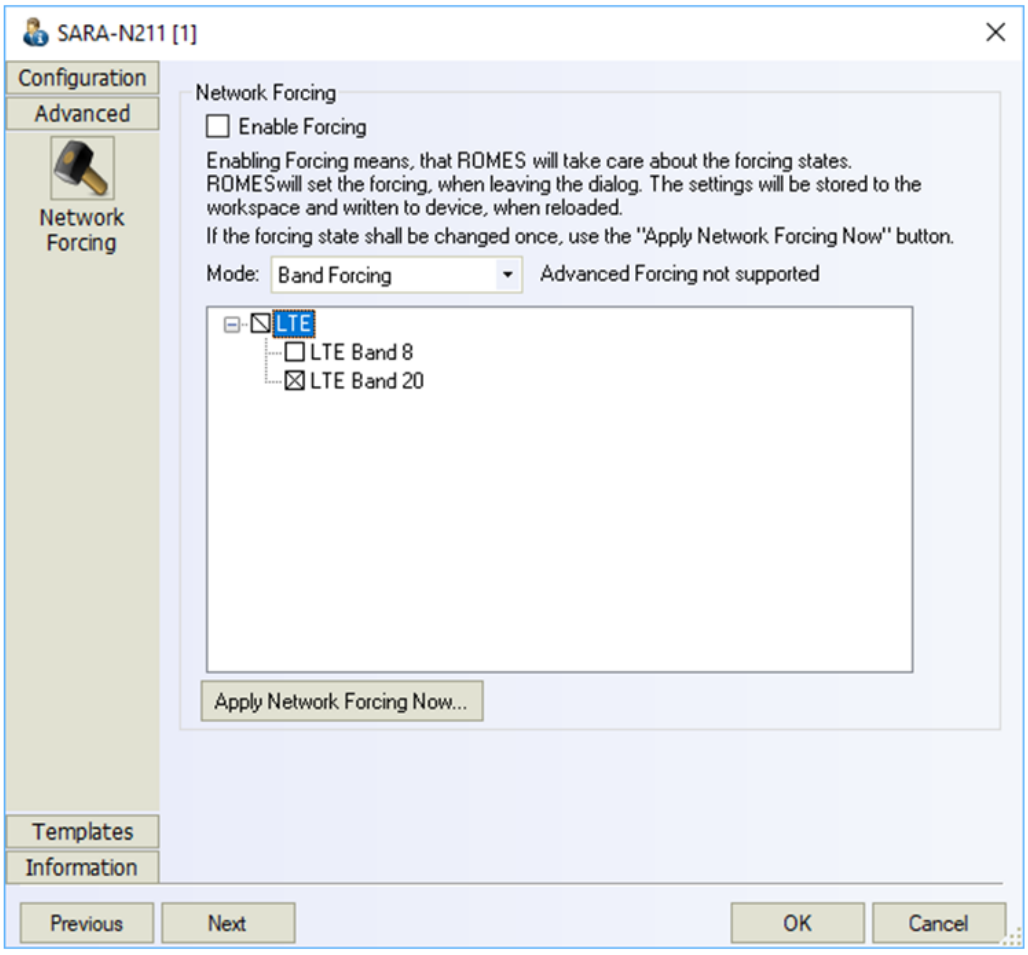


Figure 6-192: Band forcing for NB-IoT

These modules offer preconfigured DQA jobs, which allow to do the tests listed in the following table.

Table 6-12: NB-IoT supported DQA jobs

DQA Job	SARA-R410M	SARA-N211
NB-IoT Attach	available	available
NB-IoT Detach	available	available
NB-IoT Send UDP	available	available
NB-IoT Ping	not available	available
NB-IoT FTP	The job is supported if the Exelonix stick supports FTP	

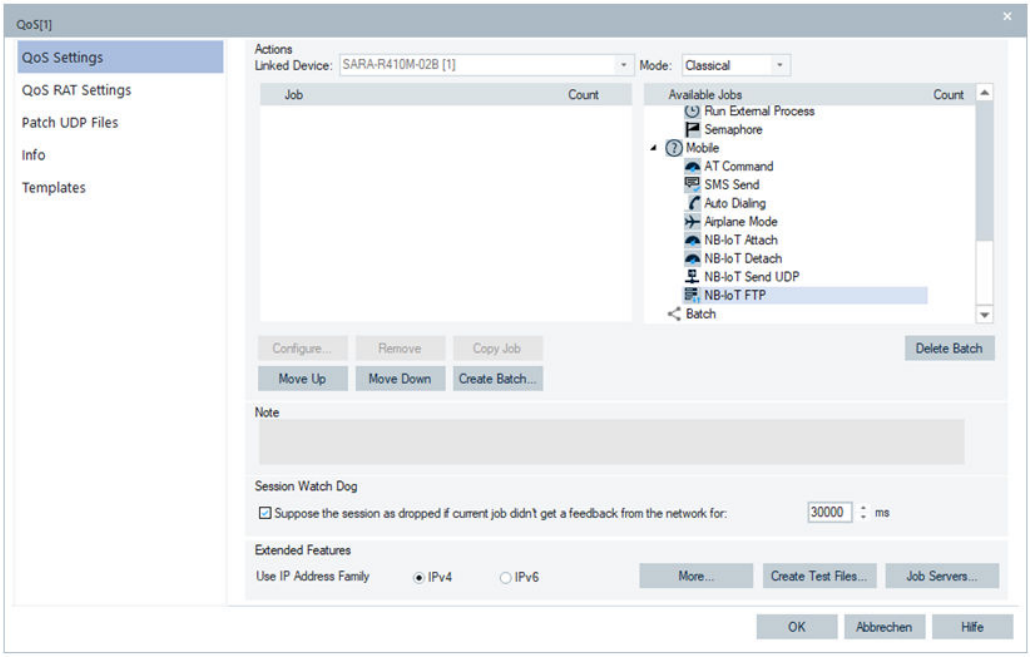


Figure 6-193: List of available NB-IoT DQA jobs

6.4.9 Support of smartphones

R&S ROMES4 supports variety of the Qualcomm Snapdragon and Samsung Exynos chipset-based smartphones.

For the supported smartphones, see the `Supported Devices2023-07-04.xlsx` file, which is a part of the customer documentation. The "x" symbol in the column QualiPoc RF of the "Devices" tab indicates the QualiPoc devices w/o POLQA which R&S ROMES4 supports. The next column, the QualiPoc QA with the same symbol indicates devices with speech quality analysis capability which R&S ROMES4 supports.

Support of Qualcomm and Samsung chipset based smartphones is indicated in "Hardware" > "Hardware Configuration" > "Mobile Devices". All services' test (for example,

FTP or HTTP service) are executed on a device, not on the computer. Such an execution of a test allows the system to simulate the user behavior more accurately.

The R&S ROMES4 fully supports service test on listed smartphone models.

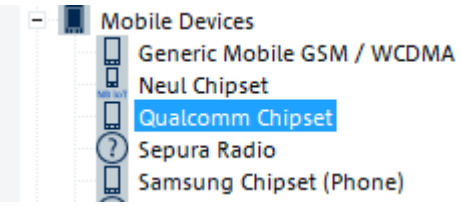


Figure 6-194: Supported smartphone

Prerequisite for Android based smartphones

To use an Android OS based mobile device as a "Smartphone" with the R&S ROMES4, a special SW is installed on it. The Rohde & Schwarz is supposed to do the installation. This installation requires the R&S ROMES4QP or the R&S ROMES4QC/ ROMES4SAM option dependent on the selected DQA operation mode.

Prerequisites for first usage a Samsung Galaxy S3 LTE GT-I9305 Smartphone with R&S ROMES4

Before you use the Samsung Galaxy S3 LTE GT-I9305 for the first time as the "Smartphone" with R&S ROMES4, perform the following steps:

- Dial *#7284# on telephone keypad.
- Choose "DM + MODEM + ADB" in the "Qualcomm Settings" submenu and press "OK".
- Leave the main menu without pressing "SAVE" and "RESET".

Reboot of a smartphone

The first time a smartphone is connected to R&S ROMES4, reboot of the phone after the installation of the Android applications can be required. If loading the R&S ROMES4 driver files fails with the message that a reboot is necessary, connect the phone again after it is rebooted.

For the successful connection to the mobile network, the software requires the properly configured default APN profile.

Dependent on mobile type, users can select predefined entries for APN type or enter them as a text via keyboard.

To set the APN type, navigate to the APN menu within your phone settings menu (for example, "Settings" > "Wireless & Networks" > "Mobile Networks" > "Access Point Names").

1. - Select the APN "Internet" if only the predefined settings are possible.
   - Type `default,supl` when the APN type setting is editable (string value).

2. Save the settings.
3. Exit the menu.

   The default APN profile is now properly configured.

The Samsung chipset based mobile device can be loaded in two ways:

- From the "Devices" in the "Welcome" page, see Figure 3-3.
- From the "Hardware" > "Connect/Disconnect" > "Hardware Configuration" page.

If the device is loaded from the "Welcome" page, the same load options as for the Qualcomm chipset-based devices are available, see Figure 6-22.

If the device is loaded from the "Hardware Configuration" page, the "Assign Serial Ports" dialog opens, which allows to select diagnostic ports.

The Samsung Exynos chipset-based smartphones offer both a diagnostic port and IP connection, see Chapter 6.1.9, "Samsung Exynos 5G chipset-based mobile devices", on page 1484.

Selection of the "as QualiPoc" diagnostic port together with the "use GPS"option, allows the internal mobile's GPS usage. The GPS driver performs the DQA jobs in QP mode. In addition, if the WLAN option is available, possible is usage of internal WLAN interface for WLAN scanning.

- Action menu 1656
- Smartphones configuration page 1656
- RAT forcing with smartphones 1657
- Advanced band forcing with smartphones 1657
- Supported GPS of smartphones 1659
- Smartphones support of WLAN scanning 1665

6.4.9.1 Action menu

For quick tests, use the "Action" > "<mobile name>(QP)" menu, which initiates data tests and visualizes the basic log results.

This interface is designed for the expert user.

Ensure not to interfere running DQA measurement sessions.

The R&S ROMES4 does not support dis- and reconnect of a smartphone during a measurement.

6.4.9.2 Smartphones configuration page

The figure shows the tabs available to set a Qualcomm chipset based mobile device and the contents of the main "Device" page. The page gives basic information about connected device.

Select measurement types/technologies to run on the device in the "Measurements" pane.

For the supported services, see Chapter 6.5.2, "DQA jobs with Android OS-based smartphones", on page 1961.

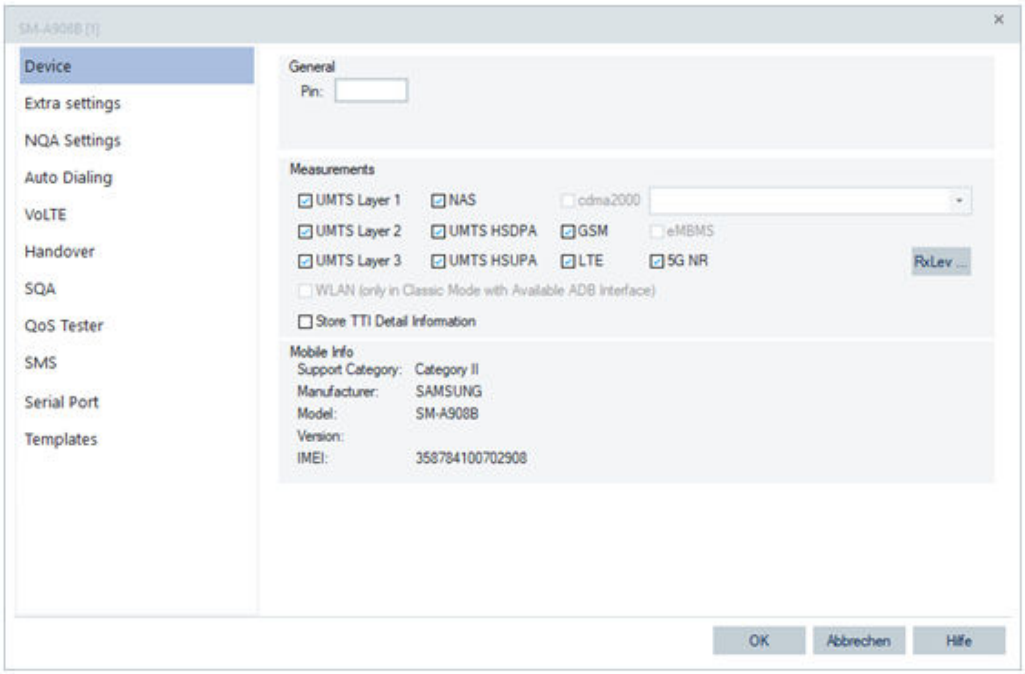


Figure 6-195: Connected Samsung device

6.4.9.3 RAT forcing with smartphones

Smartphones support the RAT forcing. The forcing is the same as with other mobile devices.

Smartphones do not support a query which allows getting the information about the currently active forcing. Thus unless the R&S ROMES4 has control over the forcing activity, the R&S ROMES4 cannot display the actual state of the forcing settings.

After sending a force command to a device for the first time, R&S ROMES4 tracks the state of forcing. The state tracking checks if the forcing commands are sent by the R&S ROMES4 and not by other products or changed manually.

RAT network forcing is not available for the Samsung Galaxy S6 smartphones.

6.4.9.4 Advanced band forcing with smartphones

Smartphones support the advanced band forcing. You can force them to a certain channel and a certain cell of the channel.

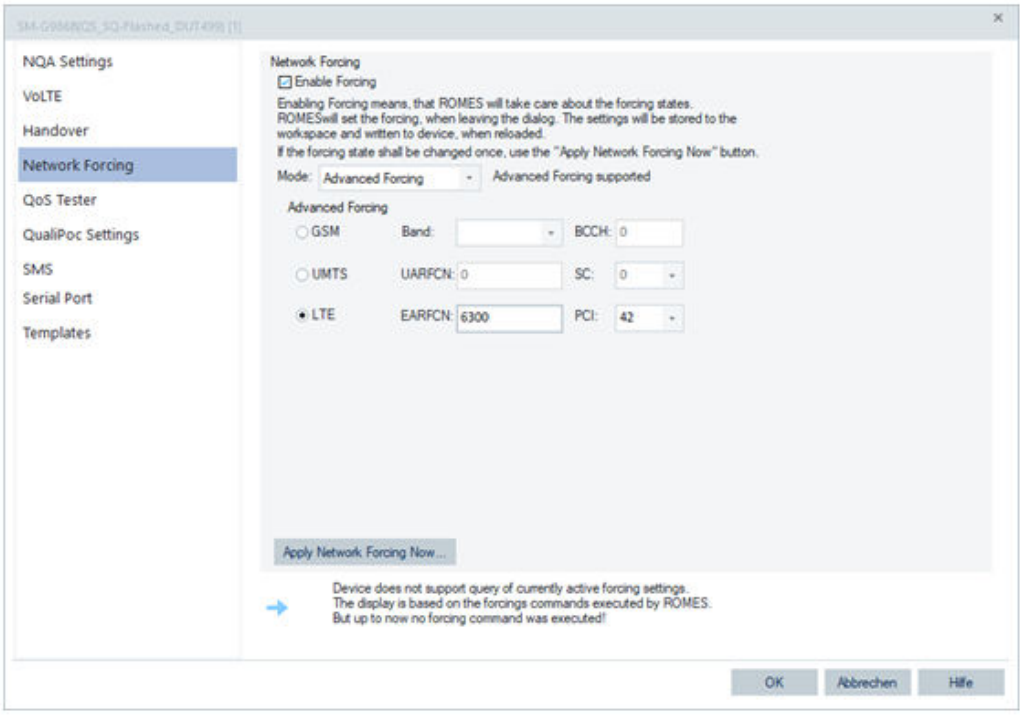


Figure 6-196: Network forcing setting

Select the band forcing type in the "Network Forcing" > "Mode" combo-box.

- Select the "Band Forcing" entry to force bands in the known way.
- Select the "Advanced Forcing" entry to configure channels and cells for band forcing of the 3GPP specified RATs. The entry is unavailable if a mobile does not support advanced forcing.

After selection, click "OK" to execute the task. The forcing process takes up to 60 seconds. After this time, the forcing stops.

Advanced forcing is an experimental feature and could harm the mobile phone.

To force UMTS or LTE only to a special UARFCN/EARFCN, the SC/PCI value in the corresponding combo-box must be set to "–".

Sometimes forcing is not possible due to the current state of a mobile phone. If the forcing fails, an error message is displayed. Often, the mobile phone must be rebooted to activate band forcing and the trace port is lost then. Confirm the related R&S ROMES4 message by pressing the "OK" button.

At a measurement start, the mobile phone is forced with the configuration of the current workspace. The "General Status View" shows the current forcing state or, if available, the reason of a forcing failure (for example, Android error, BCCH lock not available for this device).

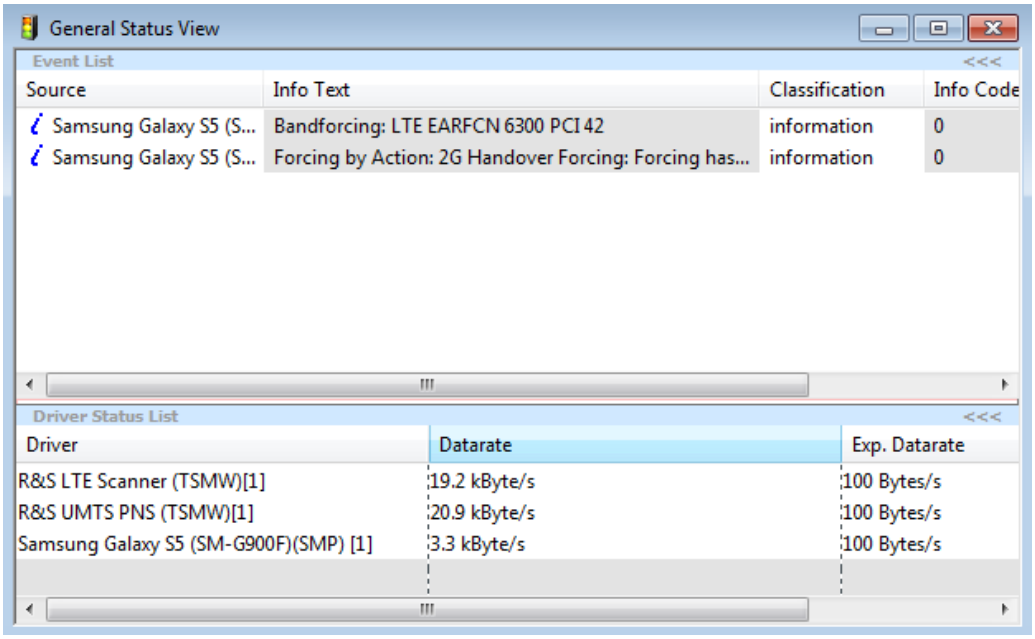


Figure 6-197: Current forcing state of a mobile

During the advanced measurement, forcing is not possible.

6.4.9.5 Supported GPS of smartphones

QualiPoc plus GPS

If a smartphone has built-in GPS, i.e. uses the QualiPoc mode plus GPS, the usual GPS configuration page is a part of the drivers' configuration dialog, see Figure 6-22.

The following figure shows the "GPS Health Monitoring" page for the Samsung Galaxy S5.

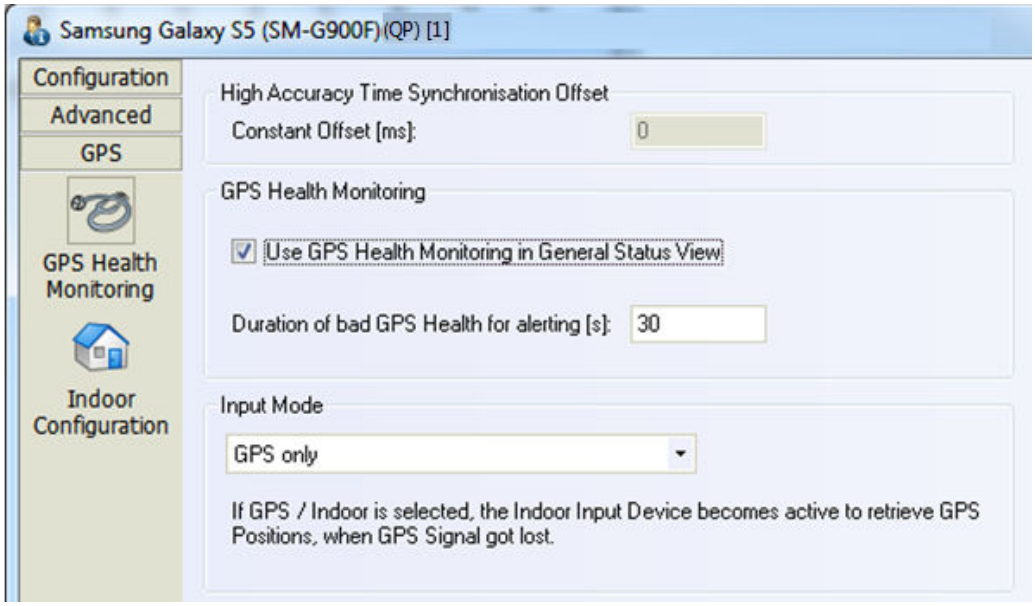


Figure 6-198: GPS configuration dialog

For the details about the functions in the "GPS Health Monitoring" and "Indoor Configuration" pages, see Chapter 6.6.1, "GPS devices", on page 2061.

GPS of iPhones

The GPS of an iPhone can also be the GPS source of the R&S ROMES4 measurement.

As most of the users use the scanner GPS or have a special GPS device, the option to use the iPhone's GPS is disabled by default.

To enable the GPS of the iPhone, select the option "Offer GPS for QualiPoc/Phone Devices" in the "Preferences" > "Advanced Settings" page.

If the option is selected, the page pops-up asking you whether to use the GPS once the iPhone is loaded into R&S ROMES4. Only one GPS is accepted in R&S ROMES4 application. If two or more iPhones are loaded into R&S ROMES4, only one of them can be the GPS source.

Confirm on the iPhone that the R&S ROMES Probe iOS App is allowed to use GPS. If it is denied, no GPS data can be forwarded to R&S ROMES4. If you decide later to activate usage of the iPhone's GPS, it has to be done in the iPhone's configuration, as usual.

iPhone app

For the GPS support of the R&S ROMES Probe iOS App on iPhone, the application asks for permission to use the phones location data. The first time the application is started you are prompted to give the application permission to use location whenever the app is in use.

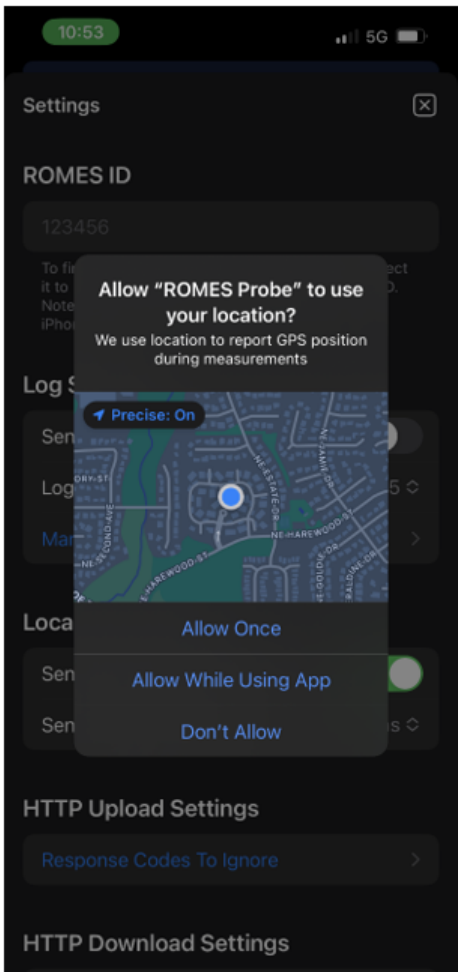


Figure 6-199: Allowing app to use device location

The following selections for the location usage are available:

- "Allow Once": The R&S ROMES Probe iOS App (further R&S ROMES Probe) provides GPS data to R&S ROMES4 only during a data test measurement. GPS during voice call test is not done as the application is in the background. Despite "Allow Once" selection, the location permission does not receive location updates while in the background. The next time the application is run, the prompt for location permission is done again.

- "Allow While Using App": The R&S ROMES Probe prompts if it is allowed to receive location updates while in the background.

- "Don't Allow": The R&S ROMES Probe does not provide location data to R&S ROMES4. It does not prompt you for location permission again. This choice can be changed in the "Settings" > "Privacy" > "Location Services" by giving the "Always" permission to the R&S ROMES Probe iOS App.

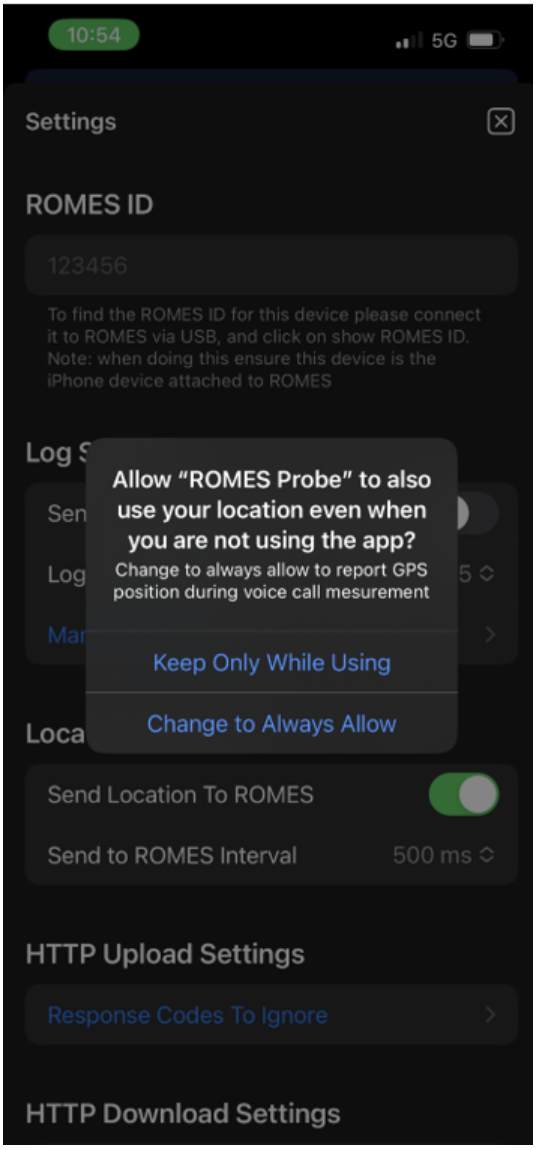


Figure 6-200: Allowing app usage during voice call

- "Change to Always Allow": The R&S ROMES Probe provides GPS data to R&S ROMES4 during data and voice test. The "Always" permission is need so that location data can be provided on voice call test while the application is in the background. The application is periodically reprompt for "Always" permission. The periodical reprompt ensures you continuously to allow R&S ROMES Probe to receive location updates while the application is in the background.

- "Keep Only While Using": The R&S ROMES Probe only provides GPS data to R&S ROMES4 during a data test measurement. GPS during voice call test is not done as the application is in the background. The location permission with "Allow While Using App" selected does not receive location updates while in the background. The app honors you selection and does not prompt for location permission again. This choice can be changed by "Settings" > "Privacy" > "Location Services" by selecting "Always" for the R&S ROMES Probe.

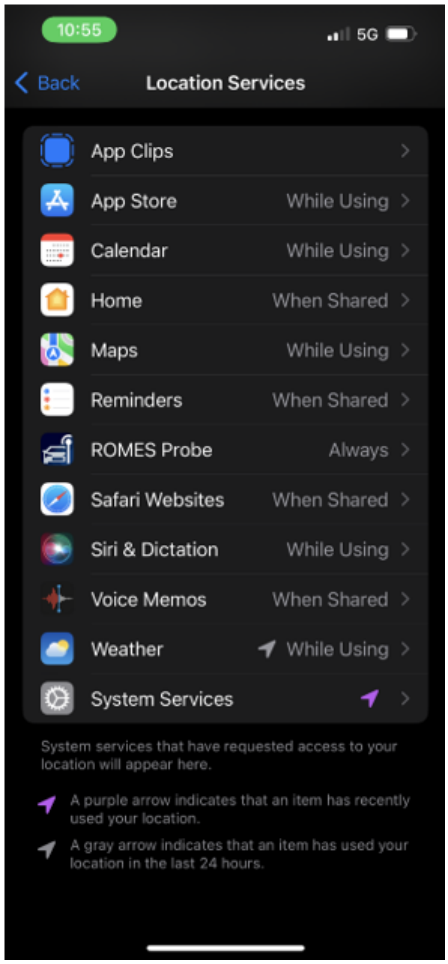


Figure 6-201: "Always" set for R&S ROMES Probe

iPhone App Settings

R&S ROMES Probe has two settings to support GPS of iPhone.

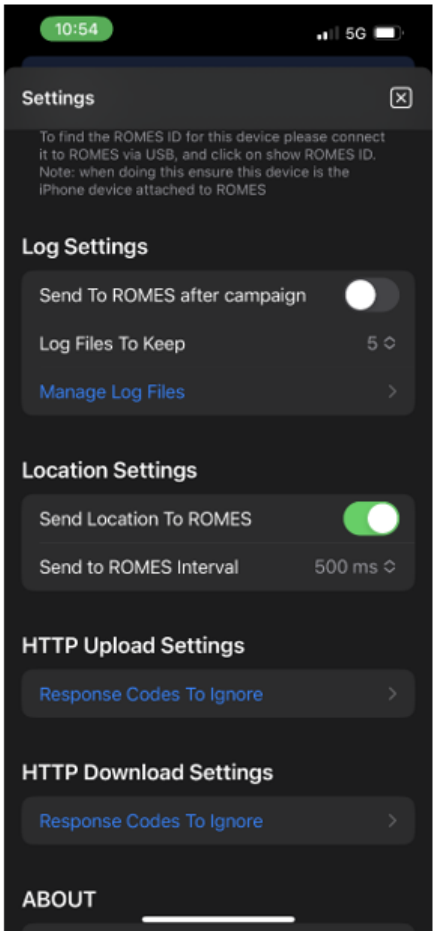


Figure 6-202: iPhone location settings

The settings are:

- "Send Location to ROMES": If activated and the application has given the location services permission, the location updates are sent to R&S ROMES4 during measurements. If not activated, the location updates are not sent to R&S ROMES4 regardless of location services permission given.

- "Send to ROMES Interval" – The frequency location updates are sent to R&S ROMES4 during measurements. The available periodicities for sending the updates are available in the "Send All Updates".

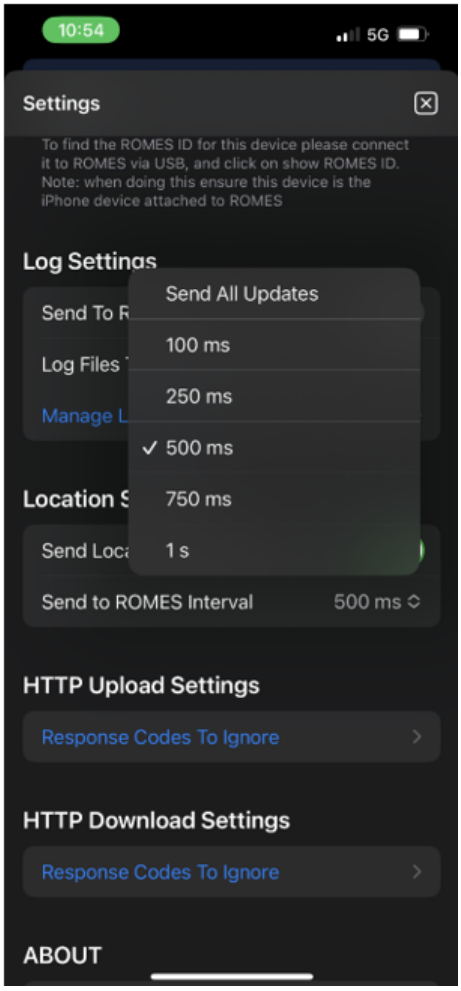


Figure 6-203: Send location update each 500 ms, default

6.4.9.6 Smartphones support of WLAN scanning

If the R&S ROMES4WF2 WLAN option is available, it is possible to scan WLAN networks with a smartphone.

The WLAN option must be activated on the smartphone to start the WLAN scanning during measurement.

The WLAN data are displayed in the all available WLAN scan views.

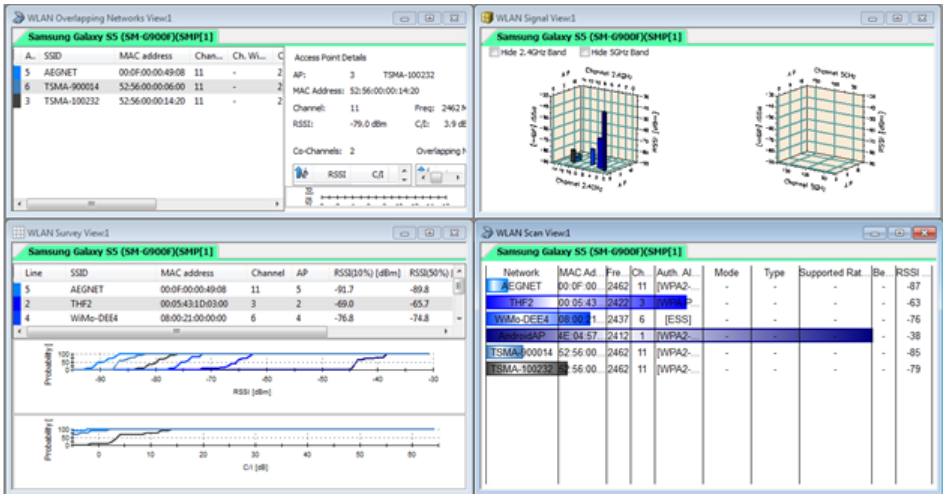


Figure 6-204: Supported WLAN scan views for Smartphone

If a smartphone is connected to WLAN, certain IP connections are offloaded to WLAN.

If the smartphone is connected to a WLAN network and a DQA job is linked to it, the R&S ROMES4 Data Quality Analyzer is informed about this connection. The offloading can run.

If the connection changes during a DOA job execution, the job is aborted, because the current connection is dropped. In this case, the job automatically restarts WLAN with the new current connection.

The current WLAN connection status can be observed within the "Signal Tree View" > "WLAN", the "Connection Status" branch.

Support of WLAN offloading for smartphone

If the connection changes from LTE to WLAN during the execution of a DQA job (for example, FTP Download), the current job is aborted. The job is aborted as the connection dropped. The job automatically restarts WLAN then.

The signals in "Interface Statistics" and "Radio State" brunch are not available. The "Smartphone Event" signal indicates scanning and connection state changing, the info is provided from smartphone.

6.4.10 Integration of Quectel RM5xxQ modules

As being integrated into R&S ROMES4, the usage of Quectel modules for measurements is made easier.

6.4.10.1 Preparation of the device

It is R&S recommendation to use the Windows Mobile Broadband approach.

To use that approach, install the Quectel's MBIM drivers and ensure that the USBnet configuration of the device is set to 2. The mentioned can be done directly via the AT commands or using R&S ROMES4, once the MBIM driver is installed.

Ensure that only the MBIM driver is installed. Remove all other Quectel drivers, as they can interfere with the MBIM driver.

R&S ROMES4 recognizes the module automatically. Nevertheless, ensure that R&S ROMES4 can access the modem and the diagnostic port of the module, that is, close any terminal program like PuTTY which opens the modem port.

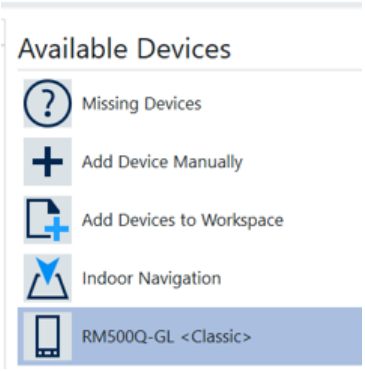


Figure 6-205: Quectel device available

R&S ROMES4 allows you to change the USBnet and the APNs via the GUI.

Change the configuration of the driver and select the "Device Properties" page.

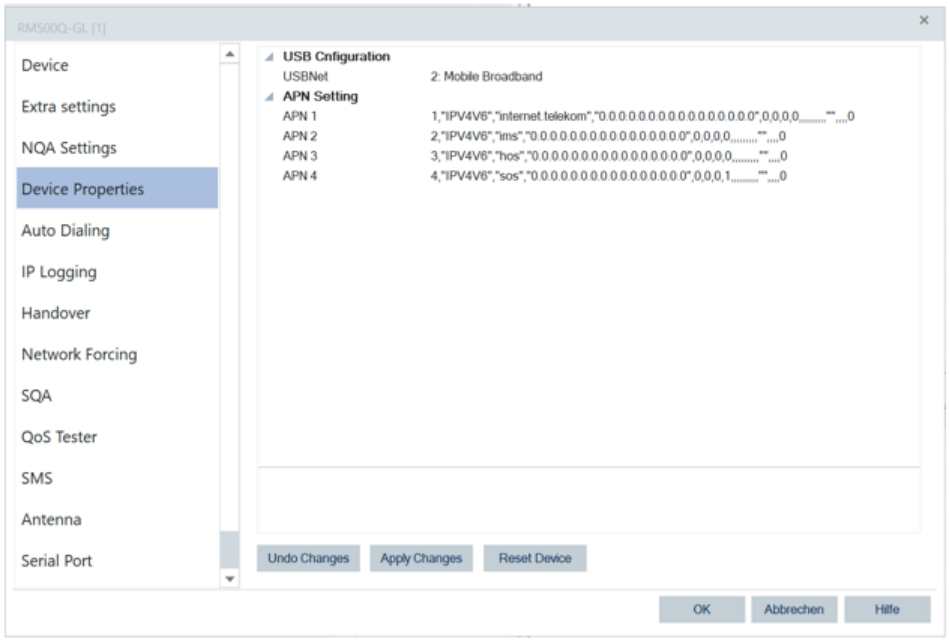


Figure 6-206: RM5xxQ-GL device properties

The APN cannot change, depending on the SIM card inserted into the module.

If for any reason the device has not been detected automatically, try the "Add Device Manually" option. Select the Qualcomm mobile driver and assign the COM ports of the Quectel device accordingly.

The APN 1 connection to the data network is the one which is used. To change the APN, enter its complete specification as required by the `AT+CGDCONT` command. Changes are not written to the device automatically. To write the new settings to the device, press the "Apply Changes" button.

To reset the device, what can be necessary for some changes, press "Reset Device" button.

The network forcing option is implemented and accessible via the GUI. To force the network, select the "Network Forcing" page.

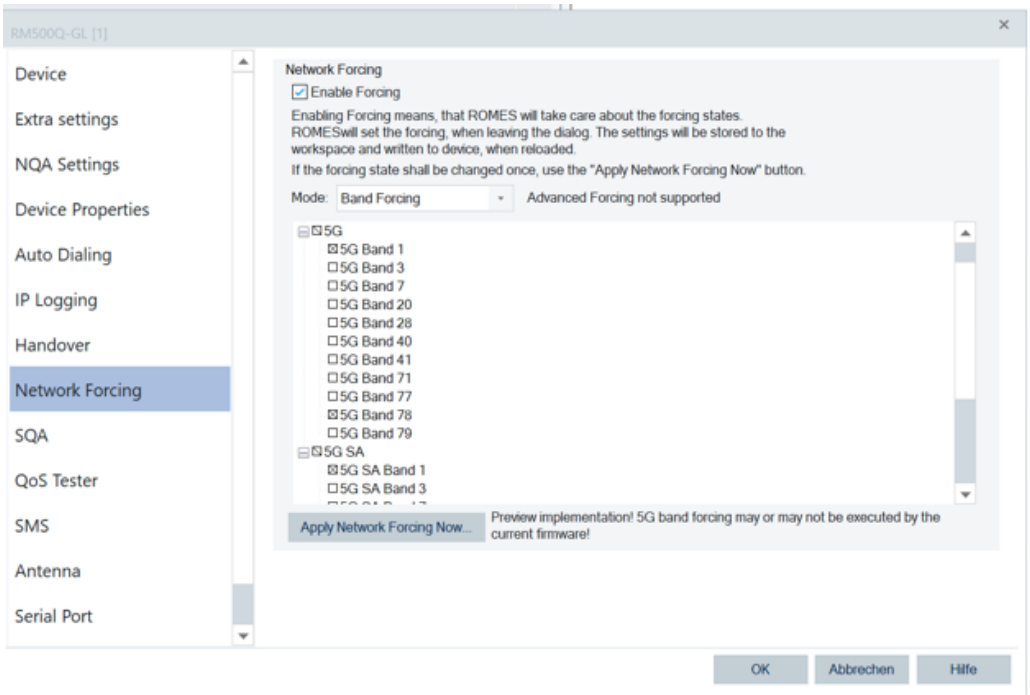


Figure 6-207: RM5xxQ-GL network forcing

Check "Enable Forcing" and select the bands which are supported. The fewer bands are selected, the faster the initial cell search finishes. If you enable only 5G bands, the UE switches into the 5G NR Standalone mode.

You can apply the selected forcing directly from the dialog. Note that applying the forcing needs a reboot of the device. If the "Enable Forcing" is checked, when pressing "OK" R&S ROMES4 takes care that the selected forcing is applied before the start of measurement.

6.4.10.2 Configuration of data session

Ensure that you have not selected Windows option to connect device to a network automatically.

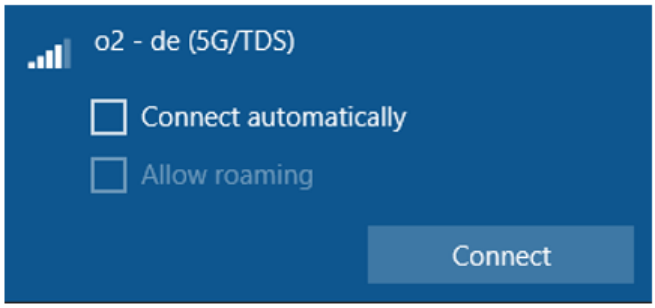


Figure 6-208: Connect automatically deselected

If the MBIM driver is installed, a Mobile Broadband adapter has to be used. Quectel USB modem does not work.

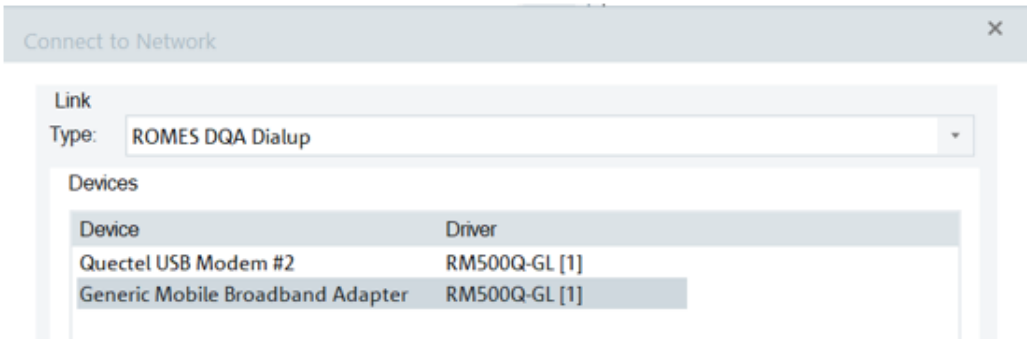


Figure 6-209: Configuring network connection

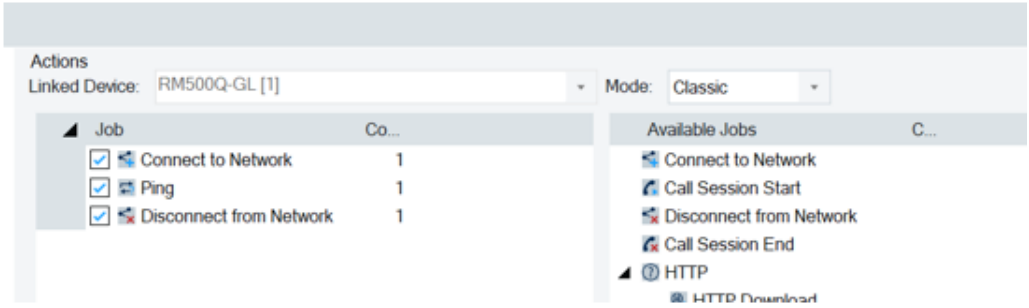


Figure 6-210: An example of the configured jobs with Quectel device

If the Windows Mobile Broadband setup is correct, the "DQA Message View" looks similar to the following screenshot for the Connect job.

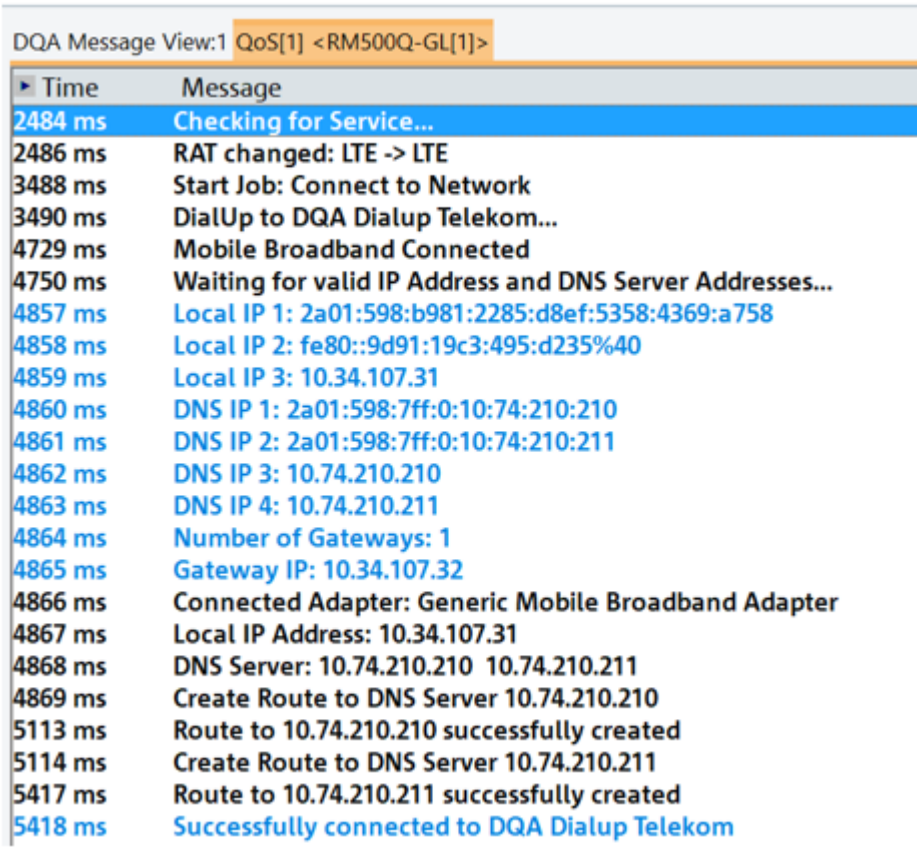


Figure 6-211: DQA messages view for connect job

6.4.10.3 Trouble shooting

Table 6-13: Possible solutions for occurred problems

Problem	Possible solutions
R&S ROMES4 does not recognize the device automatically	Restart R&S ROMES4 Ensure that the diagnostic port and the modem port are accessible and not blocked by other applications. Test the modem port with the Windows Device Manager.
Windows Mobile Broadband Connection does not work	Ensure that the MBIM driver is the only Quectel driver installed on your machine. Verify APN settings. Verify the USBbnet property of the device, it has to be set to “2.”
R&S ROMES4 does not offer the Mobile Broadband Adapter	Ensure that the MBIM driver is the only Quectel driver installed on your machine. Verify the USBnet property of the device, it has to be set to “2” .
Mobile Broadband Connection connects automatically	Ensure that the Windows property "Windows shall handle this connection automatically" is disabled.

Problem	Possible solutions
Device does not find the network	Check the currently forced bands and adapt to required band. Ensure that you have coverage.
Device does need long to find the network	Force the device to the used band or more bands.

6.4.10.4 Alternative setup

The device can be also configured as an RNDIS device.

To configure it as an RNDIS device, set the USBnet property to “3” and install Quectel’s Windows USB driver.

Ensure that all other Quectel drivers are uninstalled, as they can interfere.

The RNDIS setup is similar to a “normal” Ethernet connect. As soon, as the device is attached, the connection is established.

Configure the R&S ROMES4 DQA Connect job using the Quectel Windows Network Adapter.

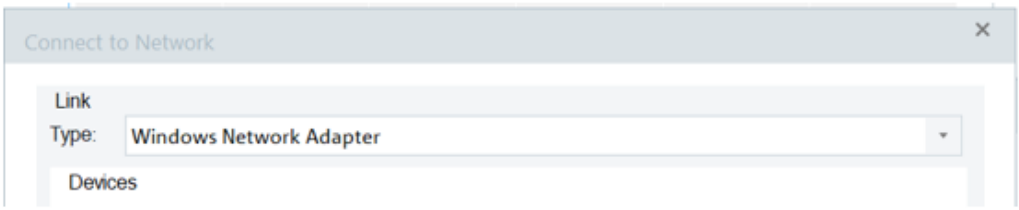


Figure 6-212: Alternative for Quectel device setup

In this case, the Connect job does not really establish a connection, but is necessary to get the link to the used network adapter. This link is necessary to calculate throughput.

This alternative setup is not recommended. Use the MBIM driver and Windows Mobile Broadband connection approach.

6.4.11 Speech quality measurements with smartphones

R&S ROMES4 allows a speech quality measurement in an easy and convenient way if smartphones are used. POLQA or SQUAD (the corresponding option is necessary) is executed actually on the smartphone itself. The analysis execution on the smartphone saves the CPU power on the PC side and even more important, makes any cabling for speech needless.

R&S ROMES4 allows the user to measure the achieved speech quality between the smartphone and a dedicated Land Unit (speech server) or between two mobile devices.

The Land Unit (LU) is a separate product with its own manual.

For detailed description of speech quality measurement jobs and parameters, see Chapter 12.11, "Smartphone SQ measurement job file", on page 2414

6.4.11.1 Measurement prerequisites

The following products/options are necessary to measure speech quality:

- R&S ROMES4 with smartphone option
- SQ smartphone with R&S ROMES4 and POLQA option
- SQ speech server

Do not load the SQA in parallel to the smartphone.

6.4.11.2 Measurement setup

The measurement sequence is defined in so called "job files". Each job file of the measurement system has a corresponding file for the server. Import the server job files to the server before using them. The server job files have the naming convention `job_nnn.ini`, where nnn is a number between 0 and 999.

R&S ROMES4 allows setting the ExcludeCallSetupFromCallDuration parameter for speech quality measurements in Fully integrated device operation mode.

The generation of the LU file allows you to set the test repetition value).

In Fully integrated device operation mode the `LU.ini` file contains the settings for the `*.wav` file recording. The same settings as for the A-side are used.

Measurement setup with land unit as B-Party

For installation and maintenance, follow the corresponding manuals of the Land Unit.

The configuration of the device is stored in the measurement file and displayed in the measurement file information.

Smartphone Speech Quality Measurement:	
Number:	+498945088293
Profile:	O:\DATEN\My ROMES\Smartphone Voice Profiles\job_001.ini
Audio:	Never
Mode:	A-Party (UE to Land Unit)
B-Party:	Land Unit
Measurement ID:	2013-03-05-13-47-28-0019-4917-8901-8978

Figure 6-213: Information on device configuration

To perform measure speech quality with a smartphone, the phone has to be loaded as a smartphone (Qualcomm chipset-based device).

Import the correct job file in the "Voice Call Settings" > "Profile" combo-box used for speech quality test with LU as a B-party.

If using a voice file profile with MTCs, ensure that a phone number of the measurement systems' smartphone is set correctly before importing the file. It is essential as the imported file contains a phone number of the smartphone.

The content of the voice file profile is displayed in the lower section of the "Voice Call Setings" page.

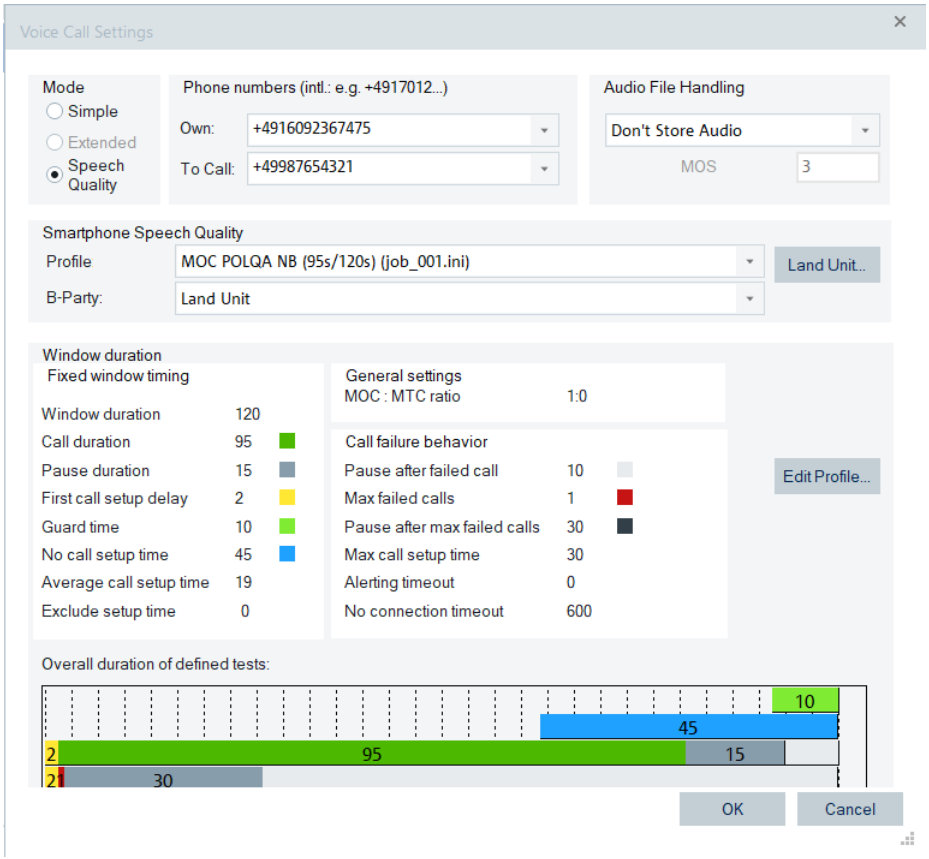


Figure 6-214: Content of the selected profile - mobile to Land Unit

The LU job file is generated automatically in the smartphone's "Autodialing" page.

The complete setup of the measurement is done in the smartphone's "Autodialing" page. If a smartphone is connected, the page offers the "Voice Call Settings" option.

1. Select the "Voice Call Settings" option.
2. Select one of the available smartphone job files in "Profile".
3. Enter the telephone number of the smartphone ("Own") and the Land Unit ("To Call").
4. Press the "Land Unit" button to generate the corresponding job file for the Land Unit.
5. Confirm the edited parameters of the Land Unit 's `job_nnn.ini` file in the opened "Land Unit Configuration Parameters" dialog.

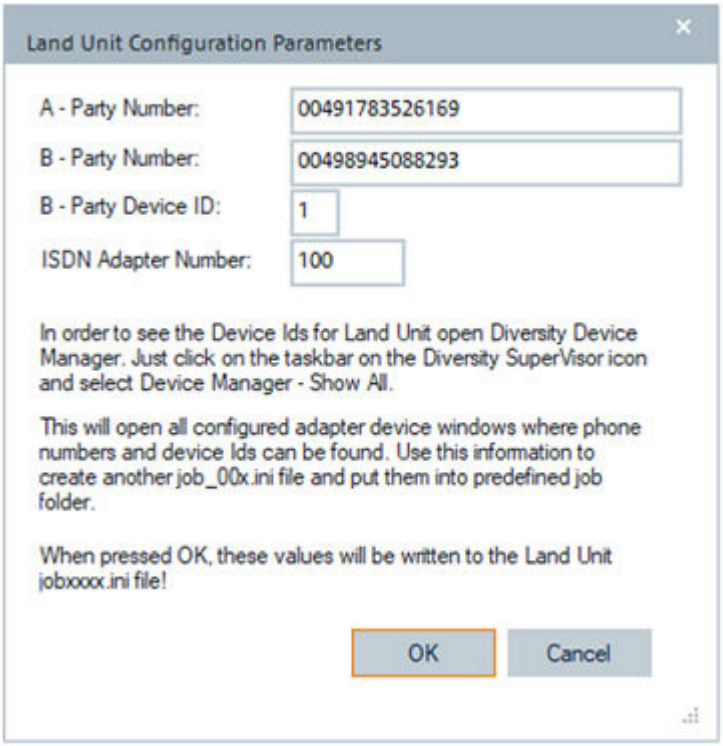


Figure 6-215: Land Unit parameters

The job file is created in the Land Unit 's subdirectory.

The parameters shown in the dialog are:

- "A-Party Number"
  Telephone number of the dialing party (the smartphone)
- "B-Party Number"
  Telephone number the Land Unit listens to
- "B-Party Device ID"
  Device ID configured in the file `LU isdn conf.txt` on the Land Unit
- "ISDN Adapter Number"
  Configured ISDN adapter number

The job files have to be writeable, as they are adapted during the measurement.

The "Voice Call Settings" > "Audio File Handling" function offers three different options for handling the recorded audio file.

Table 6-14: Options for handling the recorded audio file

Option	Description
"Don't Store Audio"	Audio files are never stored to the measurement file
"Store Audio"	All audio files are stored to the measurement file
"Store Audio, if MOS is worse than…"	Audio files are stored only, if the corresponding MOS value is worse than the given value

Click the "Edit Profile" button to edit a voice file profile you selected in the "Profile" combo box. The "Voice Call Profile <*.ini>" page is displayed.

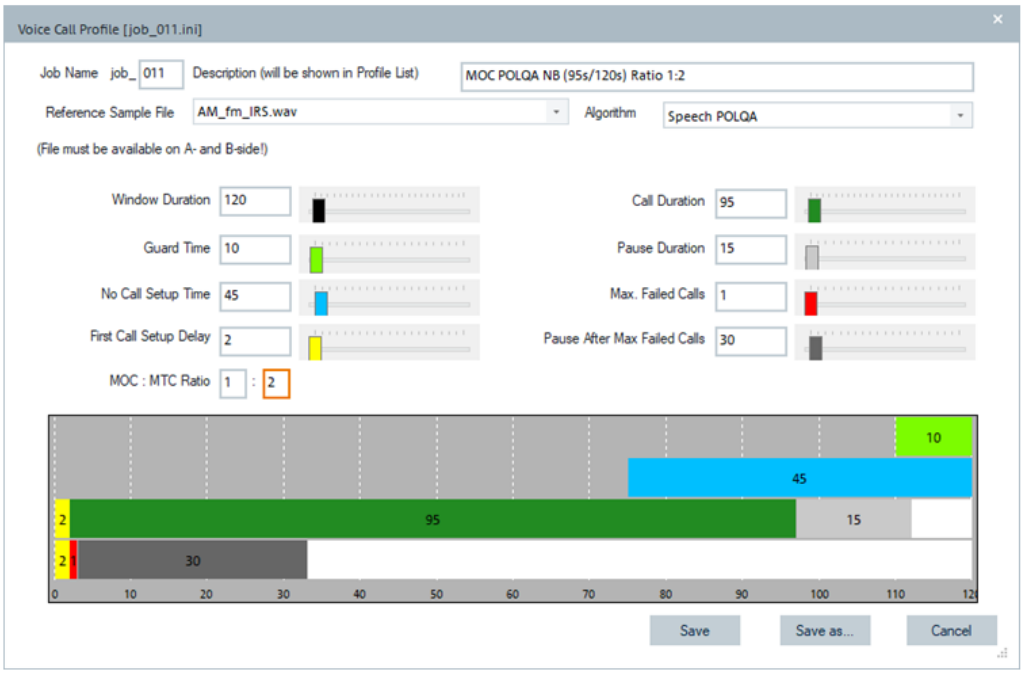


Figure 6-216: Job profile configuration

Voice call profile

The file name of the selected voice file profile is shown in the "Voice Call Profile <*.ini>" > "Description (will be shown...)" box. The additional description can be added.

Select the algorithm to be used for the voice file profile in "Algorithm".

You can change the reference sample file of a voice file profile in "Reference Sample File". The "Reference Sample File" combo-box is filled with the `*.wav` files available on the phone. After saving the reference sample file configuration of call values, R&S ROMES4 checks if the selected reference file is also available on the B-side.

This file must be available on mobiles of the A-side and the B-side, i.e. on the Land Unit used as a B-side. If not available, a warning message is displayed.

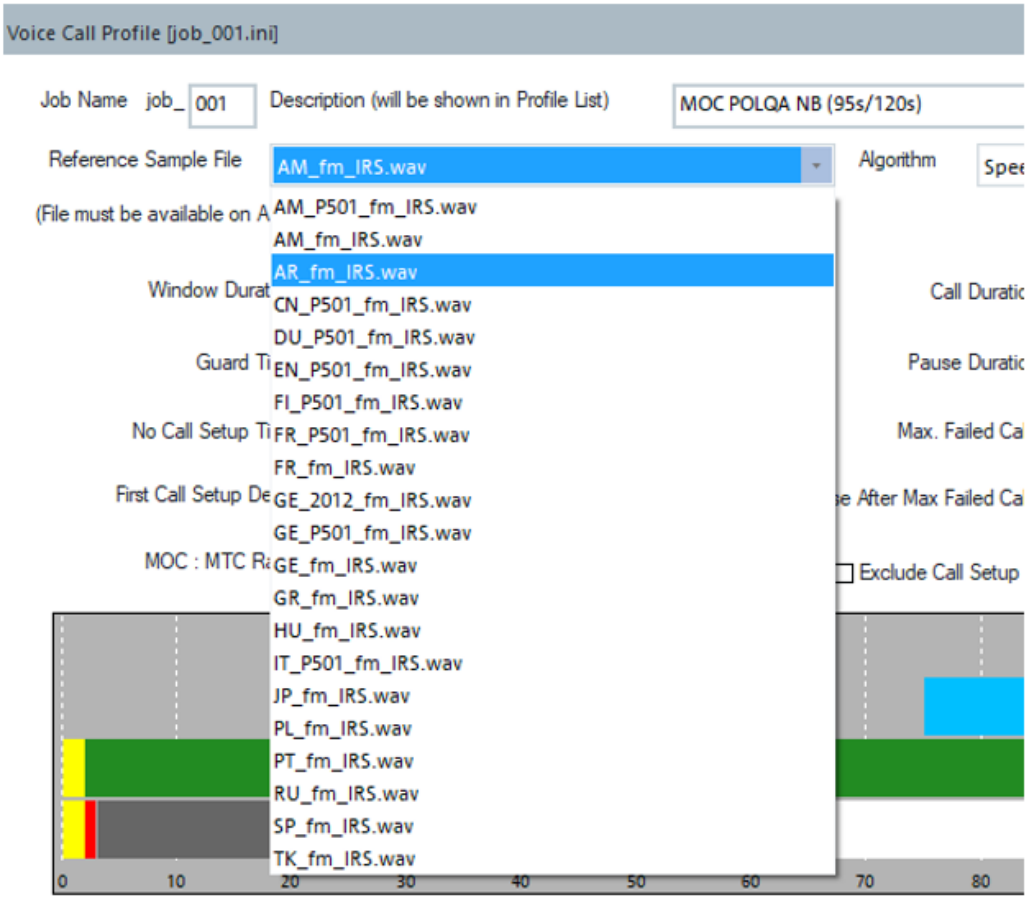


Figure 6-217: Combo-box filled with files available on A-side

To edit the call values of a reference sample file, position the mouse cursor over the desired slider and use the mouse wheel.

"Window Duration" defines the total time for the call.

The ranges of the other call values depend on the value adjusted in "Window Duration".

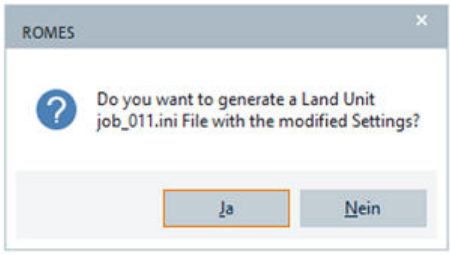
That is, the settings in the "First Call Setup Delay" + "Call Duration" + "Pause Duration" must be lower or equal than this value.

The "Voice Call Profile" page lets set the MOC to MTC ratio. The job name must be defined other than being in the range 001 to 010, as the jobs in mentioned range are R&S ROMES4 system configurations (ROMES System INI Files).

If the selected file is a R&S ROMES4 predefined profile (for example, `job_001.ini`), the "Save" button is disabled because such a profile cannot be changed. If the job's name is greater that 010, the button is active and the modified settings can be saved. The file name is automatically generated using the job name.

To create a user defined (modified) file from a predefined profile file, i.e. the source file's name is in range 001 to 010, apply "Save as" and different file name.

If the profile is configured to call the B-Party which is a Land Unit, the question whether to create the LU `job_xxx.ini` file with these modified settings is displayed.



If you select "Yes", the "Land Unit Configuration Parameters" dialog is displayed, see Figure 6-215, where additional settings can be done.

The storage directory for the new profile must be the same directory where the R&S ROMES4 standard profiles are stored. One of the following storage locations is used:

`C:\ProgramData\Rohde&Schwarz\My ROMES\Smartphone Voice Profiles\UE-UE`, if two mobiles are involved.

`C:\ProgramData\Rohde&Schwarz\My ROMES\Smartphone Voice Profiles\UE-LU`, if a Landing Unit is used.

If the profile is saved, it is shown as the current one in the "Autodialing" configuration page.

Measurement setup with smartphone as B-Party

If two smartphone mobiles are connected to R&S ROMES4, it is possible to test the speech quality of a call from one mobile to the other one.

For the test, select a connected mobile within the "B-Party" combo box. If the phone number of the B-Party is known, the number is displayed in the "To Call" box automatically.

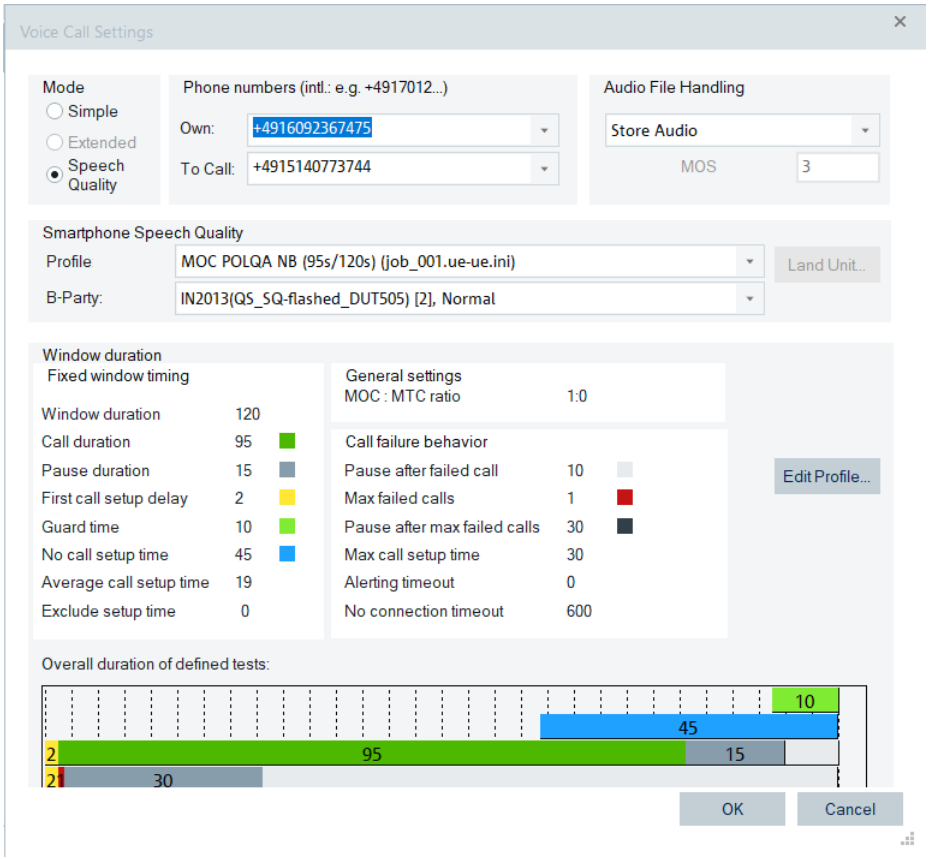


Figure 6-218: Content of the selected profile - mobile to mobile

Use different profiles for tests mobile to mobile.

The content of the "Profiles" combo box is updated automatically when switching between LU and mobile. The B-Party mobile is set to Speech Quality (B) mode automatically.

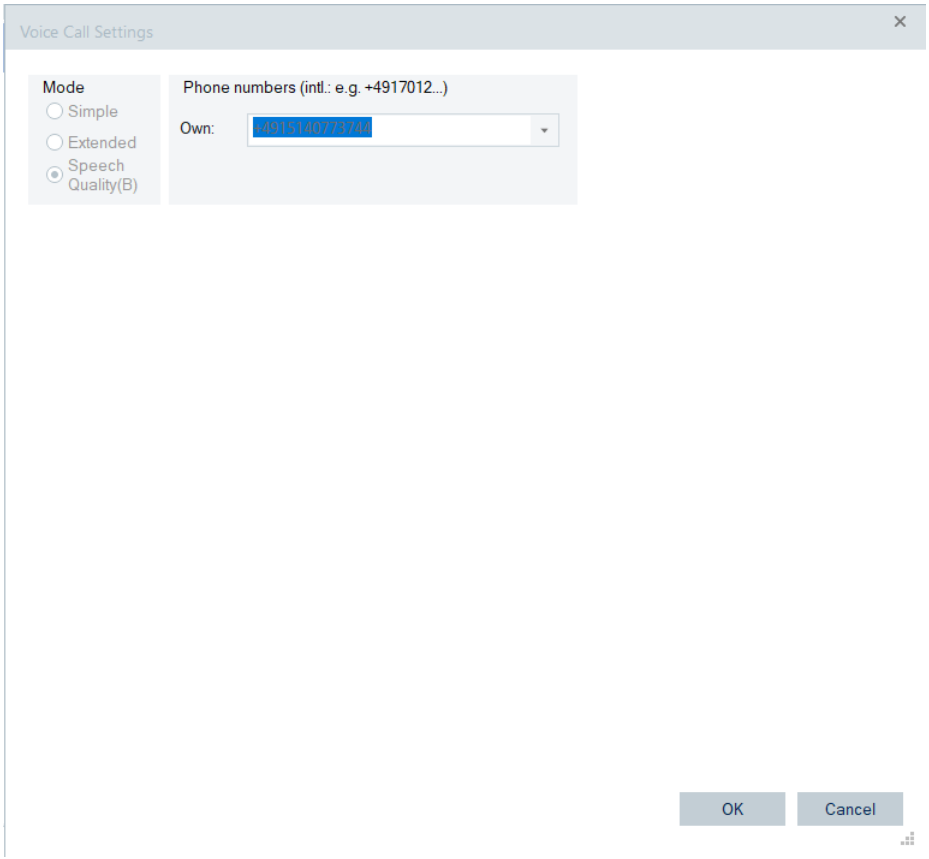


Figure 6-219: B-party mobile

Measurement results for both mobiles are merged. The A- and B-party mobiles report their downlink speech quality results separately what can be interpreted as the uplink result for the other one.

For the profiles editing, see "Voice call profile" on page 1675.

6.4.11.3 Measurement with smartphones

After having started the measurement, the smartphone tries to configure the Land Unit via the configuration call (voice call). KPIs are not generated during the configuration call.

If the configuration call is unsuccessful after five attempts, the measurement system shows an alarm and stops the speech quality measurement.

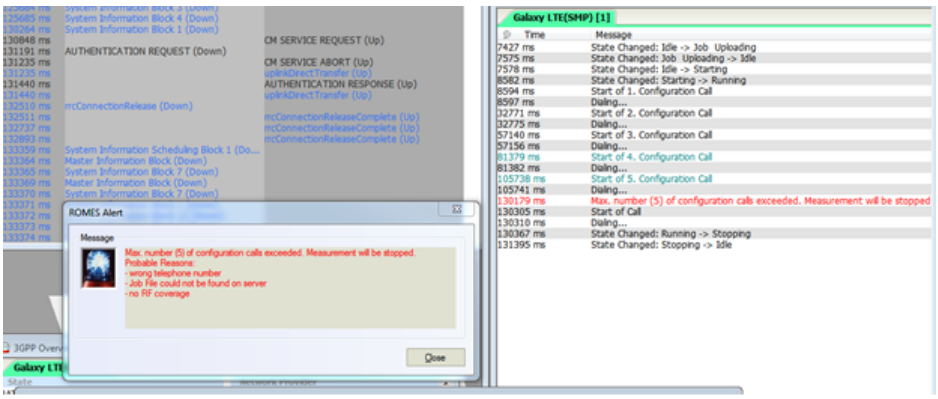


Figure 6-220: Configuration call failed five times

All other measurements continue.

If the configuration call was successful, the actual speech quality measurement starts. The smartphone starts the call and measurements as specified in the job file. The progress of the test can be observed in the "SQA Message View".

If the UE does not support speech quality measurements, the measurement stops and the user is informed, see the following figure.

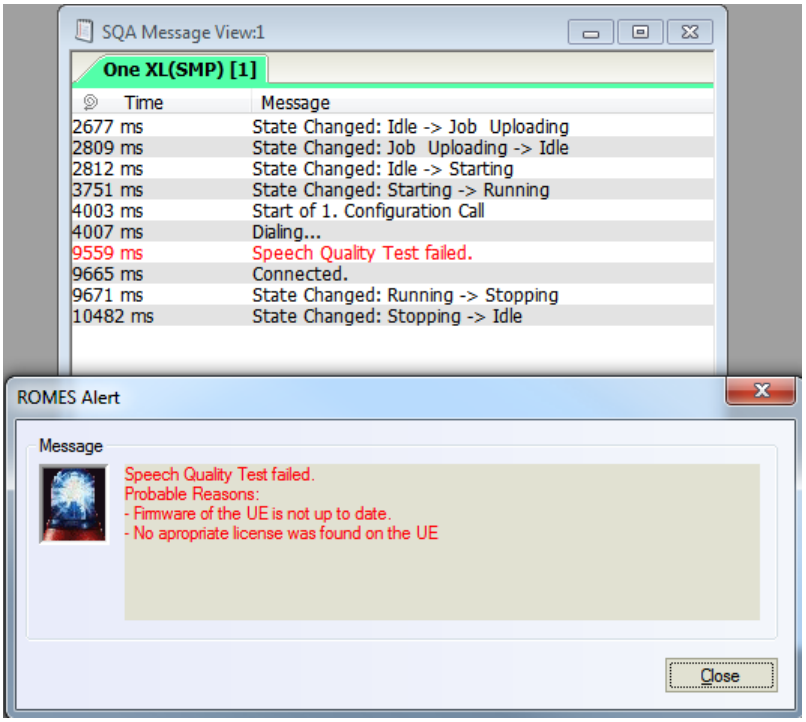


Figure 6-221: Probable cause for the speech quality test failure

6.4.11.4 Visualization of measurement results

The results of speech quality measurement made with smartphones are visualized in several views.

The results of measurements with smartphones are show in the following views:

- Chapter 4.4.14, "ETSI QoS view", on page 949
- Chapter 4.6.1.1, "SQA message view", on page 1060
- Chapter 4.6.3, "QoS KPI export result view", on page 1093
- Chapter 4.6.4, "QoS KPI generator view", on page 1095

6.4.11.5 Side effects of SQ measurement

Miscellaneous

The smartphone test writes a log file for every measurement session into the log file directory (which is located under `MyROMES`).

R&S ROMES4 cleans up this directory at each startup by default. It deletes all files which are older than 14 days.

This value can be changed with the registry entry `Romes4.xx/General/MaxAgeOfLogFilesInDays`.

The automatic cleaning of the log file directory can be switched off in "Preferences" > "General", see Figure 3-111.

Test user equipment

The "Autodialing" page is redesigned for the smartphone speech quality measurements. Also all other 3GPP, 3GPP2 and TETRA UEs benefit from this layout.

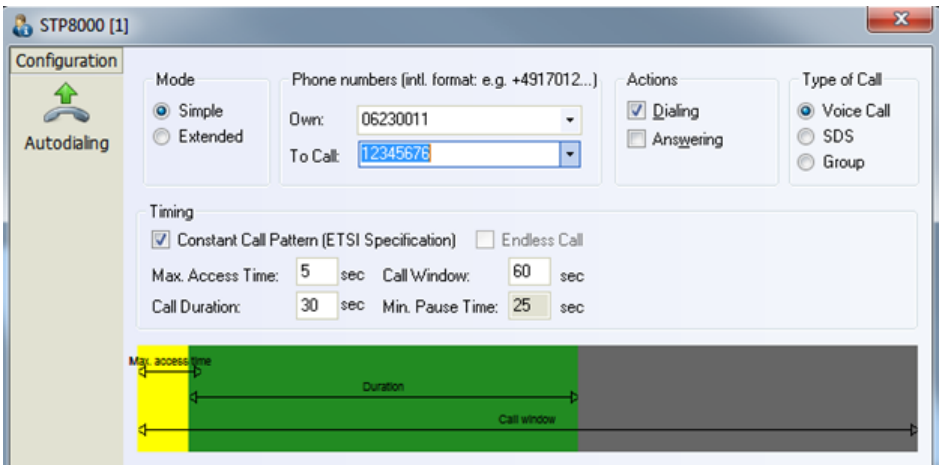
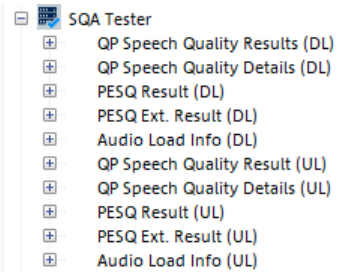


Figure 6-222: Redesigned Autodialing page

6.4.11.6 R&S ROMES4 signals for speech quality measurement with smartphone

Several R&S ROMES4 signals are generated by the smartphone speech quality measurement. The signals are located in the "Signal Tree" > "SQA Tester" branch.



"QP Speech Quality Results (DL/UL)" contains the most important signals for the speech quality test, described in the following table.

Table 6-15: QP Speech Quality Results branch signals

Signal	Description
MOS	The mean opinion square as a result of the speech quality algorithm
Offset	Start offset from the beginning of the file to first speech activity
Type	Type of used algorithm: SQuad08, PESQ, POLQA, SQuad08 (wideband) or POLQA (wideband)
Sequence	Sequence number of the voice call
Test	Test number of a speech sample within the sequence

The branch "QP Speech Quality Details" offers more detailed results of the test, which can help to analyze the reasons of degraded speech samples.

Table 6-16: QP Speech Quality Details branch signals

Signal	Description
Application	The application used for the speech quality test
Quality Code	The quality code explains the reason, why the recorded speech sample was marked as degraded
MOS-LQO NB	MOS-LQO value obtained by SQuad-LQ in narrowband (remains NIL in WB); only valid for applications 0 and 100
MOS-LQO WB	MOS-LQO value obtained by SQuad-LQ in wideband; only valid for application 2
MOS POLQA NB	POLQA MOS NB P.863; only valid for application 10 and 110
MOS POLQA WB	POLQA MOS NB P.863; only valid for application 12
Signal Length	Length of speech in seconds
Bits/Sample	Number of bits per sample
Sampling Frequency	Sampling frequency of the speech files
Missed Voice	Percentage of missed voice compared to reference signal
Gain	Gain of the transmission channel (to be in the range of +6 dB to -12 dB)

Signal	Description
Active Speech Level	Active speech level acc. to ITU-T P.56 in dB, considers only active speech parts but no speech pauses
Speech Activity	Speech activity acc. to ITU-T P.56 in percentage
Noise Level	Noise level (r.m.s. of the noise floor) in dB
SNR	Signal-to-Noise ratio between active speech level and noise level
Delay	Delay between the reference speech signal and the signal evaluated in seconds
Delay Spread	Maximal spread of observed delay jitter in milliseconds
Delay Deviation	Delay deviation of observed delay jitter in milliseconds
Bandwidth	Actual measured bandwidth

For details about ranges and units of the signals, refer to the "Description of R&S ROMES4 Signals" document.

6.4.12 Speech quality analysis

The objective of the speech quality analysis (SQA) is to assess the subjective quality of speech codecs operating in a real network. The SQA process is divided in two steps. The first step is to make the measurements. The second step is to evaluate the collected measurements and calculate the KPIs from them.

The SQA is carried out as a cyclic end-to-end measurement in downlink and/or uplink direction. The test mobile to test mobile Speech Quality measurements work without configured call. A configured call has to be performed only for measurements test mobile to Land Unit.

In outgoing wave mode, the remote test mobile plays sound files to a calling device.

In incoming wave mode the remote test mobile measures speech quality of sound coming from a calling device.

6.4.12.1 SQA – principle and test setup

- **Downlink**
  In downlink mode, a remote test mobile 2 plays a known `*.wav` file. The output of the test mobile 1 speech decoder is digitalized using a sound card and the acquired sample file is compared to a copy of the original played file (reference file). R&S ROMES4 assesses the quality of the mobile's speech decoder using the PESQ algorithm.
- **Uplink**
  In uplink mode, a file is played on a sound card. The analog output of the sound card is fed to the test mobile 1 speech coder. The speech coder data is transferred to a remote test mobile 2 where it can be compared to a copy of the original play file.
- **PESQ algorithm**

The PESQ (Perceptual Evaluation of Speech Quality) algorithm compares an original `*.wav` file with a degraded `*.wav'` file that is obtained by passing the original file through a communication system. The result of the comparison is translated into a PESQ score in the range between –0.5 and +4.5 (+1 to approx. +4.55 after conversion), where low values indicate poor speech quality and high values indicate good quality. See also the description of the "SQA Message View" in Chapter 4.6.1.1, "SQA message view", on page 1060.
The PESQ model is built aiming to ensure that the objective PESQ score is closely correlated to subjective scores of the speech quality acquired in listening tests with real subjects. For a description of the PESQ method, its use and its limitations refer to the ITU-T recommendation P.862.

- **Preconditions**
  The SQA requires option R&S ROMES4SQA, "Voice Quality Test PESQ". A `*.wav` test file must be stored both on the local PC (reference file, play file) and on the remote device. The test mobile must be equipped with an appropriate connector so that its audio circuit can be fed to the analog input/output of a sound card. The basic test setup is shown below.

A sound card without specific requirements is necessary to perform SQA, otherwise a failure message is created.

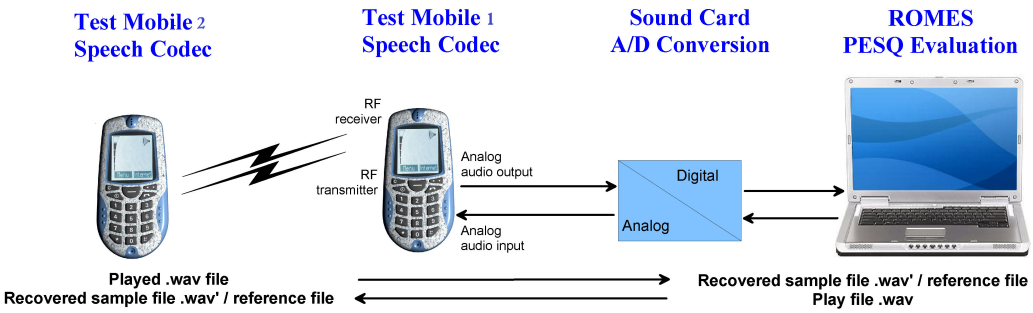


Figure 6-223: Basic SQA Test Setup

6.4.12.2 SQA settings

The "SQA" dialog lets you select the measurement mode ("Downlink" test, "Uplink" test or combined, simultaneous "Up- and Downlink") and specify the global settings.

SQA results can be displayed in the "SQA Message View", refer to Chapter 4.6.1.1, "SQA message view", on page 1060. The results can be obtained as described in the section concerning a device configuration.

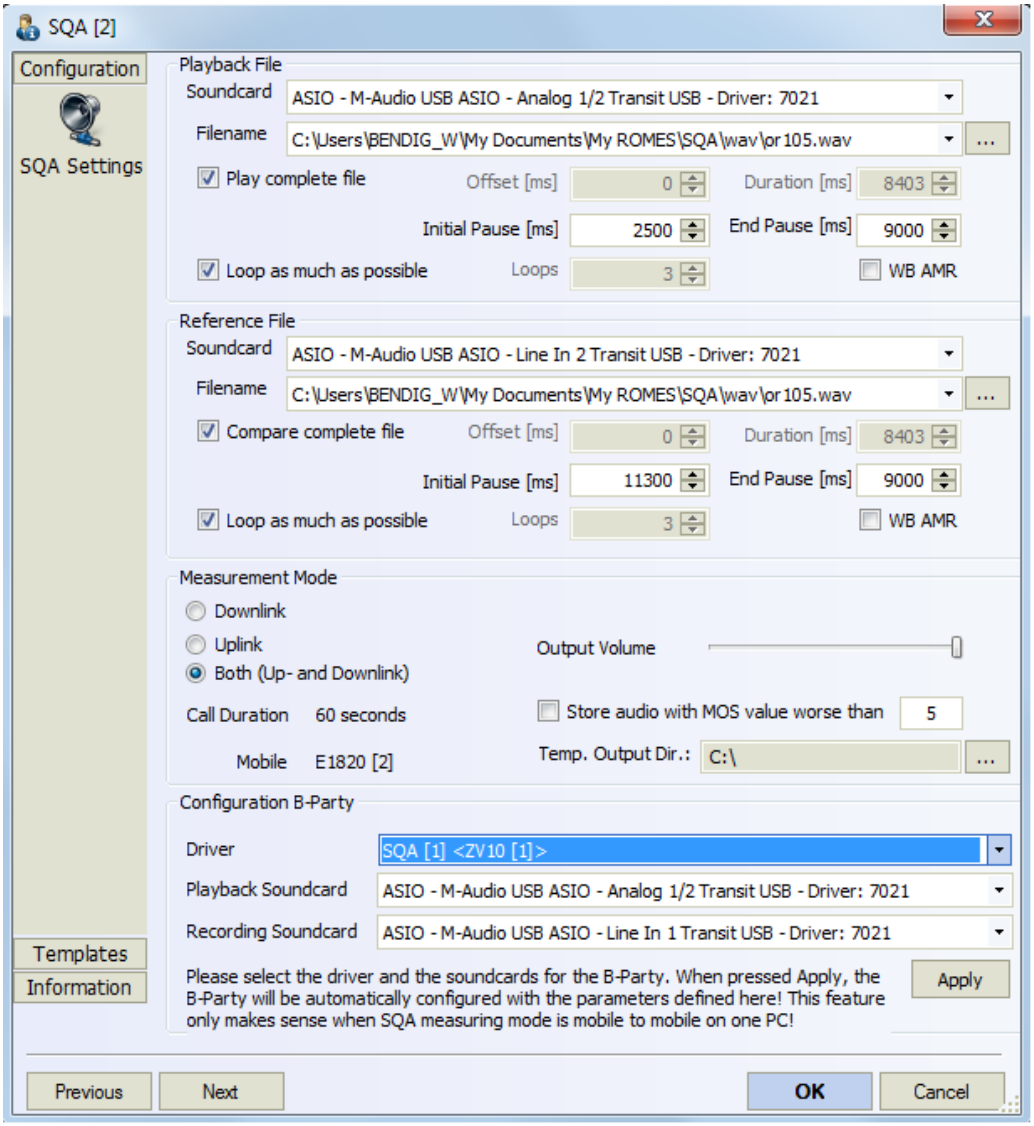


Figure 6-224: SQA Settings

The "SQA Settings" tab contains the following panes:

- "Playback File"
  Parameters in this panel are relevant for uplink signal direction. It is available after selecting the corresponding measurement mode.
- "Reference File"
  Parameters in this panel are relevant for downlink signal direction. It is available after the corresponding measurement mode has been selected.
- "Measurement Mode"
  Selects the signal direction and global test parameters.
- "Configuration B-Party"
  Enables to configure the other, B-party SQA settings automatically from the configuration dialog of the current party.

The functionality is useful when two or more Speech Quality Analyzers (SQA) are configured and SQA measurement are performed in mobile to mobile mode on one PC.

SQA settings dialog

Playback File
The "Playback File" pane lets you set the uplink SQA test. The parameters determine how often and how long the sound card will play the test file.

The uplink test consists of a repeated conversion of a test file located on the local PC to an analog speech signal and the transmission of this signal to a remote test mobile 2 using the test mobile speech coder, see chapter Chapter 6.4.12.3, "Configuration – speech quality", on page 1689.

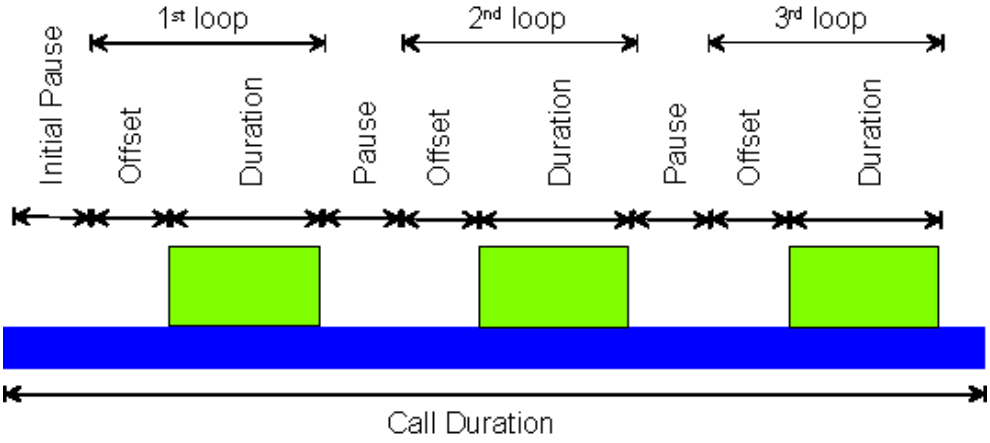
- "Soundcard"
  Selection of a sound card used to play the local test file and convert it into an analog signal.

Figure 6-225: Steinberg's ASIO trademark statement

- "Filename"
  Name and location of a played test file.
- "Play complete file"
  If checked, the complete file will be played.
- "Offset [ms]"
  Delay from the beginning of the loop (beginning of the play file) until the sound card starts playing the file. During the offset time, the sound card plays silence. In contrast to the "Initial Pause", offset is used once at the beginning of each loop.
- "Duration [ms]"
  Duration of the played section of the file. If "Play all the file" is selected, "Duration" is unavailable and shows the time needed to play the entire file.
- "Initial Pause [ms]"
  Pause time before each test loop, i.e. before each single transmission of the test file. During the pause the sound card plays silence.
- "End Pause [ms]"
  Pause time after each test loop, i.e. after each single transmission of the test file. During the pause the sound card plays silence.
- "Loop as much as possible"
  It was observed, that group calls were held by the network much longer after the call is released by the initiating party.
  To avoid this problem the "Loop as much as possible" check box is used. You can manually choose how many loops to expect at the receiving end. By setting this value accordingly, the number of PESQ evaluations per call can be kept fixed, even

if the call is released with large delay. It is recommended to use this setting whenever possible. To use the function, unselect the “"Loop as much as possible" check box, see "Correction of low PESQ values" on page 1068.

- "Loops"
  Number of test loops to be entered manually.
  The configured measurement time must be smaller or equal than the "Call Duration" defined in the "Autodialing" tab of the device configuration menu.



- "WB AMR"
  If checked also Wideband Adaptive Multi Rate (WB AMR) can be used.
  Note: Use only voice samples with a sample rate of 16 kbit/s.
  Limits: The mobile and network have to support WB AMR. For this reason up to now only mobile-to-mobile tests are supported.

The entire call is periodically repeated if autodialing is enabled.

Reference File
Sets the "Downlink" SQA test. The downlink test consists of a repeated transmission of a test file from a remote test device 2 to the local PC using the test mobile speech decoder and a subsequent conversion of the analog speech signal to a digital sample file.

The parameters are analogous to the uplink parameters in the "Playback File" section.

If parallel SQA tests are performed with different test mobiles, each test mobile must be configured with its own copy of the reference file.

Measurement mode
Selects the measurement mode ("Downlink" test, "Uplink" test or combined, simultaneous "Both (Up- and Downlink)", see Chapter 6.4.12.1, "SQA – principle and test setup", on page 1683) and specifies the following global settings:

- "Output Volume"
  Volume at the analog output of the sound card (minimum value to maximum value). The output volume is relevant for uplink tests where it controls the input level at the mobile’s audio input.
- "Call Duration"
  This is a call duration defined in the "Autodialing" tab of the mobile device's configuration menu.
- "Store audio with MOS value worse than"

If selected, voice samples below the specified PESQ score are saved in the `*.rscmd` measurement file. To save all voice samples enter the highest PESQ value (5). Generally only `*.wav` files from downlink test could be stored in the `*.rscmd` measurement file.
If a voice sample was stored in the "*.rscmd" file, the line with the measurement value is marked blue in the chapter Chapter 4.6.1.1, "SQA message view", on page 1060.

- "Mobile"
  A test mobile type is displayed for information.
- "Temp. Output Dir."
  Define a directory to store the `*.wav` files temporarily so that the files could be stored in a `*.rscmd` measurement file later on.

To avoid miss-configurations and improve overall usability, the SQA function performs a smart check of the parameters configuration in the "SQA" dialog while the user is entering. The pauses, the duration, the loops and every other input is adapted automatically in order to avoid configuiration that would lead to bad measurements.

"Mapping of PESC score and ITU P.800 values"

The PESC score according to ITU-T recommendation P.862 expresses the speech quality on a scale between –0.5 and +4.5. The PESC score values can be mapped to the ITU P800 scale of the table above; an appropriate conversion formula has been standardized by the ITU in P.862.1. The conversion formula maps the PESQ score values to a range between approx. +1 and +4.55. R&S ROMES4 displays the converted values as PESQ P862.1 results.

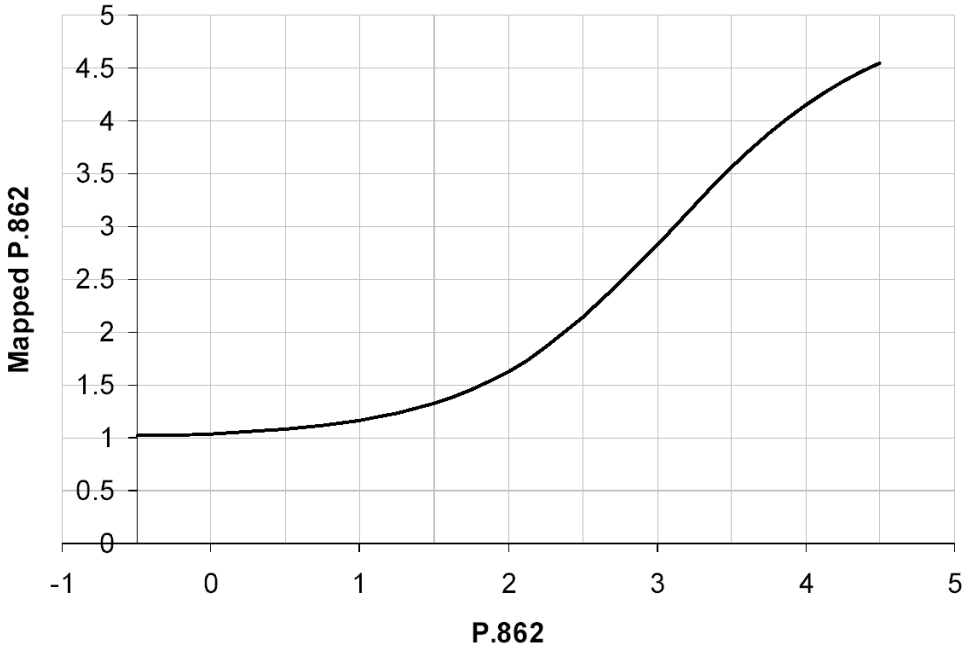


Figure 6-226: Mapping of PESC score (P862) and ITU P.800 values according to ITTU P862.1

PESQ·826.1¤	Speech·Quality¤	Impairments¤
5¤	Excellent¤	Imperceptible¤
4¤	Good¤	Perceptible,·but·not·annoying¤
3¤	Fair¤	Slightly·annoying¤
2¤	Poor¤	Annoying¤
1¤	Bad¤	Very·annoying¤

Figure 6-227: ITU P.800 PESQ scale

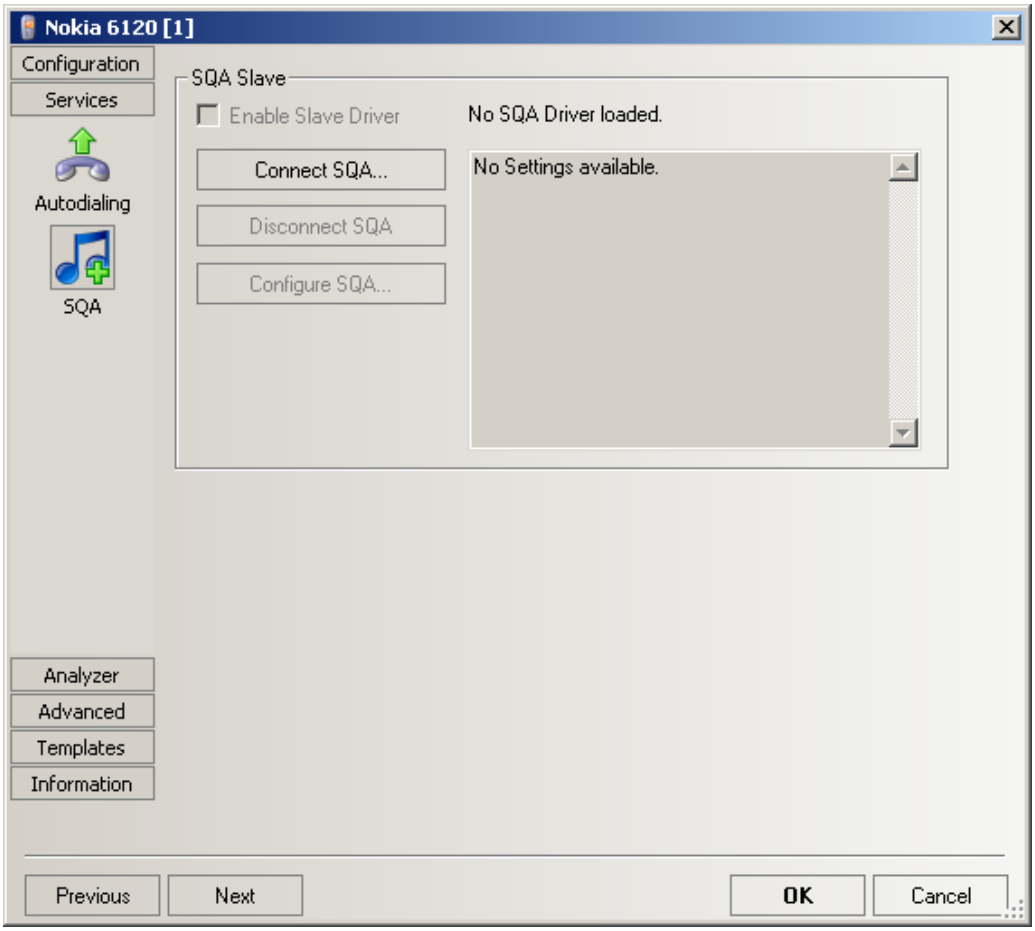
6.4.12.3 Configuration – speech quality

The "Speech Quality" tab enables and configures the speech quality analysis. You need the R&S ROMES4SQA option ("Voice Quality PESQ"). The SQA results are displayed in the "SQA Message View", see Chapter 4.6.1.1, "SQA message view", on page 1060.

The "Speech Quality" tab is provided for many mobile types and technologies (GSM, GPRS, UMTS, cdmaOne/IS-95, CDMA2000, TETRA, LTE) and is identical for all of them.

The purpose of the SQA is to test the quality of the speech codec while the mobile operates in the network.

1. Establish the basic test setup according to Figure 6-223, ensuring that the test mobiles and the local PC contain copies of the same `*.wav` file.
2. Load the appropriate mobile device , e.g. the GSM mobile device, as described in Chapter 6.1, "Devices", on page 1447.
3. In the "Autodialing" tab of the mobile device's configuration menu, select "Use Autodial" and set an appropriate "Call Duration".
4. Open the "Speech Quality" tab, click "Connect SQA,", load the SQA slave device.
5. Click "Configure SQA" and select the measurement mode and the appropriate configuration settings.
6. Back in the "Speech Quality" tab, select "Enable Speech Quality" and click "OK".
7. Open the "SQA Message" view ("View" > "QoS Views" > "SQA Messages View") and observe the displayed results.


Nokia 6120 [1]
Configuration
Services
Autodialing
SQA
SQA Slave
Enable Slave Driver
No SQA Driver loaded.
Connect SQA...
Disconnect SQA
Configure SQA...
No Settings available.
Analyzer
Advanced
Templates
Information
Previous
Next
OK
Cancel

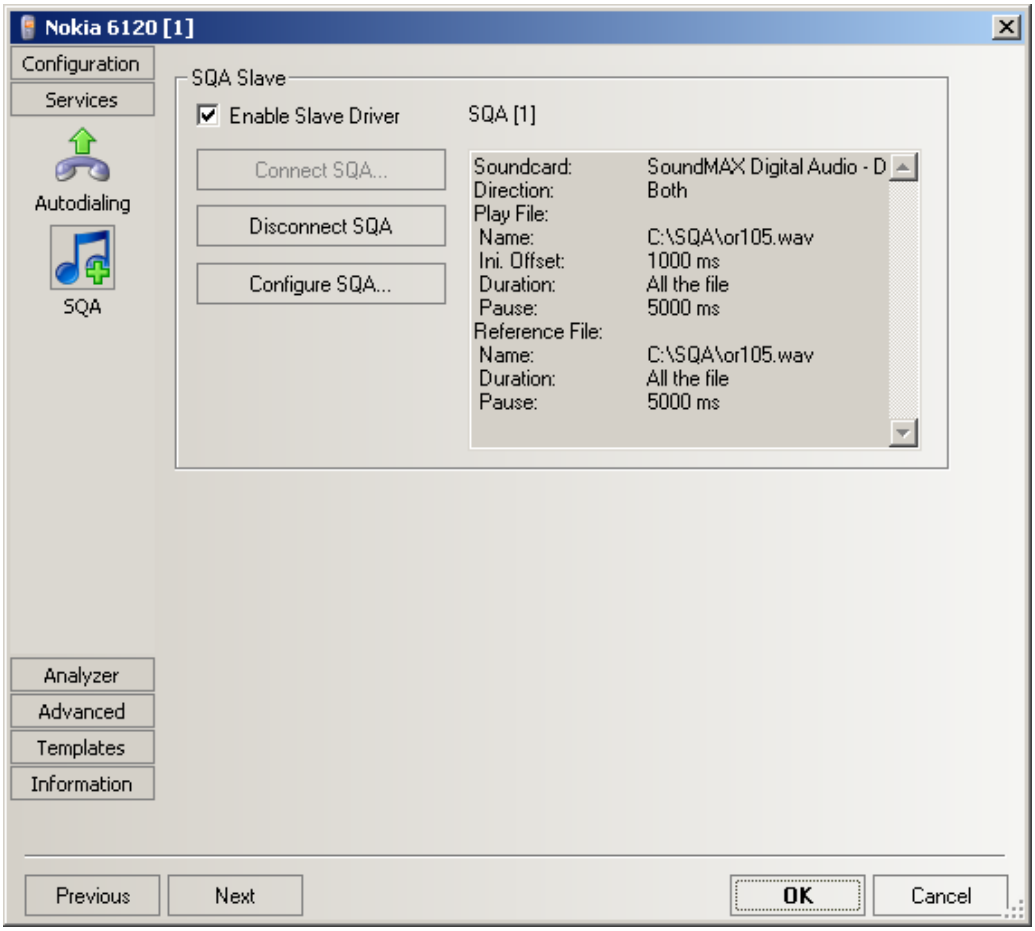


Figure 6-228: Device configuration – speech quality analysis

The SQA involves the following steps:

- "Enable Slave Driver"
  Enables the SQA slave, causing R&S ROMES4 to initiate the data transfer and the analysis as soon as the test mobile has set up a call. It is recommended to use the autodial feature, see "Autodialing" on page 1536 in order to repeat a call of fixed duration in periodic time intervals.
- "Connect SQA"
  Loads the SQA tester. The device has to be selected in the dialog box shown in the following figure.

After loading the tester, R&S ROMES4 displays its name and parameters in the settings table of the "Speech Quality" tab. The parameters can be changed using the configuration menu. The "Disconnect SQA" and "Configure SQA" buttons are available as soon as a device has been loaded. Only one SQA can be active at one time.

- "Disconnect SQA"
  Releases/disconnects the loaded SQA.
- "Configure SQA"
  Opens the configuration menu for the loaded SQA. The SQA configuration menu provides all settings for downlink or uplink SQA tests and displays information about the mobile device version.
  Tip:
  The SQA configuration menu is also accessible over the "Hardware" menu of the toolbar. If the SQA is loaded, it is appended as a slave tester to the "Hardware" menu.

6.4.12.4 Templates SQA

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

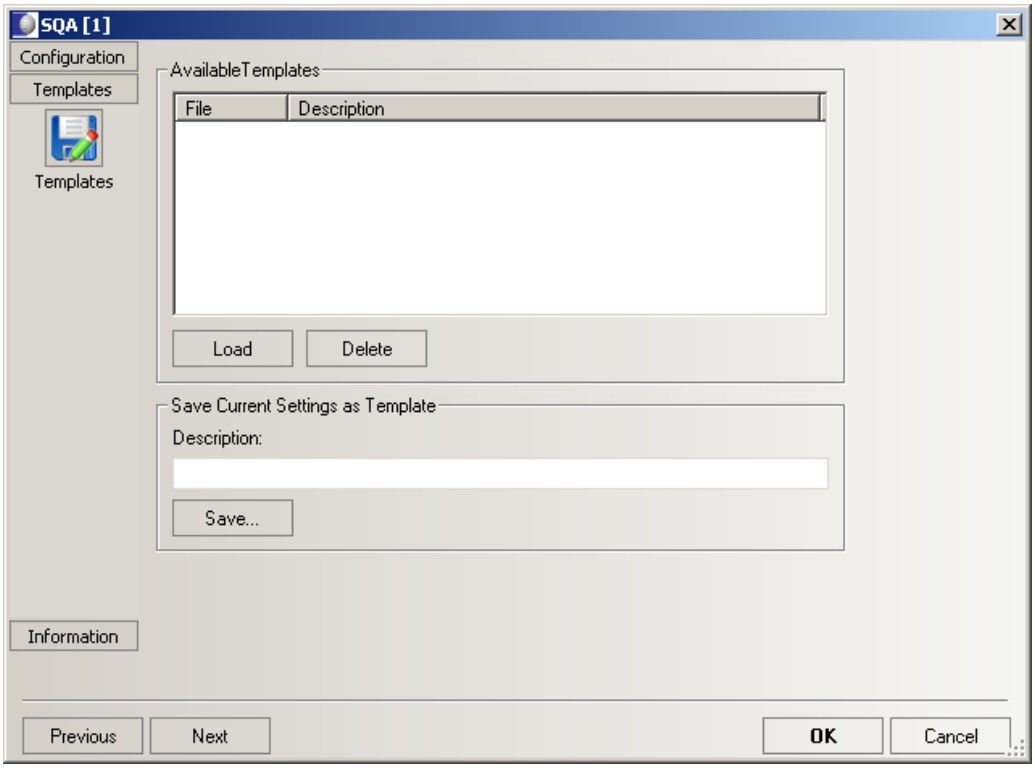


Figure 6-229: SQA tester configuration - Templates

6.4.13 Support of voice over WiFi

R&S ROMES4 supports Voice calls over WiFi (VoWiFi). The prerequisite is configuration in the Fully integrated device usage mode or a Qualcomm chipset based device with the Qualcomm IMS stack configured as On PC testing (Classic mode) device.

The following licenses and preconditions are necessary.

Table 6-17: Licenses and preconditions needed to support VoWiFi

	Fully integrated device	**On PC testing (Classic mode)/ADB**
WLAN license	Necessary	Necessary (R&S ROMES4WF2)
SMP license	Necessary	-
VoWiFi license	-	Necessary (R&S ROMES4WF2) If the license is not present, all VoWiFi calls are blocked by active R&S ROMES4.
VoWiFi license (IMS)	Necessary	Necessary (R&S ROMES4VO)
QC IMS stack	Supported	Supported
Other IMS stack	Supported	Not Supported
Qualcomm Chipset	Supported	Not Supported

	Fully integrated device	On PC testing (Classic mode)/ADB
Exyinos Chipset	Supported	Not Supported
POLQA Measurements	Supported	Not Supported
SwissQual Flash	Yes	No (Diag and ADB port have to be available)
Tested with	Samsung S6	Sony XZ

If the WLAN and VoWiFi licenses are available, a mobile device which supports ADB also reports the WiFi scan and connection status.

A mobile phone, the SIM card and the network have to support a VoWiFi call.

6.4.13.1 VoWiFi views

The call mode is VoWiFi and can be found in the corresponding R&S ROMES4 Views.

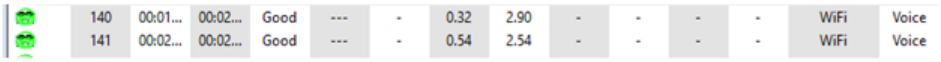


Figure 6-230: ETSI QoS View of VoWiFi

The figure shows the state of the VoWiFi call of a mobile device configured in fully integrated use mode.

6.4.13.2 ADB WLAN scan

If a Qualcomm chipset based mobile device is connected in On PC testing (Classic mode) usage mode, R&S ROMES4 does the basic WLAN scan using ADB.

Take care to fulfill the following conditions:

- WLAN option available
- VoWiFi option available
- ADB interface available
- Mobile device operates in On PC testing (Classic mode)

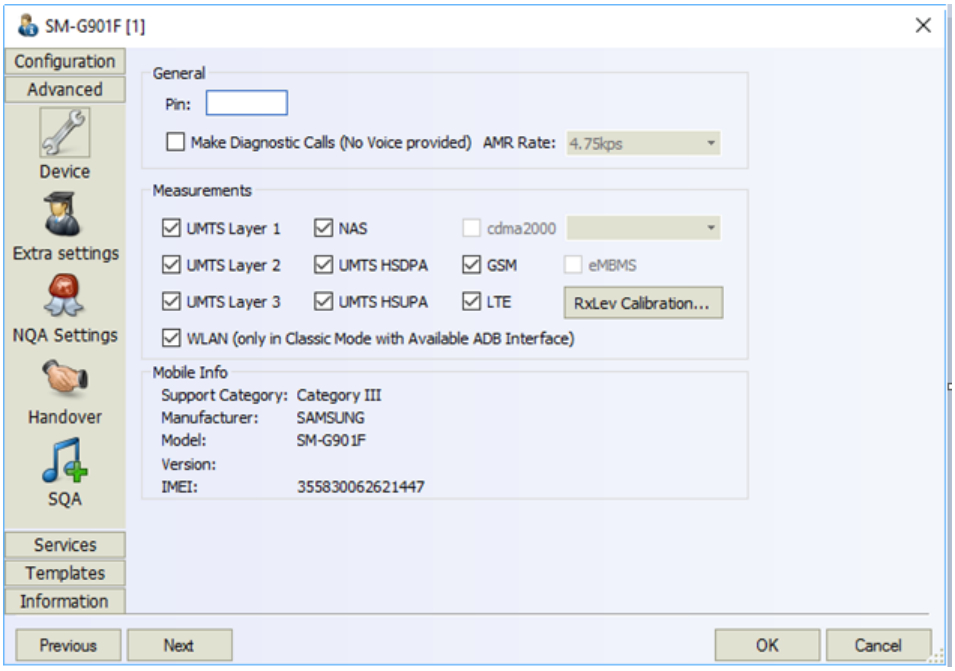


Figure 6-231: Device setting with ADB interface

6.4.14 5G NR scanner

R&S ROMES4 includes the driver to load a network scanner as 5G NR scanner.

The R&S ROMES4 5G NR scanner driver requires the R&S TSME6 or R&S TSME6B network scanner. The 5G NR measurements can run on both network scanner types..

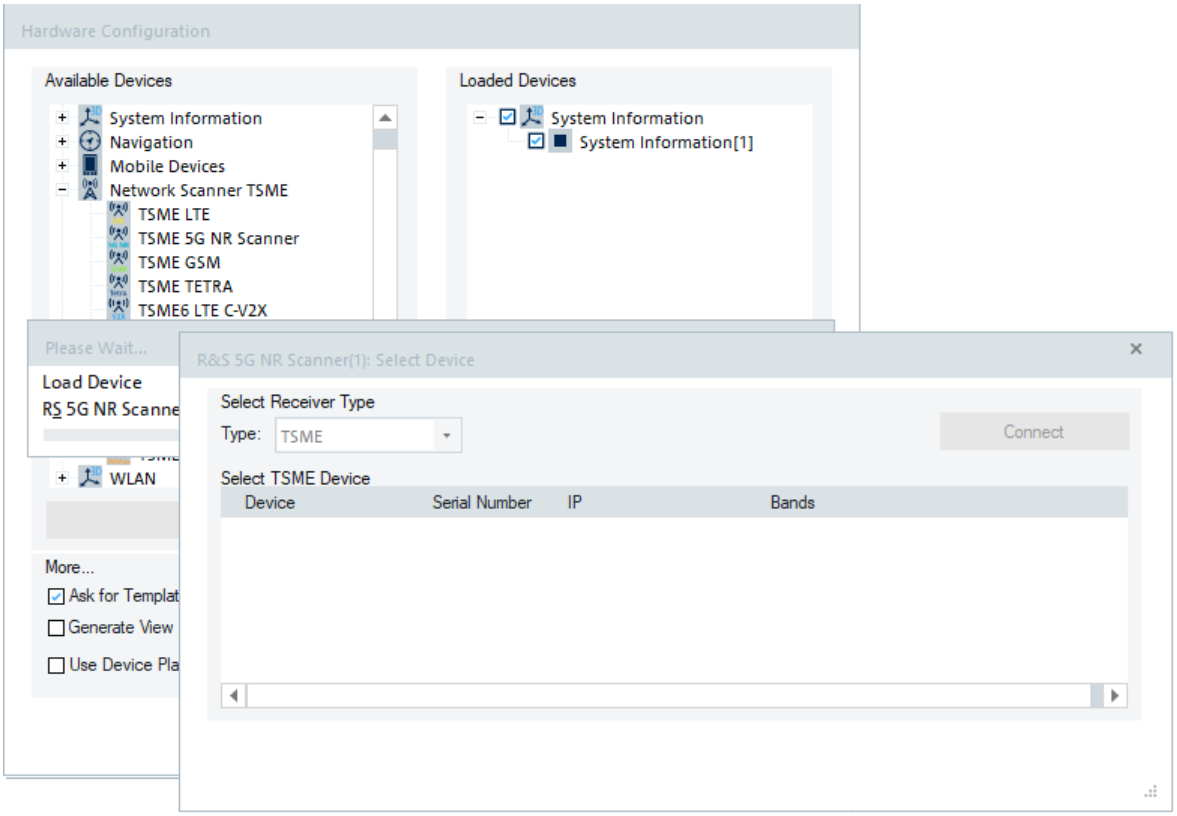


Figure 6-232: Driver selection for 5G NR

The R&S TSME6/TSME6B devices can run as the 5G NR scanners if loaded with the R&S ROMES4 5G NR scanner driver.

Click the "Hardware" > "Connect/Disconnect" menu entry. The "Hardware Configuration" page pops-up.

To load R&S ROMES4 5G NR scanner driver into R&S TSME6 device, double_click the "Network Scanner TSME" > "TSME 5G NR Scanner" branch in the "Hardware Configuration" > "Available Devices" pane. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S 5G NR Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

The device is loaded and visible in the "Loaded Devices" pane of the page.

It is now added as the "R&S 5G NR Scanner [<variable>]" command line to the "Hardware" menu.

Once loaded the driver, you can start a measurement, Click the "R&S 5G NR Scanner [<variable>]" command line to open the 5G NR scanner main configuration page.

Installation of the driver is explained in Chapter 6.1, "Devices", on page 1447.

The 5G NR scanner device configuration is explained in the following.

The outcome of the measurement is data for the configured channels. For the measured and evaluated data, see Chapter 4.8.2, "5G NR scanner views", on page 1126.

While measuring 5G NR with the R&S TSME6 scanner, other RAT measurements must not run on it.

The 5G NR scanner driver supports multiple frontends of a synchronized TSME/A6 array. For the configuration of multiple frontends, see Chapter 6.4.2, "Downconverters supported by R&S ROMES4 scanners", on page 1517.

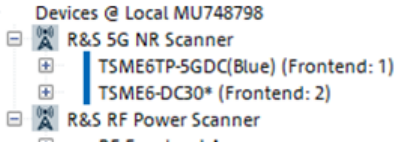


Figure 6-233: Support of multiple frontends

6.4.14.1 5G NR scanner configuration

The "R&S 5G NR Scanner" configuration page is similar to the other scanners configuration pages.

The configuration lets you select a specific frontend for a channel. All frontends which are synchronized to the selected R&S TSME6 devices can be used.

By setting the frequency of a channel (SS-Ref), the appropriate frontend is selected automatically. If more than one frontend is possible, the first usable frontend is used.

If the frequency is valid but SSB NR-ARFCN has non-standard SSB NR-ARFCN step, the SSB NR-ARFCN column is displayed with '*' instead of "---" at the end in scanner configuration dialog. The same symbol appears in the related helper dialog. The message displayed in this case in Tooltip or top section of the helper dialogs is

```
"* at end of NR-ARFCN: the NR-ARFCN has non-standard step."
```

The case is displayed in the following figures within the frequency helper dialog and Tooltip.

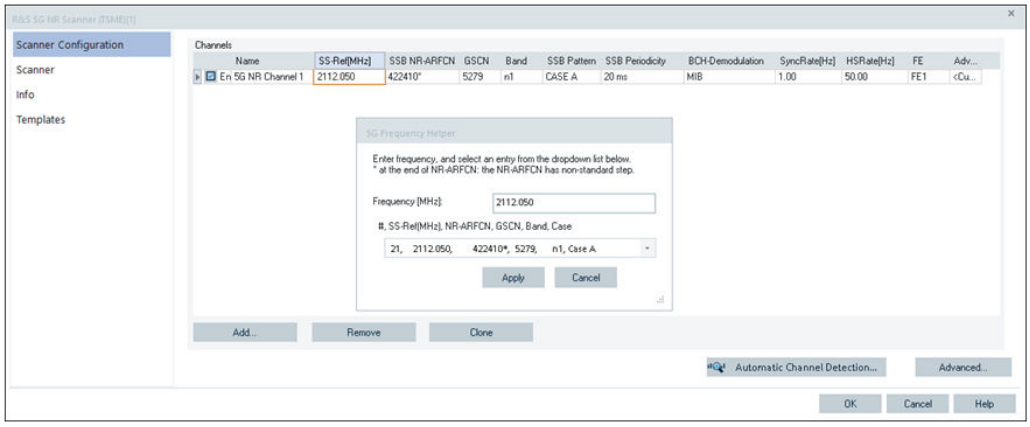


Figure 6-234: SSB NR-ARFCN step is non-standard

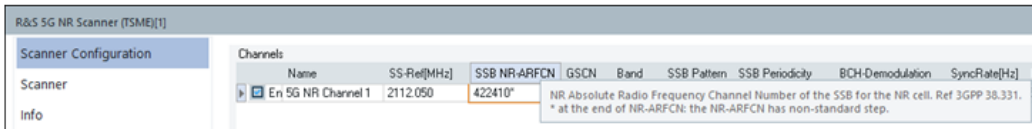


Figure 6-235: Show "" in the SSB NR-ARFCN column*

If a frequency is invalid or unsupported by scanner, a “---” is displayed for SSB NR-ARFCN. This display of the frequency could happen in export mode and if a frequency is directly entered. The figure shows entered frequency 2112.053 [MHz] which is an unsupported frequency.

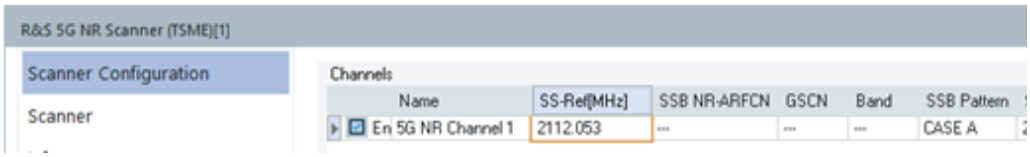


Figure 6-236: Show “---" in the SSB NR-ARFCN column

It is not possible to remove or add virtual channels. It is also not possible to select the frontend for a virtual channel. Virtual channels are configured regarding the ACD configuration automatically. Depending on the ACD configuration, virtual channels are added or removed.

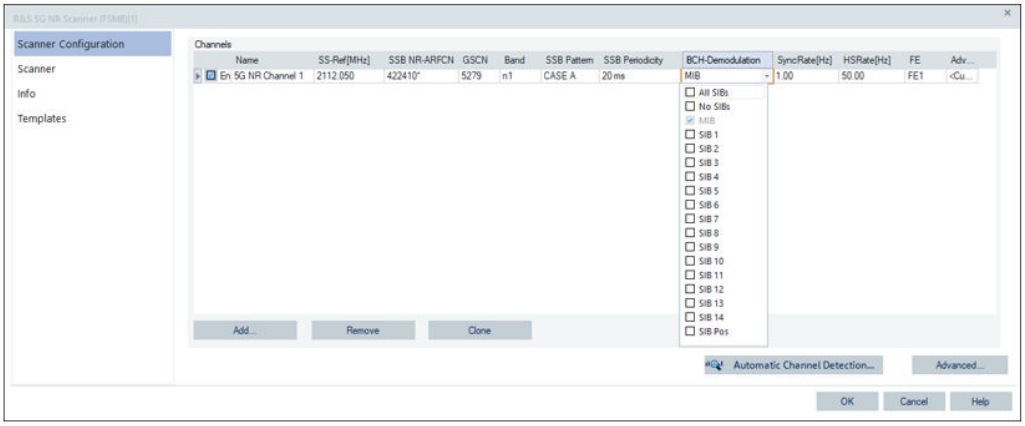


Figure 6-237: 5G NR scanner configuration page

The time domain transmission pattern of SSB blocks in 5G NR is indicated as a "case". 3GPP specifies the cases A, B, C, D and E, each one determined by the subcarrier spacing (numerology) and frequency rasters FR1 and FR2.

The Tooltip in the Figure 6-234 shows the case A with selected frequency band n1 which belongs to sub-3 band.

In accordance with 3GPP Rel 16.50, R&S ROMES4 supports the following 5G NR bands of FR1 and FR2.

- FR1
  Bands n34, n38, n39, n40 and n50 and the cases A and C; LAA bands n46 and n96 and the C case.

Band	Low Freq (MHz)	High Freq (MHz)	Low NR-ARFCN	High NR-ARFCN	CASE 1	Low GSCN	High GSCN	CASE 2	Low GSCN	High GSCN
n34	2010	2025	402000	405000	CASE_A	5030	5056	CASE_C	5036	5050
n38	2570	2620	514000	524000	CASE_A	6431	6544	CASE_C	6437	6538
n39	1880	1920	376000	384000	CASE_A	4706	4795	CASE_C	4712	4789
n40	2300	2400	460000	480000	CASE_A	5756	5995	CASE_C	5762	5989
n50	1432	1517	286400	303400	CASE_A	3584	3787	CASE_C	3590	3781

Figure 6-238: Supported Bands and cases

- FR2
  mmW band n259 and the cases D and E.

The channels of the mentioned bands can be configured by defining frequency, NR-ARFCN or GSCN in the corresponding helper dialogs. A helper dialog opens when clicking the "SS-Ref [MHz]", "SSB NR-ARFCN" or "GSCN" grid field of the "5G NR Scanner Configuration" > "Channel" pane.

The examples of channel configuration using all three types of helper dialog are shown in the following for bands n46, n96 and n259 in details.

Name
The name given to a channel.

SS-Ref[MHz]
Click "SS-Ref[MHz]" to access the helper dialog which allows you to enter the frequency. While entering the digits of the frequency, the combo box shows all valid settings which are close to the given frequency. Select one of the possible values.

You can configure only one 5G NR channel with a click in a field of channel line.

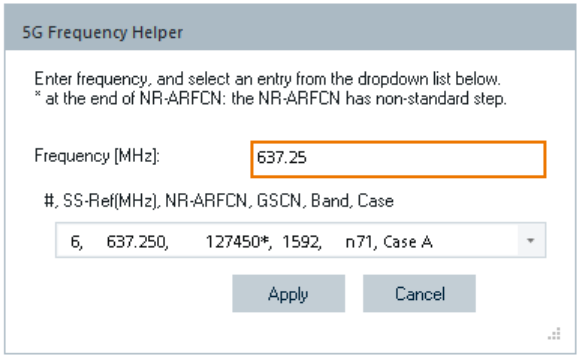


Figure 6-239: 5G frequency helper

Click "Apply" to apply these settings to the configured channels.

- If the entered frequency matches an SS-Ref, the matched item is selected and displayed.
- If the entered frequency does not match any SS-Ref in the list, the value just below the entered frequency is selected and displayed.
- If the entered frequency is below all possible SS-Ref, the first available item is selected and displayed.

Band n46 - Frequency Selection ← SS-Ref[MHz]
Click the "SS-Ref[MHz]" grid field and insert a frequency. Select one out of offered SS-Ref frequencies of band n46 (frequency range: 5150MHz to 5925MHz).

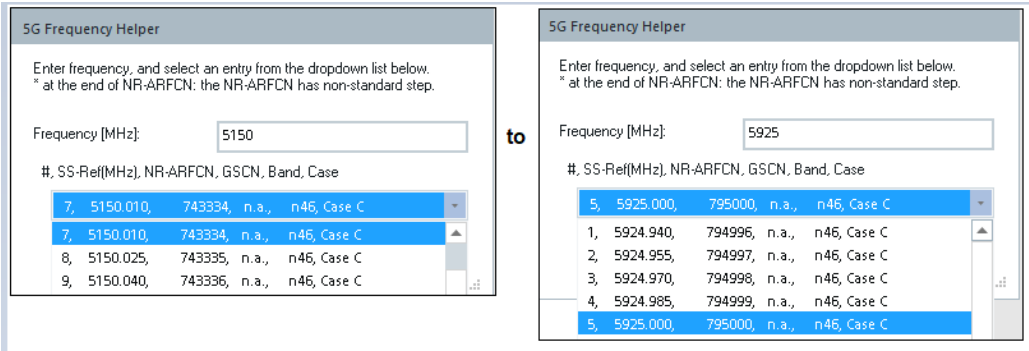


Figure 6-240: Band n46 configuration using frequency

Band n96 - Frequency Selection ← SS-Ref[MHz]
Click the "SS-Ref[MHz]" grid field and insert a frequency. Select one out of offered SS-Ref frequencies of band n96 (frequency range: 5925MHz to 7125MHz).

Scanner supporting 7125MHz is needed for frequencies above 6000MHz, otherwise, the maximum configurable frequency is 6000MHz.

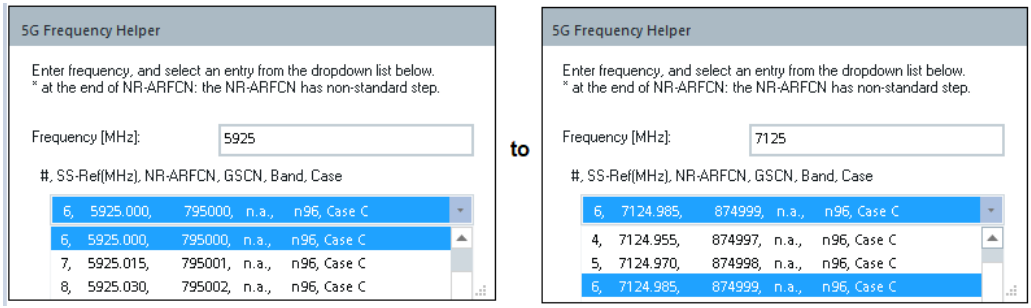


Figure 6-241: Band n96 configuration using frequency

Band n259 - Frequency Selection ← SS-Ref[MHz]

Click the "SS-Ref[MHz]" grid field and insert a frequency. Select one out of offered SS-Ref frequencies of band n259 (frequency range: 39500MHz to 43500MHz).

Downconverter is needed to verify this band.

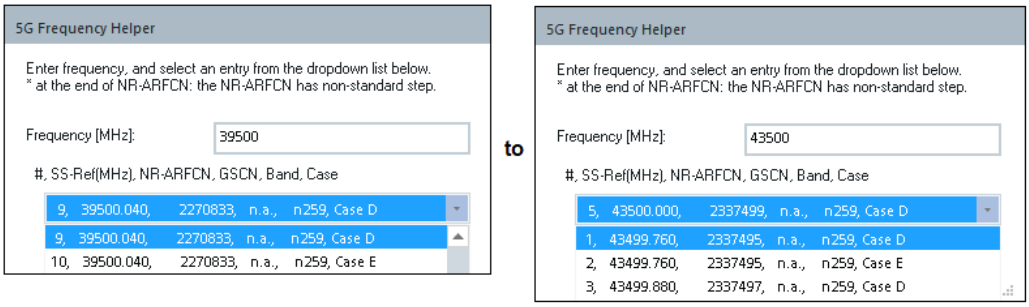


Figure 6-242: Band n259 configuration using frequency

SSB NR-ARFCN

Click "SSB NR-ARFCN" to access the helper dialog which allows you to enter SSB NR-ARFCN and select one NR-ARFCN. While entering the digits of the channel number, the combo box shows all valid settings which are close to the given channel number. Select one of the possible values.

You can configure only one 5G NR channel with a click in a field of channel line.

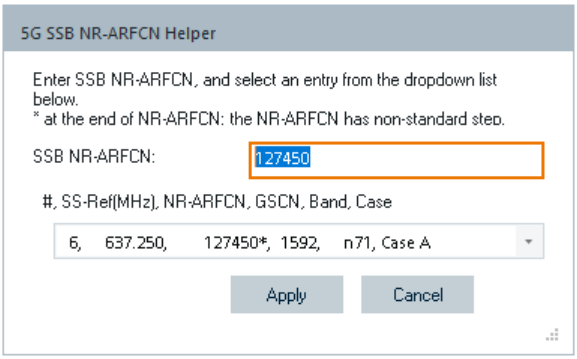


Figure 6-243: 5G SSB NR-ARFCN helper

Click "Apply" to apply these settings to the configured channels.

- If the entered channel number matches an SSB NR-ARFCN, the matched item is selected and displayed.
- If the entered channel number does not match any SSB NR-ARFCN in the list, the value just below the entered channel number is selected and displayed.
- If the entered channel number is below all possible SSB NR-ARFCN, the first available item is selected and displayed.

Band n34 - SSB NR-ARFCN Selection ← SSB NR-ARFCN
The screenshot shows a channel configuration belonging to band n34 by using SSB NR-ARFCN helper dialog. If the proper SSB NR-ARFCN is configured, the helper shows all relevant information concerning the channel.

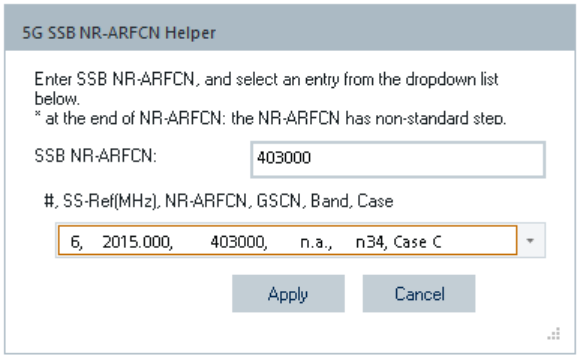


Figure 6-244: Configuration of channel in band n34

Band n46 - SSB NR-ARFCN Selection ← SSB NR-ARFCN
Click the "SSB NR-ARFCN" grid field and insert the NR-ARFCN. Select one out of offered NR-ARFCN values of band n46 (range: 743333 to 795000).

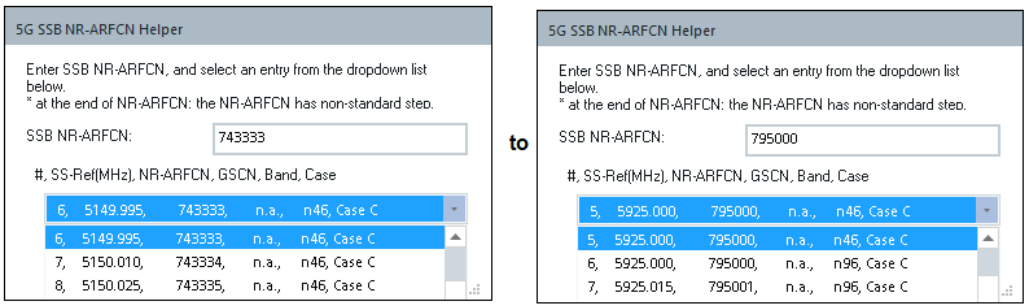


Figure 6-245: Band n46 configuration using SSB NR-ARFCN

Band n50- SSB NR-ARFCN Selection ← SSB NR-ARFCN
Example of a channel configuration belonging to band n50 by using SSB NR-ARFCN helper dialog.

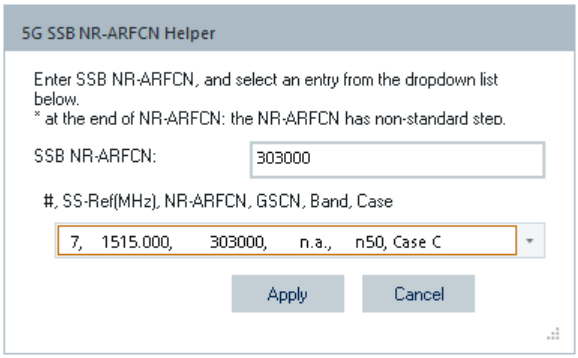


Figure 6-246: Configuration of channel in band n50

Band n96 - SSB NR-ARFCN Selection ← SSB NR-ARFCN

Click the "SSB NR-ARFCN" grid field and insert the NR-ARFCN. Select one out of offered NR-ARFCN values of band n96 (range: 795000 to 875000).

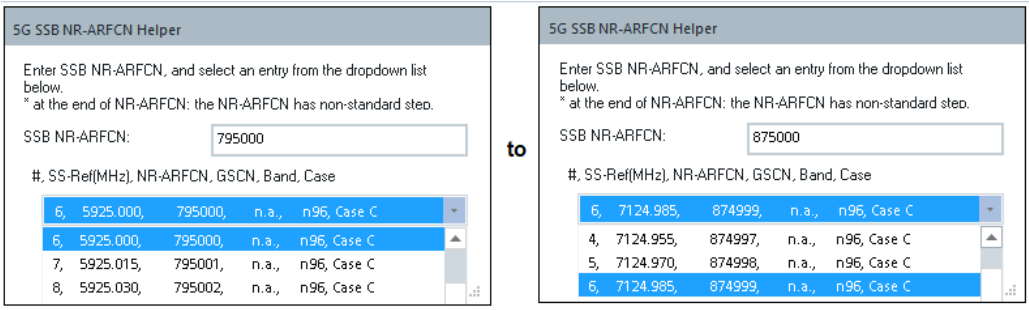


Figure 6-247: Band n96 configuration using SSB NR-ARFCN

Band n259 - SSB NR-ARFCN Selection ← SSB NR-ARFCN

Click the "SSB NR-ARFCN" grid field and insert the NR-ARFCN. Select one out of offered NR-ARFCN values of band n259 (range: 2270832 to 2337499).

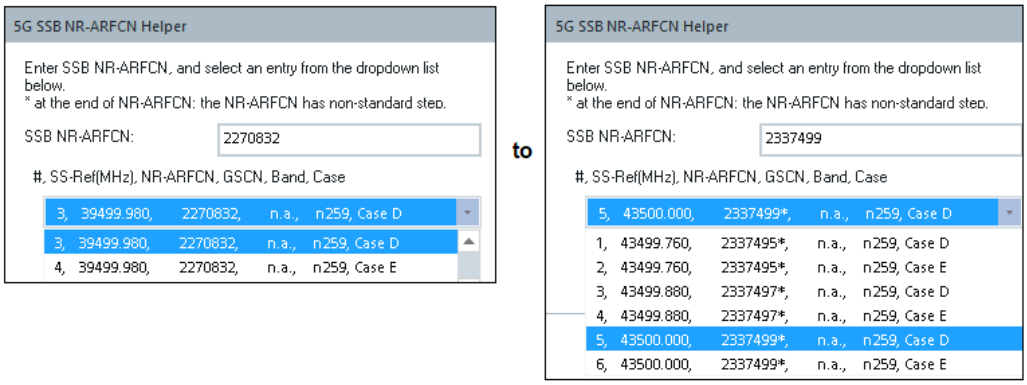


Figure 6-248: Band n259 configuration using SSB NR-ARFCN

GSCN/Band/SSB Pattern

Click one of these entry columns to pop up the GSCN helper dialog. You can configure the GSCN, band and SSB pattern value in the helper dialog. While entering the value, the combo-box shows all valid settings which are close to the given one. The associated helper dialog checks the validity of a given value and offers the values of other entries. Select one of those possibilities.

- If the entered GSCN/Band/SSB Pattern value matches a GSCN/Band/SSB Pattern value in the list, the matched item is selected and displayed.
- If the entered GSCN/Band/SSB Pattern value does not match any GSCN/Band/SSB Pattern value in the list, the one just below the entered GSCN is selected and displayed.
- If the entered GSCN/Band/SSB Pattern value is below the all possible GSCN/Band/SSB Pattern values, the first available item is selected and displayed.

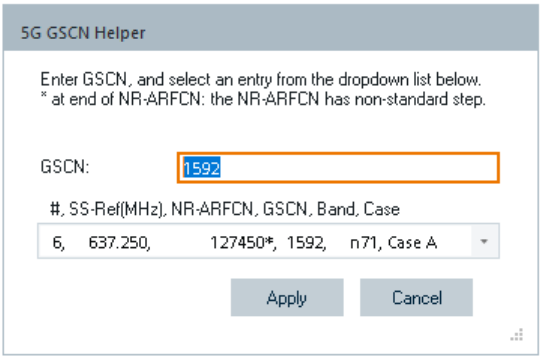


Figure 6-249: 5G GSCN helper

SSB Periodicity

Lets you select the periodicity of the SSB used by the scanner.

BCCH-Demodulation

Click this entry to open the drop-down list letting you select/deselect SIB signals for editing by BCCH demodulation. MIB in the list is always selected and is not editable.

The following SIBS can be demodulated and shown in BCCH view. The BCH view shows also the positioning SIB (posSIB).

- SIB 1 - Cell selection, cell access, cell baring information and information about availability and scheduling of another SIBs
- SIB 2 - Cell reselection, serving cell frequency and intra-freq cell reselection information
- SIB 3 - NR Intra-frequency neighbor cell list and reselection criteria
- SIB 4 - NR Inter-frequency neighbor cell list and reselection criteria
- SIB 5 - EUTRA neighbor cell list and reselection criteria
- SIB 6 - ETWS notification
- SIB 7 - ETWS secondary notification
- SIB 8 - CMAS notification
- SIB 9 - GPS time and UTC (Coordinated Universal Time)
- SIB 10 - Human readable network names of non-public networks
- SIB 11 - information related to idle/inactive measurements
- SIB 12 - NR sidelink configuration

- SIB9 13, SIB 14 - V2X sidelink configuration
- posSIB - Positioning

The BCH view shows also the positioning SIB (posSIB). The 3GPP rel.16 introduces the following SIB fields which are all posSIB elements.

- posSib1-1, posSib1-2, ..., posSib1-8 - GNSS common assistance data
- posSib2-1, posSib2-2, ..., posSib2-23 - GNSS generic assistance data
- posSib3-1 - Observed TimeDiffOfArrival assistance data
- posSib4-1 - Barometric assistance data
- posSib5-1 -TerrestrialBeaconSystem assistance data
- posSib6-1, posSib6-2, posSib6-3 - NR DL TDOA/DL-AngleofDeparture assistance data

R&S ROMES4 supports further, 3GPP rel. 17 defined SIBs, SIB 15 to SIB 21.

- SIB 15 - Carries configurations of disaster roaming information.
- SIB16 - Carries configurations of slice-specific cell reselection information.
- SIB 17 - Carries configurations of TRS resources for idle/inactive UEs.
- SIB18 - Carries Group IDs for Network selection (GINs) to support access using credentials from a Credentials Holder or to enable UE onboarding. SIB18 can only be present if there is at least one SNPN that supports previously mentioned access or onboarding UE.
- SIB 19 - Carries satellite assistance information.
- SIB 20 - Carries the information required to acquire the MCCH configuration for MBS broadcast.
- SIB 21 - Carries the mapping between frequency and MBS services.

Synchronization Rate
The 5G NR scanner offers two independent measurement rates.

SynchRate[Hz] ← Synchronization Rate
In the "SynchRate[Hz]" entry configure the max. sync-measurement rate for this channel. The rate indicates how quick the new gNBs can be detected and synchronized.

HSRate[Hz] ← Synchronization Rate
The high-speed measurement rate configured in the "HSRate[Hz]" entry indicates how quick the SSB measurements would be performed once the scanner is synchronized on a gNB.

The high-speed measurement rate can be set up to 50 [Hz], what equals the maximum number of SSBs in a 5G NR signal with a periodicity of 20 [ms]. For the measurement based on high speed, refer to Chapter 6.4.14.5, "5G NR high-speed scanner", on page 1714.

FE
Shows the appropriate frontend for the set channel frequency.

Advanced
Click the "Advanced" column to open the advanced settings dialog of the selected channel.

The "Custom" (default) mode checks if the frequency is valid (TS38.101) and if the selected case applies for the selected band.

Select "Open" to get the "Advanced channel settings" dialog.

The dialog has two tabs:
- "Dynamic PDU Settings"
- "Advanced Options"

Dynamic PDU Settings ← Advanced
The dynamic PDU setting is available for supported SIBs, which are SIB1 to SIB 21 and posSIB. MIB is not editable.

Check the associated check box of a SIB that you want to monitor in the "Dynamic" column of the "Dynamic PDU Settings" page. Enter an interval value or use the default one. The selected SIB is shown in the "5G NR BCCH View".

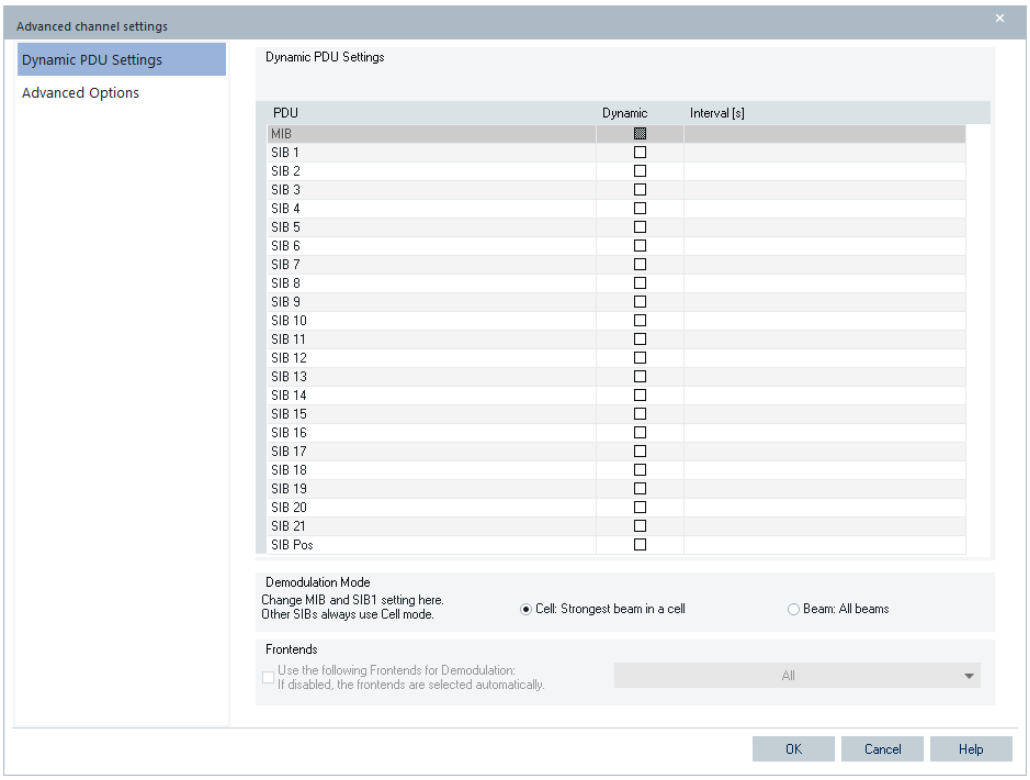


Figure 6-250: Dynamic PDU settings dialog

At the lower part of the "Dynamic PDU Settings" dialog, there are the "Demodulation Mode" and "Frontends" panes.

The "Demodulation Mode" lets you select demodulation mode out of two available.
- "Cell: Strongest beam in a cell"
  Demodulation is done at cell level for the strongest beam in the cell. The mode is the most efficient mode.
- "Beam: All beams"
  Demodulation is done for all beams in the cell. The mode can be only activated in special SIB configurations, where SIB messages per beam are different.

The mode change applies to MIB and SIB1. Demodulation modes can be specified for MIB or SIB1 and then the same mode applies to both and the specified mode applies only to a current channel. Different channels can have different modes.

Other SIBs (OSI), that is SIB2 to SIB9, always use the cell mode. The beam mode does not apply to them.

The demodulation mode can be changed by clicking the associated radio button. The mode change does not affect other SIBs, as the cell mode only applies to them.

The R&S ROMES4 5G NR Scanner's demodulator supports multiple R&S TSMEs. This kind of support increases the performance, especially for FR2 measurements. By default, the demodulator takes all R&S TSMEs connected to the same downconverter as the scanner’s TSME and supports the required frequency range. It is possible to choose the R&S TSMEs, which have to be used for demodulation.

To select the used R&S TSMEs manually, check the "Frontends" box.

TDD pattern decoding ← Dynamic PDU Settings ← Advanced
The TDD pattern is broadcasted in SIB1 of gNodeBs. As the content of SIB1 is not self-explaining, R&S ROMES4 brings it to a more human readable form.

R&S ROMES4 shows the pattern as a sequence of three different characters for a duration of 20 ms. Each character represents a 5G TDD slot.

The 5G TDD slots within a frame are marked using the following letters:

- D: downlink slot

- U: uplink slot

- F: flexible slot (some symbols are used for downlink, some for uplink)

The representation considers the pattern1 and pattern 2. The resulting text is visualized in the "5G BCH View" and as gNodeB and TopN template signals.

Example:

Carrier bandwidth: 78.120 MHz

BWP bandwidth: 78.120 MHz

BWP center frequency: 3450.00 MHz

TDD configuration; DDDFUDDDFUDDDFUDDDFU

(N)SA support: SA Supported

System Information ← Dynamic PDU Settings ← Advanced
The demodulation mode is shown at the bottom part of the measurement's "Open" dialog.

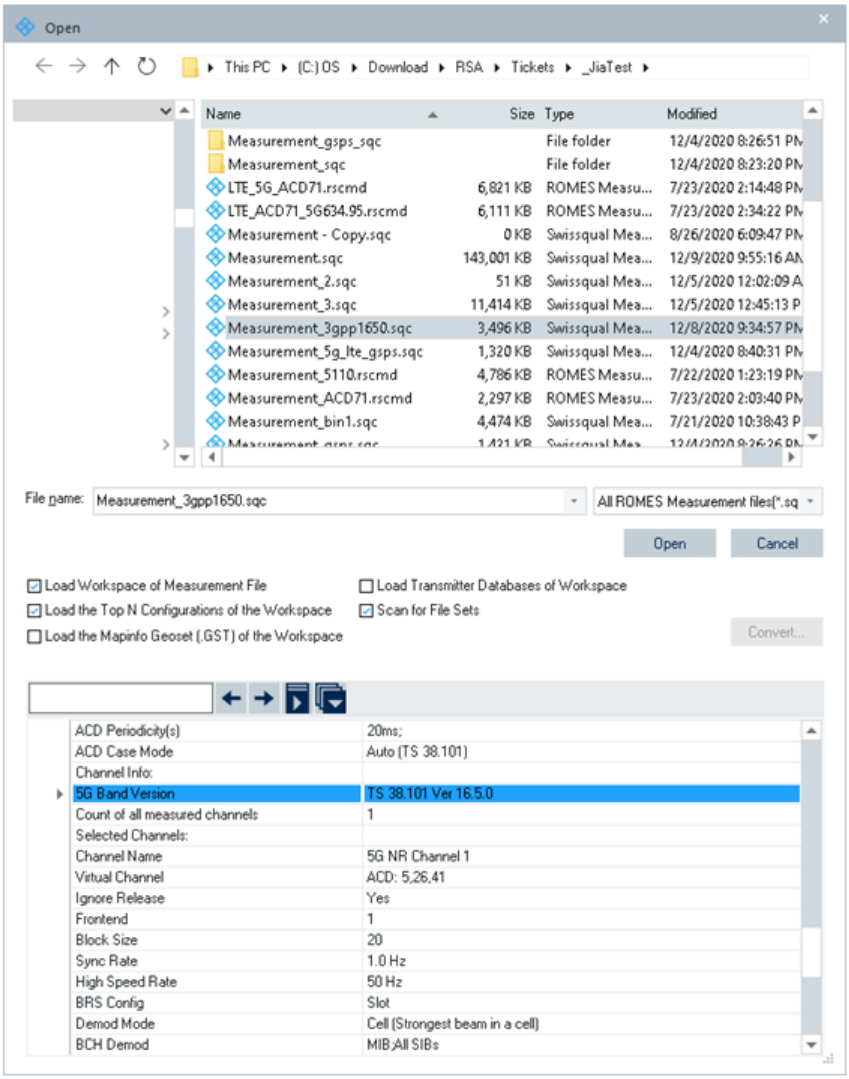


Figure 6-251: Open dialog shows data of demo channel

The information on demodulation mode is shown for a demodulation channel in this dialog.

Channel Info:

```
5G Band Version:  TS 38.101.Ver16.5.0

Count of all measured channels: 1
```

Selected channel starting with the following parameter

```
Channel Name:  5G NR Channel 1
```

contains a long list of reported parameter values.

Advanced Options ← Advanced

"Advanced channel settings" > "Advanced Options" provides the possibility to switch to an “expert input mode”. In this mode, you can select any frequency and a combination of frequencies in bands below or above 3GHz (FR1). The channel validation is not available in expert input mode. Band and GSCN do not apply in this mode.

To activate the mode, check the "Expert Input Mode" box. In expert mode you can set the Lmax threshold, which indicates the maximum number of beams per PCI. The possible number of beams is 4 or 8 dependent on frequency bands. By default, the "Expert Input Mode" is inactive and the default mode is "Auto", meaning that the selection of Lmax value is disabled and the Lmax="Auto".

For optimized scanner measurement with signal generator, select the count of generate frames value in the "Generator Frame Count" drop box.

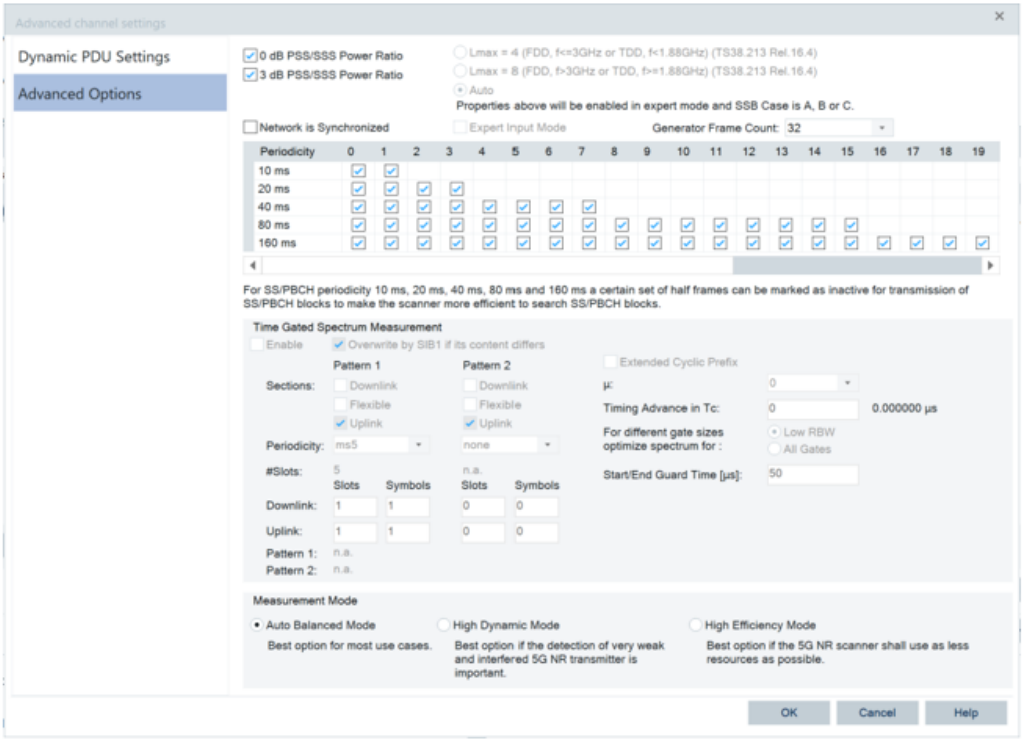


Figure 6-252: 5G NR scanner configuration - advanced options

The manual configuration of bands requires the SSB case A, B or C and active expert mode. Select the requested SSB cases in the "R&S 5G NR Scanner" > "SSB Pattern" column, see Figure 6-237.

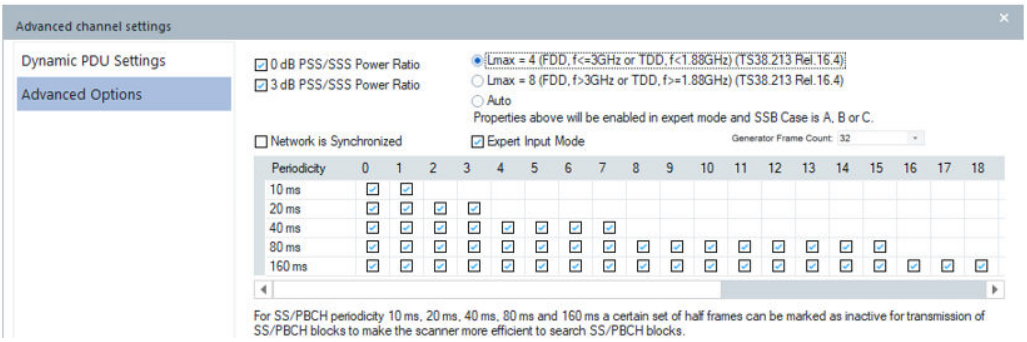


Figure 6-253: Expert input mode activated

The configured channel information is saved in a measurement file and displayed if you click the file.

Time Gated Spectrum Measurement ← Advanced Options ← Advanced
R&S ROMES4 offers in the "Advanced Options" page the possibility to configure a time gated spectrum measurement with the 5G NR scanner. The time gated spectrum measurement provides the necessary timing information to the time gated spectrum scanner.

Check the "Enable" check box in the "Time Gated Spectrum Measurement" pane to enable the time gated spectrum measurement. Define the default timing values.

The pattern1 and 2 for 5G TDD configuration are supported. You can enter the two patterns either manually or configure the software to use the SIB1's content. The value in the "Periodicity" grid is found in the SIB1 directly and makes the configuration simple.

To set up a measurement, specify only one 5G NR channel in the "Channel Configuration" page. The time gated spectrum scanner does not start if you specify more than one channel or a virtual channel.

If the "Overwrite by SIB1..." option is selected, the time gated spectrum scanner is reconfigured by the 5G NR TDD configuration which is found in the SIB1 on the channel.

If no SIB1 is available, the time gated spectrum measurement needs to be configured manually. The settings in the "Time Gated Spectrum Measurement" pane need to reflect the settings of the used NR TDD signal:

- "Extended Cyclic Prefix"
  Enable this option, if extended CP is used in the NR TDD signal scanning.
- "Selections" to scan
  Select among "Uplink", "Downlink" and "Guard Period" for scanning.
- Settings provided by SIB1
  – UL/DL TDD configuration
  – "Timing Advance"
  – "Gate Count"
  Count of time gates.

When the 5G NR scanner detects a gNodeB, the time gated spectrum scanner starts. The results can be observed in the "Basic Views" > "Time Gated Spectrum View".

Note: Create a workspace after configuring the "Time Gated Spectrum Measurement" parameters.

Note: The R&S Option TSMx-K51 is required on the scanner device.

Measurement Mode ← Advanced Options ← Advanced
The "Advanced Options" > "Measurement Mode" pane offers you to select the most suitable option for the measurement dependent on use case.

Add
Opens the dialog which allows you to add a channel for scanning. Virtual channels cannot be added.

Remove
Removes all highlighted channels from the "Channels" pane. Virtual channel cannot be removed.

Clone
Makes a copy of all highlighted channels, automatically sets the “selected” status for it and assigns name by adding the word “copy” to the original channel name.

6.4.14.2 5G NR automatic channel detection

5G NR Automatic Channel Detection function allows an easy setup of the 5G NR scanner. It is not necessary to know the exact frequency on which the SSBs are broadcasted. Instead of specifying the frequency, it is enough to specify a range or the 5G NR band in which SSB is located.

The 5G scanner ACD allows for more than the standard cases to scan. To scan for more, open the "Automatic Channel Detection" dialog in the 5G scanner configuration. By default, the ACD only searches for the standard cases as defined in TS38.101.

If desired, the ACD can be configured to scan for all possible cases of the band’s frequency range (FR1 or FR2). For all bands less than n256, the ACD searches for the cases A, B, C and for all bands above, it searches for cases D and E.

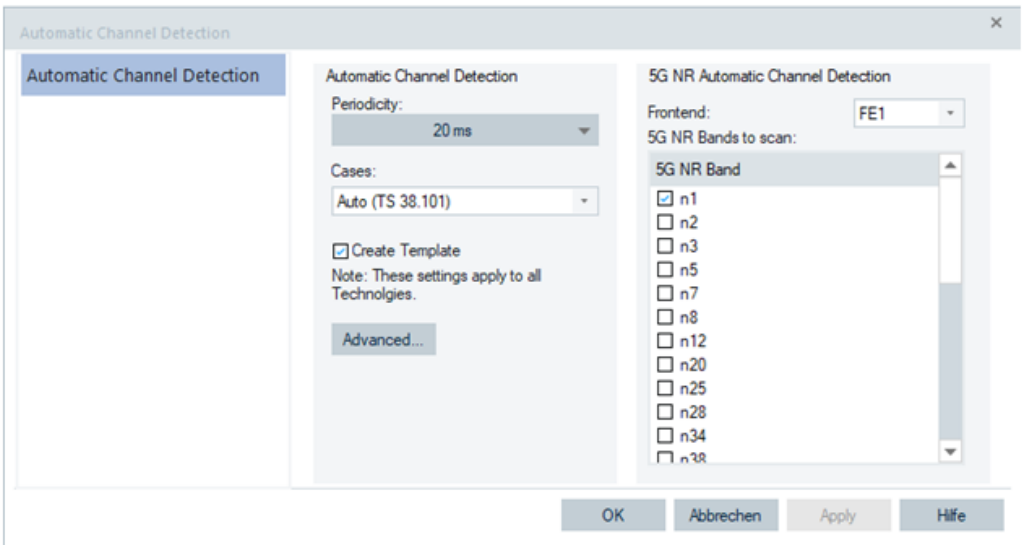


Figure 6-254: 5G NR ACD (Auto start of scan case)

For the selected band in the figure, the "scannACD Status View" shows "5G NR: n1(case: A,B,C)" as the currently active case.

If necessary, scanning for all five cases is possible. Note that scanning for more cases increases the required CPU processing time for the ACD.

The most comfortable way to set up the 5G NR ACD in R&S ROMES4 is to use the ACD wizard.

1. Click "Hardware" > "Wizard" > "Automatic Channel Detection" in the R&S ROMES4 main page.
2. Select the "TEC for 5G NR Scanner" and press "Next".

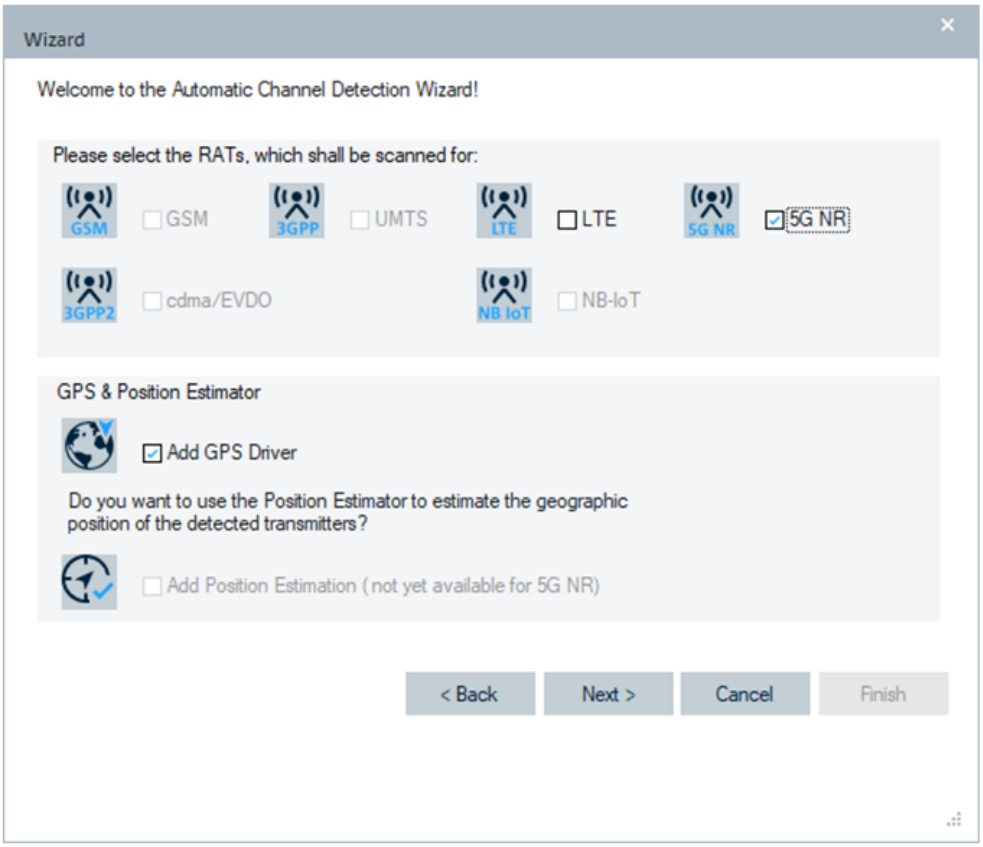


Figure 6-255: ACD wizard

3. The wizard leads you through the next steps, where you have to specify the band on which the algorithm looks for SSBs. It allows you all bands which are possible on the selected synchronized R&S TSME6 array to select.

   The band is associated with the frontends automatically. They can be adjusted in the "5G NR Scanner" configuration page in a second step, if necessary.

The wizard assumes a periodicity of 20 ms for 5G NR scanner.

The ACD wizard supports the Band Slicing feature. How to configure band slicing with ACD wizard, see Chapter 3.4.2.1, "Automatic channel detection wizard", on page 192.

The configuration of the 5G NR consists basically of the periodicity and the bands. The 5G ACD finds only SSBs with the given periodicity on the given bands. Once the ACD has found an SSB, a channel scan is set up automatically to follow the 5G NR carrier.

The ACD wizard sets-up the scanner configuration automatically. If necessary, setting up the ACD wizard could be done manually.

The RF Power Scan is not required for the 5G NR ACD.
Position Estimation is not yet available for 5G NR.

6.4.14.3 5G NR MIB demodulation

The 5G NR scanner can demodulate the MIB of the 5G NR beam. The demodulated values can be displayed as R&S ROMES4 signals.

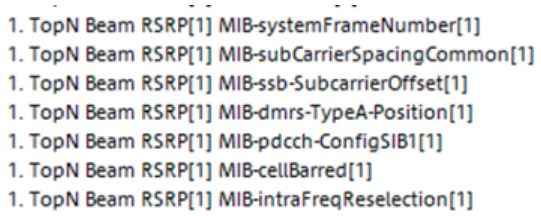


Figure 6-256: Some 5G NR signals

The shown signals are optional ones. Enable these optional signals in the configuration of the 5G NR technology module.

6.4.14.4 Advanced configuration - BCH demodulator

Click the "R&S 5G NR Scanner" > "Advanced" button at the right bottom of the scanner configuration page to launch the "Advanced Configuration" page.

Specify the minimum SINR of the 5G NR signals that you want to debe modulated in "Advanced Configuration" > "BCH Demodulator" > "Thresholds" pane.

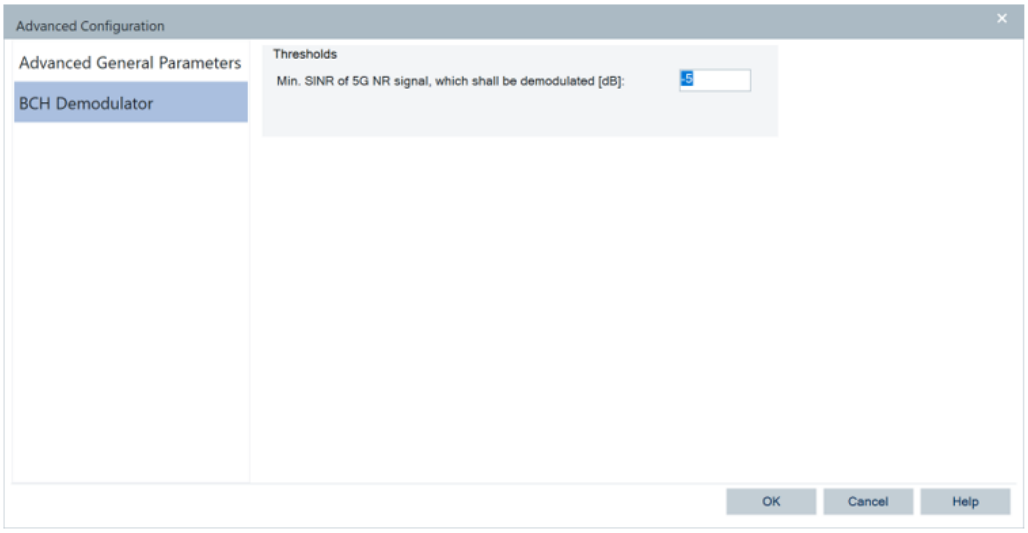


Figure 6-257: 5G NR scanner - BCH demodulator setting

The SINR threshold of 5G NR signals to be demodulated is configurable. The former default value was -5 dB.

6.4.14.5 5G NR high-speed scanner

The 5G NR scanner is able to deliver up to 50 measurements per seconds (single channel). It measures on single synchronization block, which means 50 measurements per seconds at a synchronization block periodicity of 20 ms.

The 5G NR scanner offers two independent measurement rates. The sync-measurement rate is a measure for discovering new cells and synchronizing on them. The high-speed measurement rate, however, is a measure for the effective measurement rate (independent measurement points, for example, on the map or in the 2D chart).

The high-speed measurement rate can be set up to 50 Hz in "HSRate[Hz]", what equals the maximum number of SSBs in a 5G NR signal with a periodicity of 20ms. The default setting is:

- Sync scanner rate: 1Hz

- High-speed scanner rate: 50 Hz

This setting is the best trade-off between discovering new cells on time and achieving the highest update rate for the RF measurements.

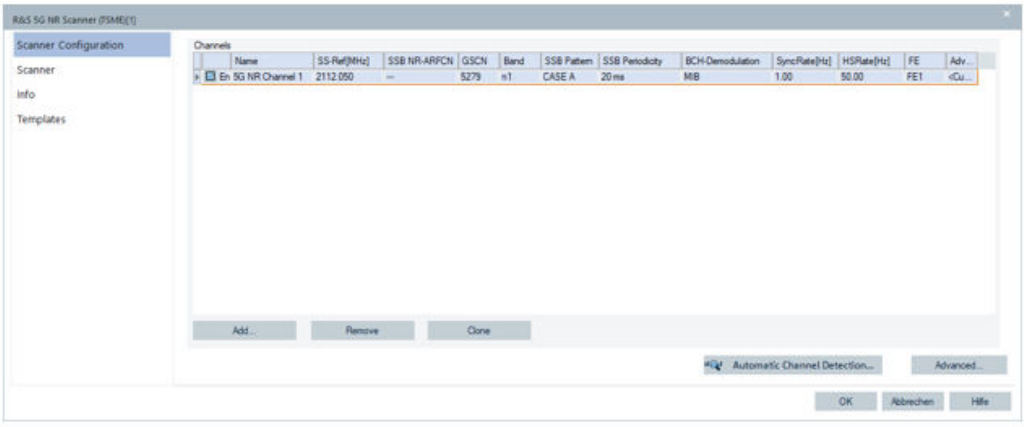


Figure 6-258: High-speed scanner setting

The scanner delivers measurement data up to every 200 [ms]. This data contains an average and the high-speed data that this average is based on, if available.

The following R&S ROMES4 signals support high-speed data:

- TopN xx-RSRP
- TopN xx-RSRQ
- TopN xx-SINR
- TopN xx RePower
- gNode B Template xx-RSRP
- gNode B Template xx-RSRQ
- gNode B Template xx-SINR
- gNode B Template xx RePower

The following R&S ROMES4 modules can handle the high-speed data:

- 2D Chart View
- Map (allows high-speed data optionally to use). By default is active, but can be deactivated for huge amount of data.
- ASCII Export
- Scanner Raw Export
- KML Export (in this case, consider the huge amount of data)

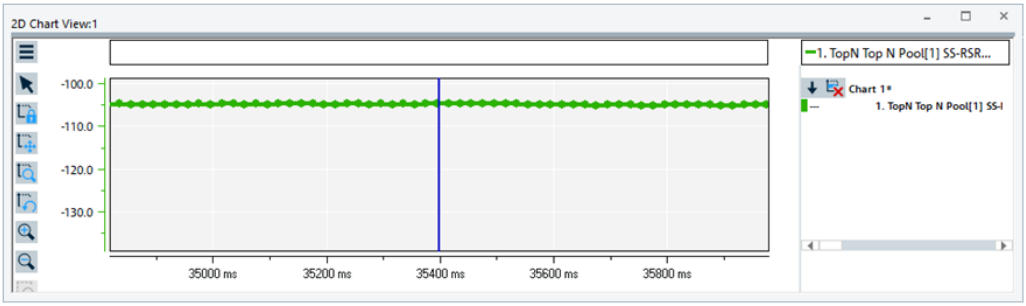


Figure 6-259: HS data shown in 2D chart view

All other R&S ROMES4 modules show the average data.

6.4.14.6 Dynamic loading of 5G band tables by using XML files

The 5G band tables for 5G NR are dynamically loaded using XML files and can be customized. The benefit is possibility to replace or extend the band tables.

There are two XML files for customizing 5G NR band tables:

- `UserBands.Sample.xml` - sample file that shows sample entries and how to customize band table.
- `UserBands.xml` - R&S ROMES4 loads this file at runtime. Entries in this file are used to add or update current LTE band tables. The actual band customizations are done in this file.

The `UserBands.Sample.xml` file is installed during the R&S ROMES4 installation on top of all user folders. The file is then copied to “My ROMES\Configuration” folder when R&S ROMES4 fully starts for the first time. If the file exists already, it is not copied.

To customize a band table, copy or rename the `UserBands.Sample.xml` file to create the `UserBands.xml` file.

Change the content of the `UserBands.xml` accordingly to customize bands. Updated bands are loaded next time when R&S ROMES4 starts.

5G NR samples in UserBands.Sample.xml

Short descriptions for band table fields are provided in the `UserBands.Sample.xml`.

Using the sample entries in this file to customize the band table.

- If the defined bands already exist in band table, the defined bands overwrite existing entries.

- If the defined bands do not exist in band table, new band entries are added.

- If the same band number is specified more than once, only the last one takes effect.

- Removing `UserBands.xml` restores the original bands.

The 5G NR user bands include the following samples whose values are decimal number strings:

1. Subband: 0 for user bands
2. Band: band to be defined, not included in 3GPP band spec range
3. Duplex: duplex mode, 0=FDD, 1=TDD, 2-SDL, 3=SUL, 4=Not Used
4. FULLOW: frequency uplink low
5. FULHI: frequency up link high
6. FDLLOW: frequency down link low
7. FDLHI: frequency down link high
8. Raster: frequency raster in kHz
9. ULLARFCN: uplink low ARFCN
10. Step: uplink step
11. ULHARFCN: uplink high ARFCN
12. DLLARFCN: downlink low ARFCN
13. Step2: downlink step
14. DLHARFCN: downlink high ARFCN
15. SCS1/SCS2: subcarrier spacing 1/2
16. Case1/Case2: 8-case A, 16-caae B, 32-case C, 64-case D, 128-case E
17. GSCN1F/GSCN2F: GSCN 1/2 First
18. GSCN2L/GSCN2L: GSCN 1/2 Last
19. Step3/4: step for GSCN 1/2
20. GeoFlag: 4294967295 for all geo locations
21. DuplexSpacing: duplex spacing for FDD can be negative. 0 for others

Sample usage to redefine band

For example, use band 5 to redefine band 1.

The following lines stand for band 5.

```
<Index Subband="0"
      Band="5" Duplex="0" FULLOW="8240" FULHI="8490"
      FDLLOW="8690" FDLHI="8940" Raster="100"
      ULLARFCN="164800" STEP="20" ULHARFCN="169800"
      DLLARFCN="173800" STEP="20"DLHARFCN="178800"
      SCS1="15" Case1="8" GSCN1F="2177" STEP3="1" GSCN1L="2230"
      SCS2="30" Case2="16" GSCN2F="2183" STEP4="1" GSCN2L="2224"
      GeoFlag="4294967295" DuplexSpacing="450" />
```

Changing now band 5 to band 1, both bands are listed when entering frequency of band 5, for example, 869.000 MHz. The two definitions are the same except the band number.

```
<Index Subband="0"
      Band="1" Duplex="0" FULLOW="8240" FULHI="8490"
      FDLLOW="8690" FDLHI="8940" Raster="100"
      ULLARFCN="164800" STEP="20" ULHARFCN="169800"
      DLLARFCN="173800" STEP="20"DLHARFCN="178800"
      SCS1="15" Case1="8" GSCN1F="2177" STEP3="1" GSCN1L="2230"
      SCS2="30" Case2="16" GSCN2F="2183" STEP4="1" GSCN2L="2224"
      GeoFlag="4294967295" DuplexSpacing="450" />
```

Click the column "SS-Ref(MHz") in the "R&S 5G NR Scanner (TSME)" dialog. The"5G Frequency Helper" dialog displays.

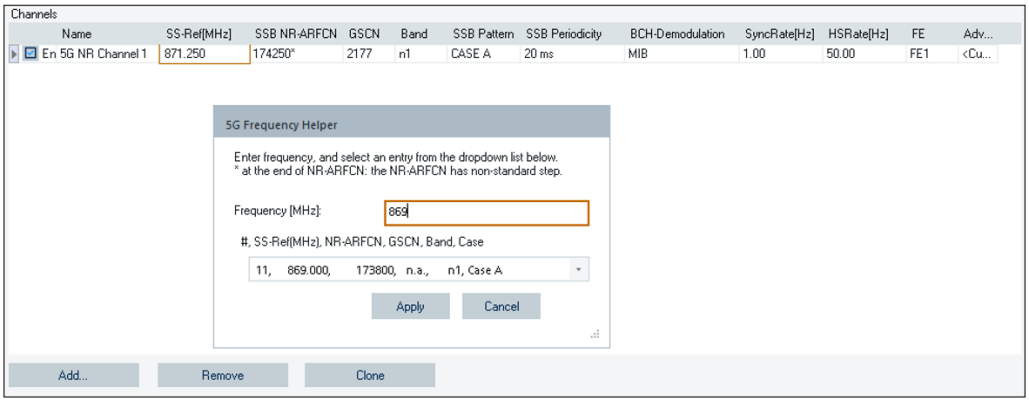
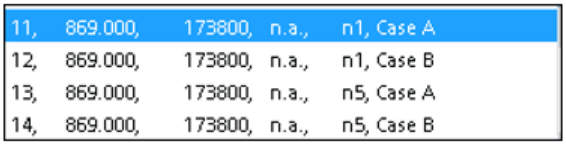


Figure 6-260: Entering wanted frequency value

Enter frequency value 869.0, clicking the dropdown arrow. The following entries are displayed along with others:

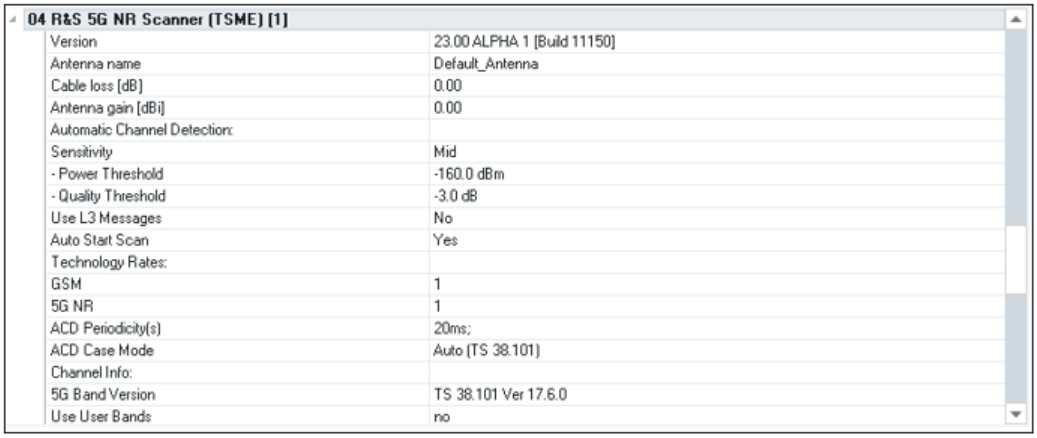
Both n1 and n5 are listed meaning that band 1 has been overwritten.



3GPP bands are overwritten most of time. You can customize the non-3GPP bands.

The "Use User Bands" entry at the bottom of the "R&S 5G NR Scanner (TSME)" > "Open" measurement dialog indicates whether "UserBands.xml" is used at the time when the measurement was created.

This entry is only available for 5G NR measurement files created with the latest R&S ROMES4 version.



04 R&S 5G NR Scanner (TSME) [1]	
Version	23.00.ALPHA.1 [Build 11150]
Antenna name	Default_Antenna
Cable loss [dB]	0.00
Antenna gain [dBi]	0.00
Automatic Channel Detection:	
Sensitivity	Mid
- Power Threshold	-160.0 dBm
- Quality Threshold	-3.0 dB
Use L3 Messages	No
Auto Start Scan	Yes
Technology Rates:	
GSM	1
5G NR	1
ACD Periodicity(s)	20ms;
ACD Case Mode	Auto (TS 38.101)
Channel Info:	
5G Band Version	TS 38.101 Ver 17.6.0
Use User Bands	no

Figure 6-261: Entries in the Open measurement dialog

As new bands can be added to the band table by 3GPP specification in the future, customize bands carefully. Your customized band can conflict with 3GPP bands. In this case, user bands are used.

Entries in scanner template use band index to reference bands. User bands cannot be always available if the template was created by others and user bands were used.

6.4.14.7 Time of arrival measurement

The Time of Arrival (TOA) measurements are essential for measuring the time synchronization between different gNBs to avoid an overlap between uplink and downlink timeslots. They are a measure for the time offset between the ultra-precise PPS pulse (from GPS) and the time of arrival of the SSB sequences. Different TOAs either show a bad synchronization or a higher distance between receiver and gNB.

Two Time of Arrival signals and two columns in the "5G Scanner TopN View" are available and let you compare the time of arrival of the signals of a gNodeB. The ToA (PPS) is based on the GPS PPS pulse and is the preferable signal for usage.

As a fallback the signal ToA (CIR) offers a time of arrival calculation based on the device’s internal timer (if GPs is not available).

The displayed time is normalized to the 5G NR 10 [ms] frame.

Example:

PCI	SSB Idx	ToA(PPS)
387	6	1.57293295
386	6	1.57219417
388	6	1.57217404
387	5	1.28698835
386	5	1.28624133
388	5	1.28622252
387	4	1.07291982
386	4	1.07218962
388	4	1.07216514
387	3	0.78685764
386	3	0.78625346
388	3	0.78622336
387	2	0.57282102
386	2	0.57216981
388	2	0.57215596
387	1	0.28708783
386	1	0.28625093
388	1	0.28622450
387	0	0.07296562
386	0	0.07219831
388	0	0.07217009

Figure 6-262: Example for TOA

6.4.14.8 TAE measurements

The 5G scanner can measure the Time Alignment Error (TAE). TAE is measured by calculating the time of transmission of a 5G NR frame with a specific System Frame Number (SFN) in UTC time.

As the TAE measurement dialog contains many expert parameters, expert's knowledge is needed for timing measurements. For the less skilled users, R&S adds an option that hides 5G NR TAE measurement expert parameters and emphasizes the important ones and their values. Here is the screenshot of the option, the minimized "TAE Measurement" dialog.

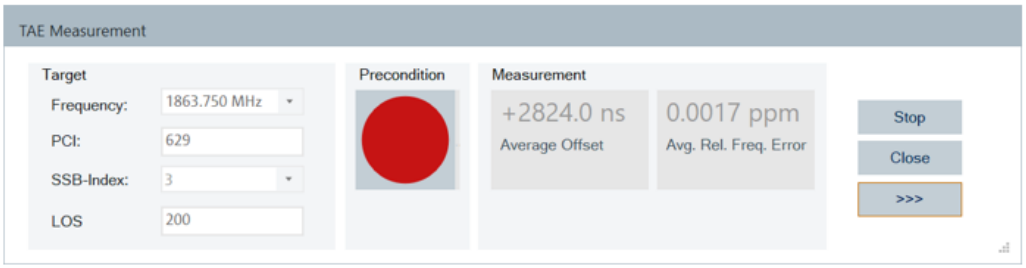


Figure 6-263: TEA measurement minimized dialog

The minimized dialog shows green or red for the precondition state and the average offset and average relative frequency error of all measurements. The expert values can be accessed by opening the dialog with the ">>>" button, see Figure 6-265.

The TAE measurement requires the R&S TSME6 option K51.

The TAE measurements configuration allows you to select the GPS source and GPS altitude source. By default, the system tries to find the best source within the set of connected R&S TSMEs. But if for any reason the GPS is taken from a specific device, you can select that device.

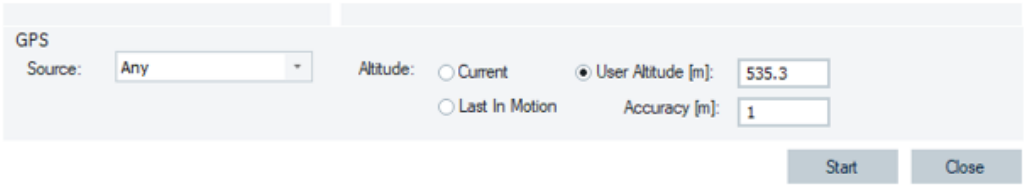


Figure 6-264: GPS source for TAE measurement

The following GPS altitude modes are available:

- "Current"
  The system uses the current GPS altitude.
- "Last In Motion"
  The most recent altitude measured with a speed more than 20 km/h is used for the uBlox devices used to produce PPS information. Each uBlox has its own altitude. Altitudes measured during motion are normally better than measured altitudes in stationary case. This option can be used when the TAE location can be arrived in a flat road using a vehicle faster than 20 km/h.
- "User Altitude [m]"/"Accuracy [m]"
  You can enter the exact altitude and its accuracy.

During replay, the used values are reported as information of the TAE start event.

Preconditions

To perform the TAE measurement, set up a normal 5G measurement with fixed channels or ACD. Once the scanner has detected the beams, double-click a beam in the "TopN View" to open the TAE measurement dialog. The dialog can be also opened if you select the "Action Menu" > "TAE Measurement".

The TAE measurement must be triggered by the user, contrary to all other scanner measurements which are done automatically.

The scanner performs TAE measurements only if the all following preconditions are fulfilled.

- PPS is available
- PPS has the necessary accuracy
- UTC time sync is available
- R&S TSME must not detect movement with one of its internal GNSS devices
- CINR of the selected beam for TAE measurements is good enough
- Weighted TAE-specific delay spread is small enough for TAE measurements

The TAE measurement shows the precondition flags for the currently selected beam. Also, the transmitter under the test has to be in line of sight (LOS). The following table shows the parameters which you have to add to the measurement.

Parameter	Remark
LOS [m]	Exact distance from the receivers' antenna to the transmit antenna. The RF propagation is subtracted for the assumption of propagation in normal air with speed of light a little slower than in vacuum. (299710 m/s)
GPS cable length [m]	The length of the GPS antenna cable. The time required by the wave is calculated as follows: Cable Length [m] / (299710 m/s * VF(GPS))
RF cable length [m]	The length of the RF antenna cable. The time required by the wave is calculated as follows: Cable Length [m] / (299710 m/s * VF(RF))
Velocity factors	The velocity factor (VF) is the relation between the speed of light in vacuum and in the cable.

As the GPS cable length, RF cable length and the velocity factors are system parameters. They can be preset in the transducer table file. If the values are found in the transducer table, the dialog does not allow them to change anymore.

Example:

<Frontend Identnumber="4900.0004K02" Serialnumber="101034" Active="true">

<CableLengthsInMeter GPS="5" RF="1" VFRF="0.66" VFGPS="0.66"></CableLengthsInMeter> </Frontend>

Measurement

Once all parameters are set, the measurement can be started for the selected beams. The results of the measurements are displayed directly in the dialog.

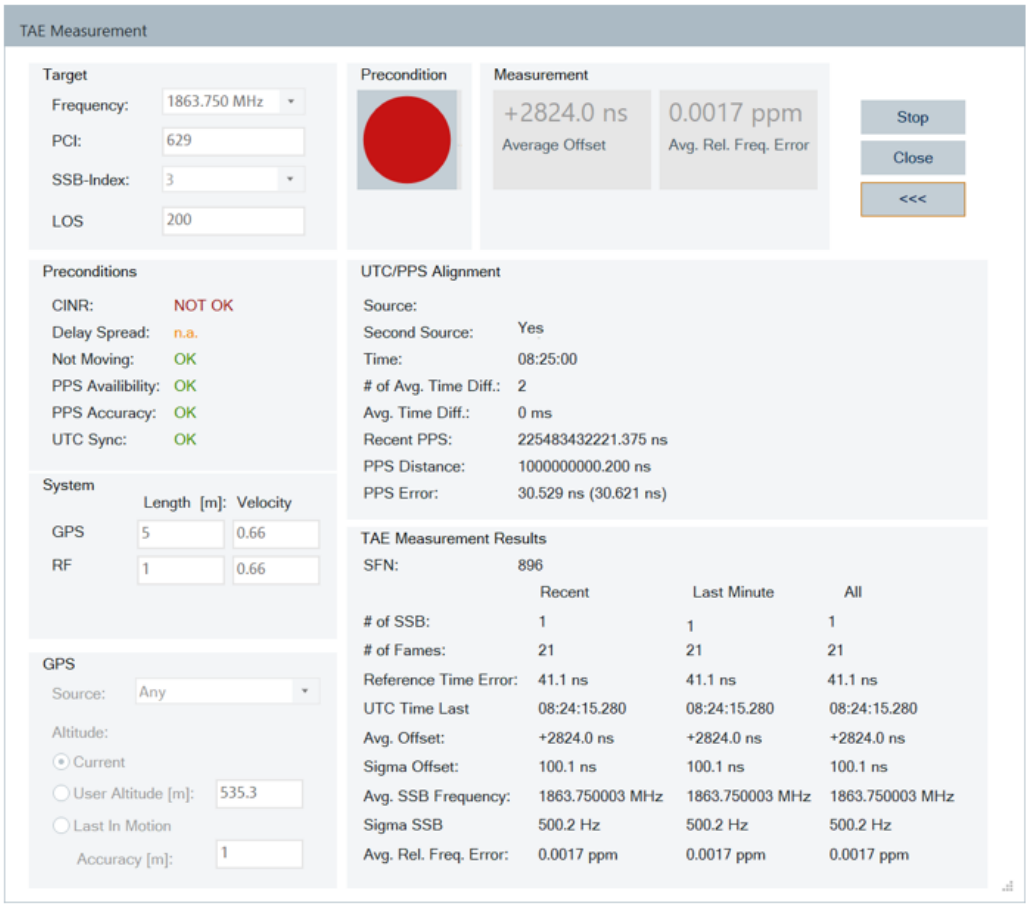


Figure 6-265: TAE measurement expert dialog

Once the required accuracy is reached, you can stop the measurement and continue to the next beam.

If you choose the "any beam" option, the measurement performs TAE measurements for all beams of the selected PCI, which do fulfill the preconditions. Select a beam whose measurement results you want to be displayed on the "TAE Measurement" dialog.

It is possible to continue with the same measurement to the next transmitter and start a new TAE measurement. All result of the TAE measurements is stored in the measurement file and can be analyzed in the "Replay" mode or exported to a `*.csv` file using the ASCII export. For export of the TAE measurement results, see the section "Export of 5G NR Scanner TAE Measurements Data" in Chapter 7.2.5.2, "Interactive export", on page 2134.

The "Signal Tree" offers all relevant signals of the TAE measurements. For the signals, see the "Description of R&S Romes Signals".

All signals are template signals. Thus, you have to specify the filter during activation of the signal.

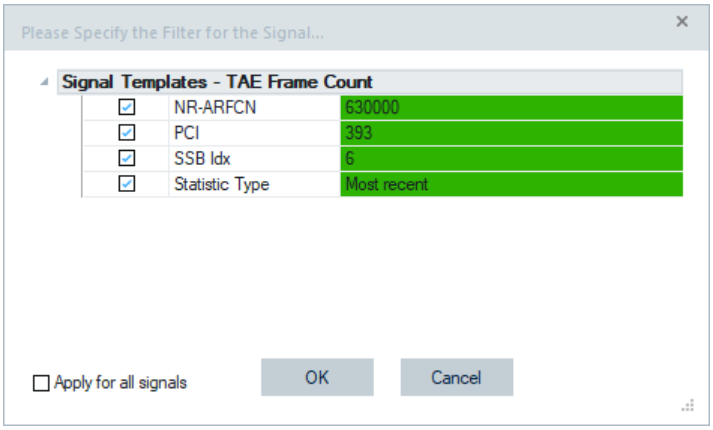


Figure 6-266: Activation of TAE signal templates

Set the following filters:

- NR-ARFCN of the transmitter under test
- PCI of the transmitter under test (0...1007)
- SSB Index of the beam under test (0...64)
- Statistic Type ("Most recent","Last minute", "All")

Specific signals are created for the applied filters.

The results of the TAE measurements can be displayed in the "Alphanumeric View".

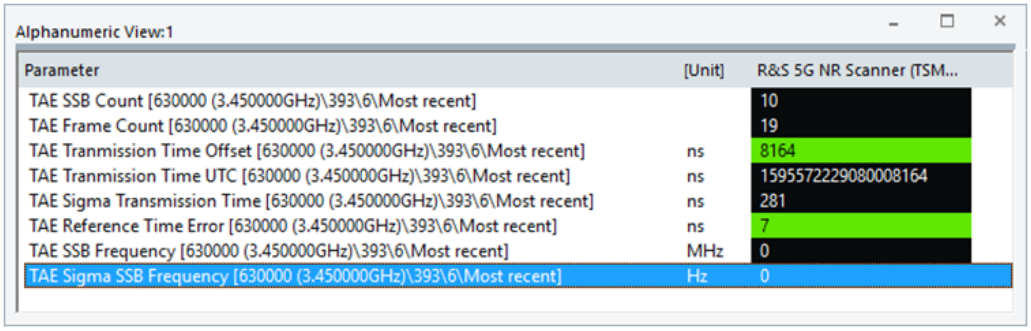


Figure 6-267: Alphanumeric view of TAE measurements

The two R&S ROMES4 events show when the measurement has started and stopped. The "Info" column contains the setting details of the TAE measurement.

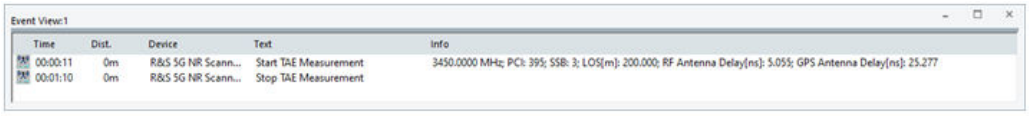


Figure 6-268: TAE events

6.4.14.9 Geometry factor calculation

R&S ROMES4 does the Geometry Factor (GF) calculation for the current 5G TopN Set.

Depending on the TopN configuration, the factor calculation depends on the selection of beams/SSB or cells. The values can be displayed as R&S ROMES4 signals, or as an additional column in the "5G Scanner TopN View".

The Geometry Factor is defined as the difference between the best cell/beam path gain and the sum of the path gains all other neighbor cells/beams in the network.

The motivation for GF calculation is getting the cell isolation or the inter-cell interference value which is an important characteristic of radio networks. It is a measure for the dominance of a certain beam/SSB or cell.

The cell isolation together with a link performance limits the achievable user throughput and the capacity for a 1-reuse link adaptive packet access systems, such as 5G.

Cell isolation is measured as geometry factors. For 5G NR, the measurement is based on Cell SS-RSRP.

The following figure highlights the GF signal, but also the Time of Arrival signals is visible.

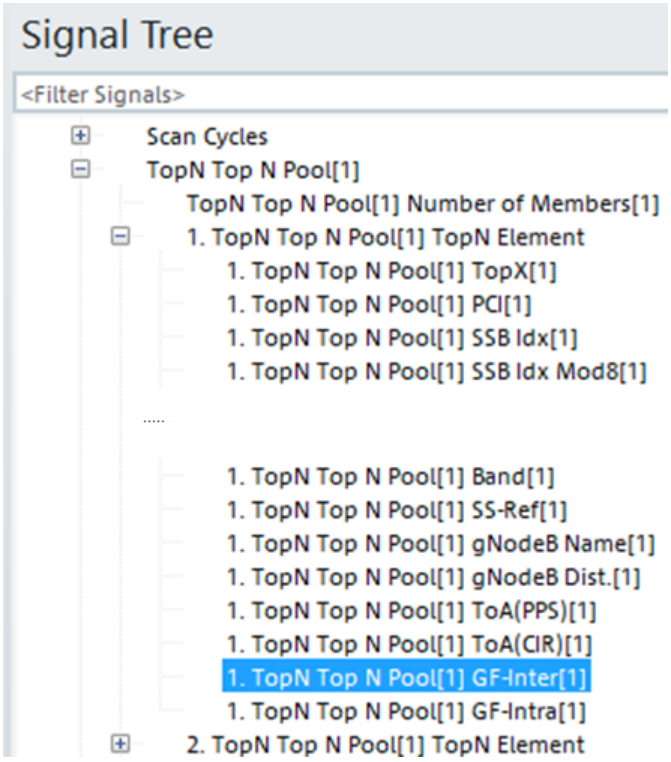


Figure 6-269: 5G NR scanner signals

The Intra-GF value is available for beam-based TopNs only.

6.4.15 LTE scanner

The R&S ROMES4 LTE scanner driver controls the R&S TSME scanner device while performing LTE measurements.

The needed hardware option is R&S TSME-K29. The options R&S TSME-K30 and R&S TSME-K32 are needed for MIMO and eMBMS measurements, respectively. The driver is available with the R&S ROMES4T1E option.

Installation of the driver is explained in Chapter 6.1, "Devices", on page 1447.

The LTE scanner device configuration is explained in the following.

For the LTE scanner measured and evaluated data, see Chapter 3.3.17.4, "LTE scanner views", on page 184.

6.4.15.1 Loading LTE scanner

The R&S TSME devices can run as the LTE scanner devices if loaded with the R&S ROMES4 LTE scanner driver.

Click the "Hardware" > "Connect/Disconnect" menu entry. The "Hardware Configuration" page pops-up.

To load R&S ROMES4 LTE scanner driver into R&S TSME, double_click the "Network Scanner TSME" > "TSME LTE" branch in the "Hardware Configuration" > "Available Devices" pane, see Figure 6-40.

The device is loaded and visible in the "Loaded Devices" pane of the page. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S LTE Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

The device is now added as the "RS LTE Scanner [<variable>]" command line to the "Hardware" menu.

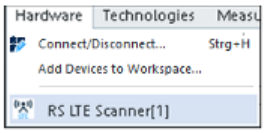


Figure 6-270: Loaded R&S TSME as LTE scanner

Click the "RS LTE Scanner [<variable>]" line to open the LTE scanner main configuration page.

The dialogs of a device chooser open when the R&S TSME driver is loaded. The device chooser dialog is used to select the test device and define the essential connection parameters, if necessary.

For details about the loader's dialog, see Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The "R&S <variable>: Select Device" dialog is used to share the test device resources between all loaded R&S TSME hardware drivers. Furthermore, over the dialog the IP address of a device can be selected, if necessary.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The scanner needs at least one frontend (Rx unit). If more than one LTE channel has to be measured, it is recommended to use two Rx units.

Note: Only the synchronized R&S TSMEs can be used simultaneously as the LTE scanners when loaded into one R&S ROMES4 LTE scanner driver. Thus, it is possible to set up the R&S ROMES4 LTE scanner driver to use different set of R&S TSME devices. It allows, for example, two times MIMO 2x2 to measure by using four R&S TSMEs.

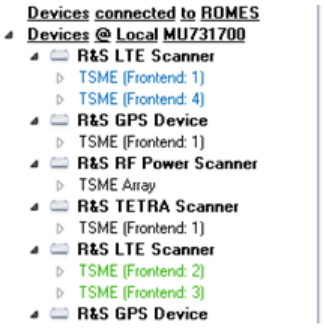


Figure 6-271: Configured frontends of four connected R&S TSMEs

The receive antenna reported by all measurements is the frontend number minus 1. For example, if the frontends 1 and 4 are connected to an R&S ROMES4 LTE scanner driver, obtained measurement data is for the receive antenna 0 and 3, see Figure 4-910.

6.4.15.2 Configuration LTE scanner

If you select the "Hardware" > "R&S LTE Scanner [<variable>]" command line, R&S ROMES4 provides a configuration menu for the R&S ROMES4 LTE scanner. The menu is available when the driver is loaded.

The "R&S LTE Scanner [<variable>]" > "Scanner Configuration" tab offers to select channels for scanning. The "Scanner" tab let you set the scanner properties. The "Info" and "Templates" tabs display information on the test receiver driver and store the settings to a template, respectively.

In "Scanner Configuration" configure the measurement parameters for one or more channels that you want to measure.

The co-existence of 5G NR and LTE in the same bandwidth requires the feature DSS. The feature allows the specific resource elements of the LTE spectrum to reserve for the 5G carrier. From the UE's perspective, this feature is identical to eMBMS. The LTE scanner is redesigned in such a way that DSS and eMBMS can be configured. Both eMBMS and DSS are signaled via SIB2.

There are signals associated to the carriers which are shared between 5G NR UEs and LTE UEs in DSS procedure. To mark these signals, R&S ROMES4uses "-D" appendix added in their names. For the conditions to mark them in that way, refer to the text below the Figure 4-472.

The narrowband scanner does not make reference symbol measurements before SIB2 is demodulated while the wideband scanner measures reference symbol only on a limited set of them.

If the LTE carrier under test offers eMBMS or DSS, the LTE scanner has to know about it to use the correct reference symbols and subframes. Enable the DSS option to make the scanner sensitive to considering DSS-specific subframes and reference symbols.

Channels pane

Configure the channels which you want to be scanned in the "Channels" pane. Activate scanning of the configured specific channels.

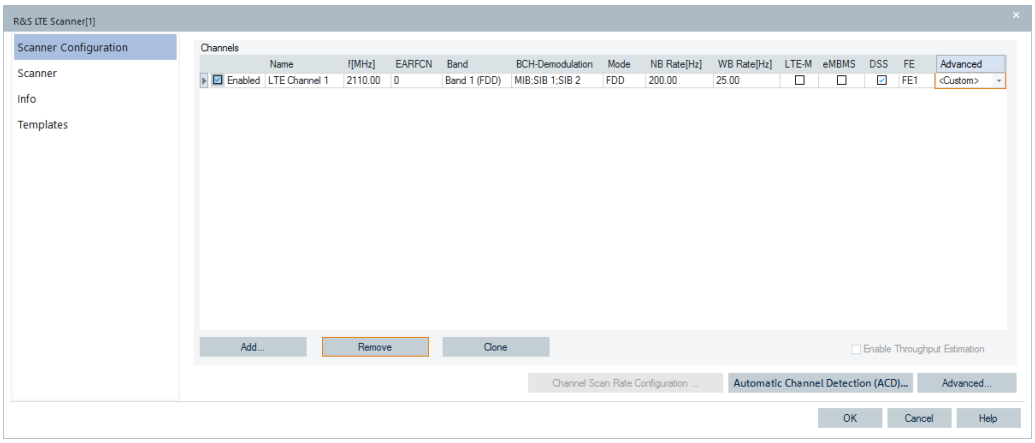


Figure 6-272: Configuration page - virtual channel option not active

Instead, you can allow the scanner to follow another device by choosing the "Virtual" option. Choosing this option, the primary R&S ROMES4 driver is selected which configures scanning dynamically. Therefore, no need for defining a certain EARFCN.

This Virtual Channel feature allows the scanning without knowing a specific frequency of the LTE network. It is useful while monitoring the UEs with configured one or more SCCs in the LTE-A networks.

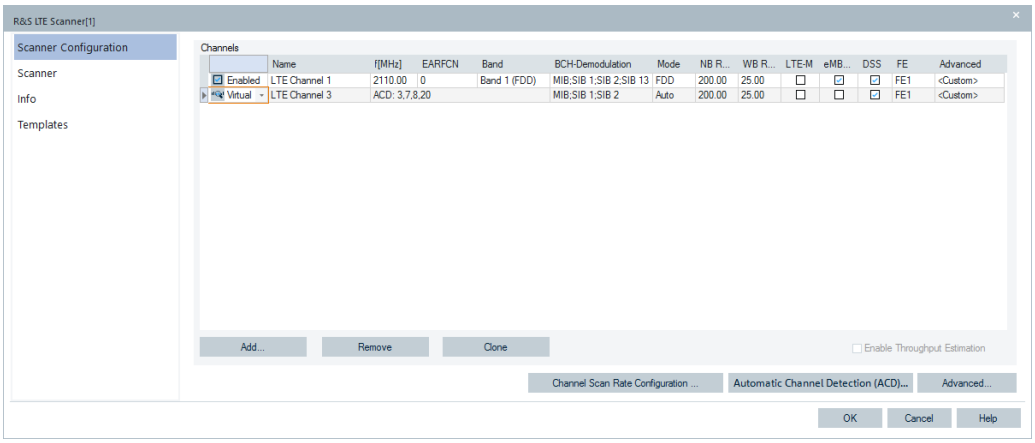


Figure 6-273: Configuration page - virtual channel option active

The following functions and their parameters are shown in the "Channel" pane.

Channel Enabled/Virtual
Enable or disable scanning of a selected channel or set the "Virtual" channel option.

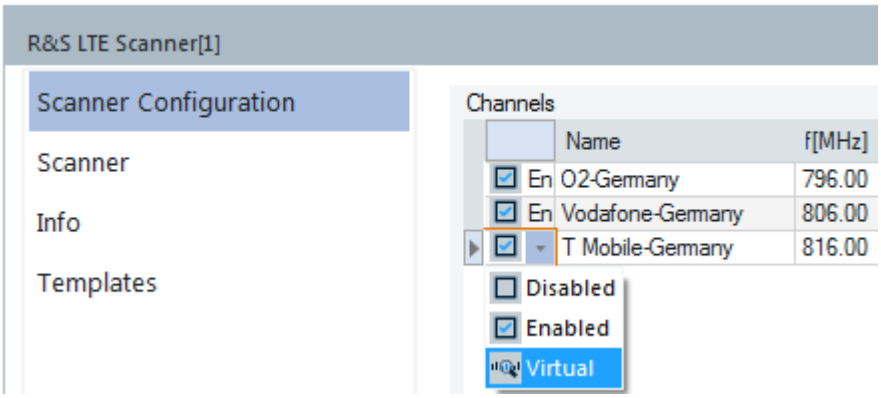


Figure 6-274: Status selection of the set channels

If "Virtual" is selected, the combo-boxes of the frequency, "EARFCN" and the "Band" columns disappear in the pane. Instead a combo-box appears which allows to select between a test device and the ACD.

If the ACD is selected, the combo-box under the "f[MHz]| EARFCN|Band" column offers all the possible sources for the virtual channel. By default, the LTE bands 3, 7, 8 and 20 are searched, see Figure 6-273.

For the ACD configuration, see Chapter 3.8.2.1, "Technologies", on page 280 and Chapter 6.4.15.2, "Configuration LTE scanner", on page 1728.

If the LTE channel is detected, the settings concerning the BCH measurements, measurement rates and the advanced settings of the virtual channel is applied to the detected channel.

Note: The entry "Virtual" is only available with the ACD option or if at least one device driver is loaded. The latest can be commanded by the scanner (currently only the Qualcomm drivers support the feature).

The primary device can add and release physical channels during the measurement. It can be useful to ignore the release command.

For example, if LTE device adds an SCC, the second channel is scanned automatically. In a case the SCC is to be released, the UE releases this channel also in the LTE scanner.

If the user wants to scan the SCC always, regardless of the UE usage of SCC, the release commands can be ignored. In this case, the scanner scans the SCC from the point in time when the UE adds the SCC the first time.

Name
Name of the channel, for example, a provider name.

f[MHz]
Carrier center frequency of the channel.

EARFCN
E-UTRA Absolute Radio Frequency Channel Number.

Band
E-UTRA operating band.

BCH Demodulation
BCH demodulation allows selection of MIB and SIB types for demodulation.

The list of SIBs which can be configured for demodulation and display in R&S ROMES4 is given in this column. To comply with 3GPP Rel 17, LTE SIBs from SIB26a to SIB32 and posSIBS are added to the list.

SIB26a: contains NR bands list which can be used for EN-DC operation with the serving cell.

SIB27: contains information relevant only for inter-RAT cell selection i.e. assistance information about NB-IoT frequencies for cell selection.

SIB28: contains NR sidelink communication configuration.

SIB29: contains common resource reservation, e.g. for coexistence with NR.

SIB30: contains configurations of disaster roaming information.

SIB31: contains satellite assistance information for the serving cell.

SIB32: contains satellite assistance information for prediction of discontinuous coverage.

posSIBs: contains positioning assistance data as defined in TS 36.355 [54].

Mode
The signal on the channel is an LTE FDD or TDD signal. FDD/TDD selection depends on selected band.

If a standard band is selected, the mode changes automatically (automatic FDD/TDD selection), depending on the band. The corresponding cell is read only.

If "No 3GPP band" is selected, the cell is accessible and the user can set the mode.

NB Rate [Hz]
Maximum narrowband measurement rate.

WB Rate [Hz]
Maximum wideband measurement rate, up to 50 Hz.

eMBMS
If selected, activates the eMBMS scanner and eMBMS measurements.

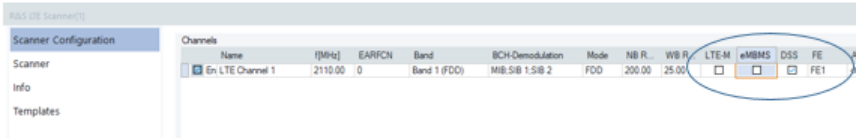


Figure 6-275: eMBMS and DSS options selection

- The narrowband scanner does not measure reference symbols until SIB2 has been demodulated. In eMBMS or/and DSS, reference symbol measurement is not performed.

- The wideband scanner uses a limited set of reference symbol measurements until SIB2 has been demodulated. After a successful demodulation of SIB2, the wideband scanner demodulates all relevant reference symbols.

Note: The column "eMBMS" is only available if the scanner option is available. eMBMS works in auto mode and therefore has no configuration page.

DSS
If DSS is selected, the following applies:

- The narrowband scanner does not measure reference symbols until SIB2 has been demodulated. In eMBMS or/and DSS, reference symbol measurement is not performed.

- The wideband scanner uses a limited set of reference symbol measurements until SIB2 has been demodulated. After a successful demodulation of SIB2, the wideband scanner demodulates all relevant reference symbols.

LTE-M
If checked, LTE-M scanner is active and measure LTE-M channel, see Chapter 6.4.15.8, "LTE-M scanner configuration", on page 1751.

Note: The column "LTE-M" is only available, if the scanner option is available.

FE
It is possible to select a frontend for each LTE channel. The selected frontend is used for the narrowband scanner and the demodulator (LTE and LTE-M).

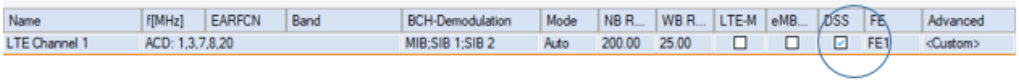


Figure 6-276: Frontend selection

Frontends for MIMO and wideband scanner can be selected independently in the advanced configuration.

Advanced
For most measurement applications, the default configuration values are the proper ones. However, if you wish to adapt them, you can do that by opening the advanced configuration pages.

The "Advanced" drop-down combo-box offers different settings for a selected channel.

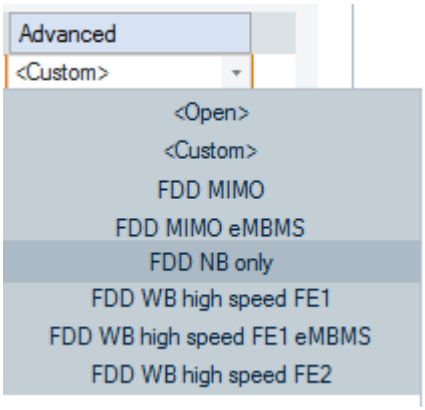


Figure 6-277: Advanced entries

All LTE views accumulate the configured channels. The currently inactive frequencies are marked with an asterisk (*) in the frequency combo-boxes. The Top N algorithm is based on the currently measured channels. It is a snapshot of the current measurement. Thus, the measurement result depends on the channel configuration done by the primary device. The BCH view accumulates all decoded eNodeBs, regardless of what channels were measured.

Advanced Channel Settings
If you select "Advanced" > "Open", the "Advanced Channel Settings" dialog shows up. The dialog offers a channel-specific setting.

If the "Virtual" option in the column "Channel" is selected, the "Virtual Channels" tab is also included in this dialog.

WB/MIMO measurements

The "Advanced Channel Settings" > "WB/MIMO Measurements" dialog contains the combined WB and MIMO measurement configuration parameters. The dialog is subdivided into the "WB RS Measurements" and the "MIMO Measurements" pane.

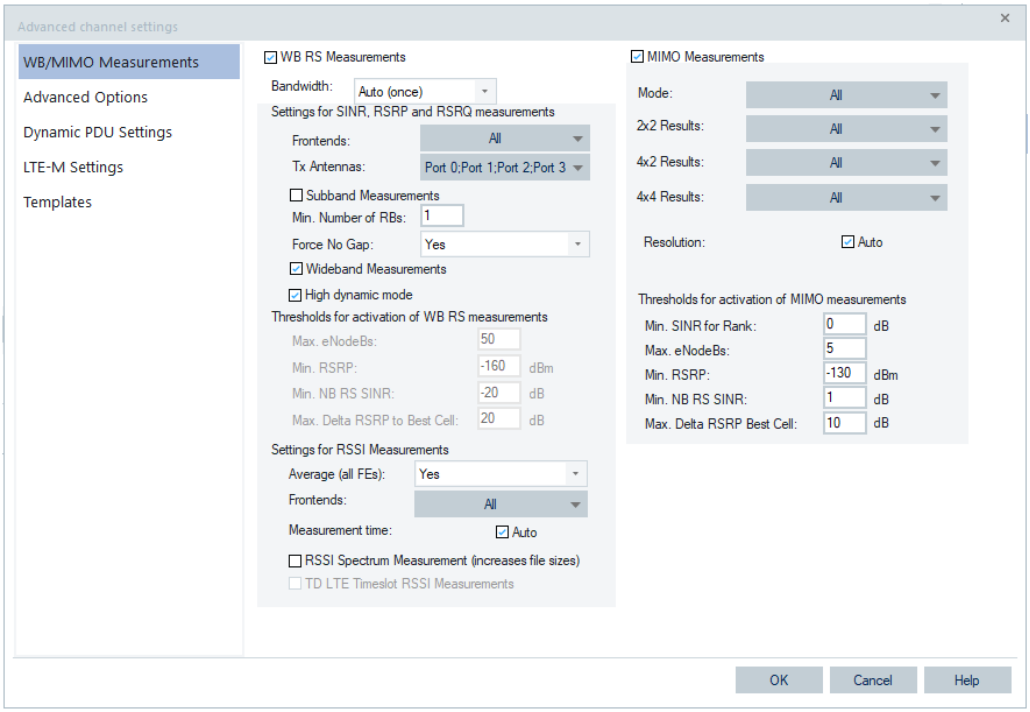


Figure 6-278: WB/MIMO Measurements

To get the dialog, you need the R&S TSME-K30 option with additional R&S TSMEs and sync cables, see Chapter 6.4.27.1, "Multiple R&S TSMEs", on page 1869.

LTE WB measurements can run at maximum speed in parallel with LTE NB measurements if using the R&S TSME ROMES4T1E. The maximum speed depends on bandwidth.

WB RS measurements pane

You can configure the following parameters in this pane:

- Bandwidth of RS measurements in the "Bandwidth" list

  Defines how the number of transmitted resource blocks (bandwidth) for each eNodeB on this channel is determined.

  – If "Auto (once)" is selected, the bandwidth is taken from the first MIB on the channel, thus the demodulation of MIB is mandatory. It is assumed that all eNodeBs on the same channel frequency use the same number of resource blocks.

  – If "Auto (tracking)" is selected, the bandwidth is taken from each MIB on the channel, thus the demodulation of MIB is mandatory. It is assumed that the eNodeBs on the same channel frequency use different number of resource blocks.
  This mode uses more resources. Apply it only if the bandwidth really differs.

  – Use the manually given bandwidth specified for LTE, that is, 1.4 MHz, 3 MHz, to 20MHz.

- Frontends and TX antenna ports for SINR, RSRP and RSRQ measurements in "Frontends" and "Tx Antennas", respectively. Up to 16 antennas can be selected, from "Tx Antenna Port 0" up to "Tx Antenna Port 15".
  Four FEs are available for these measurements if four R&S TSMEs are connected.
- If checked, "Subband Measurements" controls activation/deactivation of the subband measurements. A subband measurement with the finest granularity requires the scanner to process a long RF signal. Therefore, the subband measurements can only be provided at lower rates.
  For high-speed measurement, reduce the granularity of the subband measurements using "Min. Number of RBs" or even deactivate the subband measurements.
  Increasing the minimum number of RBs used for subband measurement improves the maximum accuracy. However, more computation time is required and measuring high RS SINRs is more difficult.
  To avoid the gap in the middle of the subbands, set "Force No Gap" to "Yes". The gap remains and includes the DC carrier in case the number of RBs is not divider of the total number of RBs.
- Check "High dynamic mode" to activate wideband (WB) RS measurement that delivers one result (RSRP, RSRQ, RS SINR or RS RSSI) over complete bandwidth. The measurement is provided down to -20 dB for RS SINR.
  This WB RS measurement requires the scanner to process a limited amount of signal. Due to that approach, the measurement is provided at the high rate.
  If the high dynamic mode measurements are not required, select the thresholds for activation of WB RS measurements.

  By deselecting "High dynamic mode" the following thresholds can be set:
  - "Max eNodeBs" - maximum number of eNodeBs which use one frequency for which the RS SINR measurement is set, default 50
  - "Min RSRP" - minimum RSRP for which the RS SINR measurement is set, default -160 dBm
  - "Min NB RS SINR" - minimum narrowband RS SINR for which the RS SINR measurement is set, default -20 dB
  - "Max. Delta RSRP to Best Cell" - maximum delta between the NB RSRP of the currently measured cell and the NB RSRP of the best received cell for which the RS SINR measurement is set, default 20 dB
- "Settings for RSSI Measurements" lets configure the parameters for the WB RSSI spectrum measurements.
  The measured WB RSSI spectrum is shown in the "TopN List" of the "LTE Scanner TopN View", see Figure 4-915.
  If "Average (all FEs)" is set to "Yes" and more than one frontend is used, the RSSI power and power spectrum of the frontends is averaged (in Watt, power combining). If not, a value for each frontend is measured separately. Select frontend/frontends to be used for RSSI and spectrum measurements in "Frontends".
  Associate a driver to both frontends to measure MIMO values. If four R&S TSMEs are connected, there are four FEs on disposal for RSSI measurement as the R&S TSME supports 4x4 MIMO.
  The WB RSSI measurement time is set to some value (in ms) or to "Auto" in the "Measurement time".

The scanner reports the actual used measurement time as the "WB RSSI Meas. Time" signal within the "Top N Templates" and "eNodeB <EARFCN\PCI> Template" branches of "Signal Tree" > "LTE Scan".
The signal is visible in the "Alphanumeric View".

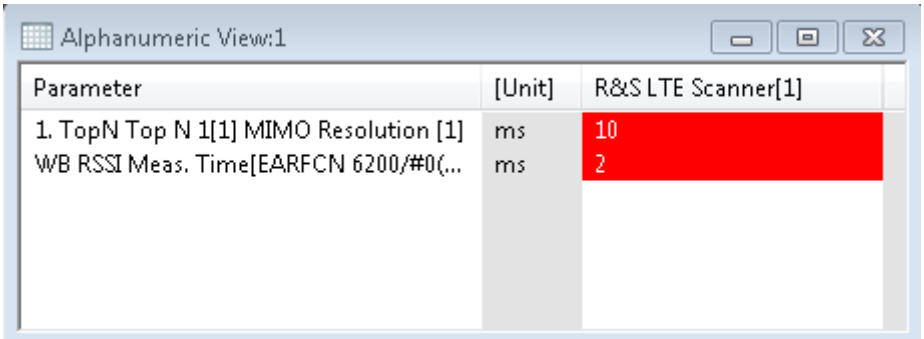


Figure 6-279: Alphanumeric view showing WB/MIMO measurements

The WB RSSI spectrum measurement is disabled by default as the measurement results generate a huge amount of data which is rarely used. You can nevertheless activate the measurements if you check the "RSSI Spectrum Measurement (increases file sizes)" checkbox. The "LTE Scanner WB RSSI Spectrum View" is the only R&S ROMES4 view which allows to visualize this data.
If "TD LTE Timeslot RSSI Measurement" is selected, the RSSI of a TD timeslot is measured in LTE TDD mode.
In that case the following RSSI TD TS-related signals are available in "Top N Templates" and "eNodeB <EARFCN\PCI> Template" branches of "Signal Tree" > "LTE Scan".

– "RSSI TD TS Rx0/Rx1" showing the received signal power on a certain receiver for each DL slot of an LTE radio frame
– "TDD RSSI Slot" showing a measured slot number (0-19) of the LTE radio frame

If the "WB RS Measurement" is inactive, the "Subband Measurements" and the "High dynamic mode" are also inactive. The related parameters cannot be set in that case.

MIMO measurements pane

MIMO Measurements
Here you can configure and activate MIMO measurements.

The following signals are configurable:

- MIMO mode in "Mode".
  Measurement and processing of 2x2 MIMO, 4x2 MIMO and 4x4 MIMO signals are supported. The signals are available in "Available Signals" > "Top N"/"Power Frequency".

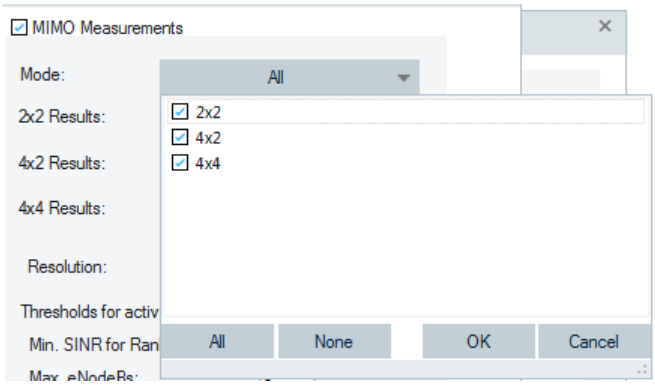


Figure 6-280: Measurement of MIMO signals

Note: The MIMO 4x4 feature needs the R&S TSME setup. The setup must include four R&S TSMEs interconnected with the four port sync cable. For the Gigabit Ethernet connection, needed is a Gigabit Ethernet switch capable to forward 9k Jumbo frames.

- MIMO channel matrix (H-Matrix), Condition Number (CN) and the theoretical Rank Indicator in "2x2 Results","4x2 Results" and "4x4 Results".
- Time interval between MIMO measurements within the captured data in "Resolution".
  The parameter can be set to some value (in ms) or as "Auto". The scanner reports the used 2x2 MIMO, 4x2 MIMO or 4x4 MIMO resolution time. This value must be less or equal the “measurement time” of the WB measurements. Value 0 is used to calculate just one MIMO result per acquisition.
  For example, if the resolution is set to 5 ms and the data capturing lasts 50 ms, the MIMO results are calculated up to 10 times and returned.
  For TDD, the resolution has to be a multiple of 10 ms (LTE frame duration).
- "Thresholds for activation of MIMO measurements" allows setting the threshold values of the parameters which are relevant for the MIMO measurement. For description, see the previously mentioned activation of high dynamic mode of WB RSSI measurements.
  Note: Default value for "Min SINR for Rank" is 0 dB.

Advanced option

Shows the narrowband measurements configuration details.

"Power of Sync-Channels" allows the ratio of the SSS power to PSS power to specify. You can select one of the three offered options.

The number of symbols per RB, that is, 6 (Extended Cyclic Prefix) or 7 (Normal Cyclic Prefix), is configured in the "Symbols" area.

The "RSRP / RSRQ Measurements" lets the LTE-TDD subframe 9 configuration, which was released in 3GPP Rel. 11.

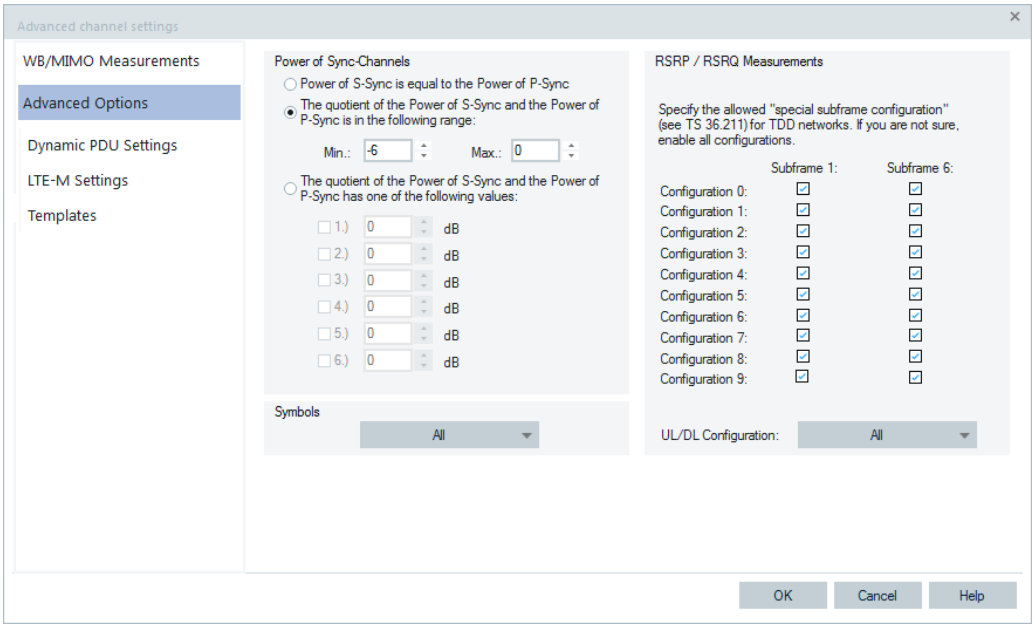


Figure 6-281: Advanced options measurements

Dynamic PDU settings

For the general issues related to dynamic PDUs handling, see "Implementation of the dynamic PDU handling" on page 284.

All the supported PDUs (MIB and SIBs) of a selected channel which can be configured for measurement are shown in the "Dynamic PDU Settings" page. The page is included in the "Advanced channel settings" dialog that can be launched by clicking the "Open" pop-up item in "Advanced" grid column.

R&S ROMES4 supports LTE 3GPP rel.17 defined SIBs, which are SIB 26a, SIB 32 and proSIB.

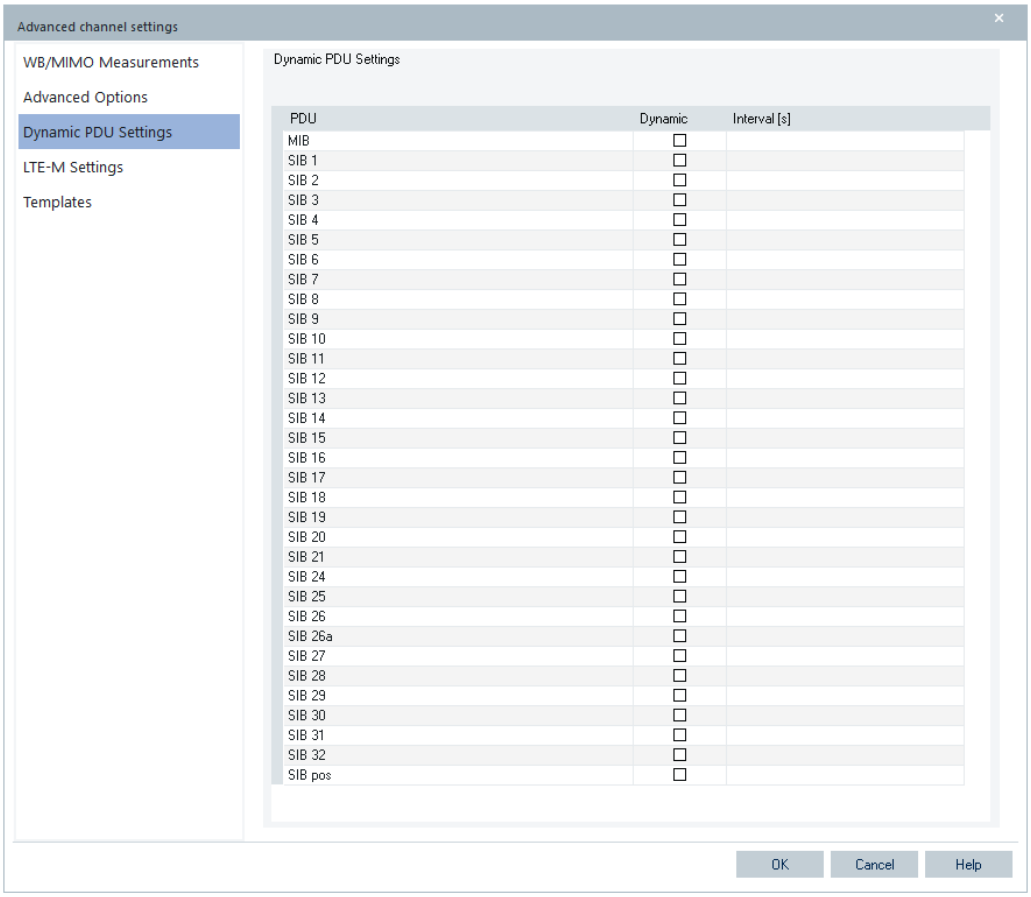


Figure 6-282: LTE Scanner - dynamic PDU settings

Check the associated check box of a SIB that you want to monitor in the "Dynamic" column of the "Dynamic PDU Settings" page. Enter a repetition interval value in "Interval [s]" or use the default value which is 1[s]. The possible range depends on the scanner driver for the technology, see Dynamic PDU Settings.

If the BCH demodulation list does not contain all the selected PDUs (MIB/SIBs), you are asked to enable them via the dialog shown in the next figure.

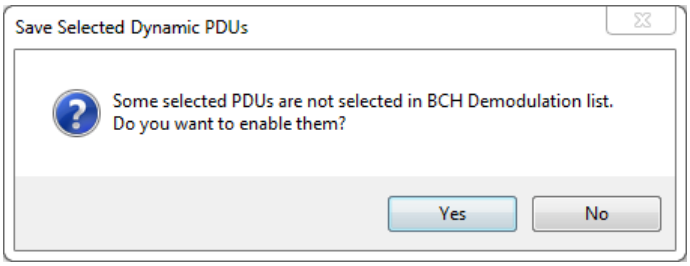


Figure 6-283: Enable missing PDUs

Click "Yes" to enable these MIBs and/or SIBs in BCH demodulation list.

Then click "OK" to add the settings to the selected channel and return to the "LTE Scanner Configuration" dialog.

Click "Cancel" to discard the changes and return to the "LTE Scanner Configuration" dialog.

Clicking "Previous" or "Next" leads you through the list.

Templates

The "Advanced" column holds combo-boxes which show the advanced settings of the channel as the name of a template. The use of the templates simplifies the channel configuration.

If the settings do not match an existing template, the "<custom>" is displayed.

All available and usable templates are shown in the combo-box and also in the "<Open>" entry. If you select this entry, the configuration page of advanced features shows up, see the following figure.

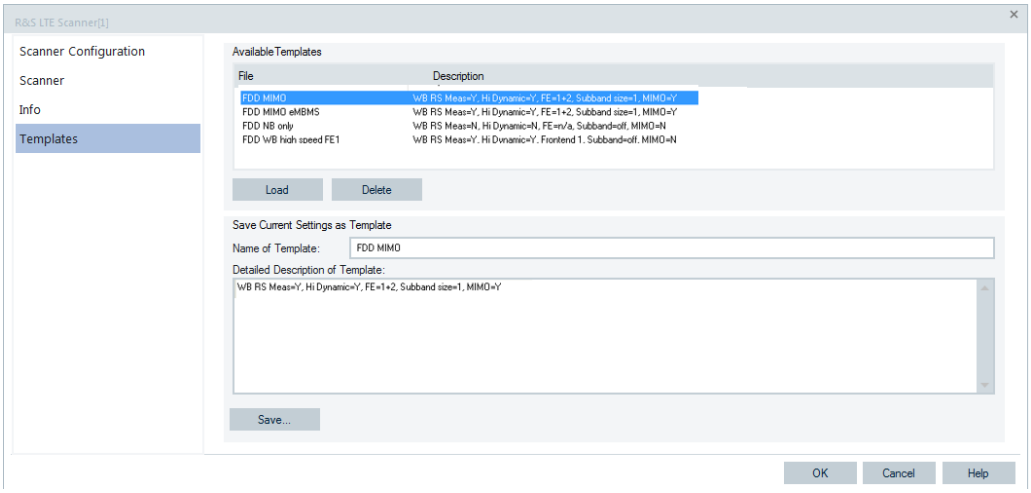


Figure 6-284: Templates page

This kind of template allows saving, loading or deleting the advanced settings of a channel.

The templates hold the wideband and MIMO settings of a channel. They are stored in the following directories:

- `My ROMES\DriverTemplates\R&S LTE Scanner_TSME\Advanced` (the user-defined templates)

- `\ProgramData\Rohde&Schwarz\My ROMES\DriverTemplates\R&S LTE Scanner_TSME\Advanced` (the system defined templates, supplied with the R&S ROMES4 installation or copied here by an administrator)

Templates with eMBMS detection are available automatically whereas they end with eMBMS, as shown for FDD/TDD mode in the following figures.

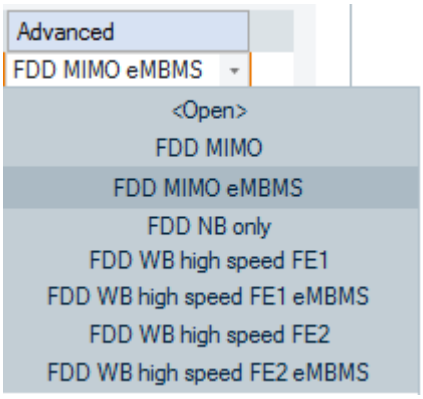


Figure 6-285: Template with FDD MIMO eMBMS detection

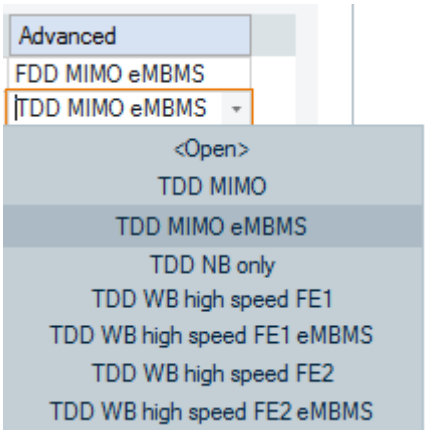


Figure 6-286: Template with TDD MIMO eMBMS detection

The following table describes the meaning of the default templates.

Template	Description
MIMO	Activates all possible measurement on both frontends. (MIMO, sub-band in finest resolution)
NB ONLY	No wideband measurements
WB High Speed Frontend 1	Activates only the WB high dynamic measurement on frontend 1
WB High Speed Frontend 2	Activates only the WB high dynamic measurement on frontend 2
WB normal Frontend 1	Activates all possibilities measurements on frontend 1, but no MIMO (sub-band in finest resolution, high dynamic)
WB normal Frontend 2	Activates all possibilities measurements on frontend 2, but no MIMO (sub-band in finest resolution, high dynamic)

Figure 6-287: Table of default templates

The "usable templates" means that templates requesting MIMO measurements are not shown if the TSME-K30 MIMO option is missing. The templates using two frontends are not shown if only one frontend is available.

If the settings of an existing template configuration are changed, then "<custom>" is shown as the pseudo name, but you can store the settings as a new own template and in this way the setting provides you defined individual name.

Virtual channels

If assumed that at least one device driver which can run an LTE scanner is loaded and the option "Virtual" is selected, the "Virtual Channels" dialog gives the option to release these channels. The "Ignore Release Command" checked is default setting.

LTE channel scan rate configuration

The Channel Scan Rate function for LTE is supported with the R&S TSME drivers.

For details, see Figure 6-49.

LTE automatic channel detection

To adapt the default ACD configuration, press the "Automatic Channel Detection (ACD)" button in the "LTE Scanner Configuration" page, see Figure 6-272.

The ACD page opens.

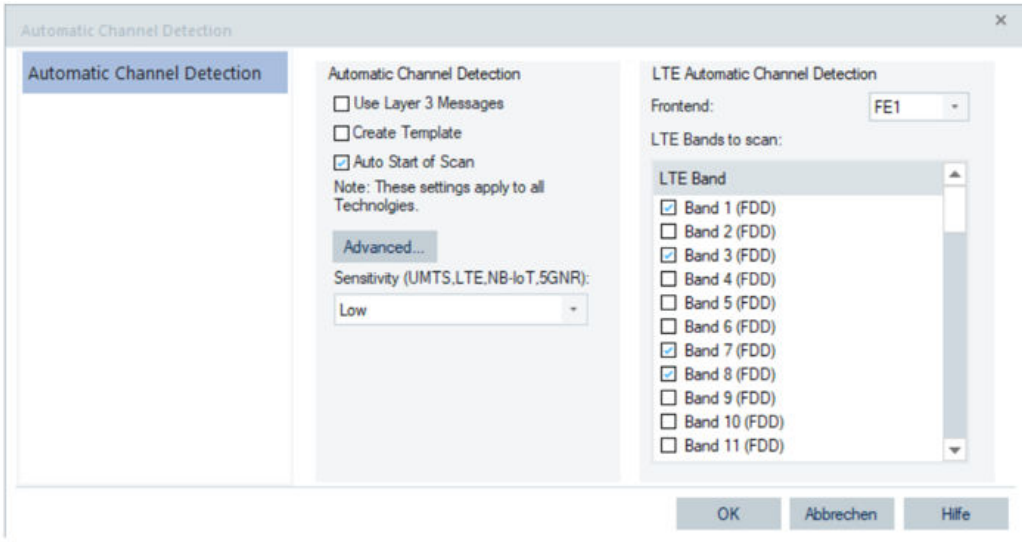


Figure 6-288: LTE Scanner ACD configuration page

The "Automatic Channel Detection" pane of the page contains the parameters that apply to all technologies. The "LTE Automatic Channel Detection" pane is the LTE specific.

Automatic Channel Detection Pane

The following parameters are configurable in the first mentioned pane:

- "Use Layer 3 Messages"
  If selected, R&S ROMES4 reads out all neighbor lists of detected transmitters and adds the detected neighbor cells' channels automatically to the system.
- "Create Template"

The template can be used to set up a new measurement with the found channels which is not requested for the monitoring use case.
If selected, R&S ROMES4 creates a template for the scanner, which includes all detected channels at the end of the measurement. The name of the template is the name of the measurement file.

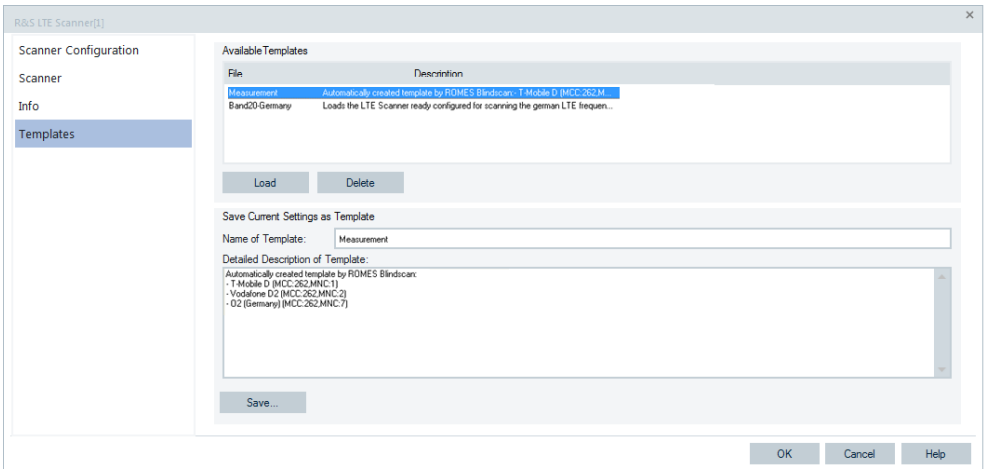


Figure 6-289: Automatically created template

- "Auto Start of Scan"
  This automatic approach has sense during a drive test. It is needed during a monitoring use case as the monitoring use case aims to measure only actual “on air” transmitters.
- "Sensitivity (UMTS, LTE, NB-IoT, 5GNR)"
  For the listed technologies, the sensitivity allows user to fine-tune the setup for the long term monitoring use cases, for details see Chapter 3.8.2.1, "Technologies", on page 280.
  Three different levels of the ACD sensitivity are available for power and quality measurements. Depending on the requirements of the monitoring use case, you can select the sensitivity level for transmitters detection between low, medium and high.
- "Advanced"
  If pressed, the "ACD Measurement Rate" page shows up, where you can set the ACD priorities for different RATs, see Figure 6-344.

The ACD feature tries to achieve the same measurement rates for all detected channels. However, R&S ROMES4 SW offers the user option to prioritize one RAT against the other. This prioritization is achieved by adding to the technologies supporting ACD (excluding TETRA) weighting factors. These factors then represent how higher measurement rate for one technology has to be in comparison to the others.

For example, if LTE has to have the double measurement rate compared to other RATs, set the LTE detected channels weight 2, and leave the weight 1 for the other RATs' detected channels.

To set the weight, press the "Advanced" button in the ACD page. Set the prioritization in the shown "ACD Measurement Rates" page.

LTE Automatic Channel Detection Pane ← Automatic Channel Detection Pane
The following parameters are configurable in the "LTE Automatic Channel Detection" pane.

- "LTE Bands to scan"
  This parameter in the LTE-specific ACD panel allows the LTE bands for scanning to select. The smart LTE ACD can detect also small bandwidths like 1.4 MHz or 3 MHz.
  It is highly recommended to activate only those bands which are specified for LTE in the corresponding geographic region.
- "Minimum LTE Bandwidth"
  Defines the minimum LTE bandwidth for scanning. The smart LTE ACD starts bandwidth searching from the bandwidth specified in this box.
  By default the ACD searches for networks with a minimum bandwidth of 10MHz. To improve the scan speed, set the minimum bandwidth correctly - if known, especially in bands which are used for several technologies (e.g. LTE and GSM).

The progress of the ACD can be observed in the "Output View".

```
09:37:28: LTE: Carrier found on 806000000 Hz with currently assumed bandwidth of 10000000 Hz
09:37:28: LTE: Carrier found on 796000000 Hz with currently assumed bandwidth of 10000000 Hz
09:37:29: LTE: Still 24 channels to be evaluated.
09:37:32: LTE: Carrier found on 1815000000 Hz with currently assumed bandwidth of 15000000 Hz
09:37:32: LTE: Carrier found on 806000000 Hz with currently assumed bandwidth of 10000000 Hz
09:37:32: LTE: Carrier found on 796000000 Hz with currently assumed bandwidth of 10000000 Hz
09:37:32: LTE: Carrier found on 816000000 Hz with currently assumed bandwidth of 5000000 Hz
09:37:34: LTE: Currently there are no channels to be tested.
09:37:34: R&S LTE Scanner[1] has been reconfigured by ACD.
09:37:34: LTE: Carrier found on 1815000000 Hz with currently assumed bandwidth of 15000000 Hz
09:37:34: LTE: Carrier found on 806000000 Hz with currently assumed bandwidth of 10000000 Hz
09:37:34: LTE: Carrier found on 796000000 Hz with currently assumed bandwidth of 10000000 Hz
09:37:34: LTE: Carrier found on 816000000 Hz with currently assumed bandwidth of 5000000 Hz
09:37:39: LTE: Carrier found on 1815000000 Hz with currently assumed bandwidth of 20000000 Hz
09:37:39: LTE: Carrier found on 806000000 Hz with currently assumed bandwidth of 10000000 Hz
```

Figure 6-290: ACD progress view

Use Cases of Automatic Channel Detection ← Automatic Channel Detection Pane
The main use case of the LTE ACD is to let you start a measurement anywhere without any knowledge of the used EARFCNs within the known LTE bands.

Typically, you have to initiate a measurement with the ACD and use the resulting template for the best measurement rates as a starting point for the actual measurement.

If the detection of transmitters along a drive is the goal of the measurement, run the ACD according to the procedure described in Chapter 3.8.2.1, "Technologies", on page 280.

The primary goal of the measurement is the detection of cells usually. The speed of the measurement on already detected cells is of secondary interest. If your goals are as mentioned, you can increase the detection speed by reducing the measurement rate of the virtual channel. For example, reduce the measurement rate to 10Hz for NB measurements and to 1Hz for WB measurements. This reduction increases the speed available for cell detection.

Measurement rate

The two input fields define how often the system synchronizes to the received LTE signals and updates the measurement file.

- "Sync Rate [Hz]"
  Defines the synchronization rate in Hz.
- "Measurement Rate [Hz]"
  Defines the used measurement rate in Hz.

The measurement rate of the channel is the max. measurement rate. The actual achieved measurement rate depends on many factors, e.g. CPU speed, memory. The actual achieved speed can be selected by the Measurement Rate signals.

The configured number is related to the number of measurements at one subframe.

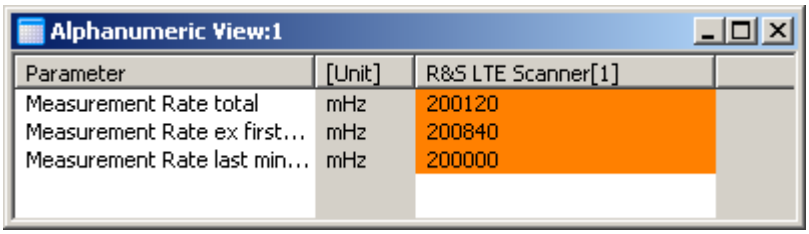


Figure 6-291: Measurement rate of LTE scanner

LTE scanner buttons/check-boxes

In the following are listed the LTE scanner buttons and check boxes present in the "Channel" pane.

Add
Opens the dialog which allows to add a channel for scanning. The basic channel configuration is the center frequency and the bandwidth to be used.

Remove
Removes all highlighted channels from the table of channels.

Clone
Makes a copy of all highlighted channels, automatically sets the “selected” status for it and assigns name by adding the word “copy” to the original channel name.

Note: The "Remove" and "Clone" buttons are available only if at least one channel in the table is highlighted.

Enable Throughput Estimation
The function makes possible to estimate the throughput of all LTE channels. The throughput estimation for the complete LTE scan can be switched on by checking or unchecking the "Enable Throughput Estimation" checkbox.

The function is available with the R&S TSME. Select the MIMO measurement and provide the R&S TSME-K29 and R&S TSME-K30 option.

The following views show the CQI values and estimated throughput (Est. TP) in kbit/s.
- LTE Scanner Estimation Throughput 3D Chart View
- LTE Scanner Estimation Throughput Chart View
- LTE Scanner Estimation Throughput Subband View

For the details about throughput estimation possible views, refer to Chapter 4.8.6, "LTE scanner views", on page 1204.

Automatic Channel Detection
For the feature description, see previous Chapter 6.4.15.2, "Configuration LTE scanner", on page 1728. The feature requires option R&S ROMES4ACD.

Advanced
If the "Advanced" button is selected, the advanced settings dialog is shown, see the following chapter.

OK
Adds the new defined channel to the channel list and returns to the "LTE Scanner Configuration" page.

Cancel
Discards the changes made and returns to the "LTE Scanner Configuration" page.

6.4.15.3 LTE scanner advanced configuration

The LTE scanner advanced configuration concerns the configuration of the scanner parameters which are not a channel specific.

Advanced general parameters

The parameters, which are not channel specific are configured in the "Advanced General Parameters" page.

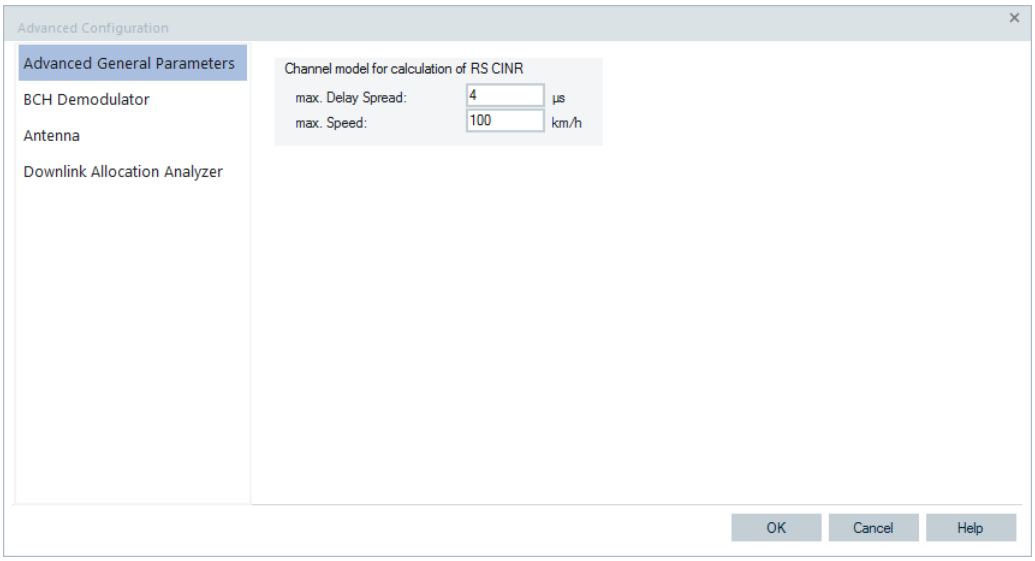


Figure 6-292: Advanced general parameters

The "Channel model for calculation of RS CINR" pane allows configuring:

- "max. Delay Spread" - time difference of a signal arrival via different paths
- "max. Spread" - maximum mobile speed that can be expected during the drive

The larger these values, the longer the computation time for RS CINR. If the maximum delay spread or the speed is bigger than set, the accuracy of measurement results is degraded or the results even get wrong.

BCH demodulator configuration

The "BCH Demodulator" page lets you configure the minimum SINR signal level which is required to demodulate BCH signal both for LTE and LTE-M (if LTE-M is activated).

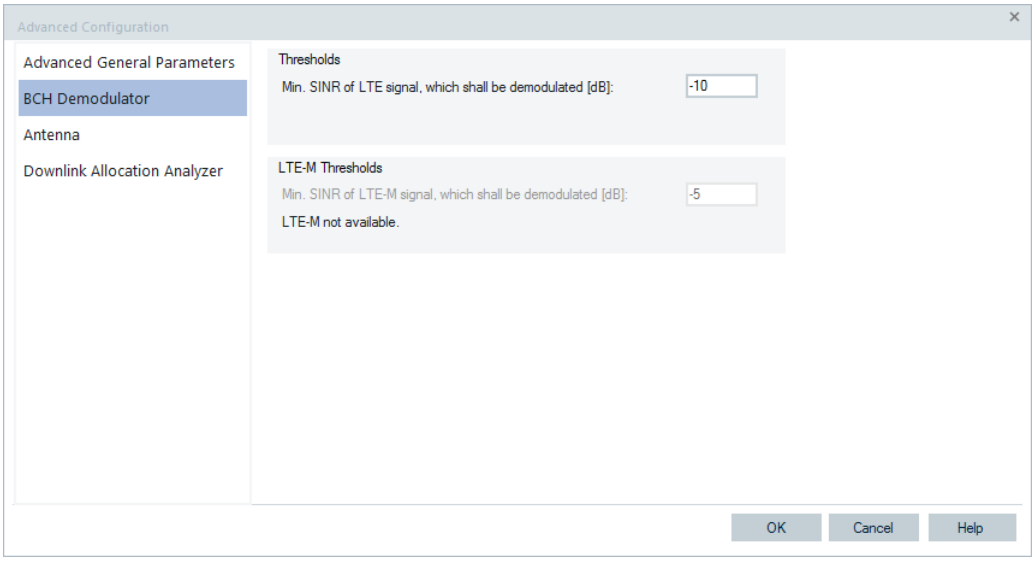


Figure 6-293: BCH demodulation parameters

- "Min. SINR of LTE signal, which shall be demodulated [dB]"
  Defines the minimum SINR that LTE BCH signal has to have to be demodulated, range -15 dB to 50 dB.
- "Min. SINR of LTE-M signal, which shall be demodulated [dB]"
  Defines the minimum SINR that LTE-M BCH signal has to have to be demodulated, range -15 dB to 50 dB.

6.4.15.4 Scanner

The "Scanner" tab opens the page which displays the properties of the R&S TSME device used as LTE scanner and the information on the file version of the R&S ROMES4 LTE scanner driver.

Preselection option

The "Scanner" page of R&S TSME6/TSMA6 offers the preselection mode of operation for these scanners.

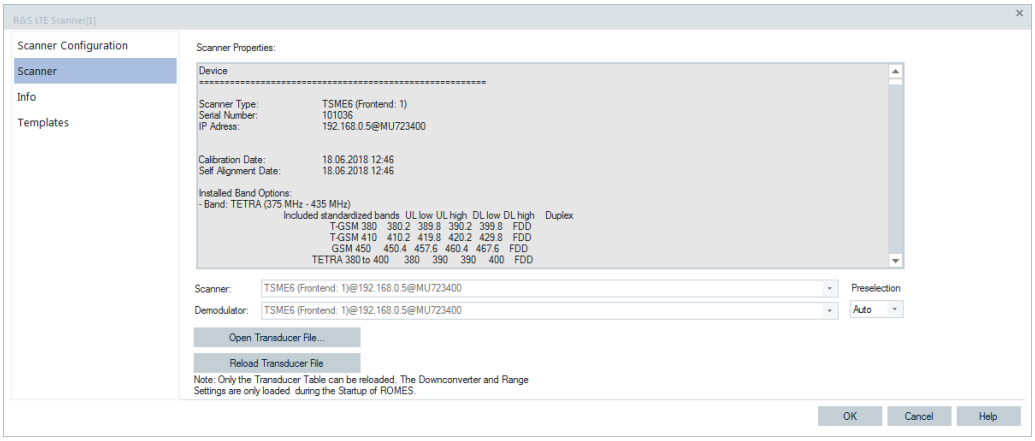


Figure 6-294: R&S TSME6 scanner page

The preselection mode is selected in the "Preselection" drop-down combo box.

The following preselection modes are available:

- "TSME(A)6 Preselection Auto" - use preselection based on R&S TSME6/TSMA6 internal spectrum measurements
- "TSME(A)6 Preselection on" - preselection on
- "TSME(A)6 Preselection off" - do not use preselection for better noise figure

6.4.15.5 Info

The "Info" page displays information on the file version of the R&S ROMES4 LTE scanner driver.

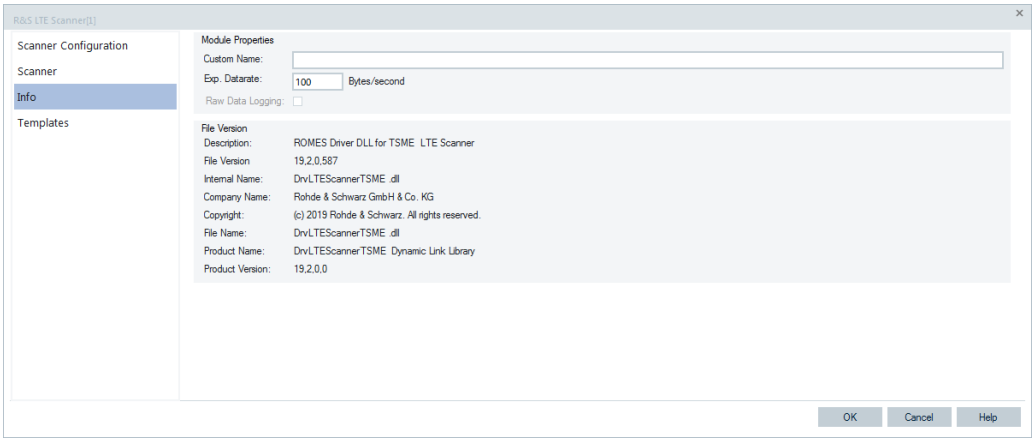


Figure 6-295: LTE scanner info

6.4.15.6 Templates

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

6.4.15.7 Dynamic loading of LTE band table by using XML files

The LTE band table is dynamically loaded using XML files and can be customized. The benefit is the possibility to replace or extend the band table.

There are two XML files for customizing LTE band table:

- `UserBands.Sample.xml` - sample file that shows sample entries and how to customize band table.
- `UserBands.xml` - R&S ROMES4 loads this file at runtime. Entries in this file are used to add or update current LTE band table. The actual band customizations are done in this file.

The `UserBands.Sample.xml` file is installed during the R&S ROMES4 installation on top of all user folders. The file is then copied to “My ROMES\Configuration” folder when R&S ROMES4 fully starts for the first time. If the file exists already, it is not copied.

To customize a band table, copy or rename the `UserBands.Sample.xml` file to create the `UserBands.xml` file.

Change the content of the `UserBands.xml` accordingly to customize bands. Updated bands are loaded next time when R&S ROMES4 starts.

LTE samples in UserBands.Sample.xml

Short descriptions for band table fields are provided in the `UserBands.Sample.xml`.

Using the sample entries in this file to customize the band table.

- If the defined bands already exist in band table, the defined bands overwrite existing entries.

- If the defined bands do not exist in band table, new band entries are added.

- If the same band number is specified more than once, only the last one takes effect.

- Removing `UserBands.xml` restores the original bands.

The LTE user bands include the following samples whose values are decimal number strings:

1. Band: user base to be defined
2. Duplex: duplex mode, 0-FDD, 1-TDD, 2-Not Used
3. DLFLOW: downlink flow
4. DLNoff: downlink N offset
5. DLLOW: downlink low

6. DLHI: downlink high

7. ULFLOW: downlink flow

8. ULNoff: uplink N offset

9. ULLOW: uplink low

10. ULHI: uplink low

11. GeoFlag: 1-Africa,2-Caribbean, 4-Central America,8-South America, 16-NorthAmerica, 32-Asia, 64-Europe, 128-MiddleEast,

12. BWMIN100KHZ: Bandwidth Minimum in 100KHz

13. BWMAX100KHZ: Bandwidth maximum in 100KHz

14. IOTSupport: 0, reserved, don not use 15. UniqueFreq: 0, reserved, do not use.

Sample usage to define band

For example, band 64 is defined as shown.

```
<Index Band="64" Duplex="0"
      FDLOW="24000" DLNoff="100000" DLLOW="100000" DLHI="101000"
      ULFLOW="26000" ULNoff="102000" ULLOW="102000" ULHI="103000"
      GeoFlag="0" BWMIN100KHZ="14" BWMAX100KHZ="200"
      IOTSupport="false" UniqueFreq="false" />
```

Click the "Band" button in the "R&S LTE Scanner" configuration dialog to see the defined band 64.

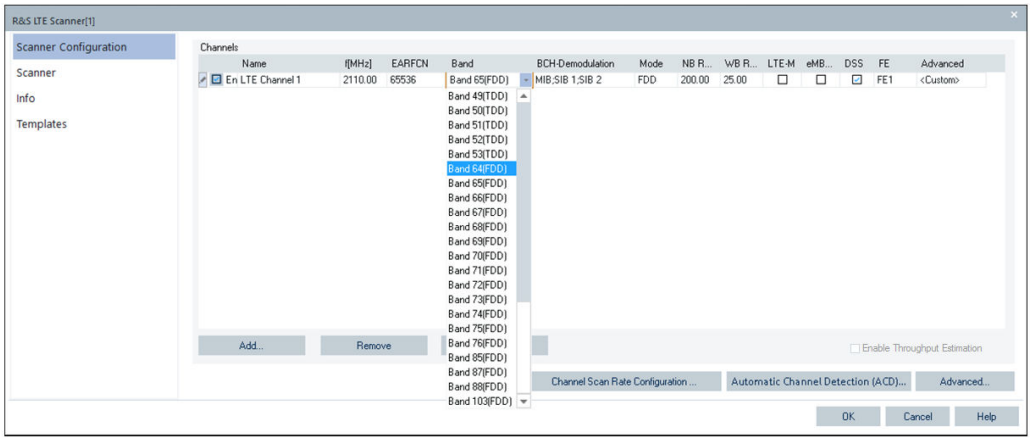
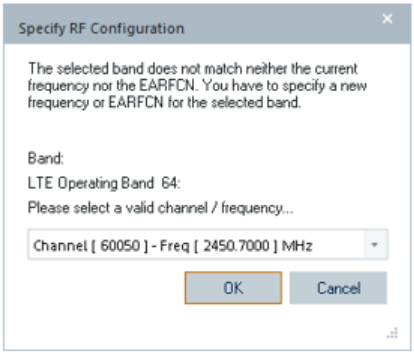


Figure 6-296: Added band 64

The details of the channel band can now be selected.



Sample usage to add bands

For example, add the new bands 104 to 105.

```
<Index Band="104" Duplex="0"
      FDLOW="24457" DLNoff="60000" DLLOW="60000" DLHI="60050"
      ULFLOW="24078" ULNoff="61000" ULLOW="61000" ULHI="61050"
      GeoFlag="0" BWMIN100KHZ="14" BWMAX100KHZ="200"
      IOTSupport="false" UniqueFreq="false" />

<Index Band="105" Duplex="0"
      FDLOW="24557" DLNoff="60100" DLLOW="60100" DLHI="60150"
      ULFLOW="24178" ULNoff="61100" ULLOW="61100" ULHI="61150"
      GeoFlag="0" BWMIN100KHZ="14" BWMAX100KHZ="200"
      IOTSupport="false" UniqueFreq="false" />
```

6.4.15.8 LTE-M scanner configuration

Launch the LTE scanner configuration page as previously described by using, for example, the R&S TSME scanner.

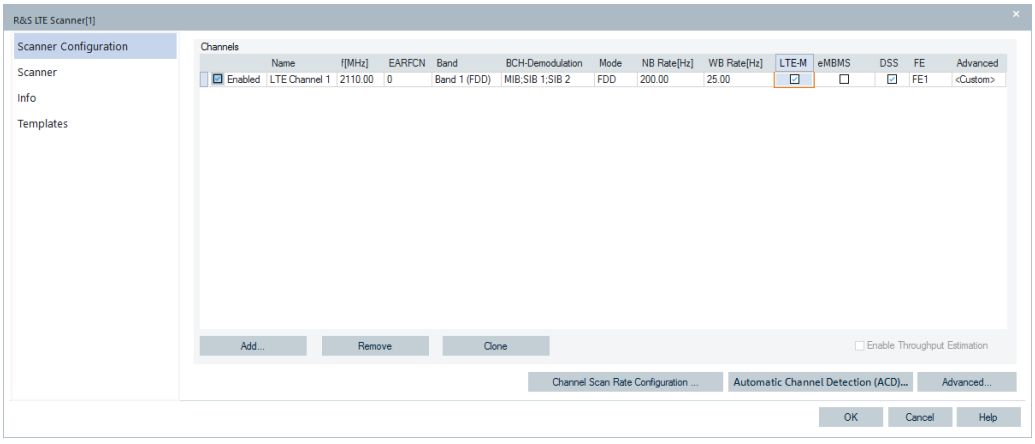


Figure 6-297: LTE scanner configuration page

There is the "LTE-M" column in the "Channel" pane and the LTE-M check box in the channel's grid row of LTE-M scanner. If the box is checked in one channel row, the LTE-M

scanner is activated for that channel. Unchecked box indicates that the scanning is deactivated for that channel.

LTE-M advanced global settings

Click the "R&S LTE Scanner" > "Advanced" button to launch the "Advanced Configuration" page.

BCCH demodulator

Specify the minimum SINR of the LTE signals that you want to be demodulated in "Advanced Configuration" > "BCCH Demodulator" > "Thresholds" pane.

In the "LTE_M Threshold" pane you can specify the minimum SINR of LTE-M signal you want to be demodulated. This section is dimmed if the option keys are unavailable or the "TEC for LTE-M Scanner" > "LTE-M Signals" check box is cleared. The valid range for the threshold is -15.0 dB to 50.0 dB.

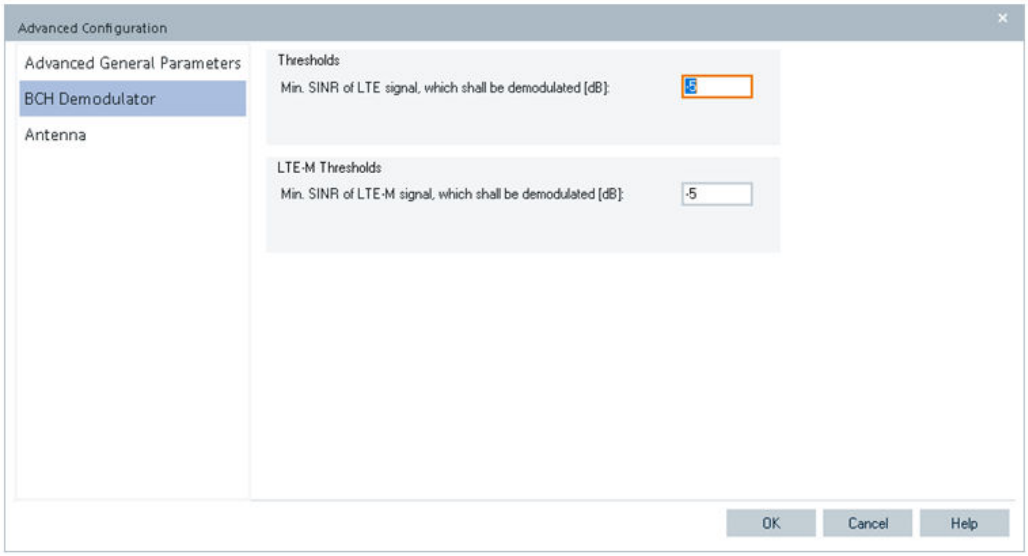


Figure 6-298: LTE-M scanner - BCCH demodulation page

The settings on this page are used for all channels.

LTE-M enabled channels configuration

If the LTE-M is activated, a new page "Advanced channel settings" is available.

Click "Open" button in the "Advanced" drop-down column.

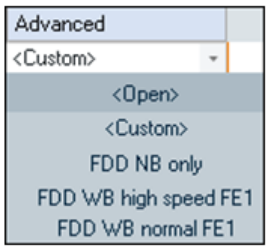


Figure 6-299: Advanced column - open command

The "Advanced channel settings" page opens.

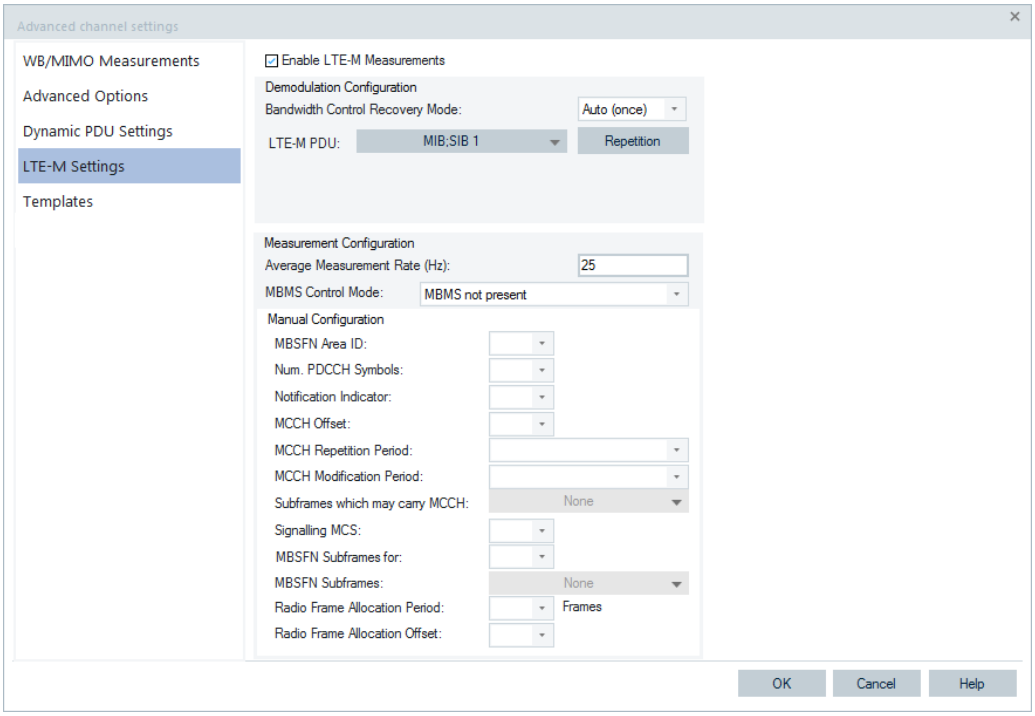


Figure 6-300: Advanced channel settings - LTE-M settings page

This page is always available no matter if LTE-M check-box is checked in the channel grid row.

Enable LTE-M measurement

Check the "Enable LTE-M Measurement" check box at the top of the "LTE-M Settings" to activate the LTE-M measurements. Uncheck it to deactivate the measurement.

If checked, the page becomes editable. Otherwise the page is grayed out and nothing can be changed. The "Enable LTE-M Measurement" check box has the same function as the LTE-M check box in channel line.

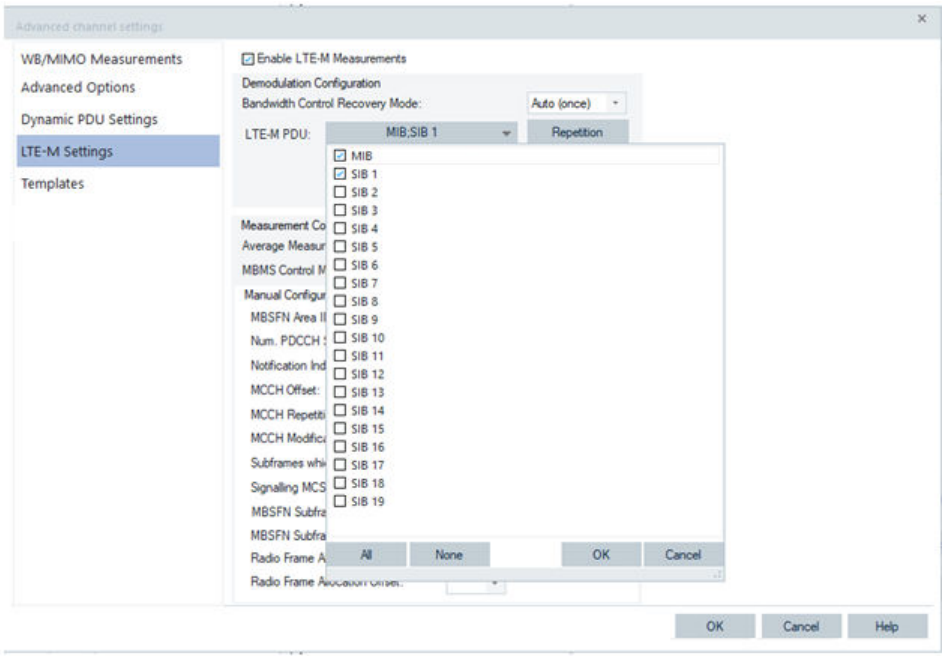


Figure 6-301: Enable LTE-M measurements

The "Bandwidth Control Recovery Mode" specifies how the bandwidth control is recovered.

The possible options are:

- "Auto (once)"
- "Auto (tracking)"
- Use the manually given bandwidth specified for LTE, that is, 1.4 MHz, 3 MHz, ... up to 20MHz.

The following buttons are contained in the previous figure:

- "All"
  Activates all messages.
- "None"
  Deactivates all messages.
- "OK"
  Click the button to accept the changes.
- "Cancel"
  Click the button to discard the changes.

LTE-M channel measurement configuration

The following settings are used to configure the LTE-M channel measurements.

Average Measurement Rate
Specify the measurement rate for the particular LTE-M channel. Valid value range is 0.0 Hz to 100.0 Hz. Default value is 25.0 Hz.

MBMS Control Mode
The drop-down box lets you select the MBMS control mode between the following options.

- "MBMS not present"
  If selected, the manual configuration selection is inactive.
- "MBMS configuration is detected automatically"
  If selected, the manual configuration selection is inactive. The MBMS settings are determined automatically.
- "MBMS configuration manually"
  If selected, the manual configuration selection is activated.

MBMS manual configuration

To configure MBMS manually, MBSFN area ID has to be selected first. The MBSFN Area ID values range 0 to 254.

Select one from the "MBSFN Area ID" drop-down box.

After the MBSFN Area ID is selected, set the other parameters accordingly. Set the following parameters:

- "Num. PDCCH Symbols"
  Select 1 or 2 symbols.
- "Notification Indicator"
  Select indicator's value in the range 0 to 7.
- "MCCH Offset"
  Select MCCH offset value in the range 0 to 10.
- "MCCH Repetition Period"
  Select the MCCH repetition period value out of the offered number of radio frames, which are 32, 64, 128, and 156.
- "MCCH Modification Period"
  Select the MCCH modification period value out of the offered number of radio frames, which are 512 and 1024.
- "Subframes which may carry MCCH"
  The subframes that can carry MCCH are shown in the following figure. Check the associated check boxes to include or exclude the subframes, respectively.

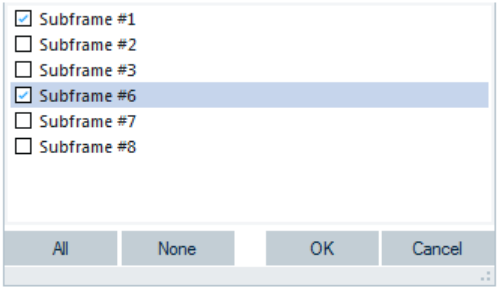
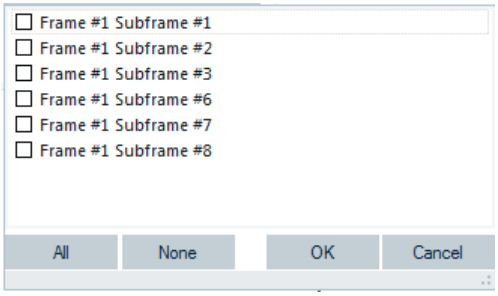


Figure 6-302: Subframes that can carry MCCH

  Click "All" to include all or "None" to exclude all subframes.
  Click "OK" or "Cancel" to accept the changes or to discard them, respectively.
- "Signalling MCS"

The available signaling MCS is MCS2, MCS7, MCS13 and MCS19.

- "MBSFN Subframes for"
  Select value 0 or 4.
- "MBSFN Subframes"
  Select the subframes associated with the "MBSFN Subframes for" selection.



- "Radio Frame Allocation Period"
  Select the frame allocation period from the range, 1, 2, 4, 8, 16 and 32 frames.
- "Radio Frame Allocation Offset"
  Select the frame allocation period from the range, 1, 2, 4, 8, 16 and 32 frames.

After setting all values, click "OK" to accept the manual setting.

All parameters must be set to be accepted, otherwise the warning message asks for entering the missing settings.

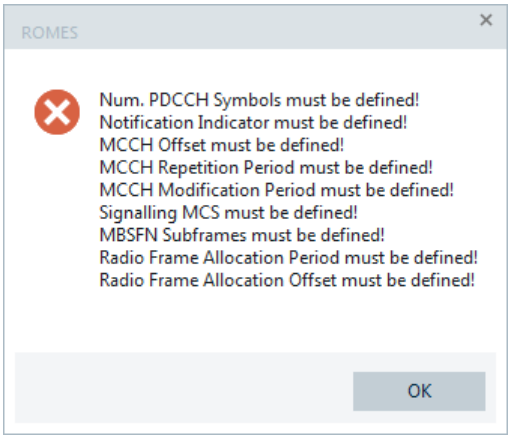


Figure 6-303: Warning messages

LTE-M PDU settings

"LTE-M PDU Settings" lets you specify the PDU for the particular LTE-M channel.

Click the "Advanced channel settings" > "LTE-M Settings" > "Repetition" tab to launch the "LTE-M PDU Settings" page.

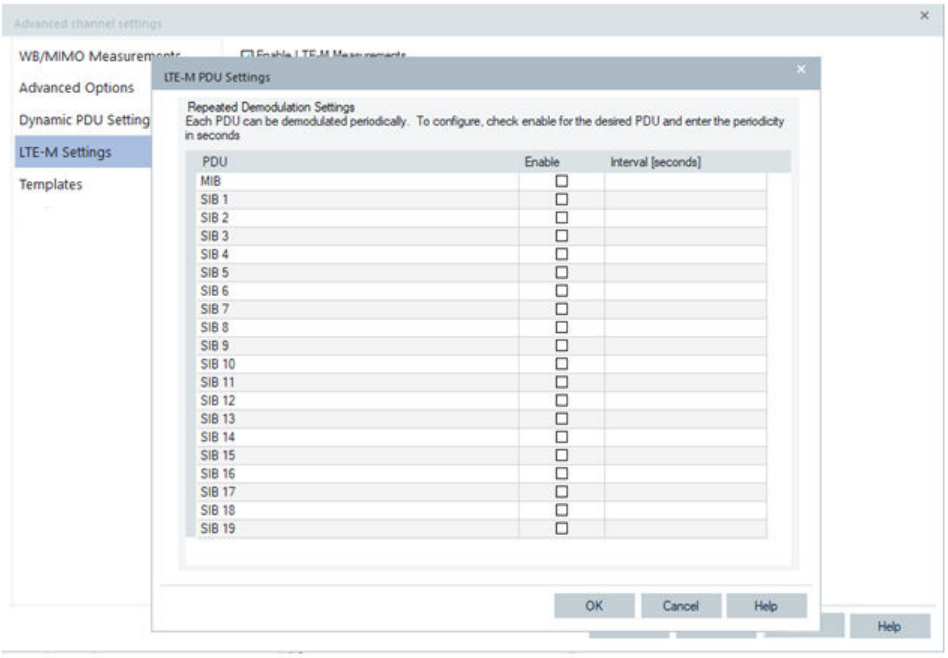


Figure 6-304: LTE-M PDU demodulation setting

Check the check box in the "Enable" column. A value is auto populated to the "Interval" column. Interval can be customized and the valid value range is 0.0 second to 65.5 seconds.

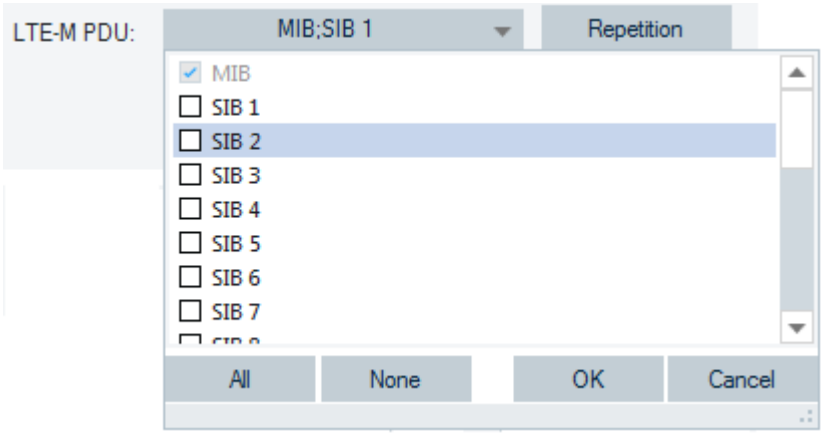


Figure 6-305: Checked PDU for repeated demodulation

If you activate the LTE-M PDU messages in this page but not in the BCH settings, the opened dialog asks whether to populate the PDU changes back to BCH settings. See also the Figure 6-301.

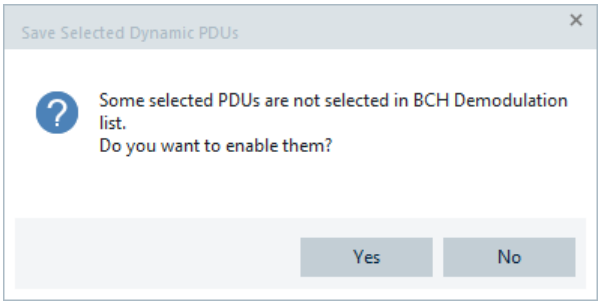


Figure 6-306: Saving selected LTE-M PDUs

Click "Yes" to apply the change in the BCH setting, click "No" to avoid the change in the BCH setting.

6.4.16 LTE-M scanner

R&S ROMES4 supports LTE-M technology as an option.

To run LTE-M scanning, you have to check in the "ROMES Technology Selector" dialog if the LTE-M technology is activated. The dialog pops-up during the R&S ROMES4 installation, see Figure 5-20. By default the LTE-M technology is activated in the dialog.

Moreover, provide that the following conditions are fulfilled:

- LTE-M module installed,
- Option key R&S K29 and R&S K35 available,
- LTE-M signals activated to support the LTE-M scanning, see Figure 6-297.

If the conditions are fulfilled, the R&S TSME LTE scanner supports the LTE-M scanning.

The LTE-M scan support is visible in the "Welcome" > "Available Devices" section and in the "Hardware" menu.

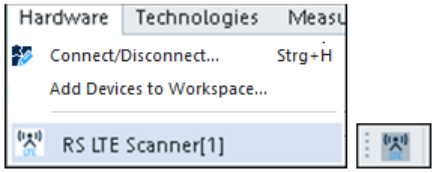


Figure 6-307: LTE-M as loaded device

The LTE-M scanner configuration is a part of LTE scanner configuration.

6.4.16.1 LTE-M scanner configuration

Click the LTE-M command line in the "Hardware" menu to configure the RS LTE scanner as the LTE-M scanner as well.

Or add the device via the "Welcome" page. In the "Available Devices" section click the icon for the connected device.

For the LTE-M scanner configuration, see Chapter 6.4.15.8, "LTE-M scanner configuration", on page 1751.

6.4.17 NB-IoT scanner

The R&S NB-IoT scanner is used to scan NB-IoT signals and to analyze the measurement data. R&S ROMES4 supports the ACD feature for NB-IoT if there is an active LTE ACD on the same band.

The corresponding scanner option and R&S ROMES4 option are necessary to load the R&S TSME as the NB-IoT scanner and visualize it in R&S ROMES4.

NB-IoT scanner configuration without using MDL

The MDL is one of the parameters for configuring NB-IoT scanner frequency. It is not used in NB-IoT scanner configuration.

This document has in focus non-virtual channel configuration for the In-Band, Guard Band and Stand Alone modes. All verifications are active if the "No 3GPP Band" mode is unselected.

6.4.17.1 Loading NB-IoT scanner

To launch the NB-IoT scanner configuration dialog, double-click "TSME NB-IoT" of the "Available Devices" field on the "Welcome" screen.

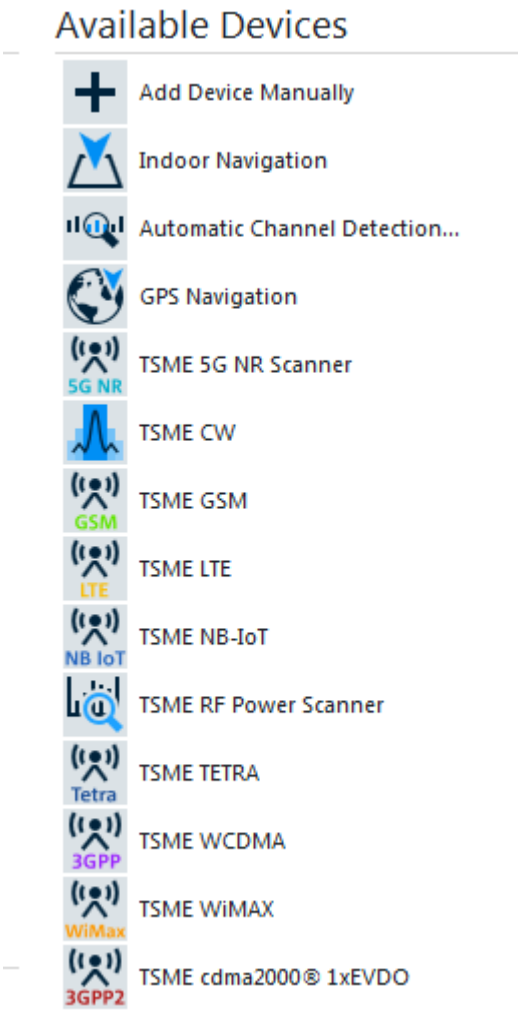


Figure 6-308: List of available devices - NB-IoT scanner included

The action opens the dialog for initial setup of the selected device.

To load the R&S TSME network scanner with the R&S ROMES4 NB-IoT scanner driver, click the "Hardware" > "Connect/Disconnect" menu command. Select the "TSME NB-IoT" branch in the list of available devices in the "Available Devices" > "Network Scanner TSME" pane, see Figure 6-40. Double-click the selected device.

The device is loaded and displayed in the "Loaded Devices" pane of the "Hardware Configuration" window. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S NB-IoT Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to complete the selection and close the window.

The loaded NB-IoT scanner is now added as the "R&S NB-IoT Scanner [<variable>]" command line to the "Hardware" menu.

Click "R&S NB-IoT Scanner [<variable>]" to open the scanner main configuration dialog.

6.4.17.2 NB-IoT scanner configuration

Launching the NB-IoT scanner device opens the NB-IoT "R&S NB-IoT Scanner" configuration dialog.

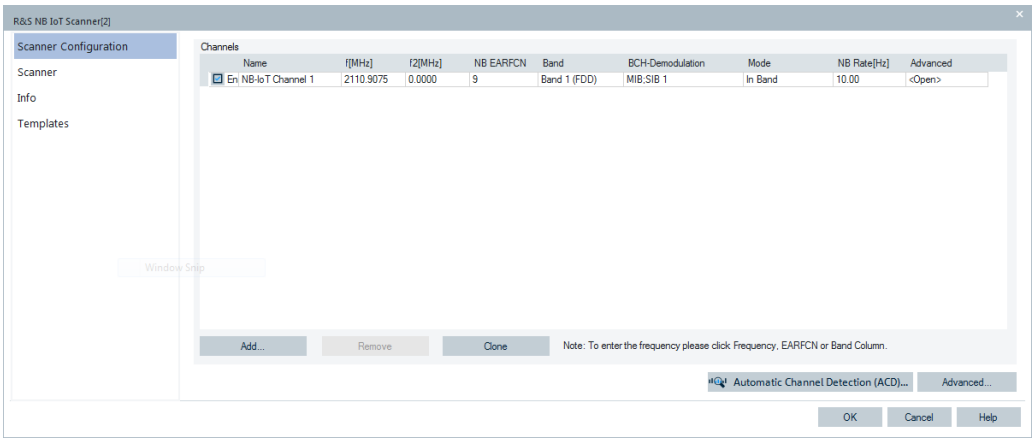


Figure 6-309: NB-IoT scanner configuration dialog

The previous figure shows the dialog at its first opening. A channel row shows the default values of the channel parameters.

The "Scanner Configuration" > "Channels" right-hand pane shows a channel grid with a few buttons at the bottom of the screen.

The first column of the "Channels" grid offers three choices for channel status:

- "Disabled"
- "Enabled"
- "Virtual"

The "Enabled" channels status is only considered in the following chapters.

Other columns related to the NB-IoT scanner parameters are:

- "Name"
  User given name of the channel
- "f[MHz]"
  Primary center frequency of the NB-IoT channel
- "f2[MHz]"
  Secondary center frequency of the NB-IoT channel
- "NB EARFCN"
  The four possible frequencies that are associated with a given channel number NB EARFCN can be selected in drop-down combo box.
- "Band"
  NB-IoT band contains all valid, NB-IoT supported bands.
- "BCH Demodulation"

The drop-down combo box contains the System Information types available for demodulation: MIB, SIB1, SIB2, SIB3, SIB4, SIB5, SIB14, SIB15, SIB16, SIB20 and SIB22. Demodulation of all SIBs is available if the "All SIBs" check box is ticked.

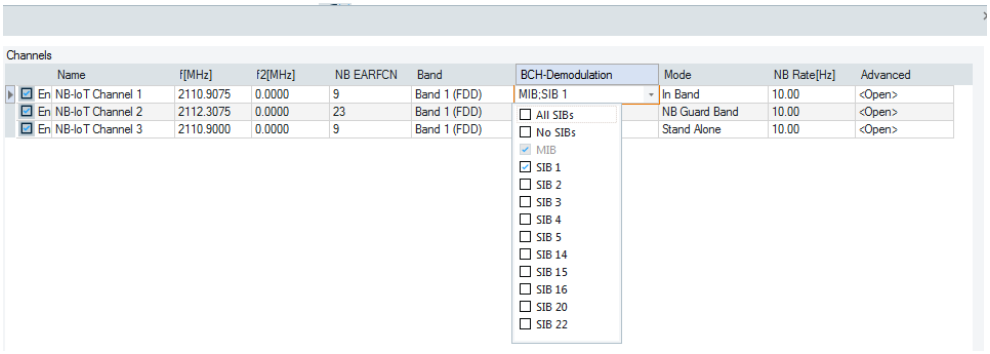


Figure 6-310: Supported NB-IoT SIBs

- "Mode"
  Calculation mode: "In Band", "NB Guard Band" and "Stand Alone" mode.
  For In Band and NB Guard Band modes, available are three possible ways to enter a frequency. Related note is displayed next to the "Clone" button.
  Note: If changing mode to a different one, the channel record parameters are reinitialized. It can happen that the frequency in one mode is not valid in other mode.
  Note: If band is not “No 3GPP Band”, the In Band and NB Guard Band require configuration helper dialog for configuring the NB-IoT frequencies.
- "NB Rate [Hz]"
- "Advanced"
  BCH demodulation by dynamic PDU changes

The buttons included in the pane are

- "Add"
  Add a new channel populated with default parameters.
- "Remove"
  Remove the highlighted channel.
- "Clone"
  Clone the highlighted channel.
- "Automatic Channel Detection (ACD)"
  Adapts the configured channel modes, refer to Chapter 6.4.17, "NB-IoT scanner", on page 1759.
- "Advanced"
  Perform the advanced configurations.

Preconfigured channels

If some channels have already been configured in the "NB-IoT Scanner" page, opening the page shows all the preconfigured channels.

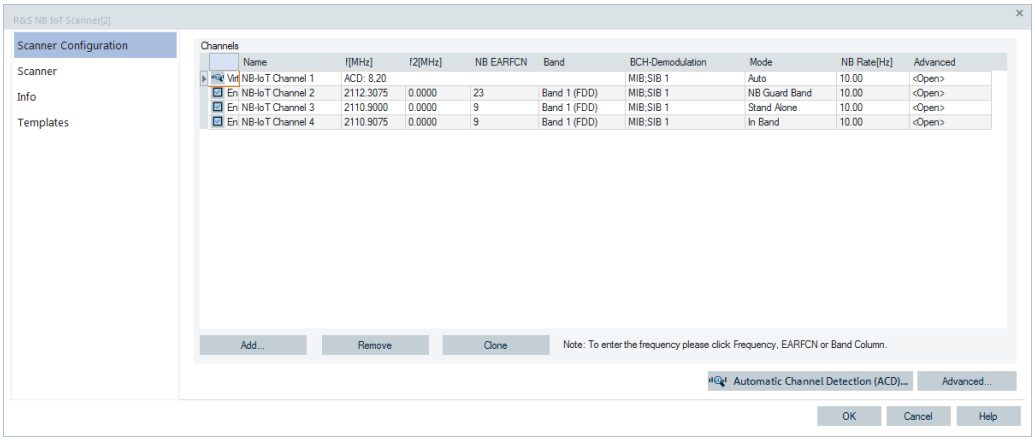


Figure 6-311: Preconfigured channels

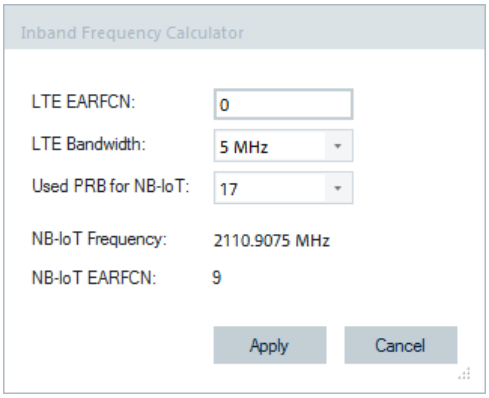
Inband mode

If the selected mode of operation is "In Band", the NB-IoT center frequencies are located inside the LTE band and occupy predefined resource blocks.

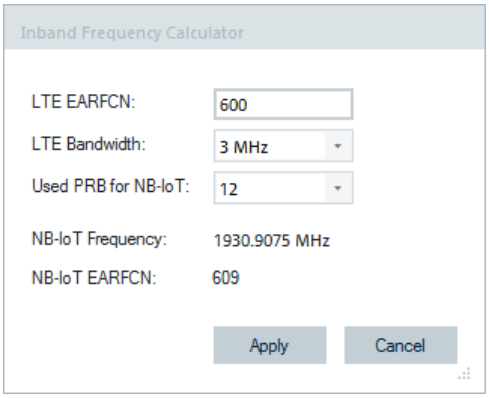
Inband frequency calculation

The calculation of inband frequency is supported by the "Inband Frequency Calculator" dialog.

1. Click "f[MHz]", "f2[MHz]", "NB EARFCN" or "Band" to launch the "Inband Frequency Calculator" dialog.

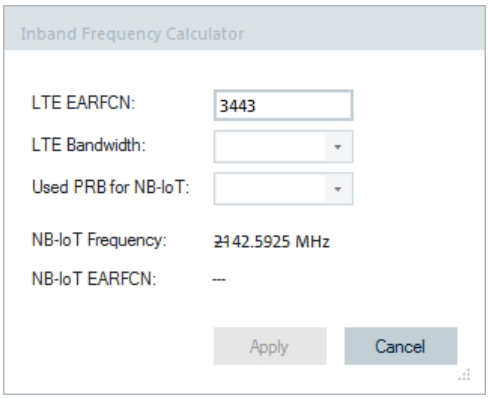


2. Enter a valid LTE EARFCN.



The corresponding "LTE Bandwidth" drop-down list is filled with all possible valid bandwidths.
The NB-IoT frequency and NB-IoT EARFCN are calculated and displayed.

3. If the entered LTE EARFCN is invalid, the "LTE Bandwidth" and "Used PRB for NB-IoT" boxes are cleared.



The "NB-IoT Frequency" and "NB-IoT EARFCN" show "---". The "Apply" button is disabled.

4. After having entered a valid LTE EARFCN, select a bandwidth from the "LTE Bandwidth" drop-down list.

   The "Used PRB for NB-IoT" is filled with all possible valid Resource Blocks.

5. Select a PRB from "Used PRB for NB-IoT".

   The NB-IoT frequency and NB EARFCN are calculated and displayed.

6. Click "Apply" to accept the frequency or "Cancel" to cancel the selection. In either case, the dialog is dismissed.

   If "Apply" was clicked, the calculated frequency and NB-IoT EARFCN would be shown in "f[MHz]", "NB EARFCN" and "Band" columns of the channel. The f2[MHz] is ".00".

NB guard band mode

If the selected mode of operation is the "NB Guard Band", the NB-IoT center frequencies are on the edges of the LTE band.

For a given NB EARFCN, there can be two valid NB-IoT frequencies, say, fa and fb.

Where: fb - fa = 15 kHz

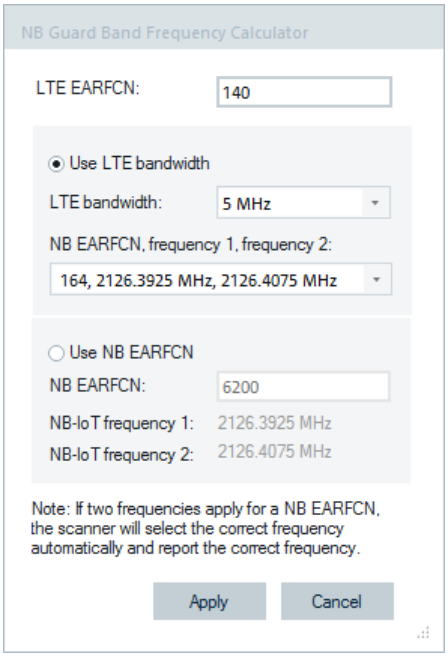
The grid column "f2[MHz]" shows the second frequency if any.

NB guard band frequency calculation

A guard band frequency calculation is supported in the "NB Guard Frequency Calculator" dialog.

NB Guard Band mode:

1. Click "f[MHz]", "f2[MHz]", "NB EARFCN" or "Band" to launch the "NB Guard Frequency Calculator" dialog.



   The dialog opens.

2. There are two buttons in the "NB Guard Band Frequency Calculator" dialog:
   - "Use LTE bandwidth" - LTE bandwidth to use for calculating NB frequency.
   - "Use NB EARFCN" - NB EARFCN to use for calculating NB frequency.

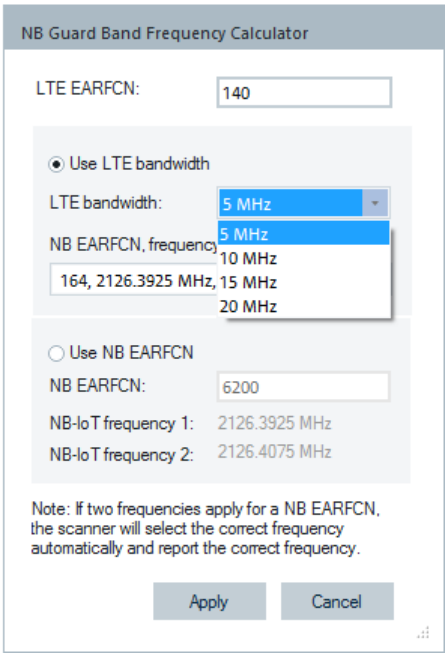
   Clicking a radio button switches the calculation mode.

Use LTE bandwidth

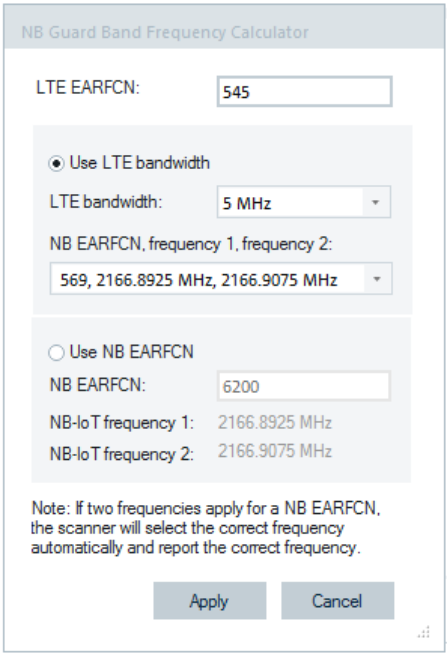
Click "Use LTE bandwidth" to switch the calculation to bandwidth mode.

1. Enter a valid LTE EARFCN.

If the LTE EARFCN is valid, the all possible valid bandwidths fill the corresponding "LTE Bandwidth" drop-down list.

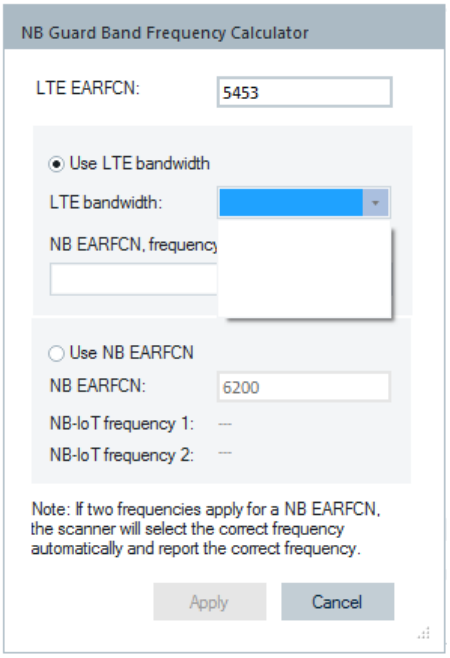


2. Now you can select a bandwidth from the "LTE Bandwidth" drop-down list.



The "NB EARFCN, frequency 1, frequency 2" drop-down list is filled with all possible valid combinations of NB EARFCN, frequency 1, frequency 2.

3. An invalid LTE EARFCN entered, clears the "LTE Bandwidth" drop-down list.



The "Apply" button is disabled. You can still click the "Cancel" button.

4. Click "Apply" to accept the frequencies or "Cancel" to cancel the selection.

   In either case, the dialog is dismissed.

5. If clicked "Apply", the calculated frequencies, NB EARFCN and Band fill the "f{MHz]", "f2[MHz]", "NB EARFCN" and "Band" columns of the channel accordingly.

The drop-down list is of the following format: "NB EARFCN, frequency 1, frequency 2", where the meaning of the entries is:

- NB EARFCN - NB-IoT channel number
- Frequency 1 - Calculated primary frequency based on the LTE EARFCN
- Frequency 2 - Calculated secondary frequency based on the LTE EARFCN

The frequency 1 is placed to "f[MHz]" grid column and the frequency 2 is placed to "f2[MHz]" grid column if it is available.

For example, in highlighted selection in the previous figure NB EARFCN = 521, Frequency 1 = 2162.0925 MHz, Frequency 2 = 2162.1075 MHz means that the second frequency is not available.

If two frequencies, for example, fa and fb are available and fb > fa, then they have to satisfy the condition fb - fa = 15 kHz.

Both frequencies are sent to the scanner. The scanner detects and tries both and use the correct one. The correct frequency is observed during measuring and replay in BCH tree view and Top N pool center frequency signal and list.

Both frequencies are also reported in the measurement file system info box as shown in the following list. You can highlight the measurement file to see the system information. If secondary frequency is not configured, the Center Frequency2 is displayed.

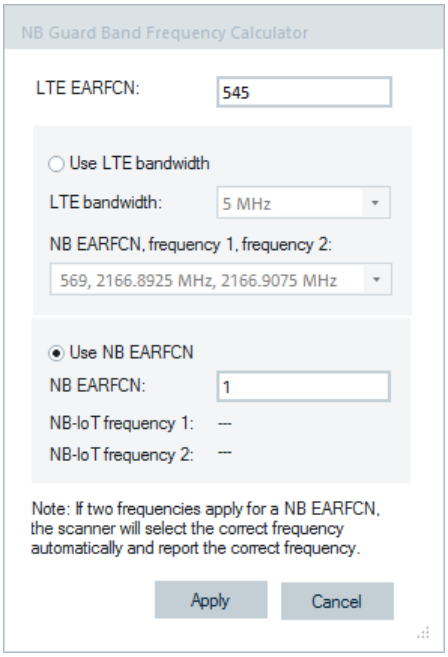
```
Count of all measured channels:    2
Selected Channels:
    Channel Name:        NB-IoT Channel 1
    LTE Band:            Band 1 (FDD)
    NB EARFCN:            53
    Center Frequency:        2115292.5 kHz
    M[DL]:                -1.0    (Informative only)
    Center Frequency2:    2115307.5 kHz
    M[DL] 2:                1.0    (Informative only)
    Mode:                 NB Guard Band
    max. Delay Speed:        4 µs
    max. Speed:           100 Km/h

    Rate per second:        10.0
    BCH Demod:        MIB(Rep: 1.000 s);SIB1(Rep: 1.000 s);SIB2(Rep: 1.000 s);
SIB3(Rep: 1.000 s);SIB4(Rep: 1.000 s);SIB5(Rep: 1.000 s);SIB14(Rep: 1.000 s);
SIB15(Rep: 1.000 s);SIB16(Rep: 1.000 s);SIB20(Rep: 1.000 s);SIB22(Rep: 1.000 s);

    Channel Name:        NB-IoT Channel 2
    LTE Band:            Band 1 (FDD)
    NB EARFCN:            167
    Center Frequency:        2126692.5 kHz
    M[DL]:                -1.0    (Informative only)
    Center Frequency2:    2126707.5 kHz
    M[DL] 2:                1.0    (Informative only)
    Mode:                 NB Guard Band
    max. Delay Speed:        4 µs
    max. Speed:           100 Km/h

    Rate per second:        10.0
    BCH Demod:           MIB;SIB1;SIB2;SIB4;SIB5;SIB14;SIB15;SIB16;SIB20;SIB22;
```

Use NB EARFCN

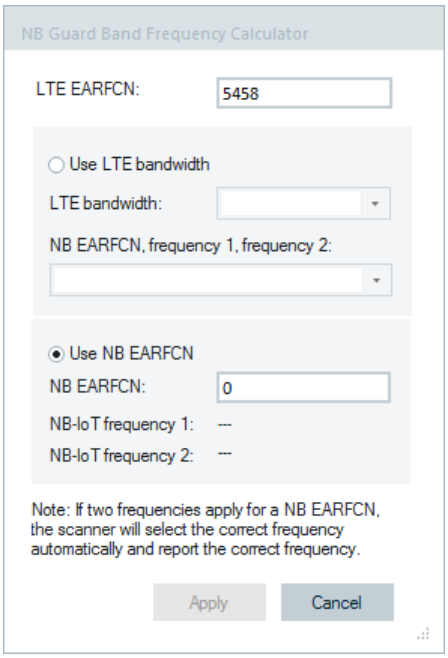
If "Use NB EARFCN" is clicked, the calculation switches to NB EARFCN mode.

1. Enter a valid LTE EARFCN.

   The corresponding NB-IoT frequency 1 and NB-IoT frequency 2 are calculated and displayed. Note that the NB-IoT frequency 2 may show "---".

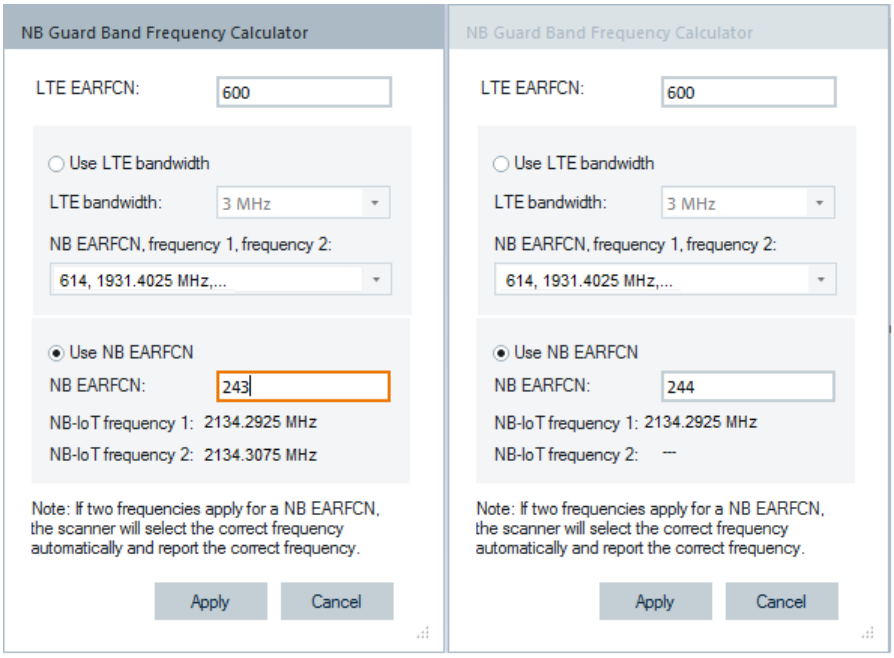


2. If the entered NB EARFCN is invalid, the"NB EARFCN, NB-IoT frequency 1, frequency 2" box is cleared.



   The "Apply" button is disabled. You can still click the "Cancel" button.

3. With a valid LTE EARFCN and NB EARFCN, one or two frequencies can be displayed.



4. Click "Apply" to accept the frequencies or "Cancel" to cancel the selection. In either case, the dialog is dismissed.
5. If clicked "Apply", the calculated frequencies, NB EARFCN and band fill the "f{MHz]", "f2[MHz]", "NB EARFCN" and "Band" columns of the channel accordingly.

Screenshot in the previous figure shows two frequencies scenario:

NB-IoT Frequency 1 = 2134.2925 MHz

NB-IoT Frequency 2 = 234.3075 MHz --- means that the second frequency is not available with NB EARFCN = 244

If two frequencies, say fa and fb where fb > fa, are available, they must satisfy the condition fb - fa = 15 kHz.

Both frequencies are sent to the scanner. The scanner detects and tries both and use the correct one.

The correct frequency is observed during measuring and replay in BCH tree view and Top N pool center frequency signal and list.

Both frequencies are also reported in the measurement file system info box as shown in the following list. You can highlight the measurement file to see the system information. If secondary frequency is not configured, the Center Frequency2 is displayed.

```
Count of all measured channels:    2
Selected Channels:
    Channel Name:         NB-IoT Channel 1
    LTE Band:             Band 1 (FDD)
    NB EARFCN:             53
    Center Frequency:        2115292.5 kHz
    M[DL]:                -1.0    (Informative only)
```

```
    Center Frequency2:    2115307.5 kHz
    M[DL] 2:                1.0    (Informative only)
    Mode:                 NB Guard Band
    max. Delay Speed:       4 µs
    max. Speed:           100 Km/h

    Rate per second:        10.0
    BCH Demod:        MIB(Rep: 1.000 s);SIB1(Rep: 1.000 s);SIB2(Rep: 1.000 s);
SIB3(Rep: 1.000 s);SIB4(Rep: 1.000 s);SIB5(Rep: 1.000 s);SIB14(Rep: 1.000 s);
SIB15(Rep: 1.000 s);SIB16(Rep: 1.000 s);SIB20(Rep: 1.000 s);SIB22(Rep: 1.000 s);

    Channel Name:       NB-IoT Channel 2
    LTE Band:           Band 1 (FDD)
    NB EARFCN:           167
    Center Frequency:       2126692.5 kHz
    M[DL]:               -1.0    (Informative only)
    Center Frequency2:    2126707.5 kHz
    M[DL] 2:                1.0    (Informative only)
    Mode:                NB Guard Band
    max. Delay Speed:       4 µs
    max. Speed:           100 Km/h

    Rate per second:        10.0
    BCH Demod:           MIB;SIB1;SIB2;SIB4;SIB5;SIB14;SIB15;SIB16;SIB20;SIB22;
```

Stand alone mode

If "Mode" is "Stand Alone" and "Band" is other than "No 3GPP Band", the "f[MHz]", "EARFCN" and "Band" column are editable. The "f2[MHz]" column is still read only.

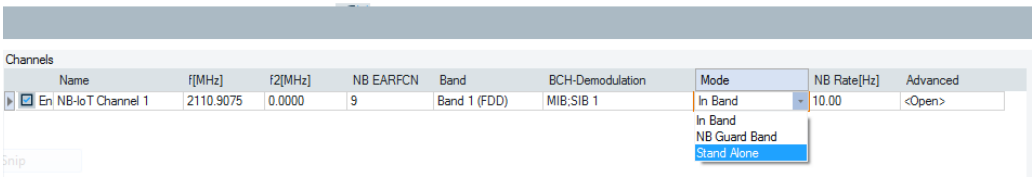


Figure 6-312: NB-IoT scanner configuration dialog for stand-alone mode

If any of the f[MHz], EARFCN or band value changes, the other two are recalculated accordingly.

For example, if you change the frequency the EARFCN and band is recalculated.

Frequency associated with unique band

If the entered frequency is associated with a valid NB EARFCN, which is unique and the NB-IoT supports it, the new frequency is accepted. The calculated NB EARFCN, Band NB EARFCN and Band are applied.

Frequency associated with multiple bands

If the entered frequency is valid and supports NB-IoT, but is associated with multiple bands, then the bands helper dialog is displayed. For example, Band 1 and Band 4 share the starting frequency.

Select an entry from the list and click "Apply" to accept it. The selected Band and NB EARFCN is inserted in the associated grid columns. If you click "Cancel", the first choice of the list is applied.

Invalid frequency

If the new frequency does not support NB-IoT or is invalid, NB EARFCN column shows "---", and band is set to "No 3GPP Band".

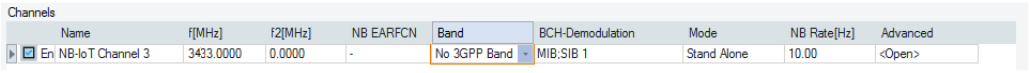


Figure 6-313: Invalid frequency case (3433 MHz)

No 3GPP band mode

The "Band" column has a special value "No 3GPP Band". If you select or set this value, the columns "f[MHz]", "EARFCN" can be manually changed without validation or recalculation.

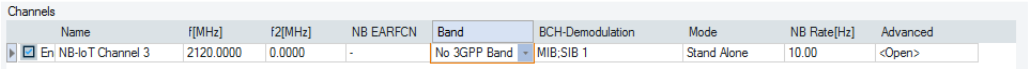


Figure 6-314: No 3GPP band mode

Enabling dynamic PDU change

1. Click the "Advanced" column.

   The drop-down box shows the "<Open>" entry.

2. Click "<Open>".

   The "Advanced channel settings" dialog shows-up.

   You can select dynamic PDUs by checking the associated check-boxes in the dialog.

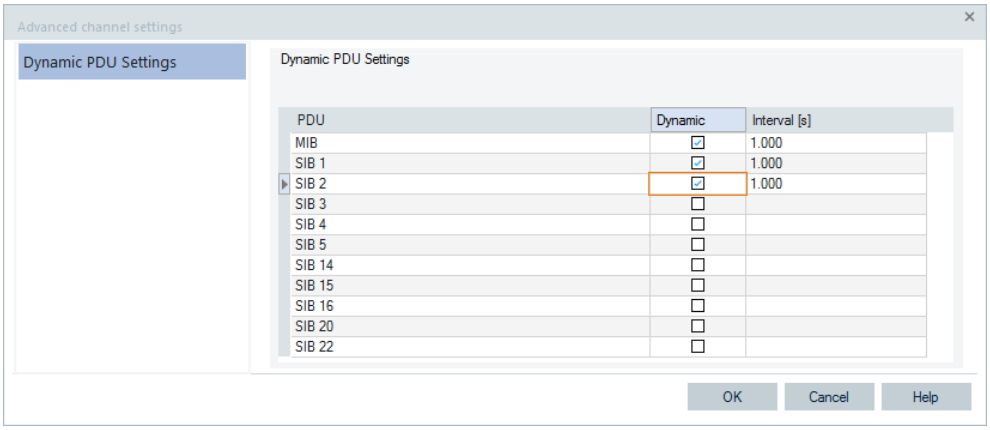
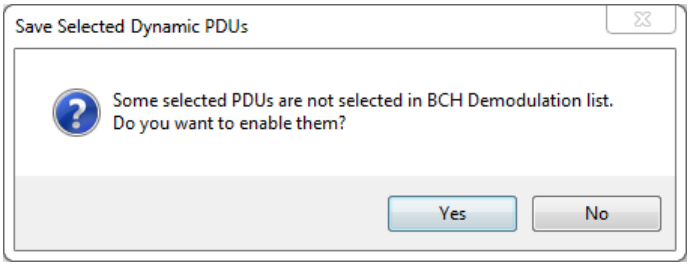


Figure 6-315: NB-IoT Scanner - dynamic PDU settings

If the BCH demodulation list does not contain all the selected PDUs (MIB/SIBs), you will be asked to enable them via the dialog shown in the next figure.



Click "Yes" to enable the settings of SIBs/MIB in BCH demodulation list.

Automatic channel detection for NB-IoT

The active LTE ACD activates always automatically the all active NB-IoT ACD bands for the ACD. Thus, for each band which is activated in the NB-IoT ACD, the LTE ACD performs also an ACD search and reports the results, see Figure 4-38.

If misconfigured ACD, R&S ROMES4 does not start the measurements as it checks the configuration at the start of it.

The NB-IoT ACD supports all three NB-IoT modes and searches for In-Band, NB Guard band and Standalone channels.

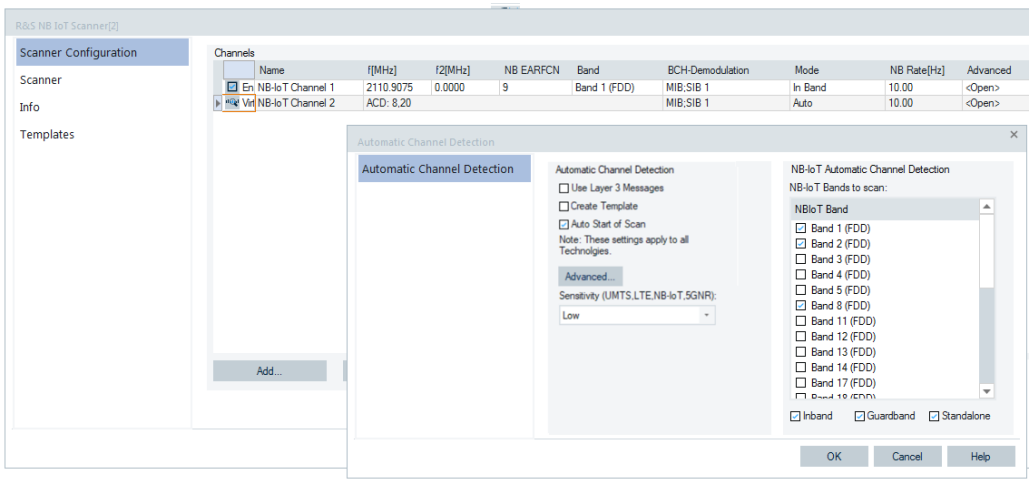


Figure 6-316: NB-IoT ACD configuration page

To set up an ACD measurement, it is recommended to use the ACD Wizard. Using the Wizard ensures that the LTE ACD is configured accordingly. The LTE ACD searches always for all three NB-IoT modes. If necessary, the modes can be adapted in the NB-IoT scanner's "Automatic Channel Detection (ACD)" configuration dialog. The found channel is visualized in the "ACD View" as an orange rectangle.

It is possible to distribute the NB-IoT channels to different frontends. The demodulator uses the same frontend as the scanner.

Advanced configuration

The "Advanced" button is used to make advanced configuration. Click the button to open the "Advanced Configuration" page.

The page contains the "Advanced General Parameters" and "BCH Demodulator" tabs.

The "Advanced General Parameters" tab lets you configure the following:

- "max. Delay Speed"
  The time difference of a signal arrival via different paths.
- "max. Speed"
  The maximum mobile speed that can be expected during the drive

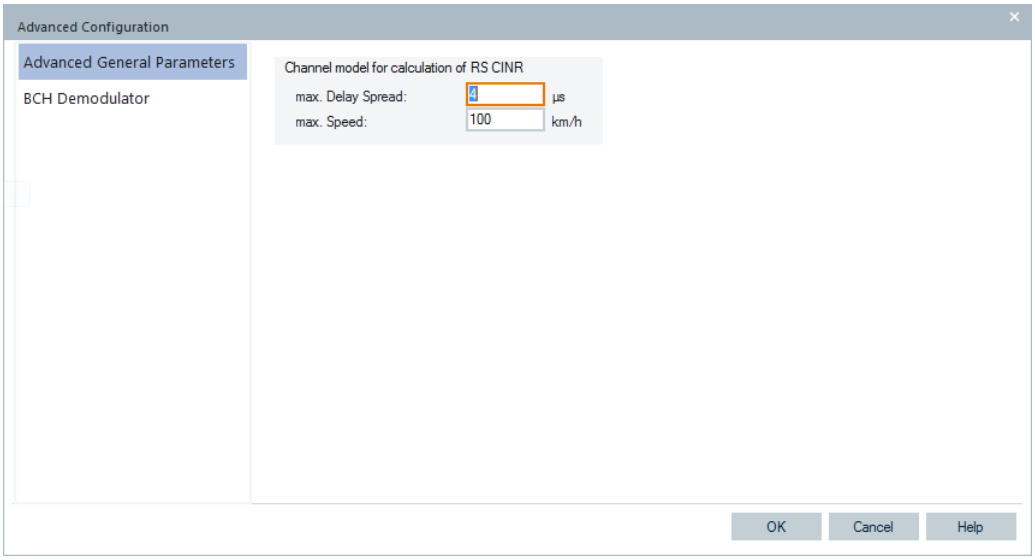


Figure 6-317: Advanced General Parameters page

Click the "BCH Demodulation" tab to open the page where you can configure the requested minimum NB-IoT SINR signal for demodulation. The valid range is 15 [dB] to 50 [dB]. Set the requested value in "Min SINR of NB-IoT signal, which shall be demodulated [dB]".

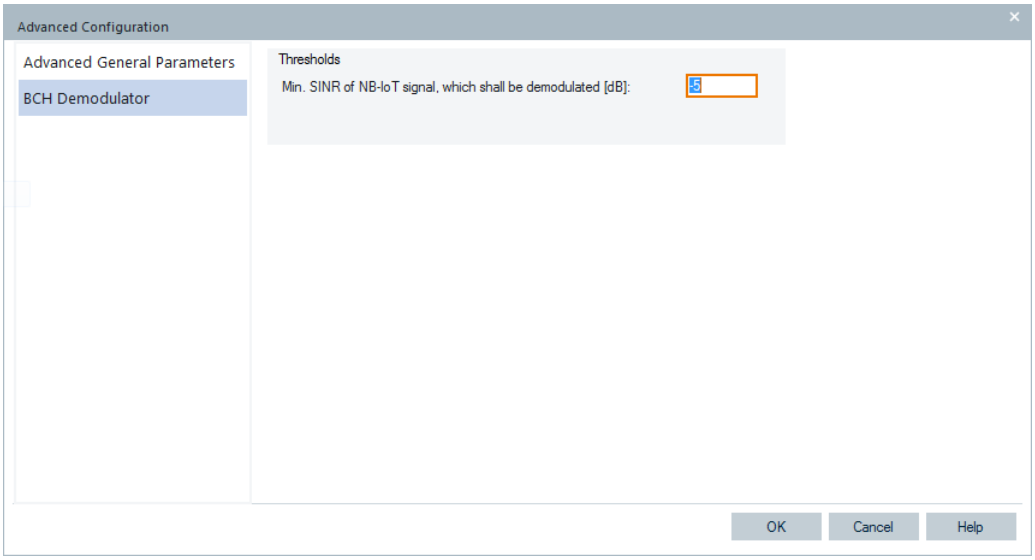


Figure 6-318: BCH Demodulation page

6.4.18 GSM network scanner

The R&S TSME and R&S TSME6 scanner device, controlled by the R&S ROMES4 GSM network scanner (NWS) driver, measure and identify all the GSM downlink radio signals.

For this purpose, the following hardware options can be used:

- R&S TSME with the R&S TSME-K23 option
- R&S TSME6 with the R&S TSME6-K23 option

The drivers are available with the option:

- R&S ROMES4T1E for the R&S TSME
- R&S ROMES4T1E6 for the R&S TSME6

However, the following descriptions of menu structure are identical for both drivers, if not mentioned otherwise.

Installation of the driver is explained in Chapter 6.1, "Devices", on page 1447.

The devices configuration is explained in the following.

The GSM NWS data can be viewed in Chapter 4.8.5, "GSM scanner views", on page 1179.

6.4.18.1 Resources configuration GSM NWS

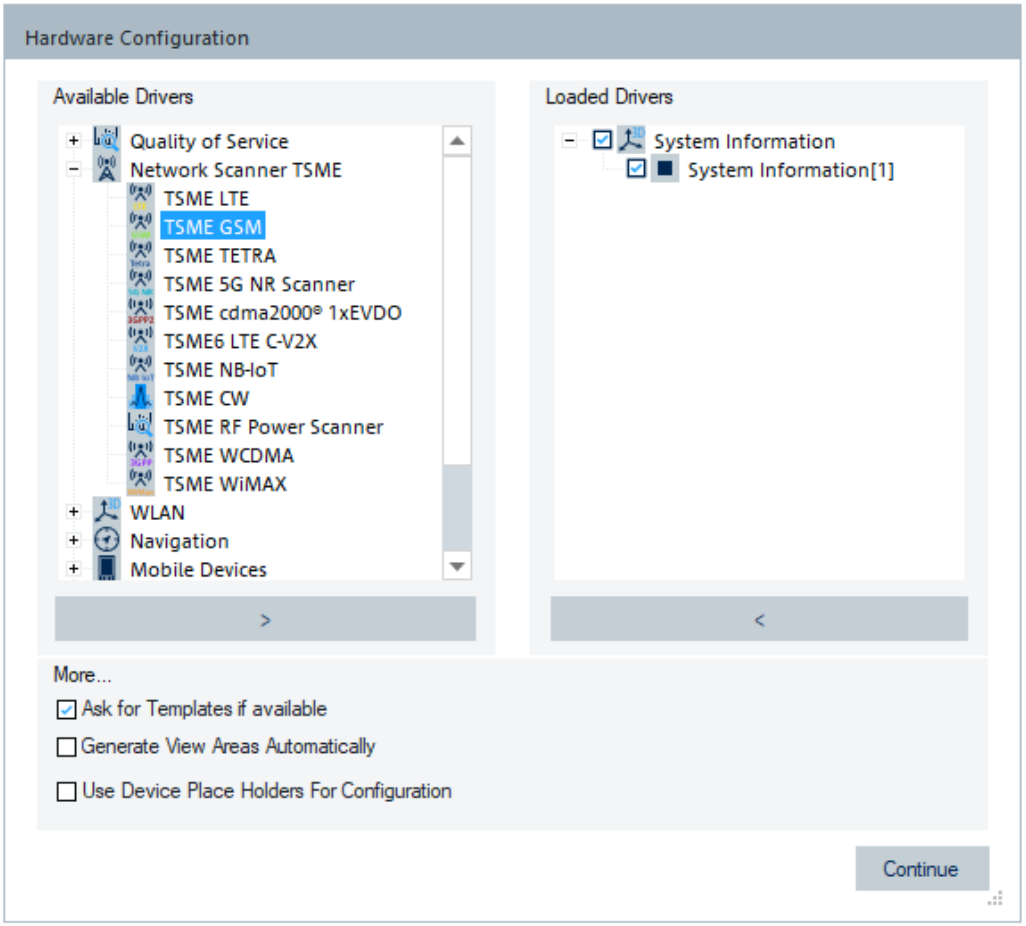


Figure 6-319: Hardware Configuration window

To load the GSM NWS-supporting device, select the "Network Scanner TSME" > "TSME GSM" branch of the "Hardware Configuration" > "Available Devices" pane, see Figure 6-40. Duble-click the selection.

The R&S TSME device is loaded with the R&S ROMES4 GSM NWS driver and displayed in the "Loaded Devices" pane. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S GSM Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

The loaded device is now added as the command line to the "Hardware" menu. Click the command line to open the GSM NWS device configuration page.

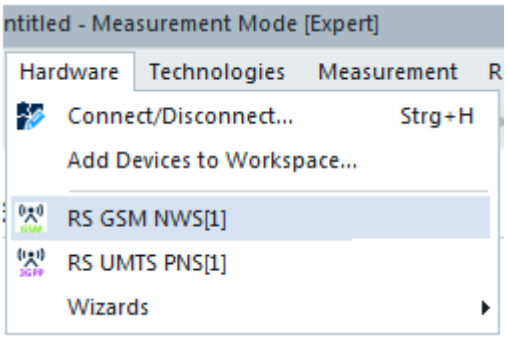


Figure 6-320: Loaded GSM NWS device

The dialogs of a device chooser open when the R&S TSME driver is loaded. The device chooser dialog is used to select the test device and define the essential connection parameters, if necessary.

For details about the loader's dialog, see Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The "R&S <variable>: Select Device" dialog is used to share the test device resources between all loaded R&S TSME hardware drivers. Furthermore, over the dialog the IP address of a device can be selected, if necessary.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

6.4.18.2 Configuration menu GSM NWS

R&S ROMES4 provides a configuration page for the GSM NWS driver when you click the "RS GSM NWS [<variable>]" command line in the "Hardware" menu. The command line is available when the driver is loaded.

The variable is an integer number indicating the number of connected devices.

The R&S ROMES4 GSM NWS opening configuration page contains several tabs having different functions. The "Channels" opening page lets you select the channels for measurement. The page contains tabs used to select the synchronization mode, configure the time slot and channel power measurement. The tabs "Info" and "Templates" are technology independent. They display information on the test receiver version and store the settings to a template, respectively.

6.4.18.3 Setup GSM NWS

In the "R&S GSM NWS" > "Channels" page you can configure the following:

- Channels to be scanned
- Scanning rate
- Frontend for scanner and demodulator, if available.

The "R&S GSM NWS" > "Channel" page differs dependent on used scanner type as shown in the following figures.

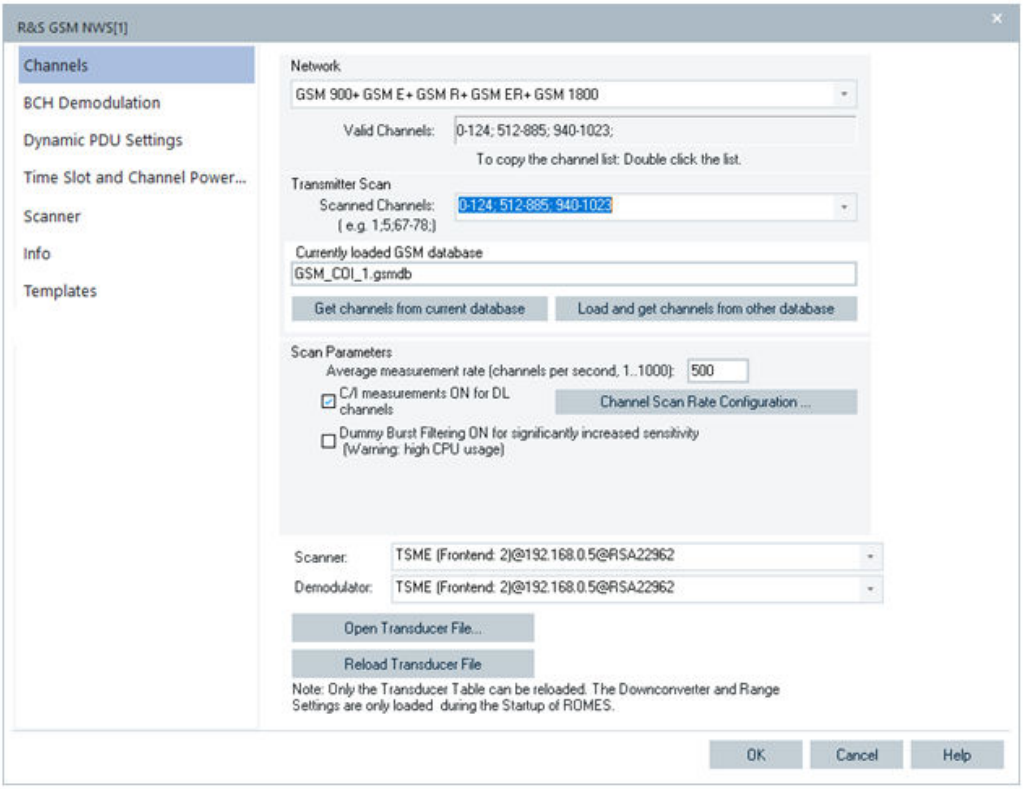


Figure 6-321: R&S GSM NWS configuration – Setup GSM NWS (R&S TSME)

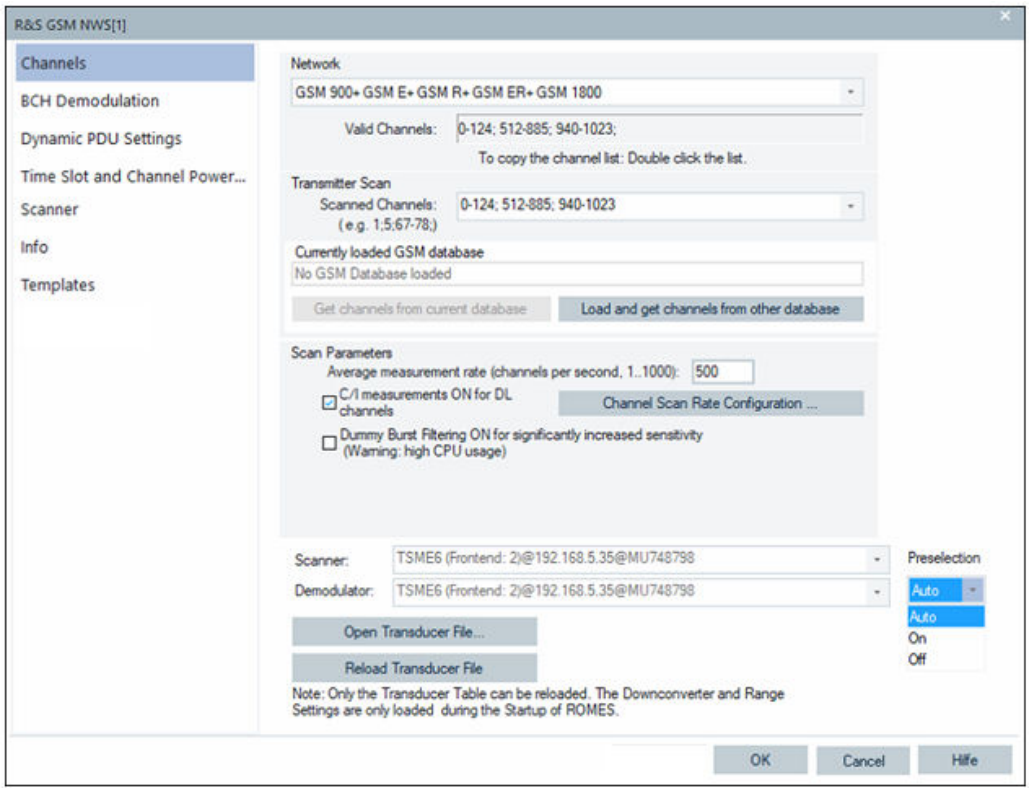


Figure 6-322: R&S GSM NWS configuration – Setup GSM NWS (R&S TSME6)

Network

You can select the GSM band or a combination of bands for scanning in the "Network" pane. The GSM channel numbers (ARFCNs) for the selected bands are displayed in "Valid Channels".

For an overview of GSM bands, channels and frequencies refer to Chapter 12.8.1, "GSM channel bands and power classes", on page 2395.

The GSM ER band is supported by R&S ROMES4 and included in the BTS database. The band has been added to all GSM 900 band definitions and also is added as a standalone. The band extension adds 15 channels (ARFCN 940…954) to the GSM R band.

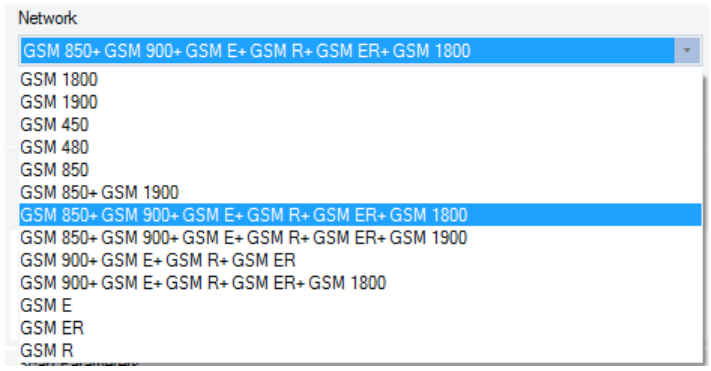


Figure 6-323: Selection of GSM band

Transmitter Scan

- "Scanned Channels"
  Allows selection of the scanned channels within the selected GSM bands. The channels are scanned periodically with the measurement rate selected below. A warning "The channel list is invalid" indicates that one or more channels do not belong to any of the selected GSM bands.
- "Currently loaded GSM database"
  Allows the used channels to extract from a database and transfer the list of channels to the "Scanned Channels" list. The file path of the current database is shown and the two buttons are available:
  – "Get channels from current database"
    Copy the channels of the current database into the "Scanned Channels" list.
  – "Load and get channels from other database"
    Load another GSM transmitter database and copy the channels into the "Scanned Channels" list. The benefit of the function is to optimize the scanning by skipping the channels of the GSM bands which are not used by the provider. The same function was already available in the GSM NWS wizard.

Scan Parameters

- "Average measurement rate…"
  Number of GSM channels measured per second. The average measurement rate of R&S TSME is up to 800 channels per second.
  A lower measurement rate limits the size of the measurement file. If the system performance is not sufficient, the R&S ROMES4 reduces the amount of evaluated data by discarding part of the results acquired by the scanners.
- "C/I measurements ON for DL channels"
  If checked, the C/I measurement is performed for all identified stations on the downlink channels. Caused by measuring more information, the data volume and the CPU load increase. The measurement is performed on the ETS part of the SCH burst. The function is active by default.
- "Dummy Burst Filtering..."
  This option activates a preprocessing step in the GSM NWS software which detects the dummy bursts in a GSM signal. The option also subtracts the dummy bursts from the signal before further processing. Handle with the care as this additional processing uses the CPU cycles.
  The benefit of the dummy burst filtering is increased sensitivity for measuring transmitters which work on the same channel (reused channel).
  After filtering, the remaining signal shows more clearly the SCH bursts that can be then demodulated and processed. Also the chance to demodulate successfully the System Information types on the BCH increases.

Scanner/Demodulator

The options allow frontend selection for scanner and demodulator if available.

Only valid frequency ranges are listed in the "Channels" > "Scanner"/"Demodulator" drop-down lists for the selected frontend. Click the drop-down box to get the list of available frontends.

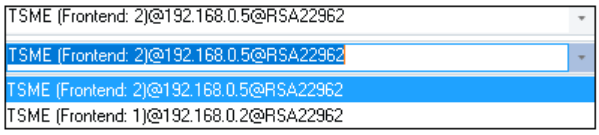


Figure 6-324: List of available frontends

The "R&S GSM NWS" > "Channels" page has in the "Scanner"/"Demodulator" pane in addition the "Preselection" option, see Figure 6-322.

The option offers three choices of frontend selection: "Auto", "On" and "Off".

6.4.18.4 BCH demodulation

The "BCH Demodulation" allows the settings for GSM BCH demodulation. The GSM NWS driver can be configured to demodulate the GSM BCCH channels (normal and extended) by specifying the System Information types to be decoded. The results of this measurement can be displayed in the GSM NWS BCH View.

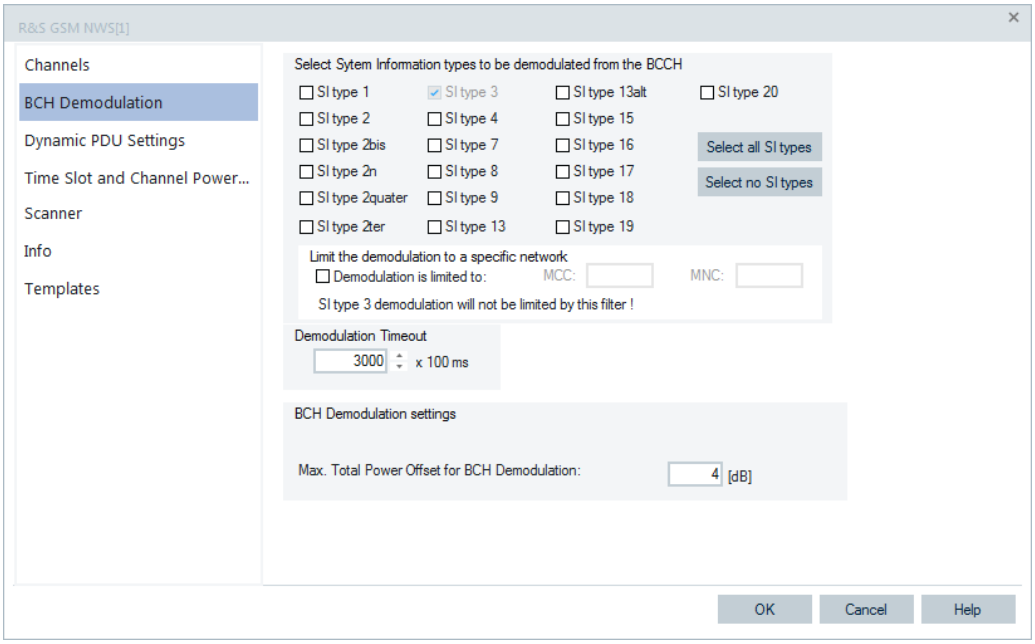


Figure 6-325: GSM NWS configuration – BCH demodulation

Select System Information

The "Select System Information types to be demodulated from the BCCH" panel offers to check demodulation of specific SITs. System Information Type 3 is always demodulated and is switched on by default.

- "Select all SI types"
  Checks all System Information Types.
- "Select no SI types"
  Removes all checks for the System Information Types.
- "Limit the demodulation to a specific network"
  Demodulation of the checked SI types can be restricted by MCC and/or MNC.

If the "Demodulation is limited to:" box is checked, the given MCC and MNC are compared to the information in the SI type 3 and only if there is a match the demodulation of the other SI types is done. If either MCC or MNC is left empty, it is not included in the comparison. This approach can be used, for example, to select only a specific country code.
The SI type 3 must be always demodulated to identify the GSM stations. Needed demodulation is also indicated by the SI type 3 check box, which cannot be unchecked.

Demodulation Timeout
After identification of a new station by demodulation of the SI type 3, all the other checked SI types will be requested and demodulation will be performed with a timeout.

- "Demodulation Timeout"
  Steps of 100ms, range 0 … 18000

BCH Demodulation settings

- "Max. Total Power offset for BCH Demodulation"
  BTSs are monitored by SCH measurements. Each SCH measurement has a total power offset from the CIR main power. If the power offset is high, the demodulation probability drops. The limitation is given by the max. total power offset. BTS measured with a higher total power offset is not demodulated.
  Range: 0 dB to 20 dB

6.4.18.5 Dynamic PDU settings

The "Dynamic PDU Settings" allows dynamic PDUs handling by selecting the SI types for measurement with a repetition interval to record their changes over time, see "Implementation of the dynamic PDU handling" on page 284.

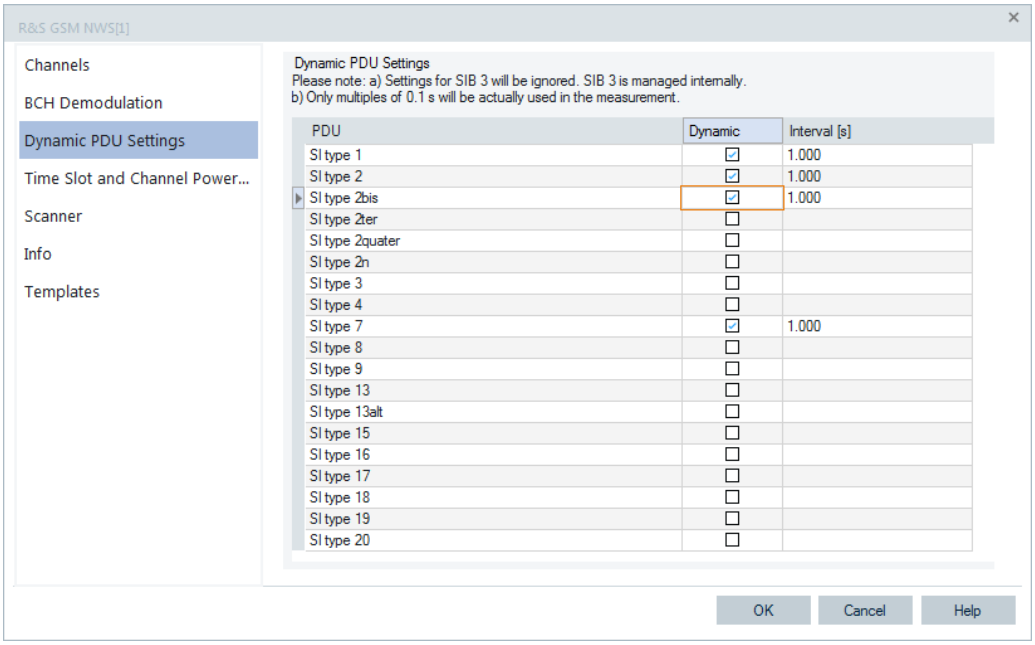


Figure 6-326: GSM NWS configuration – PDU settings

If the "Dynamic" check box is ticked, the checked PDUs in the list are measured with the repetition interval specified in "Interval".

Click "OK" to add the settings to the selected channel and return to "GSM NWS Configuration".

Click "Cancel" to discard made changes and return to "GSM NWS Configuration".

The default value for interval is 1 second. The possible range depends on the selected GSM scanner driver and is checked, see "Advanced - Open" on page 1796.

6.4.18.6 Time slot and channel power measurement

The "Time Slot and Channel Power Measurement" tab allows a new time slot and channel power of the GSM network to configure. The function is available with the R&S ROMES4COI option.

The measurements can generate a high data volume. It depends on the count of channels which are configured for measurement and on the "Results per GSM slot" setting. Set the parameters with care.

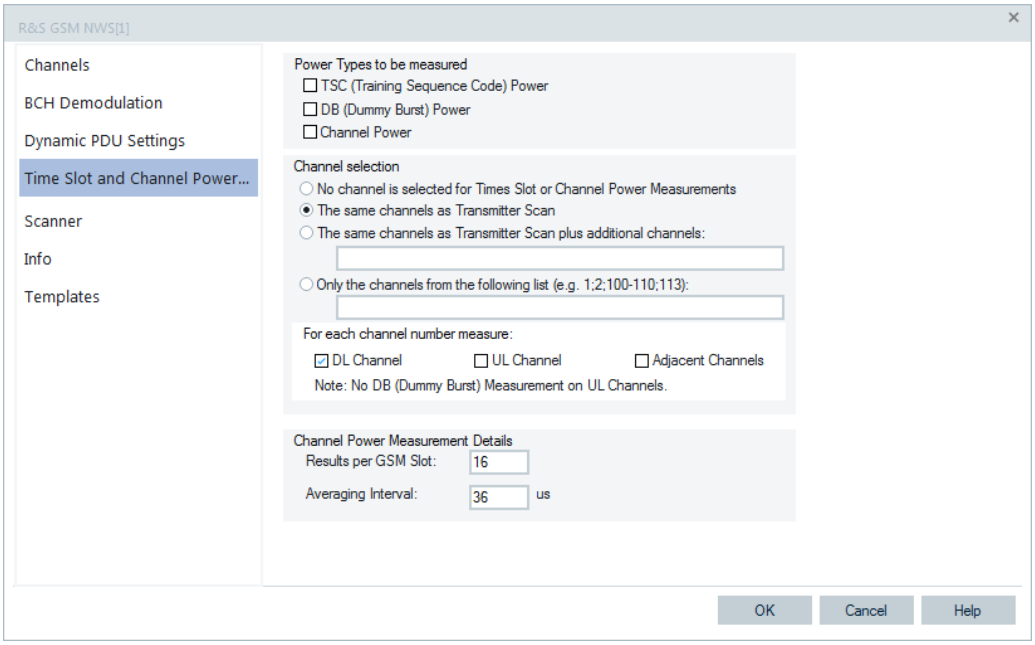


Figure 6-327: GSM NWS configuration – time slot and channel power measurement

Power Types to be Measured
Defines the measured power types.

- "TSC (Training Sequence Code) Power"
  The power of GSM bursts which have a Training Sequence Code. The bursts on the traffics channels and also the bursts on the broadcast channel which are used for System Information broadcast.
  The exact timing and the TSC (0...7) are measured in addition to the power. The TSC of a BTS has the same code as the BTS's BCC and can be used to identify the station which transmits the GSM bursts.

(This function is only available for computers with processor with SSE2 unit, e.g. Pentium 4.)

- "DB (Dummy Burst) Power"
  The power of dummy bursts which can be measured on the broadcast channels of stations.
  Besides the power, the exact timing is measured. This measurement can be used to identify the station which transmitted the dummy bursts.
- "Channel Power"
  The inband power on the channel as sequence of power values with a fine resolution over time. Each sequence has duration of about 50 ms and covers at least 11 GSM frames. The resolution and the averaging of the values can be configured in the lower section of the configuration page.

Channel Selection

The first part of "Channel selection" defines which channels are used for time slots or channel power measurements.

- None
- "The same channels as Transmitter Scan", default
- "The same channels as Transmitter Scan plus additional channels"
- Only the channels from user-defined list
- "For each channel number measure"
  Select from the above selected channels the desired types for the time slots or channel power measurement.
  Note:
  Since no dummy bursts are expected on UL channels, no dummy bursts measurement is done on UL channels.
- "DL Channel"
  If activated, downlink channels are measured.
- "UL Channel"
  If activated, uplink channels are measured.
- "Adjacent Channels"
  The measurement of adjacent channels is by default off. If activated, adjacent channels are measured.

Channel Power Measurement Details

- "Results per GSM Slot"
  Range: 1 to 50. Default value is 16.
- "Averaging Interval"
  Range: 6.4 us to 577.0 us. Default value is 32 us.

6.4.18.7 R&S TSME GSM NWS

The "Scanner" displays the properties of the R&S TSME device and information on the file version of the GSM NWS driver.

The dialogs of a device chooser open when the R&S TSME driver is loaded. The device chooser dialog is used to select the test device and define the essential connection parameters, if necessary.

For details about the loader's dialog, see Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The "R&S <variable>: Select Device" dialog is used to share the test device resources between all loaded R&S TSME hardware drivers. Furthermore, over the dialog the IP address of a device can be selected, if necessary.

6.4.18.8 Templates GSM NWS

The "Templates" page lets you store the current driver configuration as a template, to edit, load or delete the driver templates.

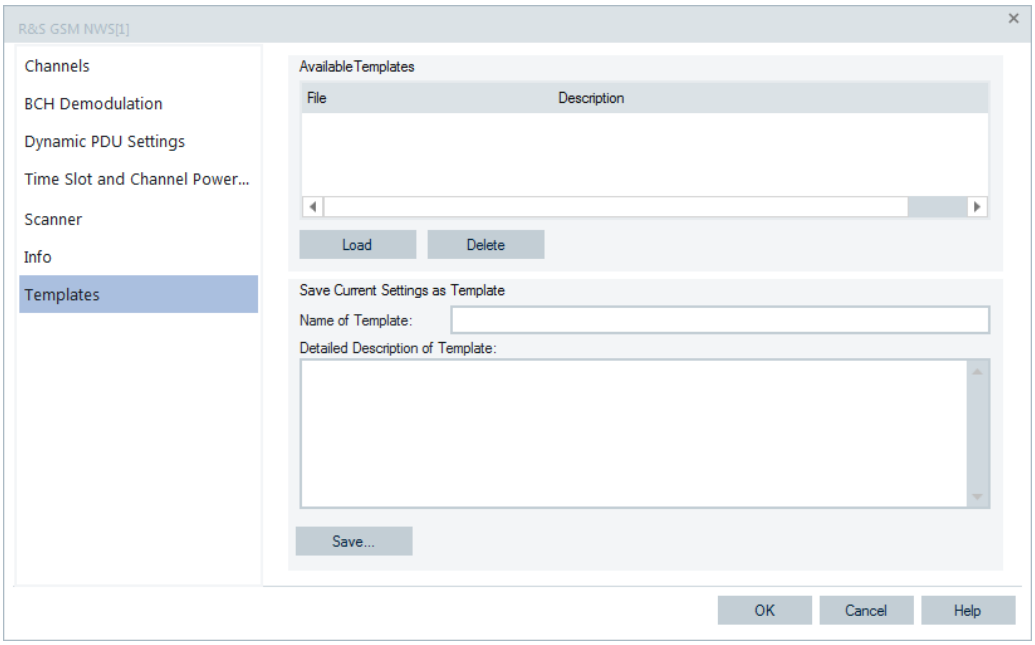


Figure 6-328: R&S GSM NWS - Templates

If a driver is loaded via "Hardware" > "Connect/Disconnect", R&S ROMES4 checks whether the device template is stored in the Driver Template directory and its subdirectories. The driver can be loaded with default settings or with the settings stored in any of the found templates.

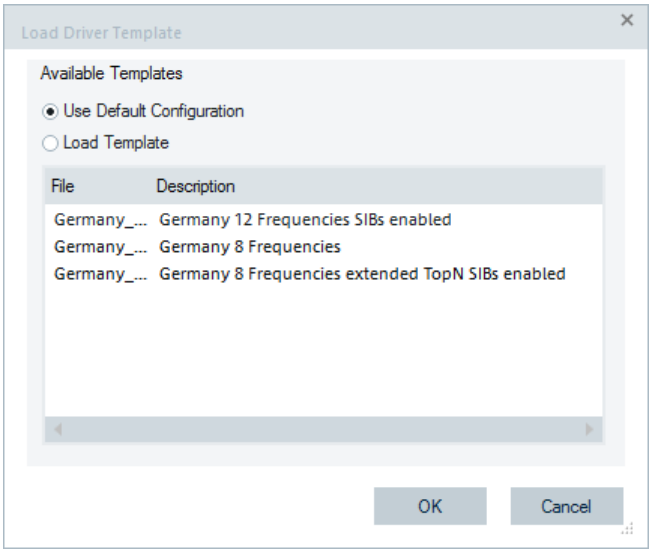


Figure 6-329: Selecting template

6.4.18.9 Information GSM NWS

The "Info" page displays some general information.

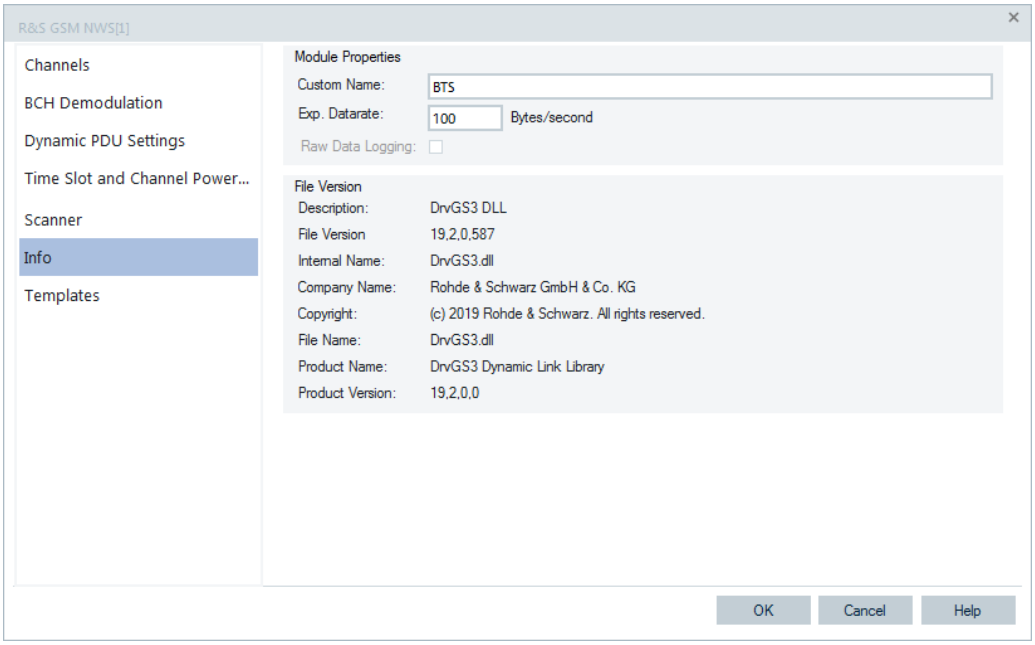


Figure 6-330: R&S GSM NWS - Info

6.4.19 UMTS PN scanner

The R&S ROMES4 UMTS Pseudo Noise Scanner (PNS) drivers control the R&S TSME or R&S TSME6 network scanner to alternate between UMTS PN scans and a spectrum analysis.

Also multiple UMTS PNS scanners can be used for measurement if so configured in "Hardware" > "Hardware Configuration".

For this purpose, the following hardware options can be used:

- R&S TSME with the R&S TSME-K21 option
- R&S TSME6 with the R&S TSME6-K21 option

The drivers are available with the option:

- R&S ROMES4T1E for R&S TSME
- R&S ROMES4T1E6 for R&S TSME6

Installation of the drivers is explained in chapter Chapter 6.1, "Devices", on page 1447.

Devices configuration is explained in the following text.

The UMTS PN data can be viewed in the "UMTS PNS Views", see Chapter 3.3.17.8, "UMTS scanner views", on page 187).

Some measurement examples using the UMTS PN scanner are outlined in Chapter 2.2, "Measurement examples", on page 72.

6.4.19.1 Resources configuration UMTS PNS

The R&S TSME devices can run as UMTS PNS devices if loaded with R&S ROMES4 UMTS scanner driver.

Click "Hardware" > "Connect/Disconnect" entry. The "Hardware Configuration" page pops-up.

To load the R&S ROMES4 UMTS PNS driver, double-click the selected "Network Scanner TSME" > "TSME WCDMA" entry in the "Available Devices" pane, see Figure 6-40.

The device is loaded and visible in the "Loaded Devices" pane of the page. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S UMTS PNS Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

The device is now added as a command line to the "Hardware" menu.

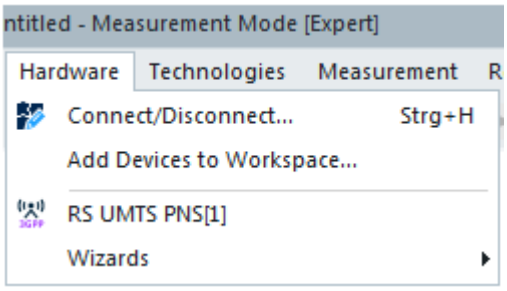


Figure 6-331: Accessing the UMTS PNS driver configurations

The dialogs of a device chooser open when the R&S TSME driver is loaded. The device chooser dialog is used to select the test device and define the essential connection parameters, if necessary.

For details about the loader's dialog, see Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The "R&S <variable>: Select Device" dialog is used to share the test device resources between all loaded R&S TSME hardware drivers. Furthermore, over the dialog the IP address of a device can be selected, if necessary.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

6.4.19.2 Configuration menus UMTS PNS

R&S ROMES4 provides a configuration menu for the UMTS PNS driver that pops-up if you double-click the "R&S UMTS PNS[<variable>]" command line in the "Hardware" menu.

The variable is an integer number indicating the number of connected devices.

The UMTS PNS driver's opening "Scanner Configuration" configuration page lets you configure the scanner by defining the "Channels" parameters. The page shows additional tabs: "Scanner" used to identity the connected driver, "Info" and "Templates". The last two tabs open the pages which show the information on the driver's file versions and the load, respectively.

- Receiver settings UMTS PNS....1790
- Measurements UMTS PNS....1801
- BCH demodulation UMTS PNS....1804
- UMTS scanner....1804
- Templates UMTS PNS....1804
- Information UMTS PNS....1805

Receiver settings UMTS PNS

The "R&S UMTS PNS[<variable>]" page of the R&S TSME driver displays the channels which you want to scan.

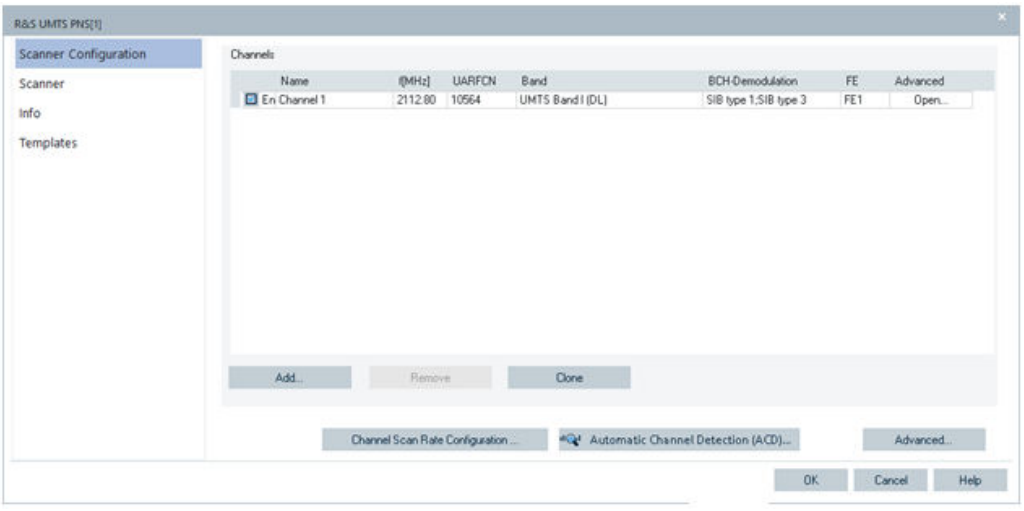


Figure 6-332: UMTS scanner configuration

Channels scanning

The following configurations are possible in the displayed "Channels" pane of the "R&S UMTS PNS" > "Scanner Configuration" page:

- Activate/Deactivate the scanning of a selected channel by checking the "Enabled"/"Disabled" checkboxes.

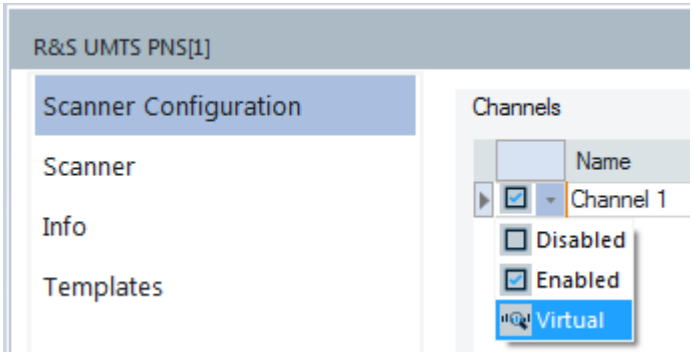


Figure 6-333: UMTS channel configuration options

- Set the virtual channel option by selecting "Virtual" instead.

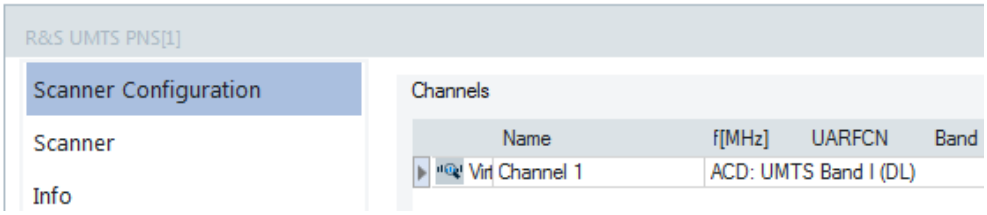


Figure 6-334: Virtual channel option - test device selected

- Select of the frontend for a channel, in the "FE" drop-down entry which shows the available frontends. Different channels can select different frontends.

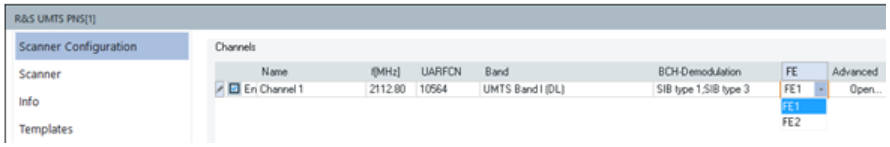


Figure 6-335: Selection of a frontend

Instead of defining a certain UARFCN, the R&S ROMES4 driver can be selected with the Virtual Channel feature, which dynamically configures the scanner. In dual network, it is useful to follow the UE configured to use the second cell.

Automatic channel detection (ACD) is supported with the Virtual Channel feature. This feature lets you use the scanner without knowing specific frequency of the UMTS network. Only the UMTS bands on which the specified UARFCNs are supposed to be located have to be entered. These bands are typically known from the spectrum allocation plan of the regulator. The UMTS scanner of the R&S TSME automatically detects the channels in this case.

If you choose "Virtual", the "f[MHz]", "UARFCN" and "Band" columns in the table disappear. Instead, a combo box appears which offers the all possible sources for the virtual channel. You can select between a test device and the ACD, as shown in the following figure.

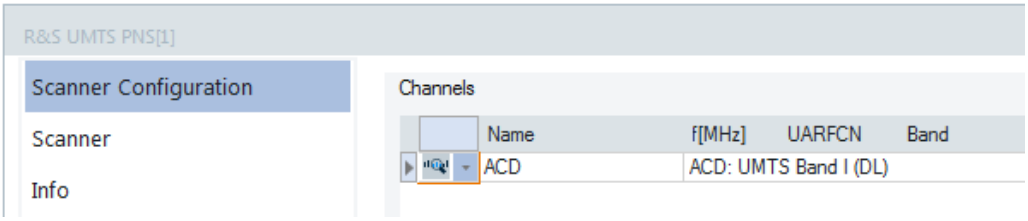


Figure 6-336: Virtual channel option - ACD selected

By default the ACD searches the UMTS band I. If a UMTS channel was detected, the settings concerning the BCH-demodulation, measurement rates and advanced settings of the virtual channel are applied to the detected channel.

For the ACD configuration, see "UMTS Automatic Channel Detection" on page 1798.

Note: The "Virtual" option is only available if at least one device driver which can command the scanner is loaded. For the UMTS scanner, currently only the Qualcomm driver can do that.

The primary device can add and release physical channels during the measurement. It can be useful to ignore the release command.

For example, if a UMTS device adds a second UARFCN, the second channel is scanned automatically. In the case that UARFCN is to be released, the UE releases also the channel in the UMTS scanner. If you want to scan the second UARFCN always, regardless if the UE uses it or not, the release commands can be ignored, see "Receiver settings UMTS PNS" on page 1790. In this case the scanner scans the second UARFCN from the point in time when the UE adds this UARFCN for the first time.

For each enabled channel the following is configurable:

- "Name"
  Name for the channel, for example, the provider's name.
- "f[MHz]"
  Carrier center frequency of the channel.
- "UARFCN"
  UTRA Absolute Radio Frequency Channel Number.
- "Band"
  UTRA operating band.
- "BCH-Demodulation"
  SIB type to be demodulated and decoded from the UMTS BCH.
- "Advanced"
  Advanced, channel-specific settings.

The UMTS PNS driver depends on a selected type of test receiver (R&S TSME).

The test receiver is selected during a driver installation in "Hardware Configuration" > "Available Devices", refer to Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The "R&S UMTS PNS" dialog is used to configure settings for the UMTS PNS driver and to display them. The modifications of the settings are done directly from the channel list of the dialog.

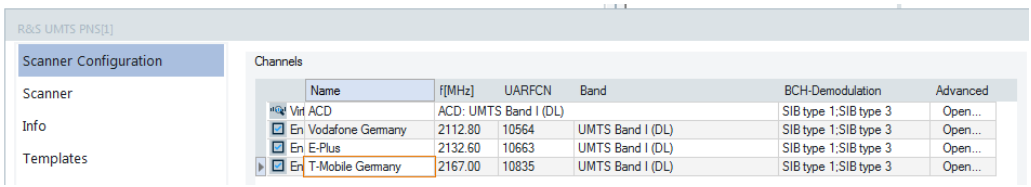


Figure 6-337: Modify provider name

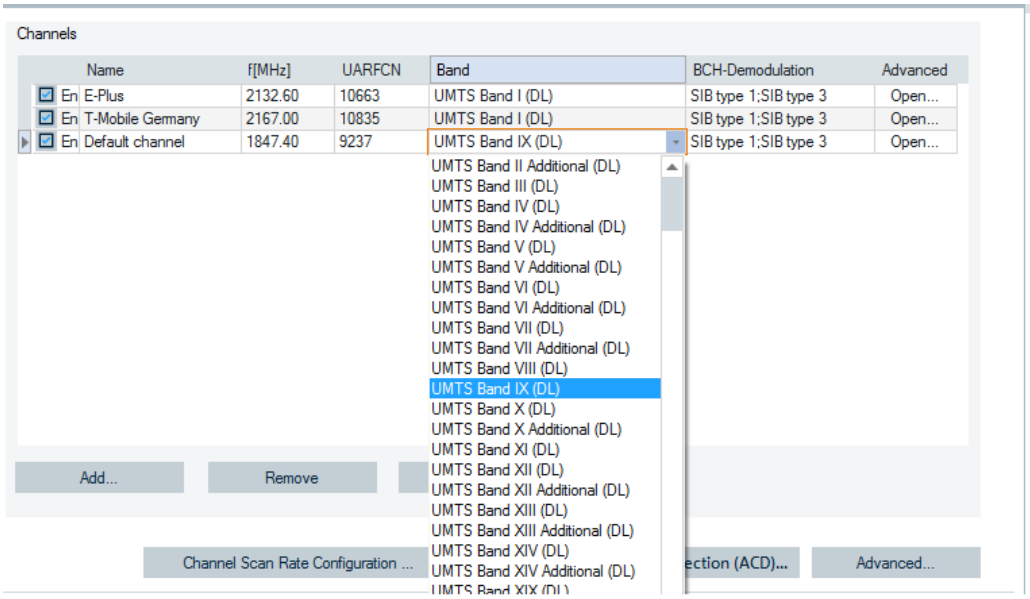


Figure 6-338: Modify frequency name

f [MHz]/UARFCN/Band

The "f", "UARFCN" and "Band" combo boxes display a selection of predefined channels to be measured. It is possible to select frequencies of the nominal UMTS downlink band. However, all frequencies must be in multiples of 0.2 MHz, corresponding to specified UARFCNs.

The WCDMA-related channel frequencies are in the nominal UMTS downlink band, depending on the WCDMA band (3GPP TS 25 101 V12.2.0), see also Table 12-18 and Table 12-19.

The channel frequency can be also defined freely from the range 80 MHz to 3000 MHz. The channel frequencies differ by the UMTS carrier spacing of 5 MHz.

The measured frequencies can be selected in the measurement range of the used test device.

Table 6-18: All WCDMA Bands (I – XXVI) and free configurable measurements

WCDMA Band	Uplink (MHz) (Spectrum)	Downlink (MHz) (Spectrum)
I	1920 - 1980	2110 -2170
II	1850 -1910	1930 -1990
III	1710-1785	1805-1880
IV	1710-1755	2110-2155

WCDMA Band	Uplink (MHz) (Spectrum)	Downlink (MHz) (Spectrum)
V	824 – 849	869-894
VI	830-840	875-885
VII	2500 - 2570	2620 - 2690
VIII	880 - 915	925 - 960
IX	1749.9 - 1784.9	1844.9 - 1879.9
X	1710-1770	2110-2170
XI	1427.9 - 1452.9	1475.9 - 1500.9
XII	698 - 716	728 - 746
XIII	777 - 787	746 - 756
XIV	788 - 798	758 - 768
XV	Reserved	Reserved
XVI	Reserved	Reserved
XVII	Reserved	Reserved
XVIII	Reserved	Reserved
XIX	830 – 845	875 -890
XX	832 – 862	791 – 821
XXI	1447,9 – 1462.9	1495,9 – 1510,9
XXII	3410 – 3490	3510 – 3590
XXV	1850 – 1915	1930 – 1995
XXVI	814 – 849	859 – 894

Band and frequency selection dialog ← f [MHz]/UARFCN/Band
If the user selects a new band which does not match the current frequency band and the UARFCN, the "Specify RF Configuration" window pops-up forcing the selection of the proper frequency or UARFCN for the selected band.

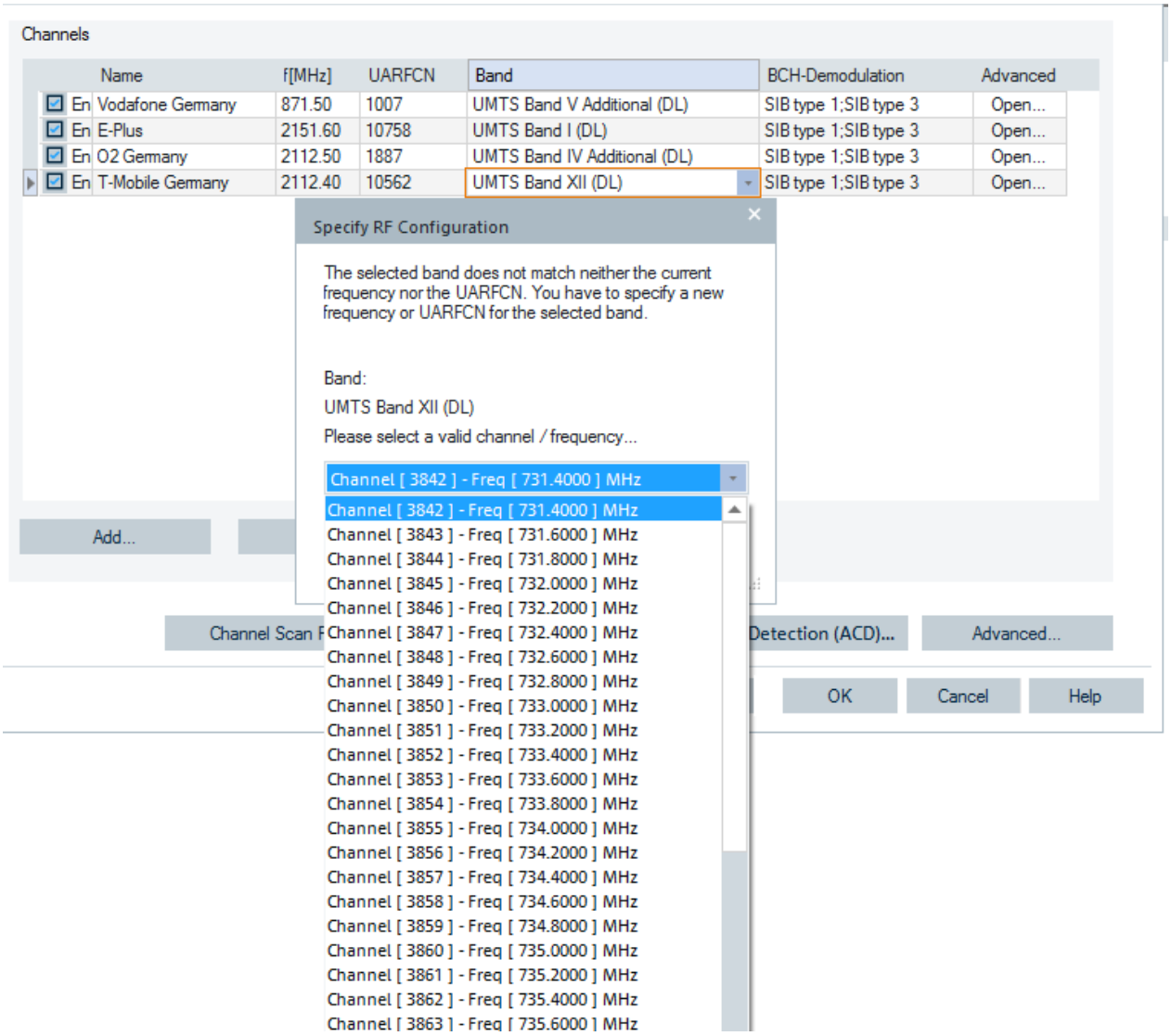


Figure 6-339: Band and frequency selection

This dialog provides list of all existing combinations of the channel numbers and frequencies for selected band. If you select one combination and click "OK", selected pair of values is inserted to the appropriate cells of the main scanner interface window. If you click "Cancel", the band value does not change.

Note: The number of channels which can be measured at the same time by the UMTS PN Scanner is limited.
R&S TSME: max. 32 UARFCN

BCH-Demodulation
Shows the System Information Blocks (SIB) to be demodulated and decoded from the UMTS Broadcast Channel (BCH). Modification of this type of measurement for a selected channel is also made here. The complete range of available SIBs have been added to the BCH-Demodulation combo box.

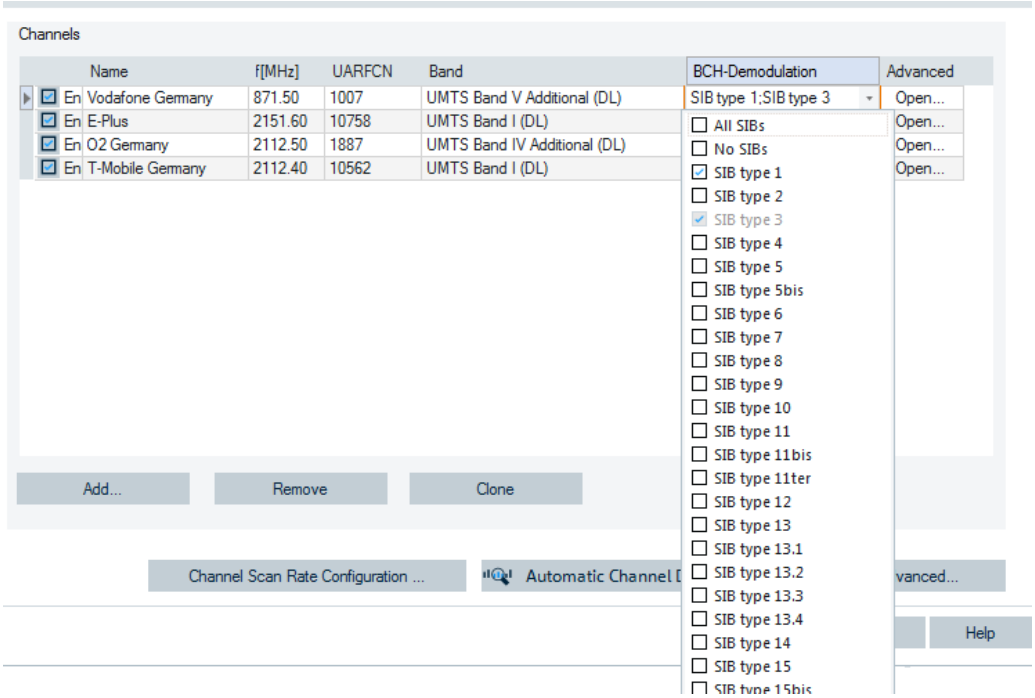


Figure 6-340: BCH-Demodulation combo box - SIB type selection

BCH decoding is performance critical, therefore it is recommended to restrict the selection to the SIBs of interest.

SIB type 3 is enabled by default for a new channel.

If disabled, selecting any other SIB type automatically activates SIB 3 because it contains MCC, MNC and CI which is fundamental for any deeper analysis of SIB content.

SIB 1 contains the LAC which is another important information.

SIB 11 contains the neighbor list.

SIB 1, SIB 3 and SIB 11 are necessary (and sufficient) for the UMTS neighborhood analysis (the option R&S ROMES4HOA is needed).

Note: The SIB contents is displayed in the "UMTS Scanner BCH View", see Chapter 4.8.11.2, "UMTS scanner BCH view", on page 1377.

Advanced - Open
Click "Advanced" >"Open". The "Advanced channel settings" window opens. Here you can select measurement settings for each configured channel separately.

The possible advanced channel settings are:

- "UL Interference"
  This option provides the measurement of uplink interference with configurable sampling rate. The fastest possible rate is 1/100 ms.
  UL interference measurement requires decoding of SIB type 7 which is enabled automatically.

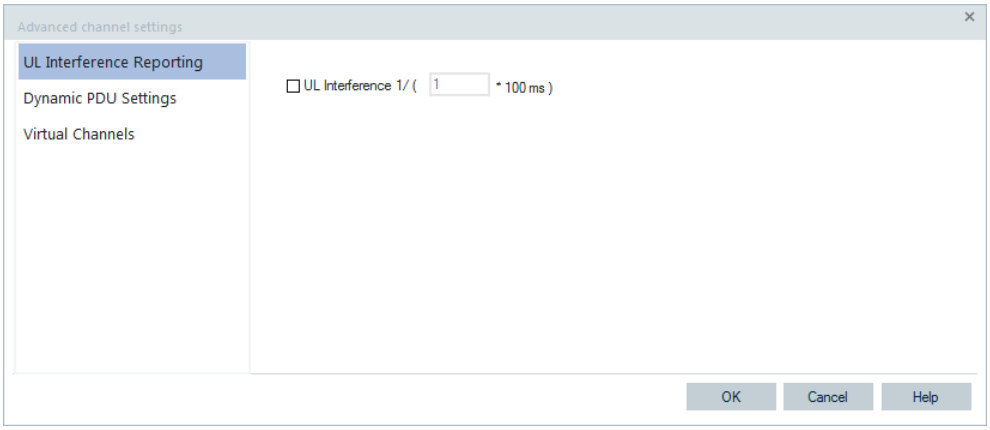


Figure 6-341: UMTS Scanner - UL interference

The value can be observed in the "PNS TopN View" and in the views using the general parameter tree like the "Alphanumeric view" or the "2D Chart View".

- "Dynamic PDU Settings"
  This option provides settings for dynamic PDUs handling.
  All the PDUs of the selected channels which can be requested for measurement are shown in the list.

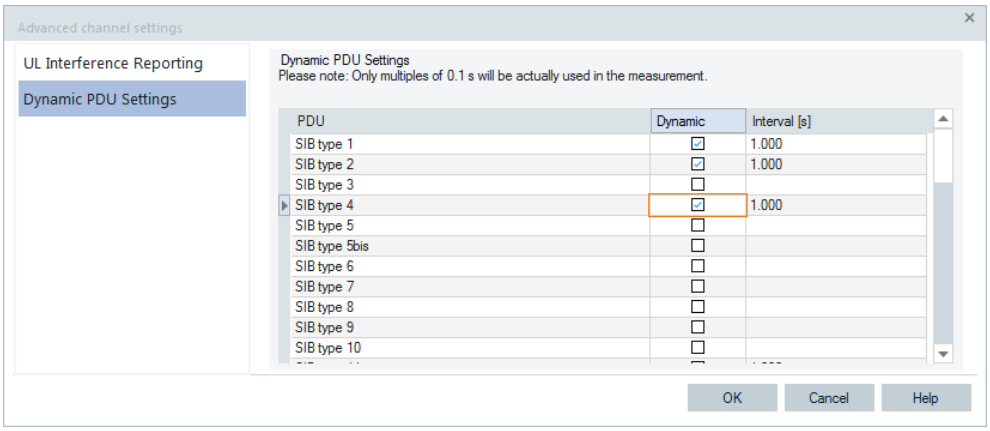
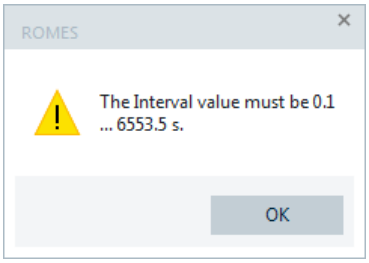


Figure 6-342: Dynamic PDU settings

In the configuration page you can select dynamic PDUs. For dynamic PDUs, refer to "Implementation of the dynamic PDU handling" on page 284.
The page is obtained in the same way for all the R&S ROMES4 supported technologies, except for GSM, where it is directly accessible.
If the "Dynamic" check box is ticked, the PDU is requested for measurement with the repetition interval specified in the "Interval" column.
To add the settings to the selected channel and return to the "R&S UMTS PNS" dialog, click "OK".
To discard made changes and return to the "R&S UMTS PNS" dialog, click "Cancel".
To go through the list, click "Previous" or "Next".

The default value for interval is 1 second. The possible range depends on the scanner driver for the technology and is checked. The message in the following figure is the interval check message for UMTS.



UMTS PNS buttons

The main "R&S UMTS PNS" page contains the following buttons in the pane area.

- "Add"
  Adds a new channel frequency to the table and configures the BCH-demodulation. For BCH-demodulation, see "BCH demodulation UMTS PNS" on page 1804.
- "Remove"
  Removes a selected entry from the list. The button is available only if at least one channel in the table is highlighted.
- "Clone"
  Makes a copy of all highlighted channels. Automatically sets the “checked” status for the channels and assigns name by adding the word “copy” to the original channel names. The button is available only if at least one channel in the table is highlighted.
- "Channel Scan Rate Configuration"
  Supports the configuration of the channel scan rate.
- "Automatic Channel Detection (ACD)"
  Supports the adaptation of the default ADC configuration.
- "Advanced"
  Supports common, frequency-independent settings of scanner. Click the button to get the "Advanced settings" page which contains the "Measurements" and "BCH-Demodulation" configuration tabs.

Channel Scan Rate Configuration

The Channel Scan Rate function for UMTS is supported with the R&S TSME driver.

For details, see Chapter 6.1.11, "Test devices", on page 1487.

UMTS Automatic Channel Detection

To activate the default ACD configuration for a certain UMTS band or adapt it, press the "Automatic Channel Detection" button in the "UMTS Scanner Configuration" page, see Figure 6-332.

In the "Automatic Channel Detection" page you can set the following ADC parameters:

- Parameters that apply to all technologies in the "Automatic Channel Detection" pane.
- UMTS-specific parameters in the "UMTS Automatic Channel Detection" pane.

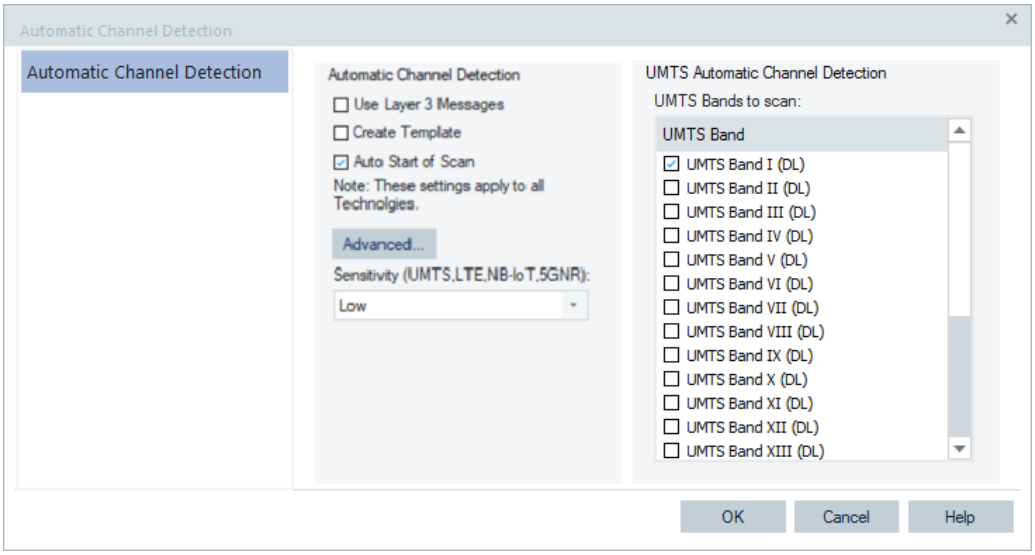


Figure 6-343: UMTS ACD configuration page

Automatic channel detection pane ← UMTS Automatic Channel Detection

The following parameters are configurable in the first mentioned pane:

- "Use Layer 3 Messages"
  If selected, R&S ROMES4 reads out all neighbor lists of detected transmitters and adds the detected neighbor cells' channels automatically to the system.
- "Create Template"
  The template can be used to set up a new measurement with the found channels which is not requested for the monitoring use case.
  If selected, R&S ROMES4 creates a template for the scanner, which includes all detected channels at the end of the measurement. The name of the template is the name of the measurement file.
- "Auto Start of Scan"
  This automatic approach has the sense during a drive test. It is not needed during a monitoring use case as the monitoring aims to measure only actual “on air” transmitters.
- "Sensitivity (UMTS, LTE, NB-IoT, 5GNR)"
  For the listed technologies, the sensitivity allows user to fine-tune the setup for the long term monitoring use cases, for details see Chapter 3.8.2.1, "Technologies", on page 280.
  Three different levels of the ACD sensitivity are available for power and quality measurements. Depending on the requirements of the monitoring use case, you can select the sensitivity level for transmitters detection between low, medium and high.
- "Advanced"
  If pressed, the "ACD Measurement Rate" page opens, where the user can set the ACD priorities for different RATs, see Figure 6-344.

The ACD feature tries to achieve the same measurement rates for all detected channels. However, R&S ROMES4 SW offers the user option to prioritize one RAT against the other. This prioritization is achieved by adding to the technologies supporting ACD (excluding TETRA) weighting factors. These factors then represent how higher measurement rate for one technology has to be in comparison to the others.

For example, if LTE has to have the double measurement rate compared to other RATs, set the LTE detected channels weight 2, and leave the weight 1 for the other RATs' detected channels.

To set the weight, press the "Advanced" button in the ACD page. Set the prioritization in the shown "ACD Measurement Rates" page.

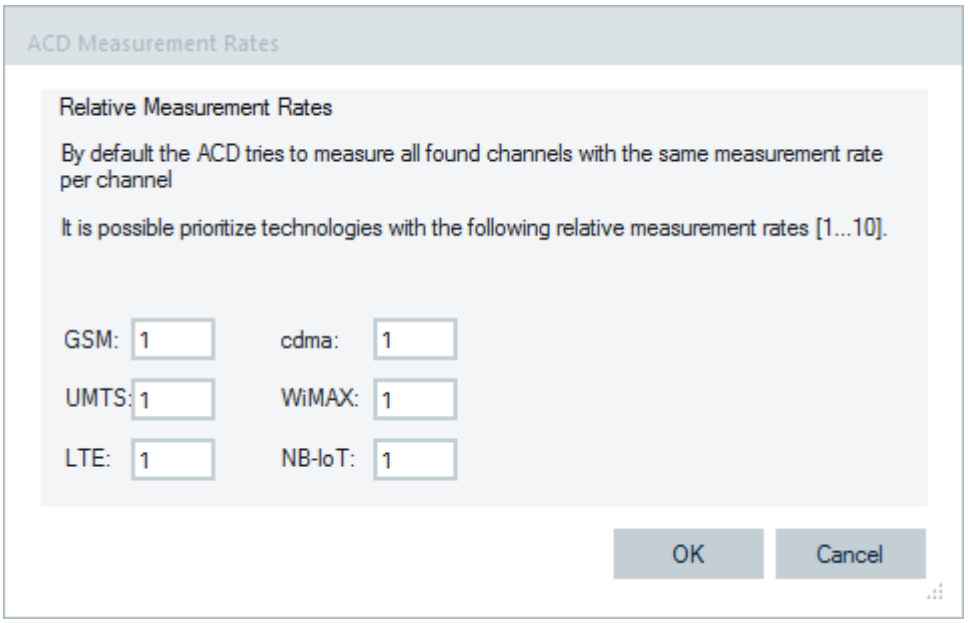


Figure 6-344: Set ACD weighting factor

UMTS Automatic Channel Detection Pane ← UMTS Automatic Channel Detection
The "UMTS Automatic Channel Detection" pane contains all UMTS bands letting you select those ones that you want to scan by checking combo boxes in "UMTS Bands to scan".

The progress of the ACD configuration can be observed in the "Output View".

Use cases of Automatic Channel Detection ← UMTS Automatic Channel Detection
The main use case of the ACD is the measurement anywhere without any knowledge of the used UARFCNs within the known UMTS bands.

Typically, you initiate a measurement with the ACD and use the resulting template as starting point for the best measurement rates concerning the actual measurements.

If the detection of transmitters along a drive is the goal of the measurement, running the ACD in smart mode is the best solution.

The primary goal of the measurement is detection of cells and the speed of the measurement on already detected cells. The second goal of the measurement with the ACD is to increase the detected speed by reducing the measurement rate of the virtual channel.

Measurements UMTS PNS

The "Measurements" configuration page allows the general measurement parameters setting for the UMTS scan.

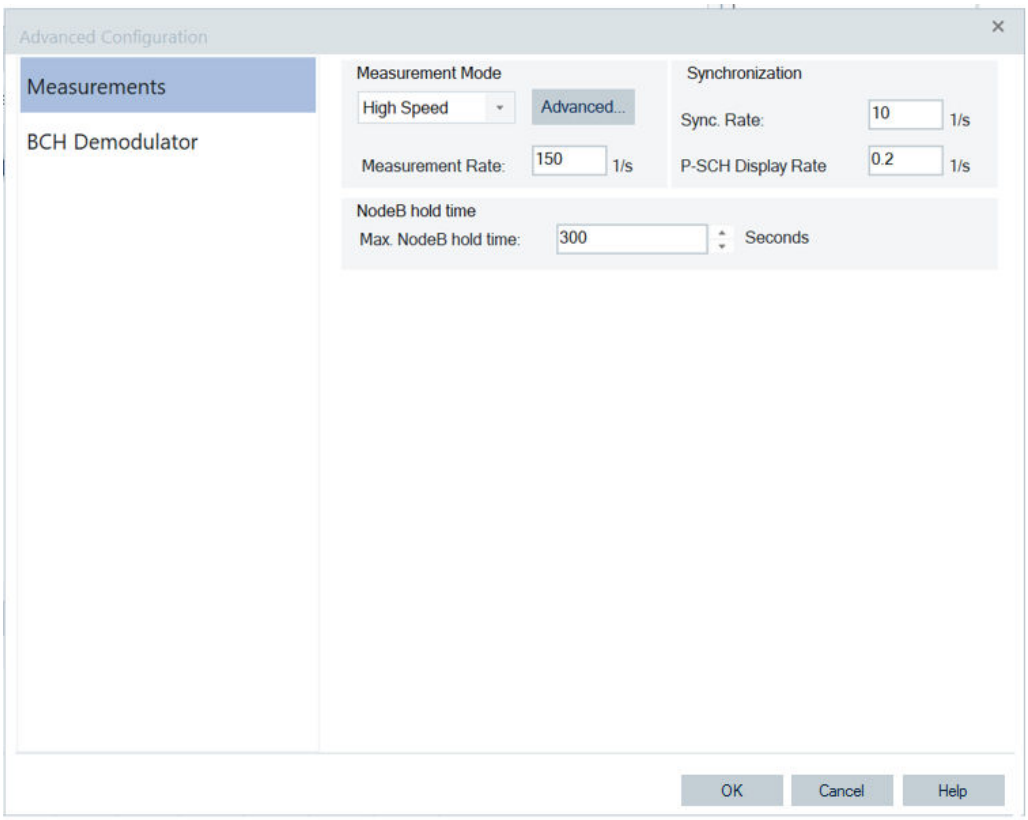


Figure 6-345: UMTS PNS configuration – Measurements tab of R&S TSME, High Speed mode

The highest real measurement rates can be expected with:

- UMTS synchronization
- All demodulation requests off
- Measuring only one channel

The R&S TSME "Measurements" page of UMTS scanner configuration offers the following:

Measurement Mode
Measurement modes are supported both by R&S TSME scanner.

The controls in the "Measurement Mode" pane define how R&S ROMES4 processes the baseband (I/Q) data for an UMTS PN scanner. The measurement mode has an impact on the measurement speed, the dynamic range, the synchronization procedure and the measured quantities, see description of the "UMTS PNS CPICH View" Chapter 4.8.11.3, "UMTS scanner CPICH view", on page 1383.

The drop-down box in this pane offers the following measurement modes:

- "High Speed"
  The analysis is based on a limited amount of data and optimized for fast evaluation.
- "High Dynamic"
  It provides the refined analysis using a larger amount of data, slowing down the measurement but increasing its dynamic range. The SC is determined by correlation with the pilot bits of the CPICH. The Doppler offset value is available.

Advanced ← Measurement Mode
Click the "Measurement Mode" > "Advanced" button to open the dialog for advanced settings.

The dialog provides the additional measurement setting "Performance", common for the UMTS scanners.

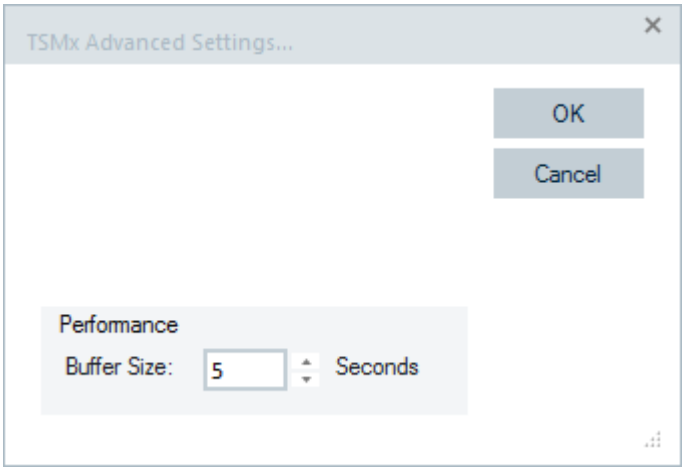


Figure 6-346: R&S TSME Advanced Settings dialog

"Buffer Size" lets you define the time for which the raw measurement data is stored in the R&S TSME if R&S ROMES4 is unable to process it immediately (for example, due to temporary low performance of the controller). If the R&S ROMES4 buffer remains blocked after the buffer size time expiry, the oldest data in the buffer is deleted and overwritten by a new data.

Data transfer starts when R&S ROMES4 is again ready to receive and process data.

A large buffer size increases the probability that no measurement data is lost, even though R&S ROMES4 can be blocked for an extended time. However, storage and transfer of large amounts of buffer data increase the possible delay between data recording and evaluation/display in the views.

The synchronization source is selected in this case automatically for the scanner types R&S TSME.

Measurement Rate ← Measurement Mode
Number of PN scans per second is shown in the following:

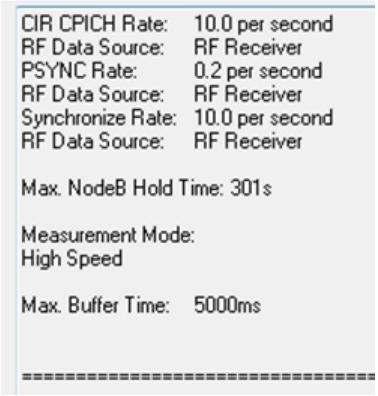
	High Speed	High Dynamic
R&S TSME:	0.1 - 300 /s	0.1 - 80 /s

The actual measurement time is shorter than the maximum rate for all provided test device settings so that even a large measurement rate never covers the spectrum measurement completely.

Synchronization
The two input fields in the "Synchronization" pane define how often the system synchronizes to the received UMTS PN signals and updates the measurement file:

- **Sync. Rate**
  Number of synchronization processes per received channel and per second. A low synchronization rate improves the system performance, especially if R&S ROMES4 receives many channels. The risk of the low synchronization rate is missing the NodeB signals that are only received for a short time.
- **P-SCH Display Rate**
  Rate by which the data for the "PNS P-SCH View" is stored to the measurement file and the view itself is updated. The P-SCH data is always acquired during synchronization so that the update rate must be smaller or equal to the "Synchronization Rate". A smaller update rate has no impact on the measurement but can considerably reduce the size of the measurement file.

NodeB hold time
The "NodeB hold time" > "Max.NodeB hold time" option is added to UMTS scanner configuration and to the `*.rscmd` file info.



The option gives the scanner a limit for the time that it remembers an already measured NodeB (channel, SC, SCId). If a NodeB defined by channel, SC and SCId were not received for the here specified time, these parameters are not used anymore. This case causes a restart of the all demodulation requests for this NodeB.

Range: 15 s to 1 day (default 300s)

BCH demodulation UMTS PNS

If selecting the "BCH-Demodulation" tab, the page opens where users can set the Ec/Io threshold for frequency-independent BCH demodulation. The page is identical for all R&S scanner types.

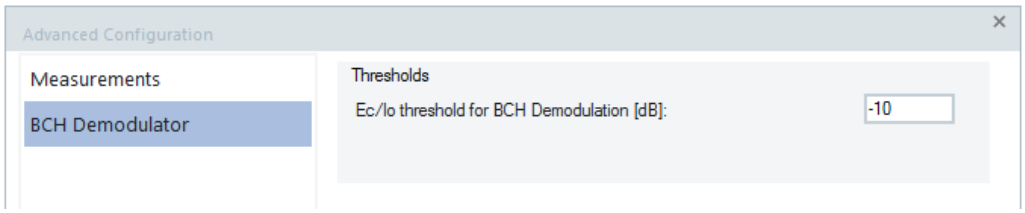


Figure 6-347: UMTS PNS configuration – BCH demodulation tab of R&S TSME

The system resources reserved for BCH demodulation are restricted by:

- **Threshold**
  Defines a minimum signal strength Ec/Io for BCH demodulation. Only signals above this threshold are decoded.

UMTS scanner

The "Scanner" tab opens the window which displays the properties of the R&S TSME device and information on the file version of the R&S ROMES4 UMTS PNS driver.

This "Scanner" window is identical for all technologies.

Templates UMTS PNS

The "Templates" tab stores the current driver configuration as a template, lists, loads or deletes driver templates.

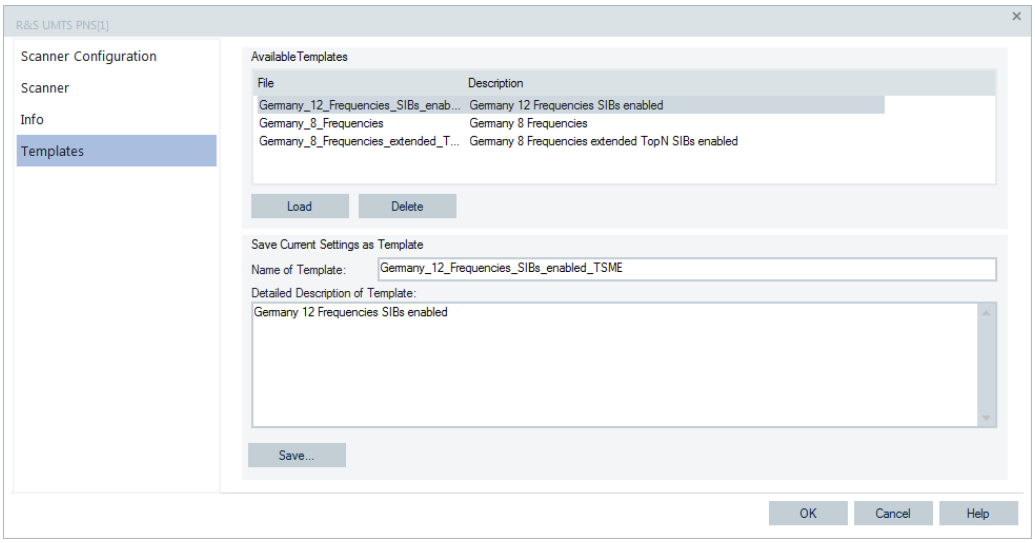


Figure 6-348: UMTS PNS configuration – templates

If a driver is loaded via the "Hardware" > "Connect/Disconnect" command, R&S ROMES4 checks whether a driver template is stored in the Driver Templates directory and its subdirectories. The driver can be loaded with default settings or with the settings stored in any of the found templates.

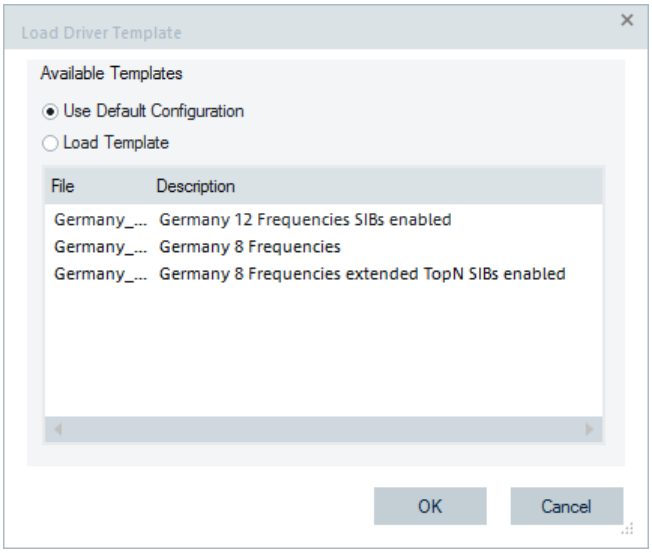


Figure 6-349: Selecting template

Information UMTS PNS

The "Info" tab displays information on the file version of the R&S ROMES4 UMTS PNS driver.

It is identical for all R&S ROMES4 UMTS PNS drivers.

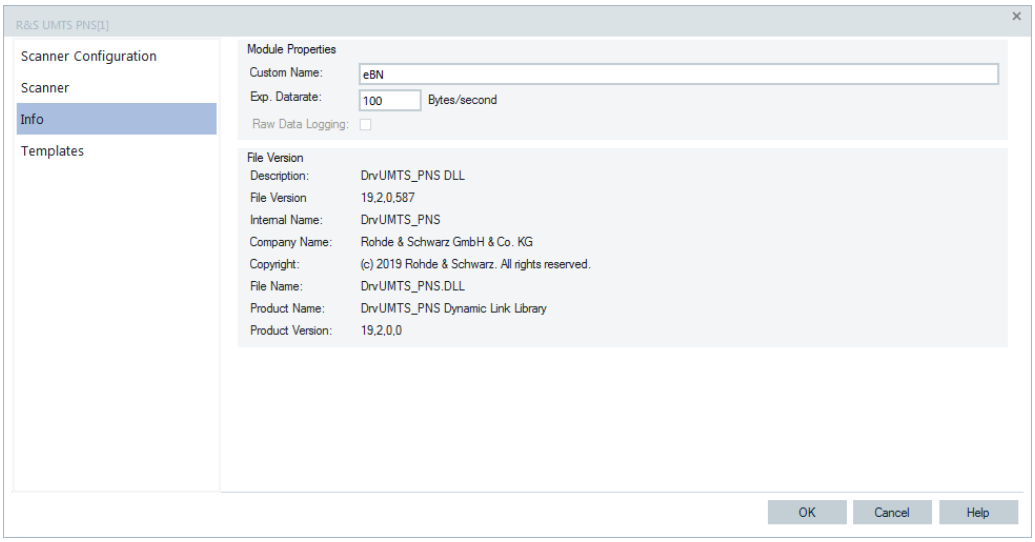


Figure 6-350: UMTS PNS configuration – info

6.4.20 CDMA2000 1xEVDO pseudo noise scanner (PNS)

The R&S TSME network scanner device controlled by the TSME cdma2000®1xEVDO driver performs the CDMA2000 and 1xEVDO Pseudo Noise (PN) scan. In a CDMA2000 and 1xEVDO PN scan, the test device measures and identifies all CDMA2000®1xEVDO downlink (BTS) radio signals.

The hardware options supported are the R&S TSME-K22 for CDMA2000 and the R&S TSME-K24 option for 1xEVDO. The drivers are available with the R&S ROMES4T1E.

For the device installation, see Chapter 6.1, "Devices", on page 1447.

The following section describes the CDMA2000® 1xEVDO PNS device configuration.

For the CDMA2000®1xEVDO PNS scanned and evaluated data, see Chapter 3.3.17.2, "CDMA2000/1xEV-DO scanner views", on page 183.

6.4.20.1 Resources configuration CDMA2000 1xEVDO PNS

Double-click the selected "Available Devices" > "Network Scanner TSME" > "TSME cdma2000(R) 1x EVDO PNS" branch in the "Hardware" > "Connect/Disconnect" > "Hardware Configuration" window to load the R&S TSME CDMA2000 1xEV-DO PNS device. See Figure 6-40.

The device is loaded and displayed in "Loaded Devices" pane of the window. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S CDMA2000 1xEV-DO PNS(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

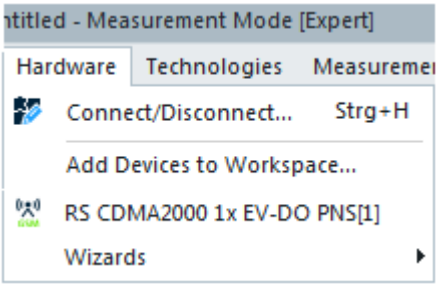


Figure 6-351: Accessing the CDMA PNS device configurations

The variable in the bracket is the name or number of connected devices.

The device is now added as the line command to the "Hardware" menu.

Click the command line to open the "R&S CDMA2000 1xEV-DO PNS[1]" configuration page.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

6.4.20.2 Configuration menus CDMA2000 1xEVDO PNS

R&S ROMES4 provides the configuration page for the RS TSME CDMA2000 1x EV-DO PNS installed and loaded device if selecting the "RS CDMA2000 1x EV-DO PNS [<variable>]" command line in the "Hardware" menu. The command line is available when the driver has been loaded.

The CDMA2000 1x EV-DO PNS driver opening configuration page contains several tabs. The opening "Scanner Configuration" page is dedicated to define channels you want to measure. In the "Scanner" page you can identify the connected scanner. The "Info" and "Templates" are common to all radio technologies and display information on the file versions of the driver and store the current setting as a template, respectively.

- CDMA2000 1x EV-DO PNS scanner configuration.....1807
- Automatic channel detection (ACD).....1814
- Advanced settings.....1817
- CDMA2000 1xEVDO PNS scanner.....1822
- CDMA2000 1xEVDO PNS templates.....1822
- CDMA2000 1xEV-DO PNS information.....1822

CDMA2000 1x EV-DO PNS scanner configuration

The "R&S CDMA2000 1x EV-DO PNS [<variable>]" main page lets you configure parameters of the channel you want to be measured. The parameters are the channel name, frequency, channel number and band, type of messages to be demodulated from the Broadcast Channel (BCH). The usage of the channel (cdma2000 1x/EVDO or cdma2000 and 1xEVDO channels, separately) is also configurable in this page.

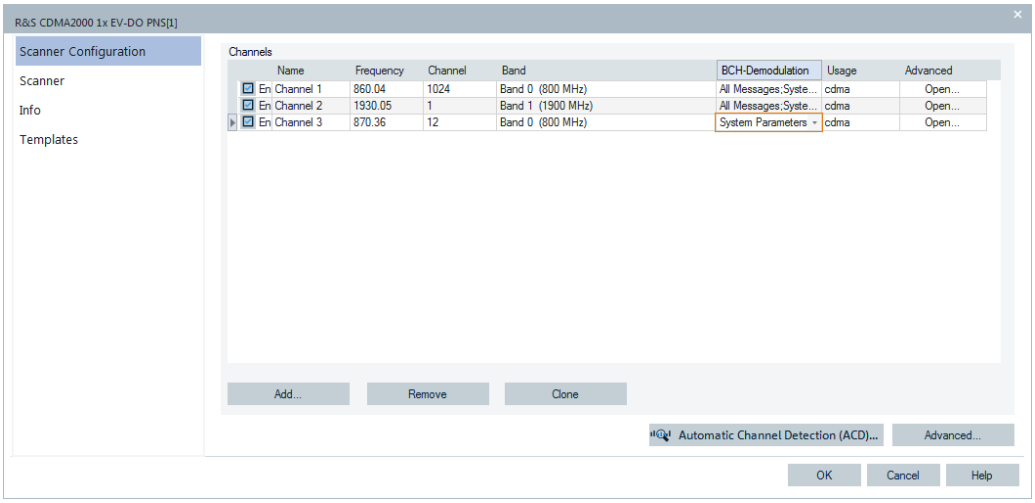


Figure 6-352: CDMA2000 1xEV-DO PNS configuration for R&S TSME

The page allows you to define the same frequency twice if the entries have the "Usage" parameter different, as shown in the following figure.

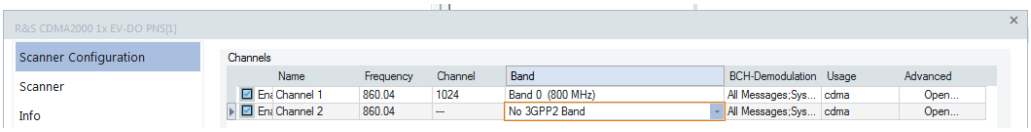
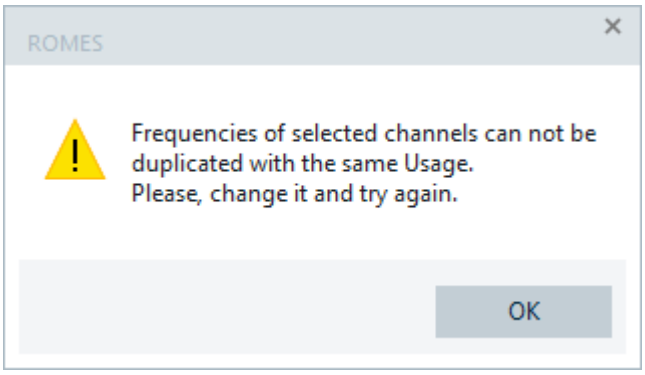


Figure 6-353: Same channel for CDMA and EVDO

The CDMA2000 and 1xEVDO measurements are allowed on the same channel.

The warning message for duplicated frequencies is shown:



Because of ambiguity of channel number and frequency combinations, the "R&S CDMA2000 1xEV-DO PNS [Device name]" > "Channel" table does not provide automatically frequency change when user changes channel number.

R&S ROMES4 CDMA2000 scanner driver allows the ATIM demodulation. If this PDU has been demodulated, it is shown in the "CDMA2000/1xEv-DO Scanner BCH View".

Scanner Configuration - Channels pane
The "Channels" pane displays configured CDMA2000/EV-DO channels for PN scanning.

All channels visible in the pane's table are measured. You can modify the channels' configuration by clicking the selected channel line. Drivers support all Spreading Rate 1 (SR 1) band classes 0 to 21 specified in standard 3GPP2 C.S0002. It is possible to select frequencies of the nominal CDMA downlink bands.

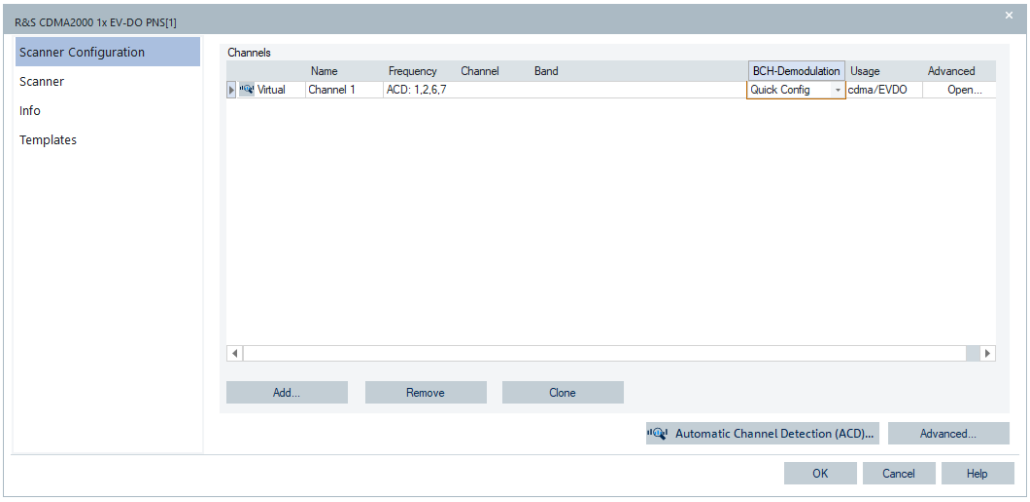


Figure 6-354: Virtual channel option - ACD selected

The CDMA2000 1xEV-DO PNS scanner of R&S TSME supports the ACD with virtual channels. This feature allows the scanner without any knowledge about used channels to use. Only the 3GPP2 bands on which channels are supposed to be located have to be entered. This support is known from the spectrum allocation plan by the regulator. The CDMA2000 1xEV-DO PNS scanner of the R&S TSME automatically detects channels in this case.

By default, the ACD searches the 3GPP2 Band 1. If a CDMA/EVDO channel was detected, the settings concerning demodulation, measurement rates and advanced settings of the virtual channel is applied to the detected channel.

For the ACD configuration, see "Automatic channel detection (ACD)" on page 1814.

The following columns and buttons are the entries of this pane.

Name ← Scanner Configuration - Channels pane
An arbitrary, optional identification string for the selected frequency.

Frequency ← Scanner Configuration - Channels pane
The frequency calculated according to the selected "Band" and "Channel" values. "Out of Band!" indicates that the frequency entered is an off-band frequency.

Channel ← Scanner Configuration - Channels pane
A channel number within the selected band. If an undefined channel number is specified, the frequency becomes invalid.

Band ← Scanner Configuration - Channels pane
Selection of the SR 1 band class (0 to 21) with selected band.

Note: BC 20 and 21 is only for satellite reception.

For an overview of all CDMA2000 band classes, refer to the appendix Chapter 12.10, "CDMA2000 band classes", on page 2411.

BCH Demodulation ← Scanner Configuration - Channels pane
Shows the BCH messages available for demodulation from Broadcast Channel (BCH). The selection or modification of already selected messages for demodulation is done in "BCH-Demodul" column. Click the "BCH-Demodulation" combo-box to get the complete range of available messages.

The content of the BCH-Demodulation messages column depends on the selected value in the "Usage" column.

The "BCH Demodulation" > "Quick Config" option contains all messages for both CDMA2000 and EVDO channels.

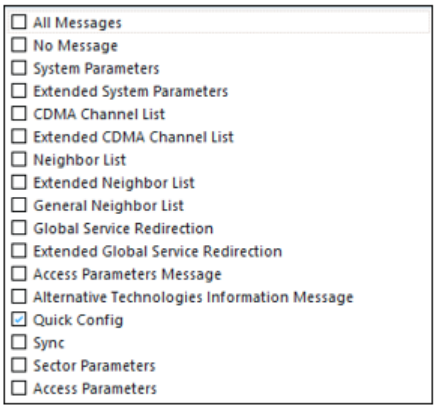


Figure 6-355: BCH-Demodulation combo box contents

The Quick Config message for EVDO is checked by default so that the detected EVDO channels are displayed in the "BCH View" automatically.

Usage ← Scanner Configuration - Channels pane
Displays the type of activated channel.

The "EVDO" value in the column indicates activated EVDO channels. This activation disables the "PN Offset Configuration" block in the "Advanced Channel Settings", as not needed for EVDO, see Figure 6-356.

If the ACD option is activated, both CDMA2000 and EVDO channels are displayed.

Note: Activation of the "Usage EV-DO Channel" defines channels as EVDO channels. The deactivated option disables the PN Offset Configuration block which is not needed for EVDO in "Advanced Channel Settings", see Figure 6-356.
To configure a 1xEVDO channel, in the column "Usage" EVDO has to be selected.

Advanced ← Scanner Configuration - Channels pane
Click the "Open" combo-box in the "Advanced" column to open the "Advanced channel settings" dialog.

There are two different "Advanced channel settings" dialogs dependent on channel usage.

- CDMA
- EVDO

If CDMA channel is used, the dialog offers the advanced channel settings and dynamic PDU settings. To do these settings, the corresponding tabs are present in the dialog.

The advanced channel settings provide the PN Offset Mask, see "Advanced Channel Settings" on page 1812.

The dynamic PDU settings provide dynamic handling of the PDUs, see "Dynamic PDU Settings" on page 1813.

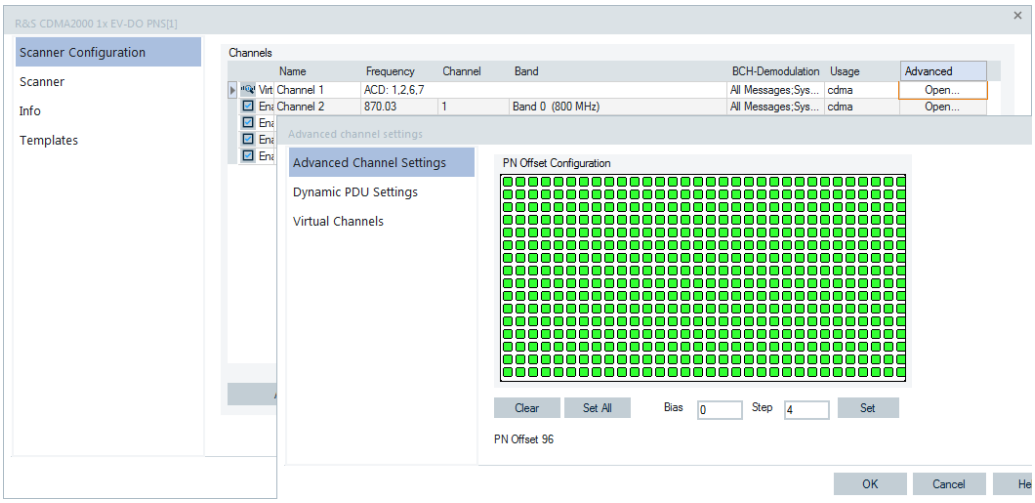


Figure 6-356: Advanced channel settings dialog - CDMA channel usage

As for EVDO channels, only the dynamic PDU settings are possible, that means, only the "Dynamic PDU Settings" tab is present.

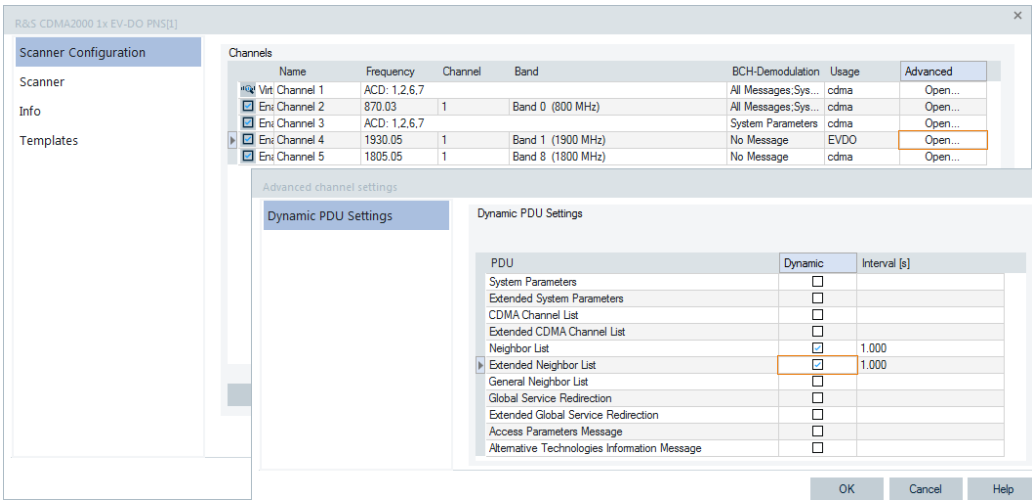


Figure 6-357: Advanced channel settings dialog - EVDO channel usage

Buttons ← Scanner Configuration - Channels pane

- "Add"
  Opens a dialog for adding a new channel to the table of channels.
- "Remove"
  Removes a selected channel from the list.
- "Clone"
  Makes a copy of all highlighted channels, automatically sets the “checked” status for it and assigns name by adding the word “copy” to the original channel name.
  Note: The "Remove" and "Clone" buttons are available only if at least one channel in the table is highlighted.
- "Automatic Channel Detection (ACD)"
  The button opens the page where you can set the parameters for ACD and select the bands you want to be scanned, see "Automatic channel detection (ACD)" on page 1814.
- "Advanced"
  Click the "Advanced" button to open the "Advanced settings" dialog.
  The dialog lets you further open the "CDMA Measurements", "EVDO Measurements" and "BCH-Demodulator" pages by clicking the corresponding tab. These pages are related to common, the scanner frequency-independent settings, see "Advanced settings" on page 1817.

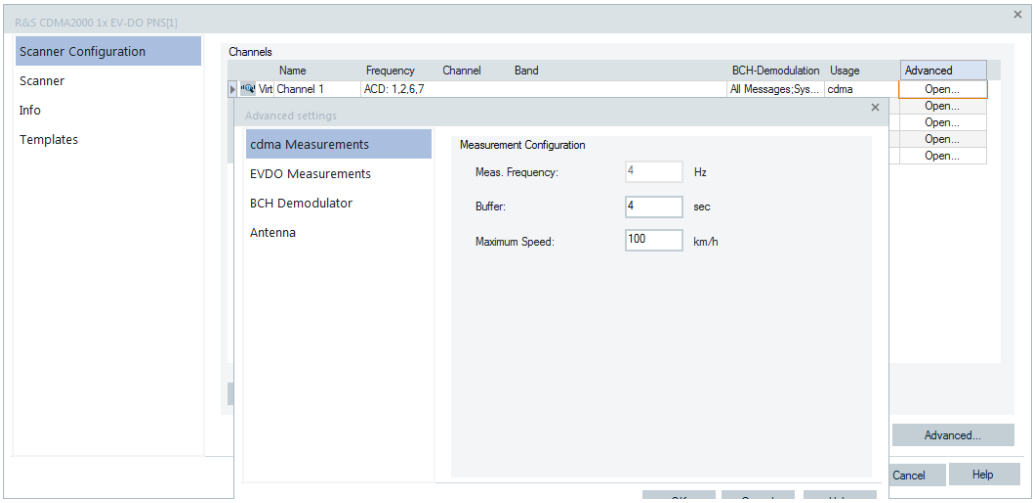


Figure 6-358: Advanced settings - Advanced button

Advanced Channel Settings

Click the "Advanced Channel Settings" tab to get the "PN Offset Configuration" pane.

Different CDMA cells and cell sectors use the same short code, but different code's phases, which is how the mobile differentiates them from each other. The phase is known as the PN Offset and defines the offset of the PN sequence. Changing the PN offset changes the timing of the pilot channel, the timing and contents of the sync channel message and the long code mask of the paging channel.

Each square represents one unit of 64 PN chips. The squares can be selected either manually (clicking a square toggles its value) or defined by entering values into the "Bias" and "Step" entry fields. They are activated with the "Set" button.

- "PN Offset Configuration" table

Shows the selected value for the PN Offset as configured (range from 0 to +511).

- "Clear"
  Clears all unit squares in the PN Offset Configuration table.
- "Set All"
  Sets all unit squares in the "PN Offset Configuration" table.
- "Bias"
  The bias value sets the number of cleared unit squares at the beginning of the "PN Offset Configuration" table. The change becomes active after "Set" is clicked.
- "Step"
  The step value defines the interval of the set unit squares as a sequence. The change becomes active after "Set" is clicked.
- "Set"
  Activates the defined settings for "Bias" and "Step".

Note: The Bias=0 / Step=4 settings are shown only if the "Set" button is pressed.

Example:

An example for a setup with a Bias=0 and a Step=4, resulting in a "PN Offset 21", is shown in the following figure.

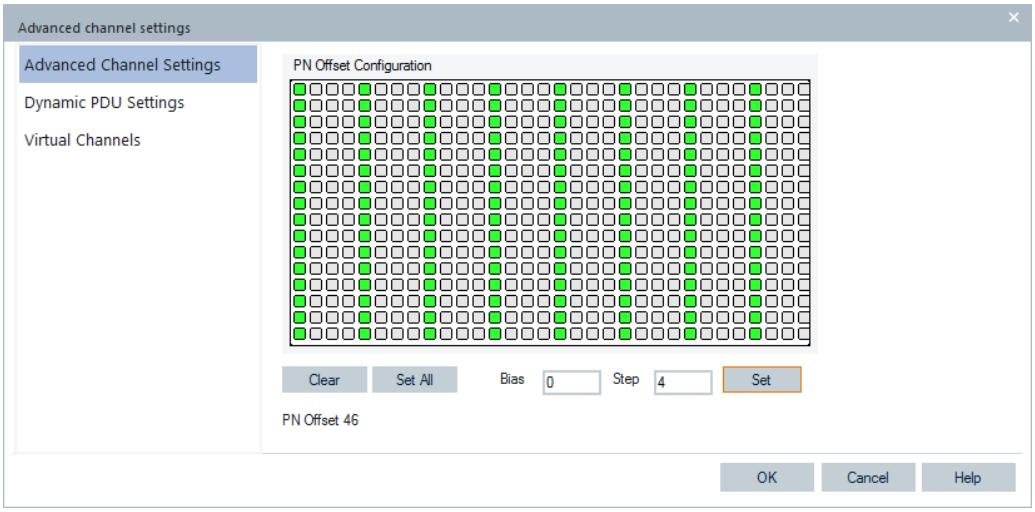


Figure 6-359: PN Offset configuration - example

Dynamic PDU Settings

As the broadcast messages demodulated by the scanner vary over time, the demodulation and visualization of them is made dynamical. PDUs, like system parameters, are configured for measurement with a repetition interval to record their changes over time. The "cdma2000 1x EV-DO Scanner BCH View" displays the sets of cdma2000/1x EV-DO PDU variants, see Chapter 4.8.4.2, "CDMA2000/1xEV-DO scanner BCH view", on page 1168.

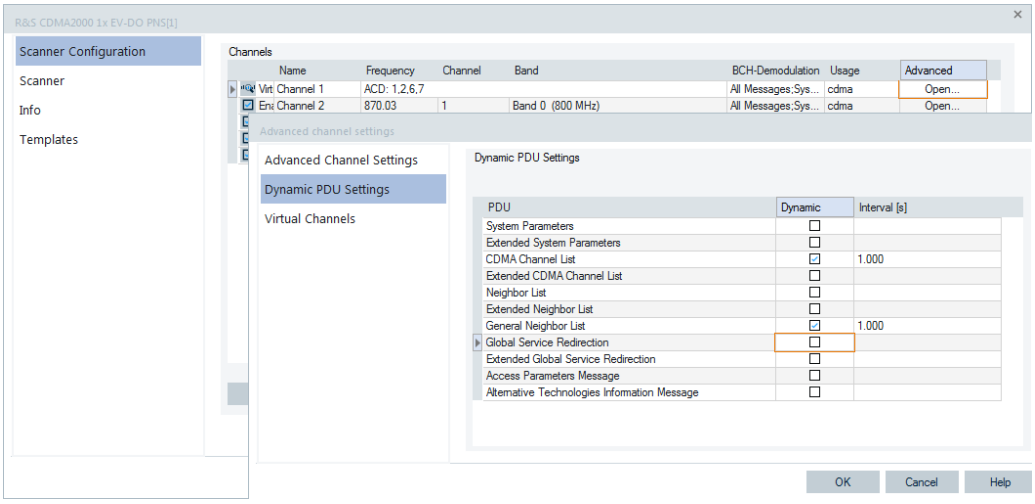


Figure 6-360: Dynamic PDU Settings dialog - CDMA channel

This window enables dynamic PDUs to configure, refer to "Implementation of the dynamic PDU handling" on page 284.

All the PDUs of the selected channel which can be requested for measurement are shown in a list, see figure Figure 6-360.

If the "Dynamic" check box is ticked, the PDU is measured with the repetition interval specified in "Interval".

Click "OK" to add the settings to the selected channel and return to the "R&S CDMA2000/1x EV-DO PNS" configuration dialog.

Click "Cancel" to discard made changes and return to the "cdma2000/1x EV-DO PNS Configuration" dialog.

Click "Previous" or "Next" to go through the list.

The default value for interval is 1 second. The possible range depends on the scanner driver for the technology and is checked, see Dynamic PDU Settings.

Virtual Channels

You can activate scanning of a specific channel, deactivate channel scanning or allow the scanner to follow other device by choosing the "Virtual Channel" option. The option dynamically configures the scanner instead of entering a certain channel value for scanning if primary R&S ROMES4 driver is selected.

Specify a measurement device as a source of the channels to be scanned instead of specifying a specific channel. The source can be a test device or the R&S ROMES4 ACD functionality. Using a test device as a source, allows the scanner to follow the channels the test device is using.

Note: For each network mode (cdma2000/1xEVDO), a separate virtual channel is necessary. If you want to scan CDMA2000 and 1xEVDO channels, two virtual channels have to be added. Configure one as CDMA2000, the other one as 1xEVDO channel.

Automatic channel detection (ACD)

The R&S ROMES4 ACD function uses the C2K/EVDO channel finder, like for other RATs. The finder is a component which scans and finds channels fast for ACD.

To adapt the default ACD configuration press the "Automatic Channel Detection (ACD)" button in the "CDMA2000 1xEV-DO PNS" configuration page, see Figure 6-352.

The opened page lets you set the ADC parameters.

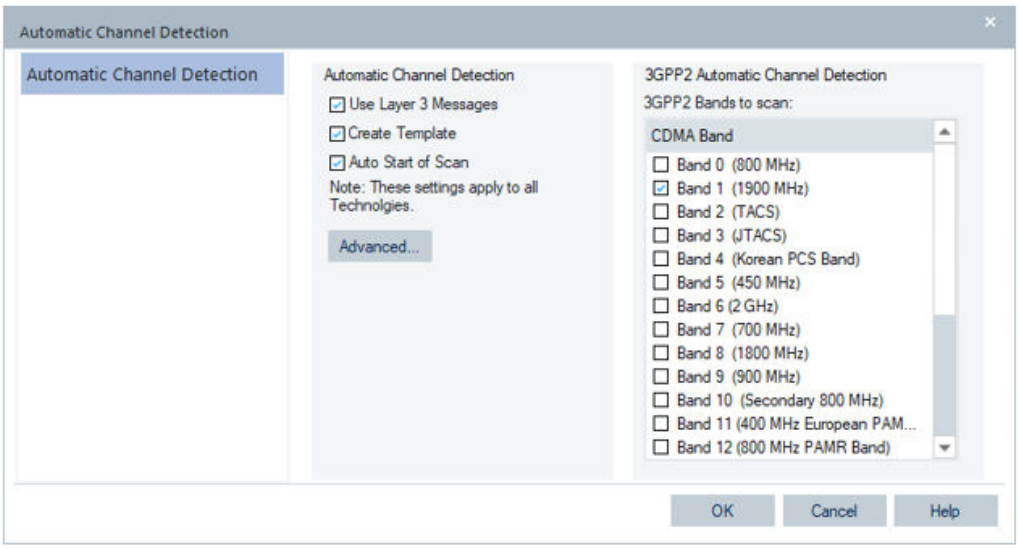


Figure 6-361: CDMA 1xEV-DO - automatic channel detection page

The "Automatic Channel Detection" pane holds the parameters which apply to all RAT. The CDMA2000 1xEV-DO specific parameters are located in the "3GPP2 Automatic Channel Detection" pane.

Click the corresponding check-box in the "Automatic Channel Detection" pane to enable or disable the following functions:

- "Use Layer 3 Messages"
  If selected, R&S ROMES4 reads out all neighbor lists of detected transmitters and adds the detected neighbor cells' channels automatically to the system.
- "Create Templates"
  If selected, R&S ROMES4 creates a template for the CDMA2000 1xEV-DO PN scanner which includes all detected channels at the end of the measurement. The name of the template is the name of the measurement file.
- "Auto Start of Scan"
  The automatic scan approach has sense during a drive test but is not what is needed during a monitoring use case. The monitoring use case aims to measure only actual “on air” transmitters.

The above settings are stored in a service that serves all technologies.

2. Click the "Advanced" button to set the measurement rates in the displayed dialog which is common for different technologies.

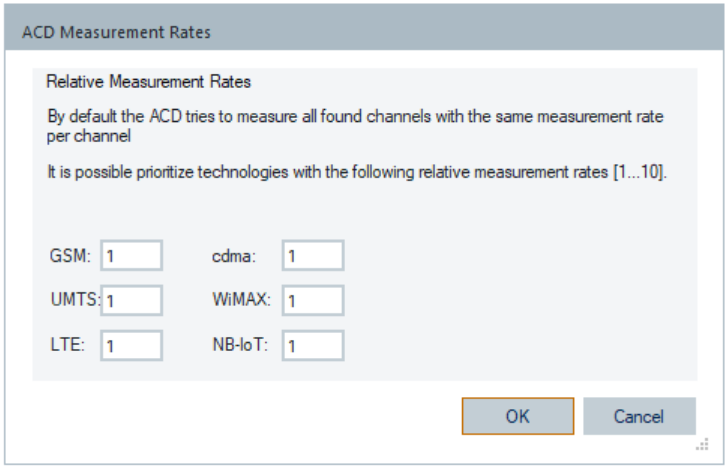


Figure 6-362: Default settings of ACD measurement rates

3. Now choose the bands from "3GPP2 Automatic Channel Detection" > "CDMA Band", by clicking the corresponding check-boxes.

Clear the check-box to deselect bands. If all check-boxes are cleared, the ACD channel is removed when changes are accepted.

4. Click "OK" to accept settings.

The screenshot Figure 6-354 shows an ACD configuration with four selected bands.

The selected bands are shown in the "Channels" > "Frequency" column. The "Usage" column shows "cdma/EVDO" and the "Name" column indicates virtual channel 1.

The main use case of the ACD is to let users start measuring anywhere without any knowledge of the used channels within the known 3GPP2 bands.

Typically, users initiate a measurement with the ACD and for the best measurement rates use the resulting template as starting point for the actual measurements.

Existing CDMA2000 1xEV-DO workspaces and templates

The CDMA2000 1xEV-DO PNS workspaces of former releases can exist with multiple virtual channels. Those channels share the selected bands, but can have different "Usage": CDMA2000 or 1x EVDO channel type.

The virtual channel is shown as "cdma/EVDO" in "Usage" column if you open an existing old workspace or template which has only one virtual channel.

If the existing old workspace or template has multiple virtual channels, a warning message is displayed.

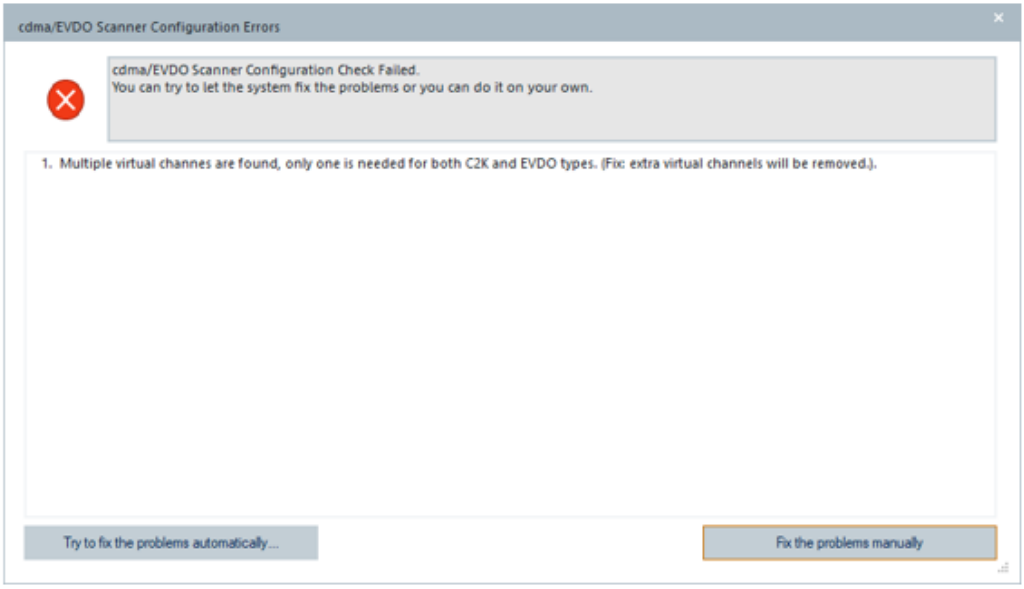
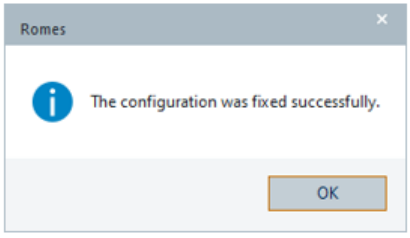


Figure 6-363: Warning message for existing multiple virtual channels

If you press the "Try to fix the problems automatically" button, the system fixes the problem and you get the information about it.



The problem fixing is done in a way that two original channels are merged into one virtual channel having the same selected band and are shown as cdma/EVDO in the "Usage" column.

Advanced settings

The "Advances settings" page opens when you click the "Advanced" button. The page lets you configure the CDMA2000 and 1xEVDO measurements as well as the BCH demodulator and antenna parameters.

CDMA measurements

"cdma Measurements" lets you define general measurement settings for the R&S CDMA2000 1xEVDO PNS.

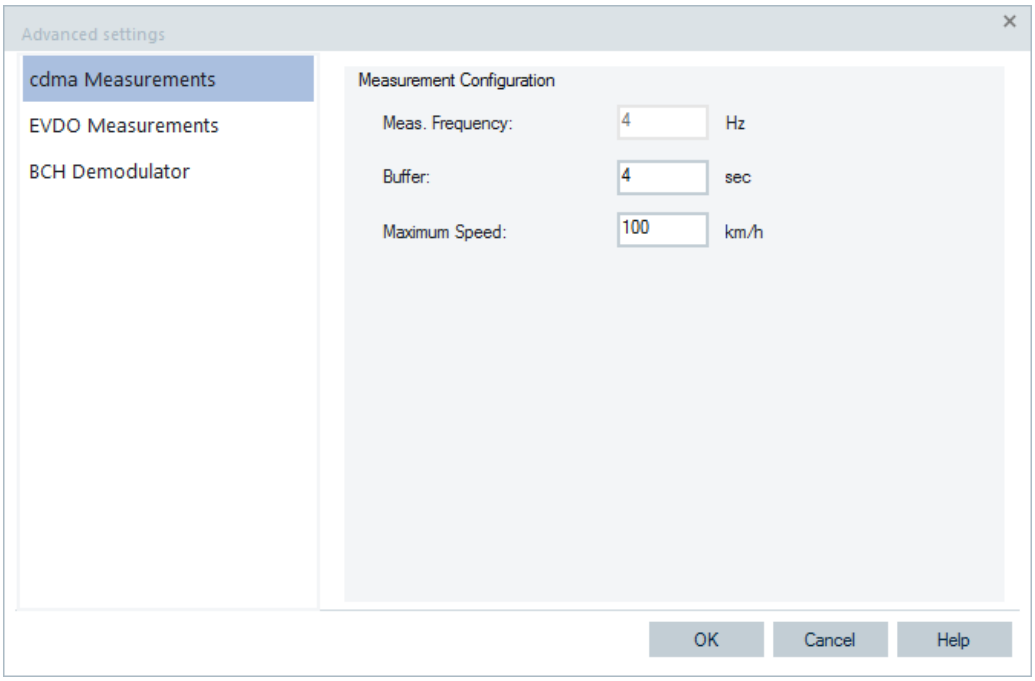


Figure 6-364: CDMA PNS configuration – measurements tab of R&S TSME drivers

Measurement Configuration
The settings in the "Measurement Configuration" pane define how R&S ROMES4 processes the baseband (I/Q) data for a CDMA PN scan.

Meas. Frequency ← Measurement Configuration
Defines the CDMA measurement frequency in Hz. The maximum scan rate for CDMA2000 is 80 Hz.

It is possible to set different measurement frequency for CDMA2000 1xRTT and 1xEVDO.

Tip: To see statistical information on the CDMA2000 1xRTT measurement frequency, select the following signals from the signal tree in the "Value" configuration tab of a view (e.g. "Statistic View").

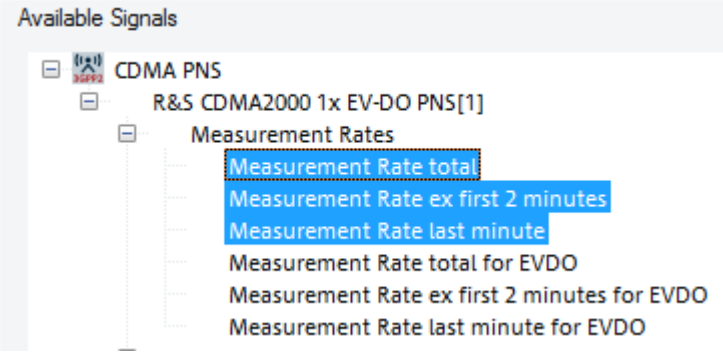


Figure 6-365: CDMA PNS signals

Buffer ← Measurement Configuration
Time for which the raw measurement data is stored in the R&S TSME as R&S ROMES4 is unable to process it immediately. The reason can be, for example, temporary low performance of the controller. If the R&S ROMES4 buffer remains blocked after the buffer size time, the oldest data in the buffer is deleted and overwritten by new data. Data transfer starts when R&S ROMES4 is ready again to receive and process data.

A large buffer size increases the probability that no measurement data is lost, even though R&S ROMES4 can be blocked for an extended time. However, storage and transfer of large amounts of buffer data increase the possible delay between data recording and evaluation/display in the views.

Maximum Speed ← Measurement Configuration
The value for the maximum speed of the measurement vehicle is used for improved evaluation of fading channel measurements. The range is between 0 km/h and 300 km/h, otherwise an error message is displayed.

EVDO measurements

The "EVDO Meas. Configuration" page defines the parameters about frequencies and measurement in a CDMA PN scan. The configured options are also shown in the enhanced measurement file header.

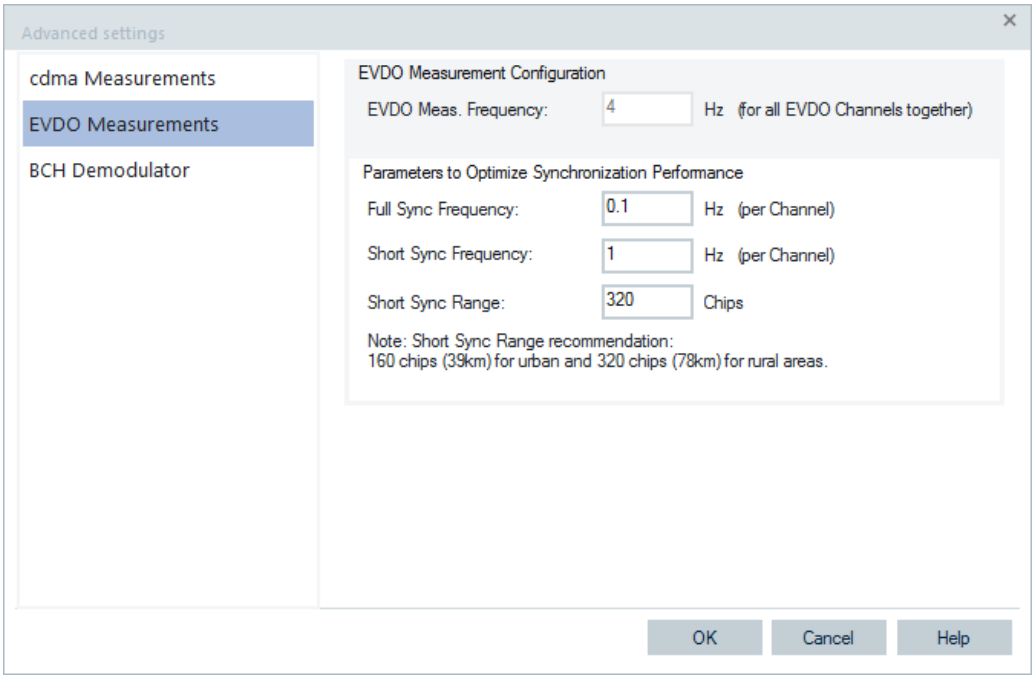


Figure 6-366: CDMA PNS configuration – EVDO measurement configuration

EVDO meas. frequency

Defines the EVDO measurement frequency in Hz. The maximum scan rate for EVDO is 30 Hz, while for CDMA the maximum is 80 Hz.

It is possible to set different measurement frequency for CDMA2000 1xRTT and 1xEVDO.

Tip:

To see statistical information for the 1xEVDO measurement frequency select the following signals from the signal tree in the "Value" configuration tab of a view (e.g. "Statistic View":

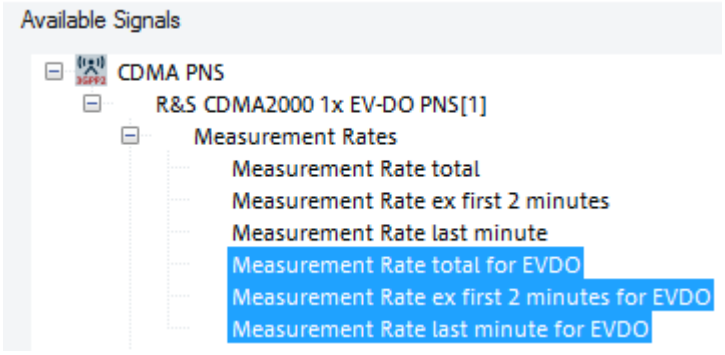
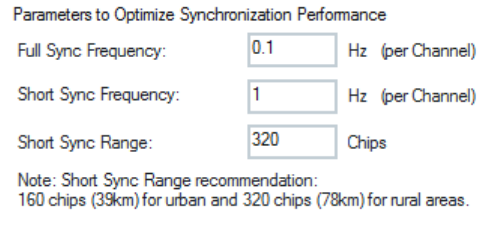


Figure 6-367: 1xEVDO PNS signals

Parameters to optimize synchronization performance

The following parameters allow the synchronize process fine-tuning.



- "Full Sync Frequency"
  Full synchronize frequency from 0.1 Hz to 1 Hz.
- "Short Sync Frequency"
  Short synchronize frequency from 1.0 Hz to 10 Hz.
- "Short Sync Range"
  Short synchronize range from 160 chips to 1024 chips.

BCH demodulator configuration

Click the "BCH Demodulator" tab of the "R&S CDMA2000 1xEV-DO PNS [Device name"] > "Advanced settings" page to set the frequency-independent Ec/Io threshold parameter for the BCH demodulation.

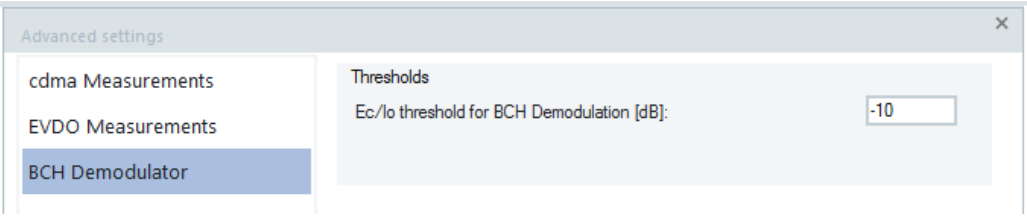


Figure 6-368: CDMA2000 - BCH Demodulator configuration

The "BCH Demodulator" page offers to set the requested minimum BCH signal quality for demodulation in the "Ec/Io threshold for BCH Demodulation" box.

Only scanner peaks with an Ec/Io of at least this threshold value starts BCH demodulation and decoding.

The demodulation threshold is displayed in the available list of decoded messages, as shown in the following figure.

The Ec/Io threshold is not a hard limit. It uses a probability function to determine the likelihood of a successful decode based on the received signal strength from the scanner.

CDMA2000 1xEVDO PNS scanner

The "Scanner" tab opens the page which displays the properties of the R&S TSME device and information on the file version of the R&S CDMA2000 1xEV_DO PNS driver.

CDMA2000 1xEVDO PNS templates

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

If a device is loaded via the "Hardware" > "Connect/Disconnect" command, R&S ROMES4 checks whether a driver template is stored in the Driver Templates directory and its subdirectories. The driver can be loaded with default settings or with the settings stored in any of the templates found.

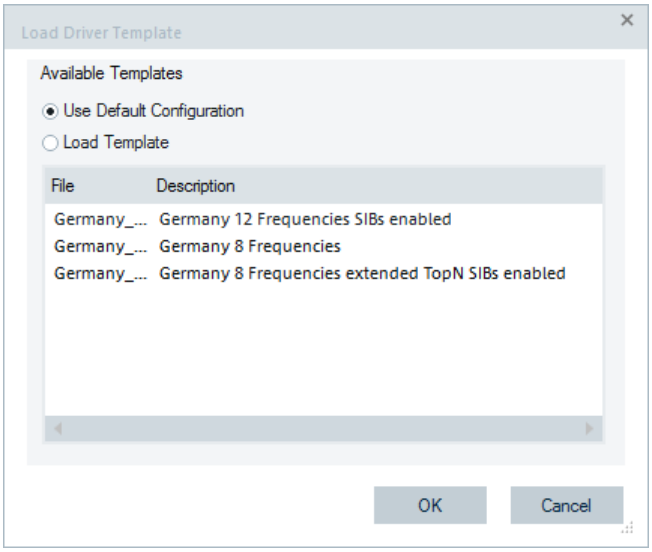


Figure 6-369: Selecting template

CDMA2000 1xEV-DO PNS information

The "Info" tab displays information on the file version of the R&S CDMA2000 1xEV-DO driver. It is identical for both CDMA2000 1xEV-DO drivers.

6.4.21 RF power scanner

The RF Power Scanner driver controls the R&S TSME scanner device. The hardware option used with the device is the R&S TSME-K27 option. The driver is available with the option R&S ROMES4T1E for R&S TSME.

The RF Power Scanner driver for R&S TSME can be used with multiple scanner devices. In this way, the RF Power Scanner driver measures and visualizes data from all devices simultaneously.

The support of multiple scanner devices requires:

- N* option ID for the RF Power Scanner
- R&S TSME with the R&S K27/K127 option

RF Power Scanner with R&S TSME is not limited. Multiple R&S TSMEs with the R&S K27/K127 option are combined to an array and loaded as one driver instance with N frontends. AE array with N devices needs one option ID, not N option IDs.

The Measurement File Info names and shows the RF frontend used in a certain sweep.

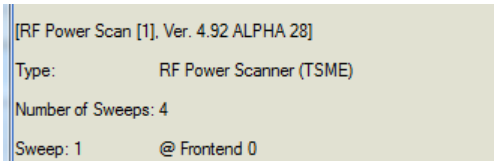


Figure 6-370: Frontend 0 used for sweep 1

The Chapter 6.1, "Devices", on page 1447 describes the drivers installation.

The following chapter describes the RF Power Scanner device configuration.

You can see the RF Power Scanner measurement data in the "RF Power Scanner Views", see Chapter 4.8.9, "RF power scanner views", on page 1319.

6.4.21.1 R&S TSME RF power scanner performances

The performances of R&S TSME RF Power Scanner are listed in the following table.

R&S TSME performances	
Supported Frontends	1
Count of Sweeps	1 – 20
Spectrum analyzer-type	FFT
Frequency Range	350 MHz – 4.4 GHz
Adjustable Frequency Resolution	yes Adjustable via FFT and sample rate (bandwidth)
Adjustable Bandwidth	1 MHz – 20 MHz
Adjustable Sample Rate	1.15 times the bandwidth => 1.15 MHz – 23 MHz

R&S TSME performances	
FFT Size	16 / 32 / 64 / 128 / 256 / 512 / 1024 / 2048 / 4096 / 8192
Window Type	Rectangle, Hann, Hamming, Blackman, Flat Top
Attenuation and Preamplifier	Automatic mode only
Adjustable Frequency Detector	Max, RMS, Auto
Adjustable Time Detector	yes Max, RMS, Auto, Min
Threshold	yes
Channel Filter (GSM, UMTS, LTE 5 MHz, LTE 10 MHz predefined)	yes
Configuration of own Channel Filters via XML-file	yes
Adjustable Sweep Rate	yes
Adjustable R&S ROMES4 Update Rate	Update rate of the views and the signals
R&S ROMES4 Signals	Marker (4x Fixed, Free, Current Peak), Sweep Rate, All Channels
Envelope	yes
Jump-To-Next-Measurement-Point	The fixed marker jumps automatically to the measurement value or channel center frequency next to the clicked frequency value
Enhanced Graphical User Interface	yes

6.4.21.2 Loading RF power scanner

The R&S TSME devices can run as the RF Power Scanner devices if loaded with the R&S ROMES4 RF Power Scanner driver.

Click the "Hardware" > "Connect/Disconnect" menu entry. The "Hardware Configuration" page pops-up.

To load the driver, double_click the "Network Scanner TSME" > "TSME RF Power Scanner" branch in the "Hardware Configuration" > "Available Devices" pane, see Figure 6-40.

The device is loaded and visible in the "Loaded Devices" pane of the page. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S RF Power Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

The device is now added as the "RS RF Power Scanner [<variable>]" command line to the "Hardware" menu.

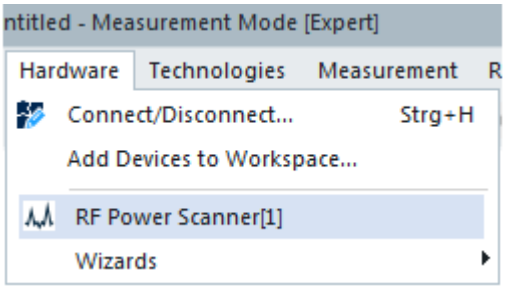


Figure 6-371: Accessing the RF Power Scanner driver configurations

The variable in the bracket is the scanner's name or a number indicating the number of connected devices.

Click the "RS RF Power Scanner [<variable >]" command line to open the "R&S RF Power Scanner" configuration page.

The dialogs of a device chooser open when the R&S TSME driver is loaded. The device chooser dialog is used to select the test device and define the essential connection parameters, if necessary.

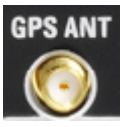
For details about the loader's dialog, see Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

The "R&S <variable>: Select Device" dialog is used to share the test device resources between all loaded R&S TSME hardware drivers. Furthermore, over the dialog the IP address of a device can be selected, if necessary.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

6.4.21.3 Configuration menu RF power scanner

R&S ROMES4 provides a configuration page for the RF Power Scanner if selecting the "Hardware" > "R&S RF Power Scanner [<variable>]" command line in the "Hardware" menu. The command line is available after loading the driver.

The R&S ROMES4 "RF PowerScan" opening configuration page shows the existing sweeps or lets you add some. Other available tabs let you define the scanner parameters, get the information on the test receiver driver and create template of current settings.

6.4.21.4 R&S TSME RF power scanner configuration

Click the "RF PowerScan" tab of the R&S TSME to get the page which shows the existing sweeps for the R&S ROMES4 RF Power Scanner. The spectrum analysis settings are made in this page.

The "Add"/"Edit" buttons open the "Basic" configuration dialog with five tabs where a new sweep can be configured or the existing one edited.

The drivers support between 1 and 20 impartially definable sweeps.

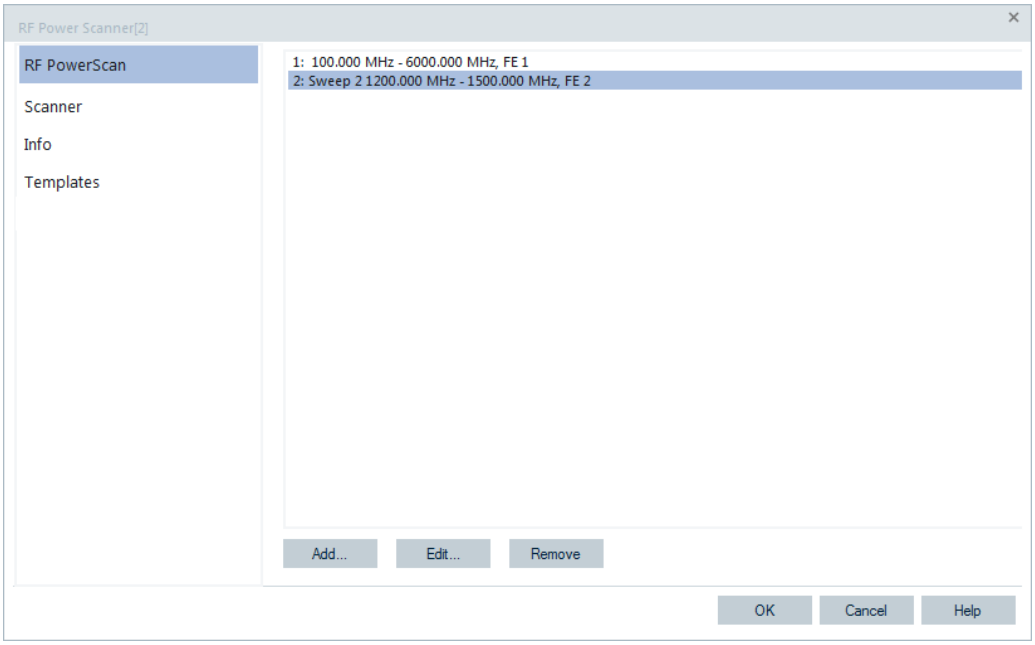


Figure 6-372: R&S RF Power Scanner – measurements

Basic settings

In the "Basic" > "Basic Settings" tab select the sweep rate, range and minimum and maximum power.

The sweep buffer defines the internal holdback time of the RF Power Scanner driver's measurement buffer. The value is automatically set to the "Time Range" value of the time detector, see "Detector settings" on page 1829. This value guarantees that the sweep buffer is large enough.

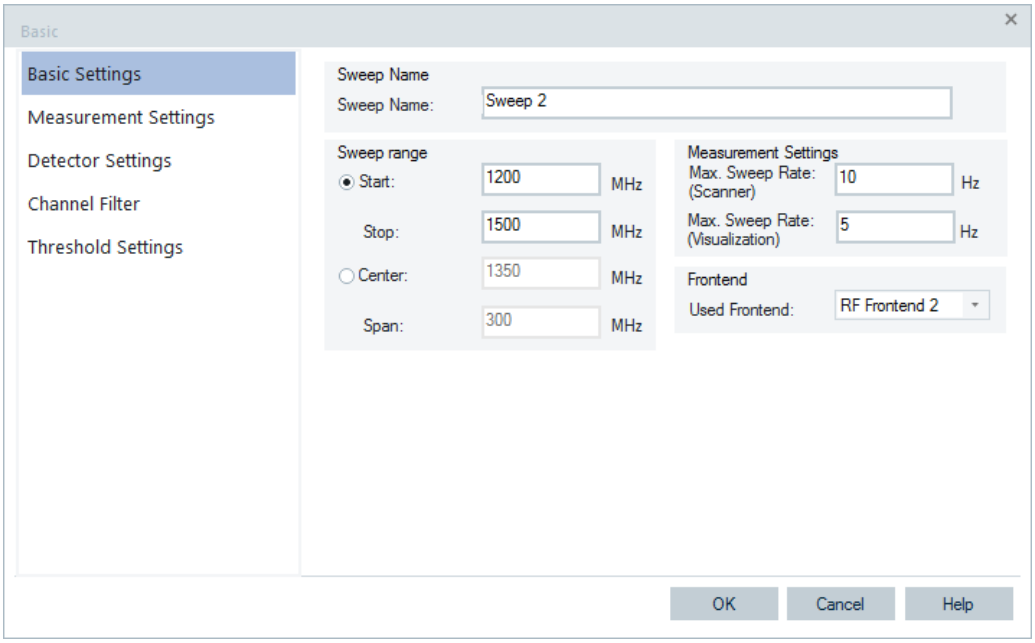


Figure 6-373: RF Power Scanner configuration – basic settings

Sweep Name
Enter an individual name as a kind of description.

Max. Sweep Rate (Visualization)
Maximum update rate of the R&S ROMES4 Views.

Sweep Range
The "Sweep range" can be adjusted alternatively by "Start"- and "Stop"-frequency or by "Center"-frequency and "Span". The values are specified in MHz. If active "Channel Filter", the sweep range is automatically calculated.

The R&S TSME scanner supports the sweep range from 350 MHz to 4400 MHz.

Frontend
Selects the R&S TSME frontend for the sweep.

Measurement settings

The "Measurement Settings" tab selects the sweep rate, range and minimum and maximum power in case the R&S TSME is used as RF Power Scanner.

Here you set the scanned bandwidth, attenuation, FFT settings and measurement time.

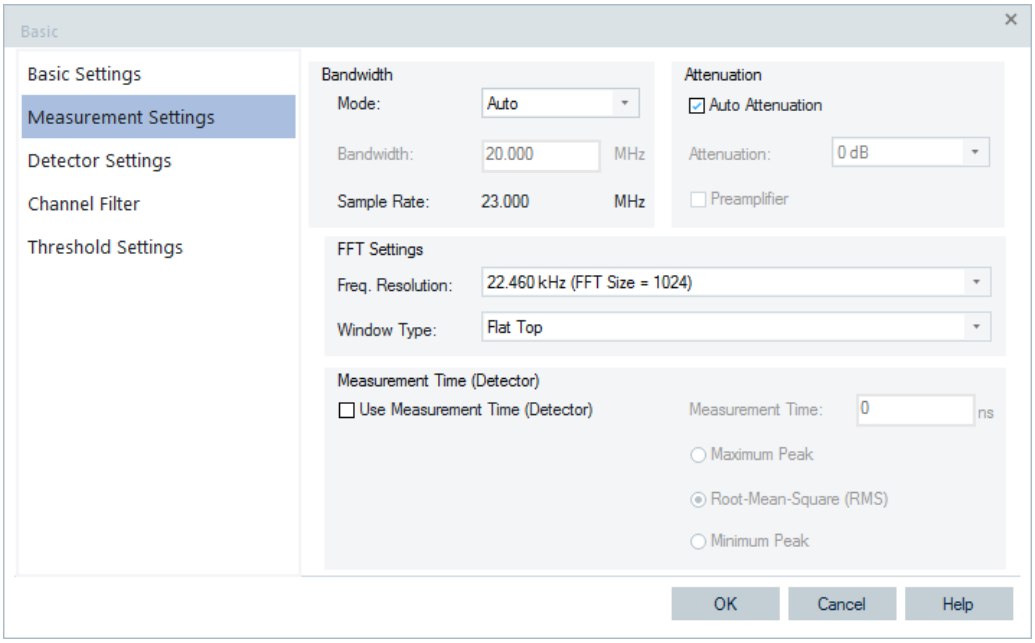


Figure 6-374: RF Power Scanner configuration – measurement settings

Bandwidth

There are three possibilities to set the bandwidth:

- **Activate Auto Bandwidth**
  If "Auto" is set, the bandwidth is 20 MHz. In this case, the center frequencies of the requested measurement jobs are set by a static 20 MHz-grid [30 MHz, 50 MHz, 70 MHz, and so on]. The setting is independent from the frequency range.
- **De-activate Auto Bandwidth**
  If "Auto Attenuation" is inactive, the bandwidth can be set manually in a range of 1 MHz ≤ BW ≤ 20 MHz. In this case, the measurement does not use a frequency-grid.
  Configure the sample rate. It is always 1.15-times the bandwidth.
- **Clear Spectrum**
  This mode is designed especially for measurements on potential clear spectra. The bandwidth is fixed to 2073 MHz (6.66 MHz). Two blocks are measured at once. The center frequency part of the bandwidth is not used so that the spectrum is free of DC-Gap/Carrier.

Attenuation

There are two possibilities to set the attenuation and pre-amplifier.

- **Activate Auto-Attenuation**
  Set "Auto Attenuation" to active first. In this case, the R&S TSME controls the attenuation and pre-amplifier itself.
- **De-activate Auto-Attenuation**
  The other possibility is to set "Auto Attenuation" to inactive. In this case, you have to set the attenuation and the pre-amplifier on your own.

FFT Settings
By the Fast-Fourier-Transformation (FFT) size and the sample rate, it is possible to adjust the frequency resolution of the spectrum.

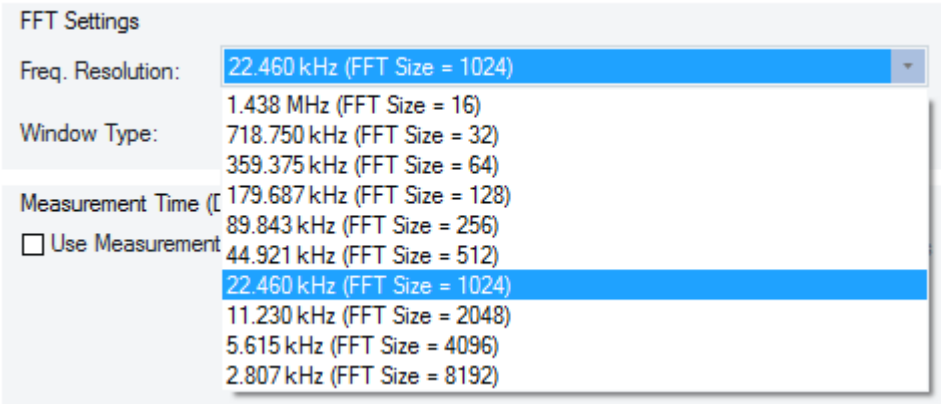


Figure 6-375: FFT settings

A continuous signal is processed in blocks. Because the lengths of the blocks are finite and the blocks usually are not a multiple of the signal period, a leakage effect is obtained. By using an adequate window function, the effect can be reduced.

Measurement Time (Detector)
Measures time-dependent signals. If "Use Measurement Time" is activated, each internal measurement block (=bandwidth) is measured for the time duration. It is adjusted with the "Measurement Time" parameter. The measurement time has a range between the measurement time for the FFT (=*FFTSize/SampleRate*) and 100 ms.

To compress the accumulated measurement values from the different FFTs, a separated detector is used. It guarantees the adjusted frequency resolution and measurement duration.

There are three possibilities to detect the frequencies:
- "Maximum Peak" - maximum value of all the dedicated samples.
- "Root-Mean-Square (RMS)" - effective value of all the dedicated samples.
- "Minimum Peak"- minimum value of all the dedicated samples.

Detector settings

The "Detector Settings" page lets you set the time and frequency detector properties of the R&S TSME devices.

The frequency detector cannot be used in combination with an active channel filter.

If more results (count of lines) are requested, they are obtained from the FFT results, independently of the detector type. The results are interpolated via Bresenham algorithm.

The following detector settings are possible for the R&S TSME.

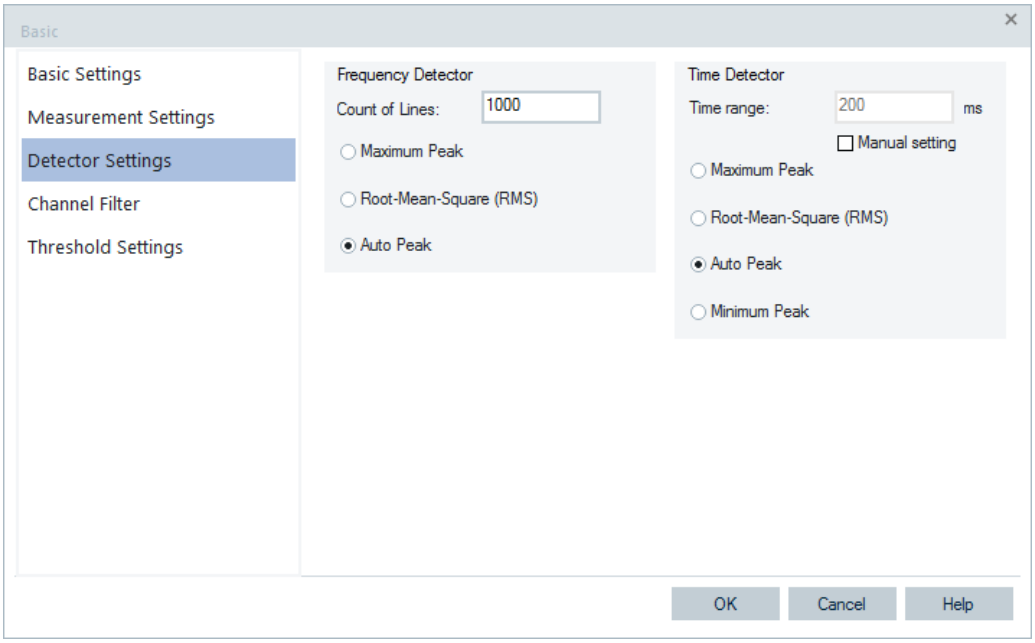


Figure 6-376: RF Power Scanner configuration – detector settings

Frequency Detector

- "Count of Lines"
  Specifies the resolution of the virtual window in the frequency domain. The maximum number of lines is defined by the scanners native resolution of 12.8 kHz.
- "Maximum Peak"
  Maximum sample value out of all dedicated ones.
- "Root Mean Square (RMS)"
  Effective value of all dedicated samples.
- "Auto Peak"
  Minimum and maximum sample value out of all dedicated ones.

Time Detector

A time detector works in a similar way to the frequency detector. It processes samples at the same frequency in a group of measurements within a time interval. The time detector compresses the values obtained in time domain like the frequency detector in frequency domain. The time detector can be used in combination with the frequency detector and in combination with the channel filter.

- "Time range"
  By default is computed from the "Max Sweep Rate (Visualization)" in the "Basic Settings" of the driver. In the configuration shown in the previous figure the rate is set to 5 Hz so that the time range is 1/5 Hz=200 ms.
- "Manual setting"
  If checked, lets you edit the time range value manually. The current configuration is stored in the Workspace if the user saves it.
  All sweeps from the recent sweep, back to the sweeps with a smaller time distance than a time range, are used.

The sweep buffer size affects the time range. Therefore, the value is automatically set to the "Time range" value. This value guarantees that the sweep buffer is large enough.

- "Maximum Peak"
  Maximum sample value out of all dedicated samples.
- "Root Mean Square (RMS)"
  Effective value of all dedicated samples.
- "Auto Peak"
  Minimum and maximum sample value out of all dedicated samples.
- "Minimum Peak"
  Minimum sample value out of all dedicated samples.

Channel filter

The channel filter is used to assign the power inside a channel of a digital modulated signal. It equates hereby the modulation filter of the respective system. The boundary areas of the filter are apportioned by a less powerful weighting. The less powerful weighting leads to a more realistic reflection of the channel. The idea is based on a fact that the signals at the center of the flanking channel are more disturbed than the signals at the boundary. To prevent these disturbances, the matched filter condition is used.

The main application of channel filters is in mobile radio communication technologies, like TETRA and WCDMA, where the power of the main and flanking channels are affected.

The "Channel Filter" tab lets you create, edit or remove channel filter.

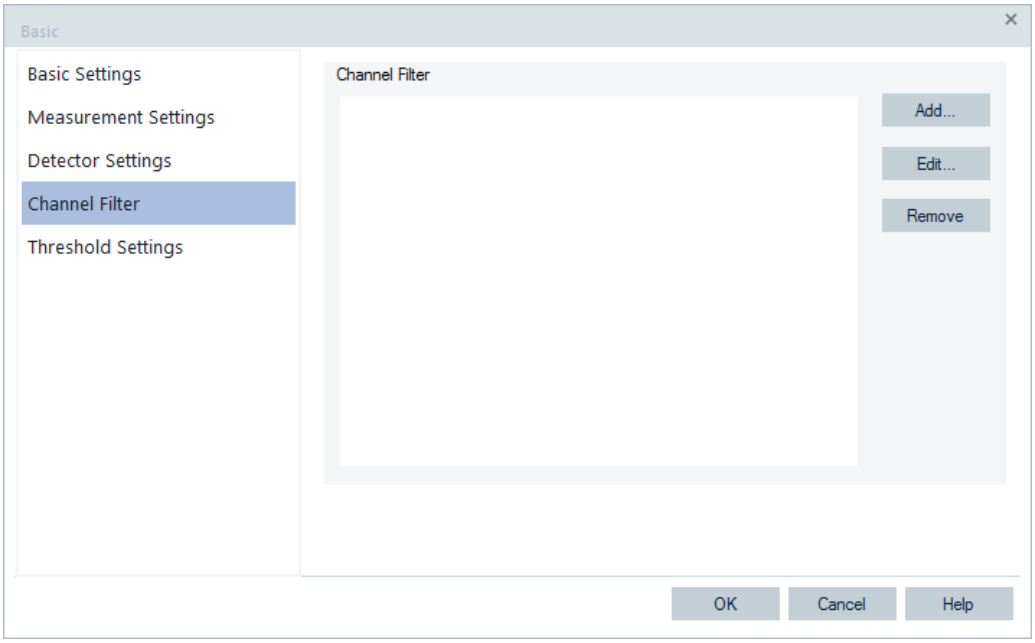


Figure 6-377: RF Power Scanner configuration – channel filter

Add
Opens the "Channel Filter" dialog to generate a new filter.

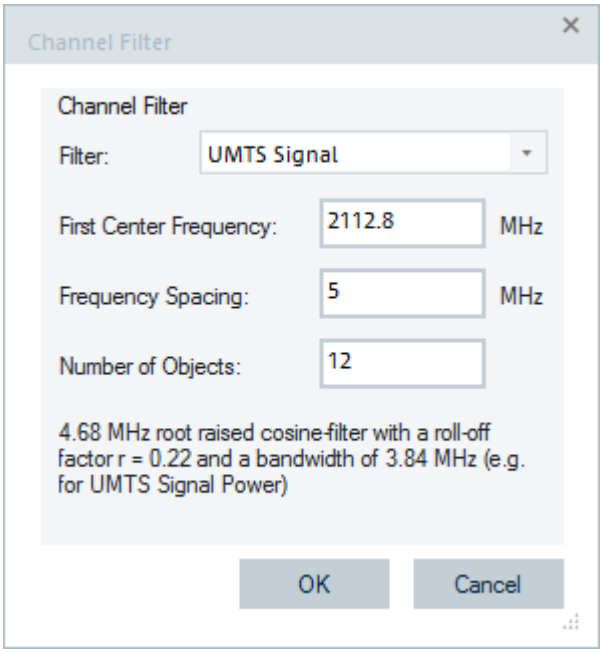


Figure 6-378: Channel filter

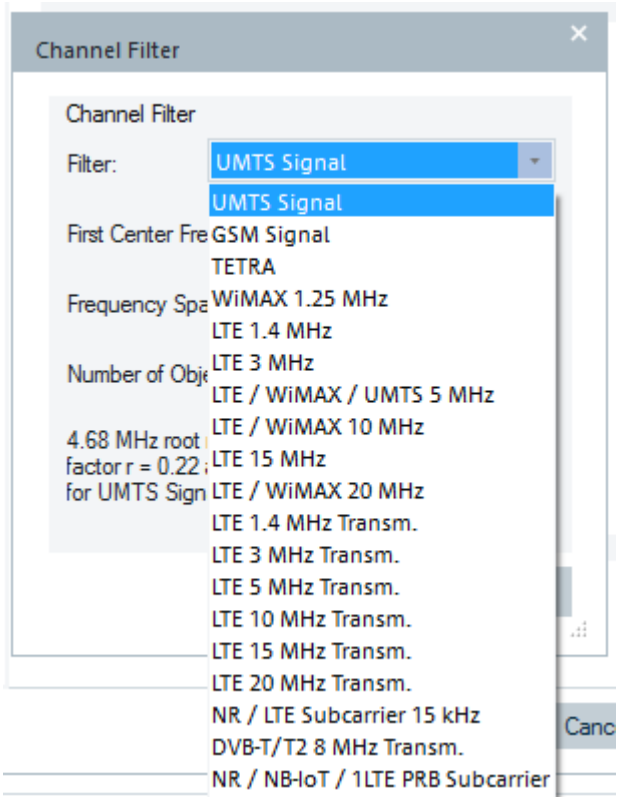


Figure 6-379: Channel Filter - select a filter

The following parameters are set in the "Channel Filter" panel:

- "Filter"

Multiple channel filters for TETRA, WiMAX and LTE are available.

- "First Center Frequency"
  Defines the first center frequency of the first channel in MHz.
- "Frequency Spacing"
  Distance between the center frequencies of two channels specified in MHz.
- "Number of Objects"
  Number of channels with the chosen filter type.

A tag in the `ChannelFilterDefinitions.xml` file describes the related channel filter.

```
<name>UMTS Signal</name>                    <!-- Channel Filter Name -->
<indicator>127</indicator>                  <!-- Channel Filter Indicator -->
<description>                               <!-- Channel Filter Description -->
  4.68 MHz root raised cosine-filter with a roll-off factor r = 0.22 and a bandwidth of 3.84 MHz (e.g. for UMTS Signal Power)
</description>
```

Figure 6-380: ChannelFilterDefinitions.xml file

The description marked in previous figure is displayed in the "Channel Filter" dialog of the RF Power Scanner driver.

XML-File

The channel filter definition describes the shape of the filter and is configured by an XML file, with the following parameters:

- **Name**
  Defines the name, which appears in the channel filter dialog of the driver.
- **Indicator**
  User-defined unique number for identification.
- **Freq-Spacing**
  Distance between filter values in Hz.
- **Weight**
  - **Value**
    Filter values vary in division of 0 and 1. It is assumed that filters are symmetrical. Only the values of one side of filter are needed.
  - **Repeat**
    Specifies, how often this value is repeated.

```
<!-- BEGIN: Channel Filter Definition for GSM -->
<channel-filter>
    <name>GSM</name>                                <!-- Channel Filter Name -->
    <indicator>255</indicator>                      <!-- Channel Filter Indicator -->
    <freq-spacing>10000</freq-spacing>              <!-- Frequency Spacing in Hz -->
    <weights>                                       <!-- Values -->
        <weight repeat="11" value="1.000"/>
        <weight repeat="1" value="0.988"/>
        <weight repeat="1" value="0.951"/>
        <weight repeat="1" value="0.891"/>
        <weight repeat="1" value="0.809"/>
        <weight repeat="1" value="0.707"/>
        <weight repeat="1" value="0.588"/>
        <weight repeat="1" value="0.454"/>
        <weight repeat="1" value="0.309"/>
        <weight repeat="1" value="0.156"/>
        <weight repeat="1" value="0.000"/>
    </weights>
    <default-sequence-values>
        <first-center value="935200000.0"/>         <!-- First Center Frequency in Hz -->
        <freq-spacing value="200000.0"/>            <!-- Frequency Spacing in Hz -->
        <number-objects value="1"/>                 <!-- Number of Objects -->
    </default-sequence-values>
</channel-filter>
<!-- END: Channel Filter Definition for GSM -->
```

Figure 6-381: Example for the GSM Channel Filter Configuration with XML

```
<!-- BEGIN: Channel Filter Definition for UMTS -->
<channel-filter>
    <name>UMTS</name>                               <!-- Channel Filter Name -->
    <indicator>127</indicator>                      <!-- Channel Filter Indicator -->
    <freq-spacing>20000</freq-spacing>              <!-- Frequency Spacing in Hz -->
    <weights>                                       <!-- Values -->
        <weight repeat="89" value="1.000"/>
        <weight repeat="1" value="0.999"/>
        <weight repeat="1" value="0.993"/>
        <weight repeat="1" value="0.970"/>
        <weight repeat="1" value="0.933"/>
        <weight repeat="1" value="0.882"/>
        <weight repeat="1" value="0.817"/>
        <weight repeat="1" value="0.741"/>
        <weight repeat="1" value="0.653"/>
        <weight repeat="1" value="0.555"/>
        <weight repeat="1" value="0.449"/>
        <weight repeat="1" value="0.336"/>
        <weight repeat="1" value="0.217"/>
        <weight repeat="1" value="0.096"/>
        <weight repeat="1" value="0.027"/>
        <weight repeat="1" value="0.000"/>
    </weights>
    <default-sequence-values>
        <first-center value="2112800000.0"/>        <!-- First Center Frequency in Hz -->
        <freq-spacing value="5000000.0"/>           <!-- Frequency Spacing in Hz -->
        <number-objects value="1"/>                 <!-- Number of Objects -->
    </default-sequence-values>
</channel-filter>
<!-- END: Channel Filter Definition for UMTS -->
```

Figure 6-382: Example for the UMTS Channel Filter Configuration with XML

Threshold settings

If the threshold is active, only sweep results with power values greater than the adjusted threshold are stored and displayed.

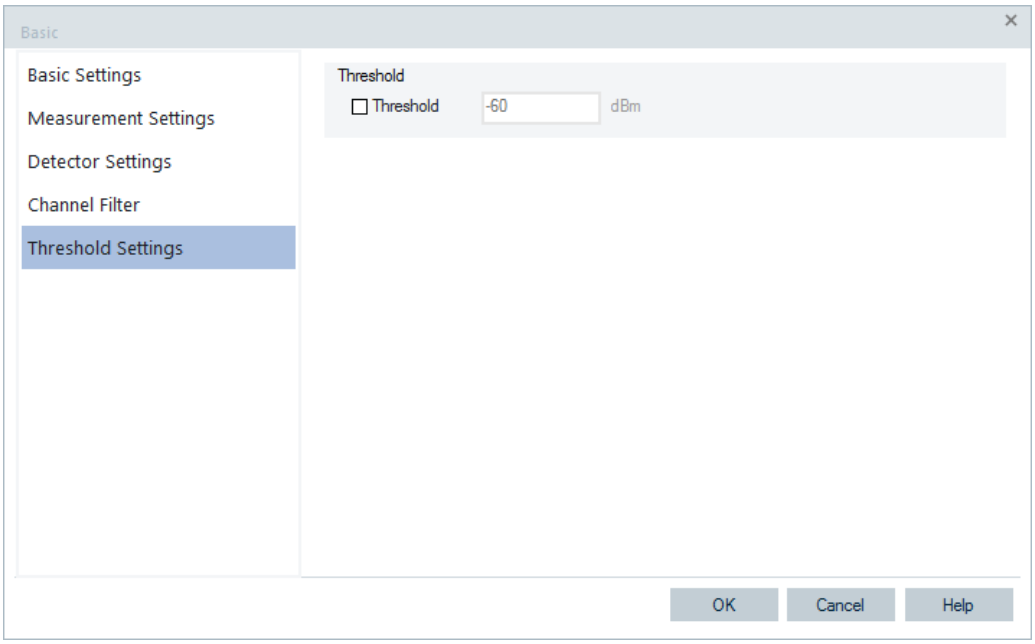


Figure 6-383: RF Power Scanner configuration – threshold settings

6.4.21.5 RF power scanner – scanner

The "Scanner" tab opens the window which displays the properties of the R&S TSME device and the information on the file version of the R&S ROMES4 RF Power Scanner driver.

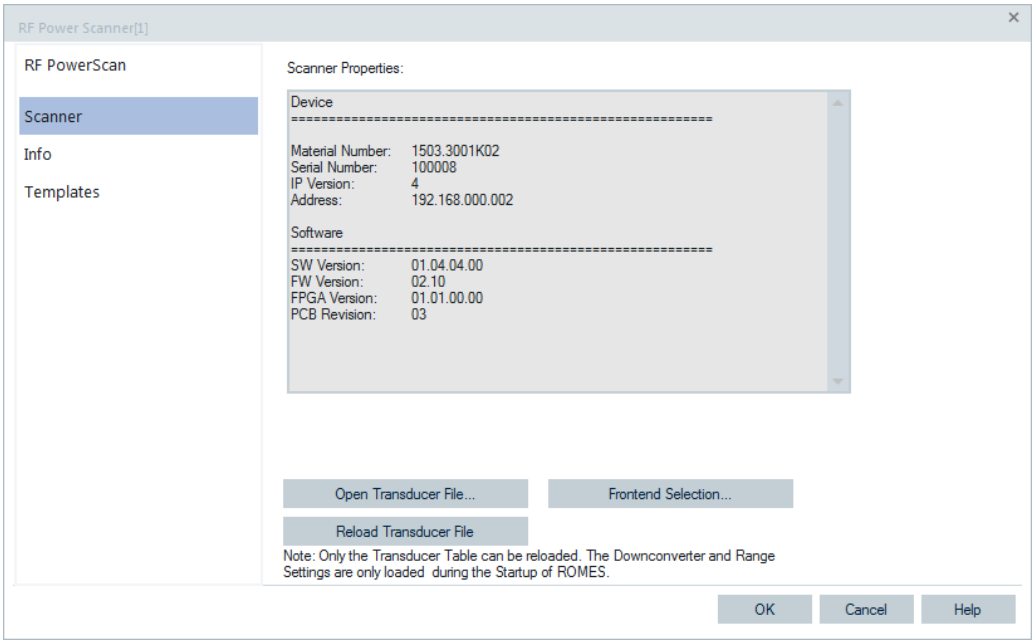


Figure 6-384: RF Power Scanner configuration

6.4.21.6 Info RF powers scanner

The "Info" page displays information on the file version of the RF Power Scanner driver. It is identical for all RF Power Scanner drivers.

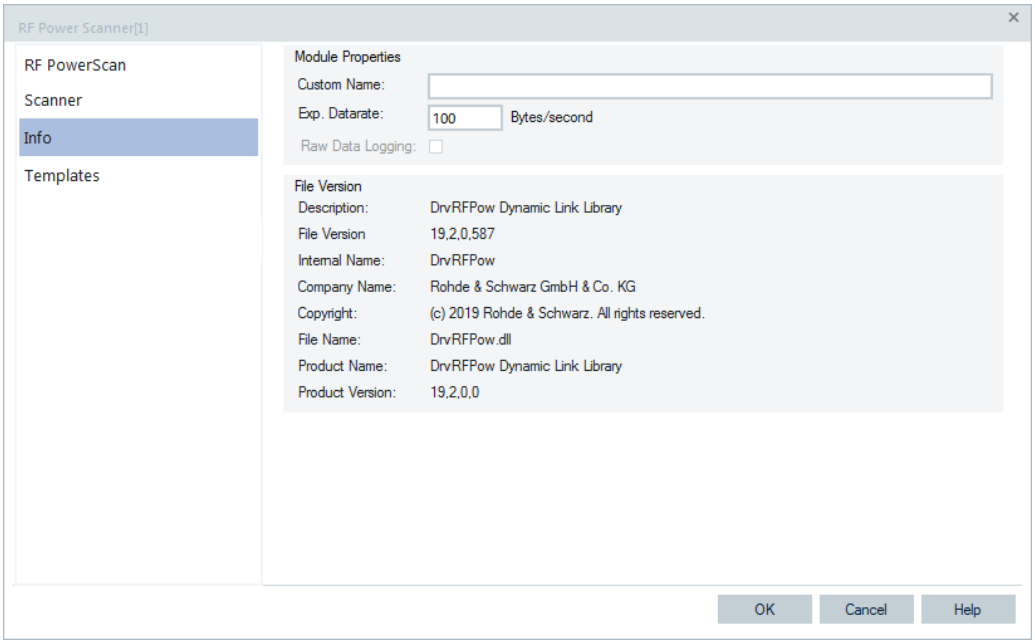


Figure 6-385: R&S RF Power Scanner – info

6.4.21.7 Templates R&S RF power scanner

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

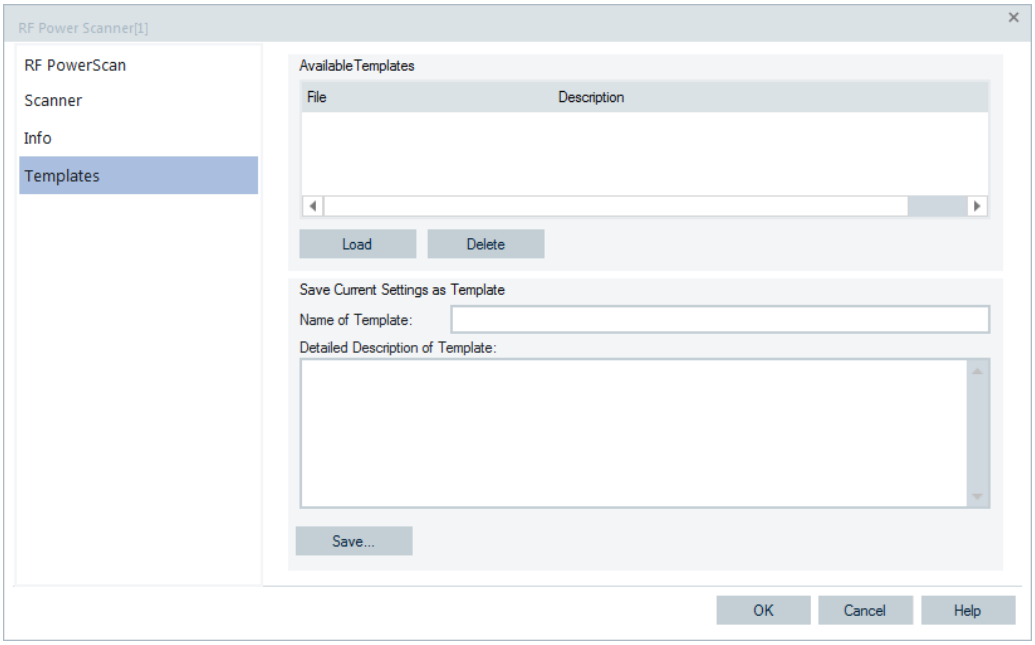


Figure 6-386: R&S RF Power Scanner - templates

6.4.22 TETRA scanner

The R&S ROMES4 TETRA scanner driver controls the R&S TSME scanner device when scanning a TETRA network. The hardware needed is the R&S TSME-K26 option which includes DMO. The driver is available with the R&S ROMES4T1E option.

The TETRA scanner configuration is explained in the following chapters.

For data collected, measured and analyzed by the R&S TETRA scanner, see Chapter 3.3.17.7, "TETRA scanner views", on page 186.

File scanning

The proper working of the coupled focus and calculation of the Top N pools, need to scan the complete measurement file when you open it for replay. Thus, if a measurement file contains TETRA scanner data, the TETRA scanner scans the file, regardless of "File Scanning" activation.

6.4.22.1 Loading TETRA scanner

The R&S TSME devices can run as the TETRA scanner devices if loaded with the R&S ROMES4 TETRA scanner driver.

Click the "Hardware" > "Connect/Disconnect" menu entry. The "Hardware Configuration" page pops-up.

To load R&S ROMES4 TETRA scanner driver into R&S TSME, double_click the "Network Scanner TSME" > "TSME TETRA" branch in the "Hardware Configuration" > "Available Devices" pane, see Figure 6-40.

The device is loaded and visible in the "Loaded Devices" pane of the page. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S TETRA Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

The device is now added as the "RS TETRA Scanner [<variable>]" command line to the "Hardware" menu as well.

Click the "RS TETRA Scanner [<variable>]" line to open the TETRA scanner main configuration page.

By default, the scanner is configured for measuring a certain TETRA band, for example, for German TETRA band.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

6.4.22.2 Measurement rate signals

The R&S ROMES4 TETRA scanner consists of two modules:

- Scanner Module which measures the level of signals in the analysis range.
- Analysis Module which measures the quality of the active TETRA frequencies.

Both modules use the same IQ-data from the R&S TSME. Due to the narrowband system of TETRA, long sequences have to be acquired for the analysis. An acquisition takes about 113 milliseconds. To get moreover high-speed level measurements, an acquisition is segmented in the Scanner-Module and three results are calculated. Therefore, the measurement rate of the R&S TSME is less than the scanning rate of the system.

To get distance information, a GPS device (for example, the R&S TSME's GPS device) must be connected to one or more TETRA scanner devices and used for the measurement.

6.4.22.3 Configuration TETRA scanner

The "Scanner Configuration" tab allows configuration of measurement parameters for one or more channels that you want to measure.

The R&S ROMES4 Automatic Channel Detection (ACD) feature is supported for TETRA scanners. You can select the mode of the TETRA channels detection by configuring manual or automatic mode.

The layout of the "Scanner Configuration" page depends on selected mode.

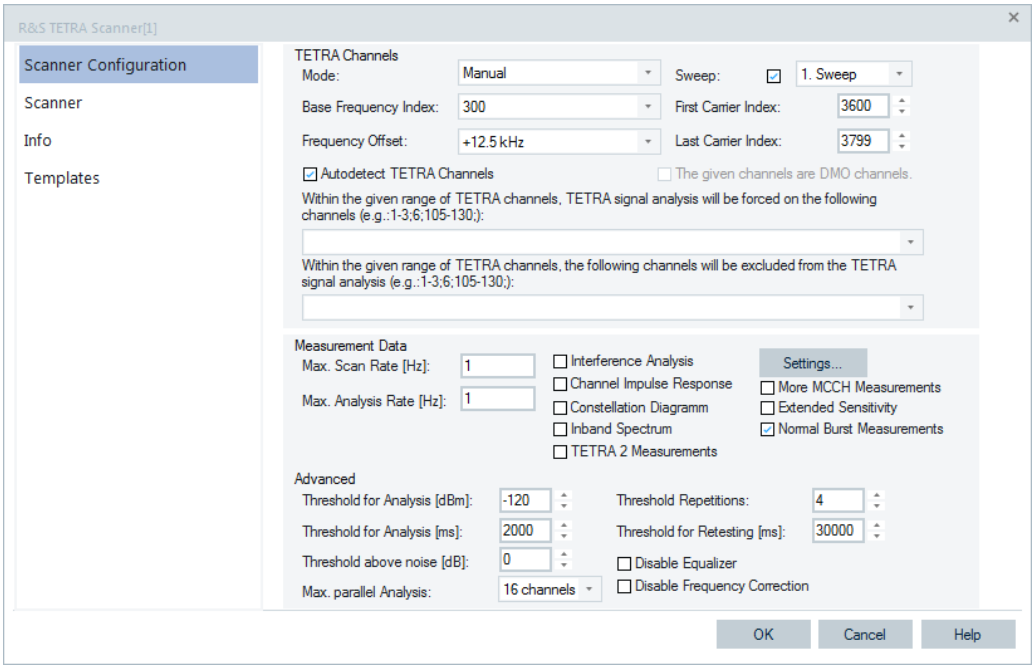


Figure 6-387: TETRA scanner configuration - manual mode

TETRA Channels

The TETRA channels detection mode is configured in "TETRA Channels". The page also contains parameters for channels detection, if you select the manual mode.

Mode ← TETRA Channels

- "Manual"
  The manual configuration of TETRA channels measurement is described in the following sections.
- "Automatic Channel Detection (ACD)"

For the ACD configuration mode, see TETRA Automatic Channel Detection.

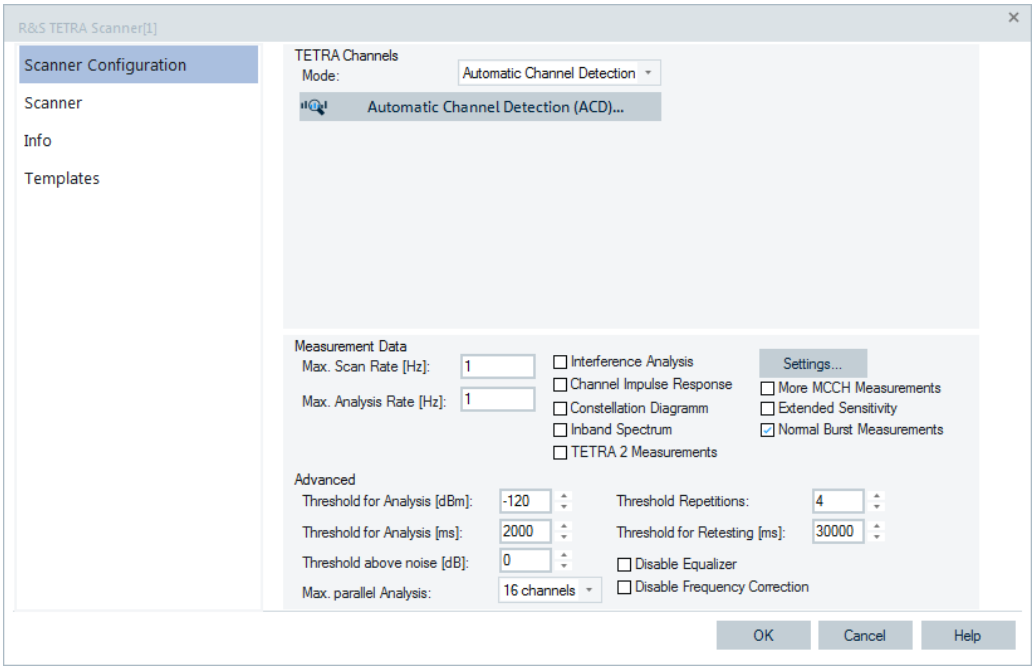


Figure 6-388: TETRA scanner configuration - ACD mode

Base Frequency Index ← TETRA Channels

Specifies the number of the base frequency.

Frequency Offset ← TETRA Channels

Specifies the carrier frequency offset. The TETRA standard defines four values (-6.25 kHz, 0 kHz, +6.25 kHz and +12.5 kHz).

Autodetect TETRA Channels ← TETRA Channels

If "Autodetect TETRA Channels" is checked, the scanner detects TETRA channels automatically. If unchecked, specify the TETRA channels for scanning within the bands specification.

The maximum limit for forcing channels and excluded channels is 100.

Note: If more channels are specified, the warning message pops-up, asking you to correct the string.

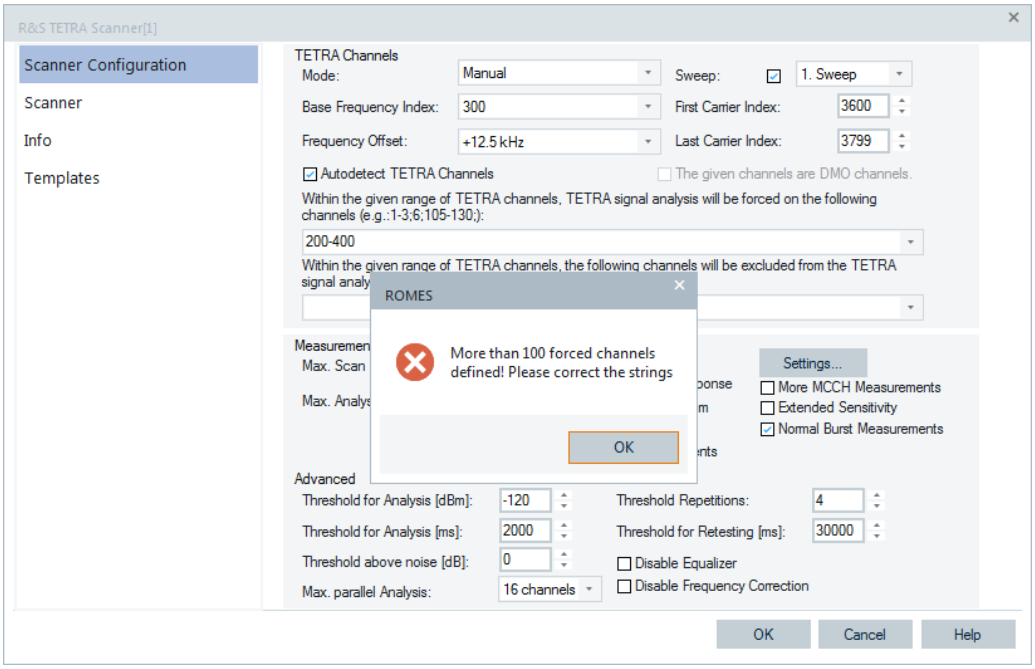


Figure 6-389: Too many channels are configured

Many forced channels can reduce the analysis speed. Also, forced channel where no signal is seen slows down analysis speed.

Sweep ← TETRA Channels
The R&S TETRA scanner supports multiple sweeps.

"Sweep" lets you select the sweep number. The checkbox on the left side of the combobox indicates whether the sweep is a part of the actual measurement setup.

To get more than one sweep in the box, increase the number of sweeps, see "ROMES signals" on page 382. The sweep number corresponds to the configured sweep number.

For example, if only sweep 2 and 4 is configured in the drivers configuration, the tabs and signals show up with symbol #2 and #4, respectively.

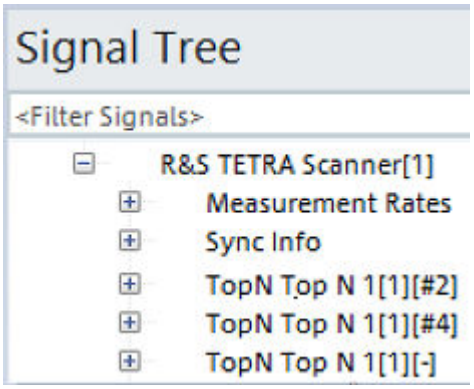


Figure 6-390: Configured two sweeps for TETRA scanner

A tab is provided for the results of each sweep in the "TETRA Scanner Spectrum View".

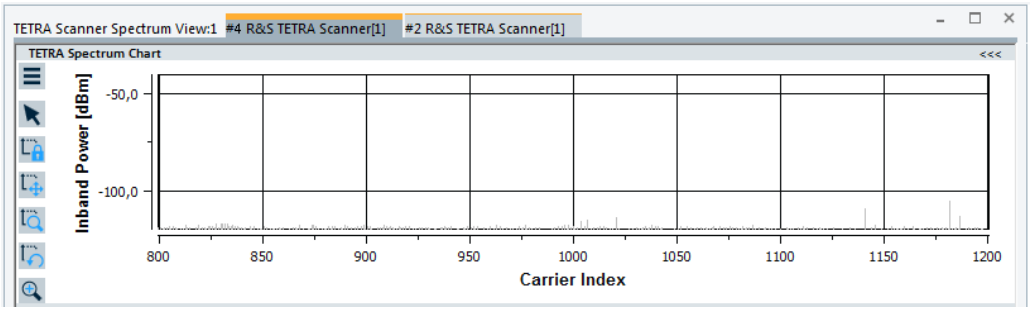


Figure 6-391: TETRA scanner sweep

The scanner driver is able to scan up to 16 frequency blocks in parallel. The scan rate per sweep decreases when adding more sweeps to the measurement configuration.

First Carrier Index ← TETRA Channels
Defines the first channel number to be scanned (0 to 3999)

Last Carrier Index ← TETRA Channels
Defines the last channel number to be scanned (0 to 3999).

The given channels are DMO channels ← TETRA Channels
The R&S ROMES4 TETRA Scanner supports also measurements on DMO TETRA carriers. The DMO measurement is exclusive, that is, a R&S ROMES4 scanner driver can scan DMO carriers or non-DMO carrier.

The R&S TSME-K26 option is required for DMO.

DMO Driver ← The given channels are DMO channels ← TETRA Channels
If the DMO measurements option is active, the scanner assumes that the given carriers are TETRA DMO carriers.

The following additional features are **not** supported with DMO measurements:
- Channel Impulse Response measurement
- Interference Analysis
- QAM measurement
- Position estimator measurement
- More MCCH measurement
- Extended Sensitivity

DMO Signals and Events ← DMO Driver ← The given channels are DMO channels ← TETRA Channels
The following TETRA DMO signals are measured:
- Frequency
- Carrier
- Inband Power
- TETRA Power
- SNR
- ModER

- MCC
- MNC
- BER Pre - Vit
- Freq. Err
- Phase Error
- Delay Spread
- Time Slot
- FN

Additional supported DMO signals and events are:

- Source Address
- Destination Address

DMO Views ← The given channels are DMO channels ← TETRA Channels
TETRA views show the available parameters of DMO carriers.

The "BCH View" shows the identified MS and the DMAC-SYNC PDU in SCH/S and SCH/H.

Measurement Data
The "Measurement Data" section of the driver configuration lets you define data to be measured during the channels scanning.

- "Maximum Scan Rate"
  Defines the maximum measurement speed for the scanner.
- "Maximum Analysis Rate"
  Defines the maximum speed of the analyzer.
- "Interference Analysis"
  If checked, the scanner analyzes interference during the measurement and stores the data.
  The results are shown in "TETRA Scanner Spectrum View". The results are also available in the "TETRA Scanner Top N View" and as the Top N Carrier signals.
  Available results are:
  – C/I
  – MCC of interferer
  – MNC of interferer
  – LA of interferer
- "Channel Impulse Response"
  If checked, the scanner measures and stores CIR data. The results are shown in the "TETRA Scanner CIR View".
- "Constellation Diagram"
  The scanner is able to measure the constellation diagram during its analysis. However, this data needs much storage space. Due to that reason, the measurement and storage of the constellation diagram has to be activated.
- "Inband Spectrum"
  If checked, the scanner measures and stores inband spectrum data. It is displayed in the "TETRA Scanner Carrier Spectrum View".
- "TETRA 2 Measurements"
  If checked, TETRA 2 measurements are switched on.
  Note: TETRA channel has carrier bandwidth of 25 kHz. TETRA 2 channel numbers entered in the channel list also refer to the standard TETRA 25 kHz channel raster, although their real bandwidth can be different, for example, 150 kHz.

- "Interference Analyzer Settings"
  Opens a dialog to specify the conditions for interference analysis.

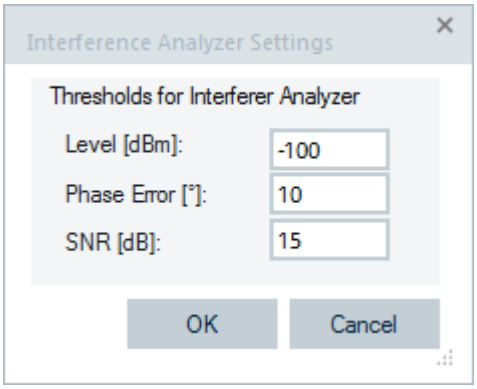


Figure 6-392: TETRA interference analysis parameters

  An interference situation is given if the following conditions are fulfilled:
  – Level is more than *a* [dBm]
  – Phase error is worse than *b* [°]
  – If SNR is less than *c* [dB], then an asynchronous interference is supposed to be the problem.

  The SNR values are considered to distinguish between a synchronous and an asynchronous interference. If SNR is less than *c* [dB], then an asynchronous interference is supposed to be the problem.
  A synchronous interference means that a signal and an interferer are in the same synchronized network. Therefore, the sync bursts are transmitted at the same time. As the SNR measurement is done on the frequency correction part of the sync burst, R&S ROMES4 does not notice an interference in this part. The SNR is high, because adding 2 sine-waves of the same frequency results in another sine-wave.
  An asynchronous interference means that a signal and an interferer are asynchronous because the network is running asynchronously or they belong to different networks. The sync bursts are transmitted at different times and the interference is resulting in a low (= bad) SNR. Distinguishing between synchronous and asynchronous interference is important for determining the interferer.
- "More MCCH Measurements"
  If checked, additional measurements on the 1st slot of the MCCH are performed.
  Hovering over the "More MCCH Measurements" displays these measurements.

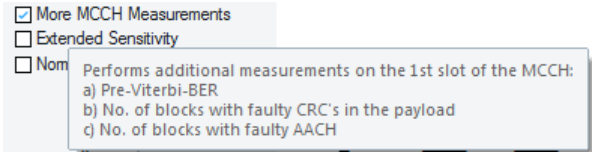


Figure 6-393: MCCH measurements

  The measured signals are also described in Top N Pool Signal Settings.
- "Extended Sensitivity"
  If checked, the sensitivity of the scanner increases.
- "Normal Burst Measurements"

The quality measurements on the normal burst are by default activated, see Figure 6-387. This measurement approach increases the measurement speed for quality parameters significantly, especially in high-loaded networks.

Advanced

"Advanced" allows you to define:

- Minimum number of successive TETRA detections to reach the candidate state.
- Minimum time the channel has to be above the minimum level to reach the candidate state.
- Minimum time the carrier is not analyzed as TETRA carrier after being declared as non-TETRA carrier.

Configure the following parameters:

- "Threshold for Analysis [dBm]"
  Specifies the minimum level for a channel to be analyzed as TETRA carrier.
- "Threshold for Analysis [ms]"
  Specifies the minimum threshold for analysis in ms. That means, the value specifies the minimum time the channel has to be above the minimum level to reach the candidate state.
- "Threshold above noise [dB]"
  Specifies the threshold that disables the analysis of signals which are close to the noise floor.
  The performance of the TETRA scanner can be improved by choosing the limited signal levels for analysis. If the analysis of the signals is limited to those signals which are at least a certain level stronger than the noise level the performances are improved. This limit can be adjusted in range 0 dB to 99 dB.
- "Max. parallel Analysis"
  To reduce the CPU load, the scanner can be forced to analyze only a certain number of signals in parallel.
  Possibility to limit the maximal number of simultaneous calculations ranges from 1 to 64.
- "Threshold Repetitions"
  Specifies the iteration of the threshold value for an analysis. That means, it specifies the minimum number of successive TETRA detections to reach the candidate state.
- "Threshold for Retesting [ms]"
  Specifies the minimum threshold value in ms before a retest starts. The value specifies the minimum time that the carrier is not analyzed as a TETRA carrier after being declared as non-TETRA carrier.
- "Disable Equalizer/Disable Frequency Correction"
  The parameter lets you disable the internal equalizer or the internal frequency correction. Usually, equalizer and frequency correction are on. However, if the measurement results refer closer to TETRA mobiles which do not use these functions, switch them off. Switching off equalizer and frequency correction for such mobiles predicts their performances better in areas with strong reflections, especially if no line of sight to the BTS antenna.

TETRA Automatic Channel Detection

If the selected TETRA channels measurement mode is "Automatic Channel Detection", the shown page lets you specify the ACD measurement parameters.

The page is divided into two parts. In the left part set the mode and the other ACD parameters independently on technology. The right part of the page is TETRA-specific.

Note: Virtual TETRA channel is a 10 MHz block. Maximum 16 virtual TETRA channels can be scanned in parallel.

In "Automatic Channel Detection" the following settings are available:

- "Mode"
  - "Simple"

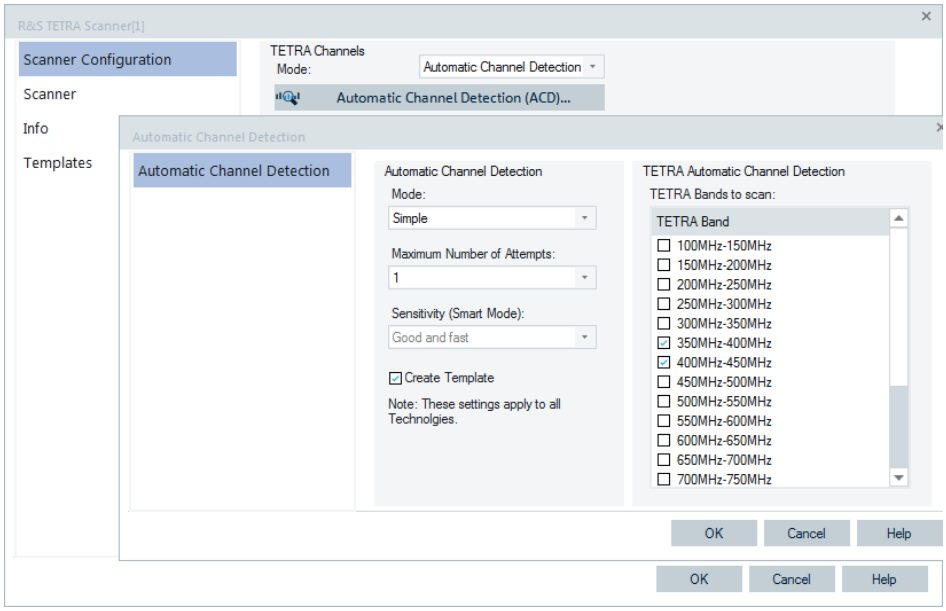


Figure 6-394: TETRA ACD - simple mode configuration

The mode tries every possible TETRA channel for a signal.

  - "Smart"

The mode uses the RF power scanner to check for power in frequency blocks before trying TETRA scan. The corresponding drivers for the R&S TSME and the R&S ROMES4 have to be available.

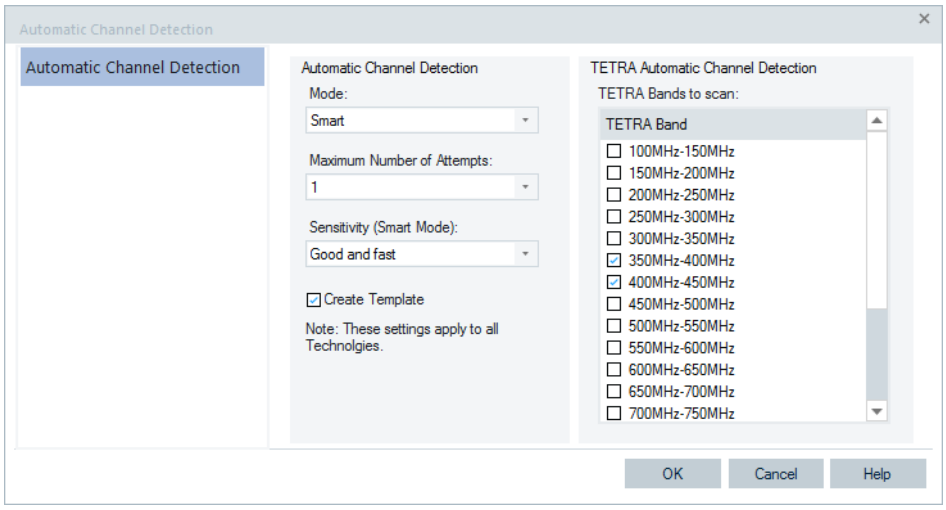


Figure 6-395: TETRA ACD - smart mode configuration

If RF Power Scanner is not loaded, you are asked to do that.

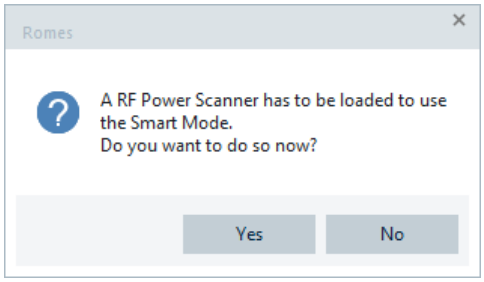


Figure 6-396: Load RF Power scanner request

- "Maximum Number of Attempts"
  Number of times the TETRA scanner tries to find a TETRA cell on a certain channel. Increasing the number helps to find weaker cells and increase the detection probability, but reduces the detection speed.
- "Sensitivity (Smart mode)"
  Three different levels of the ACD sensitivity are available. Depending on the requirements of the measurement, users can select a faster or more sensitive ACD.
- "Create Template"
  If selected, the R&S ROMES4 creates a template for the TETRA scanner which includes all detected channels at the end of the measurement.

"TETRA Automatic Channel Detection" allows selection of the frequency bands to be observed by the ACD function for TETRA channels.

For each detected virtual TETRA channel, a TETRA sweep is configured automatically.

If a template is created, it can be used to set a new measurement with dedicated channels up.

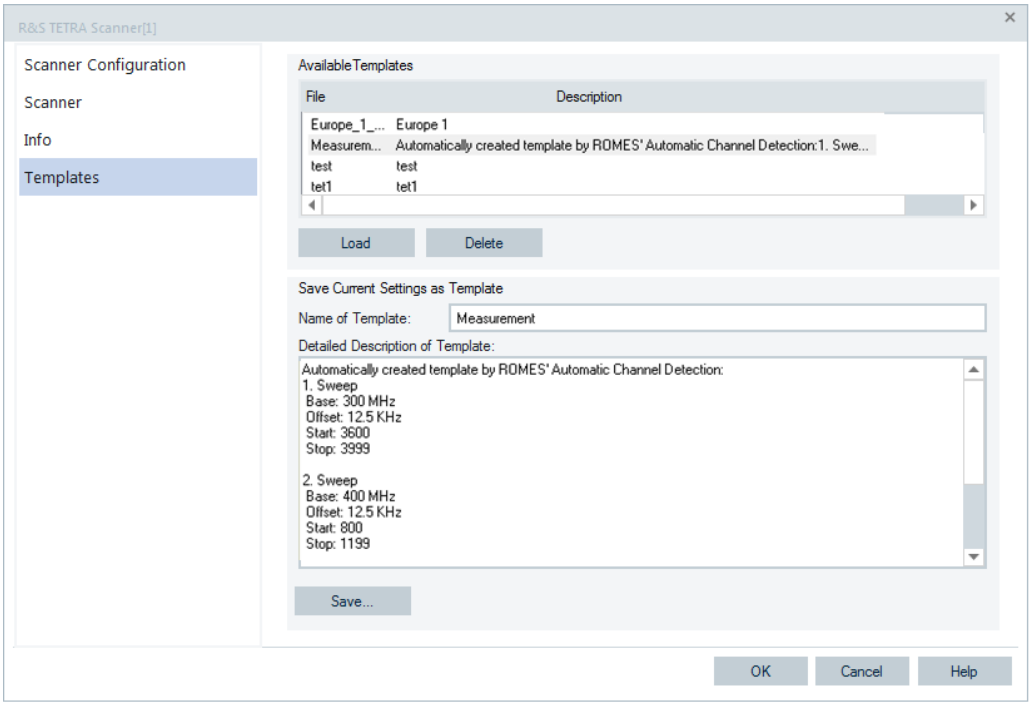


Figure 6-397: TETRA template created by ACD

The current state of the smart ACD is visualized in the "ACD Status View".

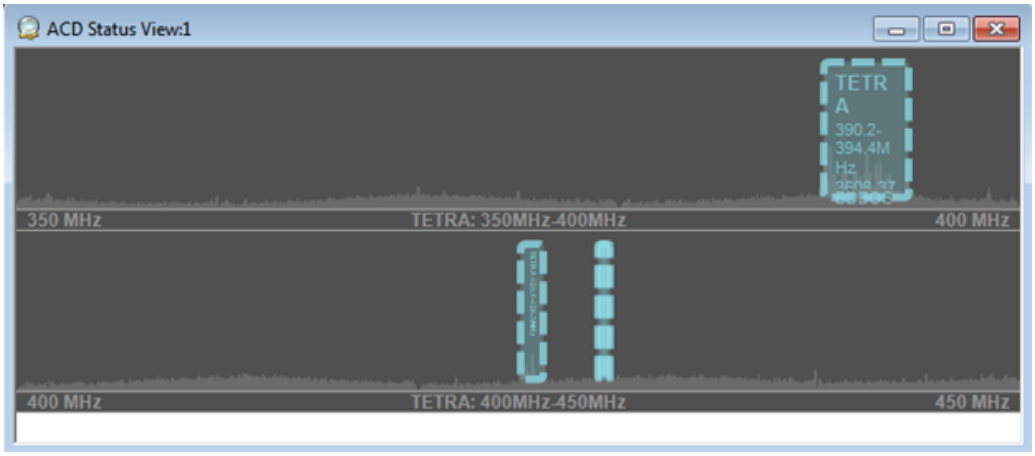


Figure 6-398: TETRA ACD status view

6.4.22.4 Scanner TETRA

"Scanner" opens the window which displays the properties of the R&S TSME devices.

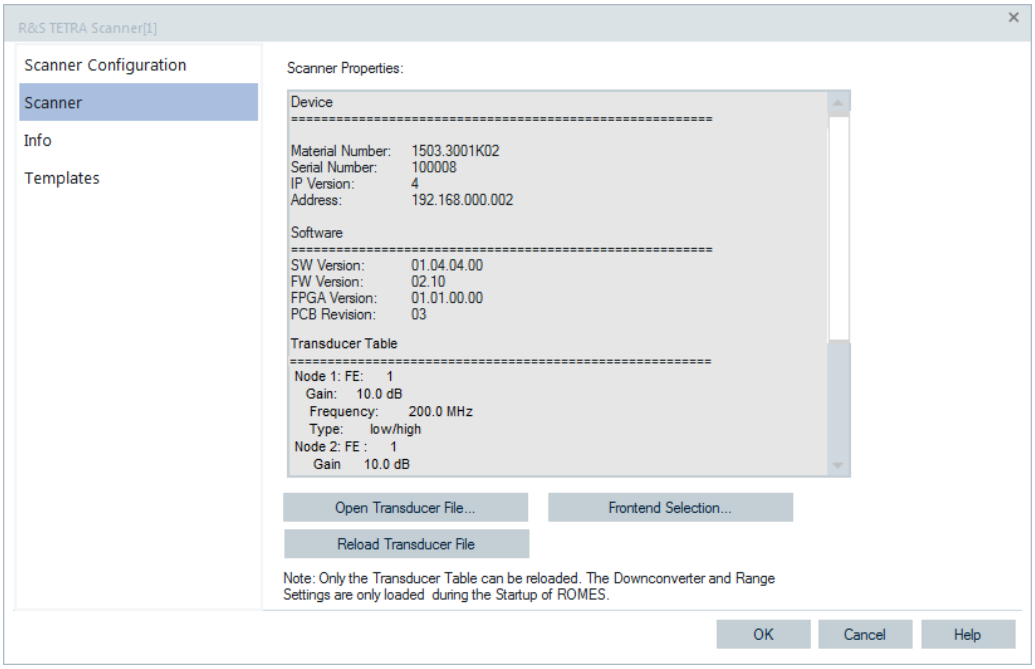


Figure 6-399: R&S TETRA Scanner properties

6.4.22.5 Info

"Info" displays information on the file version of the R&S ROMES4 TETRA Scanner driver.

6.4.22.6 Templates

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

6.4.23 WLAN device

The R&S ROMES4 WLAN driver controls the data transfer from/to Wireless LAN client adapters. It supports all common WLAN devices. Which WLAN devices are present is visible in the MS Windows "Connection Manager" > "Wireless Network Connection" section.

The WLAN driver has the subitem "WinWLAN" in the R&S ROMES4 hardware configuration.

The WLAN device loading with the R&S ROMES4 WinWLAN driver and the device configuration is covered in the following chapters. The measured WLAN data can be viewed in the "WLAN Views", see Chapter 4.7, "WLAN views", on page 1103. The measured WLAN data are also visible in many basic views.

6.4.23.1 Loading WinWLAN devices

The R&S ROMES4 WLAN provides a configuration window for the WLAN devices which are loaded. Install the WinWLAN driver previously.

To load WinWLAN driver into a WLAN device:

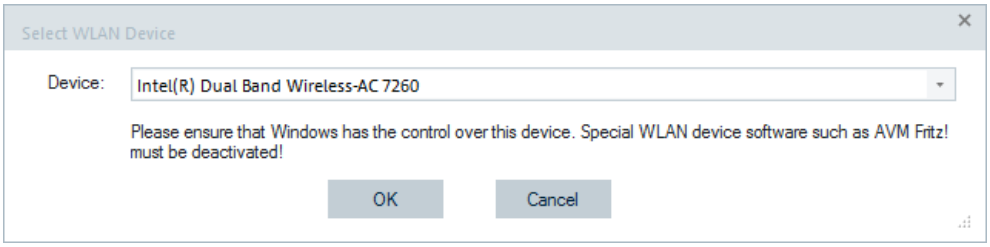
1. Click the "Hardware" > "Connect/Disconnect" command.

   The "Hardware Configuration" window pops-up showing the "Available Devices" list.

2. Select the "WLAN" > "WinWLAN" branch.

3. Click the ">" button.

   The "Select WLAN Device" dialog pops-up asking you to select the WLAN device.



4. Click "OK".

   The selected WLAN device is included in the "Loaded Devices" list.

5. Click "Continue" to confirm the selection.

   The selection is stored and the window is closed.

   The WinWLAN device is available now in the "Hardware" menu and in the "Welcome" > "Available Devices" section. You can open its configuration page if you click, for example, the device's icon in the "Available Devices" list.

6.4.23.2 Configuration WLAN

The "WinWLAN[<variable>]" configuration window offers the tab for a WLAN device setup for measurement. The other two tabs in the window carry information on device capabilities and version.

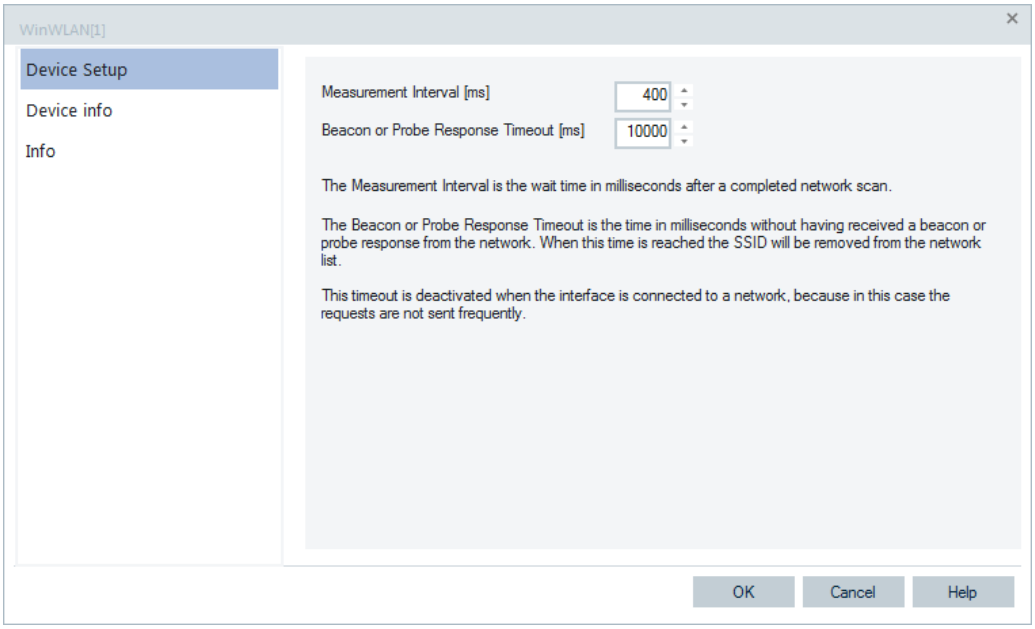


Figure 6-400: WinWLAN device setup

Device setup

The "Device Setup" dialog lets you select the measurement interval and a beacon/ probe response time.

The parameters are explained in the dialog itself.

- "Measurement interval [ms]"
  The time in ms after which R&S ROMES4 records and evaluates a new set of measurement data from the test device. A short measurement interval allows the quick variations of the signal quality and the data traffic to analyze. However, the short measurement interval causes large measurement files which require more R&S ROMES4 system capacity.
  The actual update interval of the data in the test device is shorter than the measurement interval so that R&S ROMES4 skips part of the available information. This update interval is not influenced by the driver settings.
- "Beacon or Probe Response Timeout [ms]"
  The time in ms without having received a beacon or probe response from the network. When this time is reached, the SSID is removed from the network list.

Device info

Click the "Device Info" tab to get the information on the test device capabilities.

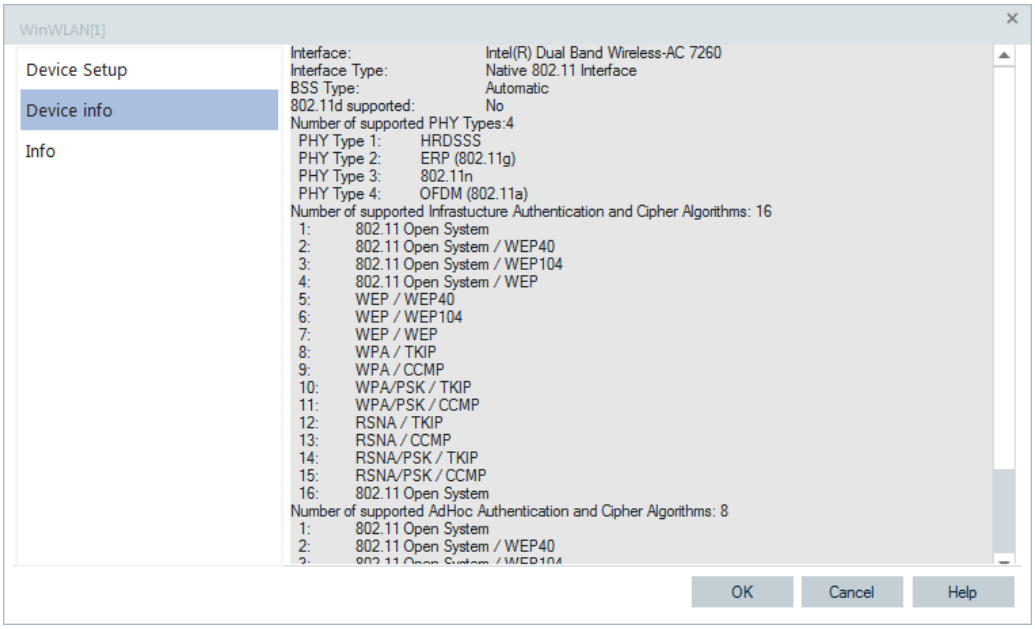


Figure 6-401: WLAN driver information

WLAN info

The opening page of the "Info" tab is identical to info tab of other technologies supported by R&S ROMES4.

6.4.24 WLAN measurements with QualiPoc converter

The QualiPoc Converter supports WLAN measurements done with the converter version 13.1.0.25 or higher.

The following data and associated parameters are available in the QualiPoc measurement file:

- **WiFi Scan Data**
  - SSID - Service Set Identifier
  - BSSID - Basic Service Set Identifier (MAC address)
  - Frequency - Frequency of the channel over which the client is communicating with the access point
    The channel number is calculated by the frequency according to IEE 802.11.
  - Capability - Authentication, key management and encryption schemes supported by the access point
    The capability is displayed in the column "Auth. Algorithm" in the "WLAN Scan View", refer to Chapter 4.7.2, "WLAN scan view", on page 1108.
    The "Net x QP Capability" signal is created for this parameter, see in "View" > "Signal Tree Bar" > "WLAN" > "Device x" > "Network Scan".

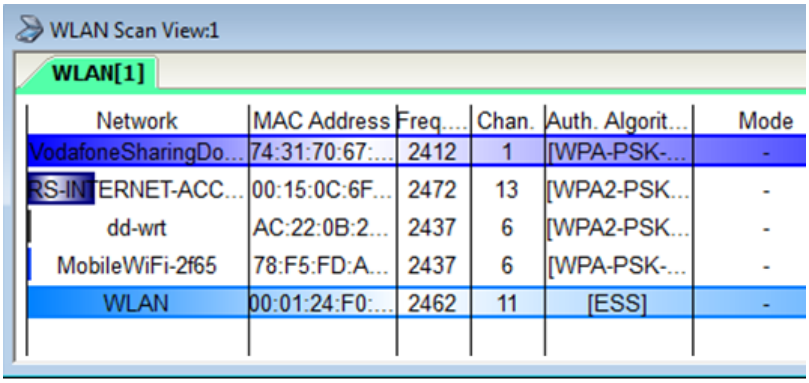


Figure 6-402: Capability shown in the Auth. Algorithm column

In the "Alphanumeric View" the capabilities are displayed as well, see the following figure.

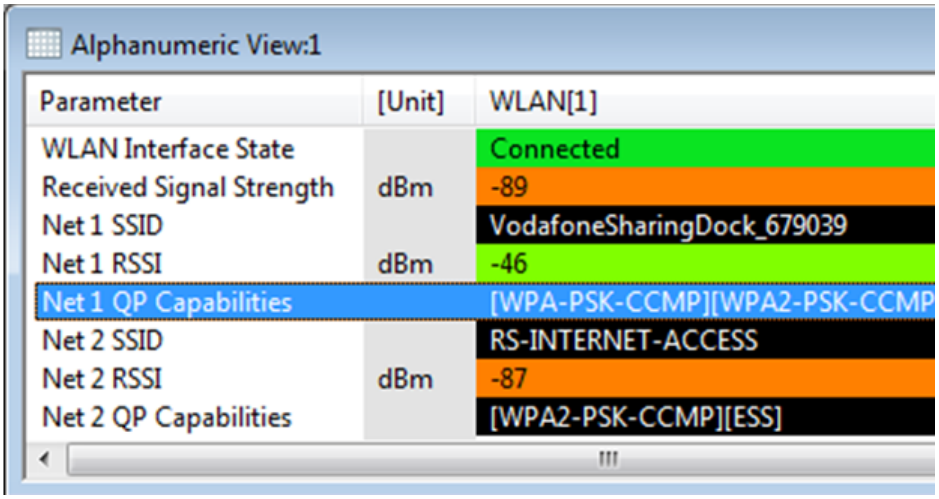


Figure 6-403: Net x QualiPoc capabilities

- **WiFi Connection Data**
  - SSID - Service Set Identifier
  - BSSID - Basic Service Set Identifier (MAC address)
  - RSSI - Received Signal Strength Indication
  - Frequency - As defined in Frequency
  - Capability - As defined in Capacity
  - Link Speed - Throughput expressed in kbps
  - Status - Detailed state of the supplicant's negotiation with an access point
    The "Connection QP Status" signal is created for this parameter in "View" > "Signal Tree Bar" > "WLAN" > "Device x" > "Connection Status", see the following figure.

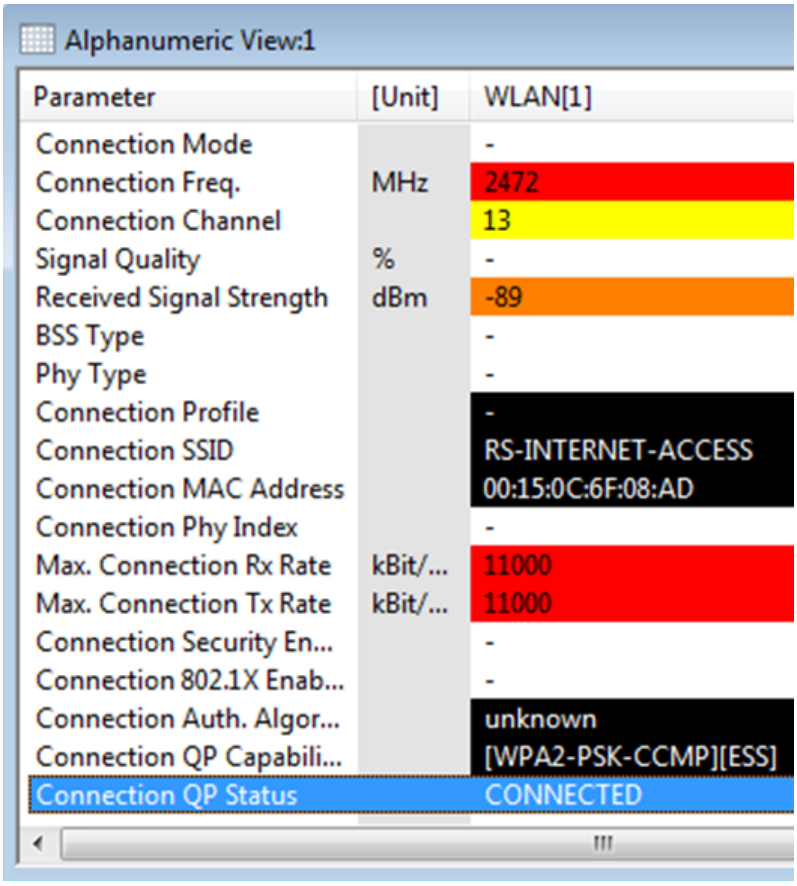


Figure 6-404: Connection QualiPoc status

The possible WLAN states of the supplicant's negotiation with an access point are given in the following table.

Table 6-19: States of the supplicant's negotiation with an access point

WLAN state	Description
AUTHENTICATING	Network link established performing authentication
BLOCKED	Access to this network is blocked
CONNECTED	IP traffic is available
CONNECTING	Currently setting up data connection
DISCONNECTED	IP traffic not available
DISCONNECTING	Currently tearing down data connection
FAILED	Attempt to connect failed
IDLE	Ready to start data connection setup
OBTAINING_IPADDR	Awaiting response from DHCP server to assign IP address information
SCANNING	Searching for an available access point

WLAN state	Description
SUSPENDED	IP traffic is suspended
VERIFY-ING_POOR_LINK	Link has poor connectivity

The QualiPoc measurement file info dialog shows just the adapter information for WLAN, which is a mobile driver's name. Other WLAN information is not available.

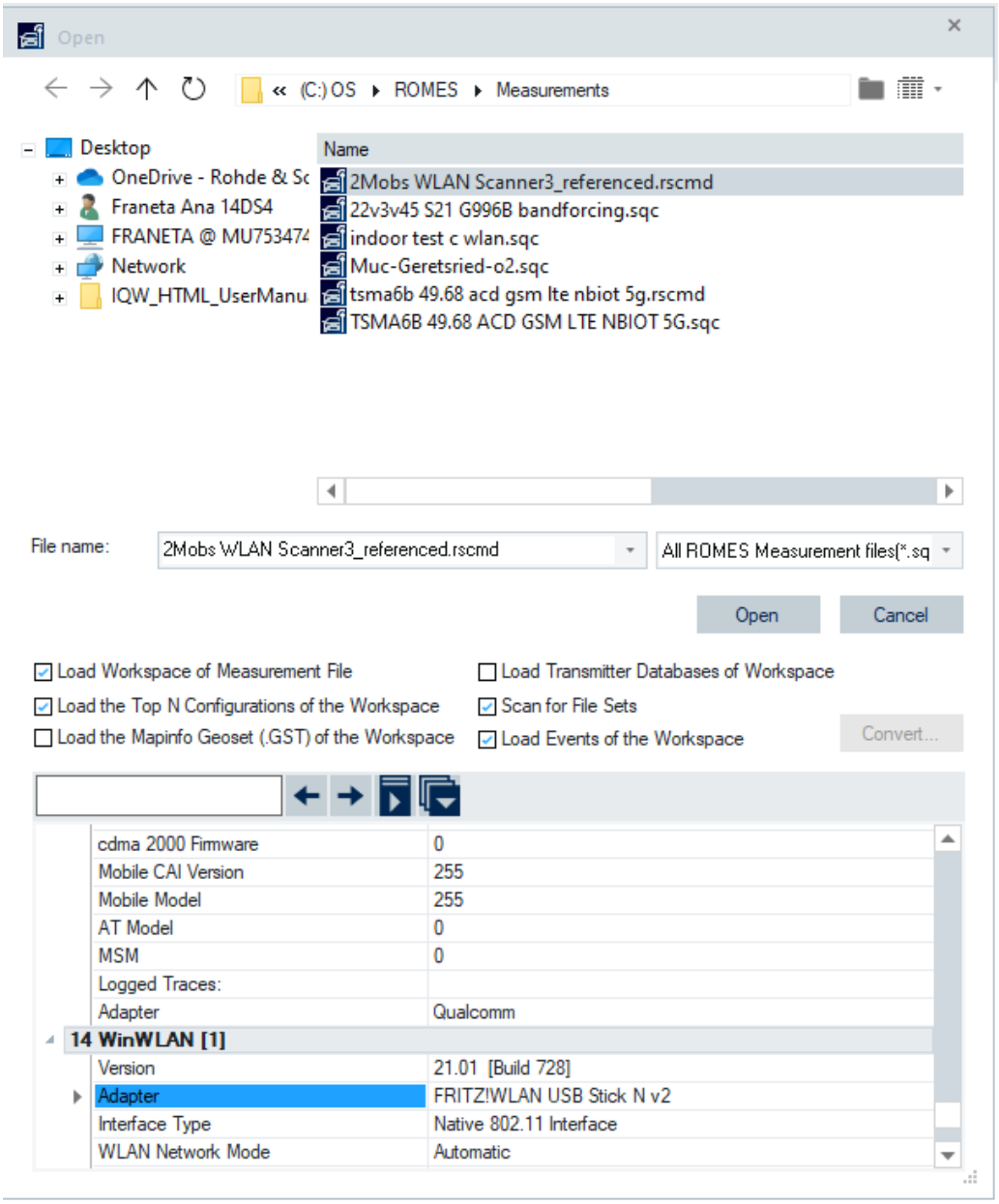


Figure 6-405: Used WLAN adapter

In the "WLAN Overlapping Networks View", the chart of the details section can stay empty. The reason for the empty chart is missing channel bandwidth measurement information of the QualiPoc.

Only the co-existing channels are displayed in the left part of the view.

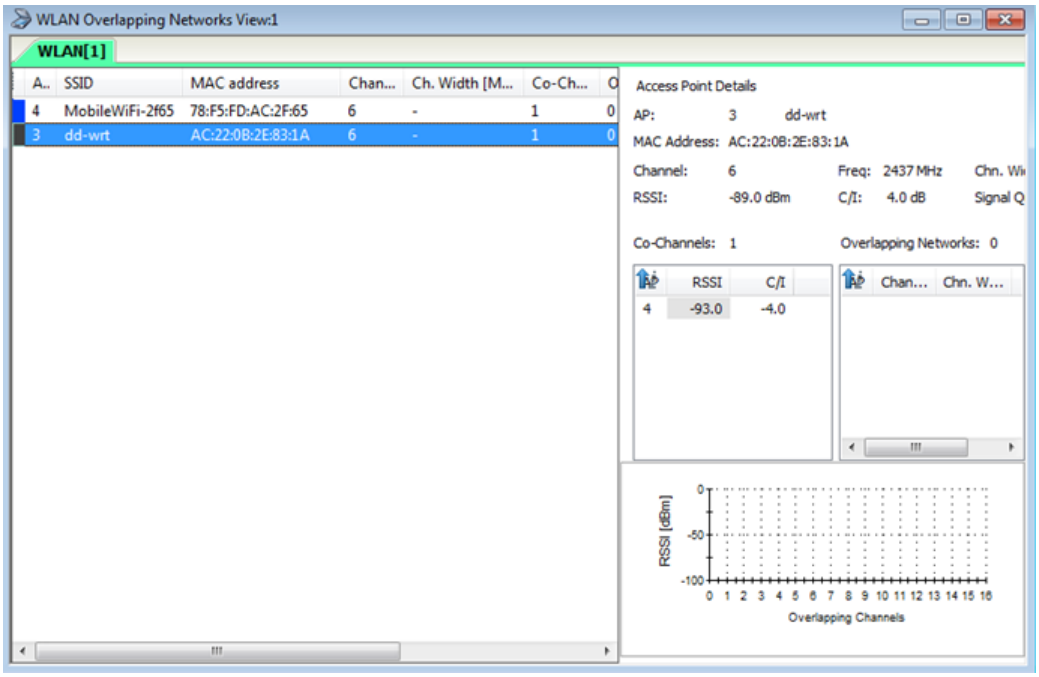


Figure 6-406: QualiPoc measurements displayed in WLAN Overlapping Networks View

6.4.25 WiMAX scanner

The R&S ROMES4 WiMAX scanner driver controls an R&S TSME scanner device to perform WiMAX measurements. You need for this control the R&S TSME hardware option R&S TSME-K28. The driver is available with the R&S ROMES4T1E for R&S TSME option.

The configuration of the R&S TSME network scanner as the WiMAX scanner is explained in the following text.

The WiMAX data measured, collected and analyzed by the R&S WiMAX scanner can be viewed in the Chapter 3.3.17.9, "WiMAX scanner views", on page 188.

6.4.25.1 Loading WiMAX scanner

The R&S TSME devices can run as the WiMAX scanner devices if loaded with the R&S ROMES4 WiMAX scanner driver.

Click the "Hardware" > "Connect/Disconnect" menu entry. The "Hardware Configuration" page pops-up.

To load the WiMAX scanner driver into R&S TSME, double_click the "Network Scanner TSME" > "TSME WiMAX" branch in the "Hardware Configuration" > "Available Devices" pane, see Figure 6-40.

The device is loaded and visible in the "Loaded Devices" pane of the page. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S WiMAX Scanner(<variable>): Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

It is now added as the "RS WiMAX Scanner [<variable>]" command line to the "Hardware" menu.

Click the "RS WiMAX Scanner [<variable>]" line in the "Hardware" menu to open the WiMAX scanner main configuration page.

Some connectors on the rear panel of the R&S TSME device are here briefly described.

- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ 45 connector using IPv4.

- SMA female [RF IN] connector for antenna RF signal.
- SMA connector for the GPS antenna. The internal GPS receiver of the R&S TSME provides a PPS signal to the scanner. The R&S TSME has no indication of the GPS signal provision.

Tip:

The R&S TSME operating manual is provided on the R&S ROMES4 DVD-ROM. Refer to the directory `Firmware & Drivers\R&S RF Receivers`. See also the paragraph about the Chapter 6.1.11.1, "R&S TSME network scanner", on page 1488.

6.4.25.2 WiMAX scanner configuration

The "R&S WiMAX Scanner" configuration page allows configuring the measurement parameters.

The "WiMAX Scanner Configuration" tab lets you select channels, frequency, band, BCH-demodulation for scanning. The "Scanner" tab shows the properties of the connected driver, the "Templates" tab displays the current driver installation and the "Information" tab displays the information on the file versions of the driver.

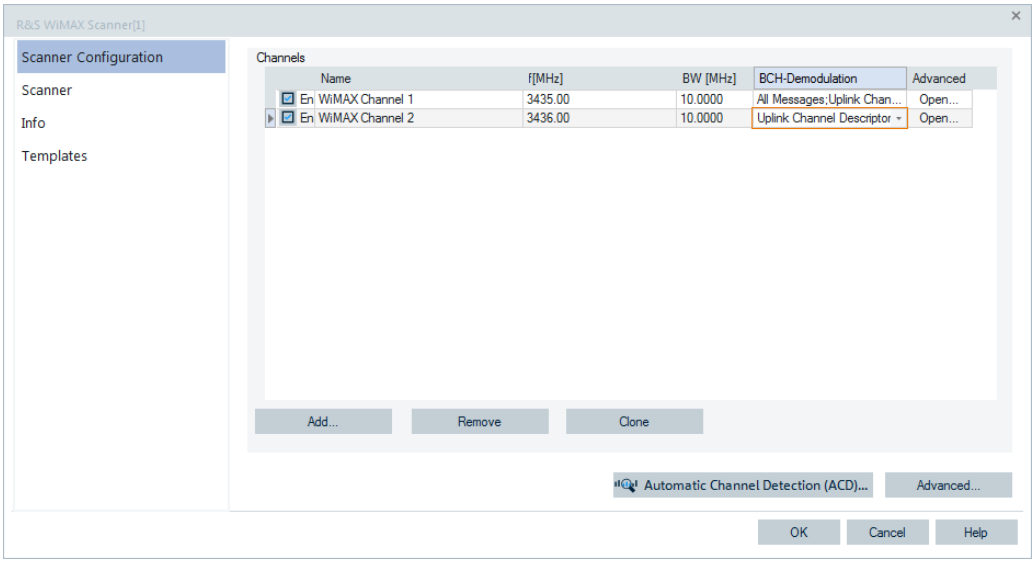


Figure 6-407: WiMAX Scanner

The "Scanner Configuration" page contains the "Channels" table and some buttons.

Channels

The "Channels" table displays a list of channels for scanning.

The user has the options to activate or deactivate scanning of a specific channel, or to allow the scanner to follow another device by choosing the "Virtual Channel" option.

The user can in this table also set the frequency or modify the parameters of an already configured channel. To modify the channel parameters, click the channel's line.

Instead of defining certain channels for scanning, the user can configure channels scanning dynamically. With the Virtual Channel option a primary R&S ROMES4 driver is selected, which dynamically configures the scanner.

This option allows the user to use the scanner without knowing specific frequency of the WiMAX network.

The "Virtual Channel" feature makes possible automatic channel detection (ACD). The automatic channel detection is configurable as a virtual channel. The WiMAX scanner R&S TSME automatically detects channels just by specifying band on which the channels have to be located.

You can enable or disable the scanning of a selected channel or set the "Virtual" channel option via the no-name combo box on the left of the "Channel" pane.

If the "Virtual" is selected, the combo box under the "f[MHz]| BW [MHz]" column offers all the configured sources for the virtual channel, see the following figure. By default the 2.3GHz band is searched.

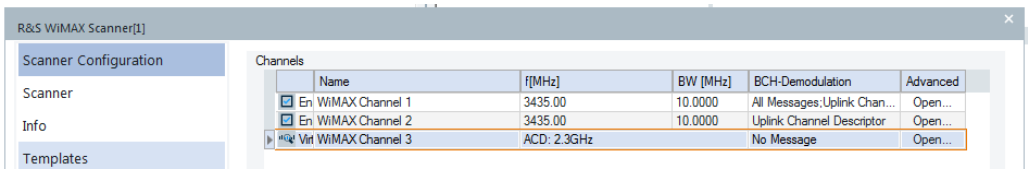


Figure 6-408: Follow specified band for WiMAX ACD

For the ACD configuration, see "WiMAX Automatic Channel Detection" on page 1860.

If the WiMAX channel is detected, the settings concerning the BCH measurements, measurement rates and the advanced settings of the virtual channel are applied to the detected channel.

Note: The "Virtual" option is only available with the ACD option.

The primary device can add and release physical channels during the measurement. It can be useful to ignore the release command.

The following channel parameters are specified:

- "Name"
  Name of the channel, for example, the provider name.
- "f[MHz]" | "BW [MHz]"
  The basic configuration of a channel is the Carrier Center Frequency (f) and the used operating bandwidth (BW). The bandwidth must be selected from a drop-down list. Values allowed in this column are: 3.5, 5, 7, 8.75 and 10. The selected value is shown on top of the drop-down list.
- "BCH-Demodulation"
  The option activates or deactivates during the scanning demodulation of the wanted information. The column has default value "None".
- "Open"
  If you select this entry of the "Advanced" column, the "Advanced channel settings" page opens. The selected setting applies to a single configured channel.
  The possible settings in this dialog are:
  – "Advanced channel settings"
    If you check the "FFT Size" and "Cyclic Prefix Ratio" combo boxes, the selected FFT size and cyclic prefix are set according to defined values.
    The frame rate can be predefined in the "Framerate Hz" text box.

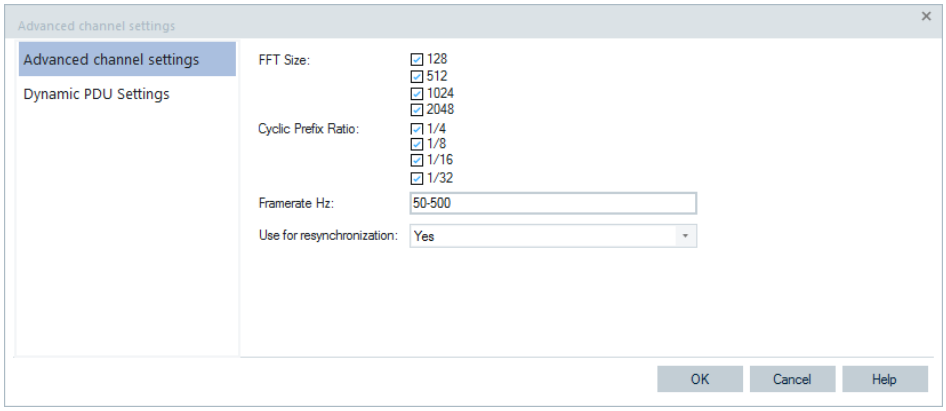


Figure 6-409: WiMAX Scanner - advanced channel settings

Select in the "Use for resynchronization" box the "Yes" option, if this channel can be used for synchronization of the receiver.

– "Dynamic PDU Settings"
The page allows dynamic PDUs handling, refer to "Implementation of the dynamic PDU handling" on page 284.
All the PDUs of the selected channel which can be requested for measurement are shown in a list.

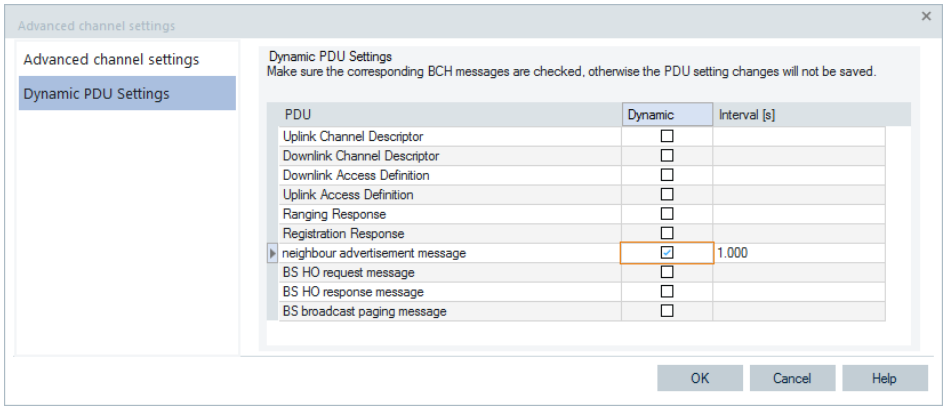


Figure 6-410: WiMAX Scanner - dynamic PDU settings

When a "Dynamic" check box is ticked, the PDU is requested for measurement with the repetition interval specified in the "Interval" column.
Click the "OK" button to add the measurement settings to the selected channel and return to the "WiMAX Scanner Configuration" dialog.
Click the "Cancel" button to discard made changes and return to the "WiMAX Scanner Configuration" dialog.
Click the "Previous" or "Next" button to go through the list.
The default value for interval is 1 second. The possible range depends on the scanner driver for the technology and is checked, see Dynamic PDU Settings.

Add
The button adds a new channel to the list of channels.

Remove
The button removes all highlighted channels from the table of channels.

Clone
The button makes a copy of all highlighted channels, automatically sets the “checked” status for it and assigns name by adding the word “copy” to the original channel name.

Note: The "Remove" and "Clone" buttons are available only if at least one channel in the table is highlighted.

WiMAX Automatic Channel Detection
The ACD configuration is the same as for other technologies. Select the WiMAX bands to use for the ACD, as shown in the following figure.

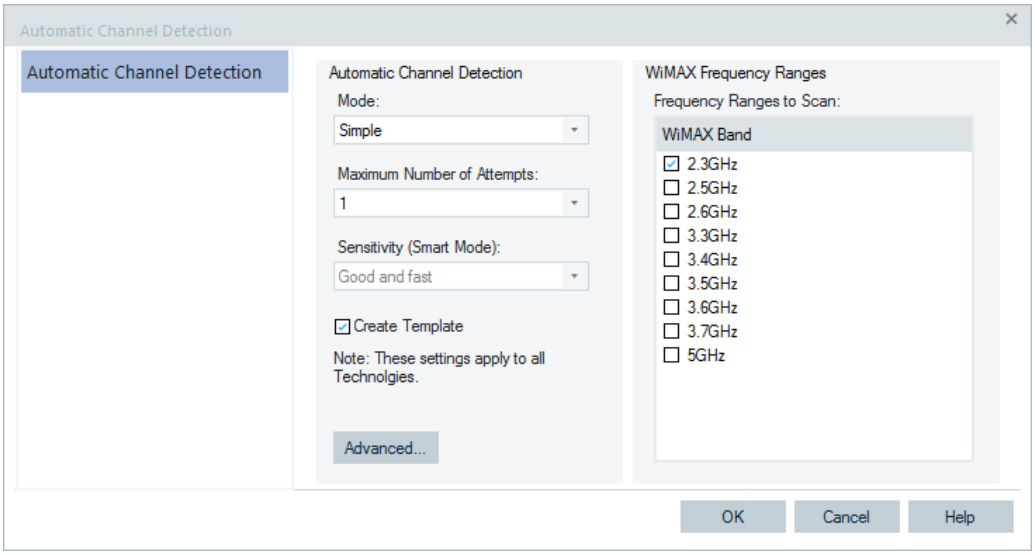


Figure 6-411: WiMAX Scanner ACD configuration page

For the parameters description, see "UMTS Automatic Channel Detection" on page 1798.

Advanced

Click the "Advanced" button. The "Advanced Configuration" dialog opens where you can find the tabs for measurement and BCH demodulation configuration. The button opens common, scanner frequency-independent settings, for details see the following sections.

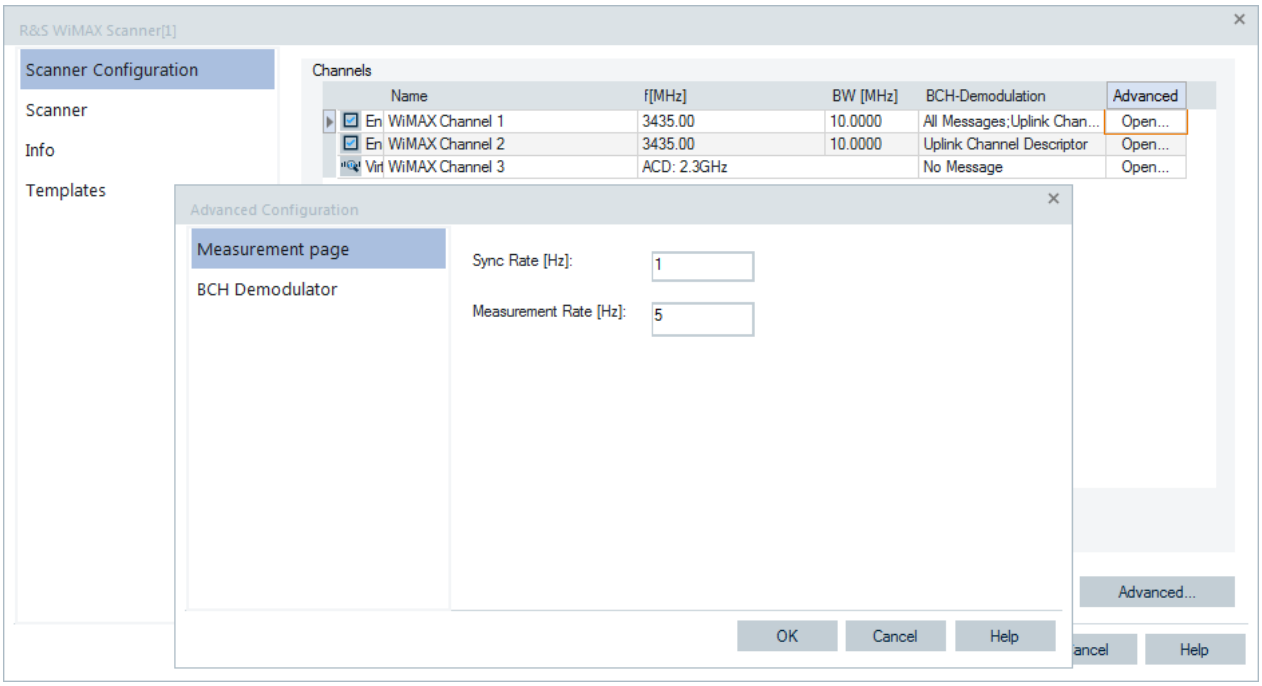


Figure 6-412: Advanced configuration dialog - Advanced button

6.4.25.3 Measurement page

The two input entries define how often the system synchronizes to the received WiMAX signals and updates the measurement file.

- "Sync Rate [Hz]"
  Defines the synchronization rate in Hz.
- "Measurement Rate [Hz]"
  Defines the used measurement rate in Hz.

6.4.25.4 BCH demodulator WiMAX scanner

The "BCH Demodulator" page lets you set the "CINR Threshold [DB]" for BCH demodulator.

Specify the requested minimum BCH signal quality for demodulation. Only scanner peaks with a CINR of at least this threshold value starts BCH demodulation and decoding.

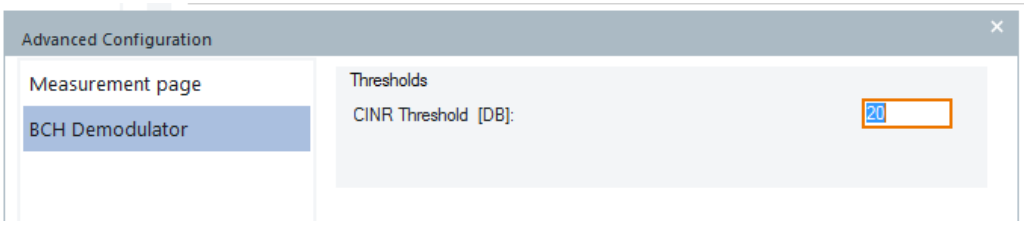


Figure 6-413: R&S WiMAX Scanner - BCH demodulator page

6.4.25.5 WiMAX scanner

The "Scanner" tab displays the properties of the R&S TSME device and information on the file version of the R&S WiMAX scanner driver.

6.4.25.6 Information

The "Info" tab displays information on the file version of the WiMAX driver.

6.4.25.7 Templates

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

6.4.26 CW scanner

6.4.26.1 R&S CW driver for R&S TSME devices

The R&S CW scanner driver controls and provides CW measurements for R&S TSME test devices. The measurements are named R&S CW Scanner.

The R&S K25 option is necessary on the R&S TSME side.

The R&S CW driver for the R&S TSME requires:

- A high-speed Gigabit Ethernet
- The R&S TSME device must be connected to the host PC via high-speed Gigabit Ethernet interface with RJ45 connector using IPv4

Loading devices

The R&S CW driver is loaded into the supported R&S TSME devices using the "Hardware" > "Connect/Disconnect" command. Select the "Network Scanner TSME" > "TSME CW" branch in the opened "Hardware Configuration" > "Available Devices" pane, see Figure 6-40. Double-click the selection to load device.

The device is loaded and displayed in the "Loaded Devices" pane of the "Hardware Configuration" window. Specify the serial number, IP address and the bands for measurement for the loaded device in "R&S CW Scanner(<variable>) Select Device". Click the "Connect" button to confirm the inserted data.

Then, click the "Hardware Configuration" > "Continue" button to store load and close the window.

Loading the R&S TSME network scanner as CW receiver is shown in the following figure.

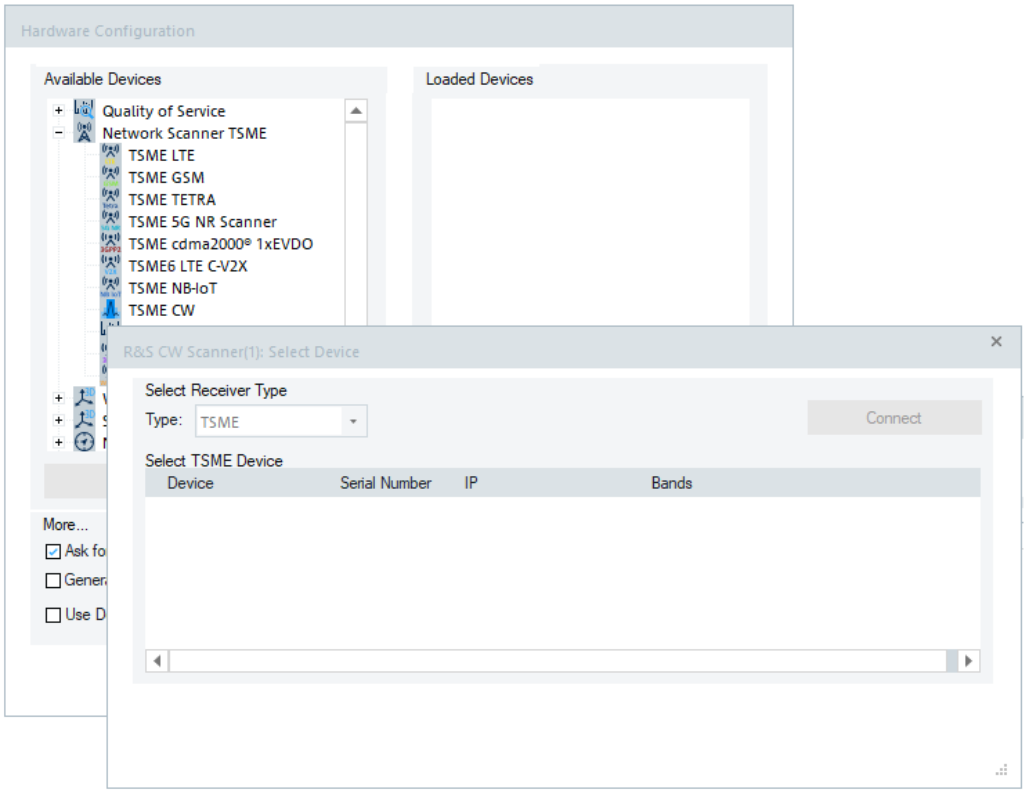


Figure 6-414: R&S CW scanner - selected device R&S TSME

The loaded device is now added as the command line to the "Hardware" menu. Click the command line to open the "CW Scanner(<variable>)" configuration page.

Predefined templates for R&S TSME CW

- Template LTE
  Defines the LTE Band 3, 7, 20 and 28. As the CW receiver can handle up to 512 channels some bands, having more than 512 channels, are split into part 1 and part 2.
- Template TETRA BOS
  The *Startfrequency 380.0125MHz, bandwidth 25kHz, 200 channels* template is created and added to the channel list.

It is possible to load a template within an empty configuration page.

6.4.26.2 Configuration menu CW scanner

The CW scanner configuration relays on a set of tabs. The "CW Scanner" > "Receiver settings" opening page lets you configure the CW scanner for measurements. Here you configure a frequency or band to be measured and the associated parameters. The "Measurement Settings" tab lets you define how to measure the signal. The "Channel Filter" tab lists all predefined channel filters.

The "Scanner", "Info" and "Templates" tabs show the information identical to previously mentioned test receivers and are common for all RATs.

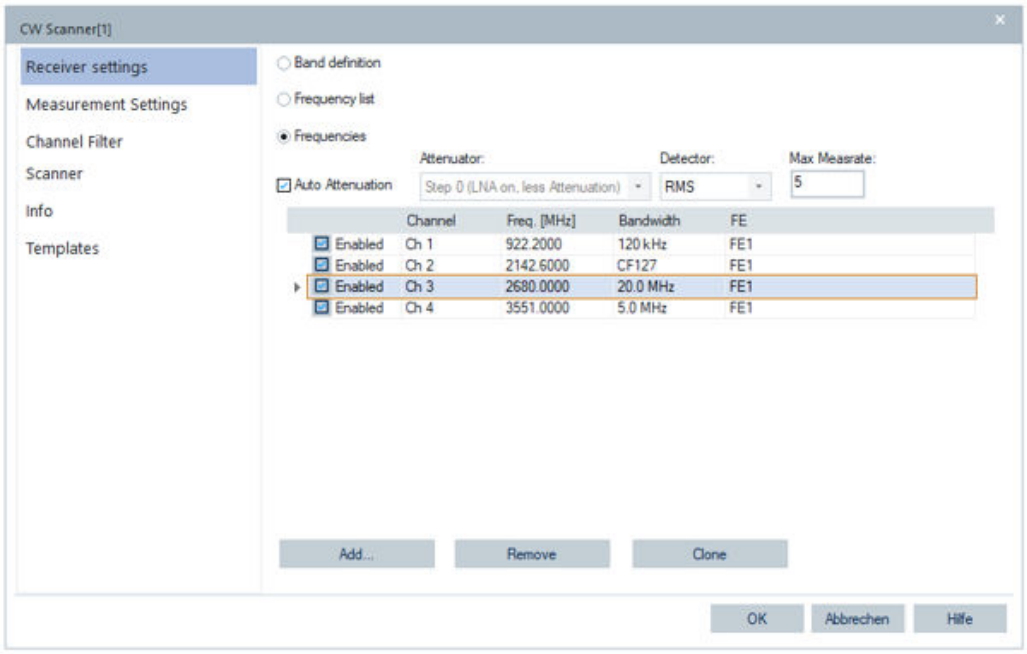


Figure 6-415: CW Scanner page - receiver settings

CW scanner configuration

Receiver settings

Frequencies can be configured as a band definition, frequency list or a frequency. The latest option allows an easy-to-use frequency input GUI.

The default "Frequencies" option applies to the R&S TSME/TSME6. It lets you enter the frequency, its bandwidth and the used frontend.

The "Band definition" option allows measurement on several GSM bands and even simultaneous measurement of several technologies. All the frequencies are listed with their parameters.

A channel at its center frequency and the selected bandwidth is configured. Consider that center frequency +- ½ bandwidth need not to exceed the receiver limits.

A bandwidth could be predefined either by a list of bandwidths or by a defined channel filter.

The channel filters are named CFxxx, where xxx stands for the channel filter indicator number. See "Channel filter" on page 1867 which shows all the predefined channel filters.

Frequencies must be unique, a warning prohibits double entries and also is issued at leaving the configuration page if the maximum of 63 added channels is exceeded.

On a single R&S TSME, there is only one FE available.

By default, "Auto Attenuation" is enabled. The receiver checks its RF paths and sets the optimal amplifier and the attenuator.

For special purposes, the Auto Attenuation feature can be disabled. In that case, one step, out of 3 possible attenuator steps, is fixed applied. This fixing can lead to overflowed data. The setting applies to the whole measurement on all frontends.

Table 6-20: Fixed attenuator's step

Manual Attenuation Steps	R&S TSME
Step 0	All possible LNAs ON, RF Att 0dB, IF Att 5dB
Step 1	All but IF LNA2 ON, RF Att 4dB, IF Att 2dB
Step 2	All but IF LNA2 ON, RF Att 4dB, IF Att 2dB

The "Detector" selectable parameter applies to the whole measurement of all region. The measurement can be Peak/RMS/Min Peak/Average.

The "Max. Measrate" parameter is the desired measurement rate per second, range [1/s] to [1000/s].

"Max. Measrate" is not a guaranteed rate.

As the other measurement tasks can be run in parallel on this receiver and depending on the configured frequencies, the receiver scheduler calculates the measurement rate. This rate could also get larger and smaller, depending on the receivers actual capacity.

The page contains the "Add", "Remove" and "Clone" buttons allowing you to add a new channel for measurement, remove configured one or make a copy of it.

Measurement settings

If "Store raw data" is checked, the raw data (i.e., all the measurement data taken by the test receiver) is saved in a measurement file. Otherwise, only the averaged data is saved.

Measurement time is the time during which the test receiver acquires the measurement data.

Average divider is a few raw data collected for an averaging value. The minimum value is automatically set according to the measurement rate. A higher measurement rate increases the minimum average divider.

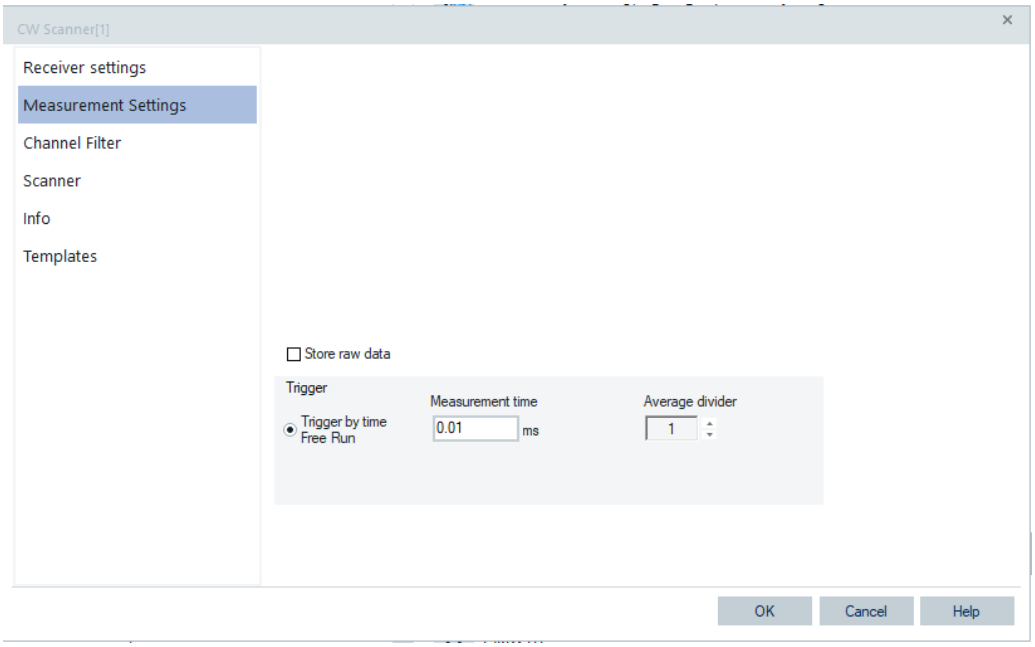


Figure 6-416: Measurement Settings page of the CW scanner

Channel filter

The "Channel Filter" page shows all the predefined channel filters. Each line describes a filter which is stored in the `...\Configuration\ChannelFilterDefinitions.xml` file and is read in into the driver at a start time.

An own filter can be designed by editing the `ChannelFilterDefinitions.xml`.

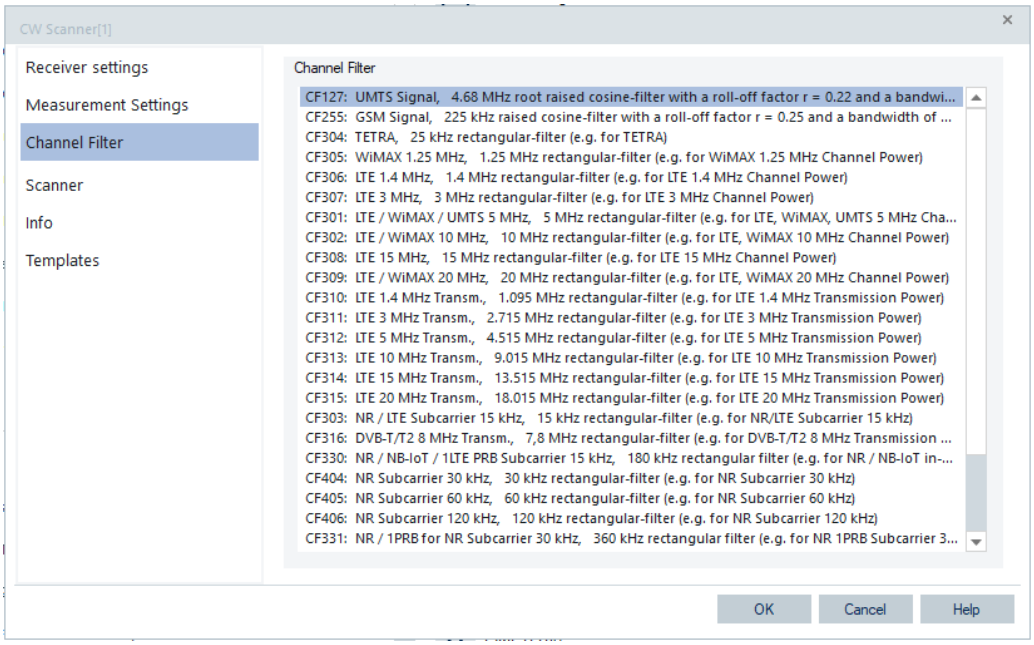


Figure 6-417: Channel Filter page of the CW Scanner

Two channel filters, which also can be used for RF Power scan, are added to the channel filter list of the CW Scanner driver.

- Channel filter with 8 MHz bandwidth named DVB-T/T2 8 MHz Transm.
  It is a rectangular filter with a bandwidth of 7.8 MHz.
- Channel filter with 180 kHz bandwidth, named NB-IoT LTE 12PRB
  It is a rectangular filter with a bandwidth of 180 kHz. It is suitable for NB-IoT measurements on an LTE in-band operation with 12 PRBs.

Support of antenna correction

The R&S TSME CW driver supports antenna correction. Based on this support, it is possible to transduce measurement values to unit dBµV/m.

It is possible to enable and specify an antenna correction file on the configuration page of antenna drivers. The file is a comma-separated file, that is, the `antenna.csv` file, which holds frequencies and correction values. Between these frequencies, the correction values are interpolated.

At measurement time, this antenna correction file is considered.

To apply the antenna correction, change the unit for signal ESVx/EBx Average data to dBµV/m.

Value [dBµV/m] = Value [dBm] +107dB + "interpolated correction value [dB]"

The antenna correction file is only applied if the selected unit is dBµV/m. The correction is not applied if the selected unit is dBm/dBµV.

Views and exports

As the CW measurement data is similar to the former R&S receiver, there are no new views and exports.

The "Alphanumeric View" and the "2D Chart View" are intended to visualize the CW data.

ASCII export is suitable to export CW measurement data.

6.4.27 Support of multiple scanners

R&S ROMES4 supports multiple scanners for R&S TSME device.

It is possible to connect and use more than one scanner of each type.

6.4.27.1 Multiple R&S TSMEs

R&S ROMES4 handles multiple R&S TSMEs as one TSME scanner array. This handling means that some R&S ROMES4 scanner drivers can be connected to multiple R&S TSMEs. These R&S TSMEs are synchronized when connected with the proper sync-cable (TSME-ZC2). Synchronized R&S TSMEs are displayed with the same color in the ROMES Device Manager dialog.

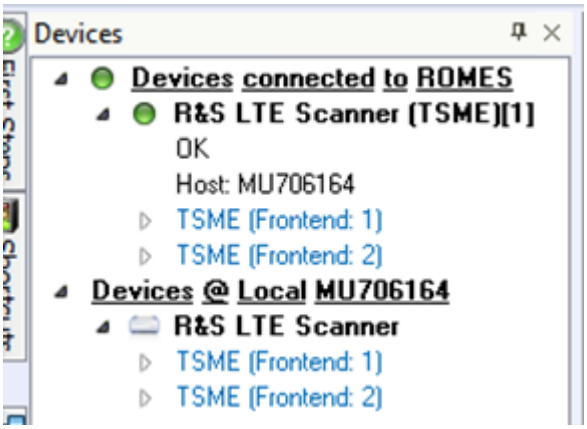


Figure 6-418: Multiple R&S TSME

R&S ROMES4 LTE Scanner can be connected to one R&S TSME or to two synchronized R&S TSMEs.

R&S RF Power Scanner connects automatically to all available R&S TSMEs.

All other scanners use one R&S TSME, as there is no benefit of using more devices.

LTE scanner connection to multiple R&S TSMEs

When loading the LTE scanner, select one frontend. If currently an additional synchronized R&S TSME is available, it is connected to the LTE scanner as well. In this case, select the R&S TSME which you want to use.

If two synchronized R&S TSMEs are connected to the LTE scanner and are used, the scanner can perform MIMO measurements. Select the R&S TSME which you want to use as the narrow-band scanner and the R&S TSME which to use as the LTE demodulator.

By default, the R&S TSME which is initially selected for loading the LTE scanner driver is the selected device. This approach applies both when the device is used as the narrow-band scanner and the LTE demodulator.

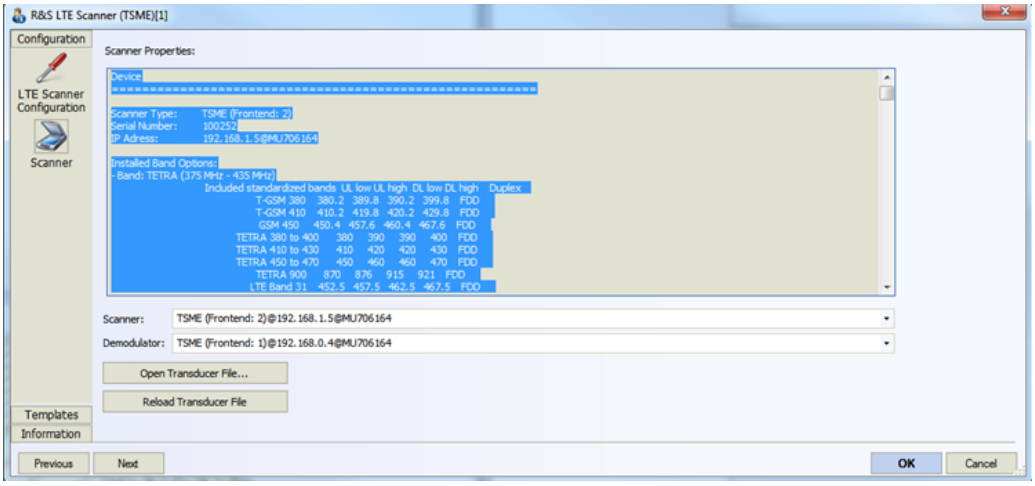


Figure 6-419: LTE scanner properties

6.4.28 BTS position estimation

Estimation process

The R&S ROMES4 BTS Position Estimation function only estimates positions of transmitters from which a new signal has been received since the last estimation. All other transmitters are not estimated again, as no new data is available.

The data of the knowledge base, see "Position Estimation Knowledge Base File" on page 1877, is used as initial state of the estimation result collector if using the Knowledge Base function. To improve the estimation results, it is highly recommended to use a knowledge base.

The R&S ROMES4 signals report the number of estimated transmitters for the number of reported positions since the last estimation.

This number only reflects the number of estimated positions during the last estimation, and not the number of all estimated positions during the complete measurement.

BTS position estimation prerequisites

To estimate a BTS position, the option R&S ROMES4LOC must be available. The BTS Position Estimator calculates BTS locations from GSM, WCDMA, cdma2000, EV-DO, LTE, NB-IoT, TETRA or WiMAX scanner measurements, GPS position measurements and high accuracy PPS signals.

Position estimation is only possible under the following preconditions:

- At least one scanner driver of the previously mentioned technologies must be loaded.
- A GPS receiver supporting a PPS pulse. PPS routed to the corresponding R&S TSME.
- The system must be moving to deliver results.

The scanner needs 100 PPS pulses to synchronize its internal time base correctly to the GPS system. Therefore, a measurement delivers results not earlier than 2 minutes after start of measurement.

BTS position estimation and automatic channel detection

Automatic Channel Detection can be used together with the BTS Position Estimator.

However, during the phase of adapting the timing between PSS, GPS and PC, the ACD does not change the configuration of the scanner, even if a new channel was detected. After the BTS Position Estimator has finished this process (which takes about two minutes), the scanner will be reconfigured and scans the additional channels.

6.4.28.1 Load the BTS position estimation driver

The first step is to load the Position Estimator driver.

To load the driver, perform the following steps:

1. Click the "Hardware" menu.

   The "Hardware Configuration" page pops-up.

2. Select the "Others" > "BTS Position Estimator" command line from the "Available Devices" list.

3. Click the ">" button to place the driver in the "Loaded Devices" list.

4. Click "Continue".

   The driver is loaded now. The loading is indicated with the added "BTS Positon Estimator" command line in the "Hardware" menu.

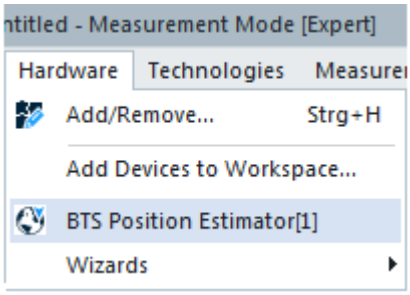


Figure 6-420: Loaded BTS Position Estimator

6.4.28.2 Scanner settings for the BTS position estimator

Click the "BTS Position Estimator" command line to get the configuration page.

By default, the "BTS Position Estimator [<variable>]" > "Scanners" page allows you technologies and scanners to include/exclude for position estimation.

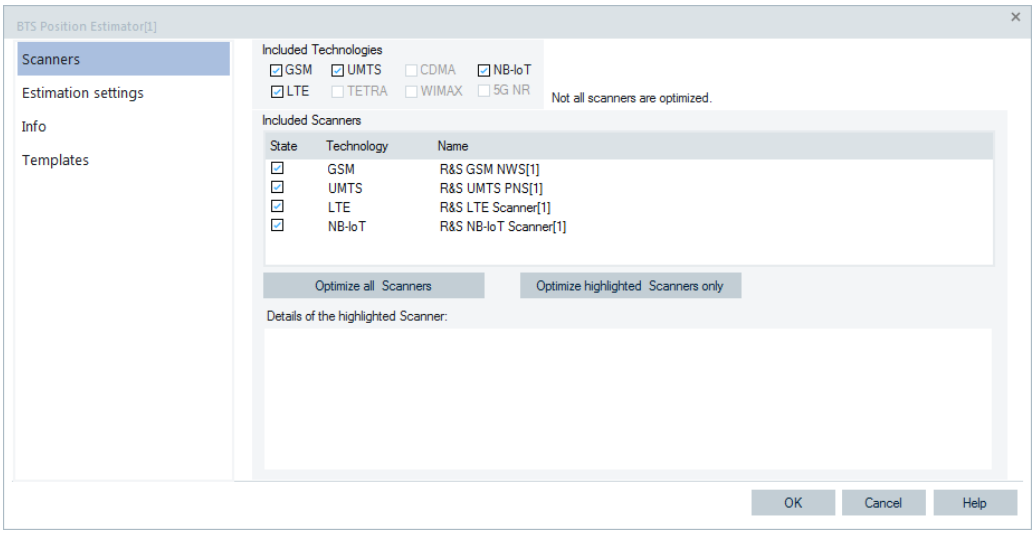


Figure 6-421: Case not all scanners are optimized

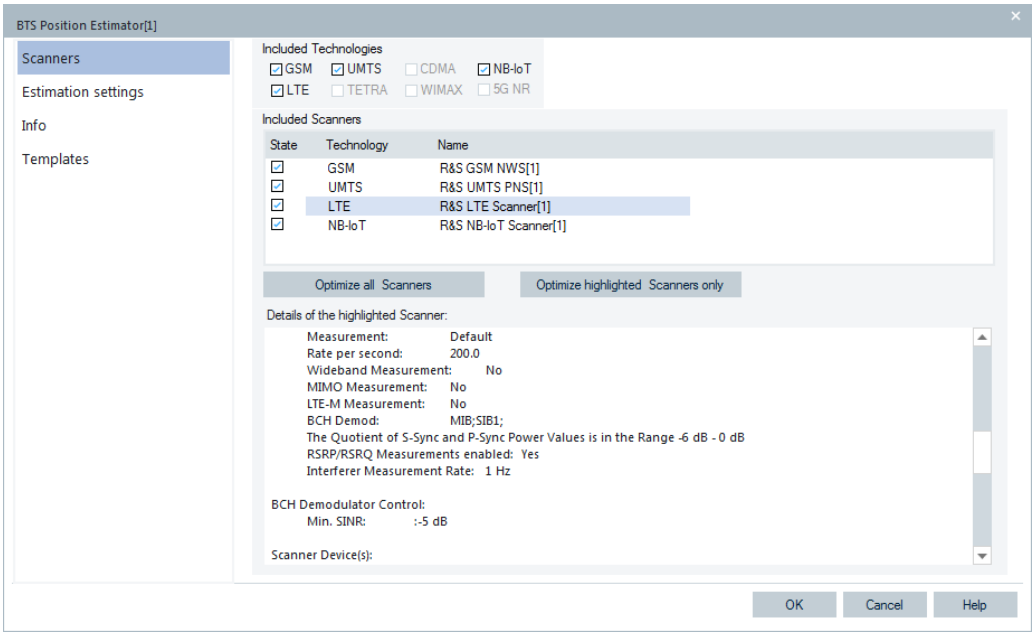


Figure 6-422: Case all scanners are optimized

The Position Estimation algorithm supports the 5G NR scanner data. Analog to the other technologies, the scanner can be loaded and the position estimator can be configured to estimate the positions and antenna directions of the detected cells.

As a cell identity is often not available in 5G non-standalone networks, the identification of the cell has to be done by frequency and PCI. Do the position estimation per cluster to ensure that PCI is unique per cell on a certain frequency.

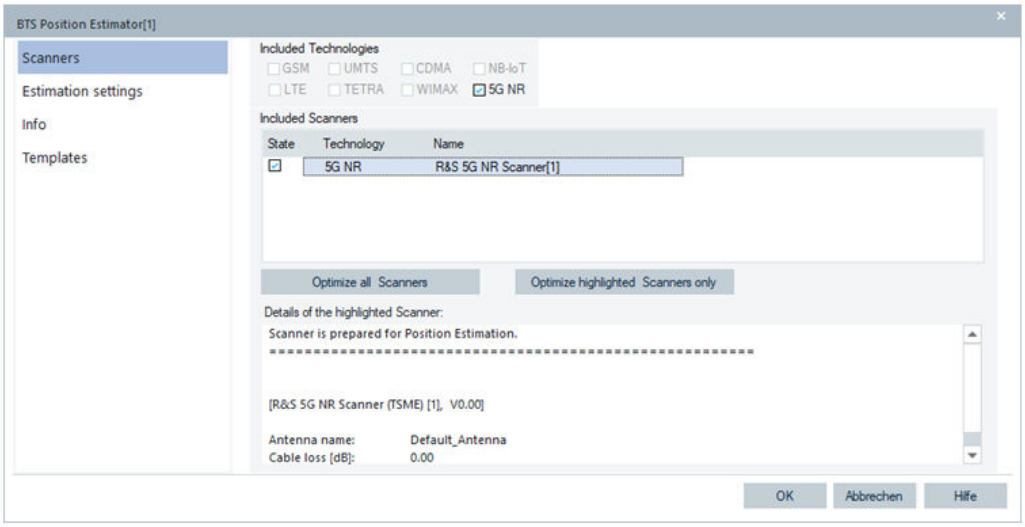


Figure 6-423: Position estimation enabling for 5G NR scanner

The position estimation is done per PCI. The estimated position is mapped to all beams of the PCI in the "5G NR BCH View".

The following parameters in the "BTS Position Estimation" dialog can be set.

Included Technologies
Default technologies are automatically included. The check-boxes per technology let you include or exclude certain technology.

The results are shown in the "<RAT> BCH View" and the "ROMESMAP Route Track View".

Included Scanners
The available scanner drivers of the included technologies are shown in the "Included Scanners" list.

All scanners are included per default in the position estimation process. The check boxes per scanner let you include or exclude certain scanner in the list.

If you select a scanner in the list, its configuration details are shown in the "Details of the highlighted Scanner" field.

TIP: For getting better results, it is recommended to set the average measurement rate for the scanner as high as possible. The measurement rate for each scanner is configured directly within the configuration menu of the scanner driver.

Note: The NB-IoT scanner requires a lot RF time of the scanner device. Thus, the scanner measurement rates for other technologies can drop significantly. This drop can lead to the worse position estimation results compared to those results you can get without the NB-IoT scanner.

Scanner Optimization
The BTS Position Estimator checks if the settings of the scanners are optimal for position estimation. The scanner settings for the position estimation are signaled in the "Scanner" page. Three states can be signalized by a red, yellow and green dot in the upper right corner of the "Included Technologies" field.

In general, the scanners have to be configured to produce as many as possible result, measured with the most sensible algorithm. Disable all measurements which are not used for the position estimation process. Also, demodulate only the necessary broadcast messages.

- Green: All scanners are set up with the optimal configuration for position estimation.
- Yellow: Some of the scanners are not configured optimal for position estimation. The scanner delivers the necessary data and allows a measurement to start.
- Red: Mandatory settings for using the position estimators are wrong. Such a wrong mandatory setting can be a synchronization method other than PPS or missing GPS driver.

The BTS Position Estimator optimizes scanners settings automatically. There are two optimization options.
- "Optimize all Scanners": All included scanners are optimized.
- "Optimize highlighted Scanners only": Only the highlighted scanners are optimized.

Note: If some essential settings of the scanner are currently not correct (for example, missing specified frequency or channel), the optimization can fail.
The configuration page of the scanners can also be opened by a double-click the item in the list.

6.4.28.3 Estimation settings for the BTS position estimator

The Position Estimator parameters are set in the "BTS Position Estimator" > "Estimation settings" page.

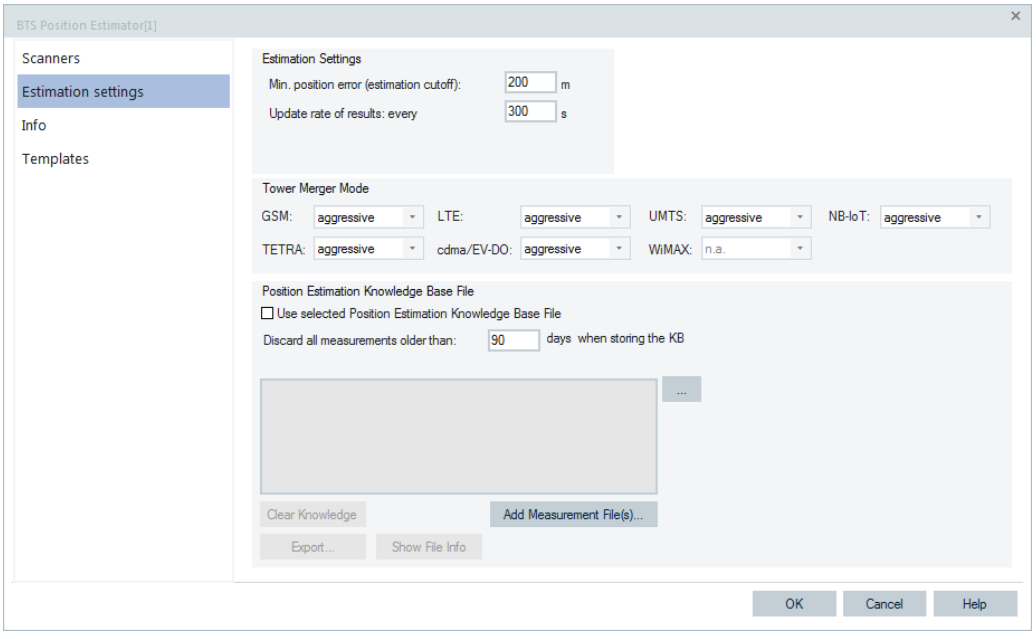


Figure 6-424: Estimation settings

The following parameters can be set.

Min. position error (estimation cutoff)
Defines a distance in meter which limits the position estimation to a reasonable accuracy for performance reasons. If the 66% probability of the estimated position falls below this distance, the estimation process for this transmitter is finished.

Update rate of results
Defines the period in seconds between estimation orders for the position estimator. After executing the estimation order, the new position estimation results will be requested from the position estimator and will be stored in the measurement file (`*.rscmd`).

The result frames are distributed to R&S ROMES4. They can be viewed in the scanner BCH views of all RATs containing BCH that R&S ROMES4 demodulates.

Tower Merger Mode
By assuming that several transmitters are on the same tower (geographic position), the estimation algorithm can improve the estimation accuracy significantly.

The following tower merging modes are supported:

- "Off"
  Prevents merging the position of towers
- "Moderate"
  Ensures that no signals are merged by mistake at the cost of less merged signals
- "Aggressive"
  Improves the number of merged signals at the cost of a higher probability of wrong assumptions

The moderate and aggressive merger modes are both based on counting the number of "positive indications". The modes only differ in criteria for the positive indication and the needed number of indications for merging.

The positive indication means that the sectors are synchronized, i.e. the sectors were measured within a start-stop cycle of a scanner and met the arrival time condition.

In moderate tower merger mode the estimator assumes that the sectors belong to the same tower if at least 5 positive indications were found fulfilling the additional distance requirement. The measurements must be collected at least 200 m away from a straight line. This line represents a major axis of a least square fitted ellipsis created with all candidate measurement locations. The positive indication is counted if the following is fulfilled:

- Arrival time difference is less than 1 µs
- At least 5 such measurements at different locations were collected
- Both sectors are measured within 0.5 sec or, when the measurement distance is less than 100 m, within 10 sec

In aggressive tower merger mode the estimator assumes that the sectors belong to the same tower if at least 3 positive indications at different locations were found. The positive indication is counted if the following is fulfilled:

- Arrival time difference is less than 2 µs
- At least 5 such measurements at different locations were collected
- Both sectors are measured within 0.5 sec or, when the measurement distance is less than 1000 m, within 20 sec

If the signal arrival time difference is bigger than 4 µs, different tower locations for sectors are assumed both in moderate and aggressive tower merger modes.

The mode can be configured separately for each radio technology, as each technology has additional preconditions for merging.

Table 6-21: Technology dependent merging precondition

Technology	Remarks concerning tower merger
GSM	The time offsets are measured between both hyperframes (51 * 26 * 2048 TDMA Frames; about 3.48 hours frame duration). Both GSM signals must have equal MCC/MNC but different frequencies.
UMTS	The time offset is measured between the 10ms radio frame of a signal and a time shifted 10ms radio frame of the other signal. The allowed time shift is +/- 256 chips or +/- 512 chips. Both WCDMA signals must be transmitted at the same frequency and equal MCC/MNC but the primary scrambling code must be different.
TETRA	The time offsets are measured between timeslots (14.167 ms duration). For accurate time of arrival estimation, only the slots containing sync bursts are used. For tower merging, both signals must have the same MCC/MNC and LA but different carrier numbers.
LTE	The time offsets are measured between the 10 ms frames of both stations. The reference signals are used as markers. For tower merging both signals must have the same carrier frequency, MCC/MNC but different physical cell IDs.
cdma2000	The time offsets are measured between PN code sequences (26.66 ms). Both cdma2000 signals must have equal PN Offset, SID, NID, REG_ZONE and BASE_ID but different frequencies. Note: A cdma2000 network can be configured in a way that all these parameters are equal at different channels.
EV-DO	The time offsets are measured between PN code sequences (26.66 ms). Both EV-DO signals must have equal PN Offset SECTOR_ID128 or SECTOR_ID24 but different frequencies. Note: An EV-DO network can be configured in a way that all these parameters are equal at different channels.

NB-IoT	No NB-IoT specifics
5G NR	No5G NR specifics

Position Estimation Knowledge Base File

- "Use selected Position Estimation Knowledge Base File"
  Use or not a knowledge base file to enhance later measurements. If the flag is checked, the currently selected knowledge base is sent to the position estimator at the start of measurement. The knowledge is used in the estimation process if at least one estimation was executed. The knowledge base of the estimator is written to the current knowledge base file (overwriting the old contents).
- "Discard all measurements older than xxx hours when storing the KB"
  For performance reasons and data volume limiting; The option to discard older measurements (than <*xxx*> hours) from the knowledge base when storing the file.

Button

The pathname of the current position estimation (PE) knowledge base file. By pressing the "…" button, the file can be selected in an enhanced file chooser dialog, which shows also a summary of the content of the selected knowledge base. Also a new (empty) knowledge base can be created in the file dialog by typing a new file name and pressing "OK". The extension `.pekb` is automatically added if not already specified.

Clear Knowledge

The content of the current knowledge base file can be reset to the initial empty content by using this button.

Add Measurement File

This function allows you to add your measurement files to the Knowledge Base File.

To add the measurement files, load the Position Estimation driver into R&S ROMES4 and select the "Estimation settings" page.

Export

The driver allows you to export the content of the given knowledge base file. The content looks like here shown.

#,MinUtc,MaxUtc,Network,MaxPower[dBm],Frequency[kHz],TowerID,Longitude[°],Latitude[°],l1[km],l2[km],phi[°],Estimation,Direction,ConfidenceInterval,MCC(GSM/UMTS/TETRA/LTE/5G NR),MNC(GSM/UMTS/TETRA/LTE/5G NR),LAC(GSM/UMTS/LTE/TETRA/5G NR),CellID(GSM/UMTS/LTE/5G NR),PCI(LTE/5G NR),BSIC(GSM),SC(UMTS),NID(cdma2000),SID(cdma2000),BaseID(cdma2000,EVDO),PN(cmda2000/EVDO),Country-Code(EVDO),Sector24ID(EVDO),BtsID128Bit(EVDO),BaseStationID(WiMAX),Segment(WiMAX),Cell(WiMAX),Preamble(WiMAX)

The following table provides description of the file content.

Table 6-22: Exported data of the Position Estimation Knowledge Base file

Content	RAT	Description
UtcMin	All	The first time when this BTS was measured
UtcMax	All	The last time when this BTS was measured

Content	RAT	Description
Network	All	GSM, UMTS, LTE, NB-IoT,...
MaxPower	All	Max. received power of the transmitter
Frequency	All	Frequency of transmitted signal
TowerID	All	ID of the tower. This ID is assigned by the tower merger and is used only internally
Longitude	All	Estimated longitude
Latitude	All	Estimated latitude
I1. I2, phi	All	Error ellipse of estimated position
Estimation	All	Type oif estimation. Estimation is based on power or time
MCC	GSM, UMTS, TETRA, LTE, NB-IoT	Mobile Country Code
MNC	GSM, UMTS, TETRA, LTE, NB-IoT	Mobile Network Code
LAC	GSM, UMTS, LTE, NB-IoT, TETRA,	Location Area Code, respectively Location Area for TETRA
CellID	GSM, UMTS, LTE, NB-IoT	Layer 3 cell identity
BSIC	GSM	Base Station Identity Code
SC	UMTS	Scrambling Code of NodeB
PCI	LTE, NB-IoT	Physical Cell Identity for eNodeB
NID	cdma2000	Network ID
SID	cdma2000	System ID
BaseID	cdma2000/EV-DO	BaseID of the 3GPP2 transmitter
PN	cdma2000/EV-DO	PN-offset of the 3GPP2 transmitter
CountryCode	EV-DO	Country code of the EV-DO transmitter
Sector24ID	EV-DO	24 bit sector ID of the EV-DO transmitter
BtsID128bit	EV-DO	128-bit Layer 3 transmitter ID of the EV-DO transmitter
Segment	WiMAX	Segment of the WiMAX transmitter
Cell	WiMAX	Cell of the WiMAX transmitter
Preamble	WiMAX	Preamble of the WiMAX transmitter

Note: This file is for information only and cannot be imported as transmitter list into R&S ROMES4 again.

Show File Info
The button displays a dialog which shows details of the content of the current knowledge base file. The provided details are the same as the info shown in the file chooser dialog.

6.4.28.4 TecPE: signals of the BTS position estimator

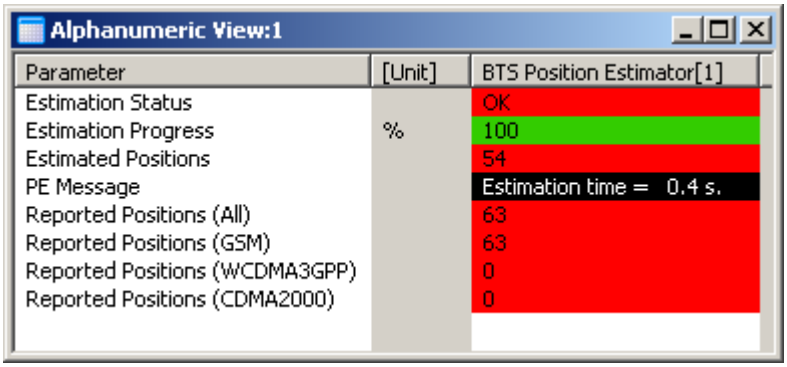


Figure 6-425: Overview of the available signals for Position Estimator

The signals allow error conditions detection and monitoring the progress of the estimation process.

The status of the position estimator is polled every 5 seconds during the first minute of measurement and in this time the Estimation Status goes to OK.

If the Estimation Status OK is reached, the estimation cycle is started and estimation results are reported periodically.

6.4.28.5 Measuring with the BTS position estimator

Preconditions

- This measurement mandates that the scanner is used with a PPS signal, so this request must be provided by the hardware and software setup.
- With a scanner a GPS source and a PPS signal available, a measurement can be configured.
- The estimation process needs from each transmitter a set of measurements which are taken from different locations.
- The locations are distributed in a larger area and are not on a single straight line. Useful patterns could be a round trip or two lines with a large crossing angle or parallel lines in a reasonable distance.

The current position estimation results can be viewed during a measurement in the scanner BCH view of all RATs for which R&S ROMES4 demodulates BCH.

The Position Estimation algorithm also tries to estimate the direction of each sector/cell (=azimuth), that is, makes the azimuth estimation. Apart from displaying the azimuth values in the BCH views, the BTS symbols are displayed on the map accordingly. The following figure of the "5G NR BCH View" shows the sector/cell direction.

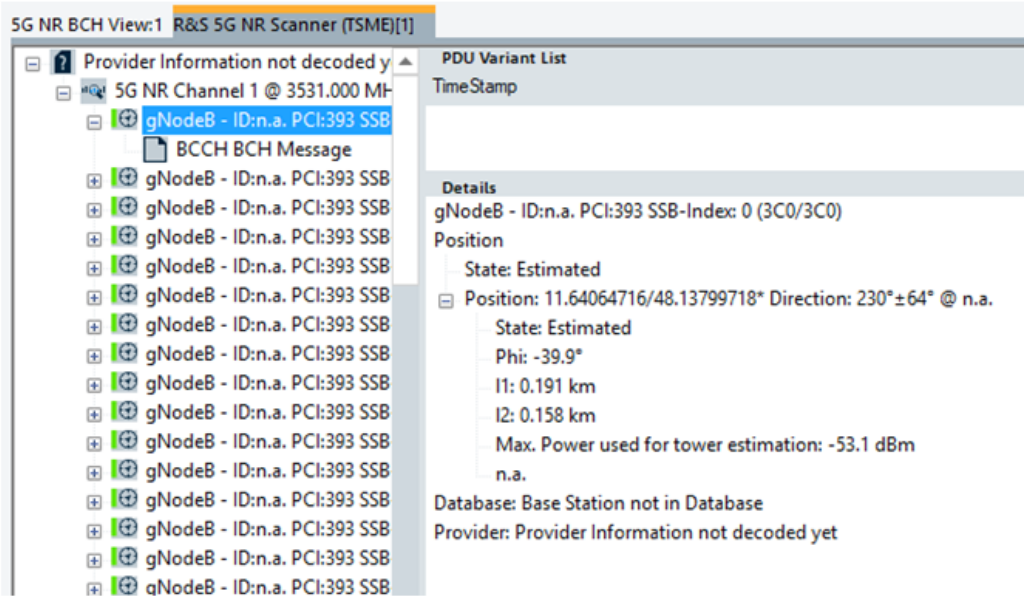


Figure 6-426: BCH View - position estimation details

6.5 Quality of service

This chapter is dedicated to data quality testers which test and analyze services independent on devices on which the services run or technology. They can be loaded as explained in Chapter 6.1, "Devices", on page 1447, however, the ports (if needed) are assigned in the device configuration menus.

- Data quality tester (DQA)....1880
- DQA jobs with Android OS-based smartphones....1961
- DQA jobs with iOS-based smartphones....2049
- DQA KPIs aggregation in KPI generator....2060

6.5.1 Data quality tester (DQA)

The Data Quality Analyzer (DQA) controls the measured parameters and assesses the Quality of Service (QoS) of any kind of data transfer connections using the R&S ROMES4DQA option. In the further text the DQA is also named the data quality tester (also the DQA tester).

For the installation of the tester, see Chapter 6.1.2, "Hardware dialog for loading devices", on page 1449.

The DQA obtained data can be viewed in the "View" > "QoS Views" > "DQA" pages, see Chapter 3.3.15.1, "DQA", on page 180.

DQA sets the tester's state according to the test results to:

- OK if any job has a failure rate less than 20% of the last 5 executions.

- WARNING if any job has a failure rate more than 20% of the last 5 executions.
- ERROR if any job has a failure rate more than 80% of the last 5 executions.

6.5.1.1 Resources configuration DQA

The DQA is loaded by selecting the "Quality of Service"> "Data Quality Analyzer" branch in the "Available Devices" pane of the "Hardware Configuration" page. Click the "Hardware" > "Connect/Disconnect" menu entry to get the page.

When the tester is installed, the entry "DQA[1]" is added to the "Hardware" menu. Click "DQA[1]" to open the DQA configuration page letting you set up different types of connections.

The DQA loading does not require any hardware or additional test devices. The data quality tester can be used to test the QoS of any kind of physical connection between the test system and a remote entity.

The connection can be a network connection established with test mobiles supporting any mobile technology or a fixed connection to a remote server accessible from the test system.

If test mobiles are used, the results of the DQA complement the information acquired with the test mobile device.

6.5.1.2 DQA settings

To configure the QoS test that you are interested in, select and arrange jobs available in the default opening page "DQA Settings" of the "DQA[1]" menu entry. The page is fully editable with keyboard. The focus is visualized over all control buttons.

Speech quality and voice test are supported. Simple and extended voice call tests can be set in the UE configuration. If a voice test is configured in the DQA job list, the UE configuration is overwritten.

The available jobs are grouped by the job types in the "DQA Settings" > "Available Jobs" list. The list has a tree structure. The branches of the tree and the jobs they include depend on a mobile device type and its supporting operation "Mode".

The R&S ROMES4 DQA supports for the On PC testing (Classic mode) devices the following jobs or groups of jobs:

- Connect to Network
- Call Session Start
- Disconnect to Network
- Call Session End
- HTTP
- FTP
- Performances
- Miscellaneous
- Mobile
- Batch

The first four previously listed entries are DQA jobs, other are groups of jobs of the similar type.

For the DQA jobs which support devices configured in fully integrated device use mode, see Chapter 6.5.2.1, "DQA jobs with fully integrated devices", on page 1962.

Click a branch to expand the tree and see all the available jobs.

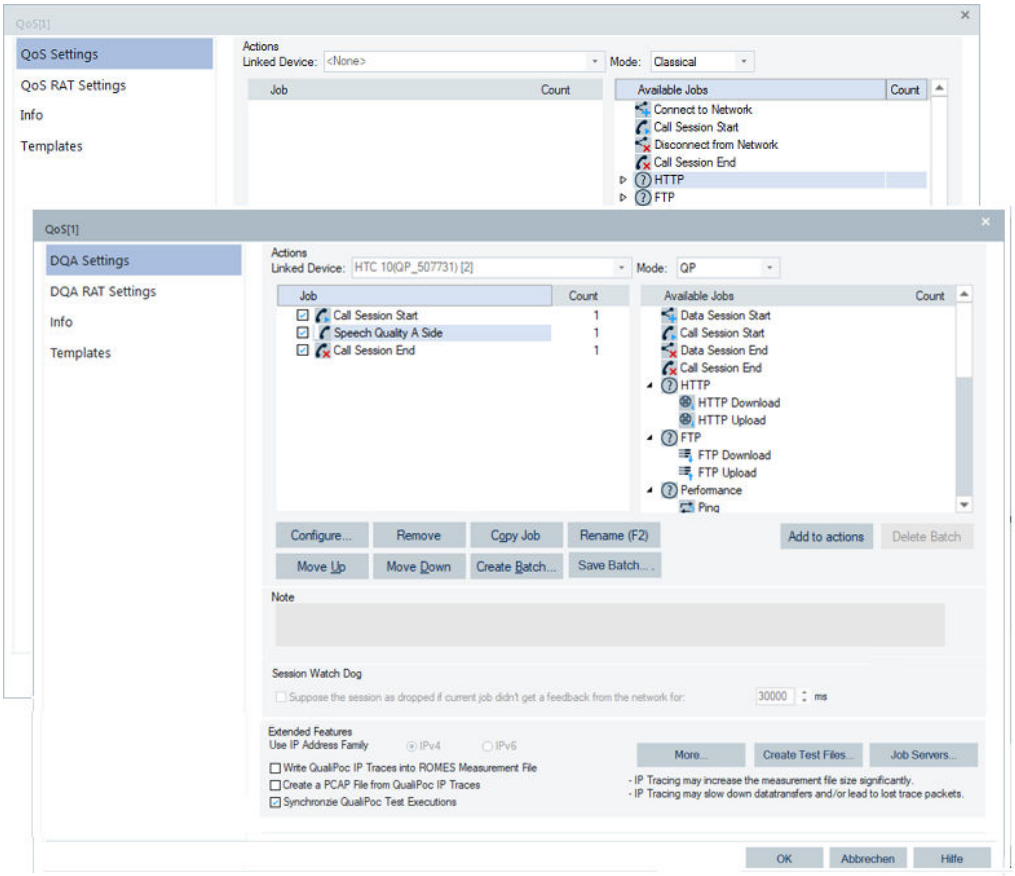


Figure 6-427: DQA configuration page

It is possible to mix available jobs. Select a job from the "Available Jobs" list and drag and drop it into the "Job" pane.

For example insert them in the following order:

1. Data Session Start
2. FTP DL
3. Data Session End
4. Call Session Start
5. Call Any Number
6. Call Session End

A voice or speech quality test is performed in parallel with one or two data jobs. The data jobs run sequentially.

For the configuration of speech quality and voice tests, see the case of the devices operating in fully integrated device use mode shown in Chapter 6.5.2.5, "Voice and speech jobs", on page 1973.

Actions
The following functions are part of the "Actions" pane.

Linked Devices ← Actions
Loaded devices are listed in the drop-down box. Select a device from here for direct DQA usage.

The DQA direct usage means that devices in this box are in use by data quality tests and an analysis instance and cannot be used by other analysis instance.

A log file to run each test is created in the <My ROMES>/LogFiles directory.

How to include a device in the list, refer to Chapter 6.1.3, "Connection via COM port", on page 1454.

The value "<None>" selected in "Linked Device" switches the DQA back to On PC testing (Classic mode) use mode.

The app for the "Diversity Data" tests is installed and updated automatically when such tests run. As for the mobile, change its settings by clicking "Settings" > "Developer Options" > "USB-Debugging". No further mobile station manual preparations are needed.

Mode ← Actions
Possible modes of operation of the DQA available jobs. The selected mode depends on a mode of operation a device can support.

You can select among the following modes:
- On PC testing (Classic mode) mode
- Classic mode 2
- Fully integrated device mode (QualiPoc)
- IPhone mode

Available Jobs ← Actions
A list of DQA jobs available for quality test and analysis.

Drag and drop or double mouse click the selected job to move it to the "Job" pane. The job's configuration page opens where you can connect/select a test file of definite size for transfer.

Job ← Actions
Once configured, the job is included in the "Job" pane.

The jobs in the "Job" pane are executed in the following order of appearance in the pane.

1. A job sets up a call to a network provider.
2. Downloads a file from a service remote server.
3. Waits for a predefined time period.
4. Releases the call from the network provider.

The entire job list is executed repeatedly as long as the DQA measurement is running.

It is possible to change the name of a job to a custom name directly from the list. Click the name and change it.

Note: Name of jobs used in a multi RAB session cannot be changed.

Note: It is not possible to calculate ETSI trigger points if a job runs more than once in a session loop.

In the "Count" row you can define how many times the selected DQA job has to be executed in a session loop. The default value is 1.

Click the column and insert preferred value. The value in the "Count" row is displayed only for the entries in the list that allow change.

Buttons ← Actions

- "Configure"
  Opens the configuration page of a selected job. The job's configuration page can be opened also when double-clicked the job.
  The opened page provides address fields for the remote access and additional settings, for example, timeouts. Each job has own configuration page. The button is disabled if there are no jobs in the "Job" pane.
- "Remove"
  Removes the job selected in the "Job" pane.
- "Copy Job"
  Duplicates the job selected in the "Job" pane.
- "Rename (F2)"
  Rename an action by pressing this button or use F2 function of your keyboard.
- "Move Up"/"Move Down"
  The jobs in the list can be moved up and down using these buttons, respectively.
- "Create Batch"
  Creates a batch job for reusing. Click the button to define a name of a new batch job. For details, see Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891.
  The feature is helpful for setting up AT command scripts for NB-IoT and for normal tests.
- "Add to actions"
  Adds available jobs.
- "Delete Batch"
  Deletes the created batch job.
- "Save Batch"
  Edits existing batches and saves them. For details, see Chapter 6.5.2.12, "Batch for fully integrated devices", on page 2047.

Note
Shows a description of the job selected from the job list.

Session Watch Dog
A watch dog process monitors the activity of the network adapter of the used connection during a current DQA job session.

Check the associated combo.box to consider the session as dropped if the current job seems to hang due to no response from the network for the specified time.

Extended Features
The "Extended Features" pane supports IP tracing, timing / statistics of a DQA session control, test files and job servers creation.

The IP Tracer is activated in the job configuration menu, as shown in Figure 6-435.

The following functions are part of the "Extended Functions" pane.

Use IP Address Family ← Extended Features
Lets you select the wanted IP address version. The views show IP of the accessed server in the selected IP version's format.

Note: A job fails if IPv6 is selected and a job establishes a connection to a server which only supports IPv4 and vice versa.

Write QualiPoc IP Trace into ROMES Measurement File ← Extended Features
This function is not applicable for the devices operating in Classic mode and the line is dimmed.

. The function is only available in fully integrated device use mode (QualiPoc mode) of smartphones with Android OS with SQ Android interface, see Chapter 6.5.2.1, "DQA jobs with fully integrated devices", on page 1962.

Create a PCAP File with QualiPoc IP Traces ← Extended Features
This function is not applicable for the devices operating in Classic mode and the line is dimmed.

The function is only available in fully integrated device use mode (QualiPoc mode) of smartphones with Android OS with SQ Android interface, see Chapter 6.5.2.1, "DQA jobs with fully integrated devices", on page 1962.

Synchronize QualiPoc Test Executions ← Extended Features
This function is not applicable for the devices operating in Classic mode.

The function supports synchronization of DQA job execution for QualiPoc tests of different UEs. To activate this function, "Synchronize QualiPoc Test Executions" has to be enabled for each QoS (UE) whose job executions you want to synchronize.

For the supported cases of synchronization of DQA job execution for QualiPoc tests, see Chapter 6.5.2.1, "DQA jobs with fully integrated devices", on page 1962.

More ← Extended Features
Opens the "More Extended Features" page.

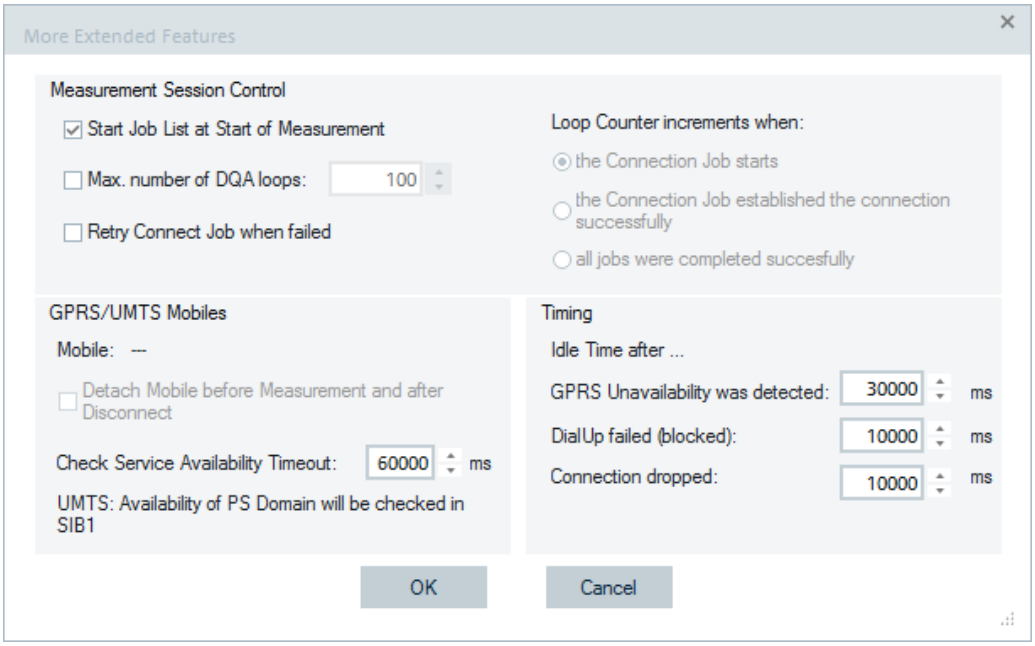


Figure 6-428: Selecting extended features

How to execute the job list and how often is configurable in the check boxes of the "Measurement Session Control" pane.

The following options are configurable in the pane:

- "Start Job List at Start of Measurement"
  If active, the entire "Job" list is automatically started when the QoS measurement is initiated ("Measurement" > "Start Measurement"). Otherwise, it is paused and can be initiated via "Action" > "DQA" > "Enable DQA".
  If the job list has been changed at the start of a measurement, the function is improved with the option to start jobs of all loaded QoS testers.
  At pressing the "More Extended Features" > "OK" button, the message box pops-up asking you if to start jobs for all loaded QoS testers.

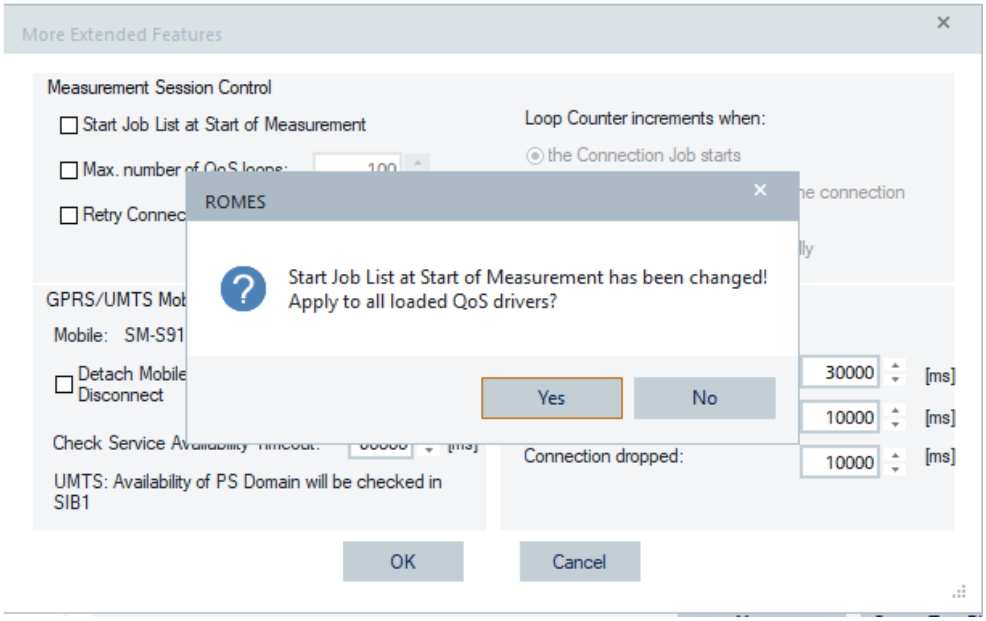


Figure 6-429: Activation of all measurement for jobs of all loaded DQAs

Press "OK" in this message box. The setting for "Start Job List at Start of Measurement" is immediately set in all loaded QoS testers.
In the "Action" menu there are the menu entries to activate/deactivate all load QoS testers at once.

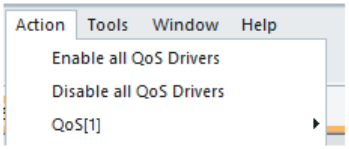


Figure 6-430: Entries associated to the option

- "Max. number of DQA loops"
  Limits the scope of the DQA measurement to a maximum number of job lists (loops) to be executed. In addition, it is possible to specify whether all loops or just the successful ones are counted.
- "Retry Connect Job when failed"
  If selected, R&S ROMES4 tries to dial up to the network repeatedly in case the previous connection failed.

"GPRS/UMTS Mobiles" controls a packet switched (PS) data connection through a GPRS or UMTS mobile. The following parameters are configurable:

- "Detach Mobile..."
  The option is enabled after an appropriate GSM or UMTS mobile device is loaded and the virtual COM ports have been assigned, see Chapter 6.1.4, "Connection via USB interface", on page 1456. It is possible to force the PS service to be detached before start of the measurement and after each Disconnect job.
- "Check Service Availability Timeout"
  Allows checking if the network supports the PS service. PS support is indicated through Layer3 System Information messages or blocks. For GSM/GPRS net-

works, it is possible to specify a timeout after which a network is considered as not supporting the PS service.

"Timing" allows an additional idle time to set after:

- "GPRS unavailability was detected"
- "DialUp failed (blocked)"
- "Connection dropped"

Create Test Files ← Extended Features

Click the "Create Test Files" button to open the page where you can define the size and the format ("Text File" or "Binary File") of a test file. The file can be stored to a local directory and used for file transfer to a remote location. The contents of the file are random.

A file of definite size is useful for many DQA applications.

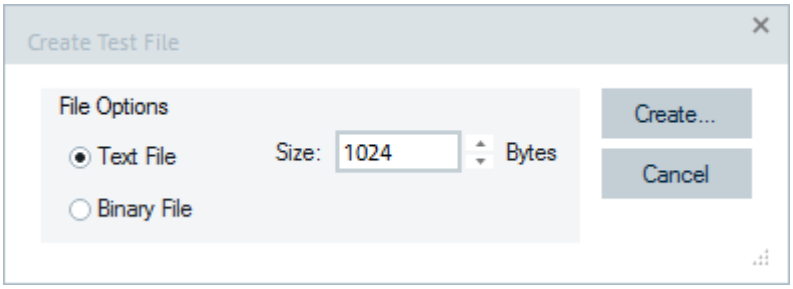


Figure 6-431: Create test file

Job Servers ← Extended Features

The "Job Servers" button lets you preconfigure the FTP and HTTP job servers providing easier and faster job configurations later.

Click the button to open the "DQA Job Servers Configuration" page.

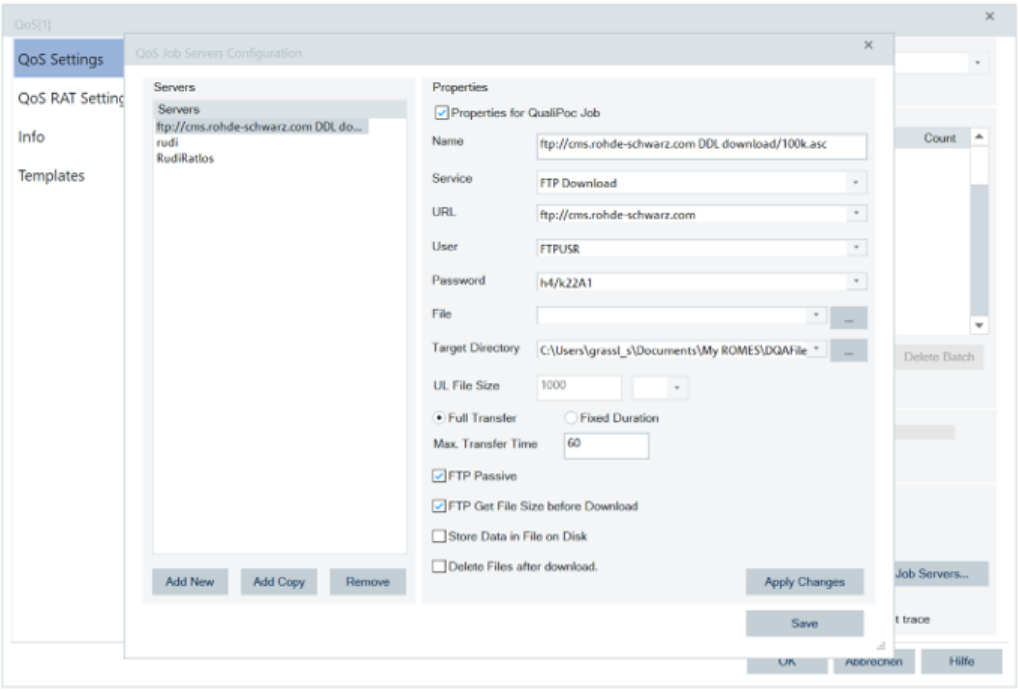


Figure 6-432: DQA Job Servers configuration

DQA Job Servers Configuration ← Job Servers ← Extended Features
The "Servers" pane shows the list of pre-configured DQA job servers if available. The "Properties" pane edits the properties of a job (service) supported by the server selected in the list.

The QoS Job Servers configuration simplifies and improves a server configuration in the following aspects:

- The "Add New", "Add Coppy" and "Remove" buttons are visually clear connected to the list of configured servers.
- After a new server or a copy of the previously selected one is added, only the new created server is selected.
- "Remove" supports multiple selections.
- The change of the selected server triggers "Apply Changes" automatically.
- If on the "Properties" pane something wrong is edited (for example, "60s" instead of "60" in the "Max. Transfer Time") and you try to select another server, an error is reported. The new selection is refused.

Properties ← DQA Job Servers Configuration ← Job Servers ← Extended Features
Check the "Properties for QualiPoc Job" combo box if the DQA job is QualiPoc supported.

To configure a DQA job server, the following properties have to be defined:

- "Name"
  The name of a DQA job server
- "Service"
  The services to be supported by the server:

  - FTP download and FTP upload
  - HTTP download and HTTP upload
- "URL"
  The target URL of the server.
- "User"
  The user name to get access to the server.
- "Password"
  The password for the user.
- "File"
  - The FTP file to be downloaded from a server or uploaded to a server.
  - HTTP n/a

  Browse the file with "…".
- "Target Directory"
  - Target directory where to store the downloaded FTP file.
  - Target directory where from to upload the FTP file.
  - HTTP n/a

  Browse the directory with "…".
- "URL File Size"
- The size of a file to be downloaded or uploaded and the unit.
- "Full Transfer"/"Fixed Duration"
  The options are mutually exclusive. If you select full transfer, the option to fix the transfer duration is disabled and vice versa. For details, see the "HTTP download / browsing" on page 1979 and "DQA FTP download" on page 1985.
- "Max. Transfer Time [s]"
  Limits the transfer time of a job, the range is from 0 [s] to 36000 [s].
- "FTP Passive"
  If checked, the FTP passive connection is activated.
- "FTP Get File Size"
  If checked, the file size of the download file is retrieved.
- "Store Data File On Disk"
  Stores data file on disk for FTP DL.
- "Delete Files after Download"
  Deletes files after download for FTP DL.

The available buttons, apart from those buttons mentioned in the "Servers" pane are:

- "Apply Changes"
  Writes the changes in the properties of the selected DQA job server.
- "Save"
  Stores the configuration to
  the `..MyRomes\Configuration\DQAJobServers.xml` configuration file.

Stop a DQA Job ← Extended Features

It can happen that a DQA job stop takes longer than 30 seconds. Continue to wait when time-out happens, as recommended in the notification that pops-up.

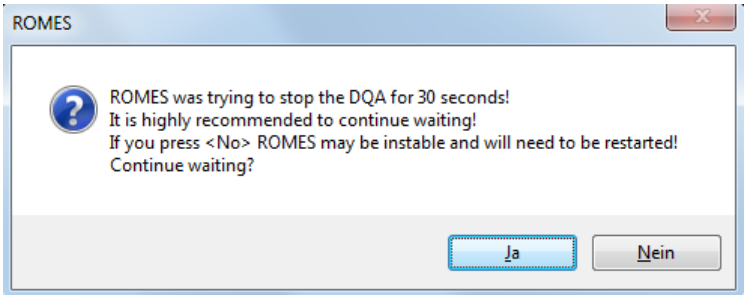


Figure 6-433: Notification of stop DQA

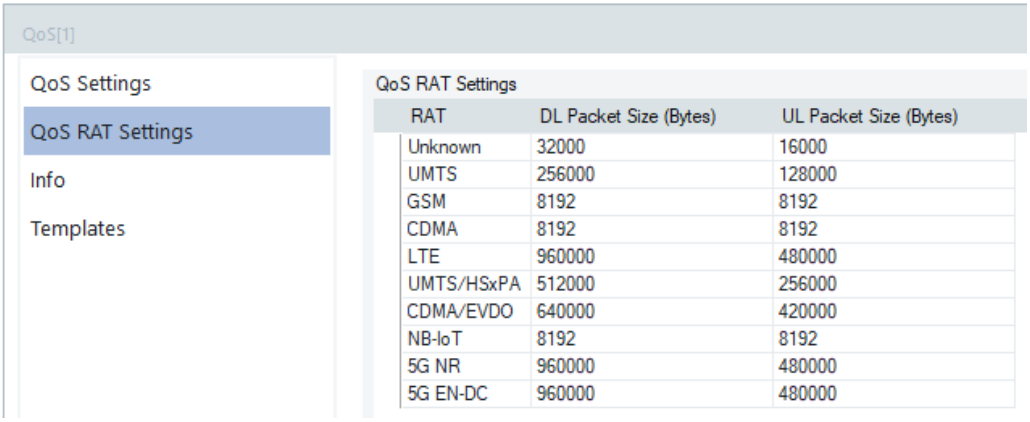
If stop DQA is aborted, it is highly recommended to restart R&S ROMES4.

6.5.1.3 DQA RAT settings

Data packet sizes can be specified for different RATs in the "DQA RAT Settings" page.

The specified size defines the size of one service data packet to be sent at once on a service data socket (FTP, HTTP, etc.).

The recommend values of the data packet sizes are given in the following figure.



RAT	DL Packet Size (Bytes)	UL Packet Size (Bytes)
Unknown	32000	16000
UMTS	256000	128000
GSM	8192	8192
CDMA	8192	8192
LTE	960000	480000
UMTS/HSxPA	512000	256000
CDMA/EVDO	640000	420000
NB-IoT	8192	8192
5G NR	960000	480000
5G EN-DC	960000	480000

Figure 6-434: Default packet size settings for different RATs

Different values for download and upload can be defined.

The RAT's "Unknown" value applies if the DQA is not in relation to a mobile device or the device cannot detect the current RAT.

6.5.1.4 Configuration menus for the DQA jobs

The following chapters describe the configuration of the DQA jobs available for On PC testing (Classic mode) devices.

The pages to configure a job open by selecting the job from the "DQA[1]" > "DQA Settings" > "Available Jobs" list or by dragging the job to "Job" pane.

The "Connect to Network" page opens also when reconfiguring a job present in the "Job" list (the "Configure" button).

Connect to network

The "Connect to Network" configuration page lets you select a network link and reference server and define the idle time intervals for redialing.

To configure the job, simple move a part of the ROMES DQA Dialup configuration to "Dialup" pane of the "Connect to Network" page.

To configure the job's parameters of a used reference server and timing, click "Advanced". The "Advanced Connection Settings" page opens, see Figure 6-438.

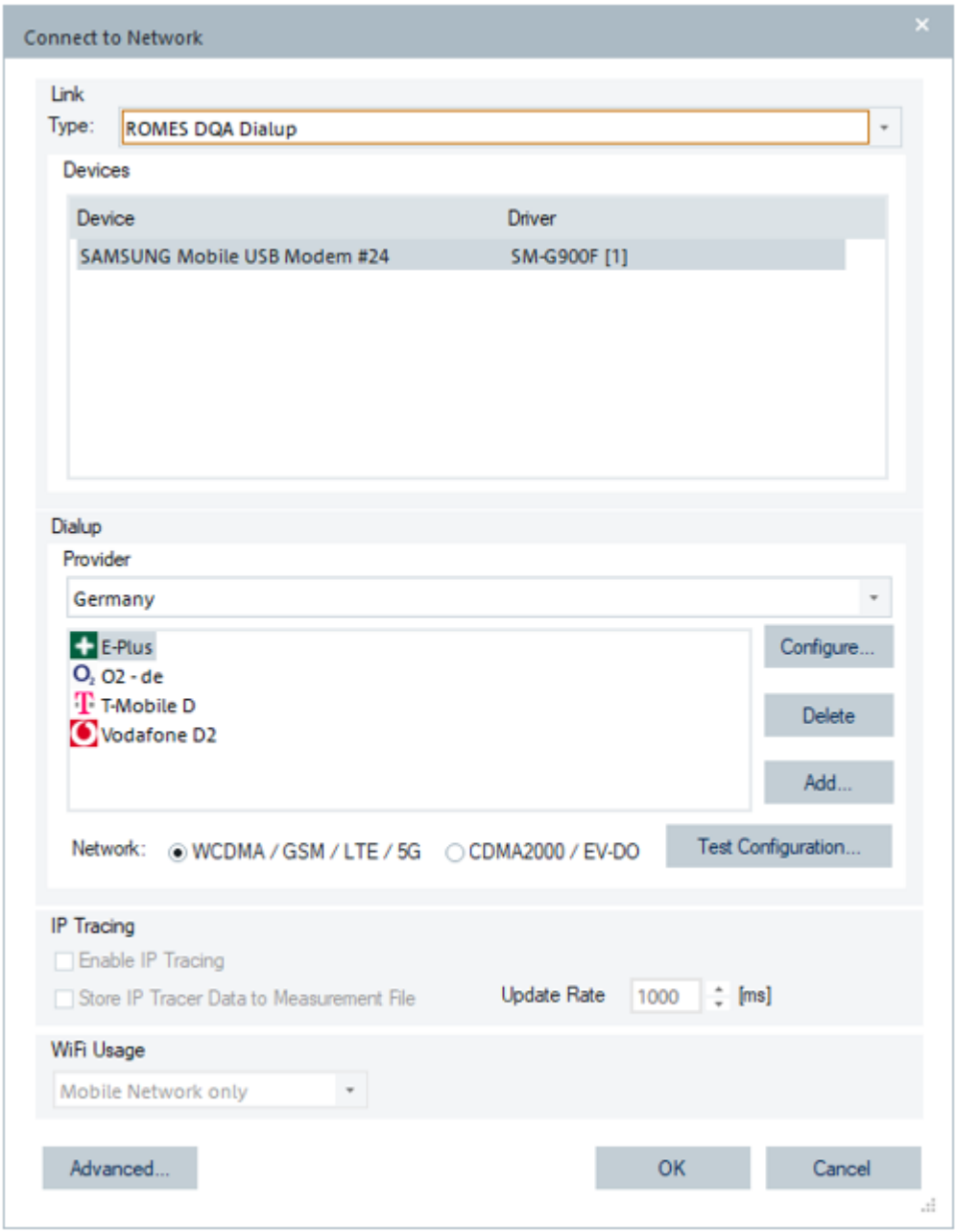


Figure 6-435: DQA Connect to Network page

The DQA "Connect to Network" entries are listed in the following sections.

Link

The "Link" pane contains the following parameters:

- "Type"
  Three different link types are available:
  – "Windows Dialup" requires a modem port of the device under test.

  - "Windows Network Adapter" allows choosing one of the existing network adaptors. The Connect to Network job does not connect or disconnect this connection without trigger. This link type is typically used for WLAN measurements.
  - "ROMES DQA Dialup" is default type. Dialup wizard allows defining all necessary access parameters. The ROMES DQA Dialup type is mandatory if the NDIS interface of the test UE is used. In this case, the DQA requests connecting to and disconnecting from the test UE device.
- "Device"
  A list of available modems or network adapters.

Dialup
The "Dialup" pane lets you select an operator from the list of operators of a selected country, choose the network type and execute the existing configuration changes or testing using the available buttons.

Choose a country from the pull-down menu and select an operator from the given list.

The 3GPP or non-3GPP RAT networks are selected with the "Network" buttons.

To confirm selections, click "OK".

Configure/Add ← Dialup
The user can reconfigure parameters of a provider selected from the provider list ("Configure" tab) or add a new one ("Add" tab). If one of these tabs is clicked, the following dialog opens.

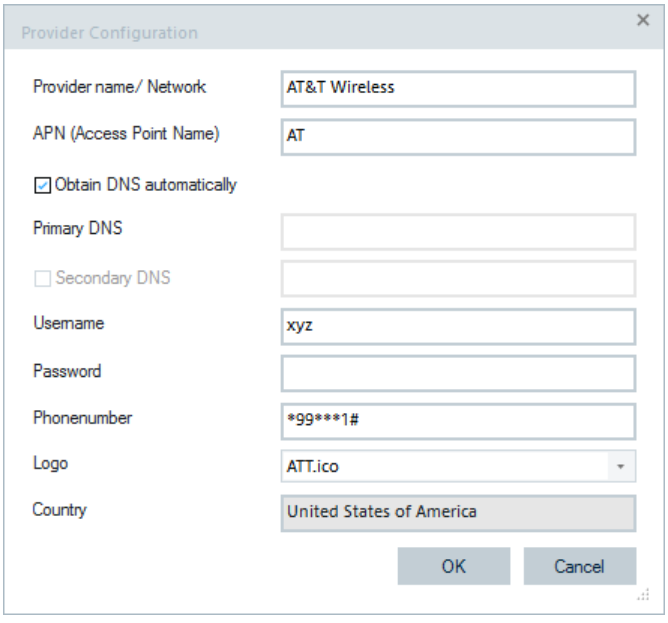
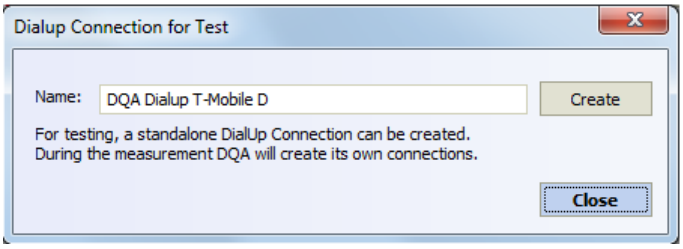


Figure 6-436: Provider configuration

Delete ← Dialup
Deletes selected provider from the provider list.

DQA Connection for Test
Opens a dialog where you can create a dial-up connection for testing.



IP Tracing (no license)

The following parameters are used to configure IP tracing in the "IP Tracing" page:

- "Enable Tracing"
  If the purchased option is activated, this flag enables the IP protocol sniffer for this connection.
- "Update Rate"
  The time span within which the results are written into a `*.rscmd` file.
- "Store IP Tracer Data to Measurement File"
  The IP tracer data are written to measurement file only if this option is selected. By default it is unselected.
  When the IP trace data are not written to the measurement file, the data are not visible in the Layer 3 view and the CAP/PCAP export is not possible. Then the data is only used for KPI calculation.
  The option is also available if a smartphone is selected for connection.

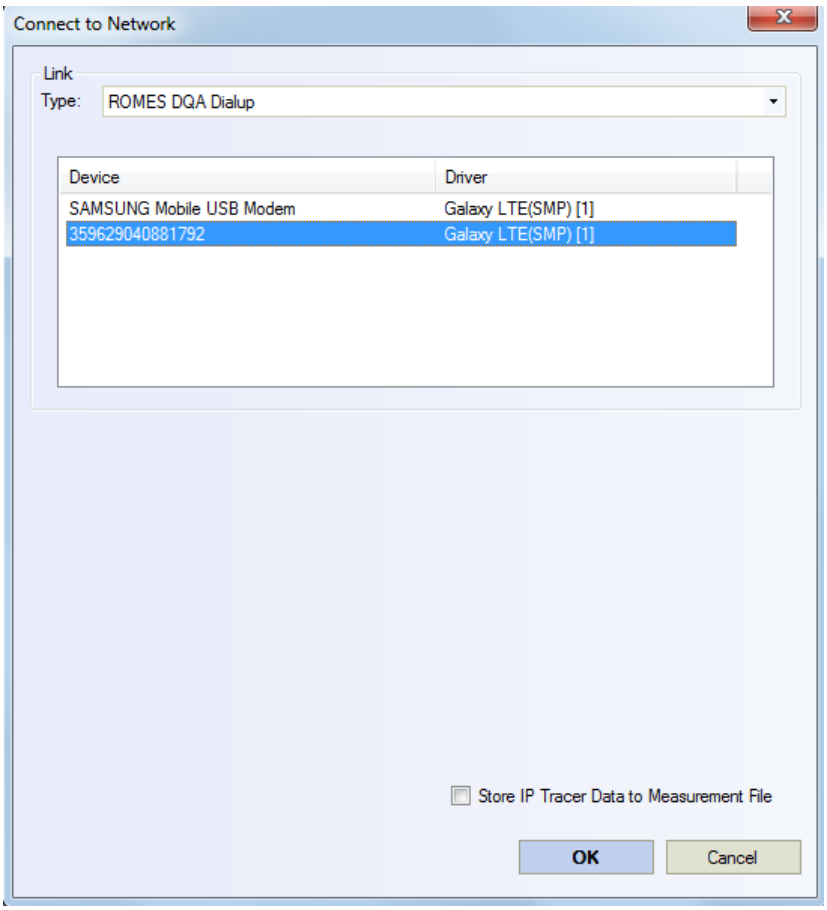


Figure 6-437: IP tracer data store supported for smartphones

Note: IP tracer results are shown in the 2G/3G Layer 3 view, see Figure 4-567.

WiFi usage
See Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891.

Advanced
Opens a page to define additional connection settings.

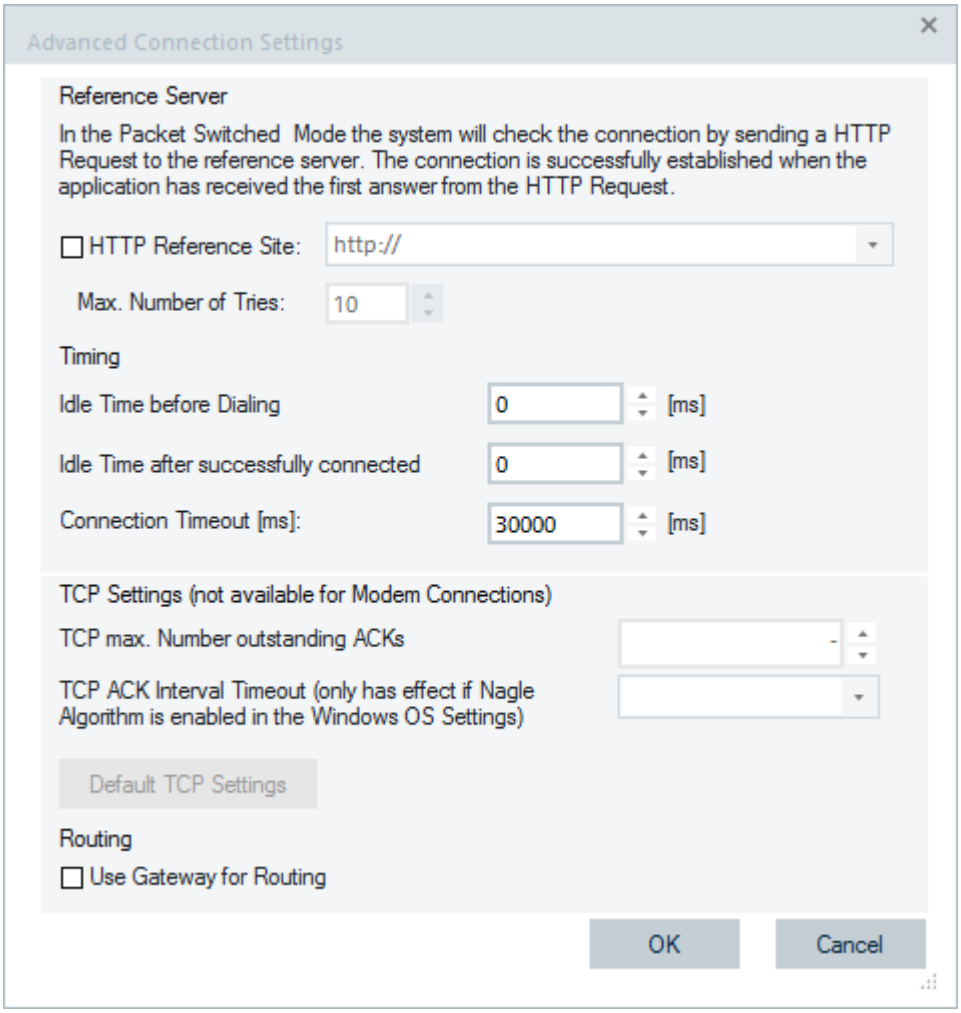


Figure 6-438: Advanced settings in Connect to Network

Reference Server ← Advanced
The name of the reference server to ping. The name can be URL or the IP address. The reference server is used to check whether a packet switched connection can be established and to define a time limit for setting up the connection.

"Max. Number of Tries" defines the maximum number of pings sent to the reference server before the system assumes that the dial-up has failed and aborts the job.

Timing ← Advanced
Defined are:

- "Idle Time before Dialing"
  Idle time interval between the start of the job and dialing (the "QoS Message View" displays the message "Waiting <n> milliseconds before dialing", see Figure 6-447).
- "Idle Time after successfully connected"
  Idle time after successful connection.
- "Connection Timeout (ms)"

Time-out due to unsuccessful connection.

TCP Settings ← Advanced
Opens a dialog to define additional connection settings.

- "TCP Window Size"
  The flow of data is controlled by the TCP window size. It defines the maximum data (in bytes) which can be received at once into the TCP buffer without losing any TCP packet. The configured TCP window size guarantees how many data can be received at once without problems and represents also an overload protection mechanism.
- "TCP max. Number of outstanding ACKs"
  Specifies the number of acknowledgments that are outstanding before the delayed ACK timer is ignored. Microsoft does not recommend changing the default value 2 without careful study of the environment.
- "TCP ACK Interval Timeout"
  Specifies the time interval that defines the end of a segment stream. If this interval elapses between the receipts of TCP segments, TCP considers the segment stream complete and sends an ACK message to acknowledge the segment. Otherwise, TCP acknowledges every other segment only. The default value is 200 ms. This default value effects only when the angle algorithm is enabled.

Routing ← Advanced
Check the "Use Gateway for Routing" check box if connecting with a network adapter, but also dependent on LAN. If checked, the route to the destination server (e.g. an FTP server) is created through the LAN's default gateway.

Note: Standard gateway for routing must be enabled for any DQA job which uses external windows programs, such as Internet Explorer. This option can be enabled in the advanced settings of the "Connect to Network" dialog.

DQA connect job using tethering mobiles

Tethering allows sharing the Internet connection of a mobile phone with a PC. Smartphones based on Android OS, such as the Samsung Galaxy family, support tethering.

The DQA supports tethering mobiles. If tethering is activated on the mobile, the mobile's network adapter can be selected in the "Connect to Network" configuration dialog by selecting the "Windows Network Adapter" option from the "Type" list.

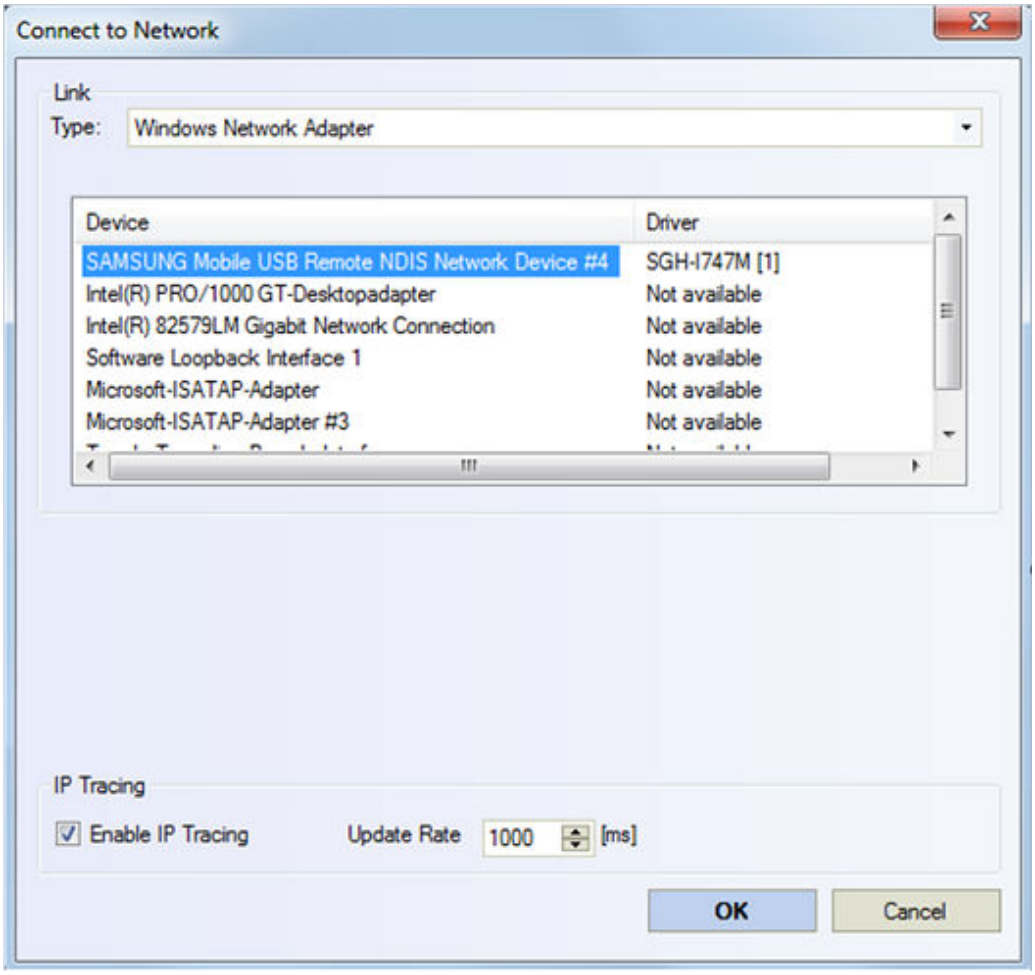


Figure 6-439: Tethering activation for Samsung mobile

If the mobile device is loaded, the device's name is displayed and the DQA is linked with the device.

It is possible to use other tethering mobiles in other DQA instances. However, in this case, the servers in the DQA jobs (for example, FTP, HTTP) are assigned with their native IP addresses. The reason is because all the tethering mobiles use the same internal DNS server. The following figure illustrates the case.

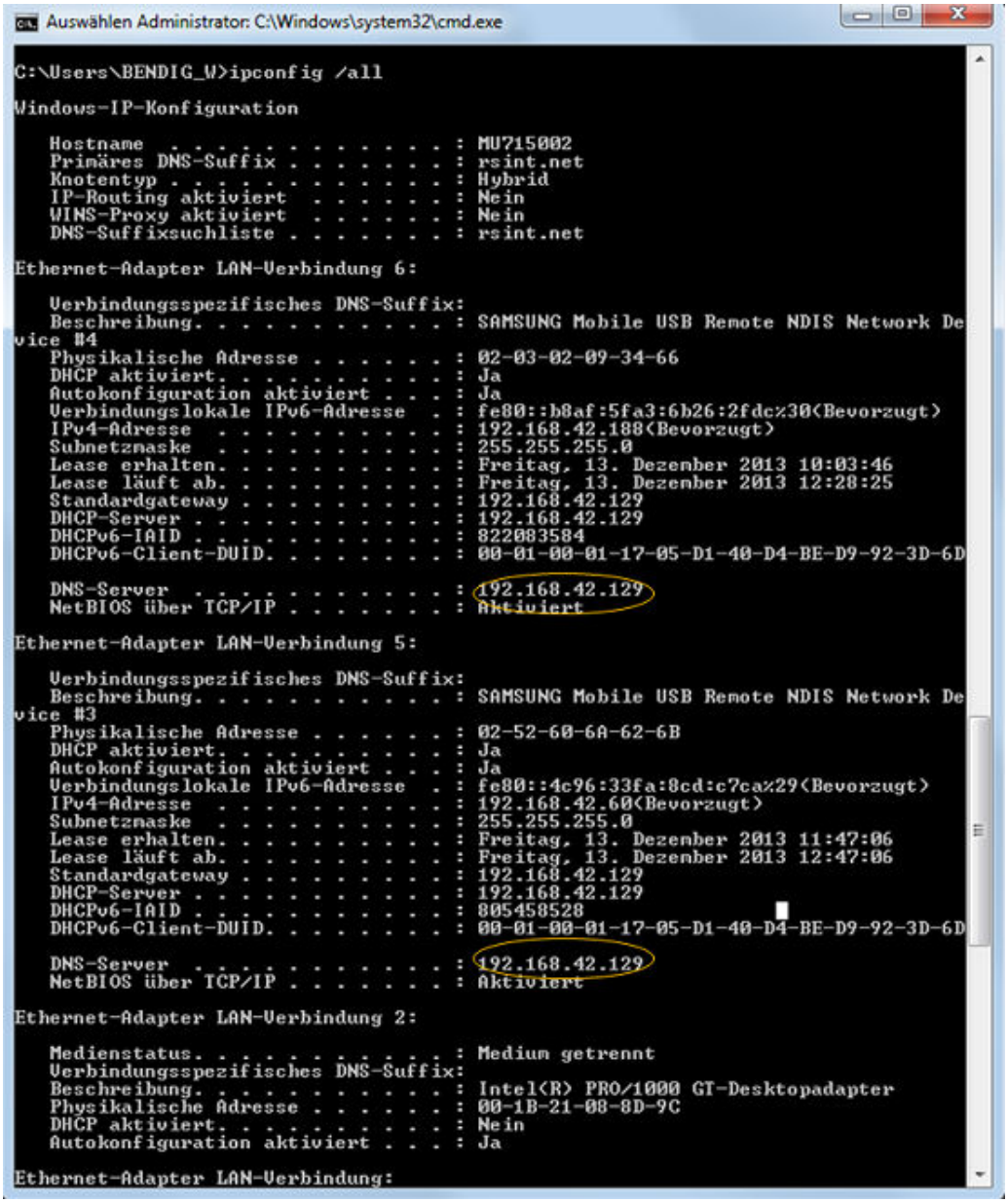


Figure 6-440: IP configuration for device 3 and 4

It is not possible to use the DQA HTTP jobs with Internet Explorer with more than one DQA instance.

To avoid undesired traffic on the network adapters, close other Windows applications that use Internet, as the default gateways of the tethering mobiles with their routes are still available.

DQA connect job using WiFi for data transfers

DQA Connect to Network job offers the option to select a mobile network type, which is then used for data transfer with smartphones.

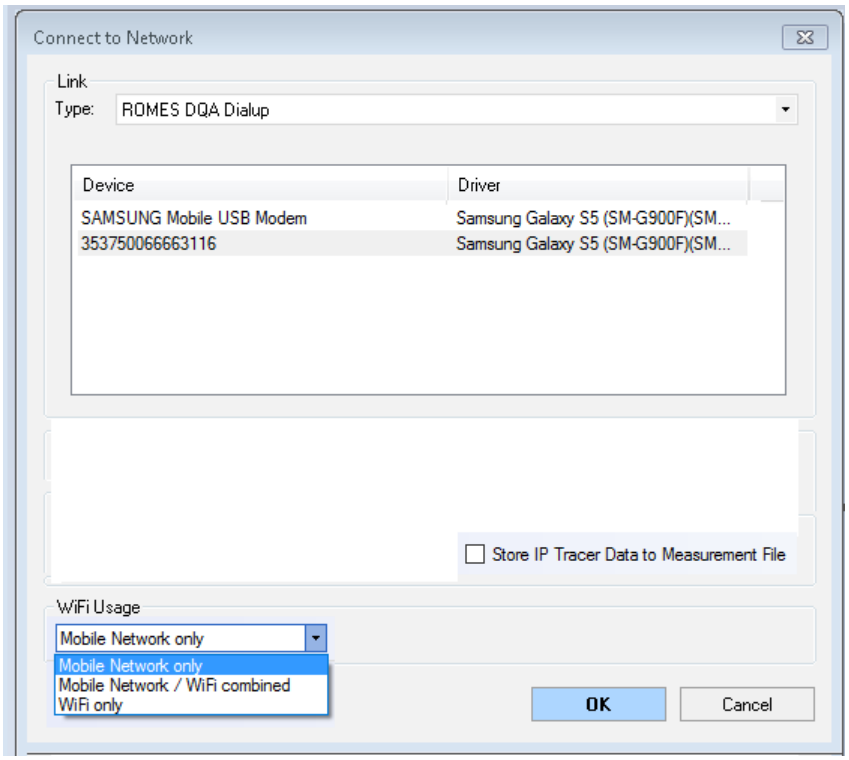


Figure 6-441: WiFi usage options

The user can select between the following network types:

- "Mobile Network only"
  Only the mobile network is used for data transfers. The WiFi usage of the mobile is switched off. Also the WiFi scanning of the mobile is disabled.
  NOTE: When in this mode, do not switch on WLAN manually in the mobile during the measurement.
- "Mobile Network / WiFi combined" (the current mode)
  If the mobile is connected to a WiFi network, WiFi is used for data transfers. Otherwise, the mobile network is used.

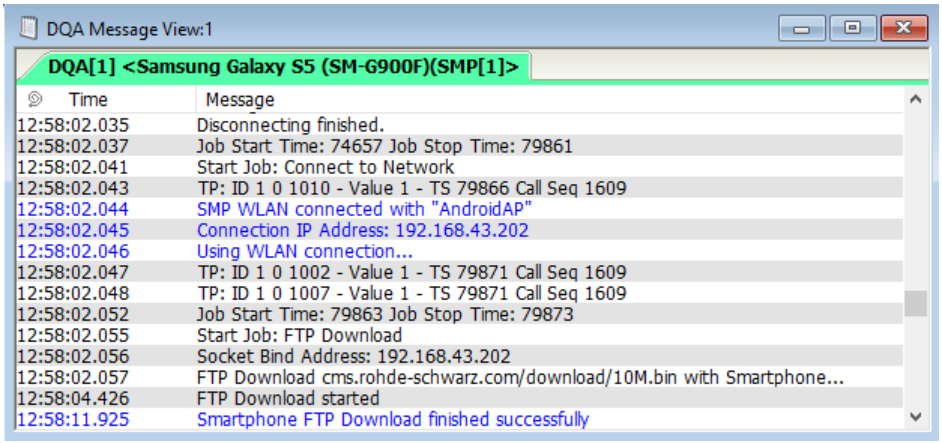


Figure 6-442: DQA messages in mobile network / WiFi combined mode

- "WiFi only"
  Only the WiFi network is used for data transfers. If the mobile is not connected to WiFi network, the connect job fails.

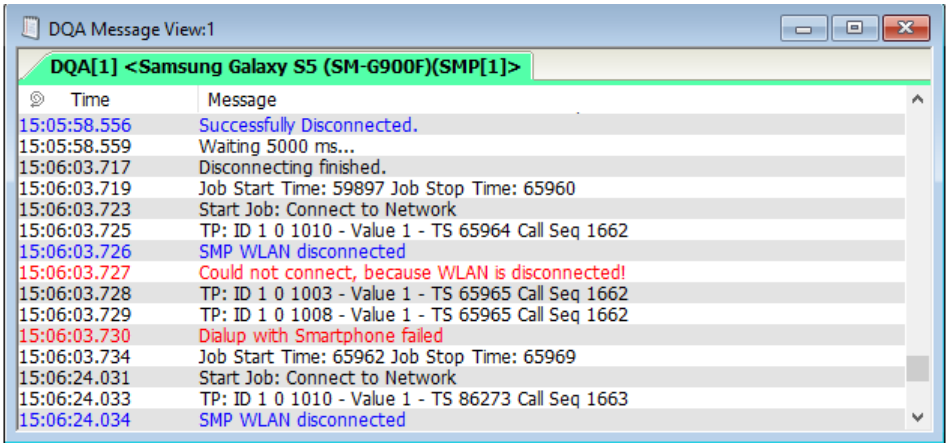


Figure 6-443: DQA messages in WiFi only

NOTE: It is highly recommended for this mode not to switch off WLAN manually on the mobile during the measurement.

Invalid connect to network job of a workspace

If a DQA session contains more than one connect job and these jobs are not valid anymore, the "DQA Configuration Error" page reports a problem.

The instance of a DQA tester or its customized name, e.g. "HUAWEI mobile Connect - 3G Modem" in the figure, is displayed in the window caption of the dialog.

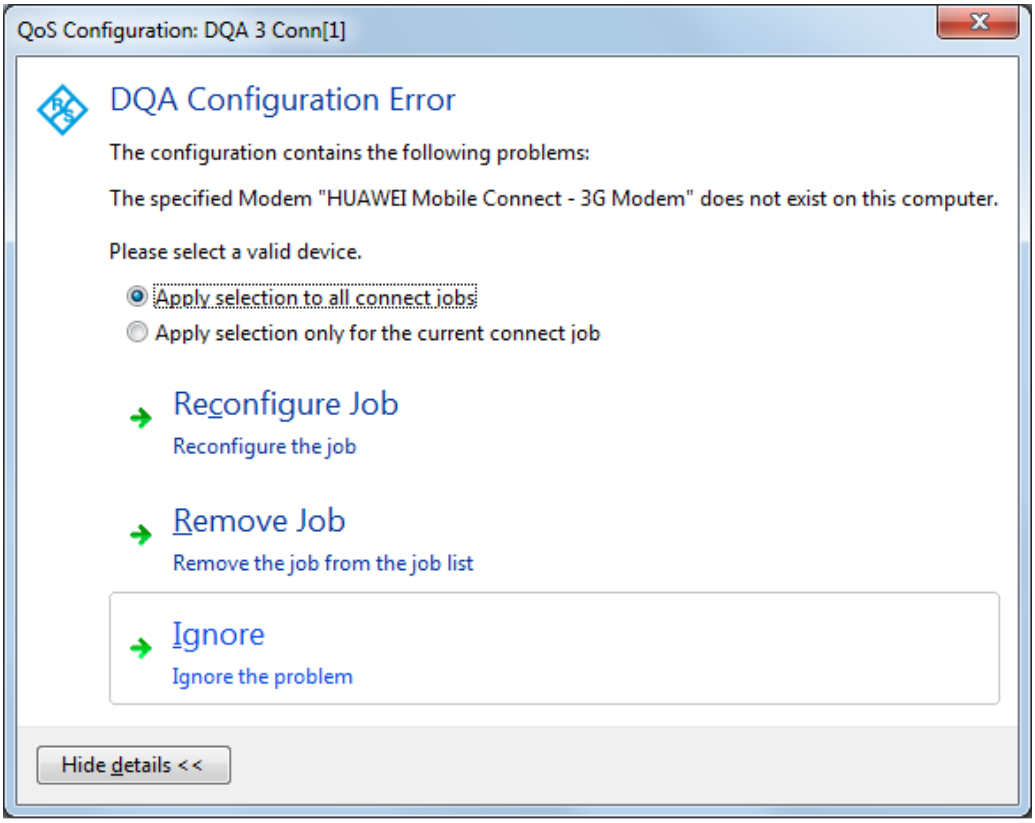


Figure 6-444: DQA configuration error

The "Apply selection only for the current connect job" function lets you execute the action for a single connected job. By default, the selection function applies to all connected jobs.

Choose whether to ignore the problem, reconfigure or remove connected jobs by choosing one of the following entries:

- "Reconfigure Job"
- "Remove Job"
- "Ignore"

DQA templates

The settings of the UE are written in one template file. The UE template files contain the settings which are linked with the DQA settings and vice versa.

On loading a template file, R&S ROMES4 checks if the template contains settings of other devices and applies the template to it if the device is applicable. On loading, not only the settings of the UE but also the DQA settings are overwritten.

If saving a template which contains a Connect to Network job with "ROMES DQA Dialup", the system asks whether to store the provider's settings of the job in the template.

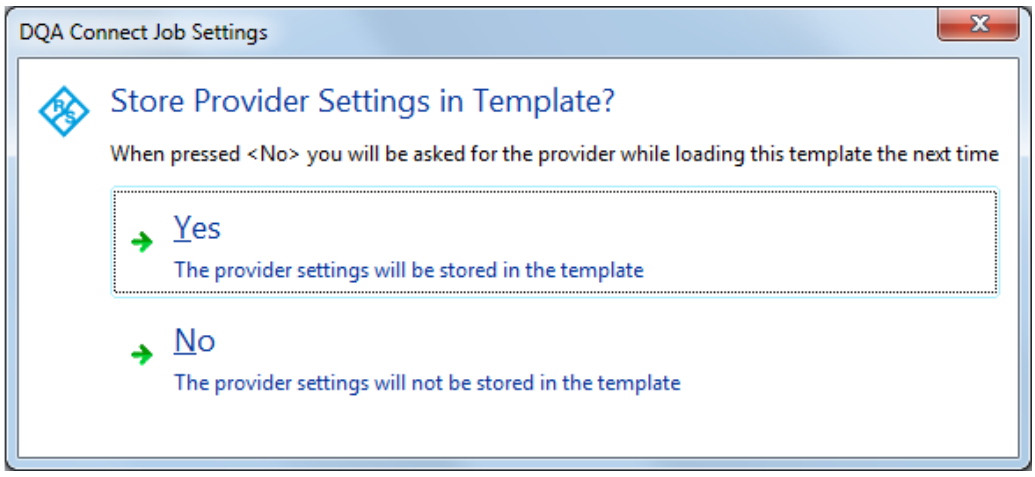


Figure 6-445: Store the settings

If you select "No", the system asks for the provider while loading this template next time.

Disconnect from network

The "Disconnect from Network" dialog lets you define an idle time in seconds between disconnection from the network and start of the next job defined in "Job" list. For more details, see Chapter 4.6.2.2, "DQA message view", on page 1072.

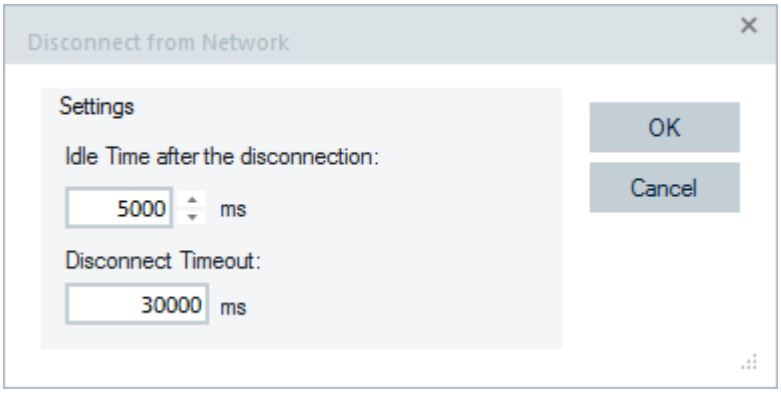


Figure 6-446: Setting of Disconnect from Network

"DQA Message View" displays message Successfully Disconnected before the Disconnect from Network job performs the idle time. The length of the idle time is also displayed in the "DQA Message View", example given, "Waiting 5000 ms…".

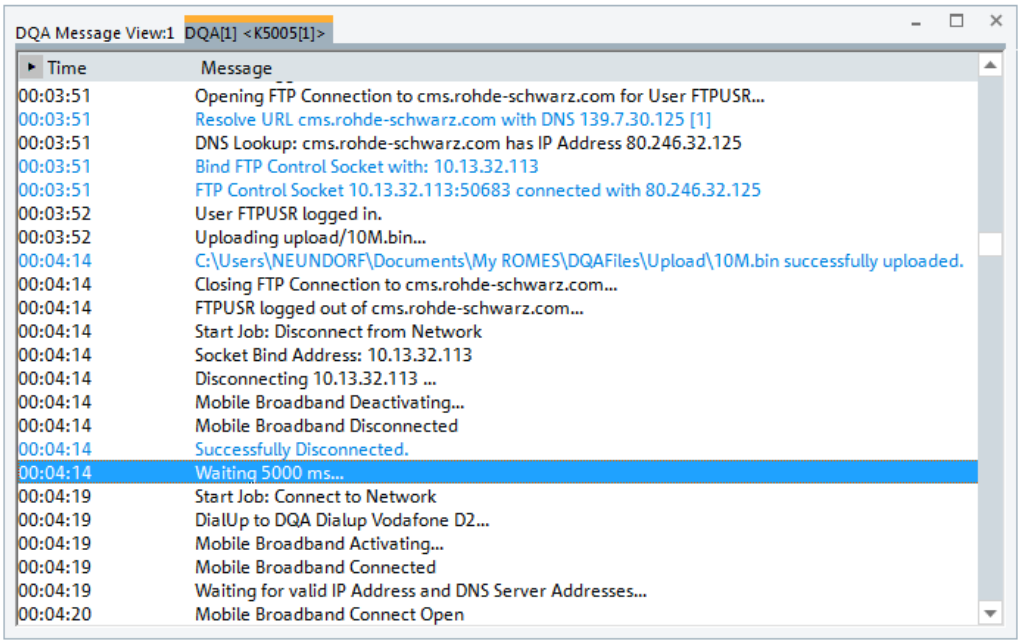


Figure 6-447: DQA Message View - Disconnect from Network

HTTP

HTTP download

The "HTTP Download" configuration dialog lets you download a file using TCP/IP on a target web server. The downloaded file is displayed in a HTTP browser and printed using "Action".

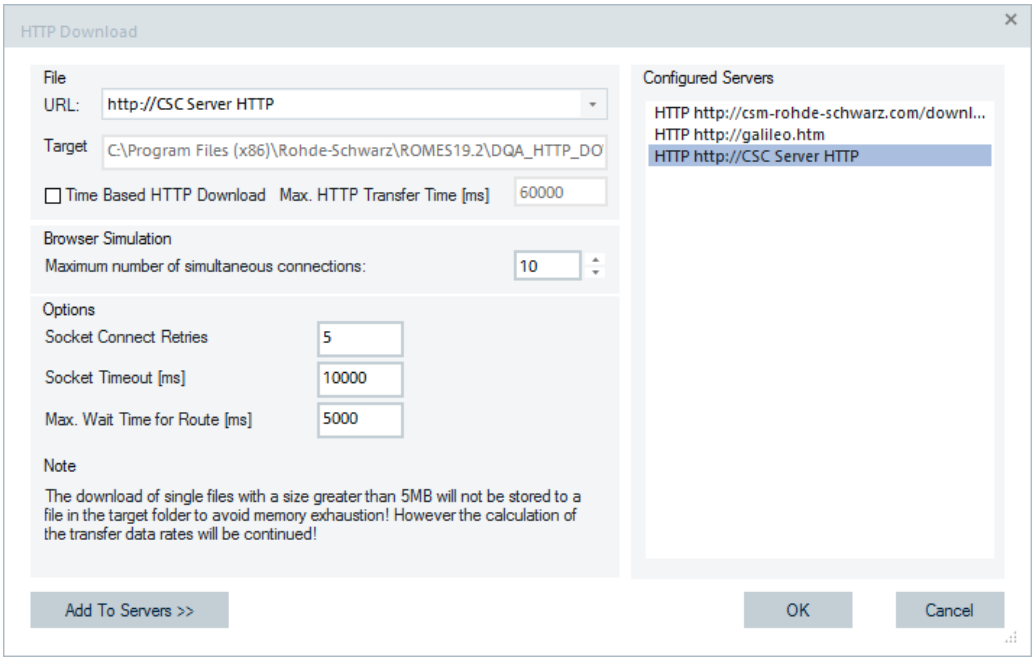


Figure 6-448: HTTP Download job - configuration

The "Configured Servers" pane shows all the preconfigured servers for HTTP Download job. Double-click an entry in the list to save the preconfigured server in the "Server" pane of the "QoS Job Server Configuration" dialog.

File
The following properties of a preconfigured server are available:

- "URL"
  Uniform Resource Locator encodes the link to the file to be downloaded, see "Properties" on page 1889
- "Target"
  The target directory, see "Properties" on page 1889
- "Time Based HTTP Download"
  The HTTP download is time-based which means that the download is stopped successfully after a defined time. The real transfer time can differ from the defined time, dependent on the current data rate and the transfer packet size.
  Example: Defined transfer time is 10000 ms and a data packet of 128 kb is required on a data socket at 9500 ms. The transfer stops when the complete packet is transferred at the data socket. The transfer can take a couple of seconds if the current data rate is slow.

Browser simulation
Specifies the maximum number of simultaneous connections. It limits the number of HTTP connections.

Options

- "Socket Connect Retries"
  Number of retries if a socket connection fails.
- "Socket Timeout [ms]"

Timestamp when the socket closes the connection without having received data. The socket time-out function is used to limit the transfer time and thus the amount of transferred information.

- "Packet Size [Bytes]"
  The socket connection is started only if the route is created. If the route is not created in the wait time, the job fails. Default is 5000 ms.

Note
Download of a single file with a size greater than 5 MB is not stored to a file in the target folder to avoid memory exhaustion. However, the calculation of the transfer data rates continues.

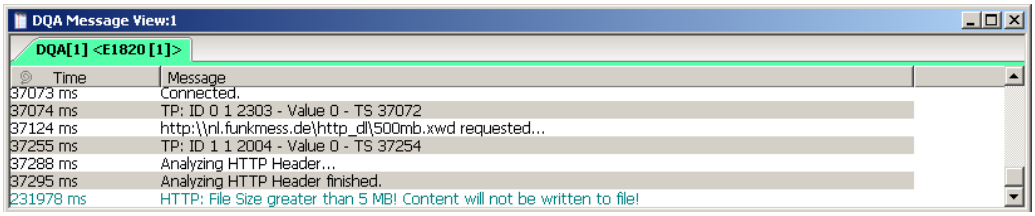
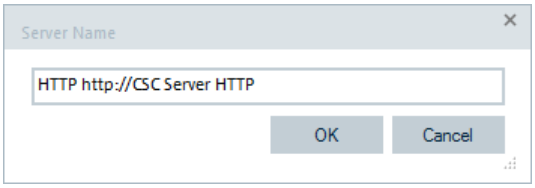


Figure 6-449: DQA message about exceeded file size

During the measurement, a note that the file cannot be stored is shown in the "DQA Message View".

Add To Servers
Select "Add To Servers" to add the current configuration with the available properties listed previously to the "Configured Servers" pane. Before storing the configuration, define the server name.



HTTP upload

The "HTTP Upload" configuration dialog lets you select a file for uploading by using TCP/IP to a target web server.

To open the configuration dialog, double-click the "HTTP" > "HTTP Upload" in the "Available Jobs" pane.

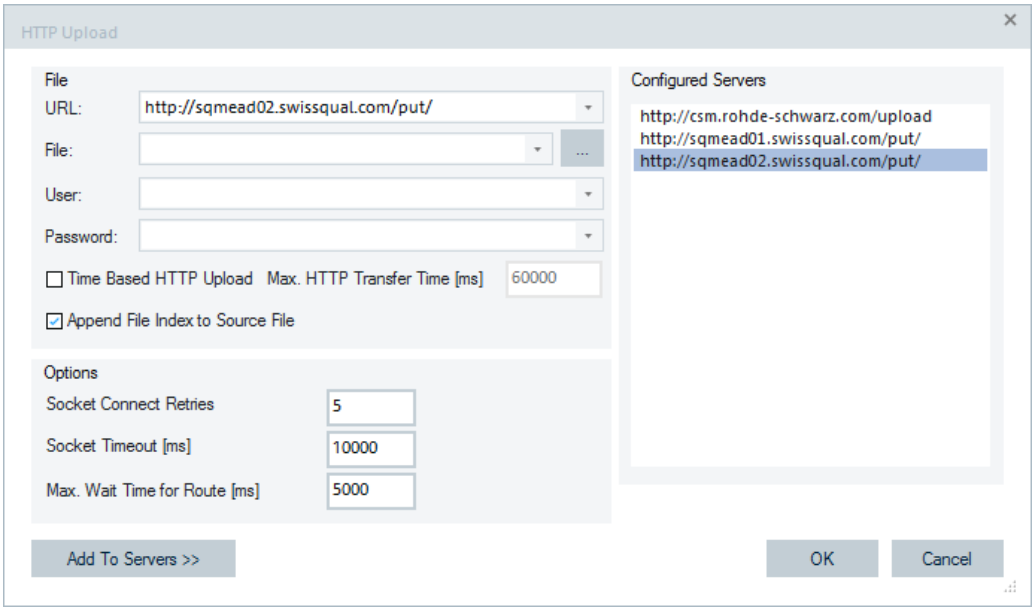


Figure 6-450: HTTP Upload job - configuration

"Configured Servers" shows all the preconfigured servers for the HTTP Upload job. Double-click an entry in the list to save the preconfigured server in the "Server" pane of the "QoS Job Server Configuration" dialog.

The following properties of a preconfigured server are available:

"File" pane

- "URL"
  Uniform Resource Locator encodes the link for uploading a file, see "Properties" on page 1889.
- "File"
  The file to be uploaded, see "Properties" on page 1889.
- "User"
  The user name for the HTTP server if the server requires a login.
- "Time Based HTTP Upload"
  Checks if the HTTP upload is time limited.
- "Max HTTP Transfer Time"
  The max. HTTP transfer time in time-based HTTP upload.
- "Append File Index to Source File"
  Check if a file index has to be appended to the source file on the server.

"Options" pane

- "Socket Connect Retries"
  Number of socket connect retries to the HTTP server if the connection fails.
- "Socket Timeout"
  Socket timeout in milliseconds
- "Max. Wait time for Route"
  The max. wait time in milliseconds for establishing a route to the HTTP Server.

- "Add to Servers"
  Adds the current configuration to configured servers.

HTTP upload progress view

The "Progress View" shows the current state of the HTTP upload.

The following information is shown in "Progress View":

- Current Data Rate
  The data rate in the last 1000ms
- Average Data Rate
  The average data rate in the time span from start of upload until the current elapsed time.
- Elapsed Time
  The elapsed time since start of upload.
- Already Uploaded
  The already uploaded bytes.
- Total Size
  The total size of the uploaded file.

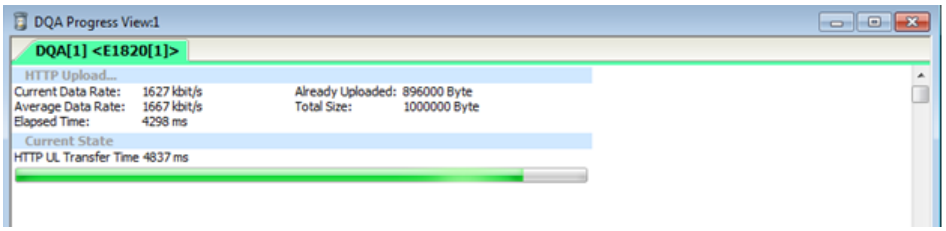


Figure 6-451: HTTP upload progress view

HTTP upload QoS report view

The "QoS Report View" shows the summary of all HTTP upload sessions.

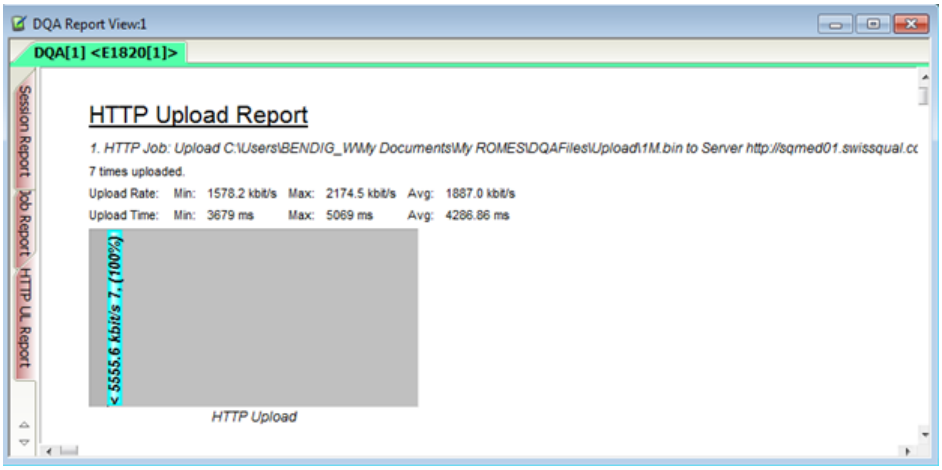


Figure 6-452: HTTP upload report view

The following information is shown in "QoS Report View":

- Upload Rate: Min., Max. and Average data rate
- Upload Time: Min., Max. and Average upload time

HTTP upload KPI generator view

The "KPI Generator View" shows the trigger points and KPIs of the HTTP Upload job, see Chapter 4.6.4.3, "DQA jobs supported by the QoS KPI generator", on page 1100.

Parallel HTTP download and ping

The job makes possible to perform pings in parallel to the HTTP Download jobs. With the HTTP Download job termination, terminates the ping job as well.

For details, see "Parallel FTP download and ping" on page 1928.

Parallel HTTP upload and ping

The job makes possible to perform pings in parallel to the HTTP Upload jobs. With the HTTP upload job termination, terminates the ping job as well.

For details, see "Parallel FTP download and ping" on page 1928.

FTP

FTP download

The "FTP Download" configuration dialog lets you download a file using the FTP server configured in "Servers" pane.

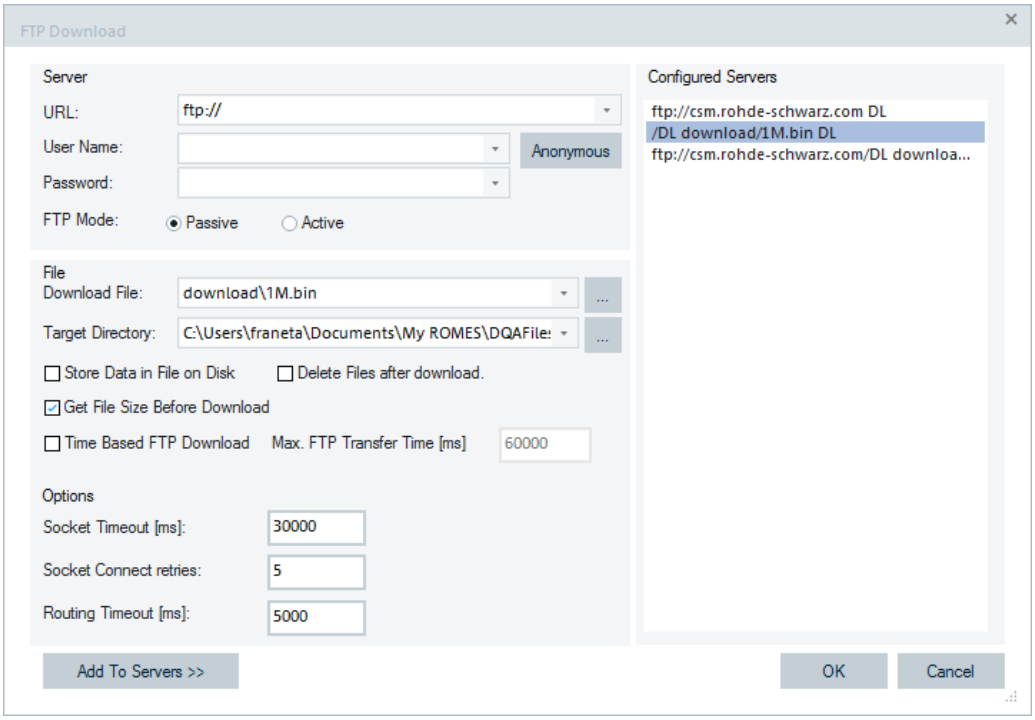


Figure 6-453: FTP Download job - configuration

"FTP Download" > "Configured Servers" shows all preconfigured servers for FTP Download job. Double-click an entry in the list to save the preconfigured server in the "Server" pane of the "QoS Job Server Configuration" dialog, see Chapter 6.5.1.2, "DQA settings", on page 1881.

The following properties of a preconfigured server are available.

Server

- "URL"
  Uniform Resource Locator (host name) or IP address identifying the remote server, see "Properties" on page 1889.
- "User name"
  See "Properties" on page 1889.
- "Password"
  See "Properties" on page 1889.
- "FTP Mode"
  - "Passive"
    See "Properties" on page 1889.
  - "Active"
    If checked, the FTP active connection is activated.
  - "Anonymous"
    Inserts the user name "anonymous" and an arbitrary password. The password can be overwritten, if necessary.

File

- "Download File"

File to be downloaded including the directory path, see "Properties" on page 1889. The "..." button provides a tree view of all available directories on the FTP server.

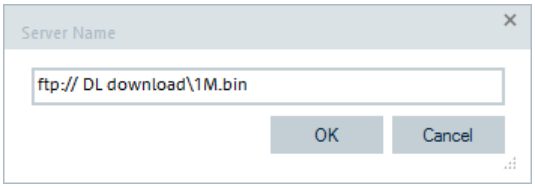
- "Target Directory"
  Directory accessible from the test system (for example, hard disk of the PC) where the downloaded file is stored, see "Properties" on page 1889. The "..." button provides a tree view of all available directories.
- "Store Data in File on Disk"
  Select this function to store the downloaded data in a file that is copied to the local hard disk. If it is cleared, the data can be kept in memory (see "Delete Files" below) but are not processed, which generally improves the system performance.
- "Delete Files..."
  Select this function to omit copying the downloaded file after finishing the job. Otherwise, R&S ROMES4 creates multiple copies of the downloaded file when the "FTP Download" job is performed repeatedly. For a downloaded file `<file_name>.<extension>`, the copies are named `<file_name>_0.<extension>`, `<file_name>_1.<extension>` etc.
- "Get File Size before Download"
  If the option "Get File Size before Download" is selected, the size of the transferred file is indicated in the "QoS Progress View" together with downloaded number of bytes "Properties" on page 1889.
- "Time Based FTP Download"
  The"FTP Download" job can be time-based which means that the download is stopped successfully after a defined time. The real transfer time can differ from the defined time, dependent on the current data rate and the transfer packet size. Example: Defined transfer time is 10000ms and a data packet of 128 kb is required on a data socket at 9500 ms. The transfer stops when the complete packet is transferred at the data socket. The transfer can take a couple of seconds when the current data rate is slow.

Options

- "Socket Timeout [ms]"
  The time when the socket closes the connection without having received data. The function can be used to limit the transfer time and thus the amount of information transferred.
- "Socket Connect retries"
  Number of retries, if socket connection fails.
- "Routing Timeout [ms]"
  The socket connection starts only when the route is created. If the route is not created in the wait time, the job fails. Default is 5000 ms.

Add to Servers

Select "Add To Servers" to store the current configuration with the available properties listed previously to the "Configured Servers". Before storing the configuration, define the server name.



FTP upload

The "FTP Upload" configuration dialog lets you upload a file using FTP to a predefined target server.

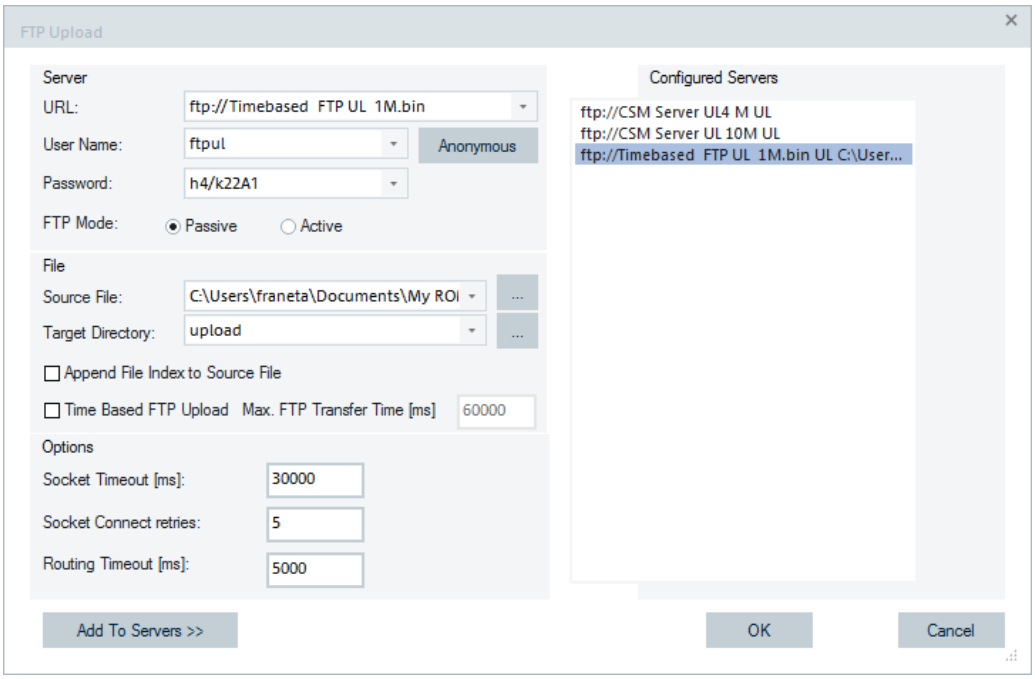


Figure 6-454: FTP Upload job - configuration

In the "Configured Servers" pane all preconfigured servers for FTP Upload job are listed. Double-click an entry in the list to save the preconfigured server in the "Server" pane of the "QoS Job Server Configuration" dialog.

Server

The following properties of a preconfigured server are available:

- "URL"
  Uniform Resource Locator (host name) or IP address identifying the remote server.
- "User Name"
  See "Properties" on page 1889.
- "Password"
  See "Properties" on page 1889.
- "FTP Mode"
  - "Passive"
    See "Properties" on page 1889.
  - "Active"
    When checked, the FTP active connection is activated.
- "Anonymous"
  Inserts the user name "anonymous" and an arbitrary password. The password can be overwritten, if necessary.

File

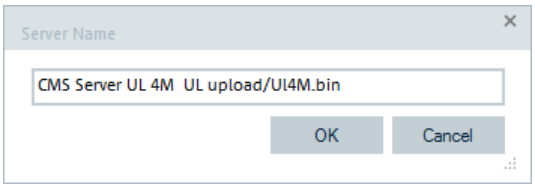
- "Source File"

File to be uploaded including the directory path. The "..." button provides a tree view of all available directories on the preconfigured servers for FTP upload.

- "Target Directory"
  Directory name and path on the target server, see "Properties" on page 1889. The "..." button provides a tree view of all available directories.
- "Append File Index to Source File"
  If this option is selected, the source file name is extended by an index before the file transferring. The index is incremented before each FTP upload. In that way the target server receives multiple copies of the same file with different file names.
- "Time Based FTP Upload"
  The FTP Upload job can be time-based which means that the upload is stopped successfully after a defined time. The real transfer time can differ from the defined time, dependent on the current data rate and the transfer packet size.
  Example: Defined transfer time is 10000ms and a data packet of 128 kb is sent on the data socket at 9500 ms. The transfer stops when the complete packet is transferred. The transfer can take a couple of seconds when the current data rate is slow.

Options
See "Options" on page 1912.

Add to Servers
Select "Add To Servers" to store the current configuration with the available properties listed previously to the "Configured Servers". Before storing the configuration, define the server name.



FTP download / upload

The "FTP Download /Upload" configuration dialog lets you define a remote server and two files - one file on the remote server and one on the local file system to be uploaded/downloaded using FTP. The configuration menu combines the "FTP Upload" and "FTP Download" configuration dialogs, see "FTP upload" on page 1913 and "FTP download" on page 1910.

In the provided KPI definition file, the session time is calculated for download and upload separately.

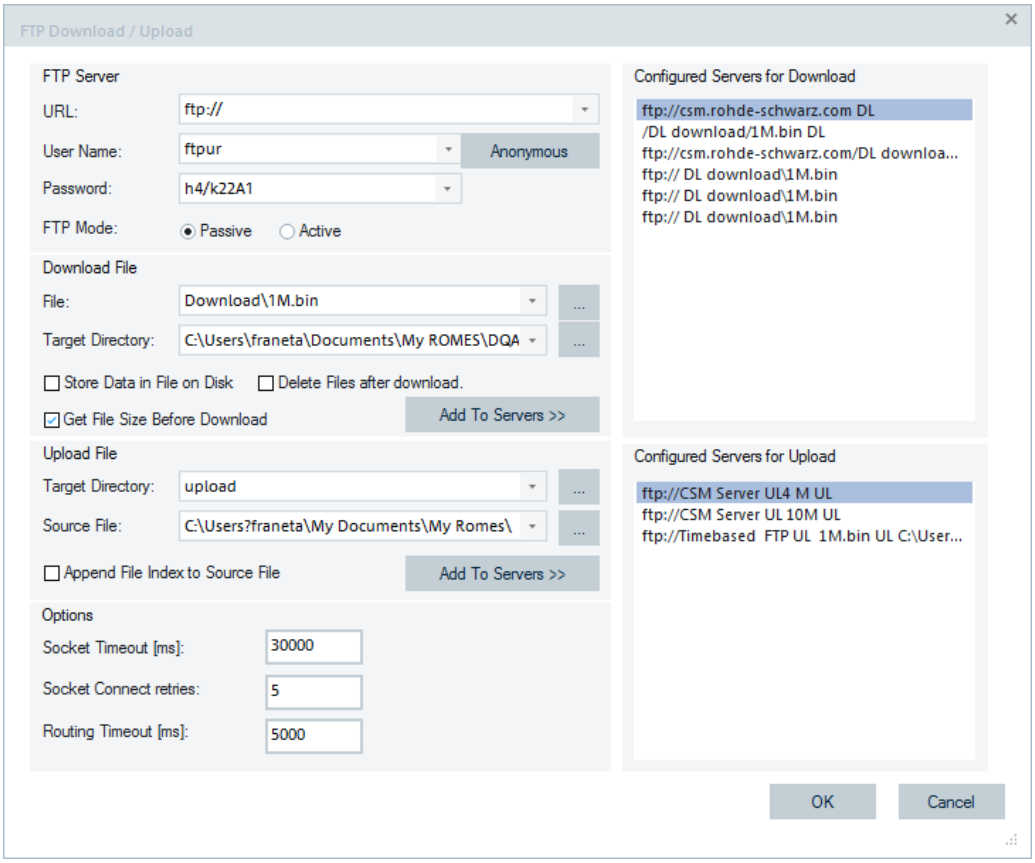


Figure 6-455: FTP Download / Upload job - configuration

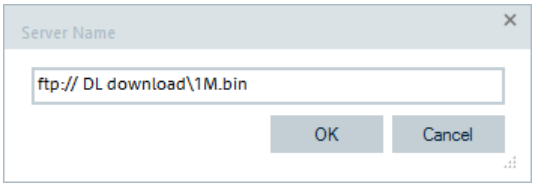
The all preconfigured servers for FTP download are listed in the "Configured Servers for Download" list. Double-click an entry in the list to save the preconfigured server in the "Server" pane of the "QoS Job Server Configuration" dialog.

The following properties of a preconfigured server are available for FTP download:

- "URL"
- "User Name"
- "Password"
- "FTP Mode"
- "Download File"
- "Target Directory"
- "Get File Size Before Download"

For the properties definition, see "Properties" on page 1889.

Click "Download File" > "Add To Servers" to store the current download configuration with the available properties listed previously to "Configured Servers for Download". A server configuration name must be defined before storing the configuration.



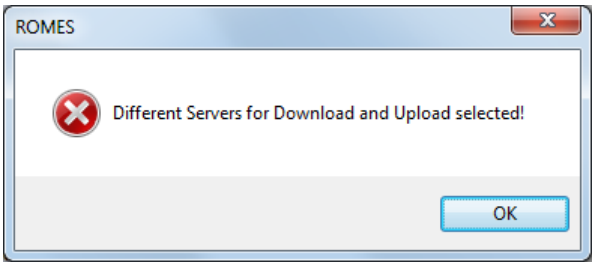
In the "Configured Servers for Upload" list box all preconfigured servers for FTP upload are listed. Double-click an entry in the list to save the preconfigured server in the "Server" pane of the "QoS Job Server Configuration" dialog.

The following properties of a preconfigured server are available for FTP upload:

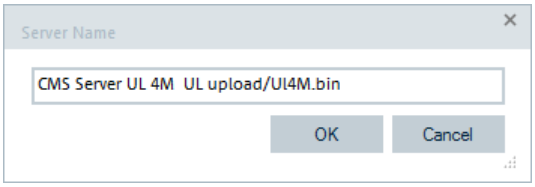
- "URL"
- "User Name"
- "Password"
- "FTP Mode"
- "Upload File"
- "Target Directory"
- "Source Directory"

For the properties definition, see "Properties" on page 1889.

It is not possible to select upload properties from a server which URL is different to the URL of this configuration. In this case the following message appears:



Click "Upload File" > "Add To Servers" to store the current upload configuration with the available properties listed previously to "Configured Servers for Upload". A server configuration name must be defined before storing the configuration.



FTP download / upload views

R&S ROMES4 supports for FTP Download / Upload jobs several views. The "Progress View" and "Report View" are shown in the following figures.

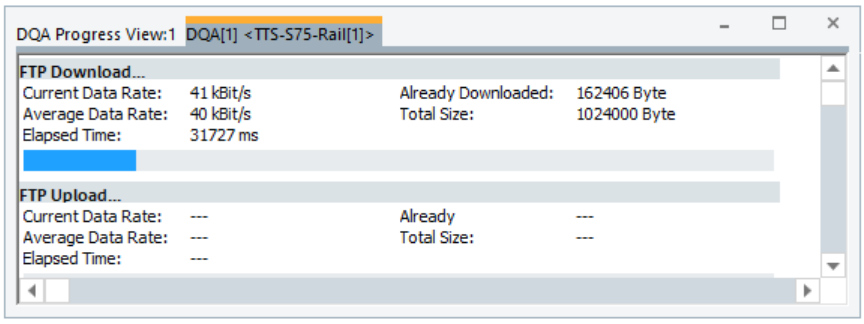


Figure 6-456: Progress view of FTP Download / Upload job

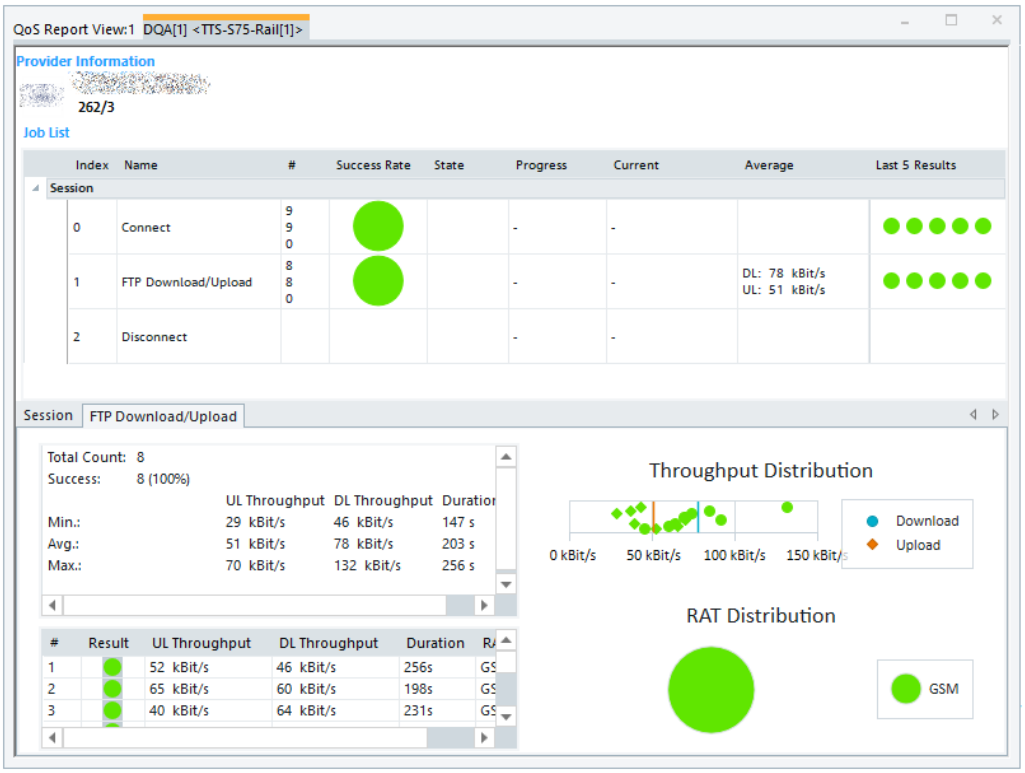


Figure 6-457: QoS report view of FTP Download / Upload job

Multi FTP

The "Multi FTP" configuration dialog lets you define a remote server and several files on the remote server. The definition also includes the local file system to be uploaded and downloaded using FTP between an FTP login and an FTP logout. The dialog is the combination of "FTP Upload" and "FTP Download" dialogs. Between the transfers, optional pauses can be defined.

The KPIs Session Time, Transfer Time and Mean Data Rate cannot be calculated by the ETSI methods. Therefore, this job is not ETSI conformed. All other ETSI KPIs are calculated, if possible.

In the provided KPI definition file, the session time is calculated for every action separately.

Example 1

1. FTP login
2. Download 300k file once.
3. Download 1Mb file 10 times.
4. FTP logout

Example 2

1. FTP login
2. 10s pause
3. Download 1Mb file once.
4. 10s pause
5. Download 1Mb file once.
6. FTP logout

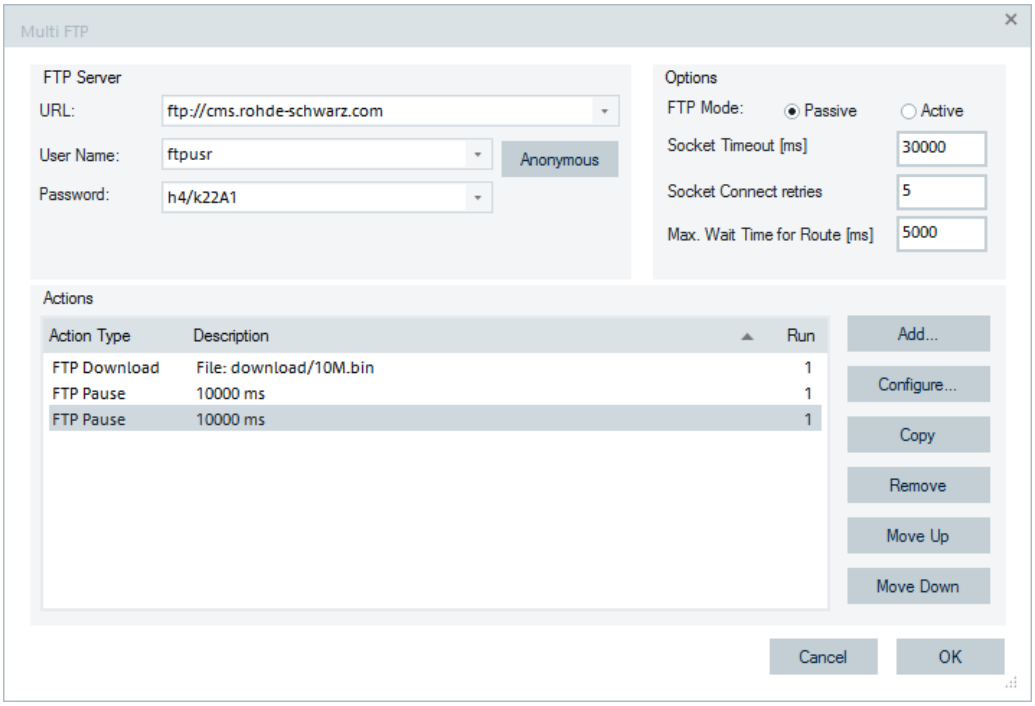


Figure 6-458: Multi FTP job - configuration

FTP Server

- "URL"
  Uniform Resource Locator (host name) or IP address identifying the remote server.

- "User Name", "Password"
  Account data: Optional input fields for authentication at the remote server.
- "Anonymous"
  Inserts the user name anonymous and an arbitrary password. The password can be overwritten, if necessary.

Options: Lets define additional file transfer parameters.

- "Socket Timeout [ms]"
  The time when the socket closes the connection without having received data. This time is used to limit the transfer time and thus the amount of information transferred.
- "Socket Connect Retries"
  Number of retries, if socket connection fails.
- "Max.Wait Time for Route [ms]"
  The socket connection starts only if the route is created. If the route is not created in the wait time, the job fails. Default is 5000 ms.

Actions

- "Add"
  Adds a new action to the action list. The action configuration dialog opens.

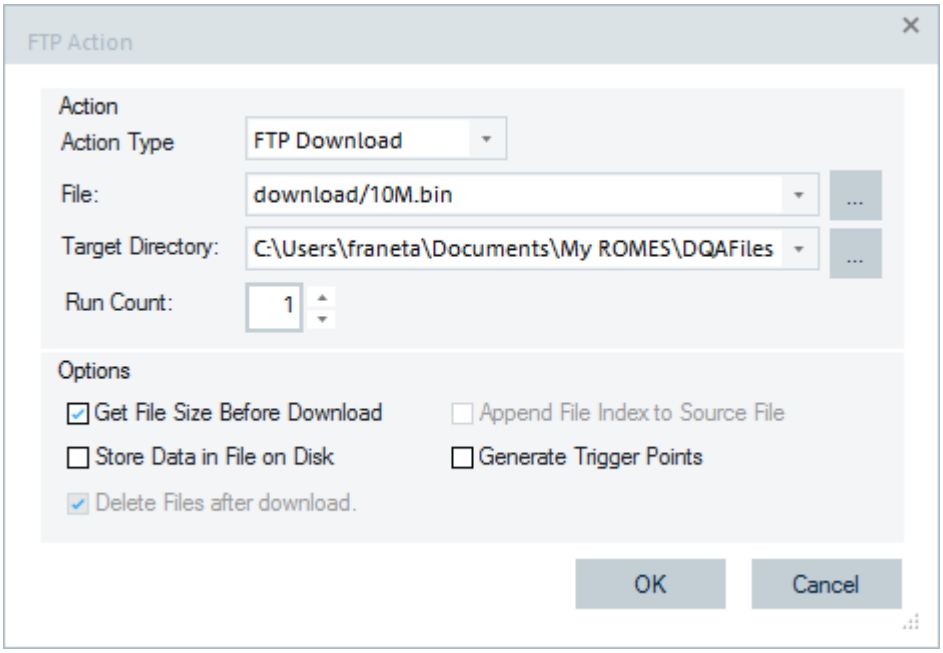


Figure 6-459: FTP Action - configuration

  – "Action Type"
    Possible actions type: FTP Download, FTP Upload, FTP Pause

  Depending on the selected action types, the following parameters are available:

  – "File"
    The file to be transferred. Press "..." to explore the file.
  – "Target Directory"

Directory accessible from the test system (e.g. the hard disk of the PC) where the downloaded file is stored. The "..." button provides a tree view of all available directories.

– "Run Count"
The number of times to repeat this action.

– "Get File Size Before Download"
If selected, the size of the transferred file is indicated in the "QoS Progress View" together with downloaded number of bytes.

– "Store Data in File on Disk"
If selected, the downloaded data is stored in a file that is copied to the local hard disk. If it is cleared, the data can be kept in memory (see the "Delete Files after download") but are not processed, which generally improves the system performance.

– "Delete Files after download"
If selected, no copy of the downloaded file is kept after the job is finished. Otherwise, R&S ROMES4 creates multiple copies of the downloaded file during job operation. For a downloaded file `<file_name>.<extension>`, the copies are named `<file_name>_0.<extension>`, `<file_name>_1.<extension>` etc.

– "Append File Index to Source File" (FTP Upload only)
If selected, the source file name is extended by an index before the file is transferred. The index is incremented before each FTP upload so the target server receives multiple copies of the same file with different file names.

– "Generate Trigger Points"
If unchecked, the trigger points of this action (FTP DL/ FTP UL) are not available for the KPI Generator.
However, the trigger points are written into the measurement file with a different service flag (0x05 for FTP DL, 0x06 for FTP UL) for internal use. Therefore these trigger points are not documented in the document `Trigger Point Definitions.doc`.

- "Configure"
The action configuration dialog opens for the selected action. Also a double-click the selected action opens the configuration dialog. For details refer to "Add" in "Multi FTP" on page 1917.
- "Copy"
Creates a copy of the selected action.
- "Remove"
Removes the selected action from the action list.
- "Move Up"
Moves up the selected action in the action list.
- "Move Down"
Moves down the selected action in the action list.

The progress information values and the job result values are available in the signal tree under the "QoS Tester" tree object.

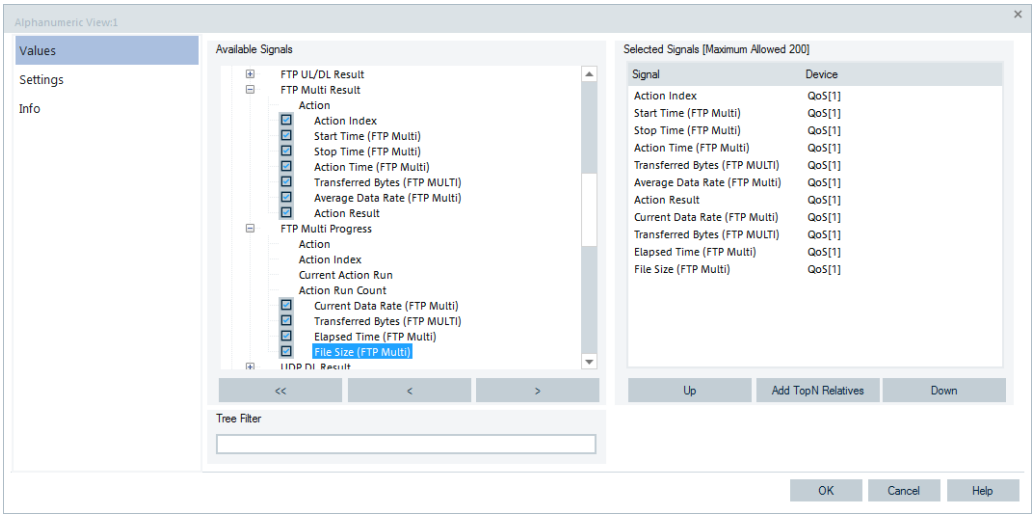


Figure 6-460: Configured Multi FTP signals

The "DQA Progress View" shows the states of the current action. Terminated actions are displayed in the "FTP Action" list.

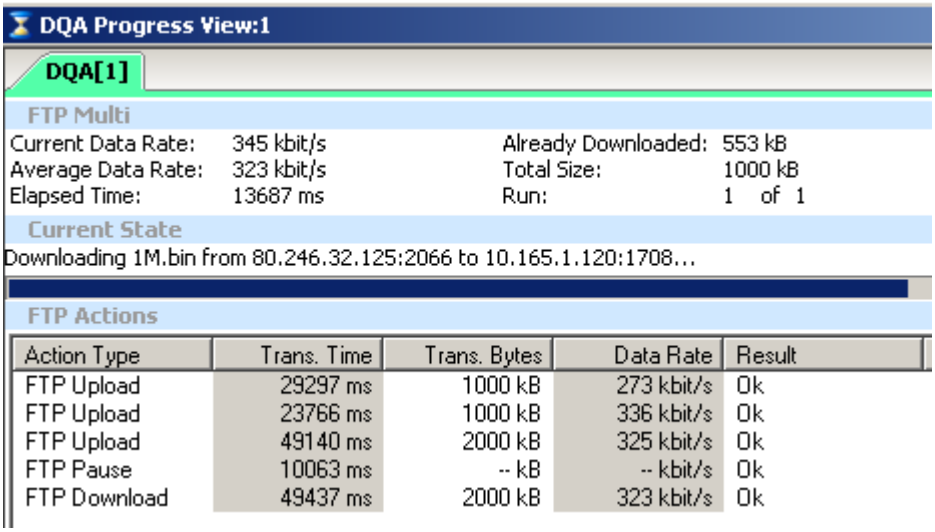


Figure 6-461: DQA Progress View of Multi FTP job

The "QoS Report View" shows the statistics of all actions. The accumulated data rates of all actions are split into download and upload.

FTP parallel download

The high traffic on the network needs to be produced for LTE test cases. A test can be done with DQA FTP Parallel Download job. The job uses different servers and/or different files, but not necessarily.

TCP/IP trigger points are not available for FTP Parallel Download job.

Double-click "FTP" > "FTP Parallel Download" in the "Available Jobs" list to open the job's configuration dialog.

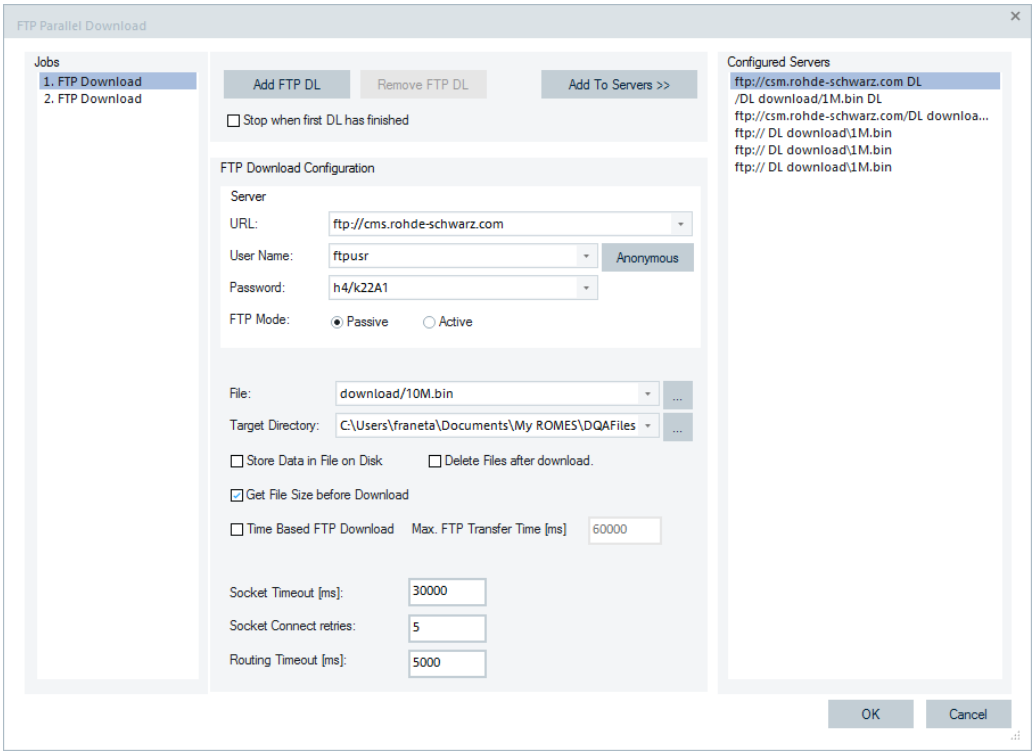


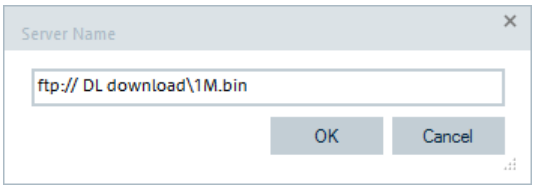
Figure 6-462: FTP Parallel Download job - configuration

The minimum number of parallel FTP downloads is 2. These 2 jobs are shown by default in the "Jobs" pane and must be configured. The maximum number of parallel FTP downloads is 10.

To add and configure further FTP Parallel Download jobs, click the "Add FTP DL" button. The configuration can be taken from the preconfigured servers included in the "Configured Servers" pane. The configured parameters of a job are shown in the "FTP Download Configuration" pane, if you select the job in the "Jobs" pane.

To remove a job selected in the "Jobs" pane from it, click the "Remove FTP DL" button.

Select "Add To Servers" to store the current configuration with the available properties listed previously to the "Configured Servers". Before storing the configuration, define the server name.



There is the option to stop the FTP Parallel Download job when one of the parallel FTP downloads is finished. To activate this option, check "Stop when first DL has finished" in the configuration dialog.

By activating this option, all other FTP download jobs are canceled when one of the jobs is finished. As a consequence, only the result of the job which finished at first can

be shown in the "QoS Report View". However, the calculation of the Total Download Rate considers the amount of data and the time window of all FTP download jobs, see Figure 6-464.

FTP parallel download progress view

The parameters are the same as in the "Progress View" of a single FTP download. However, the Current Data Rate cannot be calculated because the notifications of the parallel running FTP download jobs are not synchronous.

The Average Data Rate is calculated as follows:

$$Average\,Data\,Rate\,[kbit/s] = \frac{Already\,Transferred\,Bytes \times 8}{Elapsed\,Time\,[ms]}$$

Already Transferred Bytes: the number of transmitted bytes of all jobs.

Elapsed Time [ms]: (Current Time) – (Start Transfer Time of the job which started transfer at first)

The parameters of each parallel running FTP download are shown in the list.

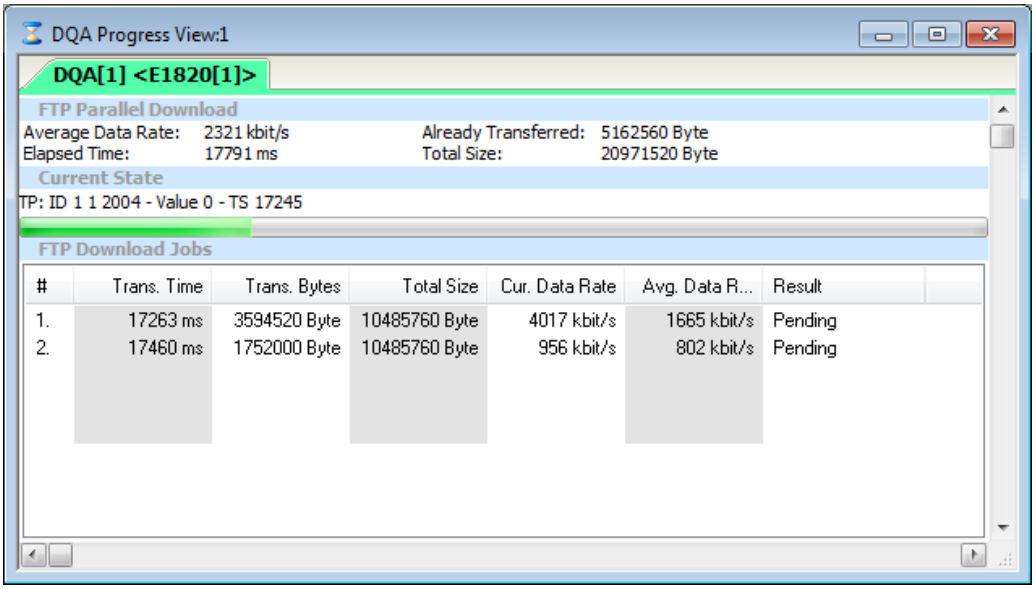


Figure 6-463: FTP Parallel Download - progress view

The sum of the Average Data Rate of all parallel jobs is not equal to the calculated Average Data Rate shown in the top-left corner, because the jobs are not running synchronous.

FTP parallel download QoS report view

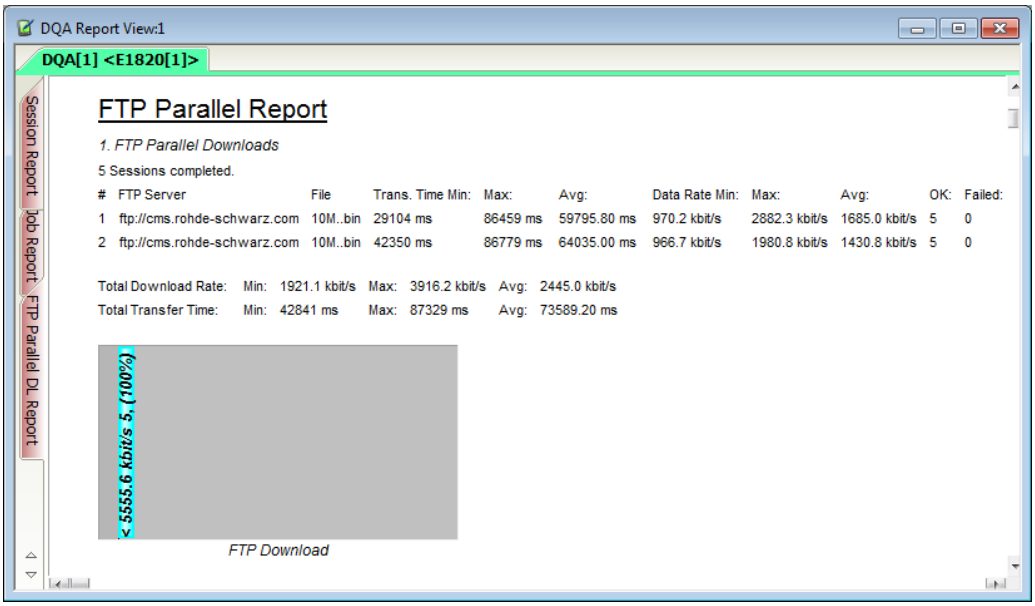


Figure 6-464: FTP Parallel Report - stop transfer when first DL finished not checked

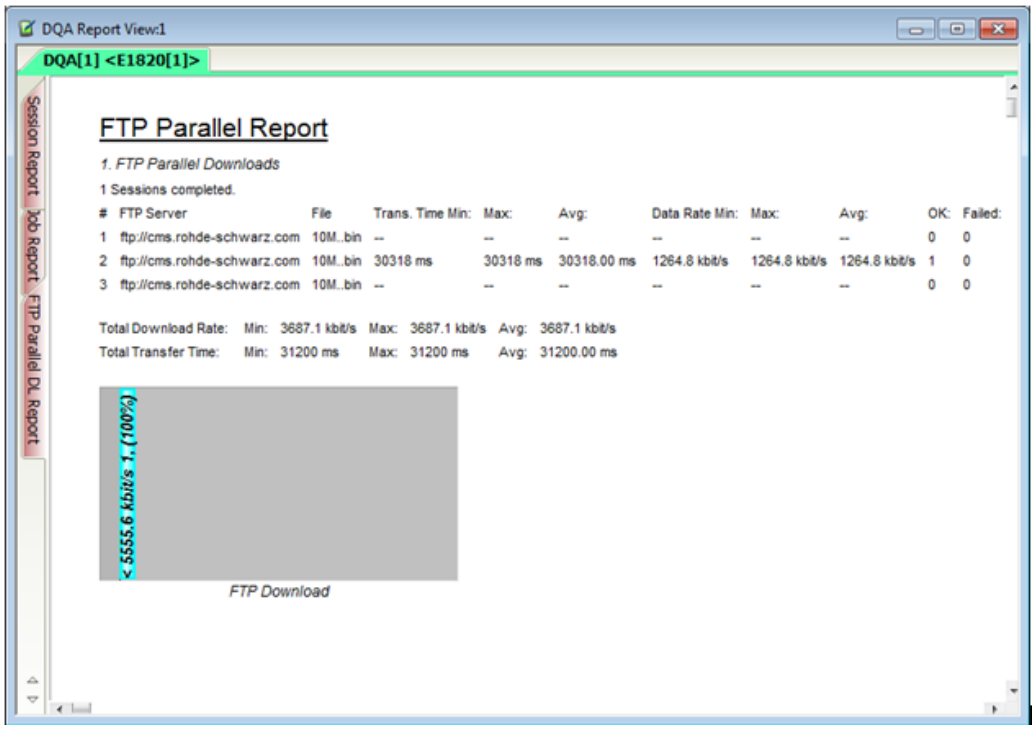


Figure 6-465: FTP Parallel Report - stop transfer when first DL finished checked

This report is similar to a "FTP Multi Job Report".

At first, the results of each parallel running job are shown in the "QoS Report View" list.

$$Total\ Download\ Rate\ [kbit/s] = \frac{Total\ Transferred\ Bytes \times 8}{Total\ Transfer\ Time\ [ms]}$$

Total Transfer Time: the time span from Start Transfer of the job which started transfer at first and Stop Transfer of the job which finished at last.

FTP parallel download signals

The FTP Parallel Download job uses the signals of the single FTP Download job. The signals are under the "QoS Tester" > "QoS [variable]" tree branch.

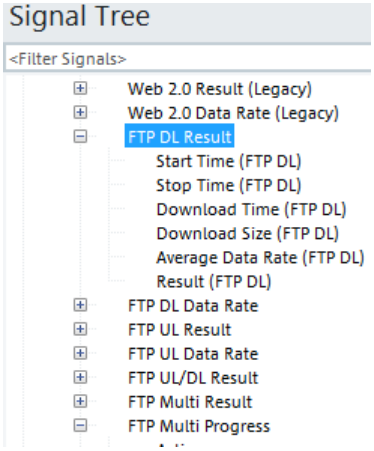


Figure 6-466: FTP DL Result signals

FTP parallel upload

The high traffic on the network needs to be produced for LTE test cases. A test can be done with the DQA FTP Parallel Upload job and Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891. The job uses different servers and/or different files, but not necessarily.

The TCP/IP trigger points are not available for this job.

Double-click "FTP" > "FTP Parallel Upload" in the "Available Jobs" list to open the job's configuration dialog.

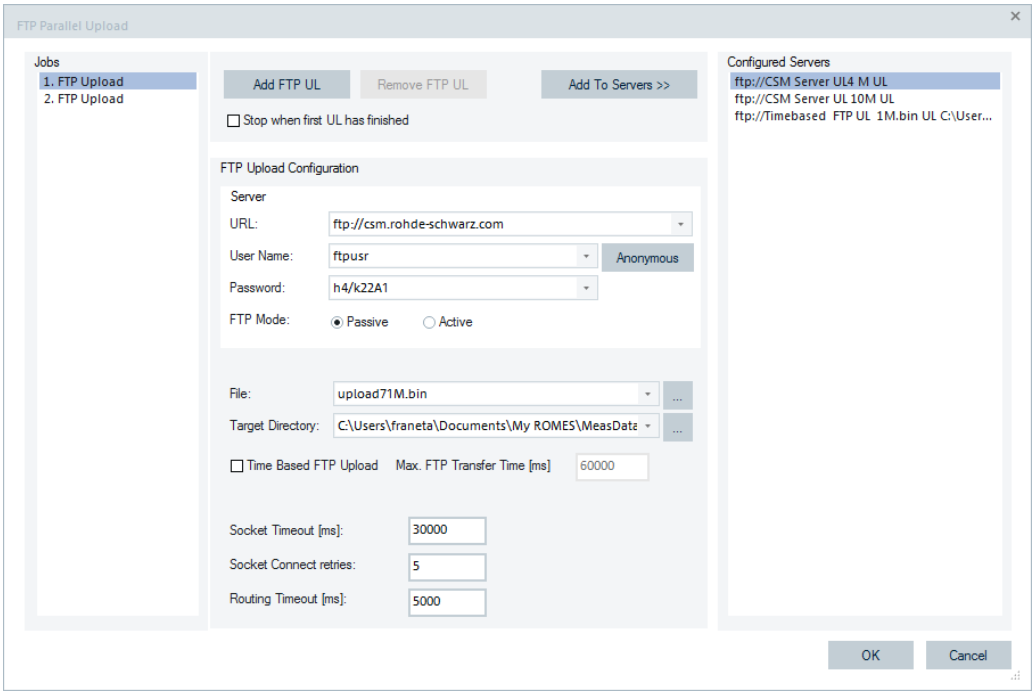


Figure 6-467: FTP Parallel Upload job - configuration

The minimum number of parallel FTP uploads is two. These two jobs are listed by default in the "Jobs" pane and must be configured. The maximum number of parallel FTP uploads is 10.

To add and configure the further FTP Parallel Upload jobs, click the "Add FTP UL" button. The configuration can be taken from the preconfigured servers included in the "Configured Servers" pane. The configured parameters of a job are shown in the "FTP Upload Configuration" pane, if you select the job in the "Jobs" pane.

To remove a job selected in the "Jobs" pane from it, click the "Remove FTP UL" button.

Select "Add To Servers" to store the current configuration with the available properties listed previously to the "Configured Servers". Before storing the configuration, define the server name.

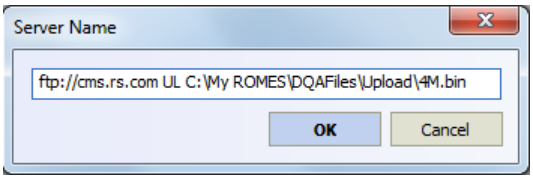


Figure 6-468: Server name

A file suffix is always added to the uploaded file to avoid accessing conflicts on the server.

FTP parallel upload progress view

The parameters are the same as in the "Progress View" of a single FTP upload. However, the Current Data Rate cannot be calculated because the notifications of the parallel running FTP upload jobs are not synchronous.

The Average Data Rate is calculated as follows:

$$Average\,Data\,Rate\,[kbit/s] = \frac{Already\,Transferred\,Bytes \times 8}{Elapsed\,Time\,[ms]}$$

Already Transferred Bytes: the number of transmitted bytes of all jobs.

Elapsed Time [ms]: (Current Time) – (Start Transfer Time of the job which started transfer at first)

The parameters of each running FTP Parallel Upload job are shown in the list.

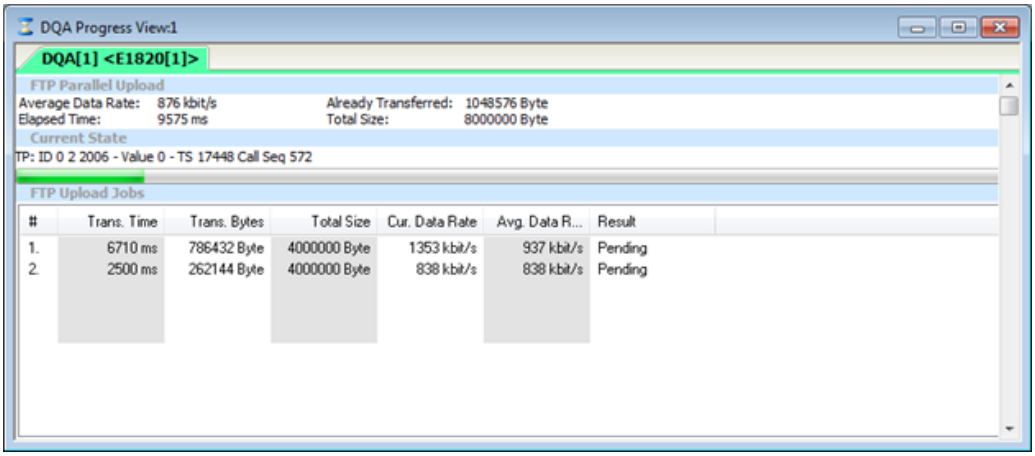


Figure 6-469: Progress view of FTP parallel upload job

The sum of the Average Data Rates of all parallel jobs is not equal to the calculated Average Data Rate shown in the top-left corner because the jobs are not running synchronous.

FTP parallel upload report view

This report is similar to a"FTP Multi Job Report".

The results of each in parallel running job are shown in the "FTP Parallel UL Report" of the "QoS Report View".

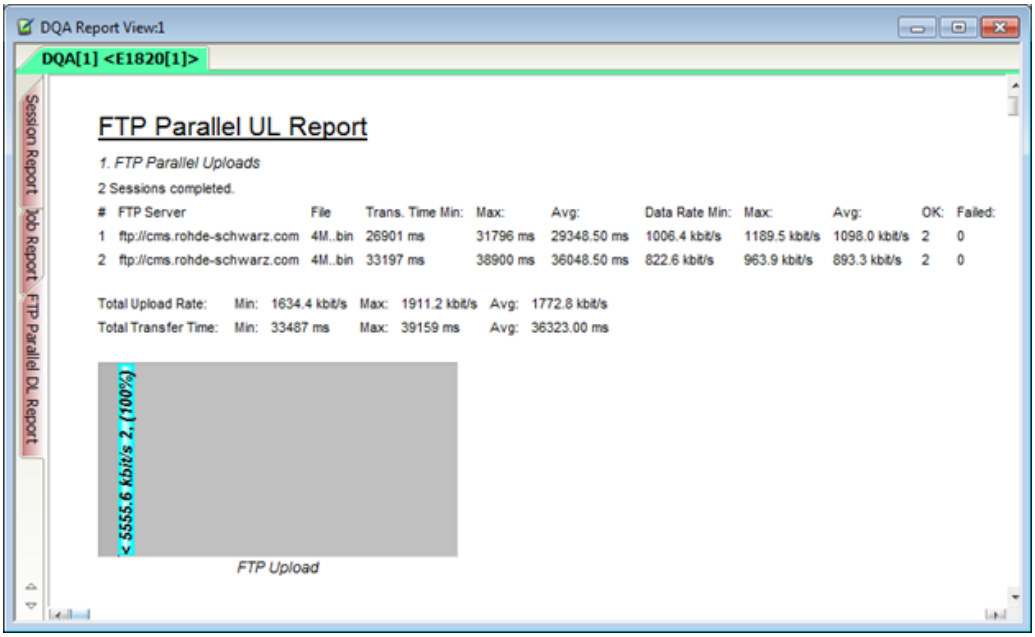


Figure 6-470: QoS report view of FTP parallel upload job

$$Total\ Upload\ Rate\ [kbit/s] = \frac{Total\ Transferred\ Bytes \times 8}{Total\ Transfer\ Time\ [ms]}$$

Total Transfer Time: the time span from FTP Multi Job Report of the job which started transfer at first and Stop Transfer of the job which finished at least.

FTP parallel upload signals

The FTP Parallel Upload job uses the signals of the single FTP Upload job, see the following figure. The signals are under the "QoS Tester" > "QoS [variable]" tree branch.

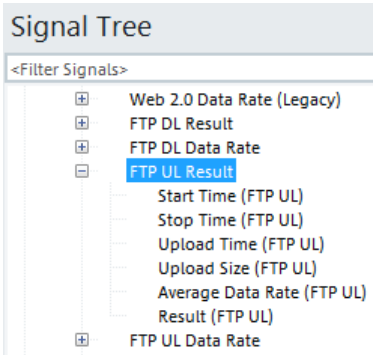


Figure 6-471: FTP UL Result signals

Parallel FTP download and ping

The job makes possible to perform pings in parallel to the FTP DL jobs. With the FTP DL job termination, terminates the ping job as well.

Double-click "FTP" > "Parallel FTP Download and Ping" in the "Available Jobs" list to open the job's configuration dialog.

Figure 6-472: FTP DL and Ping job - configuration

Parallel FTP download and ping progress view

The "DQA Progress View" shows only the progress of the main job, which is the FTP Download job.

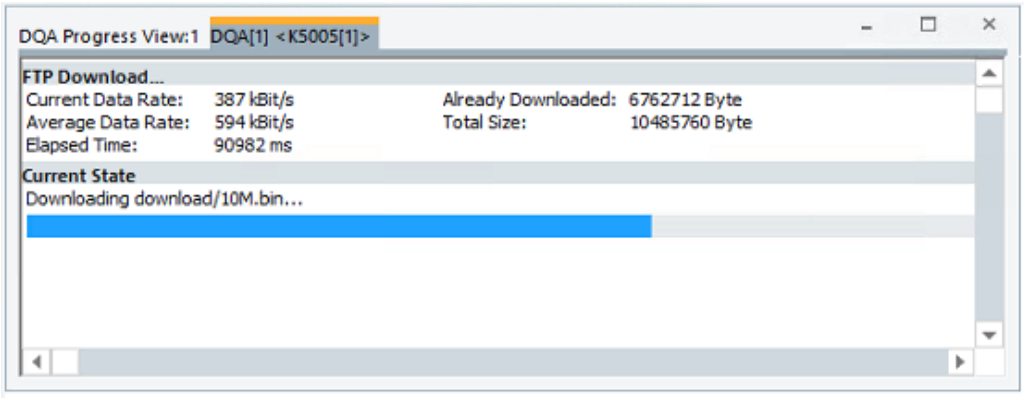


Figure 6-473: DQA jobs progress view

The Ping jobs are only shown in the "DQA Message View" and "Current State" sections of the "Progress View", see the previous figure.

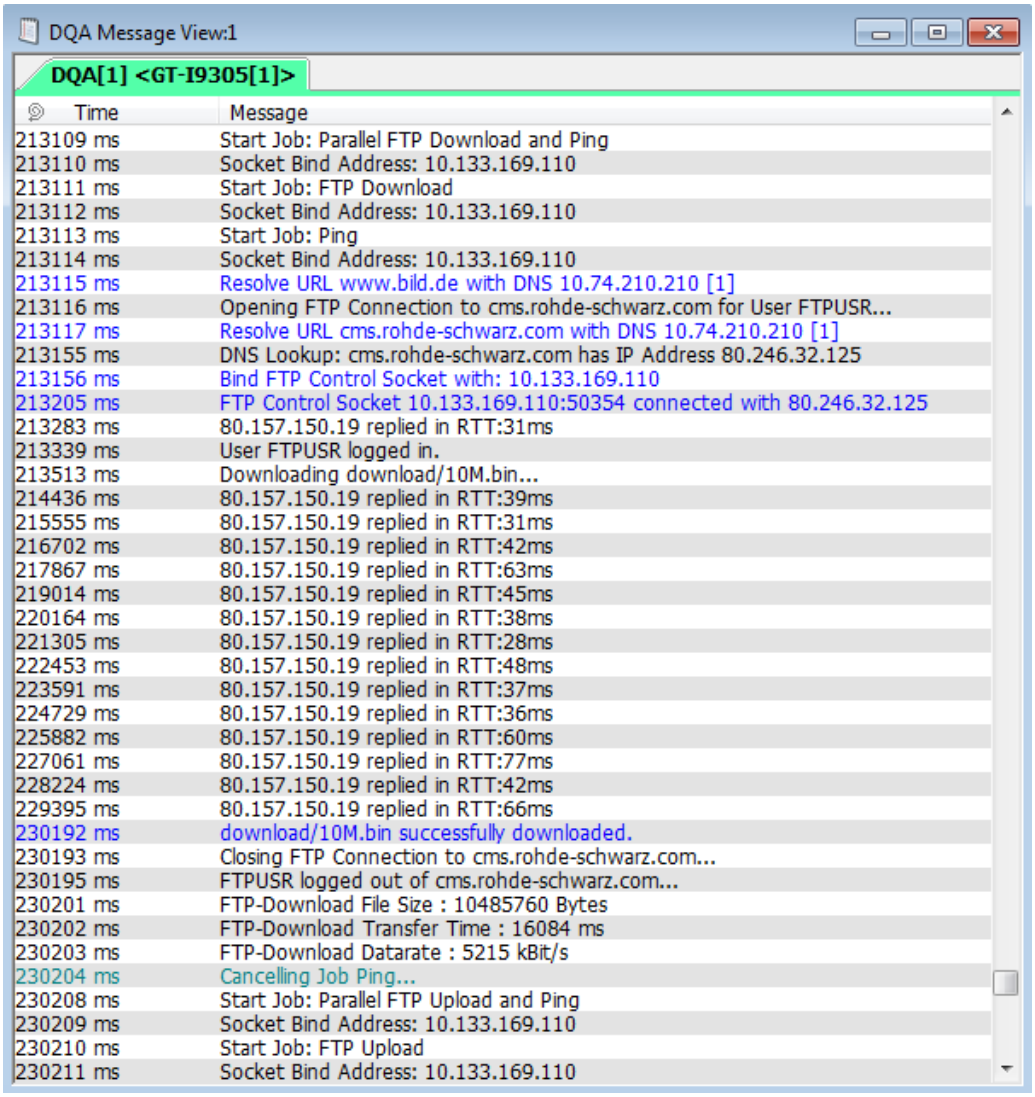


Figure 6-474: DQA jobs message view

Parallel FTP download and ping report view

The reports of both jobs are available in the "QoS Report View".

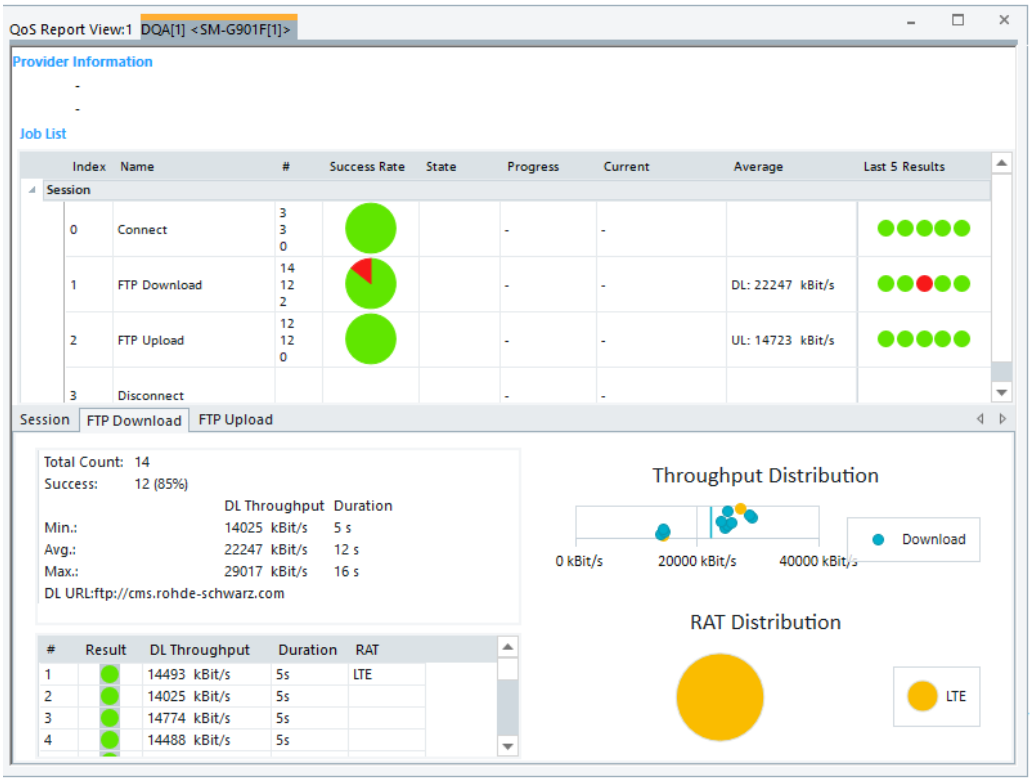


Figure 6-475: QOS report view of FTP download job

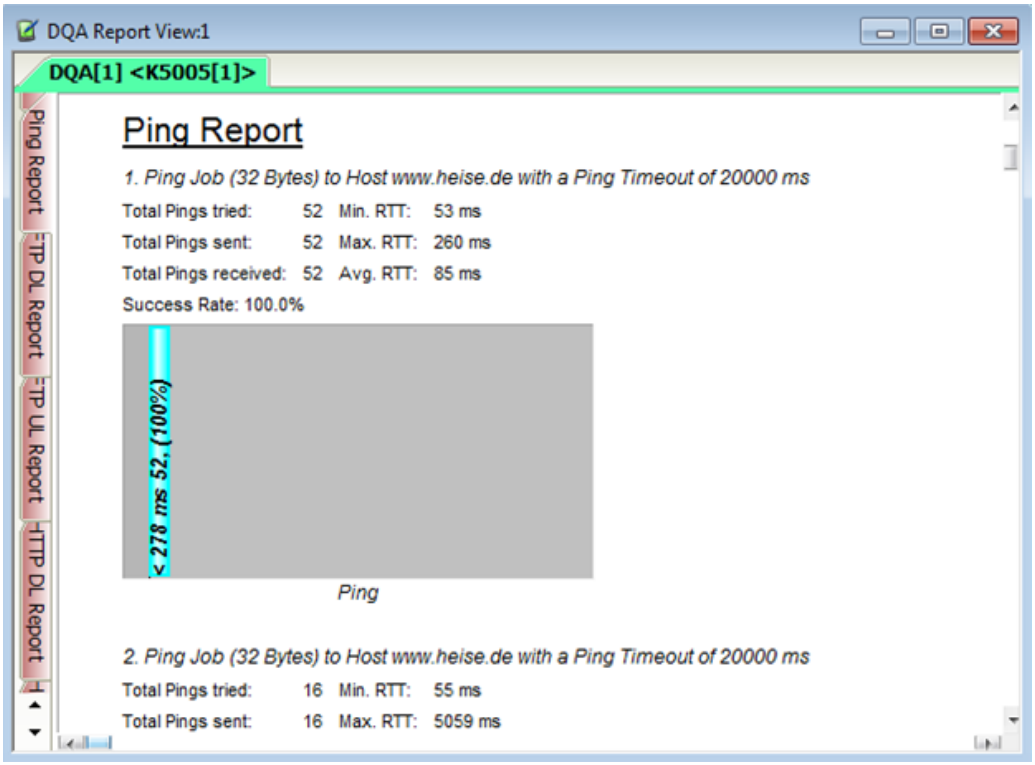


Figure 6-476: Ping job report

Parallel FTP upload and ping

The job makes possible to perform pings in parallel to the FTP UL jobs. With the FTP UL job termination, terminates the ping job as well.

See the previous chapter.

Performance

Ping

To open the Ping job configuration dialog, double-click the "Performance" > "Ping" entry in the "Available Jobs" pane.

The configuration dialog lets you define a target server for Ping job (using ICMP protocol), the timing and the number of pings to be sent.

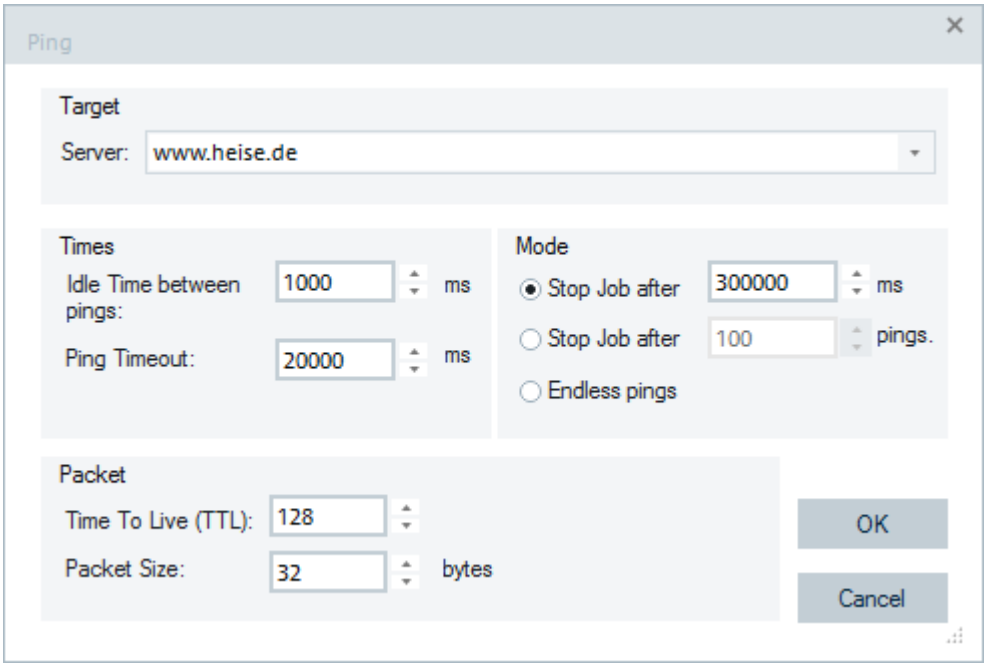


Figure 6-477: Ping job - configuration

- "Server"
  Name of the target server to ping; IP address like in the example above or host name.
- "Idle Time between pings"
  Time elapsed between reception of a response from the target server and start of the next ping. The idle time between two pings is in the range 0 ms to 100000 ms.
- "Ping Timeout"
  Maximum time between the start of a ping and reception of a response from the target server. If the configured "Ping Timeout" expires, the ping is classified as unsuccessful.
- "Mode"
  Defines the scope of the ping job: Either a time limit in seconds or a maximum number of pings can be set.
- "Time to Live"
  Time_of_life parameter allocated to the transmitted data packets. Packets are discarded if their time to live has expired.
- "Packet Size"
  Packet size in the range between 32 bytes and 1024 bytes.

Miscellaneous

Wait

The DQA Wait job provides a configurable wait time between executions of two jobs. The job includes the feature which allows the user to wait for one or more ROMES events and to wait for signal expressions to become true.

To open the Wait job configuration dialog, double-click the "Miscellaneous" > "Wait" entry in the "Available Jobs" pane.

Three wait modes of the job are supported:

- "Wait a specified Time"
- "Wait for an Event"
- "Wait for Signals"

Wait a specified Time
If adding the Wait job to the DQA Job list, the job appears with this mode as default.

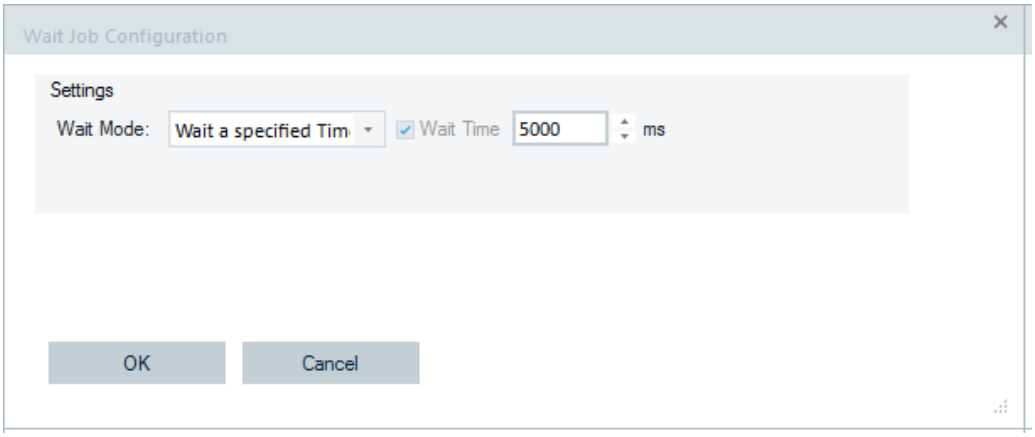


Figure 6-478: Wait a specified time

This mode is used to provide the necessary time for the system reconfigurations before the next job is started.

Wait for an Event
If selected in the "Wait Mode" combo box, the job suspends the execution of the DQA job list until the one of the specified events occurs.

The configuration dialog opens to set the mode's parameters.

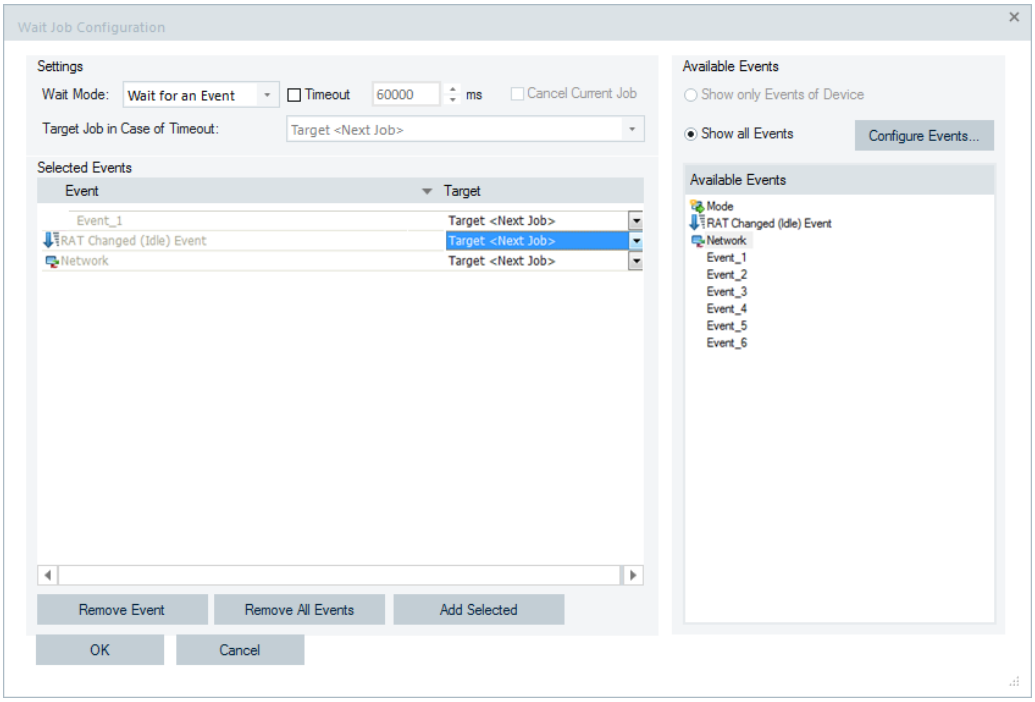


Figure 6-479: Wait for an event dialog

Wait for an Event ← Wait for an Event

The "Wait for an Event" mode of Wait job allows you to set the following parameters in the "Settings", "Selected Events" and "Available Events" panes.

Settings

- "Timeout"
  Defines a timeout to terminate the job when no specified event occurred during the specified time.
- "Target Job in Case of Timeout"
  Defines a target job when time out. By default, the next job in the list executes then.
- "Cancel Current Job"
  If selected, the job is executed in parallel to the previous job. The previous job is canceled if one of the selected events occurs. If the previous job terminates normally, this job has no influence.
  The setting is not available during initial job creation. It is selectable while configuring the job after creating the job.

Selected Events

- "Event"
  The R&S ROMES4 events enabled in the event page, see Chapter 3.8.1.3, "Available events configuration", on page 238. Several R&S ROMES4 events can be selected. The waiting/cancel condition is fulfilled whenever one of the events occurs (OR).
- "Target"
  Each selected event can define a jump to a specific job (target). By default, the next job in the list is executed.

Available Events

- "Show only Events of Device"
  The "Available Events" list shows by default only R&S ROMES4 events of the currently used UE.
- "Show all Events"
  If this option is active, however, any event can be selected.
- "Configure Events"
  The R&S ROMES4 event configuration page is available if this button is clicked.

Buttons

- "Add Selected"
  Selected an event from a list of currently available event lists using this button or drag and drop the event to the "Selected Events" > "Event" pane.
- "Remove Event"
  Removes a marked event from "Selected Events".
- "Remove All Events"
  Removes all events from "Selected Events".

Wait for Signals

If this mode is selected in the "Wait Mode" combo box, the job waits until at least one of the defined signal expressions is true. The signal expressions are evaluated in the same order as defined. If more than one expression is true, the first one in the list is the one which is responsible for the job's behavior.

A R&S ROMES4 signal expression is a tree of expressions of R&S ROMES4 signals and values, which can be combined by Boolean expressions.

The user can define several R&S ROMES4 signal expressions. If the expression becomes true, the wait job stops. For each expression, a specific successor job can be specified. By default, the next jump in the list is the successor.

The expression tree can be created in the following steps:

1. Select a R&S ROMES4 signal. By default only signals of the current device are offered by the "Signal Tree" dialog. You can select the option to see all signals.
2. If the signal has alias, the available operators are "Equal" and "Out Of".

- "Equal": Selects the desired value with the combo box
- "Out Of": Selects all desired values with the checked combo box

3. If the signal is numeric, the following operators are available for selection:

- "Equal"
- "Less Than"
- "Less or Equal Than"
- "Greater Than"
- "Greater or Equal Than"

Define a signal value to be compared. The currently selected unit for the signal is assigned to the value. The dialog displays this unit and checks if the given value is in the valid range.

Two signal expressions can be combined to Boolean expressions by using one of Boolean operators AND, OR and XOR. Two Boolean expressions can be combined to new Boolean expression.

Example: Expressions

RSSI > -90 dBm

AND

IRAT Mode == UMTS

OR

RxLev > -80 dBm

AND

IRAT Mode == GSM

Configuration of Wait for Signals ← Wait for Signals

The "Wait for Signals" mode of the Wait job allows you to set the following parameters in "Settings" and "Selected Signal Conditions" panes.

Settings

- "Timeout"
  Defines a timeout to terminate the job when no specified signal expression becomes true during the specified time.
- "Cancel Current Job"
  If selected, the job is executed in parallel to the previous job. The previous job is canceled if one of the selected signal expressions becomes true. If the previous job terminates normally, this job has no influence.

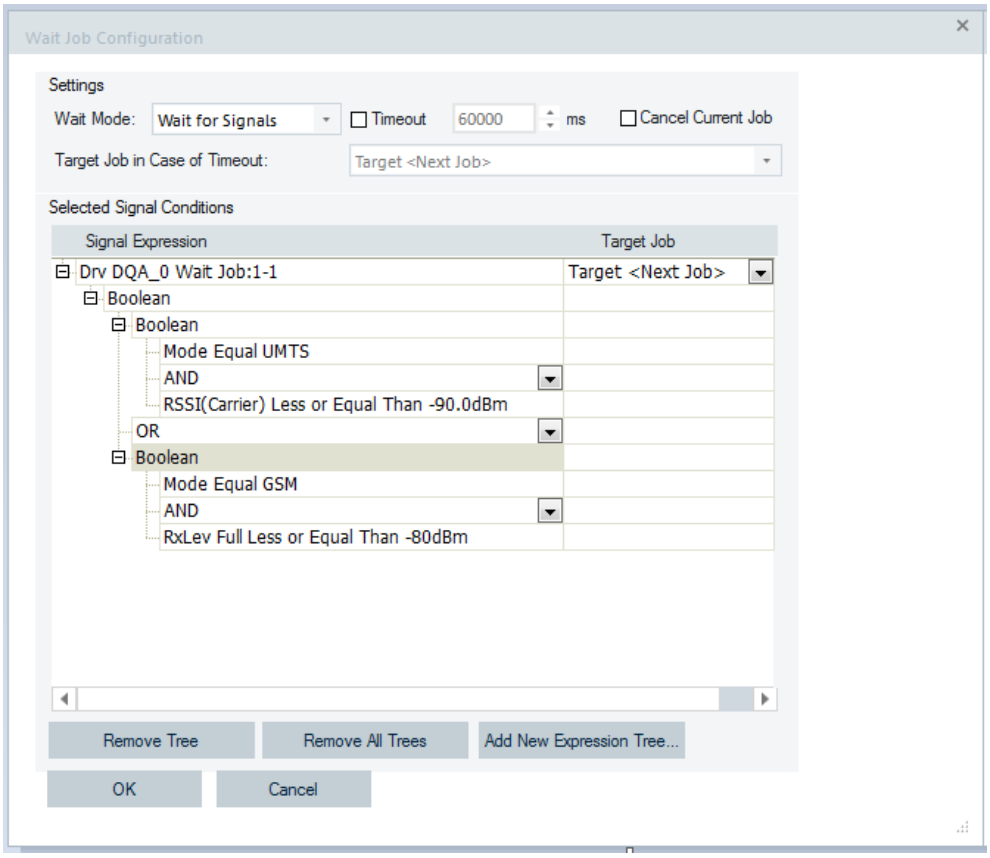


Figure 6-480: Wait for signals dialog

The setting is not available during the initial job creation. It is selectable while configuring the job after creating the job.

- "Target Job in Case of Timeout"
  Defines a target job at timeout. By default the next job in the list is executed then.
- "Add New Expression Tree"
  The button allows defining a new signal expression. Click the button to open the "Create Signal Expression" dialog.
  – "Available Signals"
    The list of available signals is shown on the left side of the dialog. The "Available Signals" pane in the following figure shows only the R&S ROMES4 signals of the currently used UE, as "Show only Signals of Device" entry is active, which is default.

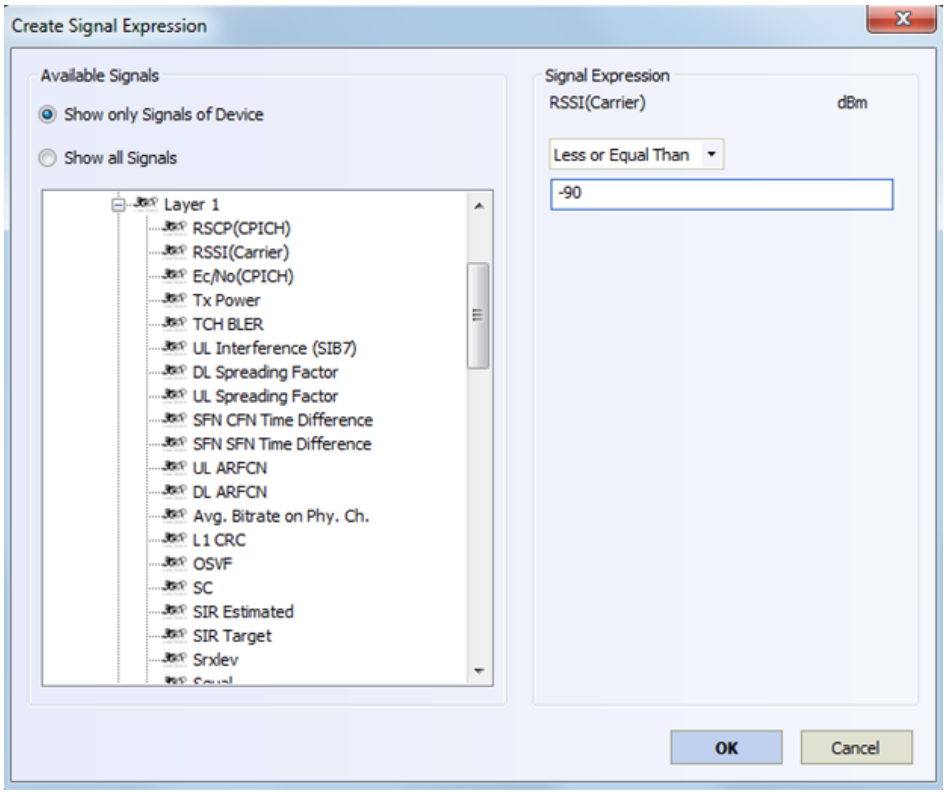


Figure 6-481: Defining new signal expressions

However, there is the possibility to select signals of other devices, if "Show all Signals" is clicked instead.

  – "Signal Expression"
    If one or more signals are selected in "Available Signals", the signals expression is shown in this pane.
    Double-click with the right mouse button a signal in the available signals list to select it. In the "Signal Expression" pane the signal is shown with its current configured unit.

The expression operator for the signal expression can be selected out of the following ones in the "Signal Expression" combo box.

- "Equal"
- "Greater Than"

- "Greater or Equal Than"
- "Less Than"
- "Less or Equal Than"

The value of current signal can be defined in the box below the "Signal Expression" combo box.

If the signal has alias, the available operators are Equal and One of.

- "Equal": Selects the alias with the combo box

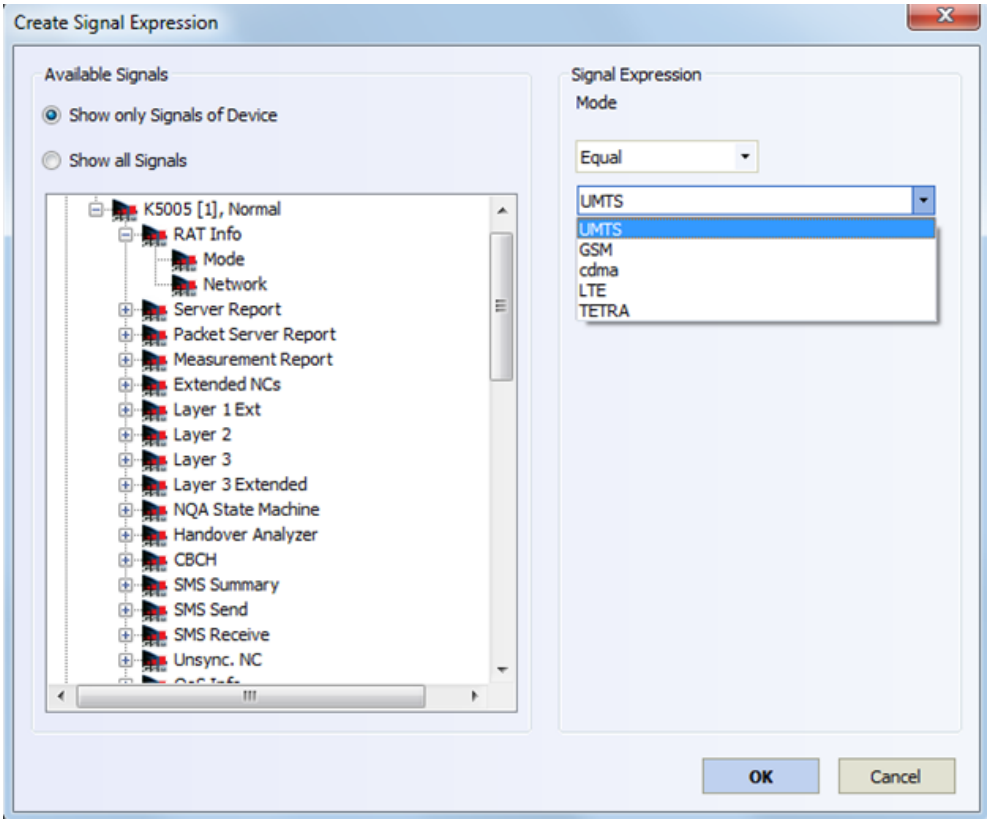


Figure 6-482: Expression operator - equal

- "Out Of": Selects several aliases with the checked combo box

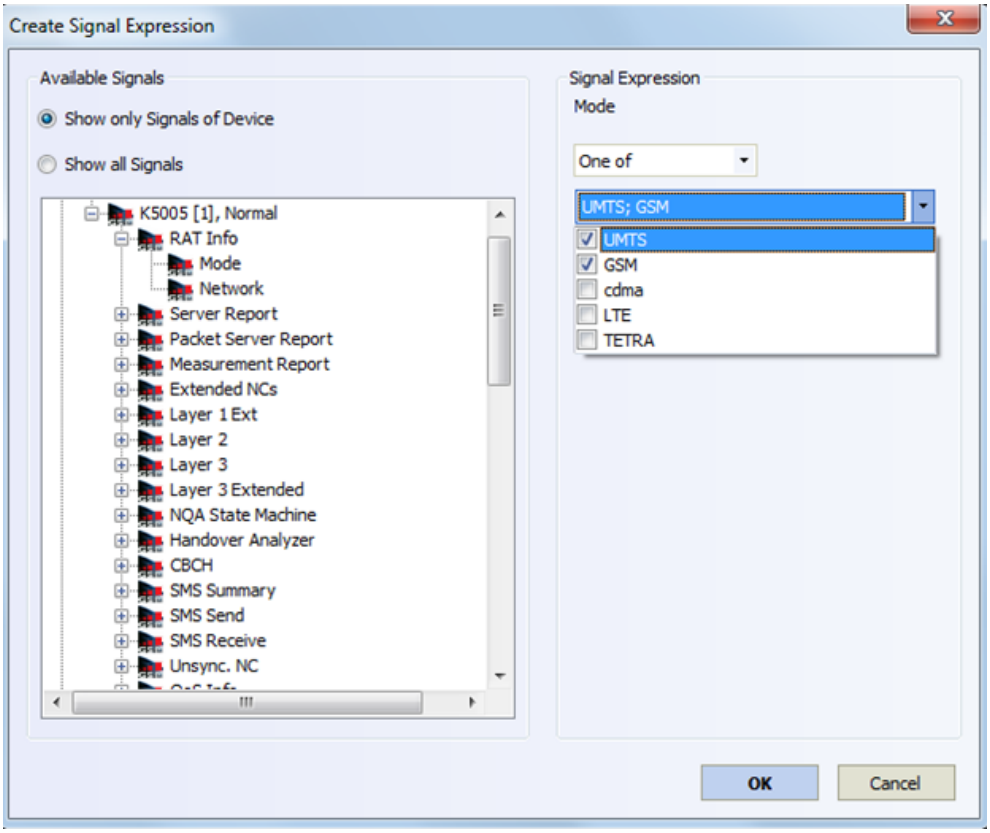


Figure 6-483: Expression operator - One of

Note: UMTS scrambling codes must be defined in 16-step mode (0 to 8192, the real SC multiplied by 16).

Configuration of Signal Expression Tree ← Wait for Signals
Right mouse-button click a signal expression of an expression tree, see the Figure 6-480. The opened context menu lets you add Boolean conditions, configure or remove signal expressions, add a new expression tree or remove the currently selected one. The context menu is shown in the following figure.

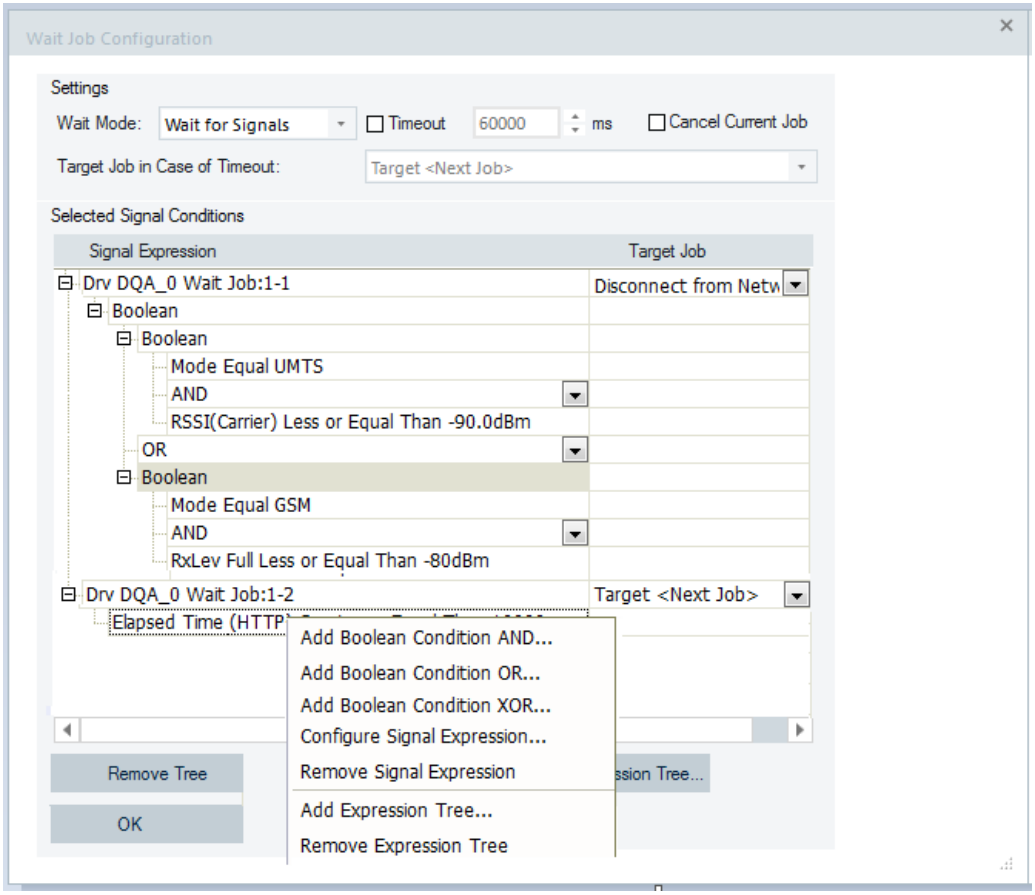


Figure 6-484: Wait for signals context menu

In the context menu the following commands are available:

- "Add Boolean Condition AND"
  The expression becomes true, if both parts of the expressions become true.
- "Add Boolean Condition OR"
  The expression becomes true, if one or both parts of the expressions become true.
- "Add Boolean Condition XOR"
  The expression becomes true, if only one part of the expressions becomes true.
- "Configure Signal Expression"
  Opens the "Create Signal Expression" dialog where the selected signal expression can be modified.
  The option is also available by double-click with the left mouse button.
- "Remove Signal Expression"
  Removes the current selected signal expression.
- "Add Expression Tree"
  Opens the "Create Signal Expression" dialog where the new signal expression can be created.
- "Remove Expression Tree"
  Removes the current selected expression tree.

Right-click the root element of an expression tree or a Boolean operator of a Boolean expression to make only the "Add Expression Tree" and "Remove Expression Tree" commands in the context menu available.

In the "Target Job" column of the tree a target job to jump to can be defined if the signal expression becomes true.

Wait job progress view
A progress view is available to see the current elapsed time of the Wait job, see the following figure.

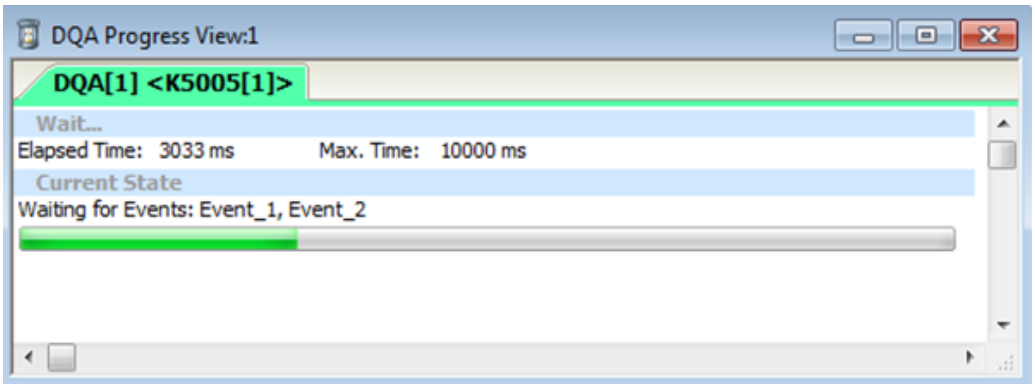


Figure 6-485: Progress view of Wait job

Go to job

The only action of the "Go to Job" job is to jump to a specific job in the "Job" list.

To open the configuration dialog, double-click the "Miscellaneous" > "Go to Job" entry in the "Available Jobs" pane. The combo box offers a list of jobs to jump to.

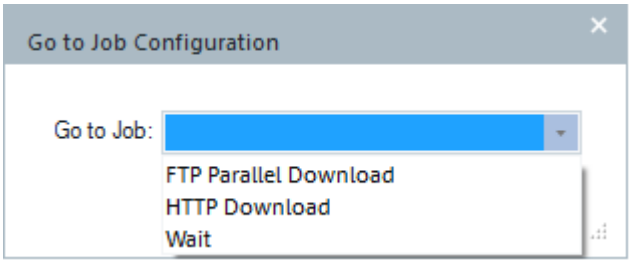


Figure 6-486: Go to selected job - configuration

The Wait job conditional testing can be programmed in combination with the "Go to Job" option.

Run external process

It is possible to execute an external process. If the external process is a console application, the console output is redirected to the DQA Message View.

To open the configuration dialog, double-click the "Miscellaneous" > "Run External Process" entry in the "Available Jobs" pane.

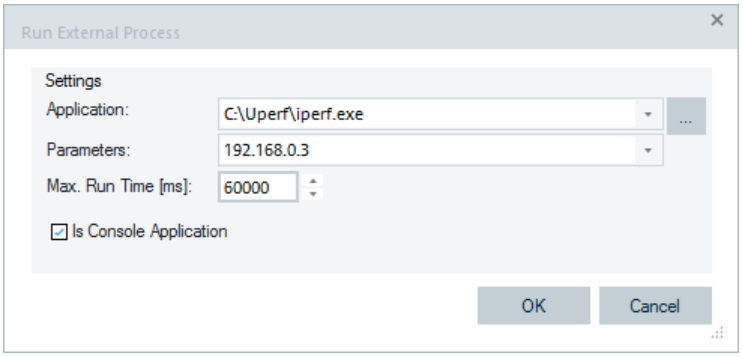


Figure 6-487: Run external process job - configuration

The following properties can be configured in the "Run External Process" configuration dialog.

- "Application"
  The application to be executed
- "Parameters"
  A list of parameters for the executable.
  The following place holders are available:
  – %IP%: The IP address of the connected network adapter or modem.
  – %DNS%: The DNS server address of the connected network adapter or modem.
- "Max.Run Time [ms]"
  The maximum run time of the application in milliseconds. If this time expires during the application execution, the process is terminated.
- "Is Console Application"
  Must be checked if the application is a console application. If checked, the console output is redirected to the "DQA Message View".

If the "Is Console Application" box is checked, the console output and the execution state of the application is shown in the "DQA Message View".

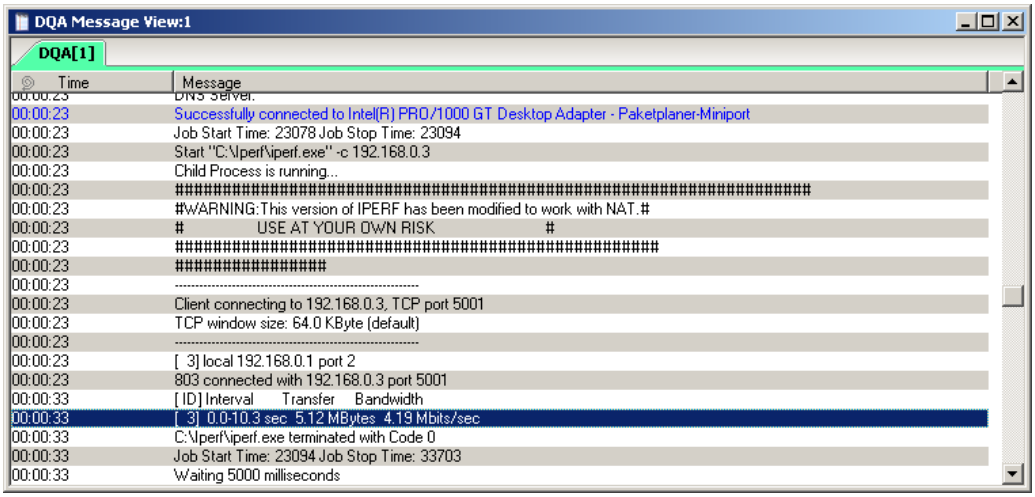


Figure 6-488: DQA message view

Semaphore

The Semaphore job allows you synchronizing several DQA testers.

To open the Semaphore job configuration dialog, double-click the "Miscellaneous" > "Semaphore" entry in the "Available Jobs" pane.

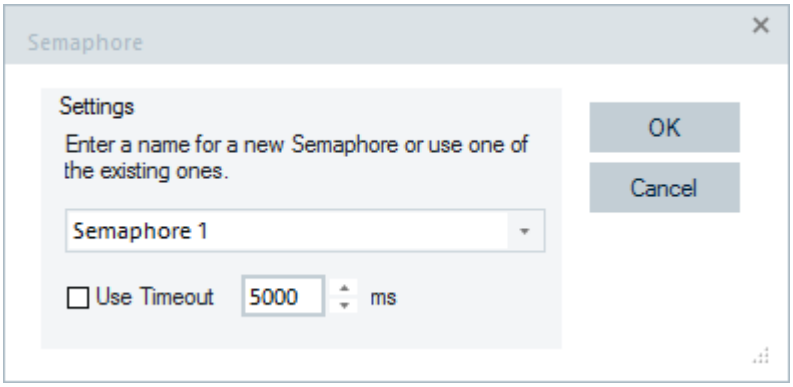


Figure 6-489: Semaphore job - configuration

The page consists of the text box to name the job and an optional timeout value.

The name of the Semaphore job is used to distinguish several Semaphores.

The timeout value can be used to limit the wait time for the Semaphore. If the Semaphore job is not signaled by all DQA testers within the given timeout, the DQA cancels the job and continues with the next job in the list. The configuration dialog offers all currently existing Semaphore names. A new name can be entered directly into the text box.

Using timeout values is not recommended, because it can lead to instability of the measurement process.

If entering the Semaphore job, the job waits until all DQA testers which have at least one Semaphore job with an identical name have entered one of those Semaphore jobs. Semaphore jobs of other DQA testers with different names are ignored for this Semaphore.

A DQA tester can have more than one Semaphore job with the same name. The DQA tester signals the Semaphore, whenever one of those jobs is executed.

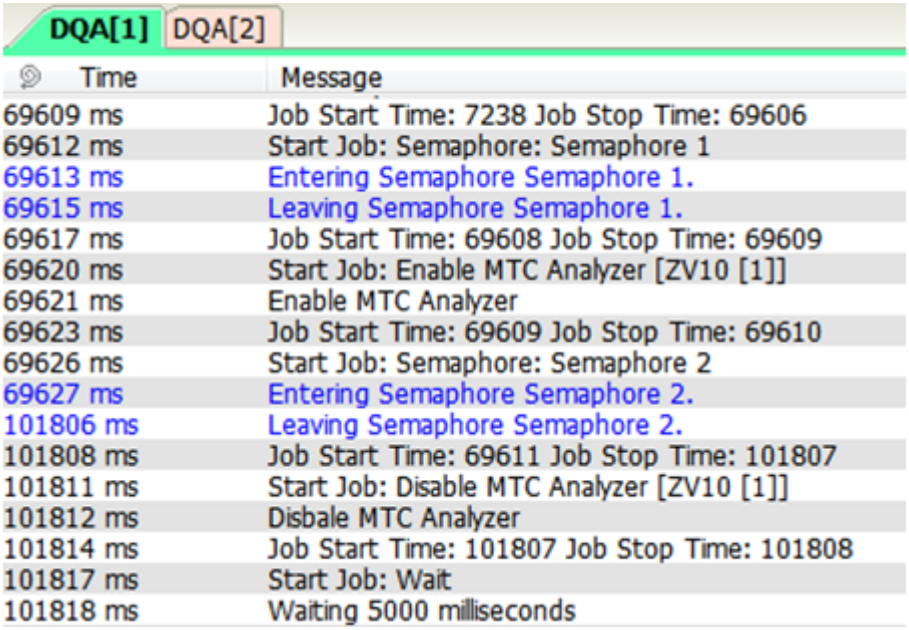


Figure 6-490: Semaphore job messages

Mobile

AT command

The AT Command job lets you send the AT commands to the test UE. The job is only available if a test UE is loaded. In that case, the AT Command job for all installed test UE can be found in the "Available Jobs" > "Mobile" branch.

To open the configuration dialog, double-click the "Mobile" > "AT Command" entry in the "Available Jobs" pane.

Specify the desired AT command, the expected response and a timeout value in the configuration dialog.

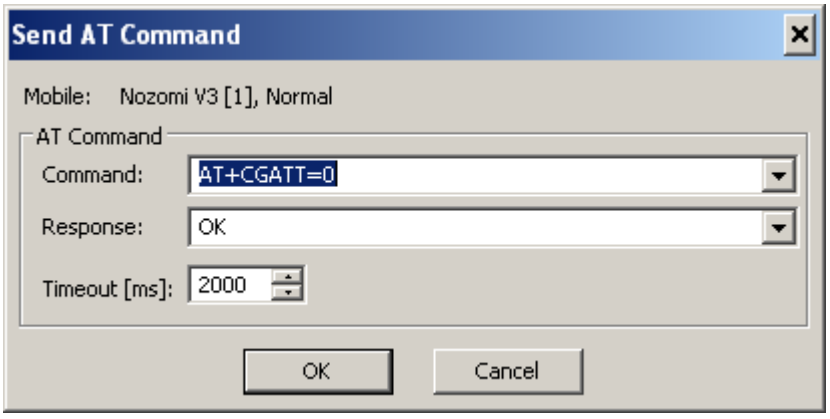


Figure 6-491: AT Command job - configuration

The "DQA Message View" shows the command and the received response.

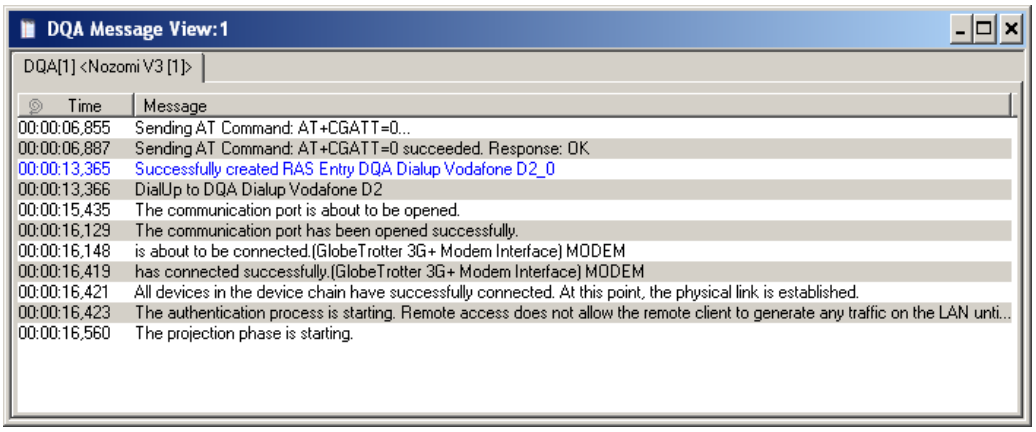


Figure 6-492: DQA message view of the AT Command job

AT command ping

R&S ROMES4 supports the specific AT Ping commands of Quectel and U-Blox, i.e. `AT+QPING` and `AT+NPING`.

If these AT commands are sent to the UE via the DQA job, R&S ROMES4 tries to evaluate the results of the pings and generate the values for corresponding R&S ROMES4 signals in "GSM" > "AT Ping Response".

AT commands are the basic communication method of 3GPP modules, starting from GSM technology.

SMS send

The "SMS Send" job lets you test sending an SMS from a test UE to other one.

The job is only available if the test UE is loaded. The job is then visible in the "Available Jobs" > "Mobile" branch. The result of the job is to test if the SMS could be sent to the SMS service provider.

Double-click the "Mobile" > "SMS Send" entry in the "Available Jobs" pane to get the "SMS Tester" configuration dialog.

A text of the message can be produced automatically or a custom text can be entered. Configure the following short message properties:

- "SMS Text"
  In the mobile display, the following text appears: "0,1203590186, This is a test ROMES SMS". In the next SMS the number before comma is increased by 1. After the comma, the UTC time is given in seconds after 1st January 1970.
- "Subscriber Number"
  Phone number of the originating subscriber
- "Addressee Number"
  Phone number of the destination subscriber
- "Service Center"
  Number of the service center
- "Domain"
  Circuit or Packet Switched
- Idle Time [s]
  Waiting time after sending the SMS before starting the next "SMS Send" job.

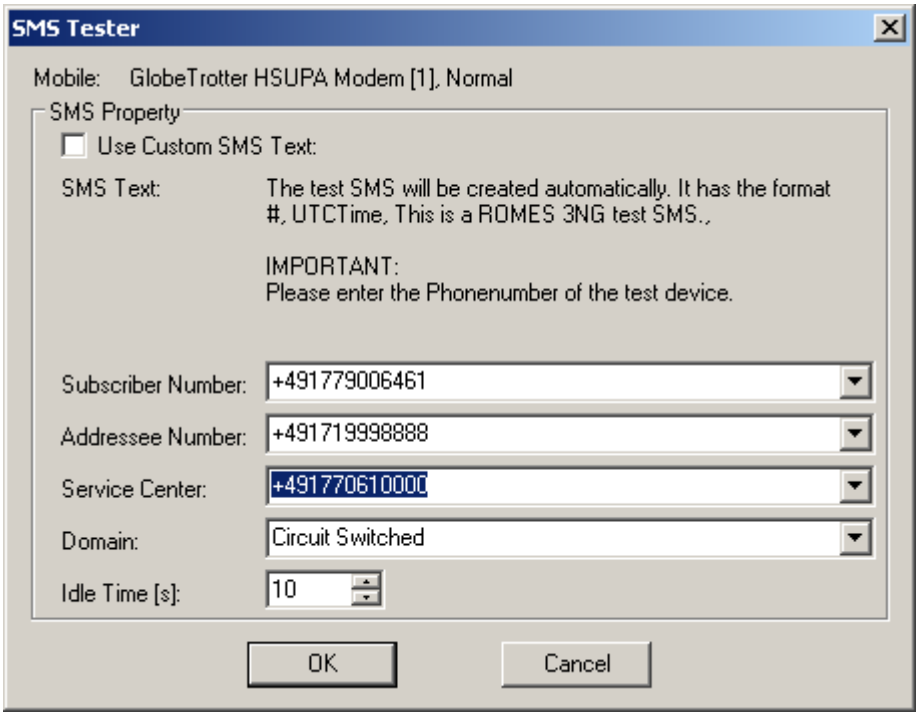


Figure 6-493: SMS Send job - configuration

"SMS Send" job can only be created outside of the Connect – Disconnect – cycle.

In the "DQA Message View" all relevant steps of sending the message are listed. ETSI specified KPIs can be evaluated by using the QoS KPI View.

MOC analyzer

The MOC Analyzer job lets you enable or disable the MOC analyzer (Outgoing Call Analyzer).

The job is available in the "Available Jobs" > "Mobile" branch if the test UE which supports this feature, for example, the Qualcomm chipset-based mobile device, is loaded.

Double-click the "Mobile" > "Audo Dialing" entry to get the configuration dialog. The analysis can be enabled or disabled for the mobile in the "Action" text box.

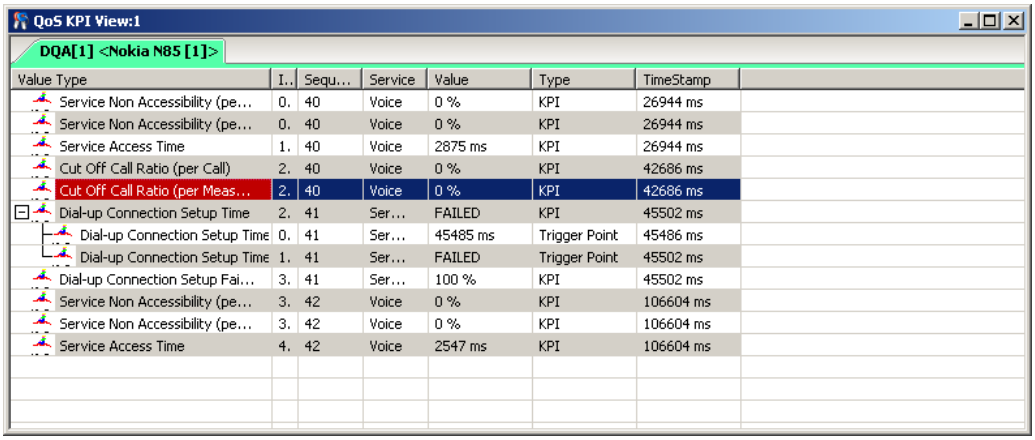
The job tests if the SMS can be sent to the SMS service provider.

The auto-dial menu of the associated mobile device is used for DQA MOC analysis.

The "Dialing" check box of the "Autodialing" > "Action" pane is disabled as long as the DQA job has control over the autodialer. How to configure the autodialer, see "Autodialing" on page 1536.

The DQA Message View shows the command and the received response.

The results of the voice calls are displayed in "NQA Chart View", "ETSI QoS View" and "QoSKPI View".



Value Type	I..	Sequ...	Service	Value	Type	TimeStamp
Service Non Accessibility (pe...	0.	40	Voice	0 %	KPI	26944 ms
Service Non Accessibility (pe...	0.	40	Voice	0 %	KPI	26944 ms
Service Access Time	1.	40	Voice	2875 ms	KPI	26944 ms
Cut Off Call Ratio (per Call)	2.	40	Voice	0 %	KPI	42686 ms
Cut Off Call Ratio (per Meas...	2.	40	Voice	0 %	KPI	42686 ms
Dial-up Connection Setup Time	2.	41	Ser...	FAILED	KPI	45502 ms
Dial-up Connection Setup Time	0.	41	Ser...	45485 ms	Trigger Point	45486 ms
Dial-up Connection Setup Time	1.	41	Ser...	FAILED	Trigger Point	45502 ms
Dial-up Connection Setup Fai...	3.	41	Ser...	100 %	KPI	45502 ms
Service Non Accessibility (pe...	3.	42	Voice	0 %	KPI	106604 ms
Service Non Accessibility (pe...	3.	42	Voice	0 %	KPI	106604 ms
Service Access Time	4.	42	Voice	2547 ms	KPI	106604 ms

Figure 6-494: Voice call KPI view

The mobile can be connected to a speech quality analyzer (SQA). In this case, the SQA reports the KPIs concerning the voice calls. If not, the DQA does the reports.

MTC analyzer

The MTC Analyzer job lets you enable and disable the MTC analyzer (Incoming Call Analyzer).

The job is only available if the test UE which supports this feature, for example, the Qualcomm chipset-based UE, is loaded.

The job is then visible in the "Available Jobs" > "Mobile" branch. The result of the job is to test if SMS sent from the service provider can be received by UE.

Double-click the "Mobile" > "MTC Analyzer" entry in the "Available Jobs" pane to get the configuration dialog. The analysis can be enabled or disabled for the UE in the "Action" text box.

The job's only function is to activate/deactivate the MTC analyzer of the UE (check/uncheck the "Answering" checkbox in the "Autodialing" > "Action" pane). The job ends immediately after having changed this setting.

Use the MTC Analyzer job together with the MOC Analyzer job and Semaphore job.

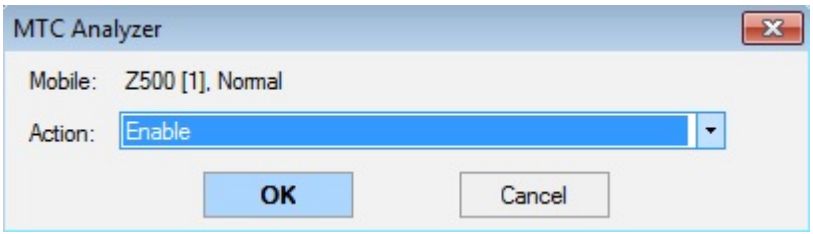


Figure 6-495: MTC analyses enabled for Z500 mobile

MOC / MTC analyzer use case: Ping-pong calls

The MOC/MTC Analyzer jobs allow setting-up ping-pong voice calls between two loaded UEs.

Two DQA testers are added to the configuration and they manage the UE's measurement jobs.

The DQA testers are running independently. The MTC Analyzer job has no information about the expected incoming call. Thus, it is not applicable to use timeouts or other indications about the state of the incoming call. A better solution is to synchronize DQA testers.

While the MOC Analyzer job (Autodialing) is active during the complete duration of the outgoing call, the MTC job finishes immediately after having enabled/disabled the MTC Analyzer.

Example:

Two cases are considered in this example:

- **Case 1**: DQA1 and DQA 2 settings when the UE1 initiates an originating call addressing the UE2, while the UE2 waits for the incoming call (initiated by UE1)
- **Case 2**: DQA1 and DQA 2 settings when the UE 2 initiates an originating call addressing the UE1, while the UE1 waits for the incoming call (initiated by UE2)

Case 1 - DQA 1

1. Start with the DQA 1 of UE1 by enabling the MOC Analyzer and Semaphore 1 jobs.
2. On the UE2 side, enable the MTC Analyzer job.
3. Wait until the UE1 finishes the MOC Analyzer job.
4. Then disable the MTC Analyzer job.

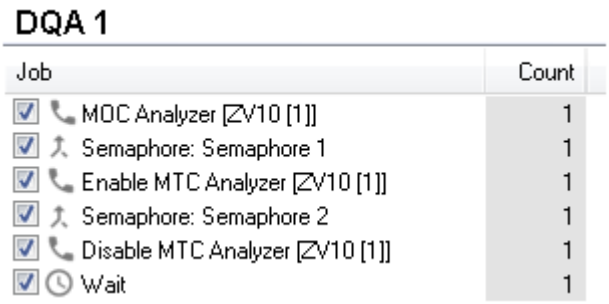


Figure 6-496: Enabled jobs for UE1

Case 1 - DQA 2

1. Start with the DQA 2 of UE2 by enabling the MTC Analyzer and Semaphore job with the same name "Semaphore 1".
2. On the UE2 side, disable the MTC Analyzer job.
3. Add Wait job to give the UE some time to the recent call properly.

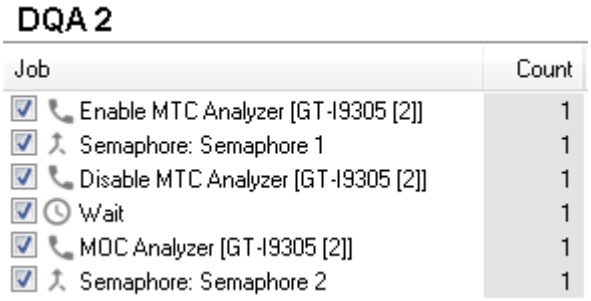
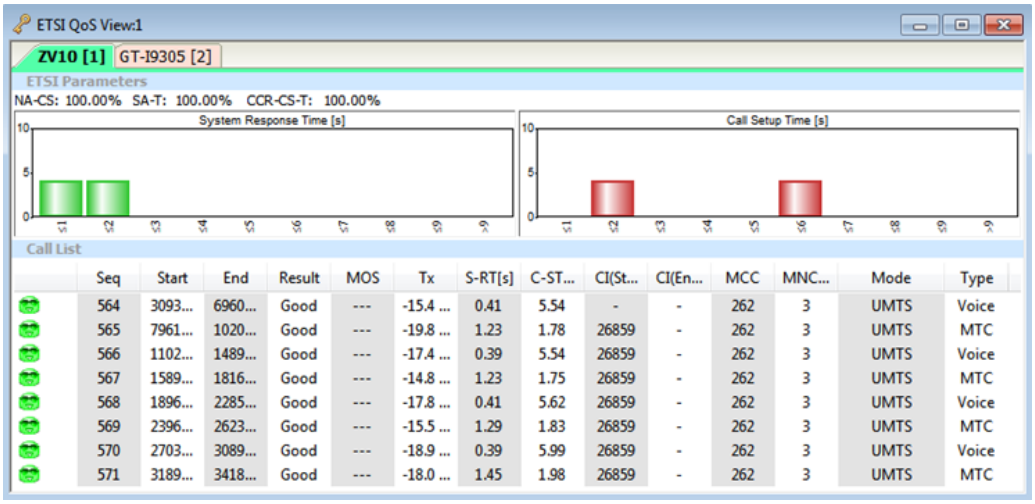


Figure 6-497: Enabled jobs for UE2

The **Case 2** for the call from UE 2 to UE 1 does the same but vice versa. The result job lists look similar to the ones for the Case 1, which are shown in the previous two figures.

The result of such a ping-pong call is visualized in the "ETSI QoS View", see the following figure.



Seq	Start	End	Result	MOS	Tx	S-RT[s]	C-ST...	CI(St...	CI(En...	MCC	MNC...	Mode	Type
564	3093...	6960...	Good	---	-15.4 ...	0.41	5.54	-	-	262	3	UMTS	Voice
565	7961...	1020...	Good	---	-19.8 ...	1.23	1.78	26859	-	262	3	UMTS	MTC
566	1102...	1489...	Good	---	-17.4 ...	0.39	5.54	26859	-	262	3	UMTS	Voice
567	1589...	1816...	Good	---	-14.8 ...	1.23	1.75	26859	-	262	3	UMTS	MTC
568	1896...	2285...	Good	---	-17.8 ...	0.41	5.62	26859	-	262	3	UMTS	Voice
569	2396...	2623...	Good	---	-15.5 ...	1.29	1.83	26859	-	262	3	UMTS	MTC
570	2703...	3089...	Good	---	-18.9 ...	0.39	5.99	26859	-	262	3	UMTS	Voice
571	3189...	3418...	Good	---	-18.0 ...	1.45	1.98	26859	-	262	3	UMTS	MTC

Figure 6-498: ETSI QoS View for ping-pong calls

Airplane mode

The DQA Airplane Mode job is intended to test the UE which supports switch-on and -off the airplane mode remotely. The job lets you include this action in the DQA job list, for example, to force the UE to register to the network.

DQA jobs for NB-IoT

If one of the NB-IoT modules mentioned in the Chapter 6.4.8, "NB-IoT devices", on page 1652 is loaded, the DQA configuration page shows the jobs available for NB-IoT modules in the "Available Jobs" > "Mobile" branch.

For the supported jobs, see Table 6-12.

All NB-IoT jobs running on the modules are commanded by AT commands. No Windows IP stack, modem or network connection is involved in these job tests.

The results of the job tests can be found in the associated branches of the "GSM" signals.

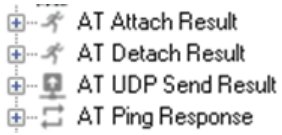


Figure 6-499: Branches for AT command results

The test results are available in the Alphanumeric view.

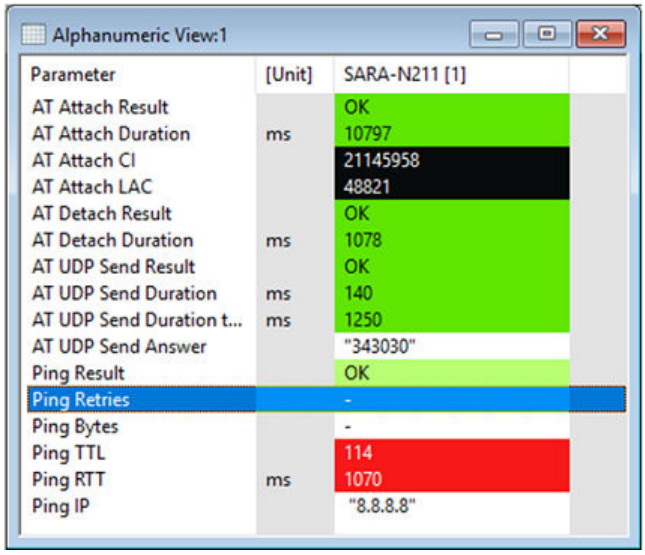


Figure 6-500: Alphanumeric view of NB-IoT jobs test

The details of the current tests are shown in the DQA Message View.

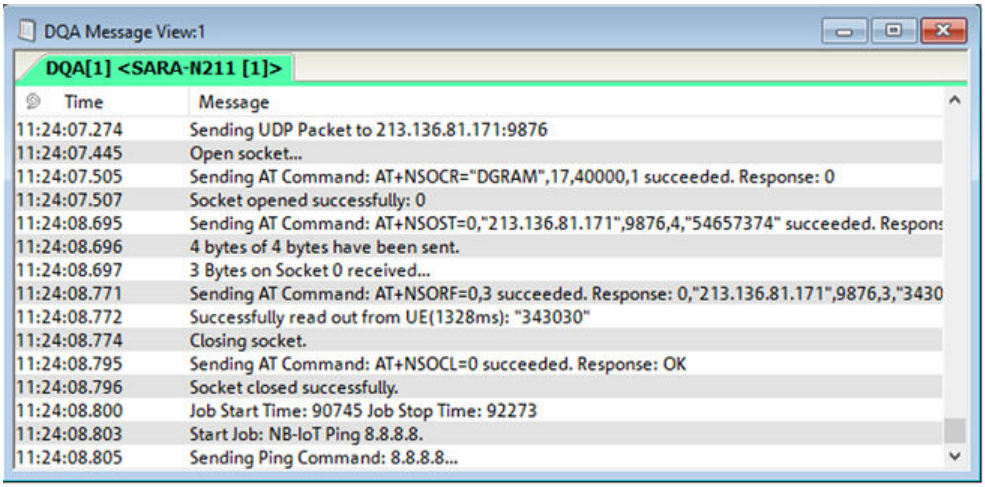


Figure 6-501: Alphanumeric view of NB-IoT jobs test

NB-IoT attach

The NB-IoT Attach job switches-on the modules and commands of the mobile to attach it to a specific network, defined by MCC and MNC.

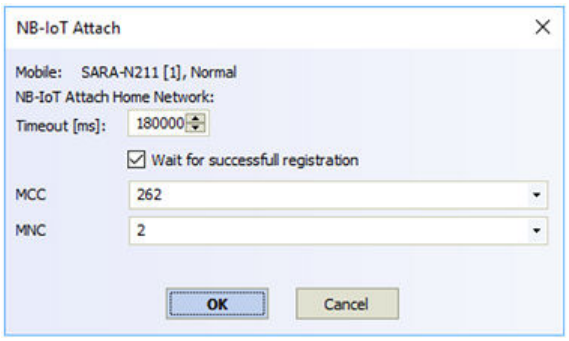


Figure 6-502: NB-IoT Attach job - configuration

The job can wait until AT+CGATT returns 1 or continue immediately after having sent out the commands.

NB-IoT detach

The NB-IoT Detach job switches off the module.

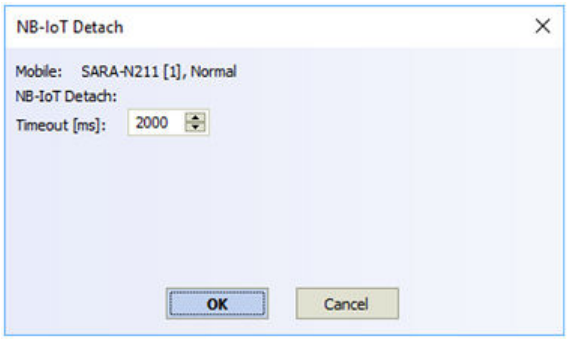


Figure 6-503: NB-IoT Detach job - configuration

NB-IoT ping

The NB-IoT Ping job uses proprietary AT commands to send pings from the module to the specified IP address. You can specify a maximum amount of pings or the test duration.

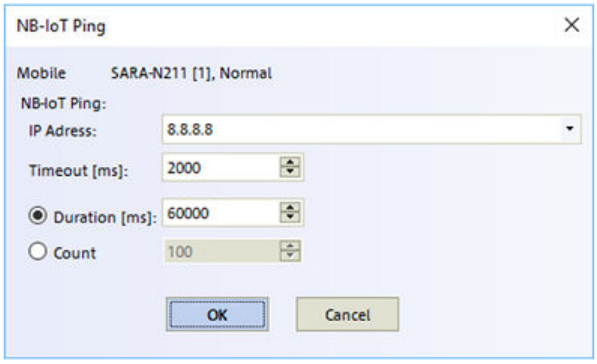


Figure 6-504: NB-IoT Ping job - configuration

The test is validated as OK if more than 50% of the pings are successful.

NB-IoT send UDP

The Send UDP job sends the packet with the content inserted in "Message" to a specified IP address and port. The format to specify them is <IP address>:<port>.

If the server is supposed to send-back some byte, the job can wait for this response.

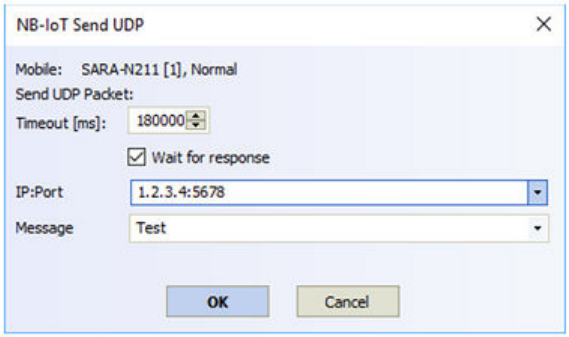


Figure 6-505: NB-IoT Send UDP job - configuration

NB-IoT FTP

If the NB-IoT FTP job is selected, the configuration page shows up.

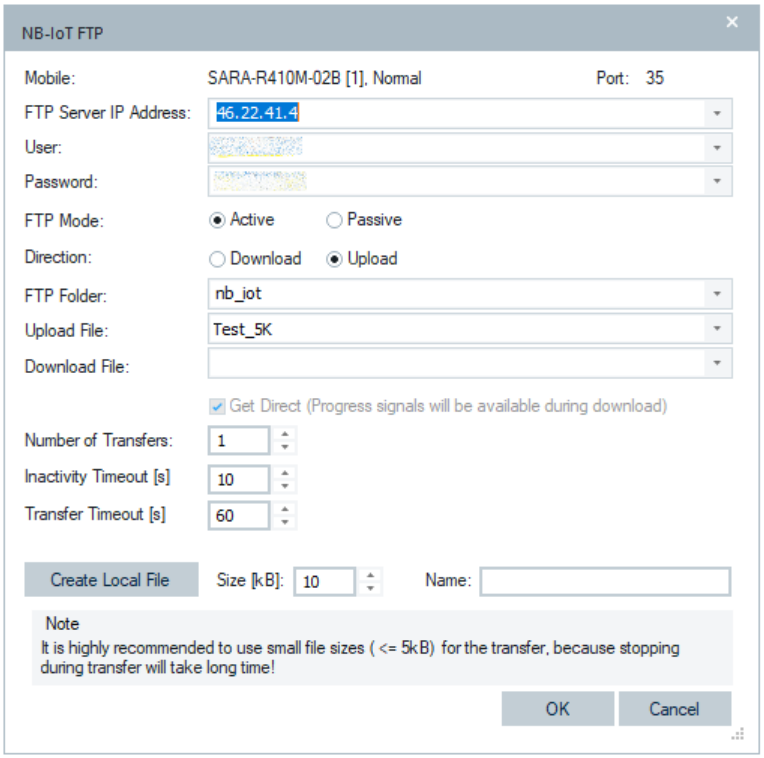


Figure 6-506: NB-IoT FTP job - configuration

- "FTP Server IP Address": The IP address of FTP server

- "User": User name
- "Password": User's password
- "FTP Mode": Passive/Active
- "Direction": Download or Upload
- "FTP Folder": In upload, it is the FTP destination folder. In download, it is the folder of the download file.
- "Upload File": A file which exists on the stick. The available files are listed in the combo-box.
- "Download File": A file which exists on the FTP server in the selected folder
- "Get Direct": If checked, shows a progress during download.
- "Number of Transfers": Number of transfers configured for this job.
- "Inactivity Timeout": The job is canceled with result "timeout" after expiry of this time.
- "Transfer Timeout": The time during data transfer without received data.
- "Create Local File": If pressed, a file with the defined size and name is created on the stick.

Report view of NB-IoT FTP job

The "QoS Report View" of NB-IoT FTP job shows both the job's progress and the results. There is no dedicated progress view for this job.

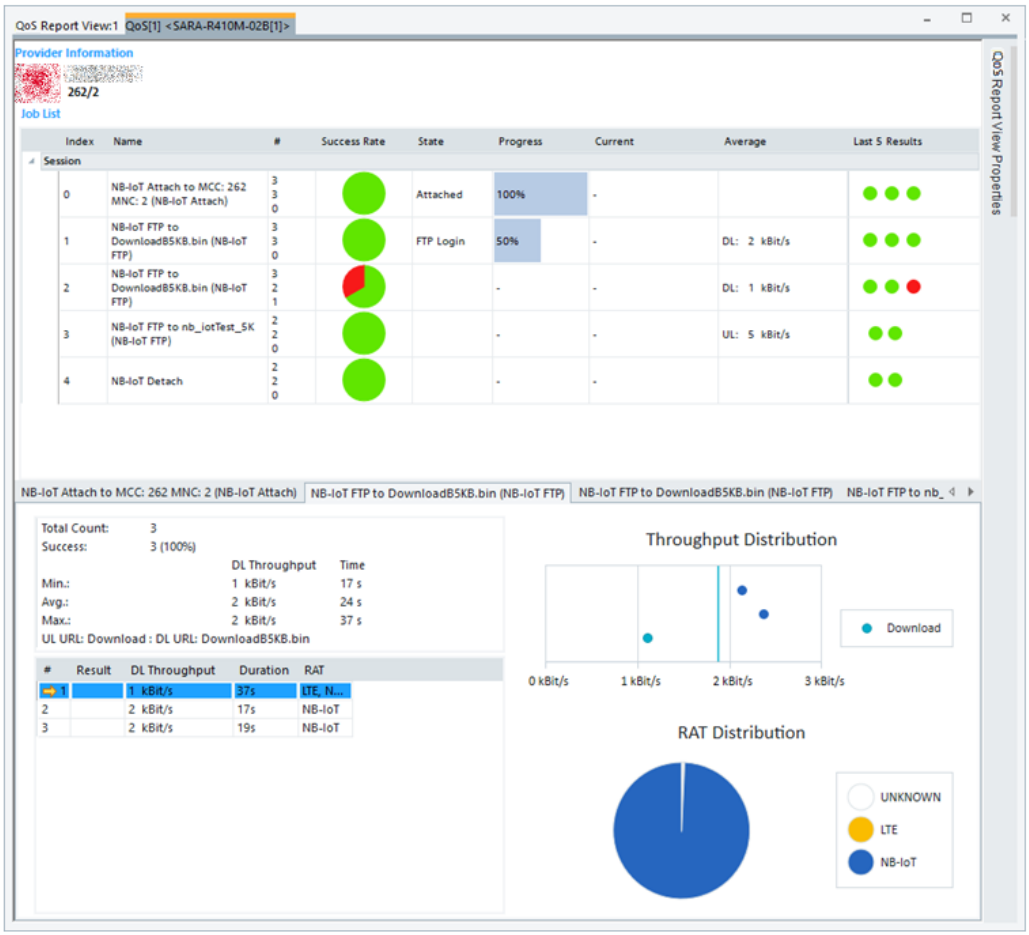


Figure 6-507: QoS Report View for NB-IoT FTP job

KPIs and KPI generator view for NB-IOT FTP job

KPIs of the NB-IoT FTP job are not supported. Therefore, the "KPI Generator View" does not show them.

Signals of the NB-IoT FTP job

The signals generated by this job are shown in the "Available Signals" > "NB-IoT" in the "NB-IoT Progress" and "NB-IoT Result" branches. For the signals and their description, see "Description of R&S ROMES4 Signals" document.

Batch

The Batch job is used for reusing.

1. Click the "DQA Settings" > "Available Jobs" > "Batch" to include it in the "Job" list. At least two jobs have to be already present in the "Job" list.
2. Select the jobs to be batched. Select the successive jobs 1...n in the "Actions" > "Job" list.

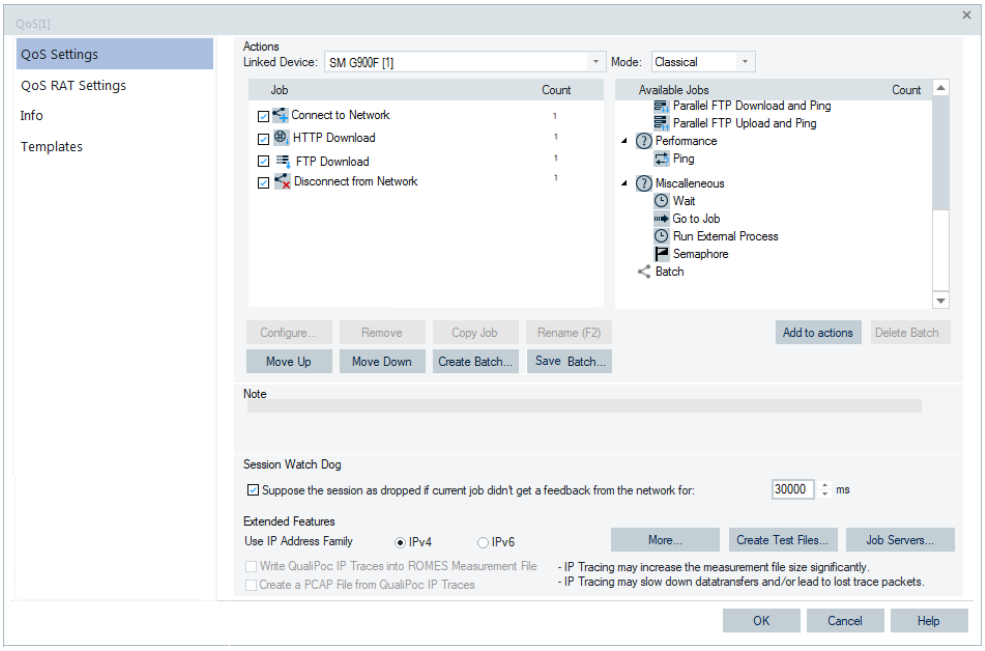


Figure 6-508: Two jobs selected

3. Click the "Create Batch" button to name the Batch job. This Batch job's name includes the names of selected jobs with its current configuration.

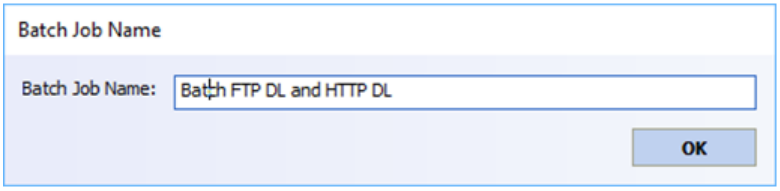


Figure 6-509: Batch job name

The "Job" list now rearranges in such a way, that the name of the Batch job replaces the selected jobs (FTP and HTTP in the previous figure). Under the job, a tree "Branch" with the jobs of the batch are displayed.

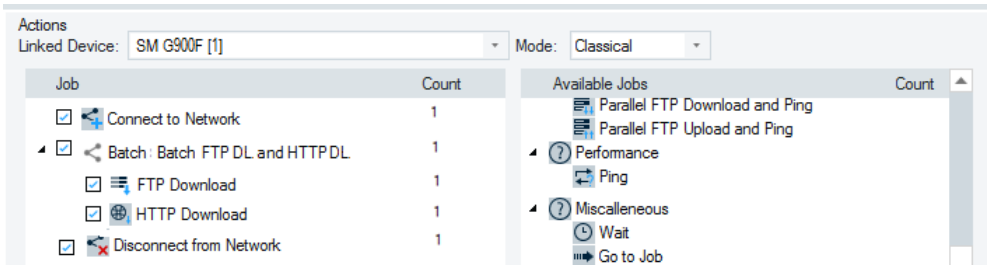


Figure 6-510: Batch creation

The job as a batch tree branch is added to the "Batch" branch of the "Available Jobs" pane.

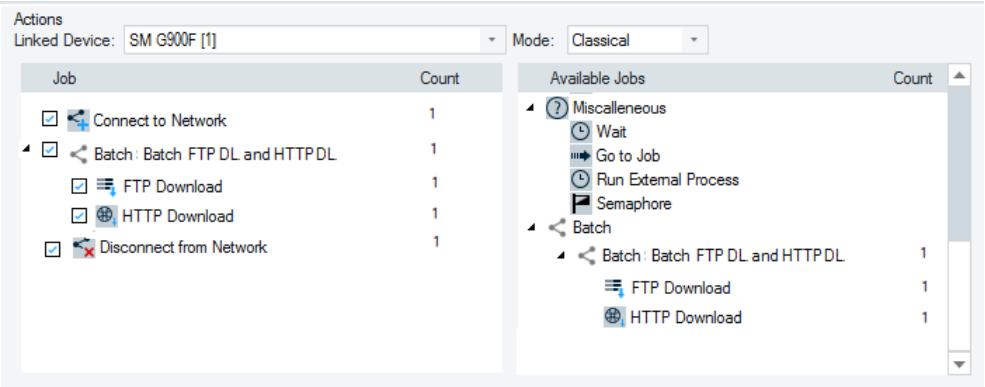


Figure 6-511: Change in the available signals pane

The "QoS Settings" page let you edit existing batches and save them. While saving the batch, you are asked to enter a new name or keep the name and overwrite the existing batch.

If you try to leave the page with an unsaved modified batch in the configuration, you are prompted to auto save the batch with a new name. Otherwise, you stay on the page.

A Batch job can be configured in any hierarchy of the job tree. The job can contain other Batch jobs in the "Job" list. However, it is not allowed to create Batch jobs from other ones. A Batch available job can be added to the "Batch" tree of the "Job" list by dragging it from the "Available Job" list to the position of the Batch in the "Job" list.

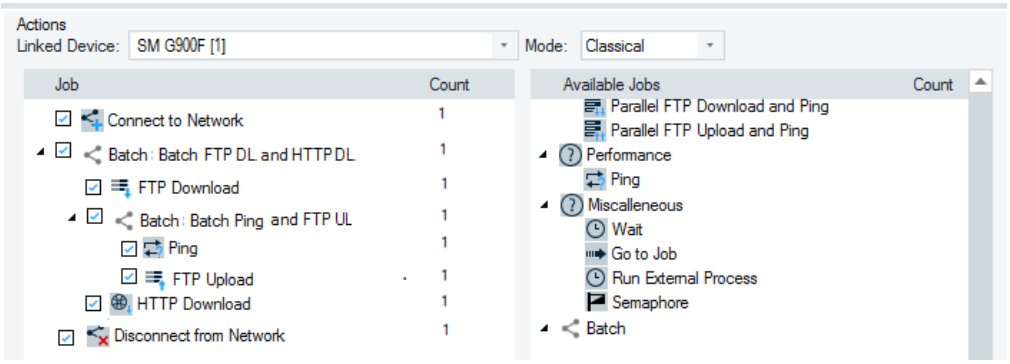


Figure 6-512: Batch ping and FTP UL under the batch FTP and HTTP

A Batch job can be executed n times (the "Counter" column), similar to other jobs. Double-click the "Counter" column to change the number of executions.

A job in the "Job" list can be added to a Batch job by using drag and drop. Click the "Remove" button if you want to remove it from the list.

To delete the Batch jobs from the "Available Jobs" list, click the "Delete Batch" button.

A Batch job is supported in the fully integrated device use mode in the same way. For a few limitations in that mode, see Chapter 6.5.2, "DQA jobs with Android OS-based smartphones", on page 1961.

6.5.1.5 Templates DQA

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

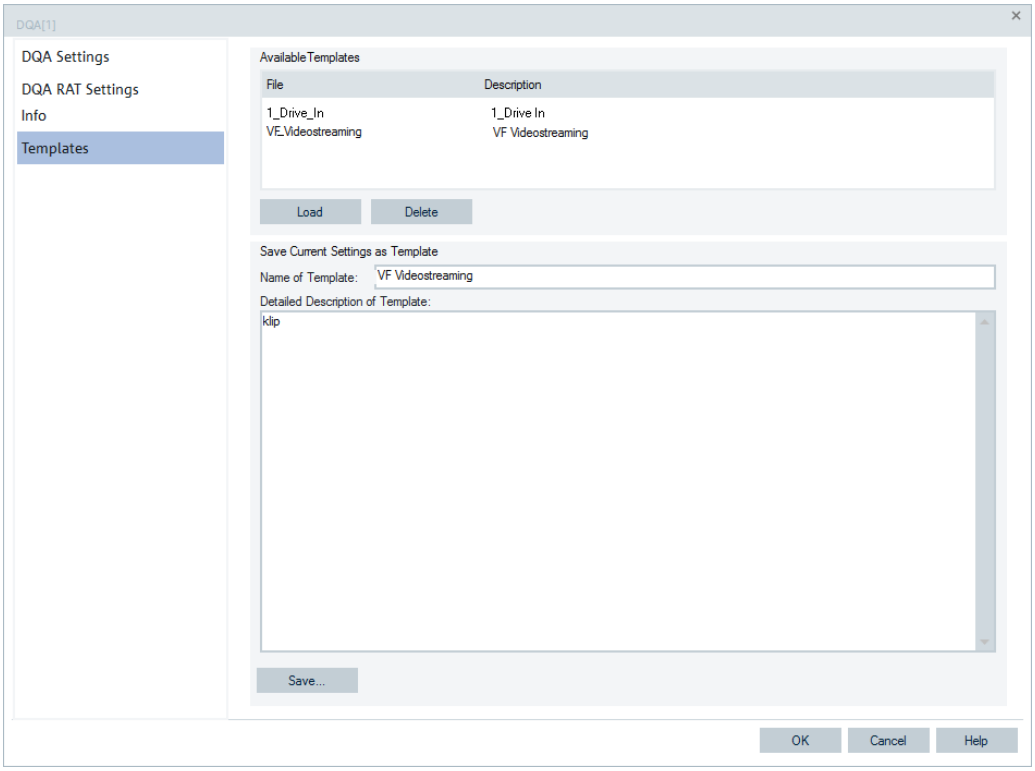


Figure 6-513: DQA configuration - Templates

By creating the DQA job list with a template, the jobs which are using devices open a device selection dialog if more than one device is available for the job. The following jobs support this feature:

- "Connect to Network"
- "Auto Dial"
- "Send AT Command"
- "Send SMS"

Example: Loading a template with the "Auto Dial", "Send AT Command" and "Send SMS" jobs when two mobiles are connected to the PC.

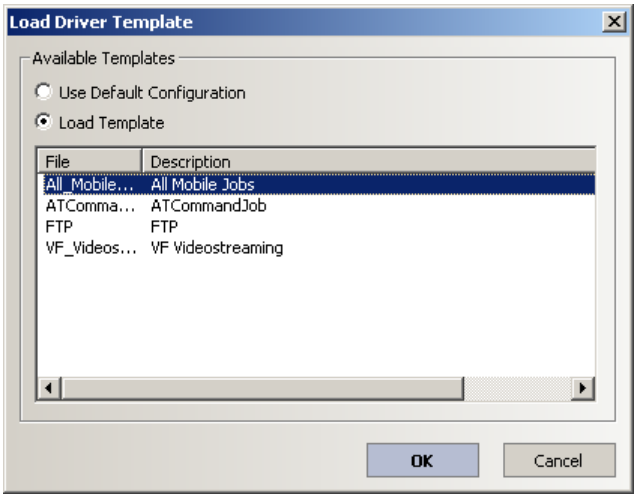


Figure 6-514: Loading mobile devies template

The following dialog appears:

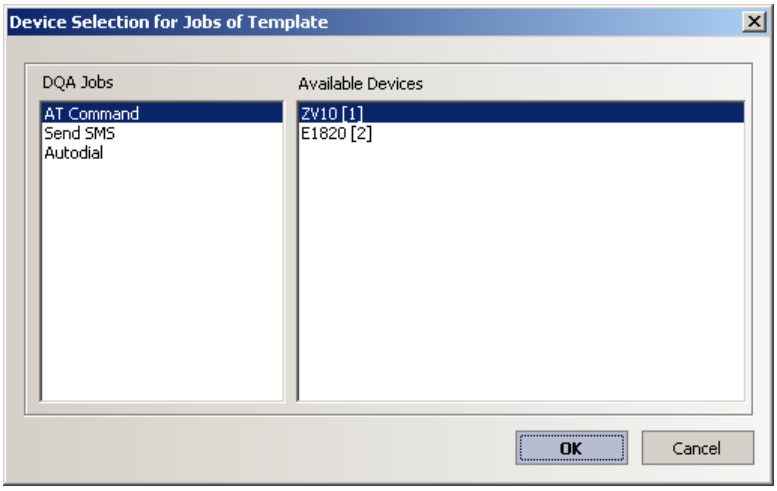
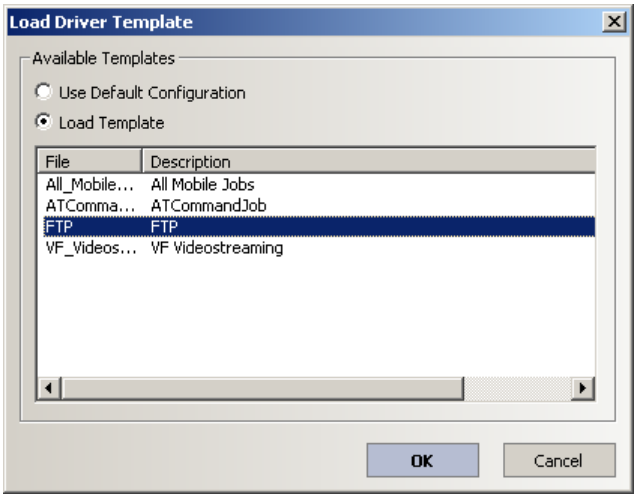


Figure 6-515: Device selection for configured job

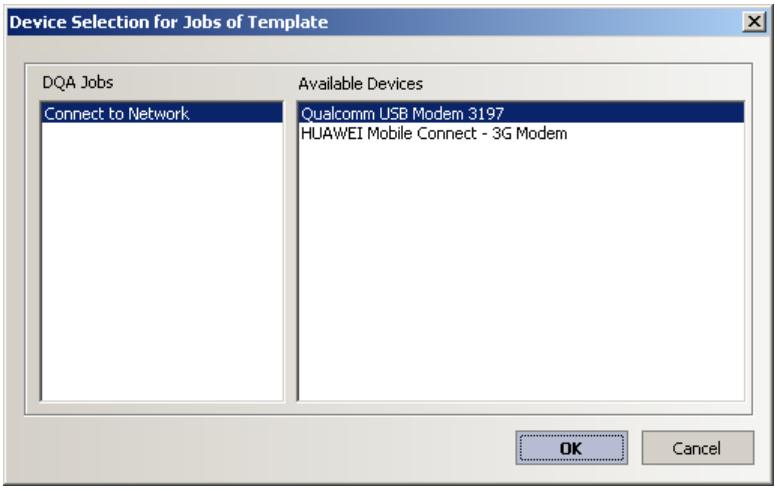
The "DQA Jobs" list shows the configured jobs of the template. For every DQA job in the left list, an available device can be selected.

If confirmed with "OK", each job uses its selected device. If clicked "Cancel", each job uses the initial selected device.

Example 2: Loading a template with the "Connect to Network", "FTP" and "Disconnect from Network" jobs when two mobiles are connected to the PC.



The following dialog appears.



For the Connect to Network job, 2 modems are available. An entry in "Available Devices" can be selected.

If confirmed with "OK", the selected device is used for the connect job. If clicked "Cancel", the initial selected device is used.

The "Available Devices" list shows only available devices, which are not used by other instances of the DQA.

6.5.2 DQA jobs with Android OS-based smartphones

The "DQA" page of jobs made with the Android OS-based smartphones contains the same controls as the "DQA" page of the On PC testing (Classic mode) jobs. The page is fully editable with keyboard and the focus is visualized over the control buttons.

For the description of the panes and control buttons of the page, see Chapter 6.5.1.2, "DQA settings", on page 1881. For the Classic mode 2 mobiles, see "DQA jobs in classic mode 2" on page 1969.

The following is applicable for the DQA jobs with the Android-based smartphones:

- DQA job from the list can be connected only to one smartphone.
- Watchdog is always disabled for smartphone sessions.
- Application socket trigger points and the relating KPIs are not available for smartphone jobs. Therefore, the selection of ETSI calculation is disabled.
- Currently smartphones support IPv4 only.
- For all smartphone jobs, the IP tracing is always available. The KPI generator can calculate the relating TCP/IP KPIs of the TCP/IP trigger points.
- Export of the IP tracer data must be done with the PCAP export; the Netmon export fails.
- QualiPoc mobiles and the R&S ROMES4 DQA measurements support DQA throughput measurement during a smartphone session.
- Recording of PCAP files must be enabled in the QualiPoc measurements.
- "Device" column shows IMEI of a smartphone.
- Speech quality and voice tests are supported. If a voice test is configured in the DQA job list, the configuration made in UE is overwritten.
- Data test configurations in R&S ROMES4, QualiPoc and SmartBenchmarker are harmonized and look similar.

The "QoS KPI Export Result View" shows nothing useful due to limitation of the underlying Android package.

6.5.2.1 DQA jobs with fully integrated devices

If an Android OS-based smartphone with the SQ Android interface is loaded, the R&S ROMES4 DQA jobs available for the smartphone are the same as the jobs for a fully integrated device. The available jobs are grouped by a job type in the "Available Jobs" list.

The following jobs or groups of jobs are available in fully integrated device's use mode:

- Data Session Start
- Call Session Start
- Data Session End
- Call Session End
- Multi RAB Session
- HTTP
- FTP
- Performance
- Miscellaneous
- App Test
- Mobile
- Batch

The Network Forcing function supports the call sessions.

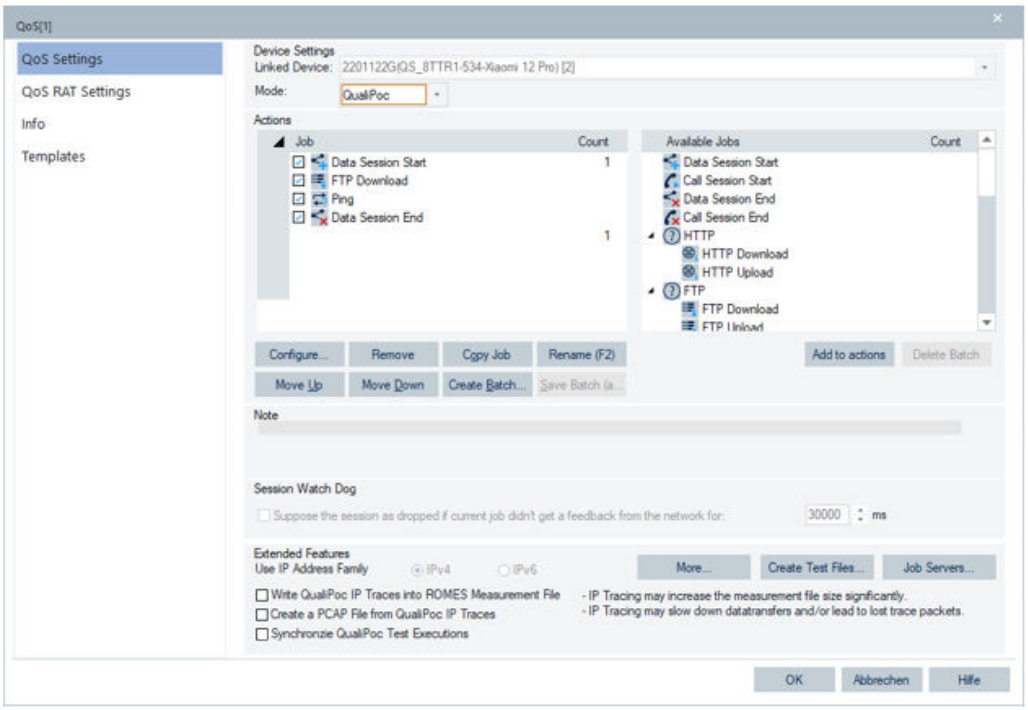


Figure 6-516: Android based fully integrated device - available jobs

It is possible to mix data and voice session in the "Job" list.

- Data Session Start
- FTP DL
- Data Session End
- Network Forcing for Call Sessions
- Call Session Start
- Call Any Number
- Call Session End

A voice or speech quality test can be performed in parallel with one or two data jobs. The data jobs run sequentially.

R&S ROMES4 supports Video MOS (VMOS) analysis of the fully integrated devices. The analysis is based on ITU J343.1 standard for Perceptual Video Quality measurement algorithm.

Perceptual Evaluation of Video Quality (PEVQ) measurement algorithm is not supported.

A smartphone with SuissQual Android interface does not support other DQA connect job configurations like dialup, IP tracing and advanced settings. FTP download and FTP upload jobs are by default available as being the time-based jobs.

DQA jobs in fully integrated device use mode

If the R&S ROMES4 DQA function is linked with a fully integrated device, the "QualiPoc" mode is available. The QualiPoc supported measurements can be configured.

If the fully integrated device use mode (QualiPoc) is selected, the list of available jobs is the same as that one for smartphones with SQ Android interface.

Extended features with Android OS-based smartphones

The "QoS" > "Extended Features" pane offers the support of IP tracing, timing/statistics of a DQA session control, test files and job servers creation.

Extended Features
The "QualPoc" mode selection offers in the "Extended Features" pane the functions that are mentioned in the chapter dedicated to the DQA jobs of the On PC testing (Classic mode) devices.

Use IP Address Family ← Extended Features
Lets you select the wanted IP address version. The views then show IP address of the accessed server in the format of selected IP version.

Write QualiPoc IP Trace into ROMES Measurement File ← Extended Features
If selected, writes the QualiPoc IP traces into the R&S ROMES4 measurement file. The traces are logged in the same way as they are shown on the phone's monitor.

Note: R&S ROMES4 logs the same IP trace as QualiPoc does. If no details are logged, no details are available in R&S ROMES4 as well.
The IP logging can increase the measurement file size significantly. It can influence the achievable throughput and lead to lost trace packets on high throughput scenarios.

Create a PCAP File with QualiPoc IP Traces ← Extended Features
If selected, QualiPoc IP tracing results are recorded in PCAP format file. The traces are logged in the same way as a PCAP file is logged.

It is also possible to create a `*.pcap` file using TCPdump directly of the Android OS-based smartphones. This setting is found on the mobile's QualiPoc configuration page.

There are some differences between both approaches. The following table shows the differences.

Differences	QualiPoc IP trace	TPCdump
What is logged	Not all raw messages are logged. QualiPoc applies a time filter and does not log details by default	Everything is logged as tcpdump logs and written directly to the SD card of the UE
VoLTE	RTP is logged	RTP is not logged
Performance Influence	Medium to high	Medium
Configuration	What is logged, configure manually in QualiPoc	Nothing to configure

Synchronize QualiPoc Test Executions ← Extended Features
The function supports synchronization of DQA job execution for QualiPoc tests of different UEs. To run this function, "Synchronize QualiPoc Test Executions" has to be enabled for each QoS device (UE) whose job executions you want to synchronize.

Synchronize QualiPoc Test Execution - Example 1 ← Synchronize QualiPoc Test Executions ← Extended Features
In the example 1, the first data session of both UEs starts at the same time. The second data session of both UEs starts when the jobs of the first data session of both UEs are finished.

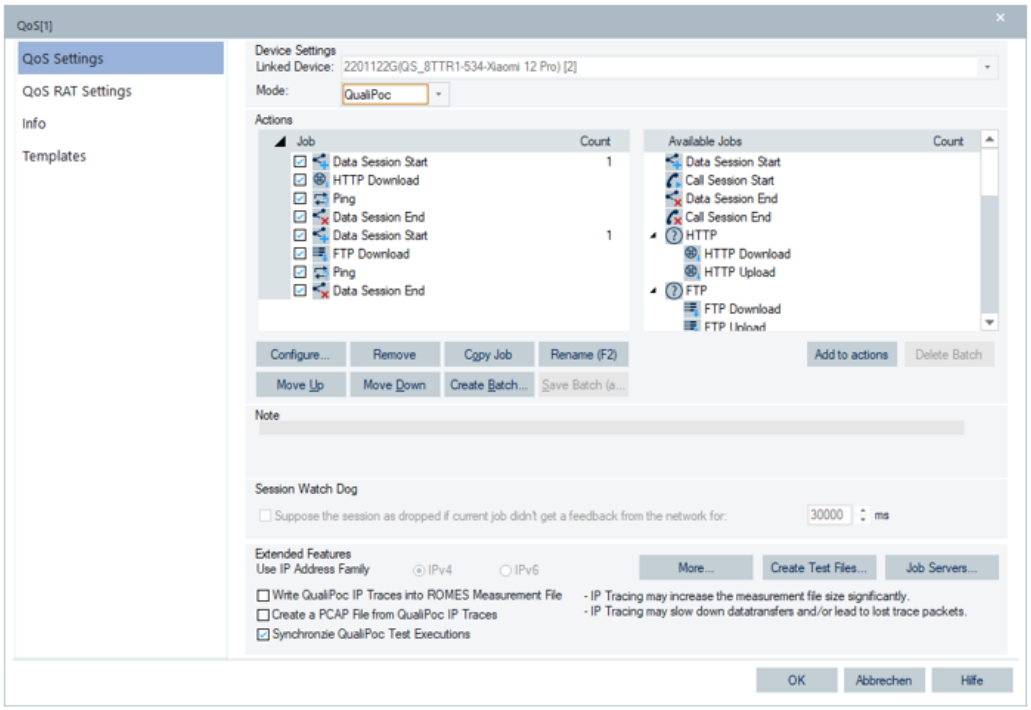


Figure 6-517: Configured job sessions of UE1 - example 1

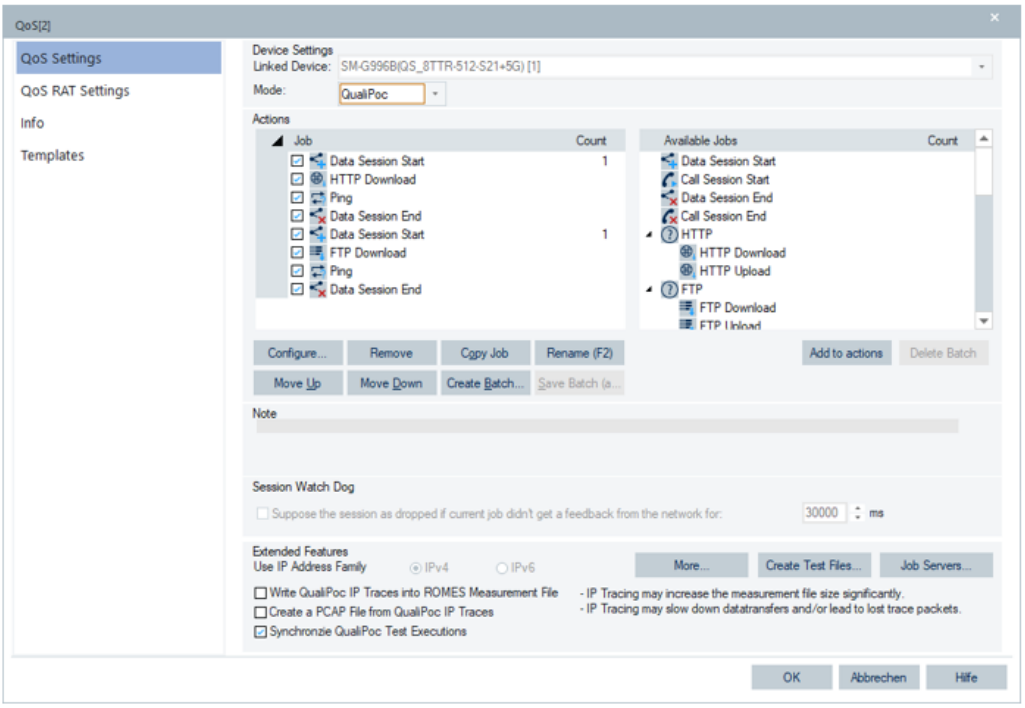


Figure 6-518: Configured job sessions of UE2 - example 1

The first data session of both UEs starts again when the jobs of the second data session of both UEs are finished. All jobs have the same execution count at the end of the measurement. The exception from this rule is the aborted jobs at the time of measurement stop.

Synchronize QualiPoc Test Execution - Example 2 ← Synchronize QualiPoc Test Executions ← Extended Features

In the example 2, the first data session of UE1 and the single data session of UE2 start at the same time. The second data session of UE1 and the single data session of UE2 start again when the jobs of the first data session of UE1 and the jobs of the single data session of UE2 are finished.

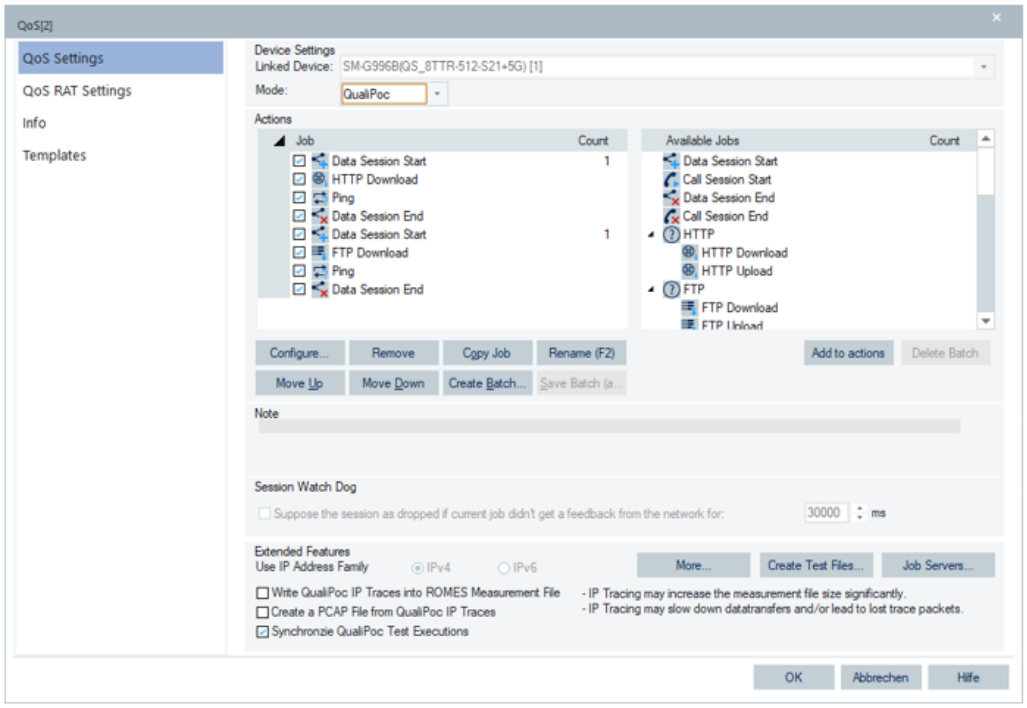


Figure 6-519: Configured job sessions of UE1 - example 2

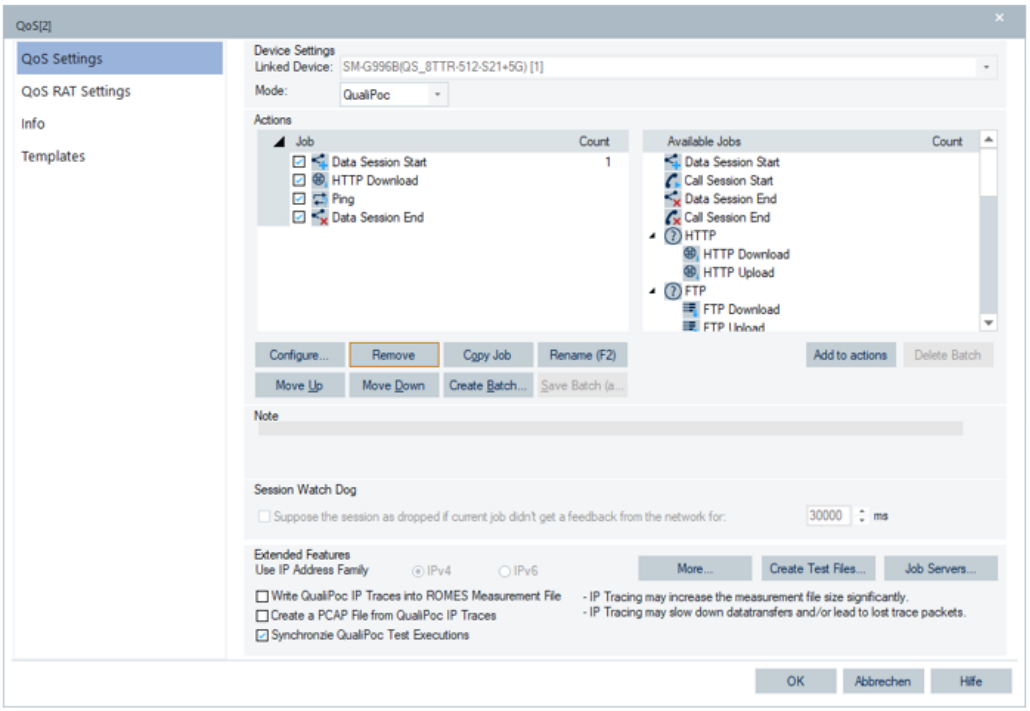


Figure 6-520: Configured job sessions of UE2 - example 2

The first data session of UE1 starts again and the single data session of UE2 starts again, when the jobs of the second data session of UE1 and the jobs of the single data session of UE2 are finished. The sum of the execution count of all jobs of UE1 is equal to the sum of the execution count of all jobs of UE2 at the end of the measurement. The exception from this rule is the aborted jobs at the time of measurement stop.

Buttons of Extended Features ← Extended Features
The pane contains the following buttons.

More ← Buttons of Extended Features ← Extended Features
Opens the "More Extended Features" page, see "Extended Features" on page 1885.

Create Test Files ← Buttons of Extended Features ← Extended Features
Opens the page where you can define the size and the format of a test file. The file can be stored to a local directory and used for file transfer to a remote location. The contents of the file are random.

Job Servers ← Buttons of Extended Features ← Extended Features
The "Job Servers" button lets you preconfigure the FTP and HTTP job servers providing easier and faster job configurations later, see "Job Servers" on page 1888.

6.5.2.2 DQA jobs with devices without QualiPoc

DQA jobs in classic mode

The following jobs or groups of jobs are available for devices operating as On PC testing (Classic mode).

- Connect to Network
- Call Session Start
- Disconnect to Network
- Call Session End
- HTTP
- FTP
- Performances
- Miscellaneous
- Mobile
- Batch

The first four previously listed entries are DQA jobs, other are groups of jobs of the similar type.

The Performance group supports the capacity test for HTTP job, but not the tests for FTP and UDP jobs which are supported for the fully integrated mobile device mode.

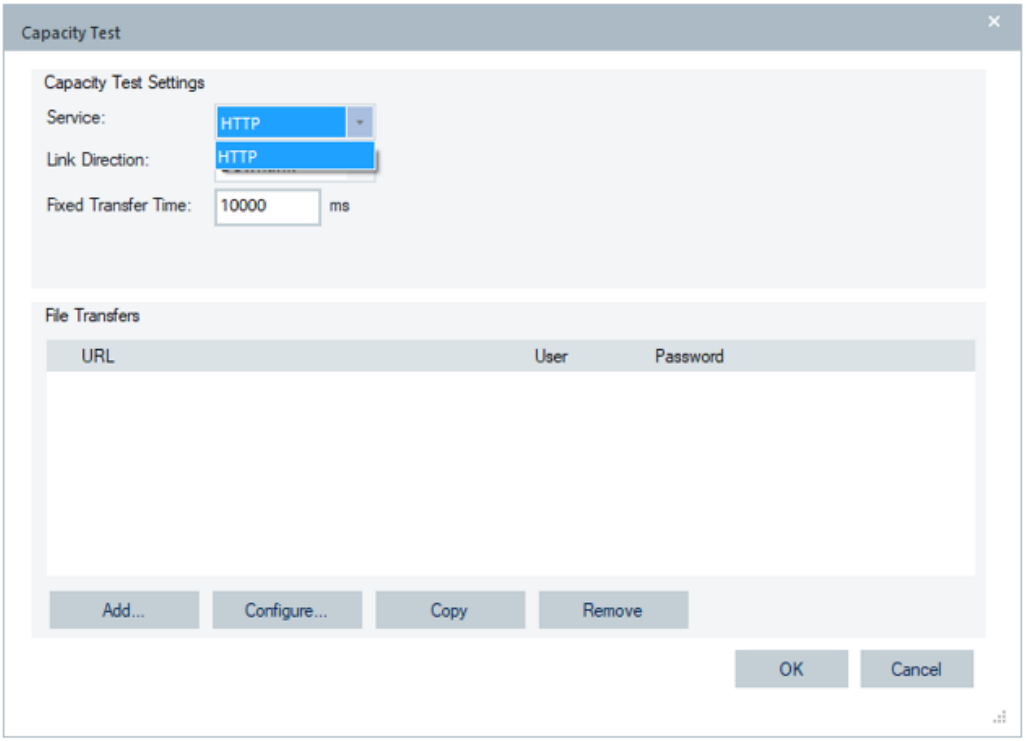


Figure 6-521: Capacity test page of unrooted devices

The configuration of classic mode devices is covered in the Chapter 6.5.1, "Data quality tester (DQA)", on page 1880.

DQA jobs in classic mode 2

The DQA page of the jobs with non-QualiPoc mobiles used in Classic mode 2 contains the same controls as the DQA page of the On PC testing (Classic mode) jobs.

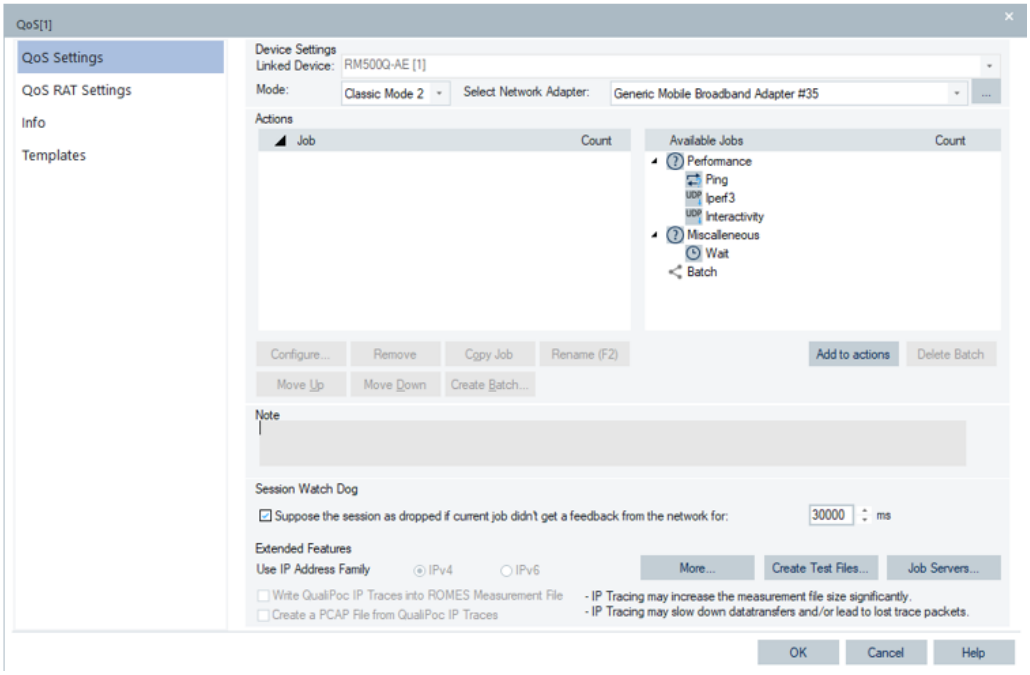


Figure 6-522: Supported jobs in Classic mode 2 use mode

For the non-QualiPoc mobiles in Classic mode 2 use mode, supported are the following DQA jobs:

- Ping
- Interactivity
- Iperf3
- Wait

The Classic mode 2 uses the Windows network adapter selected in the "Select Network Adapter" combo-box. Only IP addresses are allowed to configure the hosts.

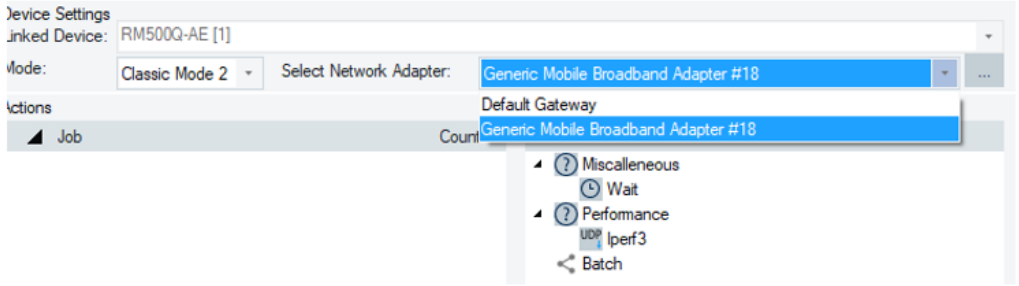


Figure 6-523: Network adapter selection for Classic mode 2

If you select the "Default Gateway" as the adapter, make sure that no other applications (e.g. e-mail, browser, update services), which can influence the test results, are active during the data tests.

If you select a Windows Mobile Broadband adapter, the APN can be set as in the Classic mode, that is, using the "Connect to Network" dialog with the "…" button placed on the right side of the "Select Network Adapter" combo-box.

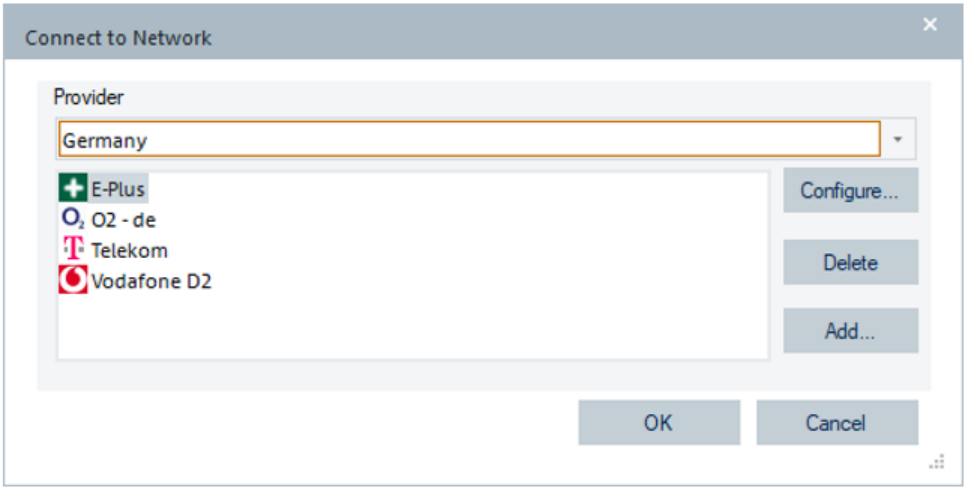


Figure 6-524: An option to set the APN

The Classic mode 2 is only offered, if the mobile is loaded from the "Welcome" page or using a QoS job wizard. It is not available in the "Hardware" > "Connect/Disconnect" dialog.

Only one Classic mode 2 is possible in a workspace.

There are some preconditions that have to be fulfilled.

- Java 11 must be installed on the computer. The Java setup is a part of the R&S Romes4 installation kit.

- Ping and Interactivity tests are only supported if at least the Windows Subsystem for Linux WSL 1 with Linux distribution Debian is installed on the computer.

How to install WSL, refer to the application note "Performing Data Tests with 5G Modules" which is available in the
`Documentation\Application Notes\`
`Application Note – Performing Data Tests with 5G Modules.pdf`.

The measurement files can be analyzed in NQDI and SmartAnalytics, if "Write SQZ Files for Mobiles and QoS in Classic Mode" is checked in the "Preferences" > "File Handling" page.

6.5.2.3 Data session start

"Data Session Start" triggers the start of a data session. The session number is incremented and the Session Start Trigger Points are written.

1. Select the smartphone that you want to connect.
2. Double-click the "QualiPoc Session Start" in the "Available Job" list.

   The "Data Session Start" page opens.

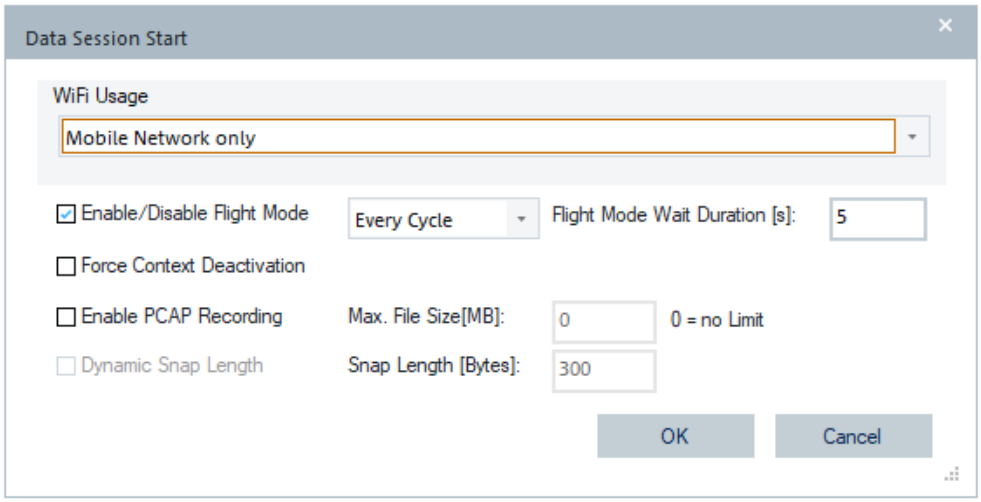


Figure 6-525: Selection of connection type

3. Select the type of the connection. Default is "Mobile Network only".

   The job is included in the "Job" list.

By selecting the job, from this point in time, the DQA job list offers only the jobs which can be executed by a smartphone.

The following functions are included at data session start:

- "WiFi Usage" - the WiFi usage in the QualiPoc "Data Session Start" job.

  The usage is defined by selecting one of the following options:

  – "Mobile Network only" - WiFi not to be used.
  – "Mobile Network / WiFi combined" - QualiPoc decides which network to use.
  – "WiFi only" - Use WiFi network only.
- "Enable/Disable Flight Mode" - if checked, offers the Flight Mode to switch on/off every cycle or once per measurement.
- "Flight Mode Wait Duration [s]" - if "Enable / Disable Flight Mode" is checked in "Data Session Start", a wait duration between enable and disable can be defined. The wait time is expressed in seconds.
- "Enable PCAP Recording" - if checked, PCAP recording is activated on the session level with defined snap length and maximum file size.
- "Dynamic Snap Length" - if checked, QualiPoc stores only needed information to keep the amount of data manageable. The "Snap Lenght [Bytes]" value is then configurable.

If "PCAP Recording for all Sessions" is checked in the QualiPoc settings page, see Figure 6-29, the PCAP controls are disabled in this dialog.

6.5.2.4 Data session end

"Data Session End" triggers end of the data session. The Session End Trigger Points is written.

There is no configuration menu for this job.

6.5.2.5 Voice and speech jobs

Voice test and Speech Quality jobs can be configured by selecting "Mobile" > "Auto Dialing" job in the "Available Jobs" list.

For "Auto Dialing", see "Auto dialing" on page 2045.

R&S ROMES4 allows setting the parameter ExcludeCallSetupFromCallDuration for speech quality measurements in fully integrated device use mode.

The generation of the land unit file allows you to set the test repetition value.

Voice test w/o speech quality

A MOC voice test must be surrounded by the "Call Session Start" and "Call Session End" jobs.

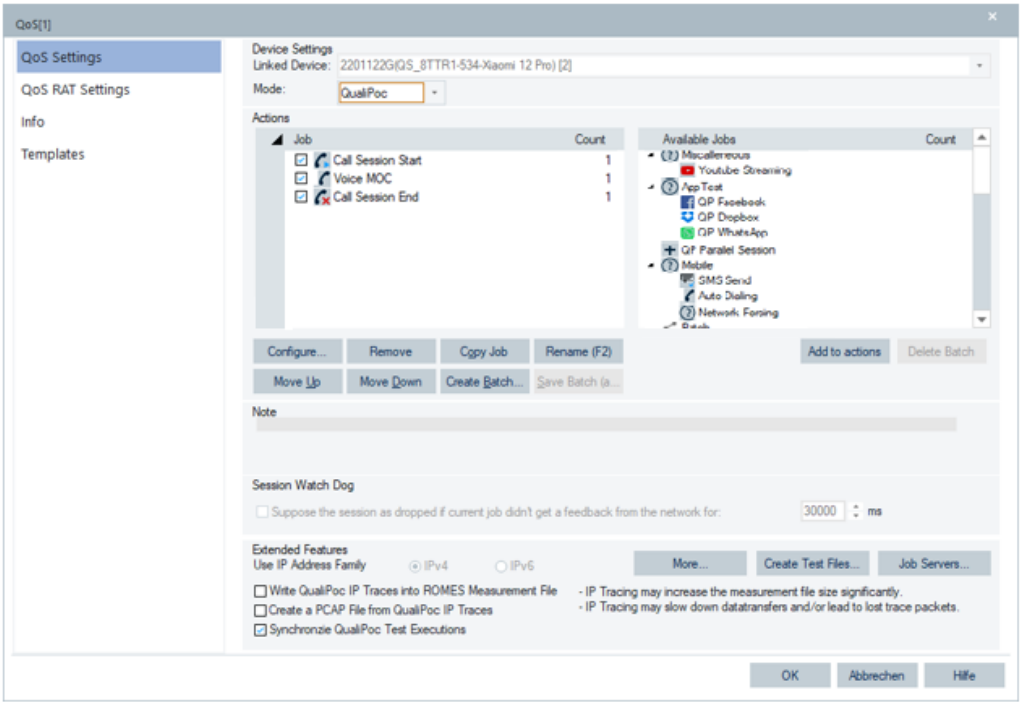


Figure 6-526: Voice MOC configuration

Voice test with speech quality

A speech quality test must be surrounded by the "Call Session Start" and "Call Session End" jobs, see Figure 6-516. The job configuration is unchanged, as shown in the following figure.

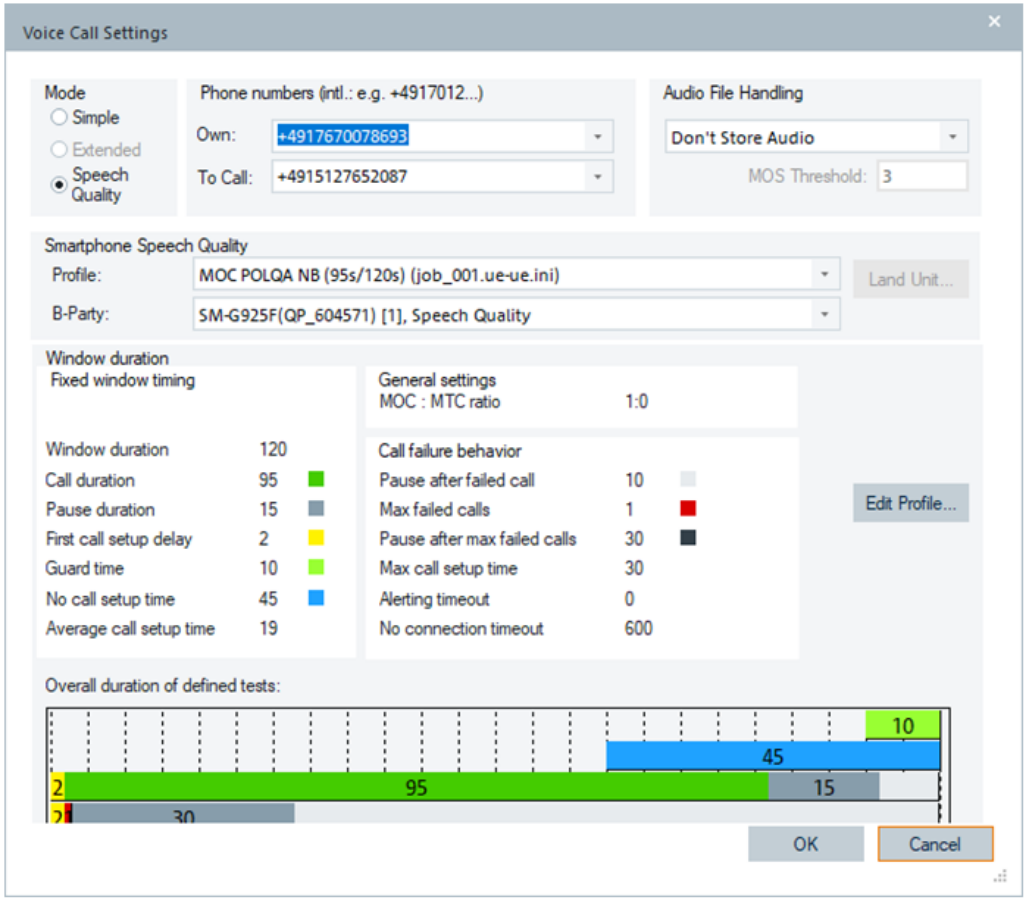


Figure 6-527: Speech quality configuration

If the B-Party is an UE, a speech quality B-side job is automatically created in the job list of the B-side UE.

An existing B-side job list is overwritten because double ended speech quality tests can only run exclusively on a fully integrated device.

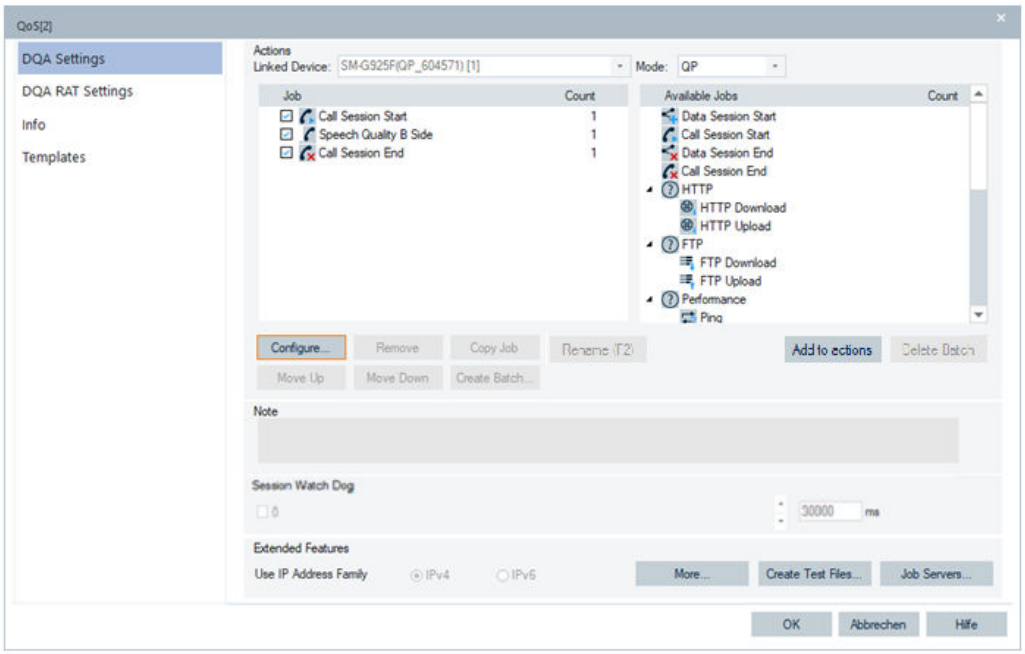


Figure 6-528: Speech quality configuration - B-side

The "Available Jobs" buttons are deactivated (dimmed) in the "Speech Quality / B-Side" configuration page.

Multi RAB session

Multi RAB session is combined speech quality and data quality test.

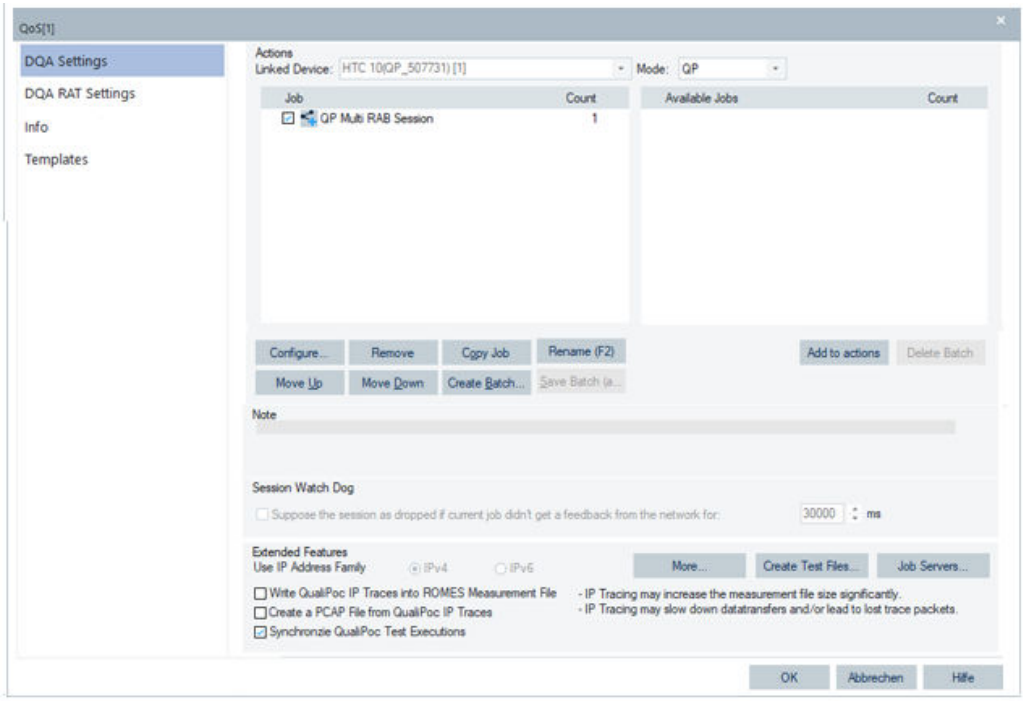


Figure 6-529: Multi RAB session active - other jobs unavailable

If a double ended call test is defined in the voice test within a such session, the B-side also has the multi RAB session with the voice test on its side and the same data test as the A-side has. The data test on the B-side can be modified.

If the settings of the A-side have been changed, you are supposed to overwrite the data jobs on the B-side.

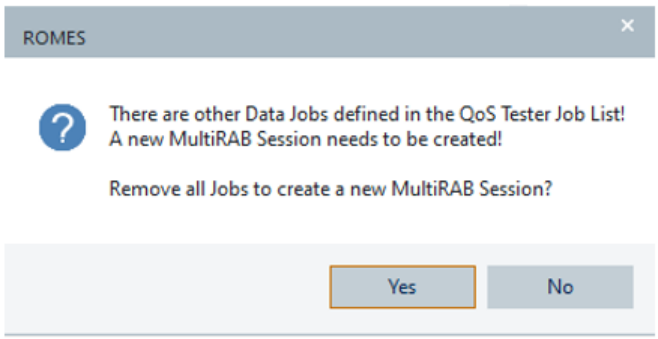


Figure 6-530: Request to overwrite data jobs on B-side

For the use case which requires this action, see the Example 4 in the "Job list examples" on page 1978.

Configuration of multi RAB session

To configure a multiple RAB session job, select "Available Jobs" > "Multi RAB Session". The configuration page opens.

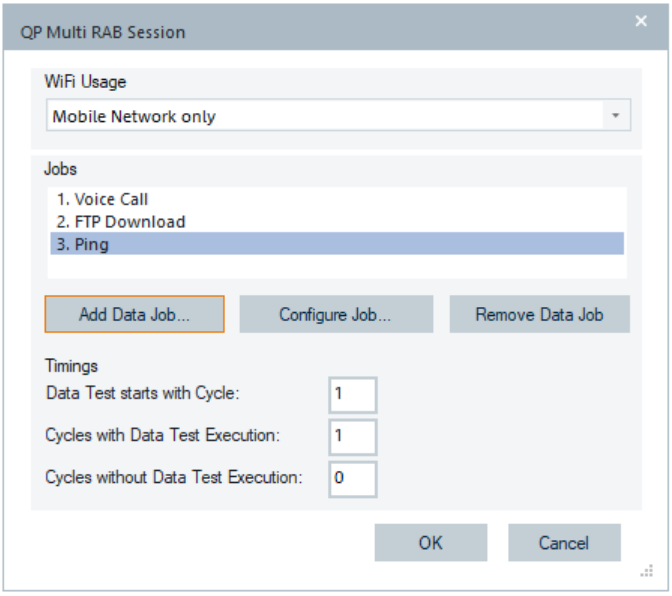


Figure 6-531: Configuration page of multi RAB session job

- "WiFi Usage"
  WiFi usage definition, equal to the WiFi usage of the Data Session Start job.
- "Jobs"
  The first job in the list is always a voice call. A speech quality test or a voice call can be defined. If the A-side speech quality test is configured, the B-side job list is configured automatically.
- "Add Data Job"
  The button to define two other data jobs from the offered list of jobs.

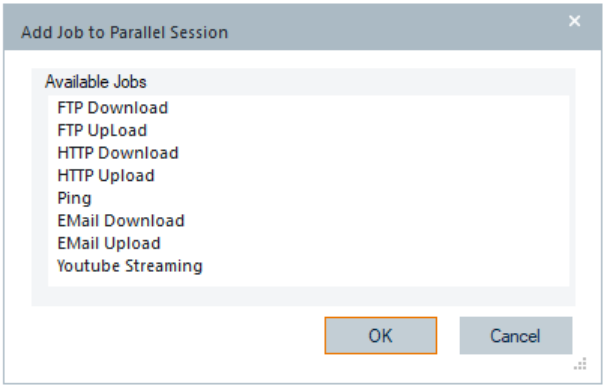


Figure 6-532: Possible jobs to be added

No other jobs can be added to the Multi RAB Session job.

If the Multi RAB Session job is configured, the "Available Jobs" list is empty.

For the previously mentioned case of double ended call test of voice test and data test, the following configurations are requested:

1. Call duration 60 [s] for double ended call of voice test,

2. Wait job duration 65 [s],
3. Ping job duration 30 [s],
4. Wait job duration 20 [s].

Limitations

The following limitations apply:

- Only one Multi RAB Session can be in a job list.
- If a Multi RAB Session is in a job list, no other jobs can be in the job list.
- Multi RAB Session Report is unavailable.
- If a Speech Quality job is in the job list, no other jobs can be in the job list.
- If an Auto Answering job is in the job list, no other jobs can be in the job list.

Job list examples

Example 1: Two call sessions to different destinations

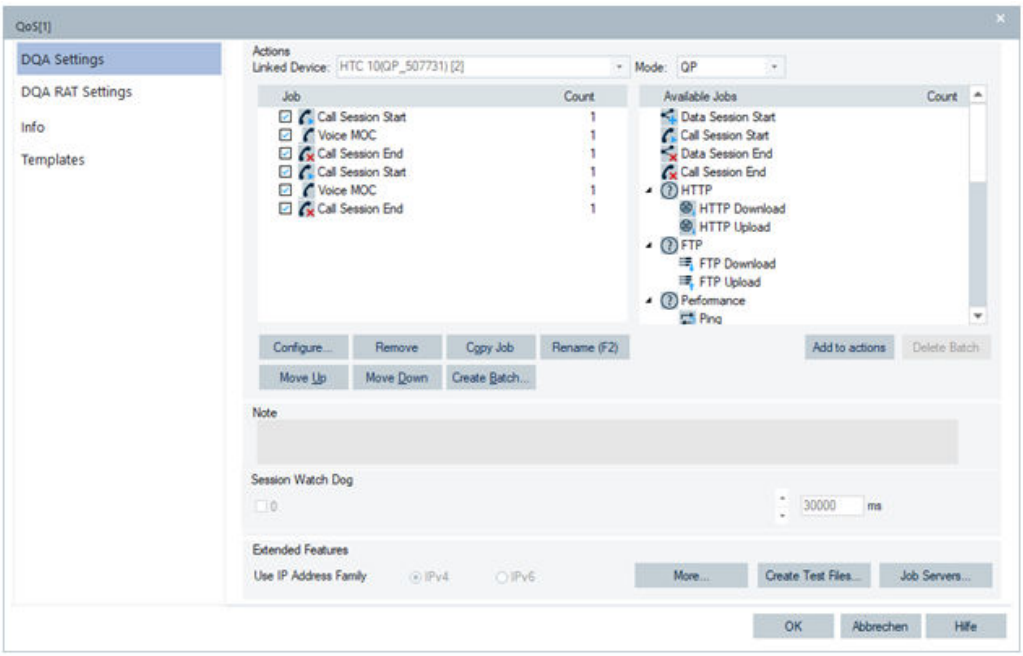


Figure 6-533: Call sessions to different destinations

Example 2: Maximum of two call sessions and two data sessions

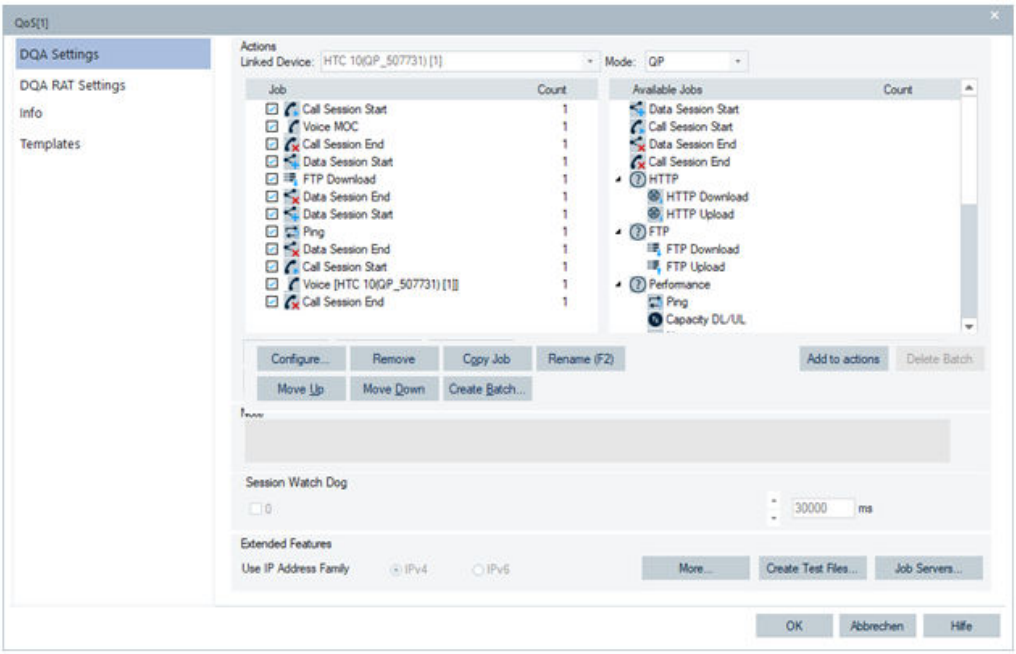


Figure 6-534: Two data and two call sessions

Example 4: Voice test with double ended call test and data test

NPS1 - Auto mode

MO UE	Idle	Ping	Wait
Voice Call(VoLTE fallback) to MT UE		32B,Ping to Google/Ping to MT UE	
60	5	30	20

NPS2 - Auto mode

MT UE	Idle	Ping	Wait
Receive Voice Call(VoLTE fallback) from MO		32B,Ping to Google/Receive Ping from MO	
60	5	30	20

Figure 6-535: Double ended call test in voice call test

6.5.2.6 HTTP

For the HTTP transfer test in fully integrated device use mode, it is possible to set a maximum transfer time even if the transfer is not a time-based one. If a transfer has not been finished in the defined maximum transfer time, the result is calculated as failed. The minimum value for the maximum transfer time is 5000ms.

HTTP download / browsing

The "HTTP Download" page supports a file download or browsing job for smartphones in fully integrated device use mode.

- If "File Transfer" is checked, the QualiPoc HTTP Download test is executed.

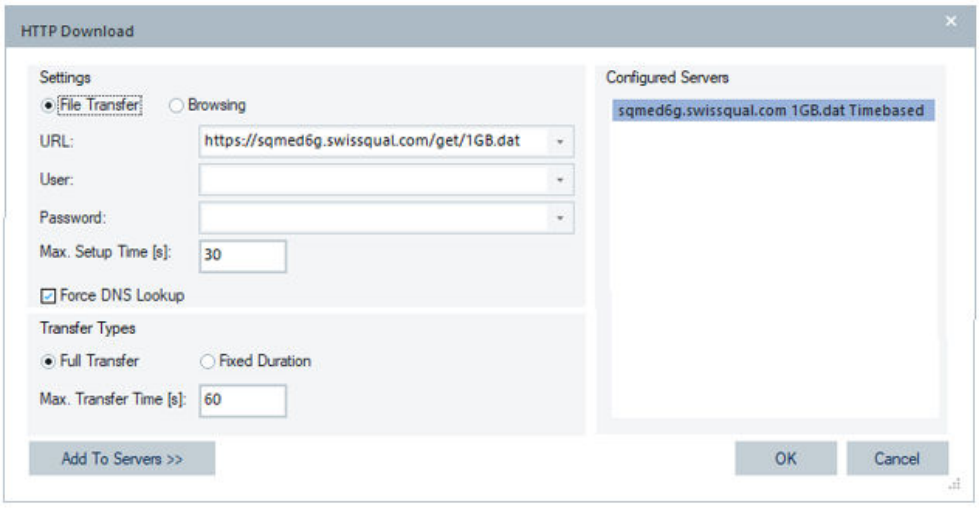


Figure 6-536: HTTP download complete file

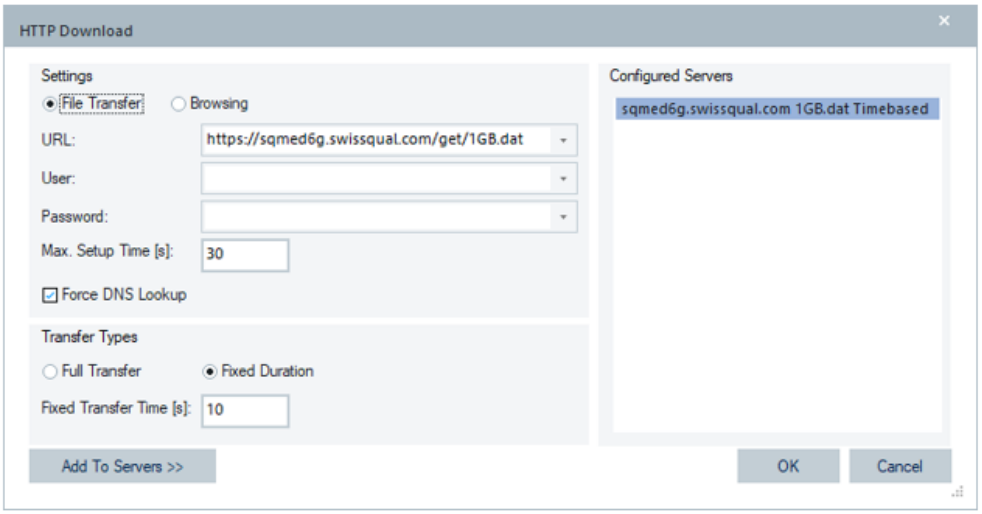


Figure 6-537: HTTP download file time-based transfer

- If "Browsing" is checked, the QualiPoc job HTTP Browsing is executed. The socket and PC connection-related configuration parameters are not available in that case. Specify a `*.htm` or `*.html` file for browsing.
- "URL" - the URL for encoding the link for a file download or select an entry in "Configured Servers".
- "User" - the user's name
- "Password" - the user's password
  Support of username and password as an input for this QP job makes an UE access to a protected server possible.
- "Max. Setup Time [s]" - max setup time for the HTTP Download test job
- "Force DNS Lookup" - If checked, activates the function to clean the DNS cache before the HTTP Download/Browsing job test starts. The function checks the status

of DNS records or troubleshoot issues with accessing a service, which provides the reliable DNS cache control.

- "Transfer Types" - allows selection between the HTTP Download test for complete file transfer or for fixed duration of file transfer.
  - "Full Transfer" - if checked, the duration of HTTP Download file transfer corresponds to complete file transfer. This transfer type is non-time-based transfer and is the default setting. The transfer duration is limited with the value specified in "Max. Transfer Time".
    The test fails if the download is not finished within the "Max. Transfer Time". Default is 60 [s].
  - "Fixed Duration" - if checked, the HTTP download file transfer lasts as configured in the "Fixed Transfer Time [s]". This transfer type is time-based transfer. At a time-based transfer, the test finishes after the fixed time with success. Default time is 60 [s].
- "Configured Servers" - shows all the preconfigured servers for HTTP download.

Views and signals

The views and signals are the same as for the HTTP download in On PC testing (Classic mode) usage if the HTTP browsing job is selected.

In the "Progress View", there is only one entry for the main object on the page.

HTTP upload

The "HTTP Upload" in the list of available jobs lets you select a file for uploading test by using TCP/IP to a target web server.

Double-click the line to open the configuration dialog for this job.

"File"

- "URL" - the host name or IP address identifying the remote server
- "Upload File Size" - size of a file you want to upload expressed in kB, MB or GB. HTTP supposes the file size to be expressed in MB which is also default unit.
- "UL File Name" (fully integrated device use mode only) - created a file name on the HTTP server

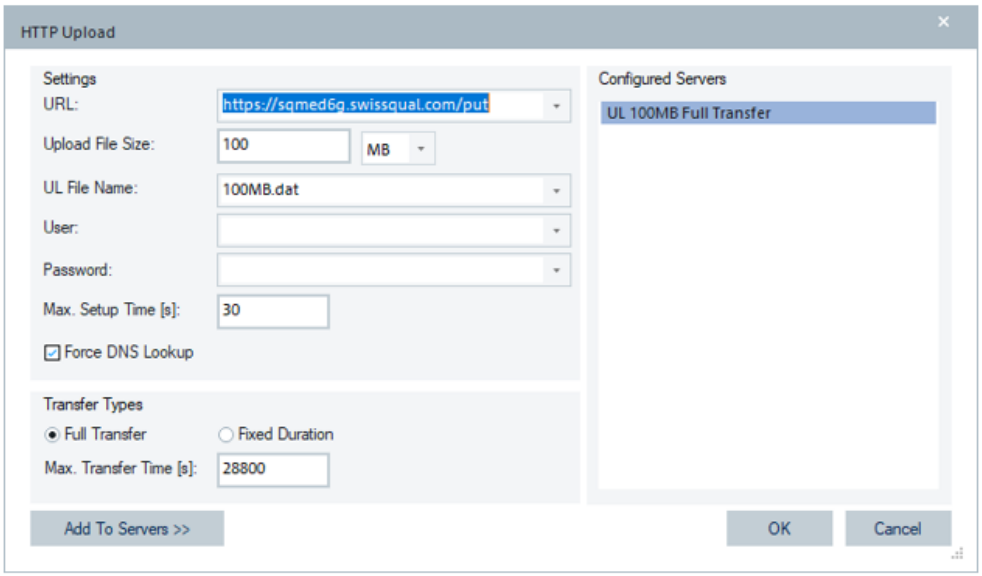


Figure 6-538: HTTP upload complete file

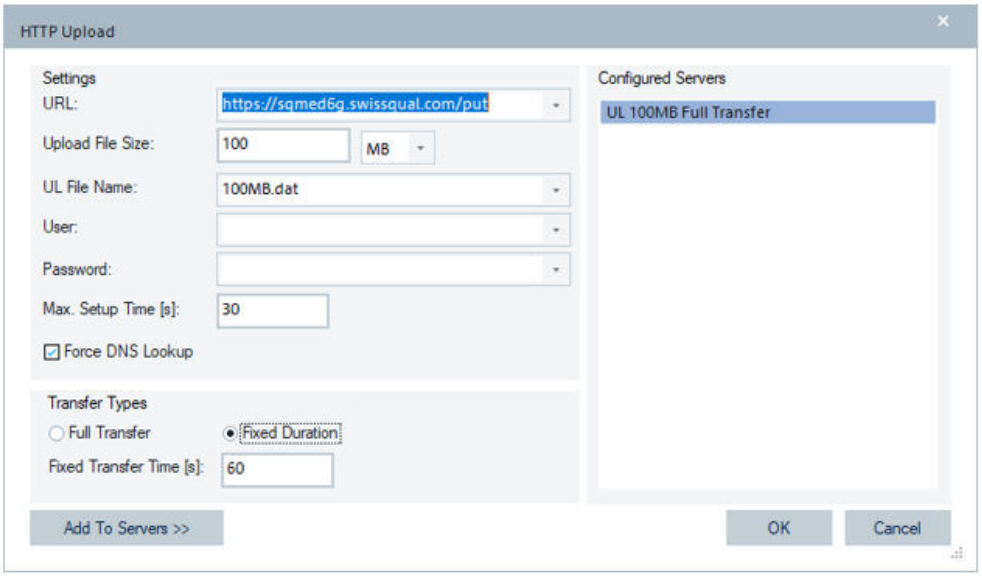


Figure 6-539: HTTP upload time-based transfer

- "User"- the user's name
- "Password" - the user's password
- "Max. Setup Time [s]" - maximum allowed setup time for this job in [s]
- "Force DNS Lookup" - If checked, activates the function to clean the DNS cache before the HTTP Upload job test starts. The function checks the status of DNS records or troubleshoot issues with accessing a service providing the reliable DNS cache control.

"Transfer Types" - allows selection between the HTTP Upload test for complete file transfer or for fixed duration of file transfer.

- "Full Transfer" - if checked, the duration of HTTP upload transfer corresponds to complete file transfer. This transfer type is non-time-based transfer and is default setting. The transfer duration is limited with the value specified in "Max. Transfer Time".
  The test fails if the upload is not finished within the "Max. Transfer Time", default is 60 [s].
- "Fixed Duration" - if checked, the HTTP Upload file transfer lasts as configured in the "Fixed Transfer Time [s]". This transfer type is time-based transfer.
  At a time-based transfer, the test finishes after the fixed time with success. Default time is 60 [s].

"Configured Servers" - shows a list of all the preconfigured servers for HTTP upload. Double-click a list entry to store the available properties of the preconfigured server for HTTP upload.

NB-IoT HTTP download with Quectel BG77 device

R&S ROMES4 supports the HTTP download of a file analog to the NB-IoT FTP with the Qualcomm Quectel based devices - tested with BG77 device. The device has to support the corresponding AT command set.

The configuration of the job asks for the complete path of the file to download and some additional timeout settings.

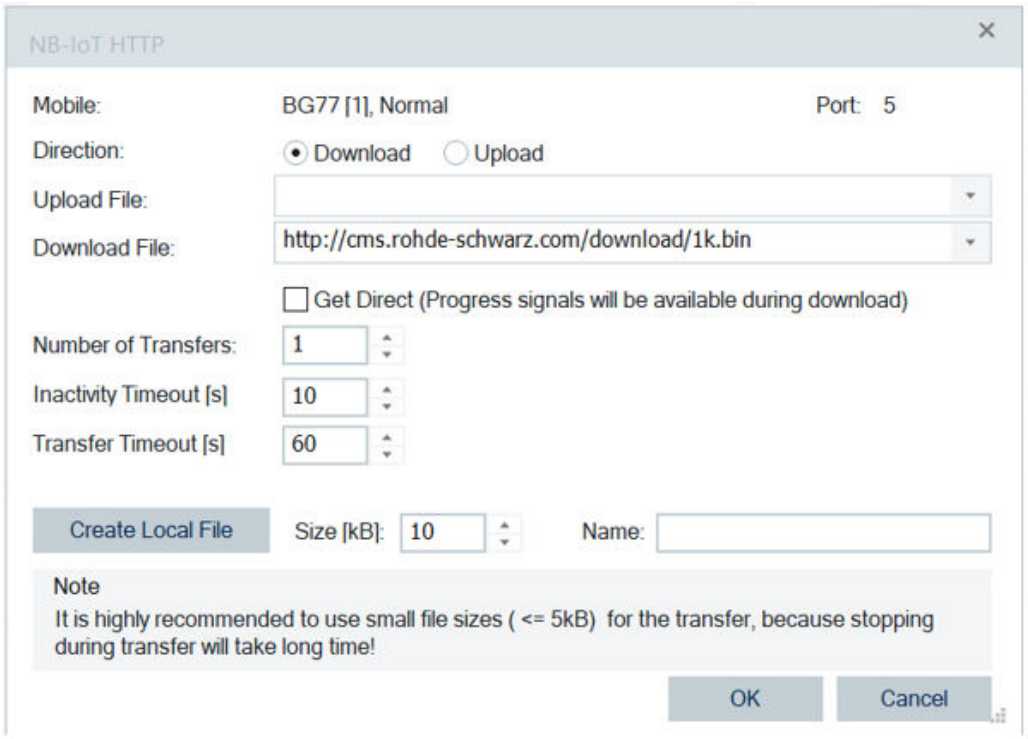


Figure 6-540: Configuration page of NB-IoT HTTP download

The normal mode uses an AT command, which writes the complete file onto the device. It returns GET after the complete file has been downloaded and written to the device.

Download small files only to get frequent feedback.

The direct mode does not store the file to device. The used AT command allows R&S ROMES4 to read the content of the file itself. This mode offers progress signals during the download.

The BG77 device does the HTTP download in two steps. The first "Get" step reads the header and some bytes of the file to download. A second step reads the rest of the file. For short files, the first step can occupy most of the transfer time.

The HTTP upload can be done only file based. Use a small file and more transfers to get more results.

The content of the file is sent to the server, but the DQA does not verify what the server does with this data. If there is no specific script running on the server, the data is most probably just deleted. However, the data is transferred to the server and thus the available throughput can be calculated.

The following screenshot shows the NB-IoT HTTP download job available signals.

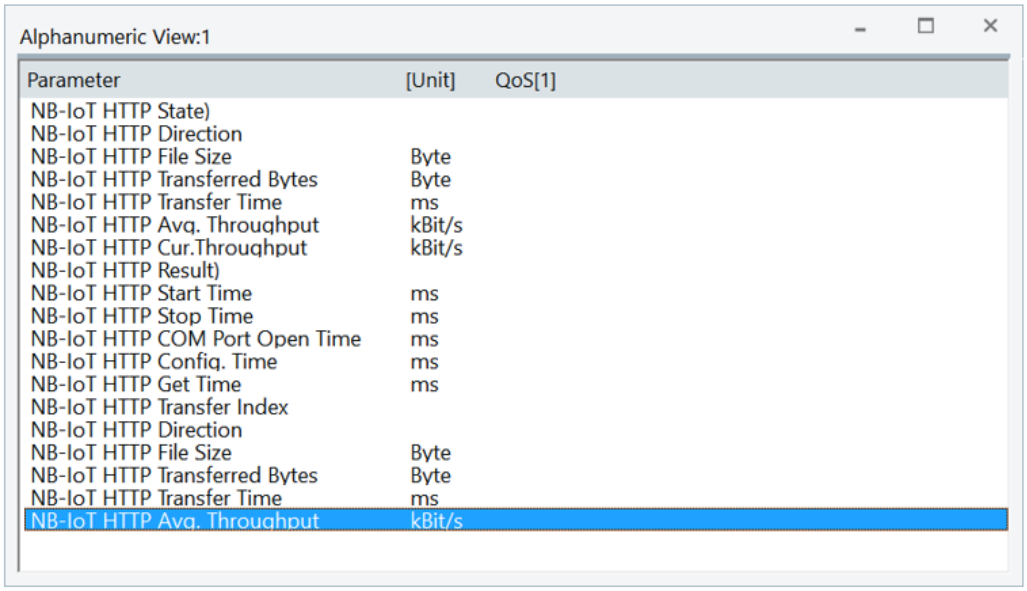


Figure 6-541: Supported signals of the NB-IoT HTTP download job

For the signals description, see "Description of the R&S ROMES signals" document.

6.5.2.7 FTP

DQA FTP download

The FTP Download job allows downloading a file from the selected server.

The FTP download supports the SFTP protocol. The `sftp://` instead of `ftp://` must be used for transfer with SFTP servers.

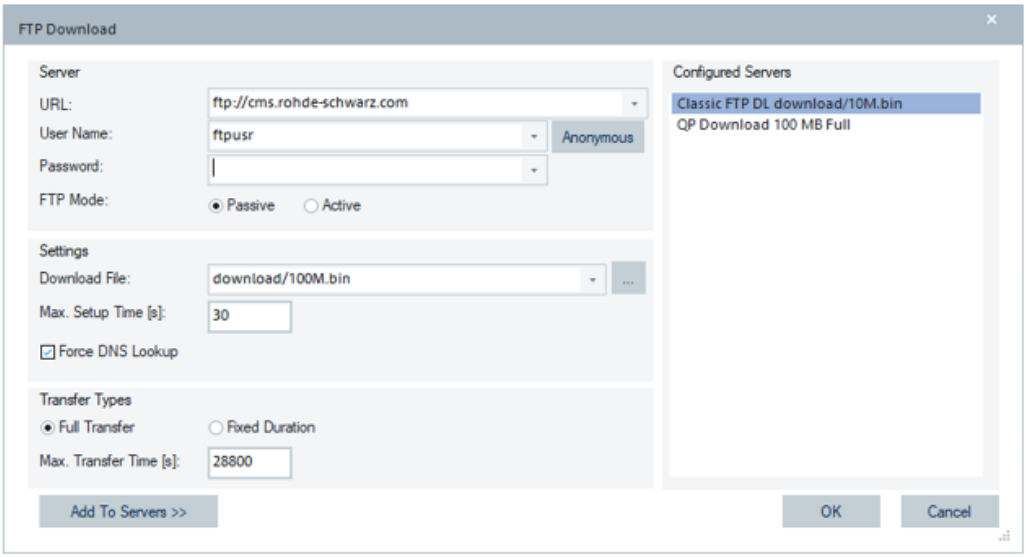


Figure 6-542: FTP Download complete file transfer

The page contains the following parameters:

"Server"

- "URL" - the host name or IP address identifying the remote server
- "User name" - the user's name
- "Password" - the user's password
- "FTP Mode" - selection of active or passive FTP connection
- "Anonymous" - if clicked, creates the user name and password automatically

"Settings"

- "Download File" - allows browsing for the file
- "Max. Setup Time [s]" - max setup time for the FTP Download test job
- "Force DNS Lookup" - If checked, activates the function to clean the DNS cache before the FTP Download job test starts. The function checks the status of DNS records or troubleshoot issues with accessing a service, which provides the reliable DNS cache control.

"Transfer Types" - allows selection between the FTP Download job test for full file transfer or for fixed duration of file transfer.

- "Full Transfer" - if checked, the duration of FTP Download transfer corresponds to complete file transfer. This transfer type is non-time-based transfer and is default

setting. The transfer duration is limited with the value specified in "Max. Transfer Time".
The test fails if the download is not finished within the "Max. Transfer Time", default is 60 [s].

- "Fixed Duration" - if checked, the FTP Download file transfer lasts as configured in the "Fixed Transfer Time [s]". This transfer type is time-based transfer.

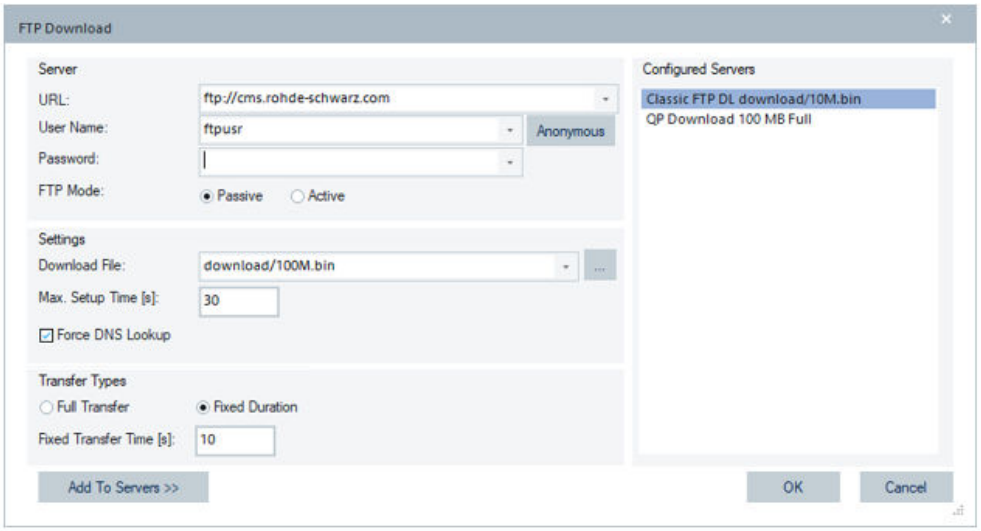


Figure 6-543: FTP Download time-based transfer

At a time-based transfer, the test finishes after the fixed time expiry with success. Default time is 60 [s].

- "Configured Servers" - shows the list of all the preconfigured servers for FTP download.
Double-click a list entry to store the available properties of the preconfigured server.

The socket and PC connection-related configuration parameters are not available.

It is not possible to get a file size before downloading the file.

The configuration page of this job is common for both operating modes (the Classic and QualiPoc modes).

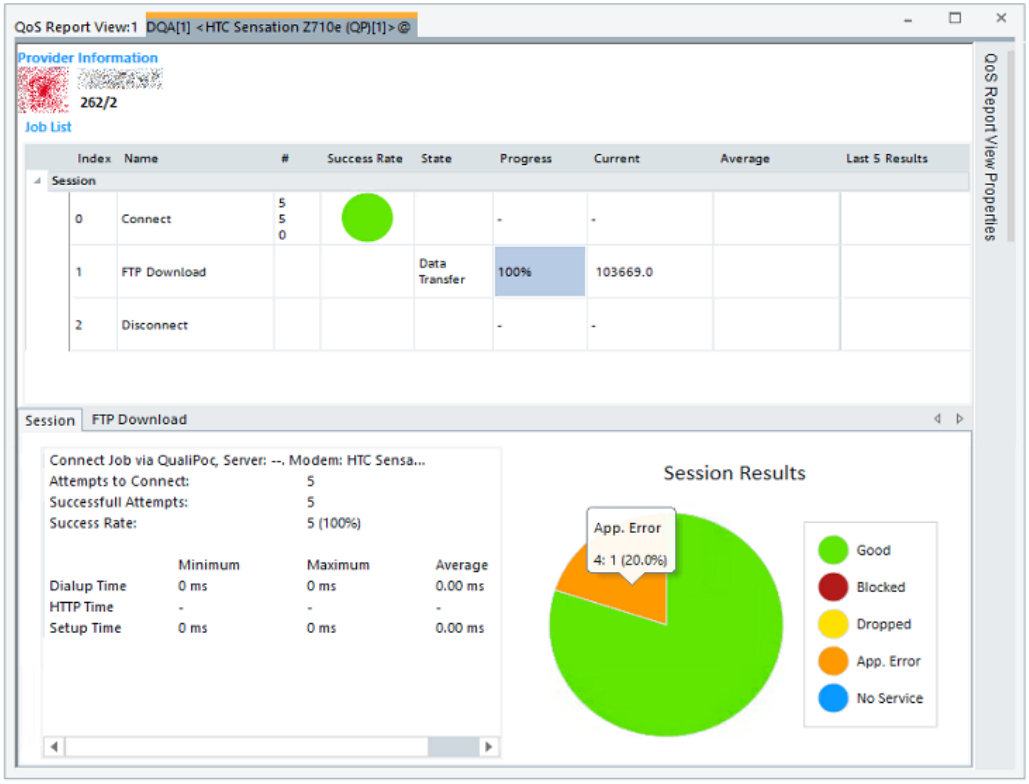


Figure 6-544: QP FTP download QoS report view

DQA FTP upload

The FTP Upload job allows uploading a file to the selected server.

The DQA FTP Upload job supports the SFTP protocol. The `sftp://` instead of `ftp://` has to be used for transfer to SFTP servers.

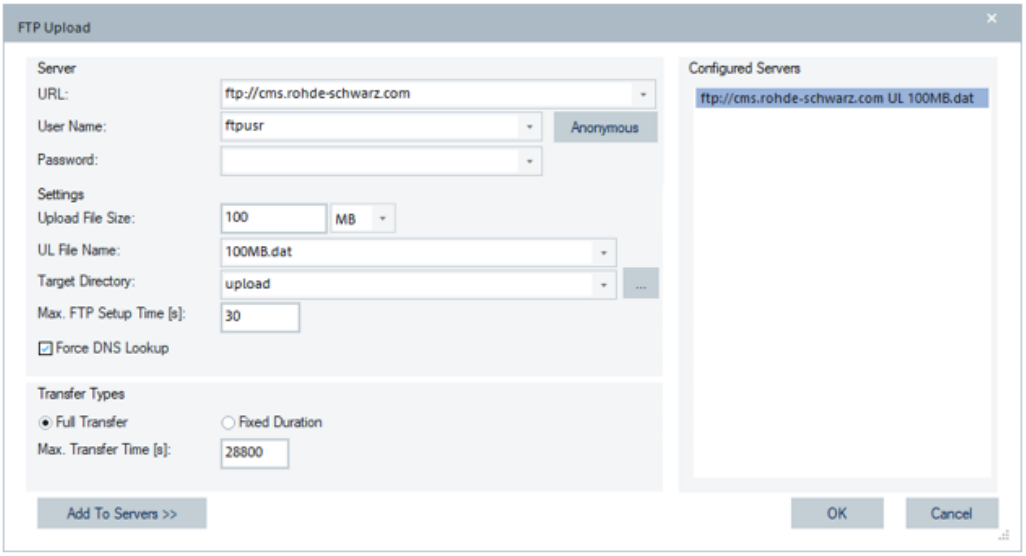


Figure 6-545: FTP Upload - complete file transfer

The "FTP Upload" configuration dialog of fully integrated device mode includes the following entries.

"Server"

- "URL" - host name or IP address identifying the remote server.
- "User Name" -predefined user's name
- "Password" - user's password

"Settings"

- "Upload File Size" - size of a FTP file you want to upload expressed in kB, MB or GB. MB is the default unit.
- "UL File Name" - name of a file you want to upload (only fully integrated device use mode)
- "Target Directory" - name of the target FTP server
- "Time Based FTP Upload" - FTP upload time-based job is configured by checking the box
- "Max. FTP Transfer Time" - the max. transfer time of the activated time-based FTP upload
- "Force DNS Lookup" - If checked, activates the function to clean the DNS cache before the FTP Upload job test starts. The function checks the status of DNS records or troubleshoot issues with accessing a service, which provides the reliable DNS cache control.

"Transfer Types" - allows selection between the FTP Upload test for full file transfer or for fixed duration of file transfer.

- "Full Transfer" - if checked, the duration of FTP upload transfer corresponds to complete file transfer. This transfer type is non-time-based transfer and is default setting. The transfer duration is limited with the value specified in "Max. Transfer Time".

The test fails if the upload is not finished within the "Max. Transfer Time", default is 60 [s].

- "Fixed Duration" - if checked, the FTP Upload file transfer lasts as configured in the "Fixed Transfer Time [s]". This transfer type is time-based transfer.

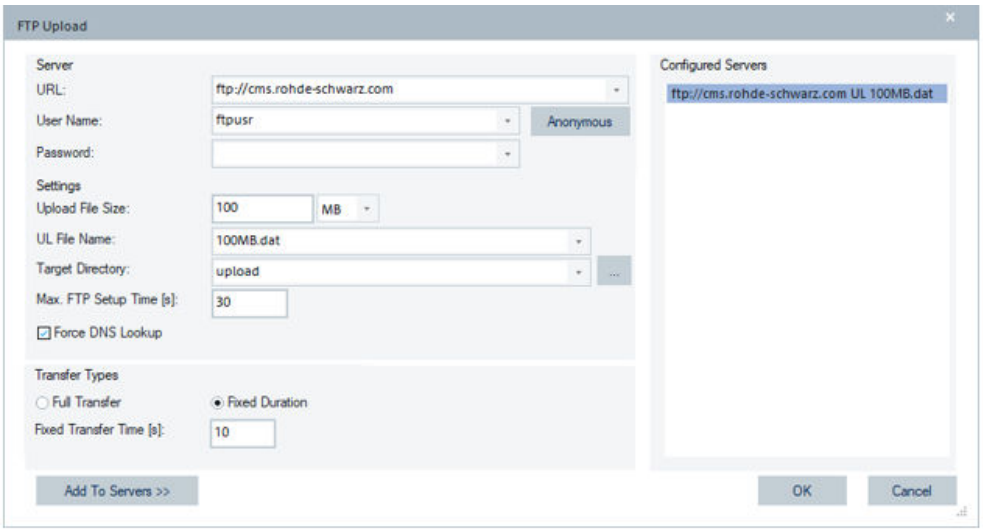


Figure 6-546: FTP Upload time-based transfer

At a time-based transfer, the test finishes after the fixed time with success. Default time is 60 [s].

"Configured Servers" - shows a list of all the preconfigured servers for FTP upload. Double-click a list entry to store the available properties of the preconfigured server for FTP upload.

The socket and PC connection-related configuration parameters are not available.

Specify the server address "URL" to encode the link for uploading a file and the size of file you want to upload, apart from other requested entries (user name, password). After selection, the dialog with all available files pops-up on the smartphone.

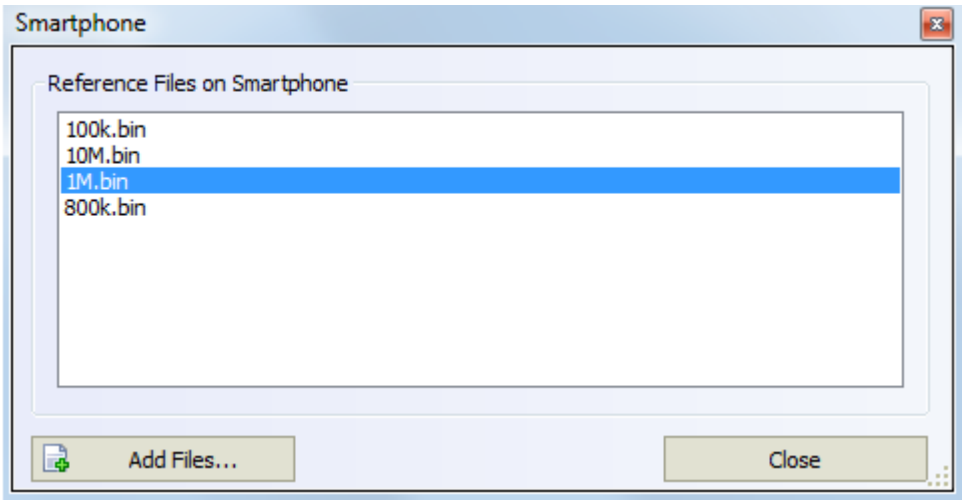


Figure 6-547: Selection of reference file

Double-click a selected file and click "Close" after the selection. The selected file is written into the "...\My Romes\DQAFiles\Upload" directory of a PC. After the file has been successfully transferred, you can see it there.

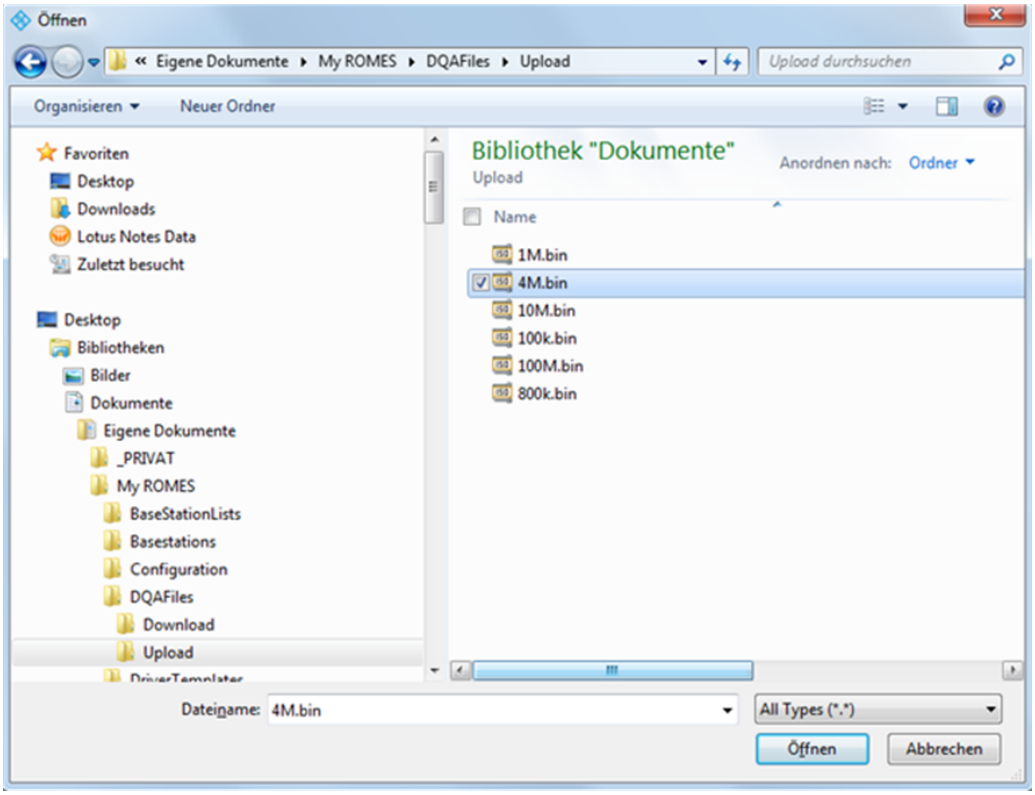


Figure 6-548: Location of the uploaded file

Click "Add Files" to transfer a file from PC to a smartphone.

6.5.2.8 Performance

The jobs available in the "Performance" group are shown in the following figure.

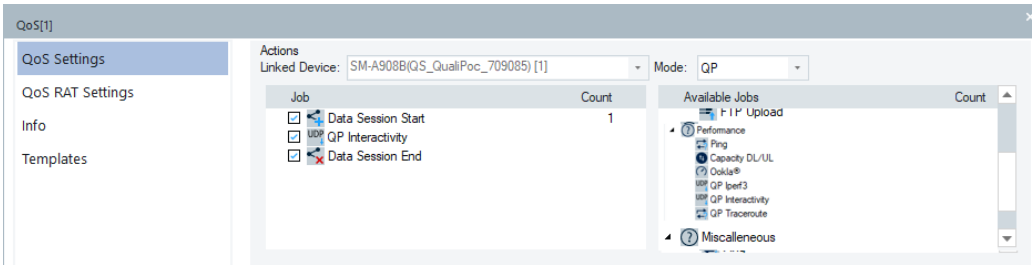


Figure 6-549: QP jobs in Performance group

Ping

The following figure shows the configuration page of the QP Ping job.

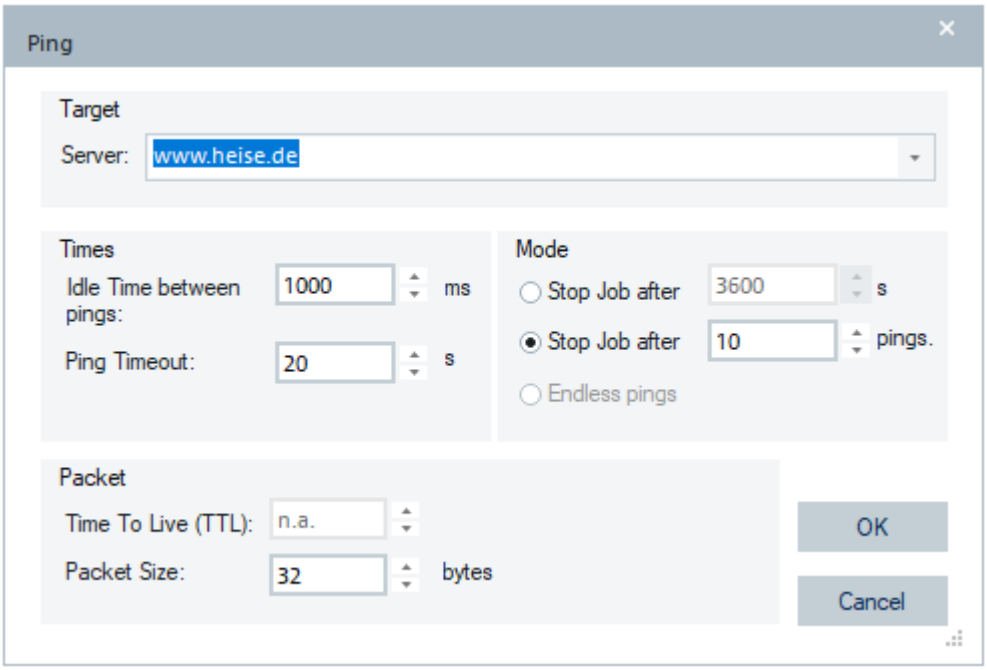


Figure 6-550: Ping job configuration page

The time based and the endless ping modes are not supported. These TTL parameters are not configurable and shown dimmed in the page.

RTT values are calculated with a higher accuracy in QualiPoc and Classic Mode 2 measurements. For example, RTT = 22.2 ms instead of 22.0 ms

Ping test views

The following views are available for the Ping test:

- "Alphanumeric View"
- "DQA Message View"
- "DQA Progress View"
- "QoS Report View"

In the presented screenshots, one can remark mentioned RTT high resolution.

Figure 6-551: Ping test results in Alphanumeric view

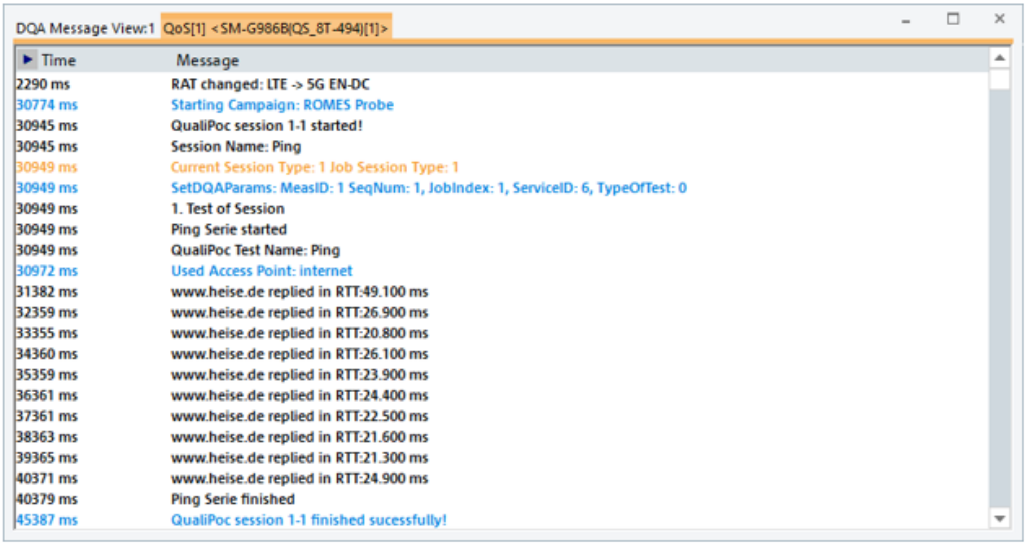


Figure 6-552: List of messages related to Ping test

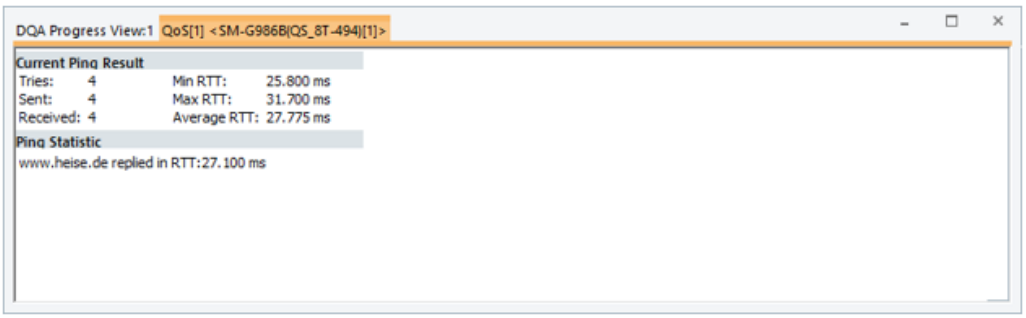


Figure 6-553: Ping test statistic in DQA progress view

Capacity DL/UL test

The "Capacity DL/UL" job allows the capacity test of FTP/HTTP/UDP DL/UL jobs to perform.

The following is valid:

- It is not possible to combine services in capacity tests (e.g. all FTP or all HTTP)
- There is no additional license for FTP/HTTP/UDP capacity test (the capacity test license)
- FTPS/FTPES is not supported in capacity test
- Not all KPIs are available for HTTP

Capacity DL/UL test configuration

The Capacity Test job supports FTP, HTTP and UDP services.

The screenshots show the HTTP and FTP DL capacity tests configuration pages for Android OS-based smartphones with SQ Android interface, the fully integrated devices use mode.

The Capacity DL/UL tests apply the adaptive bandwidth algorithm.

The advantage of using an adaptive bandwidth algorithm over the fixed one is less waisted data. Also, the input about maximum expected bandwidth from the user is not required.

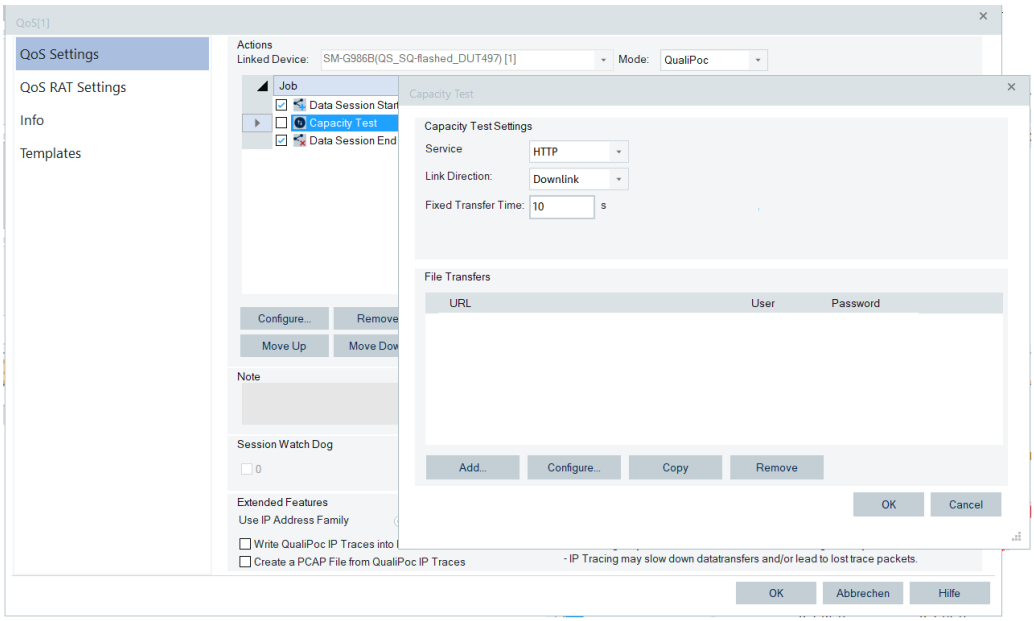


Figure 6-554: Capacity HTTP DL test in fully integrated device mode

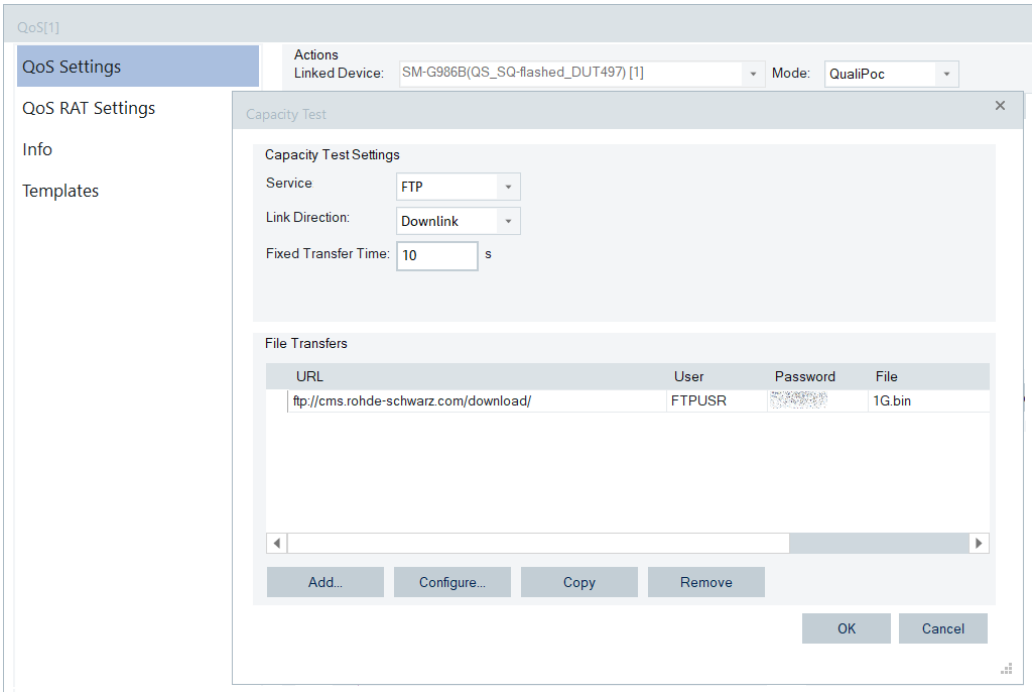


Figure 6-555: Capacity FTP DL test in fully integrated device mode

The following settings are included in the "Capacity Test Settings" pane:

- "Service"
  Select the service type for the test out of three offered in the combo-box according to your need.

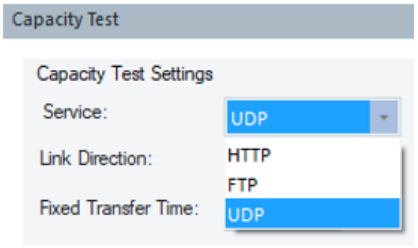


Figure 6-556: Service selection

- "Link Direction"
  Select the operation mode of the selected service out of offered "Downlink" or "Uplink"
- "Fixed Transfer Time"
  Set the duration of a test that you want to perform, default 60 [s]. The entry is mandatory for all services. If one of the file transfers ends before the fixed duration is reached, the job fails.

If the UDP capacity test is selected, the "Capacity Test Settings" pane holds in addition the "Host" and "Port" combo boxes to specify a host name or IP address and its port number.

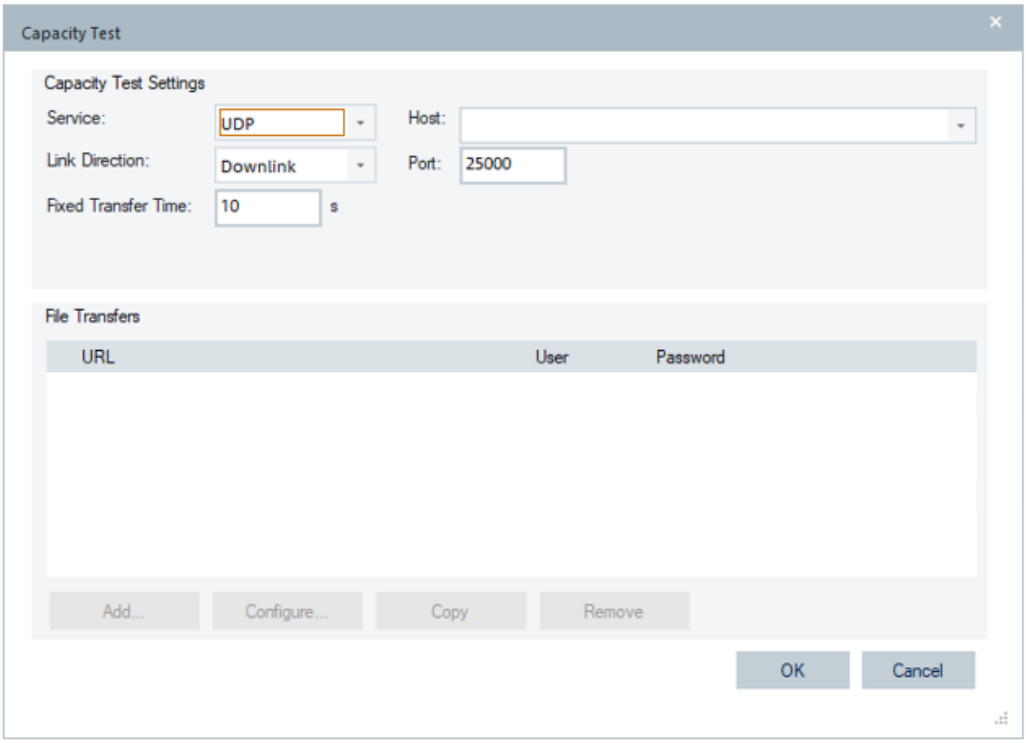


Figure 6-557: Capacity UDP DL test in fully integrated device mode

The "File Transfer" pane shows the list of files available for capacity test and the set of buttons to add an URL, configure it, copy a selected one or remove it from the URL list. The pane of UDP service selection is disabled as this capacity test does not request to specify the full URL.

If you click the "Add" button for HTTP or FTP as selected service, the following dialogs are displayed.

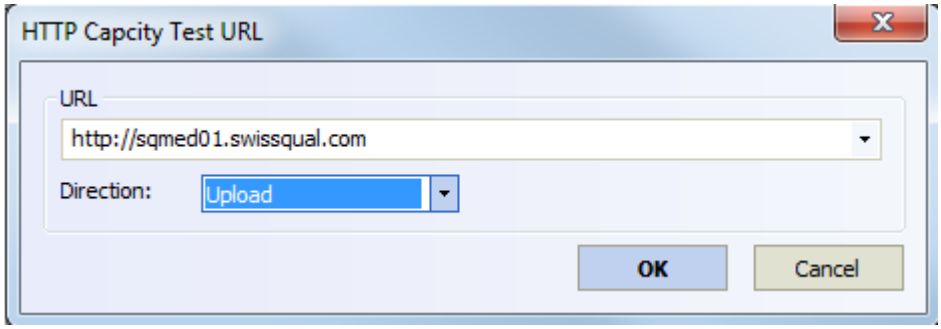


Figure 6-558: HTTP capacity test - upload direction

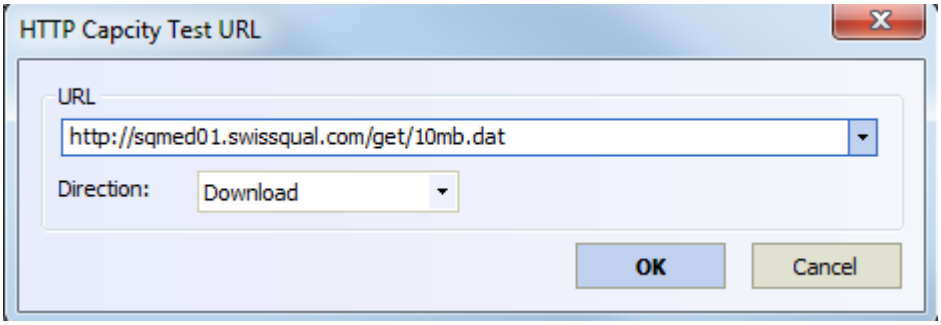


Figure 6-559: HTTP capacity test - download direction

- "URL"
  URL to transfer a file from/to must be defined.
- "Direction"
  Download or upload. A file to be downloaded must be included in the URL's entry, as shown in the previous screenshot.
  It is possible to define an HTTP transfer directory in upload direction. A file suffix (the zero-based list-box index) is appended to the transferred file to avoid access violations on the HTTP server.

Click "OK" to add the configured job to the DQA job list and leave the "Capacity Test" dialog.

DQA capacity DL/UL test views

The following DQA views are available for the Capacity DL/UL job with HTTP as selected service on smartphones supporting SQ Android (i.e. fully integrated device mode).

- "DQA Message View" shows the actions of the currently running job.
- "DQA Progress View" shows the current results of the job.

- "QoS Report View" shows a summary of the all sessions of the measurement.
- "Capacity Test Summary View" shows throughput values of capacity test job.
- "QoS KPI Generator View" display for a job defined KPIs.

DQA message view

The "DQA Message View" of capacity test shows the test outcome and the values of the monitored signals. The following figure shows the HTTP capacity test signals and results.

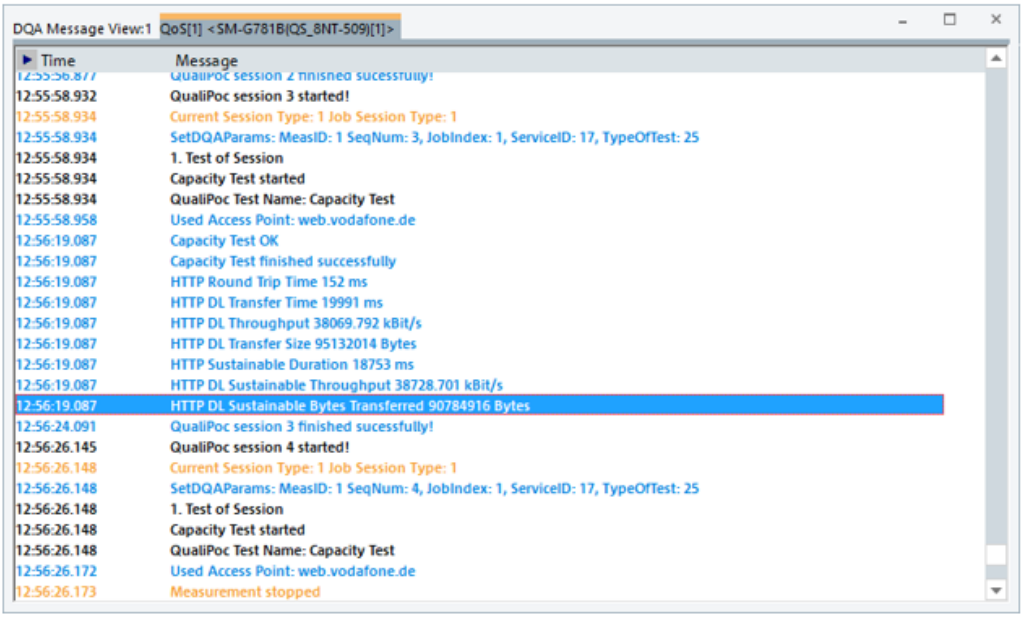


Figure 6-560: Messages exchanging during the capacity test

DQA progress view

The "DQA Progress View" shows the measured values during the job execution of the following signals in the upper part.

Table 6-23: Capacity test progress view entries

Signal	Description
Average Data Rate DL	Current throughput of the download; only available in operation mode Download/Download and Upload
Already Transferred DL	Already downloaded bytes; only available in operation mode Download/Download and Upload
Average Data Rate UL	Current throughput of the upload; only available in operation mode Upload/Download and Upload
Already Transferred UL	Current throughput of the upload; only available in operation mode Upload/Download and Upload
Elapsed Time	Current elapsed time of the test

Signal	Description
Round Trip Time	Round trip time of the first packet.
Max. Transfer Time	Maximum transfer time of the test

The Elapsed Time and Max. Transfer Time values are used to calculate the position of the progress bar, as Elapsed Time divided by Max. Transfer Time, unit [%].

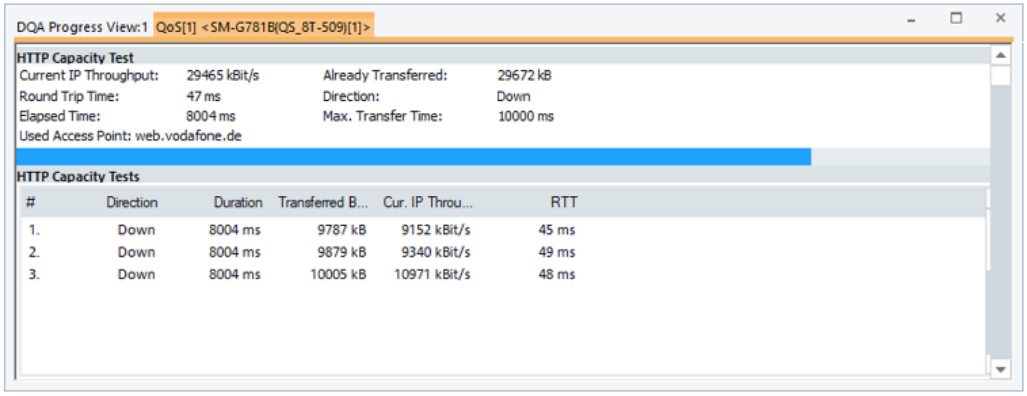


Figure 6-561: DQA progress view of HTTP capacity tests

The lower part of the view, named "HTTP Capacity Tests", is a list displaying the current values of each defined HTTP transfer. The current IP throughput is a part of the list values.

The data to be transferred is buffered between the TCP and application layers.

The buffering can lead to differences in the amount of received and sent data for the same point in time on the two layers. The differences are in the measured throughput, so that the first result can show too high number of transferred bytes and data rate of an HTTP upload.

The buffering of data is the reason why the first result of the transferred bytes and data rate of an HTTP upload seems to be too high.

For details, refer to SQ document
`Application Note - Fixed Duration Tests.pdf`.

QoS report view

The "QoS Report View" is a summary of all sessions.

The "QoS Report View" of the HTTP capacity test shows minimum, maximum and average values of Transfer Time and Data Rate. The view shows these values for each defined HTTP transfer and for the total result of all defined HTTP transfers.

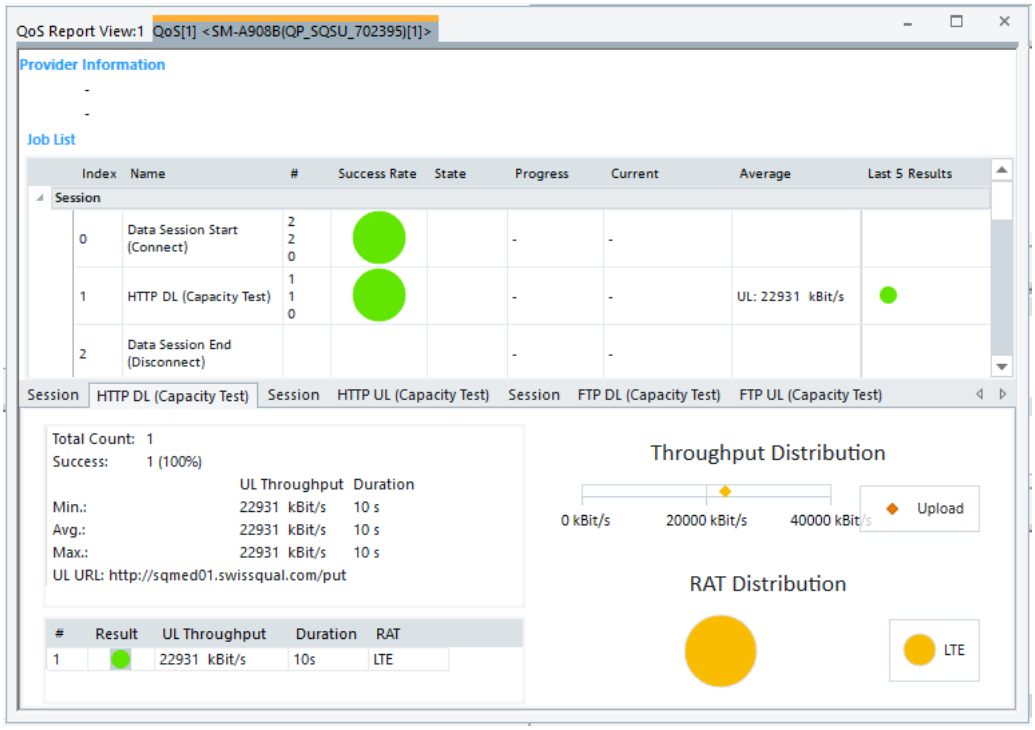


Figure 6-562: QoS report view of HTTP capacity test

Histograms for download and upload data rates are available.

KPI generator view

For the DQA HTTP Capacity Test job, the following KPIs are defined.

- HTTP Capacity Test (DL) start
- HTTP Capacity Test (UL) start
- HTTP Capacity Test (DL/UL) start
- HTTP Capacity Test (DL) completed
- HTTP Capacity Test (UL) completed
- HTTP Capacity Test (DL/UL) completed
- HTTP Capacity Test (DL) Time

To derive listed KPIs, the following two trigger points are defined:

- HTTP Capacity Test Start
- HTTP Capacity Test Stop

The mentioned tests are shown in the "QoS KPI Generator View".

Other KPIs are not available because there are no trigger points delivered by the Android interface.

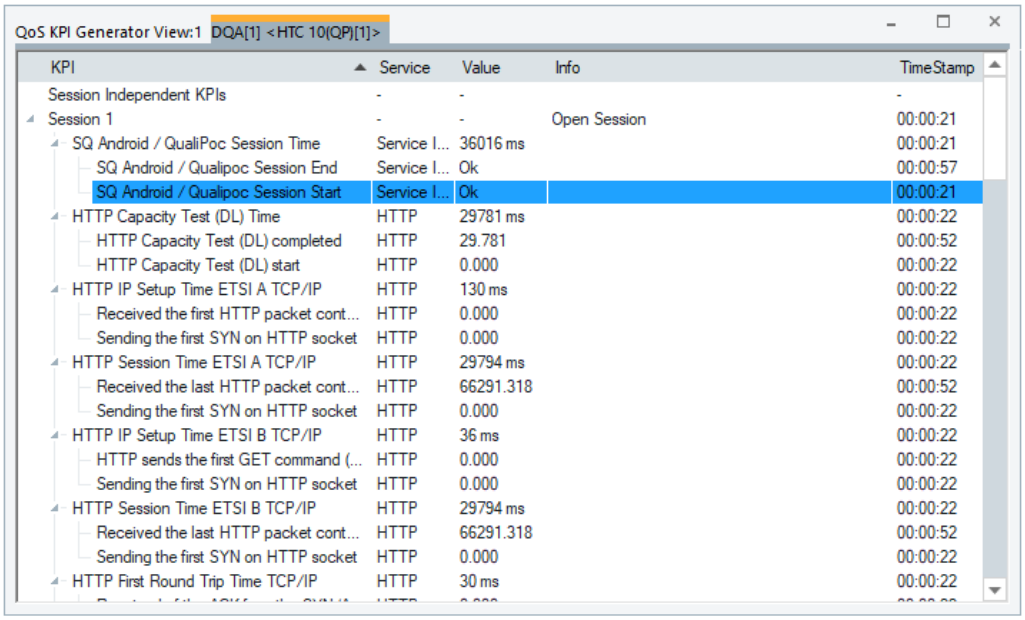


Figure 6-563: QoS KPI generator view of HTTP capacity test

For details of the job's trigger points and the KPIs, refer to Chapter 9, "R&S ROMES4 KPI generator", on page 2229.

Available signals for capacity test DL/UL

The following figure shows the signals available for this job.

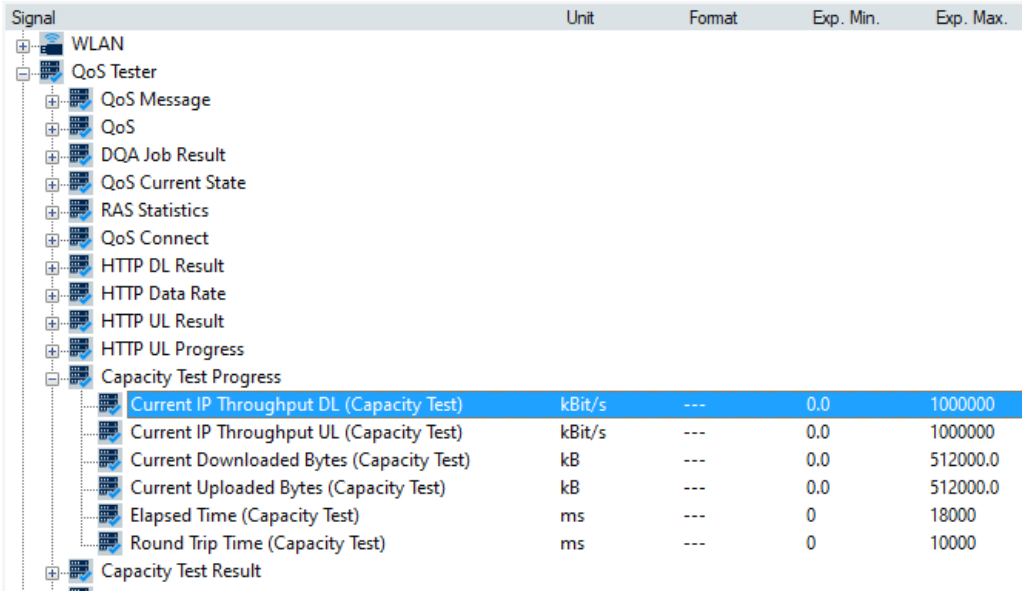


Figure 6-564: Capacity test signals

There are two sets of signals for this job.

- Capacity Test Progress

For the description and ranges of signals in this group, refer to "Description of R&S ROMES4 Signals" > "QoS Tester" > "Capacity Test Progress".

- Capacity Test Result
  For the description and ranges of signals in this group, refer to "Description of R&S ROMES4 Signals" > "QoS Tester" > "Capacity Test Result".

A signal description appears as well in a Tooltip when hovering with mouse over the signal in R&S ROMES4 GUI, in "Signal Tree" >"QoS Tester".

The Round trip time signal is displayed in the Message View and DQA Progress View. The signals related to sustainable throughputs are displayed in "Message View".

Sustainable throughput calculation

In the Network Performance Test each capacity measurement can be short compared to the test interval, typically around 6 to 10 seconds. Therefore, the ramp-up of the throughput cannot be neglected when calculating the average achievable capacity. Instead of discarding fix number of data samples from the calculation, the test utilizes an algorithm to detect the end of the throughput ramp-up. In this way the test does not lose information about later drops in the capacity that can occur.

The example results of the ramp-up detection algorithm are presented in the following figure. The blue bars are showing the measured throughput in a capacity test. The red line is marking the end of the ramp-up and thus the first data sample that is taken for calculating the average sustainable capacity.

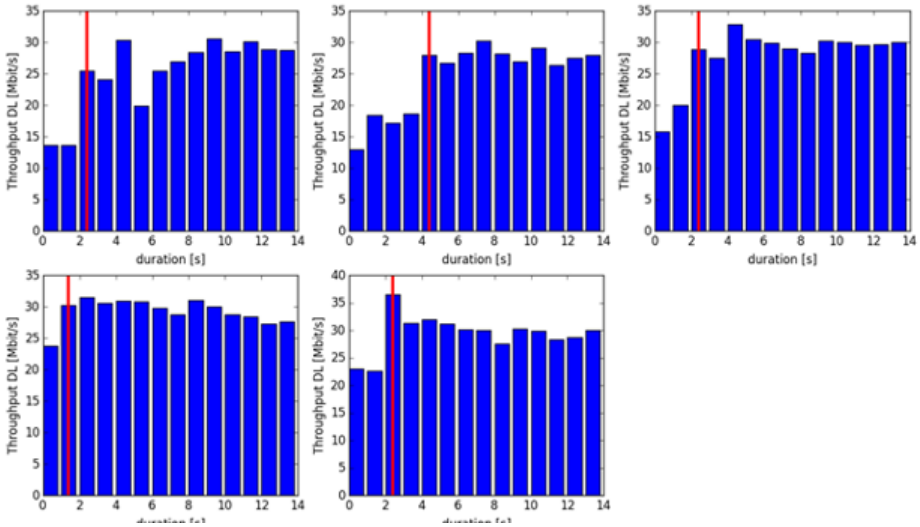


Figure 6-565: Ramp-up detection algorithm example

The algorithm in the example works as following:

- The moving average length "n" is defined to be 3.

- Every time a new 1 [s] interval throughput value t0 is reported, compare the value t -n with the average of the following n newer ones.

- If t -n > c * average(t0 - t -n-1), where c is a constant threshold (currently 0.95), then the end of the ramp-up is reached at t -n.

- If the condition cannot be met for the whole capacity peak, the ramp-up detection fails. Consequently, the throughput ramp-up is not finished during the capacity peak duration.

QP Ookla ®

The QualiPoc supports the Ookla ® test as a DQA job.

Upon the start, the App for Ookla ® job first looks for the best server. Then the job performs subtests in the following order:

1. Ping
2. Download
3. Upload

For more details and preconditions e.g. installing the App, see the "QualiPoc" manual.

QP Ookla ® job configuration

Select the job from the list of available QP jobs.

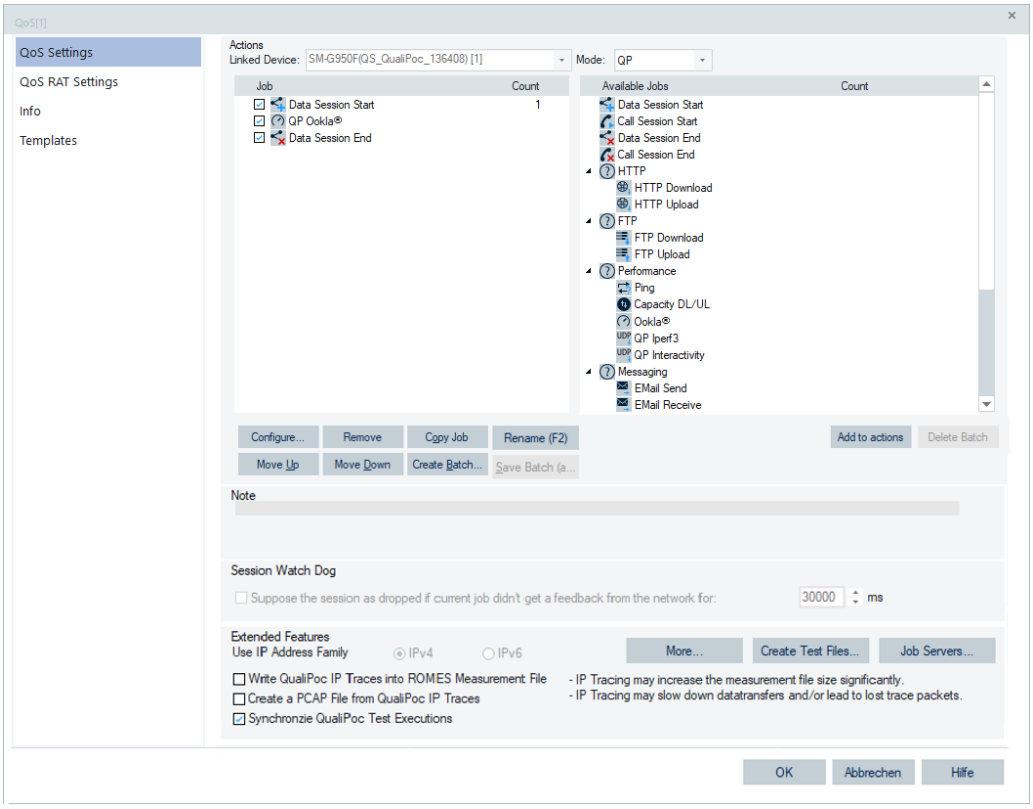


Figure 6-566: QP Ookla ® job selection

If this job is selected, the following configuration dialog appears.

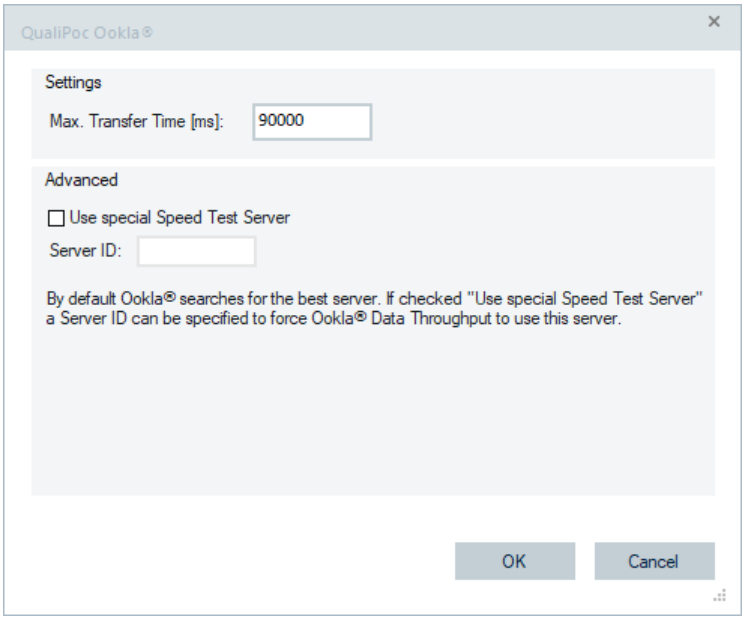


Figure 6-567: QP Ookla ® job configuration

The maximum transfer time (test duration) is configurable.

Click "Use special Speed Test Server" to use the speed test server with the defined server ID. Otherwise, Ookla ® searches for the best server.

A list of valid server IDs can be found at https://www.speedtestserver.com/.

The special Speedtest ® server is not available with QualiPoc 17.2.0.14 and the earlier versions. The defined server ID is ignored.

DQA QP Ookla ® job views

The following views are available for the R&S ROMES4 test:

- "Alphanumeric View"
- "DQA Message View"
- "DQA Progress View"
- "QoS Report View"

Alphanumeric view

The R&S ROMES4 "Alphanumeric View" supports configuration and display of the Ookla ® signals. The screenshot shows some Ookla ® speed test signals configured for display.

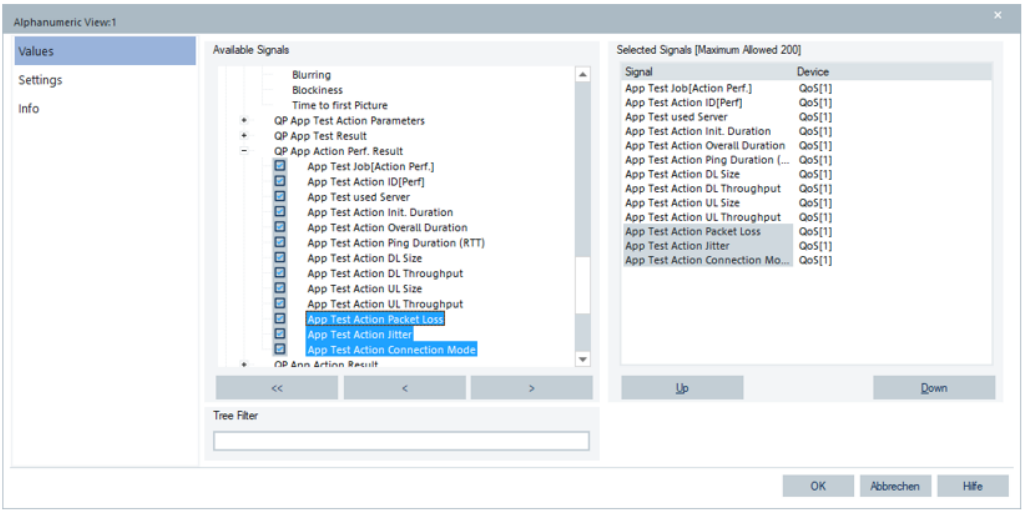


Figure 6-568: Selected Ookla ® signals in Alphanumeric view

DQA message view

The "DQA Message View" monitors all actions of the currently running job. The supported Ookla ® signals are shown in this view. In the following figure highlighted is the supported jitter signal.

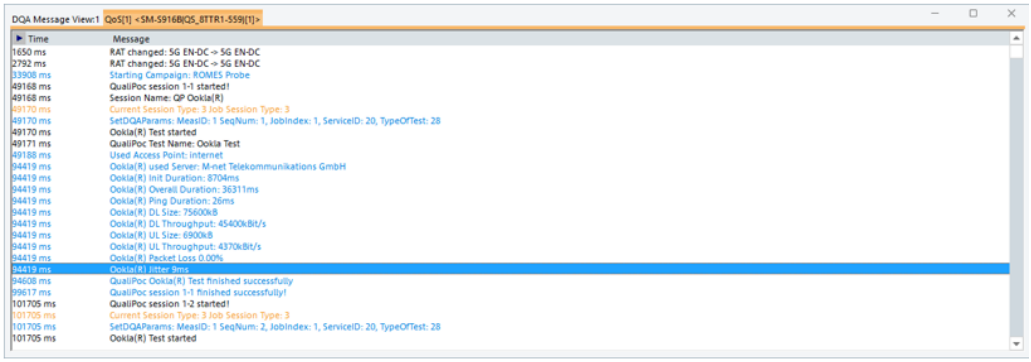


Figure 6-569: Ookla ® job DQA message view

DQA progress view

The "DQA Progress View" displays the current action id and the action name of the test. QP Ookla ® test has only one action, "Execute Test". No further information is available during the progress.

QoS report view

The "QoS Report View" displays the overall result of the QP Ookla ® test.

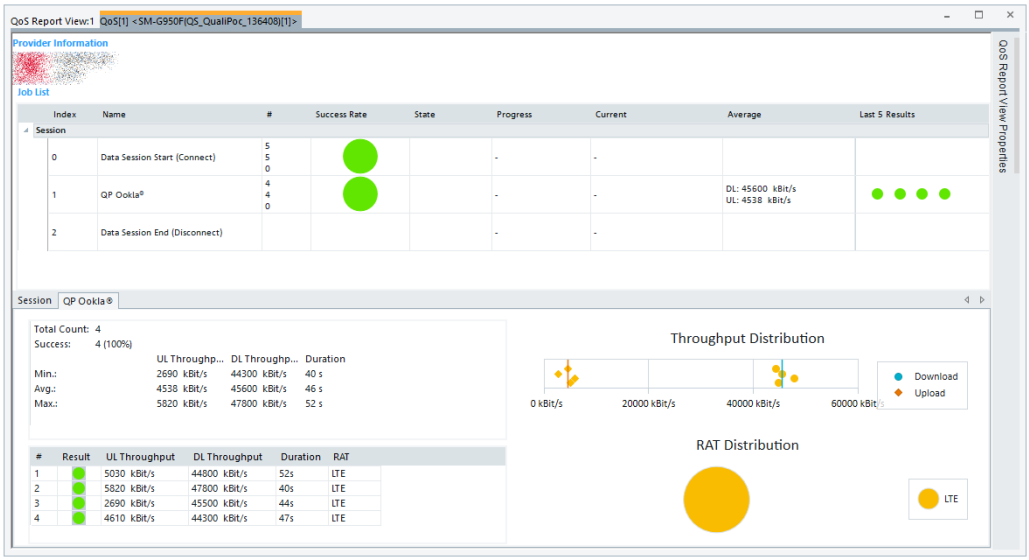


Figure 6-570: QP Ookla ® test QoS report view

KPI generator view

No KPIs are available for this test.

QP Ookla ® test signals

The signals are not named as Ookla ® because of other QualiPoc tests, like Facebook, which use these records and parameters as well. In the "Available Signals" or "Signal Tree" page, the Ookla ® signals are shown under the "QP App Test Result" and "QP App Action Pref. Result" branches. In the parameter "App Test Job", the job name Ookla ® is displayed.

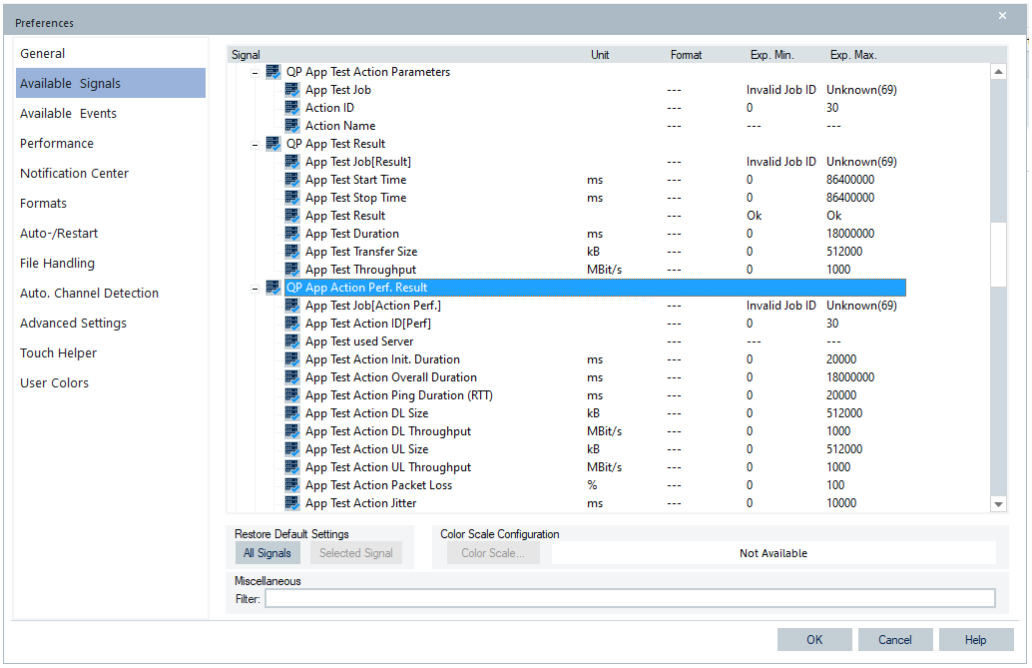


Figure 6-571: QP Ookla ® signals

For more details, see Tooltips in the "Signal Tree" or signals description in the "Description of R&S ROMES4 Signals" document.

QualiPoc Iperf3

A QualiPoc mobile must have the Iperf3 license to perform the QualiPoc (QP in further text) Iperf3 test job.

QP Iperf3 configuration

If the QP Iperf3 job has been selected, the configuration page is displayed.

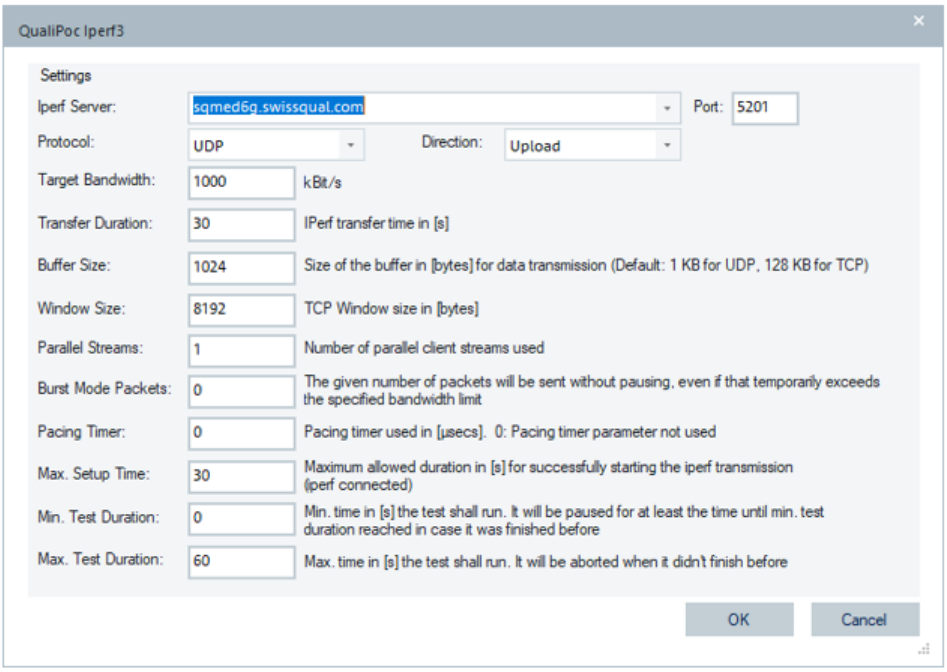


Figure 6-572: QP Iperf3 - configuration page

The meaning of the QualiPoc Iperf3 configurable parameters is given in the "QualiPoc Iperf3" > "Settings" pane. Configure the "Port" value according to a port the Iperf3 server is listened to. Download or Upload can be selected in "Direction". The protocols supported are UDP and TCP. The UDP buffer size is set to 1400 Bytes by default. This setting is preferred to avoid the packet fragmentation and provide the safety-margin, as the MTU size is 1500 Bytes in most IP networks.

QP Iperf3 test views

The following views are available for the QP Iperf3 test:

- "DQA Progress View"
- "QoS Report View"

DQA progress view

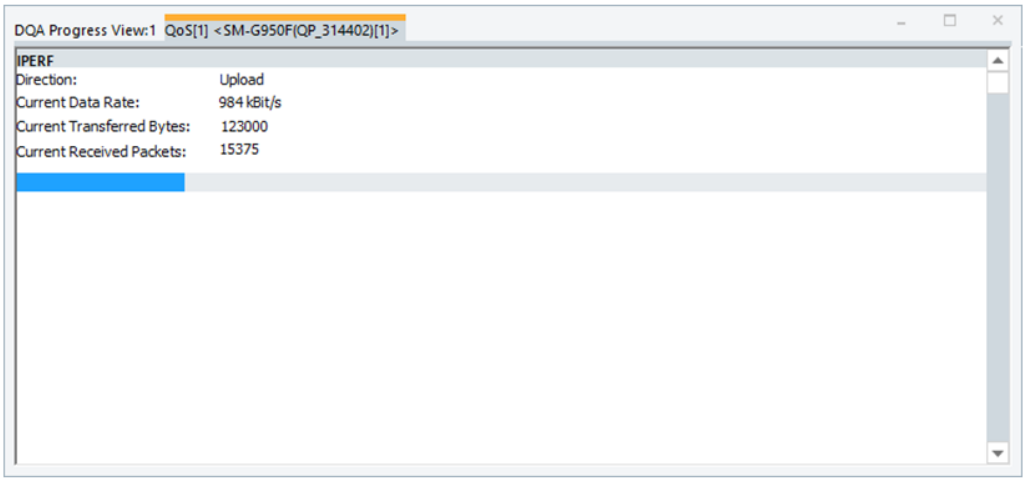


Figure 6-573: QP Iperf test progress view

The "Progress View" is not filled during a measurement because the data from QualiPoc come delayed after the test.

QoS report view

The "QoS Report View" shows the overall result.

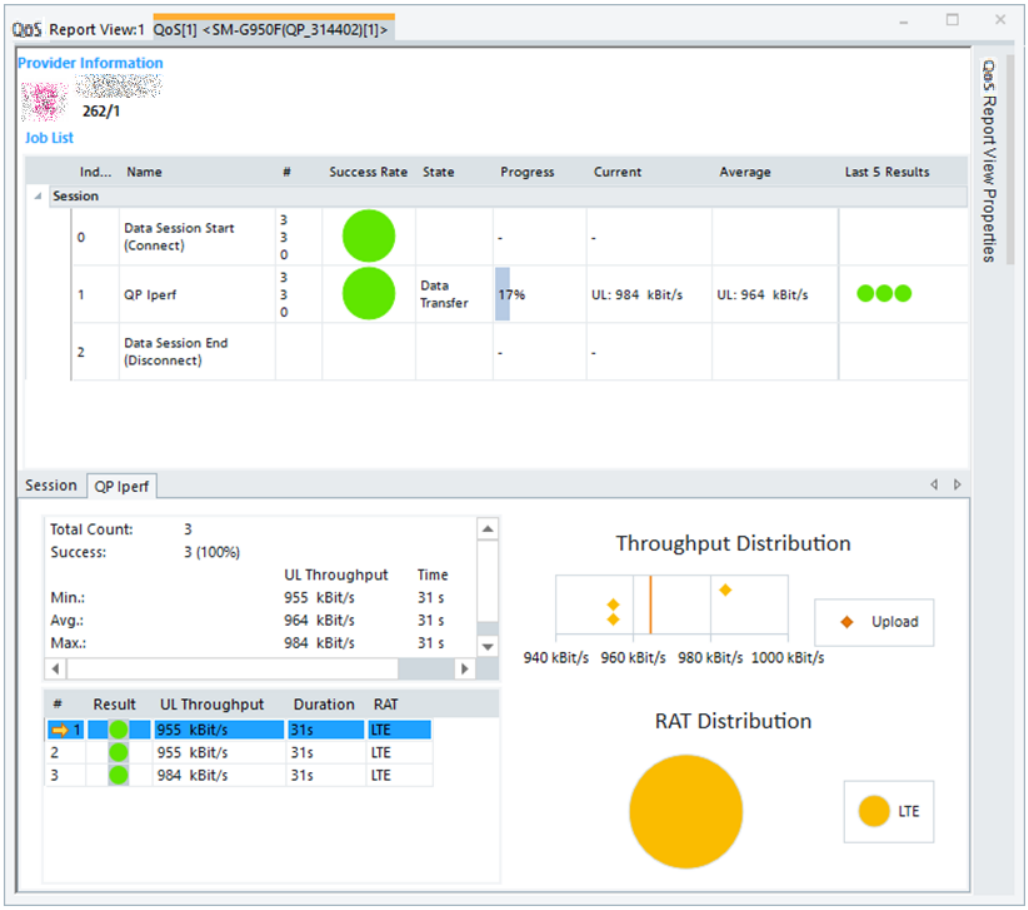


Figure 6-574: QoS report view of QP Iperf3 test

QP Iperf3 signals

The following figure shows the QP Iperf3 signals available for display in the "Basic Views".

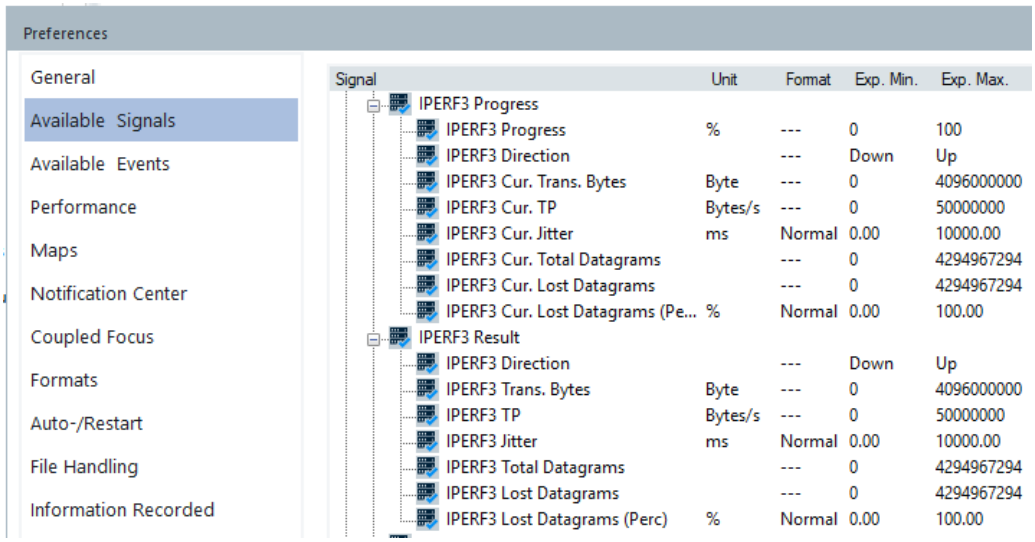


Figure 6-575: QP Iperf available signals

For the signal description, see "Description of R&S ROMES4 Signals" document.

QP interactivity test

This test is the QualiPoc UDP performance test based on technical measures that is 5G ready, targeting uRLLC scenarios. It is a single-sided QoS test between one UE and a server instance.

QP interactivity test configuration

The QualiPoc Interactivity job requires the QualiPoc license for the configuration. Select the "QP Interactivity" in the "Available Jobs" > "Performance" group.

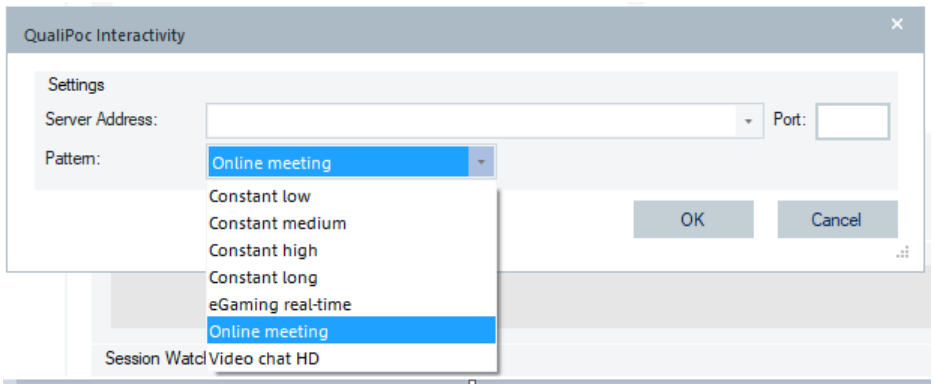


Figure 6-576: QP Interactivity - configuration page

In the "Settings" pane you can configure the following parameters of the QP Interactivity test job:

- "Server Address" - destination address of the TWAMP server the application connects to.
- "Port"- destination port for TWAMP control connection.

- "Pattern" - predefined configuration set for the test.

Table 6-24: Parameters of the traffic patterns of predefined configuration set

Pattern	Constant low	Constant medium	Constant high	Constant long	eGaming real time	Online meeting (<23.0)	Online meeting (>=23.0)	Video chat HD
Parameters	Parameter values of the patterns							
Packet per second	125	200	1300	150	125/375/1250	62/250	62/248	62/125
Traffic shape	Constant low rate	Constant medium rate	Constant high rate	Constant low rate over longer time	Bursty	Bursty	Bursty	Changing
Packet size UL[Bytes]	100	650	1450	250	100	1000	1008/252	1000
Packet size DL[Bytes]	100	650	1450	250	100	1000	1008/252	1000
Resulting target bandwidth UL[Mbit/s]	0.1	1	15	0.3	0.1/0.3/1	0.5/2	0.5/2	0.5/1
Resulting target bandwidth DL[Mbit/s]	0.1	1	15	0.3	0.1/0.3/1	0.5/2	0.5/2	0.5/1
Packet delay budget [ms]	< R23.0: 500 >= R23.0: 2000	< R23.0: 500 >= R23.0: 2000	< R23.0: 500 >= R23.0: 2000	2000	100	300	300	300
Test duration [s]	2	2	2	30	10	10	10	10
Max. packet error rate [%]	2	2	2	2	0.2	0.2	0.2	0.2
Traffic shape (1 s step, l-low, m-medium, h-high, u-ultrahigh)					l m h mmmm lll	ll h llll h ll	DL: ll lllll H ll UL: ll h llll l ll	ll hhhhhhhh

Pattern	Constant low	Constant medium	Constant high	Constant long	eGaming real time	Online meeting (<23.0)	Online meeting (>=23.0)	Video chat HD
Interactivity score (3GPP 5QI value)	no	no	no	no	Real-time Gaming (5QI = 3)	Conversational video (5QI = 2)	Conversational video (5QI = 2)	Conversational video (5QI = 2)
Comment						Symmetrical	Symmetrical	

Support of asymmetric traffic patterns

Some interactivity applications show different data flows in up- and down-link. In general, there is much less data transported in uplink than in downlink. R&S ROMES4 offers more realistic applications' target patterns in the interactivity test. These target patterns are even available for the applications based on highly asymmetric traffic, for example, cloud-gaming.

The following table shows the configuration parameters available for the asymmetric traffic patterns.

Table 6-25: Parameters of the asymmetric traffic patterns

Pattern	Constant DL dominant	Stepwise DL dominant	Constant UL dominant	VR/Cloud- gaming HD	I4.0 Process automotion
Parameters	Parameter values of the upper patterns				
Traffic shape	Constant high DL, low UL	High DL, low UL changing stepwise with constant relation	Constant high UL, low DL	Changing DL dominant	Constant low rate
Packets per second	1400	l:134/ m:672/:2688	1040	60	625
Packet size UL[Bytes]	120	93	1200	520	100
Packet size DL[Bytes]	1200	1400	120	l:5460/h:10920	100
Resulting target bandwidth UL [Mbit/s]	1	l:0.1/m:0.5/h:2	10	0.25	0.5
Resulting target bandwidth DL [Mbit/s]	10	l:1.5/m:7.5/h:30	1	l:2.5/h:5	0.5
Packed delay budget [ms]	2000	2000	2000	100	20
Test duration [s]	10	10	10	10	30
Max packet error rate [%]	2	2	2	0.2	0.02

Pattern	Constant DL dominant	Stepwise DL dominant	Constant UL dominant	VR/Cloud- gaming HD	I4.0 Process automotion
Traffic shape (1 s step, l-low, m-medium, h-high, u-ultra-high)		ll mm hh mm ll		DL: ll hhhhhh ll UL: iiiiiiiiiii	
Interactivity score (3GPP 5QI value)	no	no	no	Real-time gaming (5QI = 3)	Discrete automotion (5QI = 82)
Comment	1:10	1:15	10:1	- Based on real traffic captures of Google stadia - Emulates a FullHD @60fps video streaming - One TWAMP DL packet has size of 3 to 8 MTUs	Input of real traffic captures pending

In Classic mode 2 patterns listed in both tables are available.

The asymmetric traffic patterns are only available in the QualiPoc mode with the QualiPoc option Interactivity- PatternPackage_1 or in the Classic mode 2.

The parameters introduced with the R&S ROMES4 support of asymmetric traffic patterns during the interactivity tests are included as signals in the "Signal Tree" > "QoS Tester" branch.

For the signals description, see the "Description of the R&S ROMES4 signals" document, or hover with mouse over a signal in "QoS Tester" > "QP Interactivity Progress"/"QP Interactivity Result".

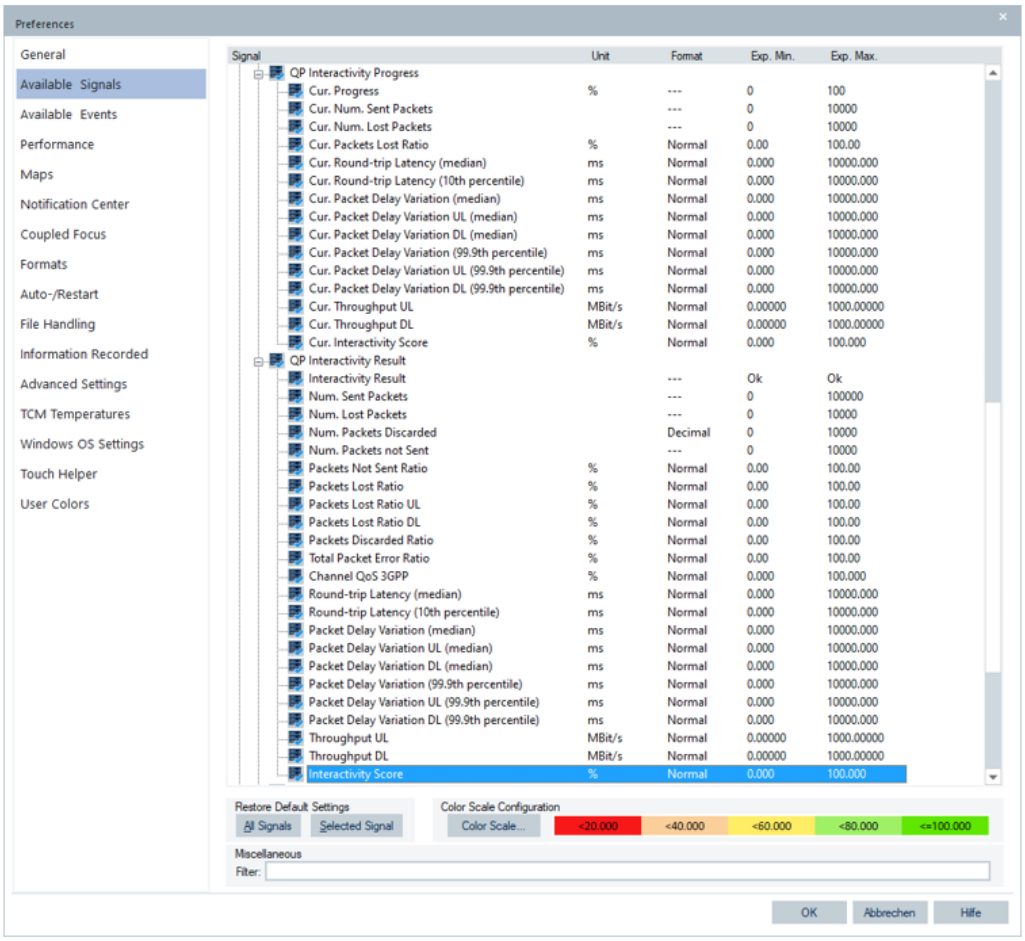


Figure 6-577: Available signals of QP interactivity test

The Pattern parameters are shown in the "DQA Message View" at the start of the test. The "Number of Packets" value in the view is calculated as packets/s x test duration.

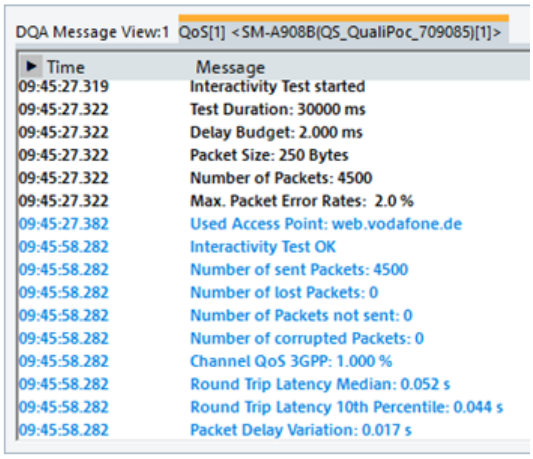


Figure 6-578: QP Interactivity test - message view

QP interactivity views

The following views are available for the QP Interactivity test:

- "DQA Progress View"
- "QoS Report View"
- "Interactivity Test Summary View"

The "DQA Progress View" and "Interactivity Test Summary View" are available for interactivity tests of supported asymmetric traffic applications.

KPIs are not supported for the test.

DQA progress view

The "Progress View" shows the current result of the test. The signals for the parameters of the current progress shown in this view are available in the "Signal Tree" > "DQA Tester", under the "DQA Interactivity Progress" branch. For the signals description, see "Description of the R&S ROMES4 Signals" document.

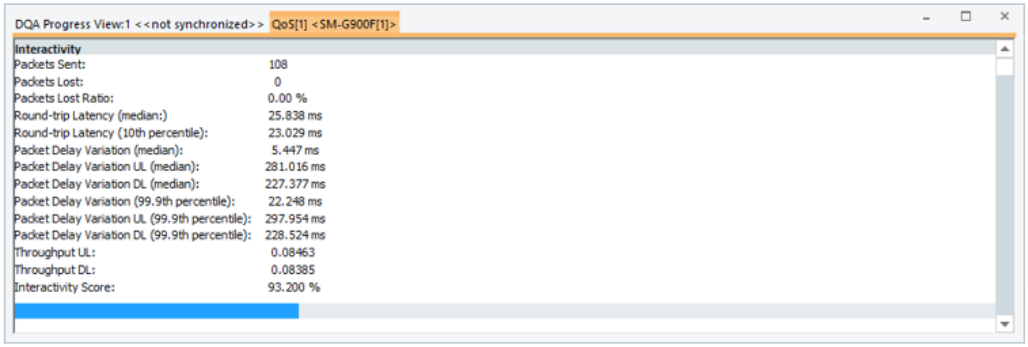


Figure 6-579: DQA progress view of a QP interactivity test

The view is only available during replay because all intermediate results are delivered at the end of the test.

QoS report view

The "QoS Report View" displays the Interactivity score.

When displaying the results of the Interactivity Test job, the view has two additional columns in the "Result" table, containing measured results of the latency and packet delay that is:

- RTT (median): Round-Trip Latency (median)
- PDV (median): Packet Delay Variation (median)

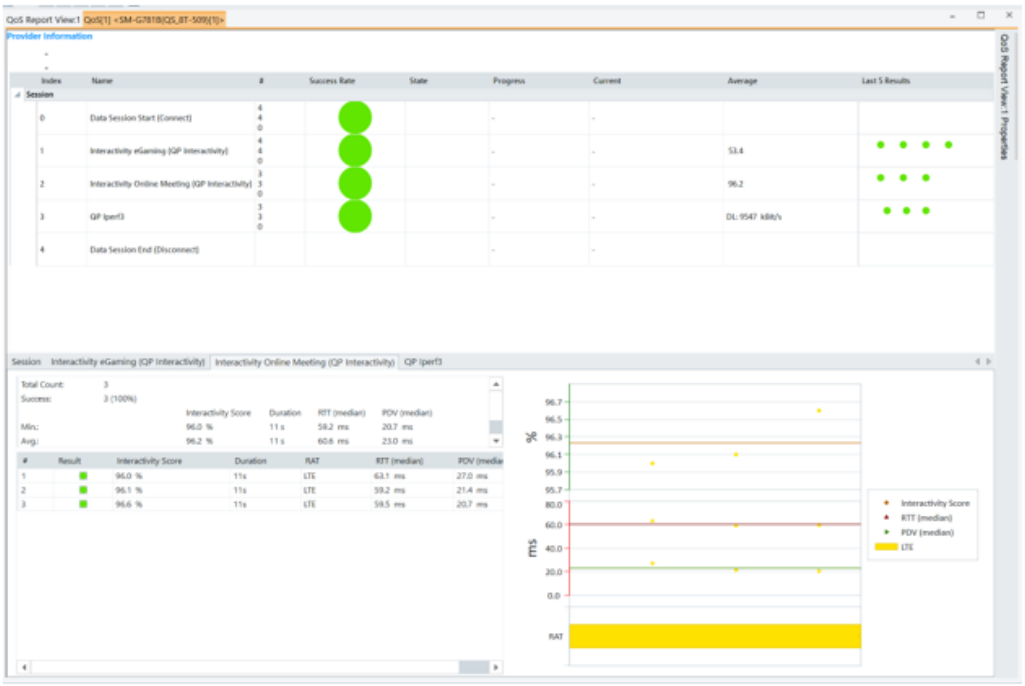


Figure 6-580: QoS report view of interactivity test

The signals for the parameters of the interactivity score shown in this view are available in the "Signal Tree" > "DQA Tester", under the "DQA Interactivity Progress" and "DQA Interactivity Result" branches.

For the signals description, see "Description of the R&S ROMES4 Signals" document.

QP traceroute

The QualiPoc Traceroute job is only available for SQ fully integrated devices.

The Traceroute is also known as a Windows or Linux test tool. It tests the route from the network device to the destination. On its way, the route hops over several router and switches. The time to leave (TTL) counter of the data packet (probe) is decremented on every node. Each targeting node can send back this data. The traceroute measures also the sending and receiving time (round-trip time, RTT). The more nodes or slow networks and slow hardware extent the RTT. As a result, the route is detected, how many hops are needed and its RTT is measured.

The QP Traceroute test performs one time the measurement, which is, detecting the route and the round-trip time from the QualiPoc mobile device to each network node.

QP traceroute configuration

The following screenshot shows the QP Traceroute configuration page.

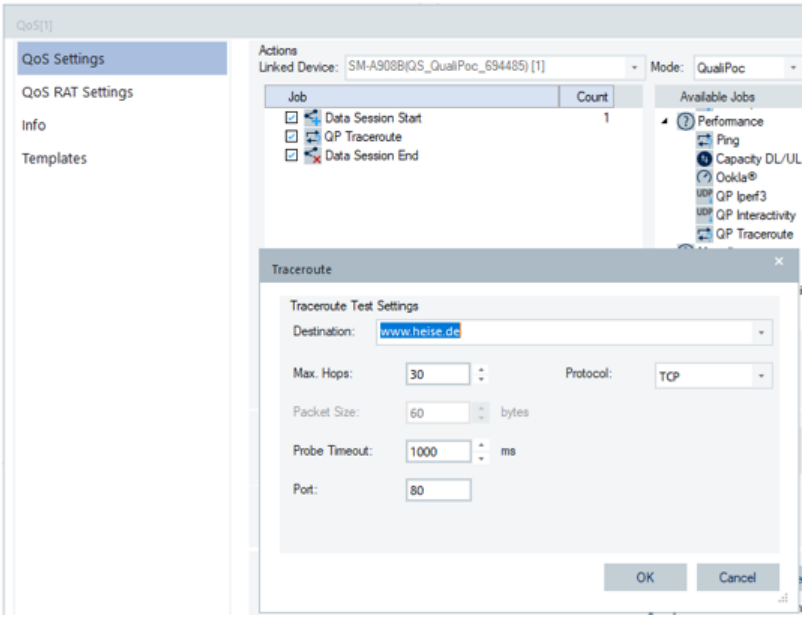


Figure 6-581: QP Traceroute - configuration page

Configure the following parameter:

- "Destination" - destination or IP address has to be here defined
- "Max. Hops" - specifying the maximal number of hops helps to limit the searching range. If the destination is valid and reachable, the search ends when the destination is reached. If the destination is temporally not available, the test stops searching after reaching the "Max. Hops" value.
- "Protocol" - several protocols are selectable, TCP, UDP and ICMP.
- "Packet Size" - the packet size to be set. For TCP, the size is fixed to 60 [bytes].
- "Probe Timeout" - the parameter specifies how long the measurement waits until it assumes no responding and proceeds testing the next network node. The function is needed as there are some network nodes configured not to answer to probe packets.
- "Port" - the network port which is used to send out the probe. Some ports are predefined and used for certain network services and protocols, for example, port 80, port 8080.

The previous screenshot shows the Traceroute test for the route www.heise.de configured with max. 30 hops. The TPC protocol on port 80 is used. Whenever the network node does not respond, the test proceeds to next node after 1 s.

QP traceroute supported views

Supported are the following views for QP Traceroute test:

- "DQA Message View"
- "DQA Progress View"
- "QOS Report View"

DQA message view

The information, warnings and errors are shown in this view.

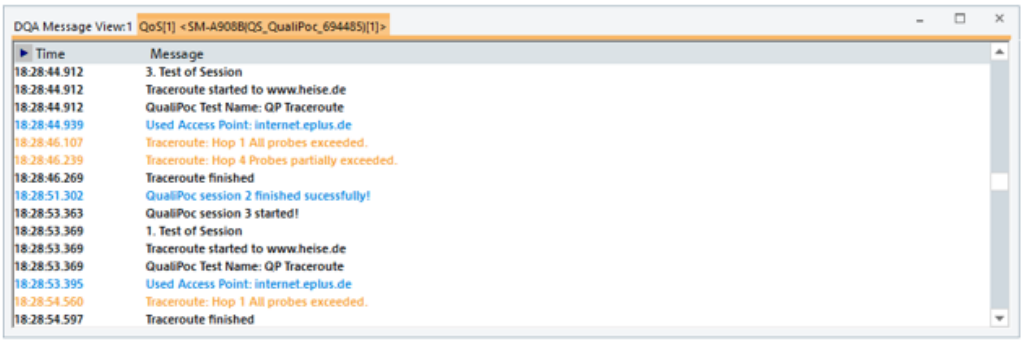


Figure 6-582: QP Traceroute test result

During a QP Traceroute measurement, the "Progress View" shows in the upper part the configured parameters.

The lower part informs you about the route to the destination. If a node does not answer within the probe timeout, no address is reported and the RTT shows an asterisk. To each node are sent 10 probes. A Min./Max./Average RTT is shown for 10 or less responses.

The following screenshot shows the Traceroute test of the www.heise.de route reached in 11 hops. The node on first hop did not answer in configured time.

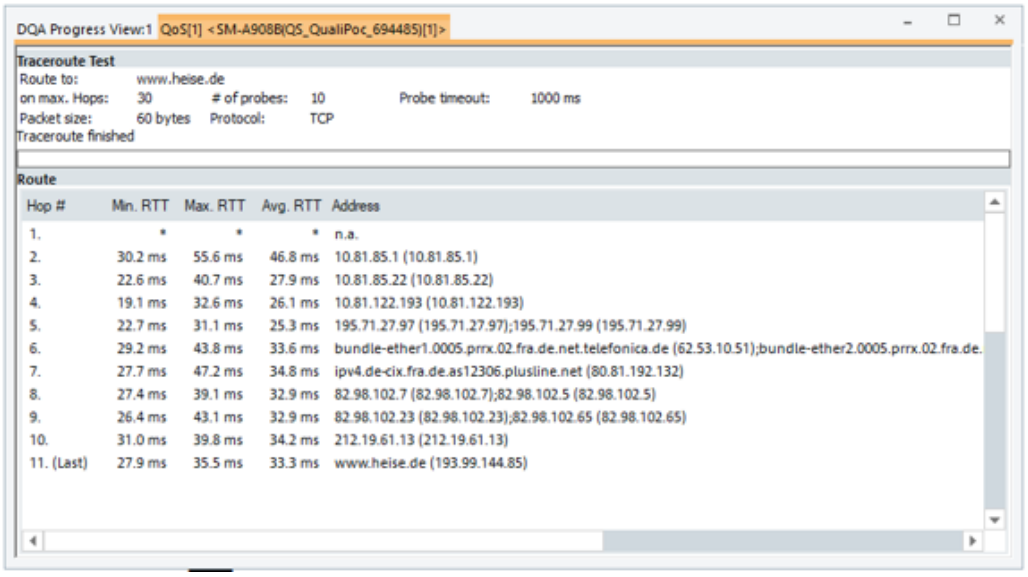


Figure 6-583: Progress view of www.heise.de route test

In the following example (port 8080) there are 14 hops on the route to www.heise.de but the last server did not answer. The nodes on first hop and on hops 10,11,12,13 did not answer in time.

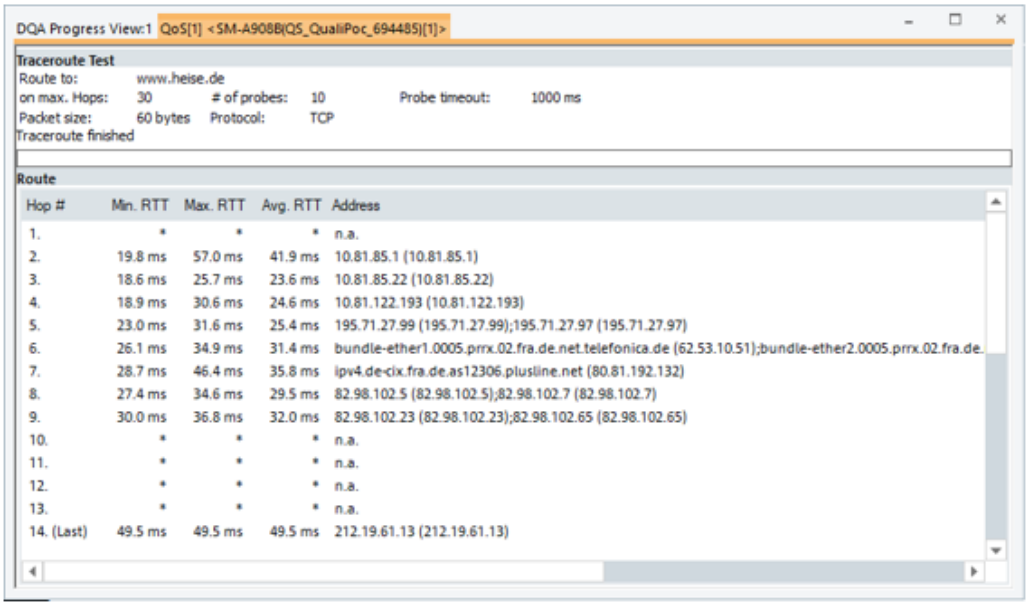


Figure 6-584: Progress view of www.heise.de route test - other route

QoS report view

In the "Report View" the average round-trip time and the duration results are shown.

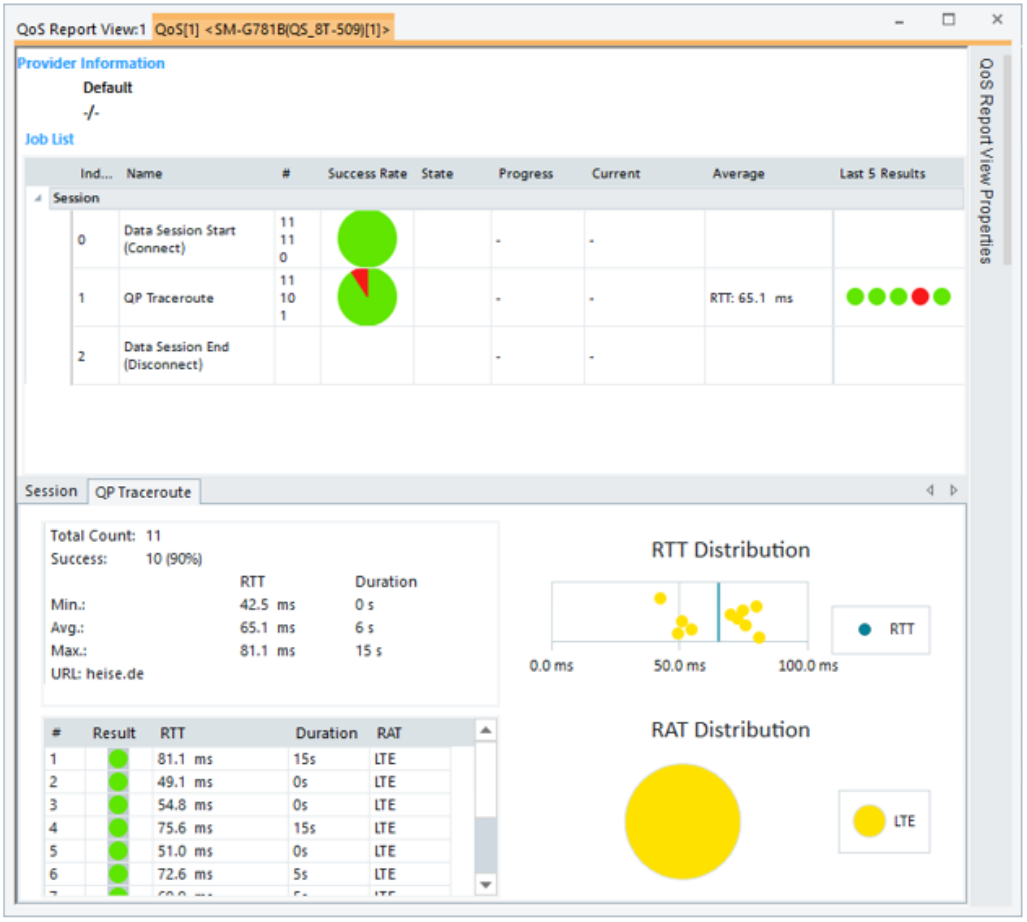


Figure 6-585: QOS Report View of QP Traceroute test

QP traceroute signals

The available QP Traceroute test signals are introduced under the "QoS Tester" branch of the "Signal Tree". For each actual hop, signals are shown. For the signals description, see the "Description of R&S ROMES4 Signals" document.

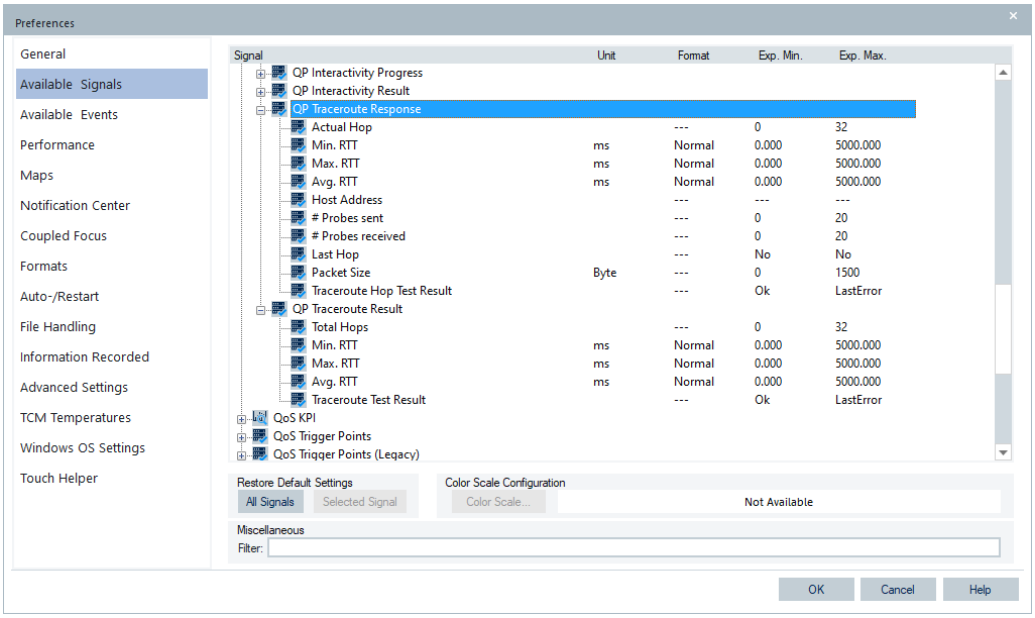


Figure 6-586: QP Traceroute signals

The signals can be shown in the "Basic Views", for example in the "Alphanumeric View," as shown in the following screenshot and can be used for export.

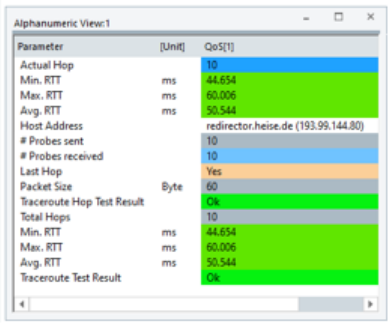


Figure 6-587: Alphanumeric view of the QP Traceroute signals

6.5.2.9 Miscellaneous

Wait

The Wait job of a fully integrated device lets you configure pauses between execution of other QP jobs.

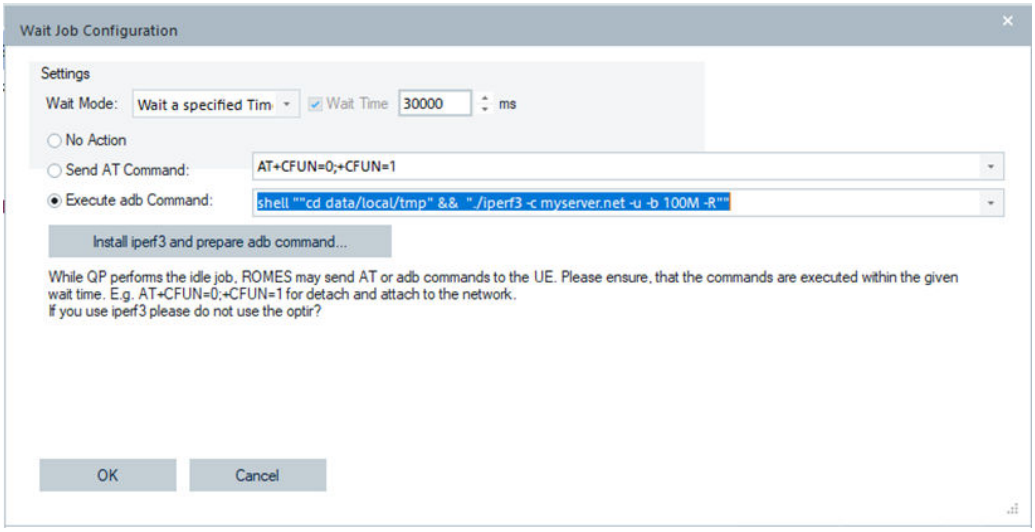


Figure 6-588: Wait job of fully integrated device - configuration

Wait job configuration

To open the configuration page, press "Configure" after selecting the Wait job in the "Action" > "Job" list.

The configuration page lets you configure the following parameters.

- "Wait Mode"
  Three wait modes are available:
  - "Wait a specified Time"
  - "Wait for an Event"
  - "Wait for Signals"
- "Wait time"
  Time QualiPoc waits until the next job in the lists is executed if the first mentioned wait mode is selected.
- "Send AT Command"/"Execute adb Command"
  The R&S ROMES4 implementation allows you to configure AT or ADB commands which can be executed while QualiPoc is waiting. If one of these options is activated, important is that the configured wait time is longer than the expected maximal duration of the AT or ADB command.

The ADB command can be used, for example, to run some Iperf3 tests. R&S ROMES4 offers to install Iperf3 on the UE and prepare the wait job accordingly.

Exchange the iperf server to your needs.

YouTube streaming

If a device is used as fully integrated, the DQA job "Youtube Streaming" is available in the DQA job list.

Install the YouTube version 11.27.53.130 on the smartphone. Install the version manually.

A note is displayed on the DQA YouTube job configuration pane indicating the version request and manual installation on the phone.

YouTube streaming job configuration

To open the configuration page, press "Configure" after selecting the "Youtube Streaming" job in the "Action" > "Job" list. The screenshot displays the configuration page.

If the QualiPoc option YouTube 4K is available on the fully integrated device, it is possible to make test with YouTube UHD (4k) videos.

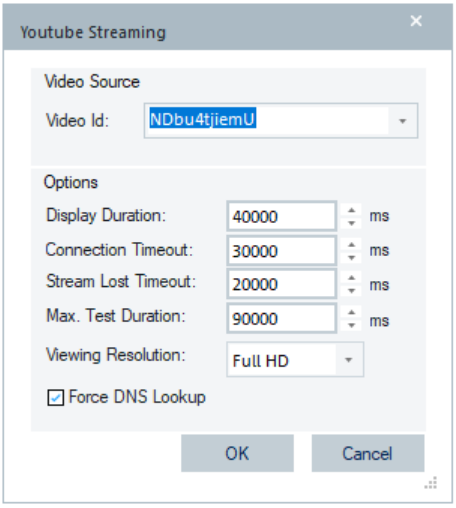


Figure 6-589: YouTube Streaming page

Select the "Video Id" in the "Video Source" pane.

The following parameters can be configured in the "Options" pane, although they are adapted to the QualiPoc rules by default:

- "Display Duration" - duration of the video display, by default [40 s]
- "Connection Timeout" - time after which the job fails because not yet connected, by default [30 s]
- "Stream Lost Timeout" - time for the job to fail, after the last stream input, by default [20 s]
- "Max. Test Duration" - max. time for the job execution, by default [90 s]
- "Viewing Resolution" - dependent on license availability, select full HD or UHD (4k) resolution
- "Force DNS Lookup" - If checked, activates the function to clean the DNS cache before the YouTube job test starts. It is active by default. The function checks the status of DNS records or troubleshoot issues with accessing a service, providing the reliable DNS cache control.

The YouTube job tests always calculate the MOS values.

The YouTube `*.apk` files and the related Playservice `*.apk` files are located in the ROMES application folder, see the following figure.

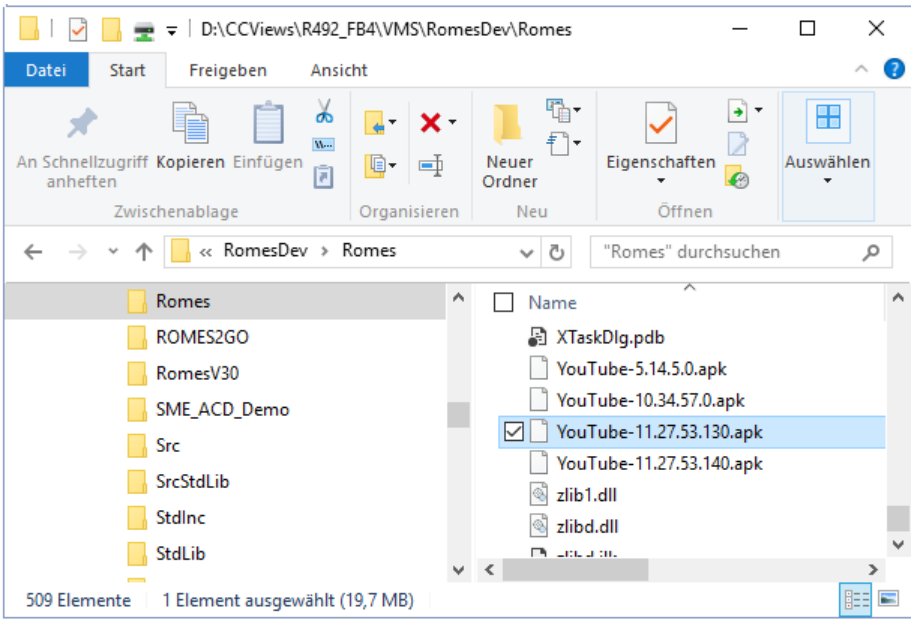


Figure 6-590: Location of the YouTube files

The required YouTube `*.apk` and all Playservices `*.apk` files must be copied to the device storage of the smartphone. For the transfer of files to the smartphone, the phone must be in MTP mode.

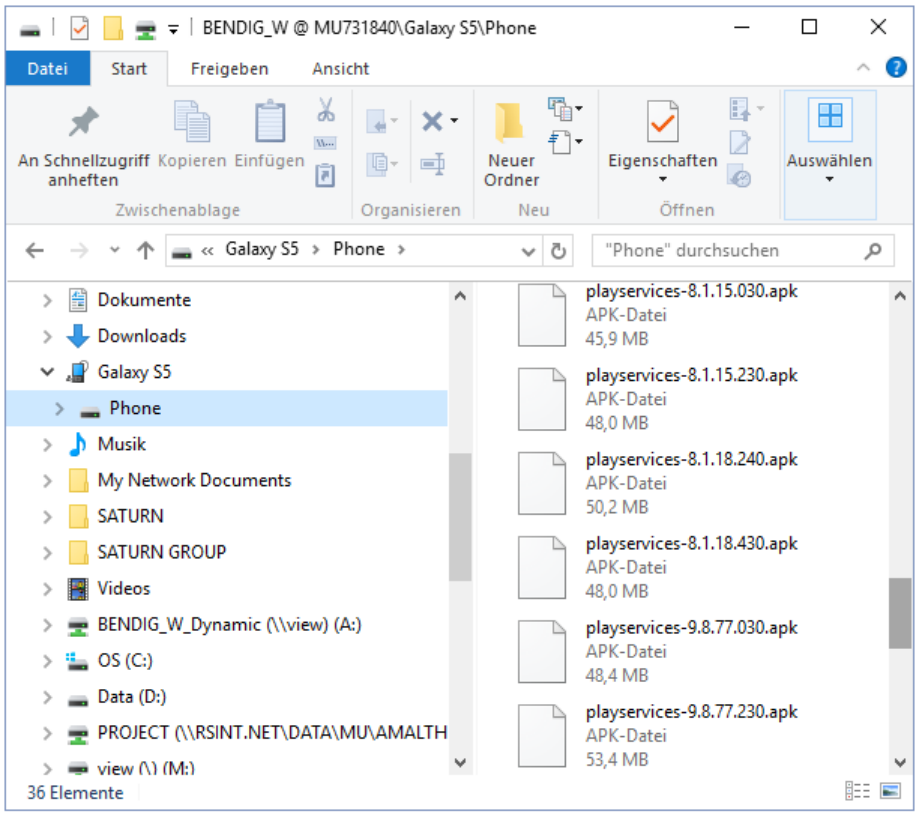


Figure 6-591: Youtube files copied in smartphone

To install the YouTube version 11.27.53.130:

1. Copy the YouTube `*.apk` and all Playservices `*.apk` files to the device storage of the smartphone
2. Select the `Youtube-11.27.53.130.apk`.
3. Run the file.

   The version is installed.

If the installation fails, install `YouTube-10.34.57.0.apk` first and then `Youtube-11.27.53.130.apk`.

YouTube streaming test views

The following views are available for the YouTube Streaming test:

- "DQA Message View"
- "DQA Progress View"
- "QoS Report View"

DQA progress view

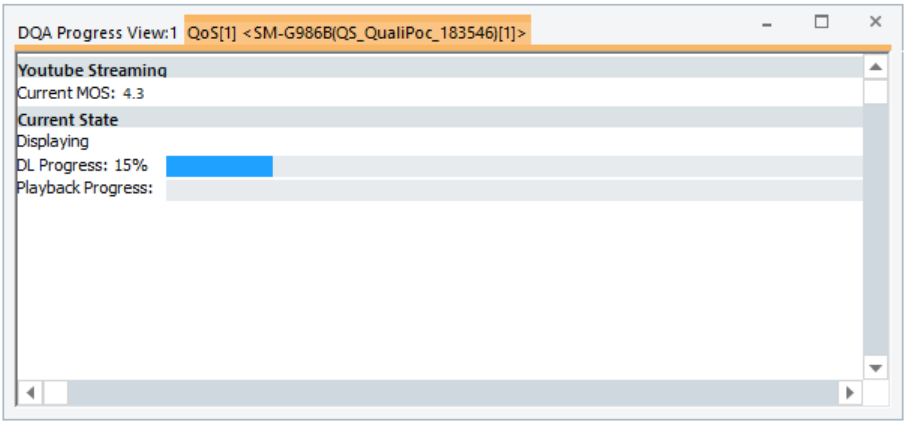


Figure 6-592: Youtube Streaming DQA progress view

The "DQA Progress View" of a YouTube Streaming job displays:

- "Current MOS"
  The current MOS value of the streamed video
- "Current State"
  The current progress of the streamed video in relation to the whole movie duration

QoS report view

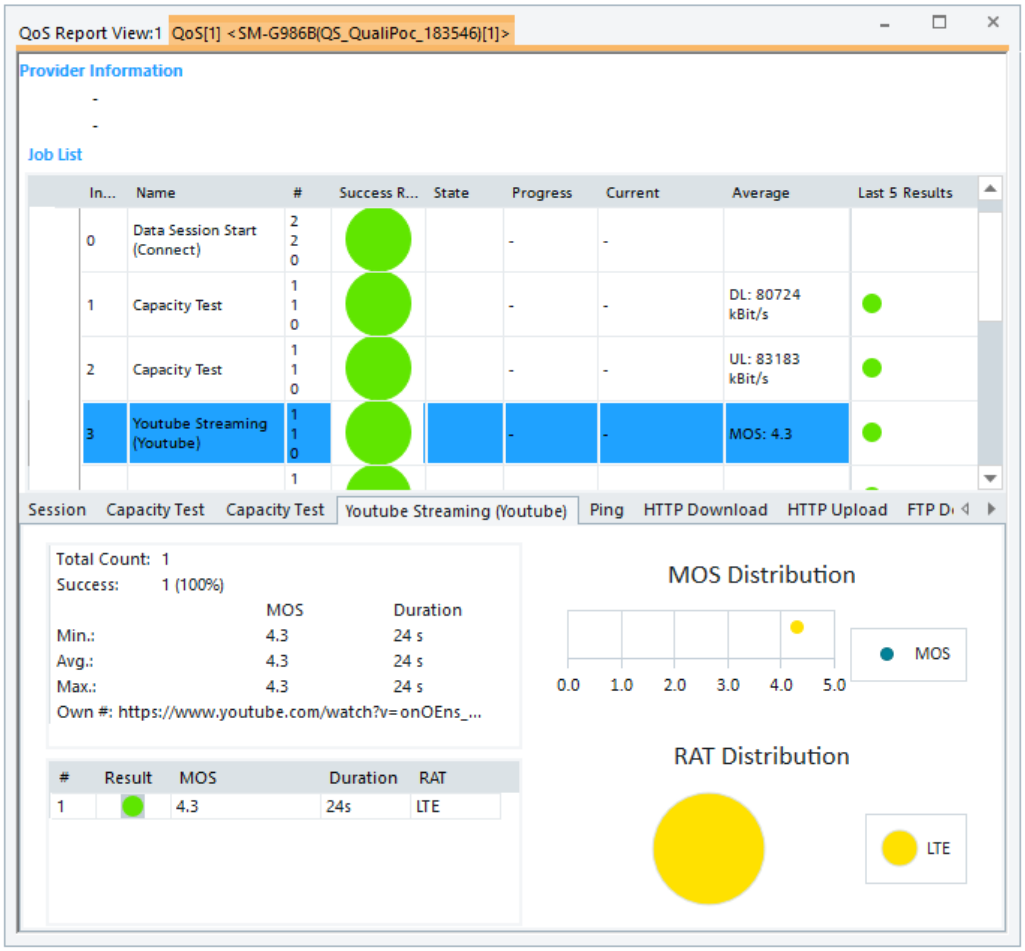


Figure 6-593: Youtube Streaming QoS report view

The "QoS Report View" displays:

- "Min./Max./Avg MOS"
  Minimum / maximum and average MOS over all jobs

YouTube streaming job KPIs

There are no trigger points and KPIs available.

YouTube streaming job available signals

The YouTube Streaming job test provides values of the signals in the "Youtube Progress Info" and "Youtube Result" group of signals.

The available signals for the YouTube test job are shown in the following screenshot.

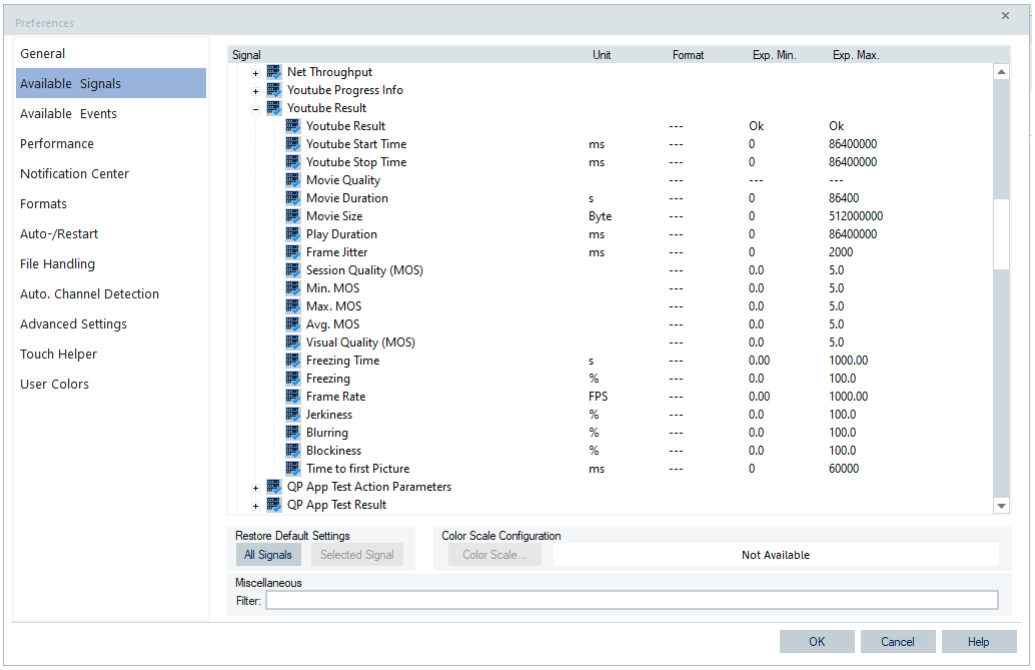


Figure 6-594: Youtube Progress/Results Info signals

For detailed description of the signals in these two groups, refer to "Description of R&S ROMES4 Signals" document, the "QoS Tester" chapter.

6.5.2.10 App test

QP Facebook

Smartphones with SQ interface and fully integrated devices support DQA Facebook job.

Prerequisite

A Facebook test requires an App ID and the access token, which you can obtain when you create a Facebook App.

Therefore, before you can create and run a SwissQual Facebook test, create a Facebook App. Consider the note about the App ID and the access token for the app.

This process involves the following steps:

1. Create a regular Facebook account.
2. Create a Facebook developer's account.

Creation of Facebook app and account

To create Facebook:

Open a browser, go to https://www.facebook.com and then click "App Console".

To create account:

1. Enter the account information in the sign-up form.

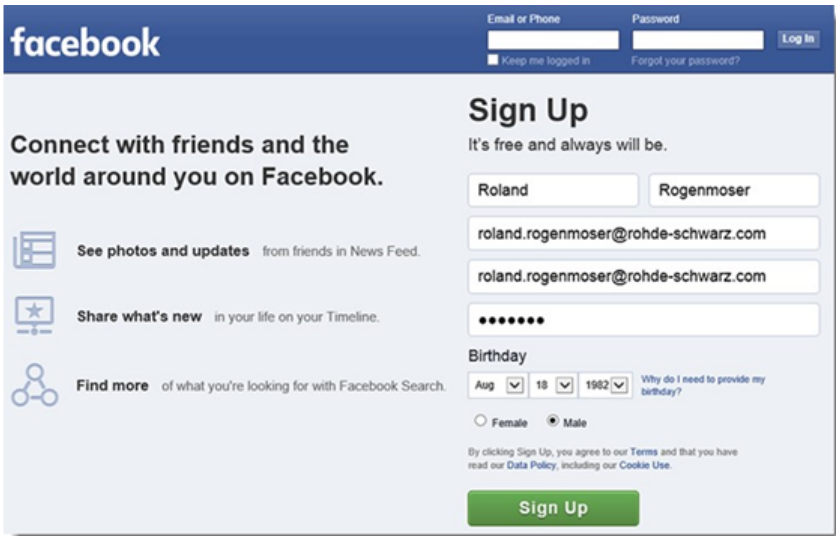


Figure 6-595: Facebook sign up page

2. Click "Sign Up".
   If you do not see the form, click the "Sign Up" button at the bottom of the page.
3. On the "Find your friends" page, click "Next".
4. Log in to the e-mail account that you provided on the sign-up form.
5. Open the confirmation message from Facebook.
6. Click the link.

   The account is created.

Registration as a Facebook developer

1. Go to https://developers.facebook.com in your browser.
2. Click "Register" at the top right of the page.
3. Click "Yes" in the dialog box to accept the registration terms.
4. Click "Next".
5. Enter your phone number in the "Register as a Facebook Developer" dialog.
6. Click "Send as Text".
7. Type the confirmation code that you received on your phone.

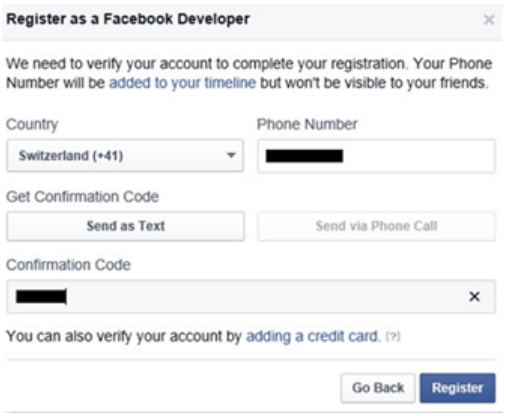


Figure 6-596: Registration as a developer

8. Click "Register" to end the procedure.

   You are registered as a Facebook developer.

Creation of an app for Facebook test

1. Click "My Apps".
2. Click "Add a New App".

   The "Add a New App" page pops-up.
3. On the "Add a New App" page, click "Basic setup".

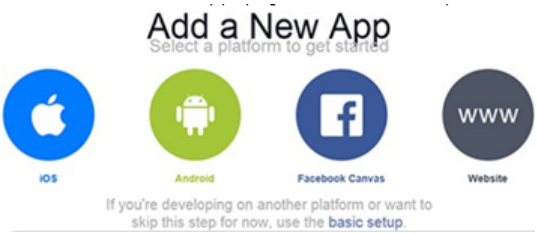


Figure 6-597: Adding new App

4. Enter a name for the App in "Display Name", for example, SQ.

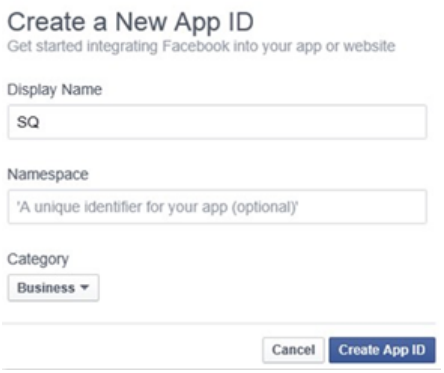


Figure 6-598: Creation of App ID

5. Select the App category in "Category".
6. Click "Create App ID"
7. Perform the "Security Check".
8. Click "Submit" to complete the App ID creation.
9. Copy your App ID from the "Dashboard" to a text file for your records. You need this ID when you configure a Facebook test.

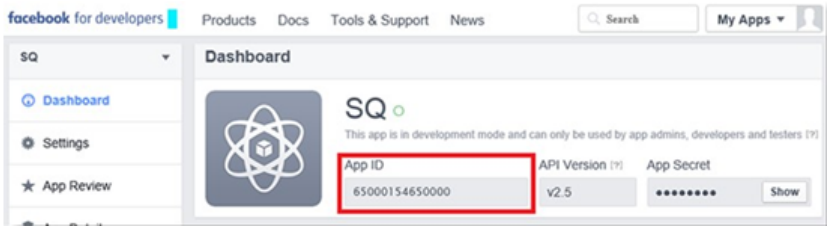


Figure 6-599: Created App ID on dashboard

Obtaining Facebook access token

To get the Face access token:

1. At the top of the page, click "Tools & Support".
2. Click "Access Token Tool".
3. Locate your App.
4. Copy the "App Token" to a text file for your record.
5. Click "Submit"

You need this token when you configure a Facebook test.

App ID and Facebook access settings in QualiPoc settings

1. Open QualiPoc in "Handheld Mode".
2. Open "Settings".
3. Open "Apps".
4. Change the entries for Facebook access token and the App ID.

QP Facebook job configuration

1. Select the QP Facebook job from the "Available Jobs" list, see Figure 6-516.
2. Double-click the selection.

   The "QualiPoc Facebook" page opens.

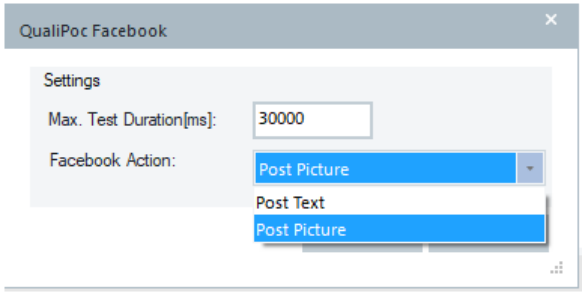


Figure 6-600: QualiPoc Facebook configuration page

3. Define the maximum test duration, default is 30000 ms.
4. Select an action from the "Facebook Actions" drop-down box.

   The selected Facebook test job is placed in the "Actions"> "Job" list of the "QoS Settings" configuration page.

It is not possible to create multiple Facebook actions in one test. Create the actions separately in a session.

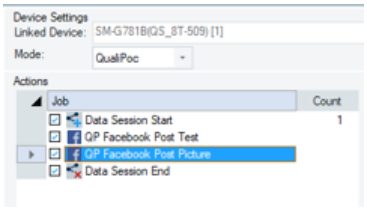


Figure 6-601: Separate QualiPoc Facebook actions

Pause about 5 minutes before performing the Facebook test to avoid wrong recognition of R&S ROMES4/QualiPoc by the Facebook server.

To configure the pause, define the wait time in the QualiPoc "Settings" > "Wait Time after DQA Data Job".

The wrong recognition can be avoided also if you define other tests after the Facebook test which runs a couple of minutes.

DQA QP Facebook test views

The following views are available for the QP Facebook test:

- "DQA Progress View"
- "QoS Report View"
- "Alphanumeric View"

DQA progress view

The "DQA Progress View" is the same as for the Ookla ® test.

The "Current Throughput" and "Already Transferred" values are always reported as 0 values from the QualiPoc application.

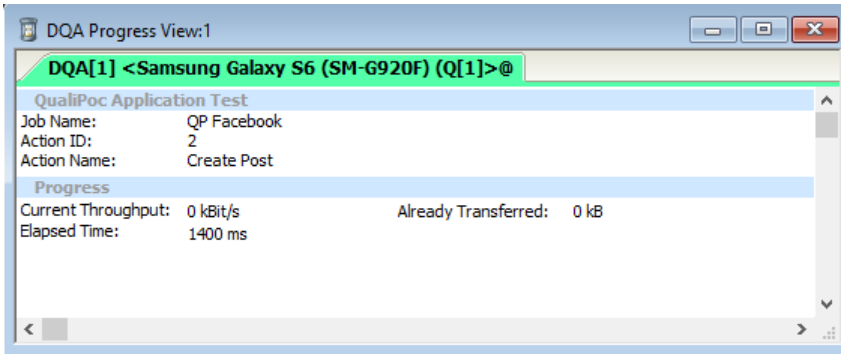


Figure 6-602: QP Facebook job DQA progress view

QoS report view

The view reports the "Min" /"Max" /"Avg" values of the Facebook test duration.

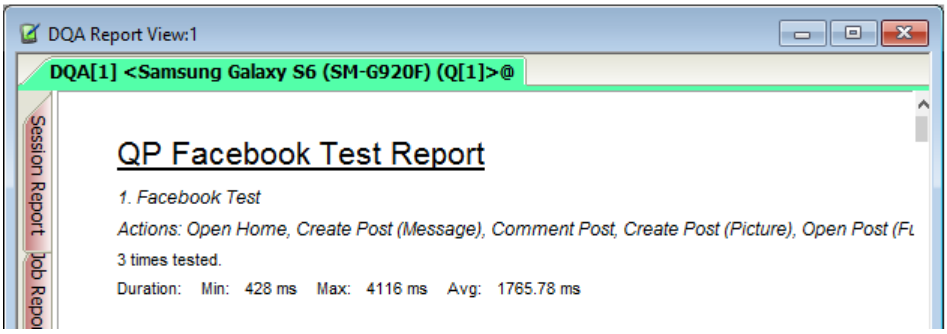


Figure 6-603: QP Facebook test QoS report view

Alphanumeric view of QP Facebook job

The "Alphanumeric View" displays the QP Facebook job signals. The App test signals are used. For the signals and their description, see "Description of R&S ROMES4 Signals" document.

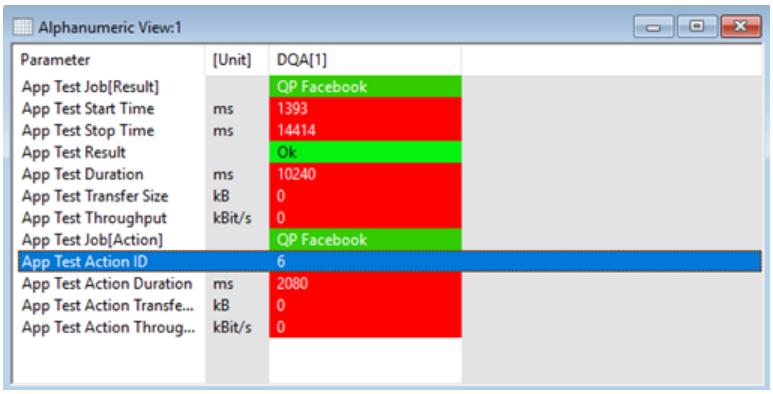


Figure 6-604: QP Facebook test alphanumeric view

KPI generator view of QP Facebook job

No KPIs are available for this job, therefore the view does available.

QP dropbox

QualiPoc Dropbox is supported by the DQA.

Prerequisites

Before you can create and run a QualiPoc Dropbox test, you need to create a Dropbox App and take a note of the access token for the App. This process involves the creation and configuration of a Dropbox account.

Creation and configuration of a Dropbox account

The Dropbox test requires a Dropbox developer account and an access token.

To create an access token for your Dropbox account:

1. Select the https://www.dropbox.com/developers/ link in opened browser.

   The "Build your app on the Dropbox platform" access pane pops-up.

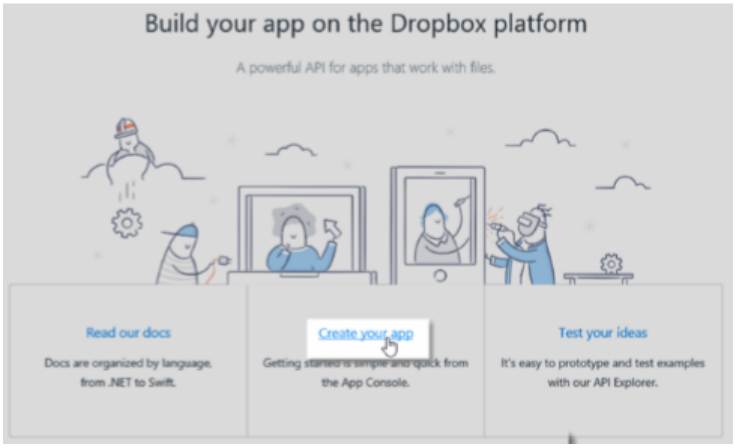


Figure 6-605: Dropbox platform

2. Click "Create your app"
3. Create a Dropbox account in a following way:
   - a) Click "Create an account".
   - b) Enter the account information.

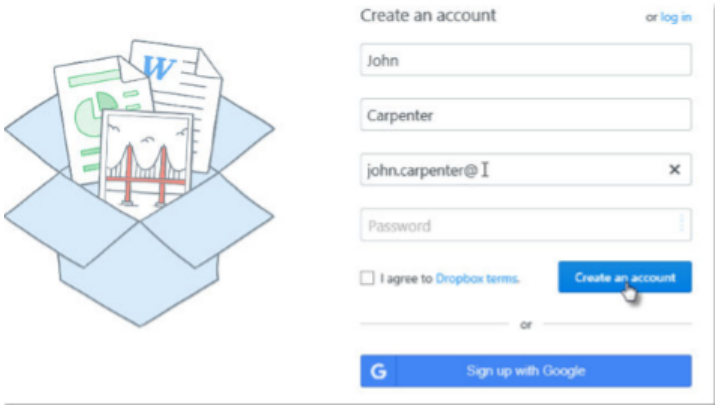


Figure 6-606: Dropbox account creation

   - c) Select "I agree to Dropbox terms".
   - d) Click "Create an account".
   - e) Use the browser's "Back" button to cancel the Dropbox app download and to return to the previous page.
   - f) Optionally, if you do not receive any verification message, click "Send email for verification".
   - g) Login to your email account.
   - h) Open the verification message from Dropbox.
   - Click "Verify your email".
     Note: You do not need to download the Dropbox App.
4. Create an app for the Dropbox test in a following way:
   - a) On the "Create a new app on the Dropbox Platform" page, click "Dropbox API" on "1. Choose an API" area.

- b) Click "App folder – Access to a single folder created specifically for your app." on "2. Choose the type of access you need".
- c) Enter a name for your app in "3. Name your app".
- d) Check "I agree to Dropbox API Terms and Conditions".
- e) Click "Create app".

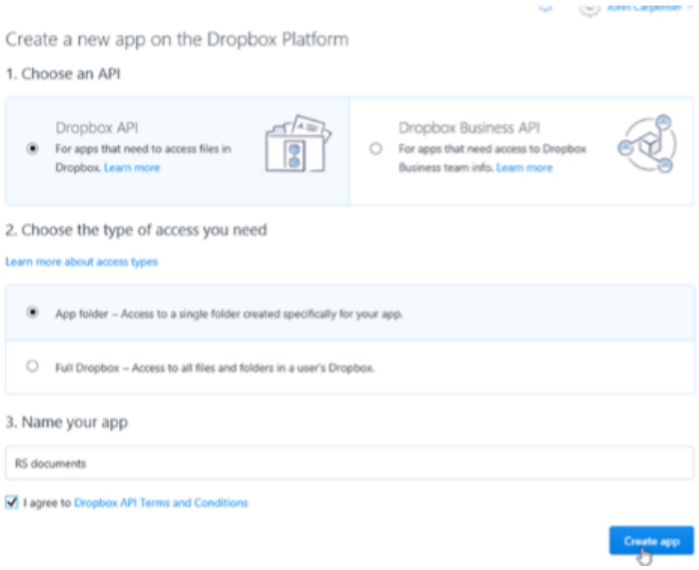


Figure 6-607: Dropbox app creation

- f) Click "Enable additional users" in the "Development users" area.
- g) Confirm the selection with "Limit raised to 500 users" > "Okay".
- h) Click "Generate" in the "OAuth 2" area.
- i) Copy the access token to a text file and save the file.

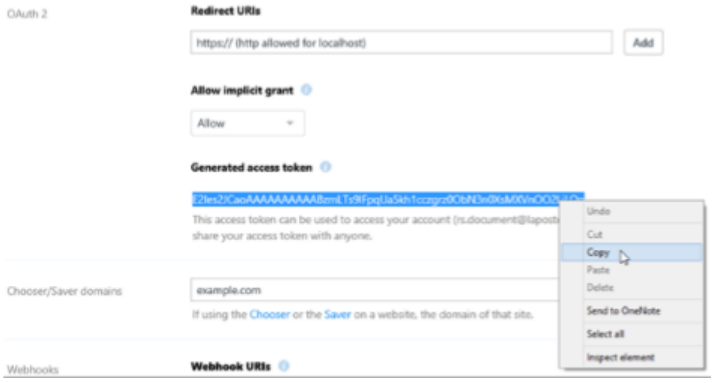


Figure 6-608: Coping the generated file

- k) Sign out.
  Note: You need the access token to configure the Dropbox test.

5. Open QualiPoc in Handheld Modes:
   - a) Touch Settings
   - b) Touch Apps

- c) Type the access token in the related field and the Dropbox settings.

Dropbox job configuration

1. Select the QP Dropbox job from the "Available Jobs" list. Double mouse click the selection to open the configuration page.
2. Click "Add Action" in the opened page to get the "Dropbox Action" page.

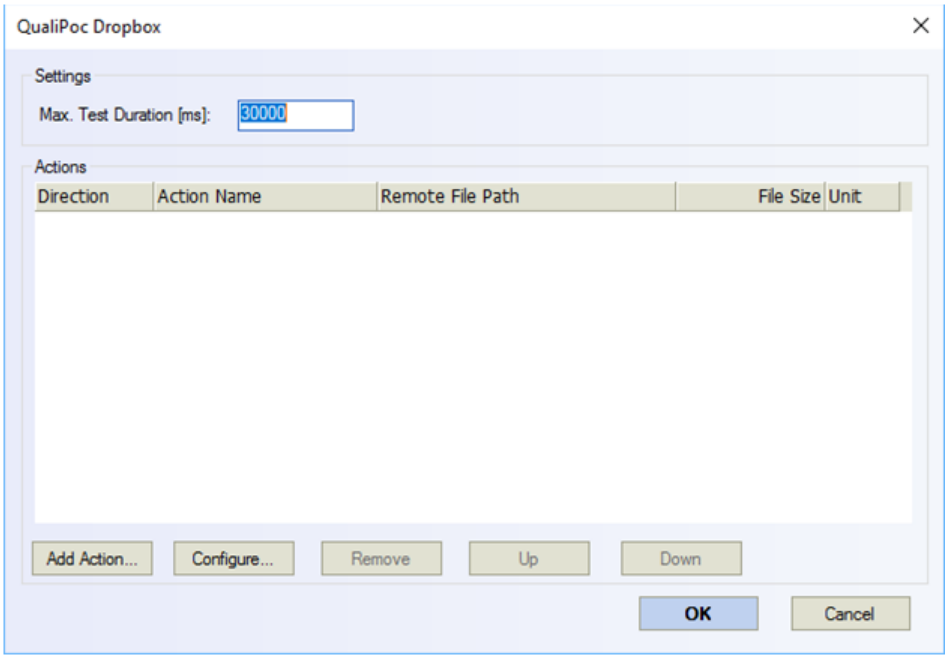


Figure 6-609: DQA Dropbox job configuration page

3. In the opened page define the job direction. Download or upload directions are available.

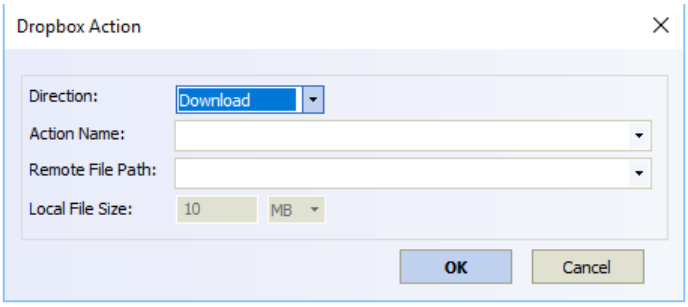


Figure 6-610: Dropbox job direction

If you select download, define an action name (example given, Download 10MB) and the remote path of the file's location in the Dropbox server.

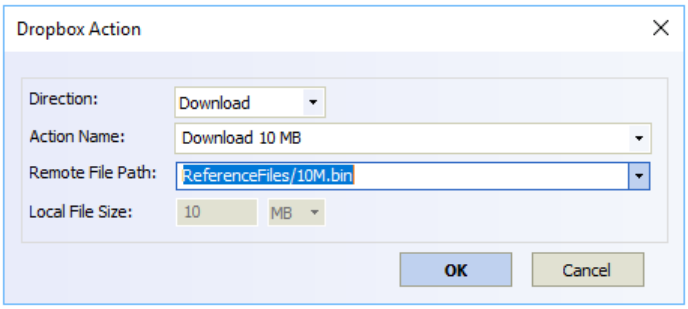


Figure 6-611: Dropbox job download

4. If you select upload, define in addition the maximal size of the file for uploading.

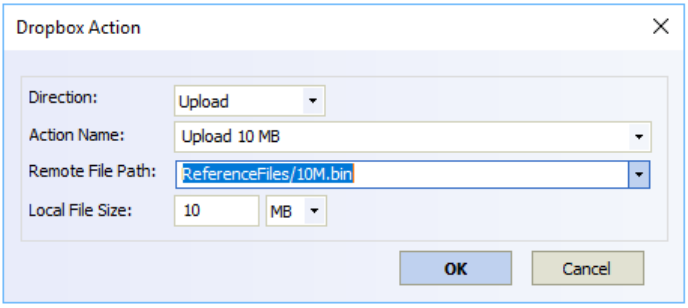


Figure 6-612: Dropbox job upload

DQA QP dropbox job views

The following views are available for the QP Dropbox test:

- "DQA Progress View"
- "QoS Report View"
- "Alphanumeric View"

DQA progress view

The "DQA Progress View" for this job is the same as for QP Ookla ® and QP Facebook jobs.

QoS report view

The "Min" /"Max" /"Avg" values of the Throughput and Transfer Time of the test are reported.

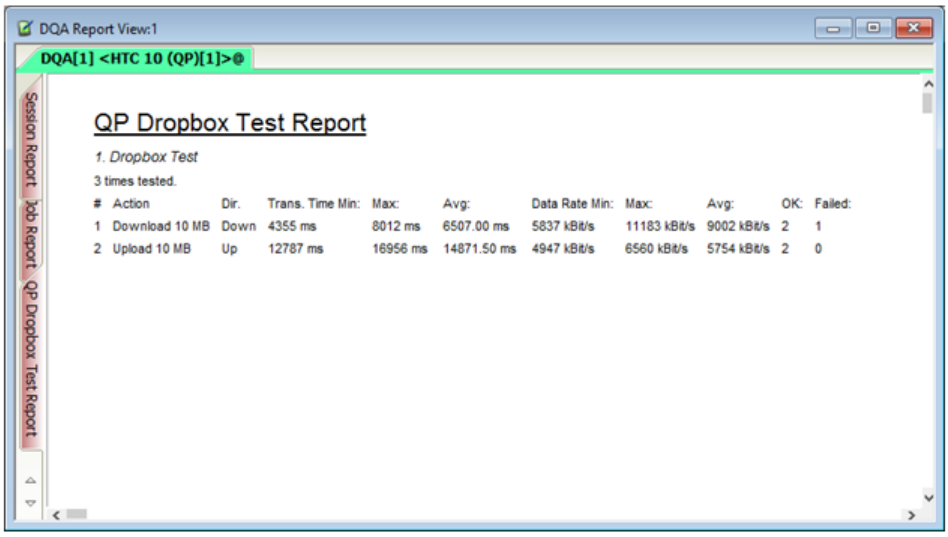


Figure 6-613: QP Dropbox test QoS report view

Alphanumeric View

The "Alphanumeric View"displays the QP Dropbox job signals. The App test signals are used. For the signals and their description, see "Description of R&S ROMES4 Signals" document.

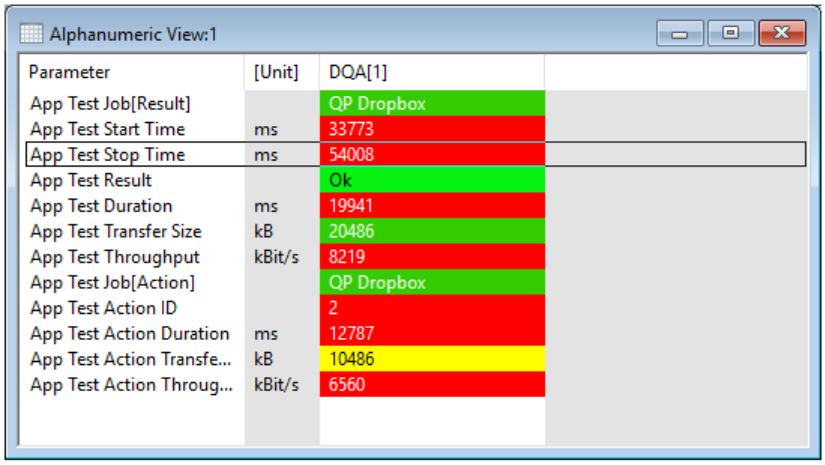


Figure 6-614: QP Dropbox test alphanumeric view

KPI generator view

No KPIs are available for this test.

QP WhatsApp

QP WhatsApp Send and Receive jobs are supported by the DQA.

Prerequisites

Before you can create and run a QualiPoc WhatsApp test, you need to install the application on your phone and to create a WhatsApp account for the used SIM.

Install WhatsApp

The application must be downloaded from "QualiPoc" > "Settings" > "Apps" (currently only version 2.17.395 is supported). If different version is already available in the device, WhatsApp tests are not supported in QualiPoc.

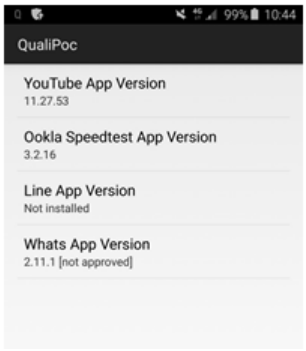


Figure 6-615: Available applications

Touch "WhatsApp Version" and confirm the suggested version.

The WhatsApp application is downloaded and installed.

Create WhatsApp account

Initial WhatsApp configuration requires to start the WhatsApp application manually and follow the verification steps.

Adding only one friend in the WhatsApp "Contacts" list must be done manually (use the same name as the WhatsApp name set on the other device). Pay attention where you save the contact accordingly to your needs (on the device or on the SIM).

If you change SIM, WhatsApp asks to repeat the verification steps.

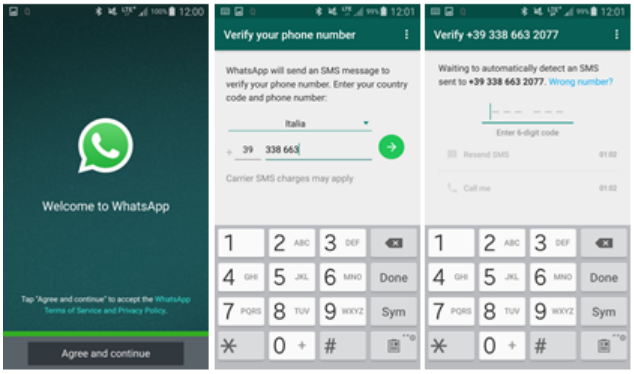


Figure 6-616: Verifying own phone number

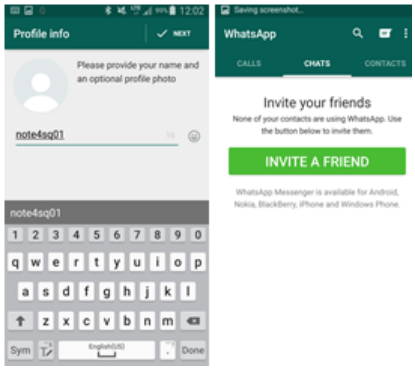


Figure 6-617: Creating own name

Touch "WhatsApp" > "Settings" > "Data usage" > "Media auto-download" to disable all the auto-download options (set "No media" for all the options).

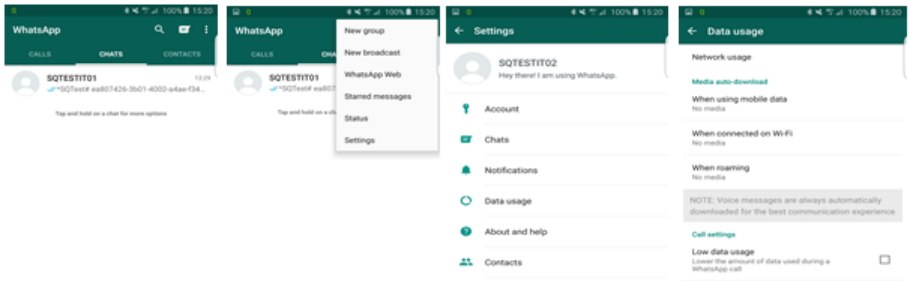


Figure 6-618: Disabling options

WhatsApp messages tests

The sending side sends first an initialization message containing test identifier and the number of messages. In the case shown in the following figure, two messages are sent, the text messages (‘1’) and a photo (‘3’). Sending messages is indicated by the last part of the initialization message (1,3,1).

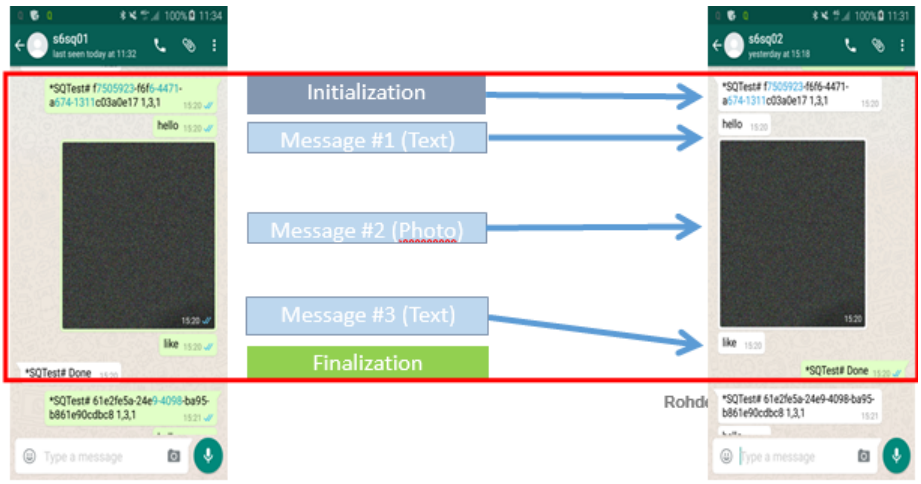


Figure 6-619: Message flow

The receiving side sends the finalization message "*SQTest # Done" after receiving all messages as an indication that all them have been successfully received.

QP WhatsApp job configuration

Configuration of sending party

1. Load a mobile as fully integrated device.
2. Configure a related DQA.
3. DQA page opens.
4. Select the "QP WhatsApp" job with double-click from the "Available Jobs" list. The "QualiPoc WhatsApp Send Message" page pops-up.

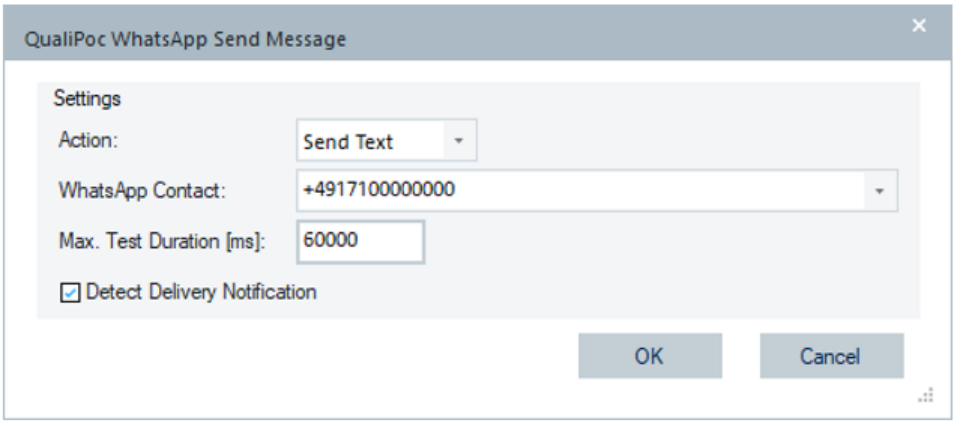


Figure 6-620: WhatsApp configuration page - send text

5. Select the wanted WhatsApp service's type test in "Action" out of offered options"Send Text" and "Send Photo".

6. Type the contact of the receiving party in "WhatsApp Contact".
7. Specify the test duration in "Max. Test Duration".
8. Check the "Detected Delivery Notification" combo-box.
   When checked, the function calculates duration of delivery. If the feature is active, a message can be delivered to an inactive B-party without QualiPoc, but with WhatsApp on.
   Set the UE's operating system to English language to make possible calculation of the delivery duration.

QP WhatsApp views

The following views are available for the QP WhatsApp test:

- "DQA Progress View"
- "QoS Report View"
- "Alphanumeric View"
- "Message View"

DQA progress view

The "DQA Progress View" of WhatsApp is the same as the views of QP Ookla ®, QP Facebook and QP Dropbox.

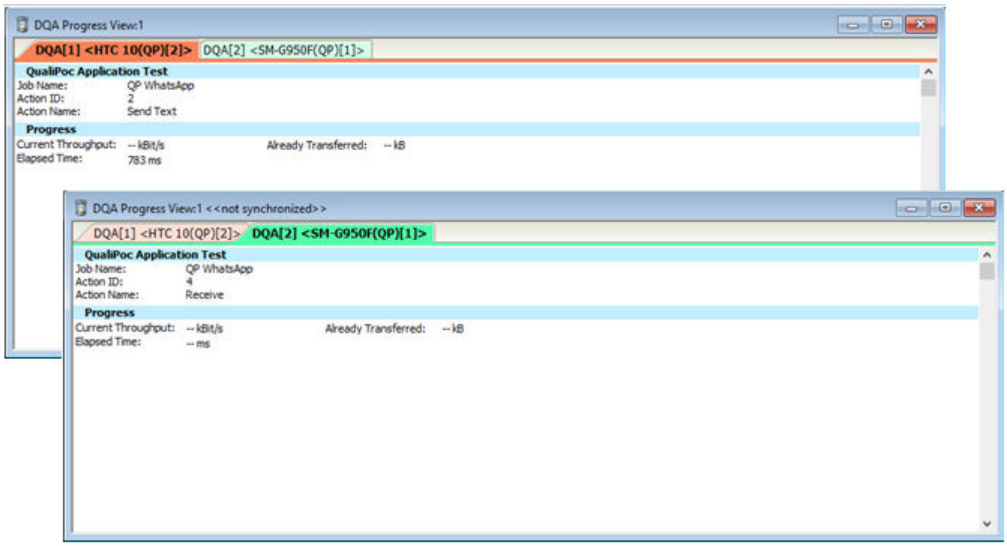


Figure 6-621: WhatsApp sending/receiving party DQA progress view

The Current Throughput and Already Transferred Bytes values of the WhatsApp sending and receiving party are not available in the "Progress View".

In addition, the Elapsed Time value of WhatsApp receiving party is not available in this view.

QoS report view

The Min /Max /Avg values of the Throughput and Transfer Time of the test are reported in the Report View of WhatsApp sending party.

Only the counters for OK and failed tests are reported in the "QoS Report View" of WhatsApp receiving party.

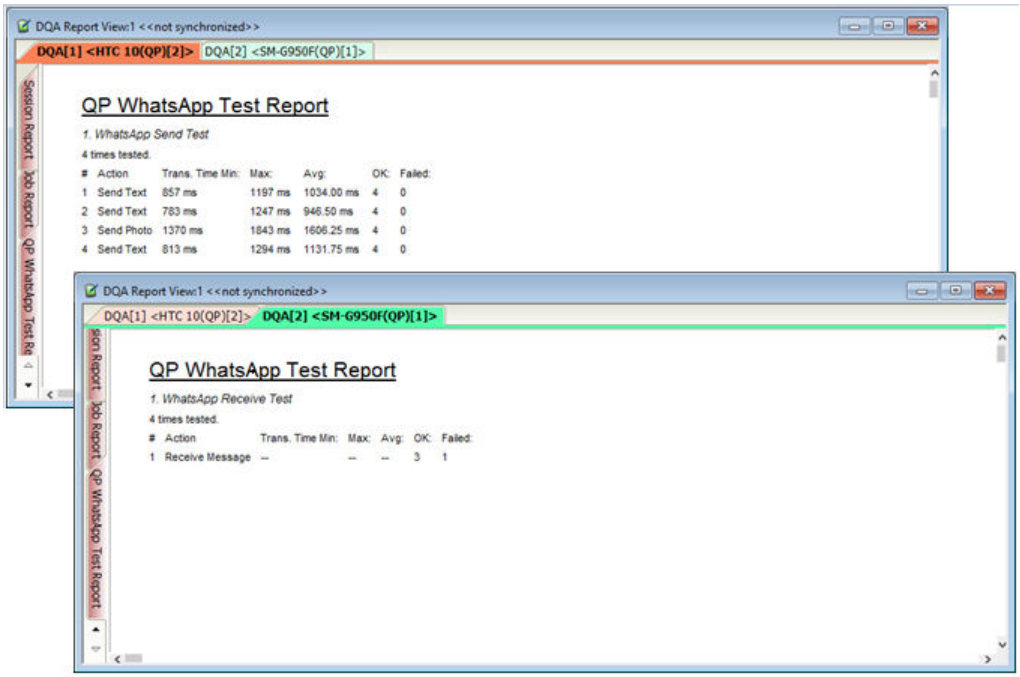


Figure 6-622: WhatsApp sending/receiving party QoS report view

Alphanumeric view

The view displays the QP App test signals. For signals, see "Description of R&S ROMES4 Signals".

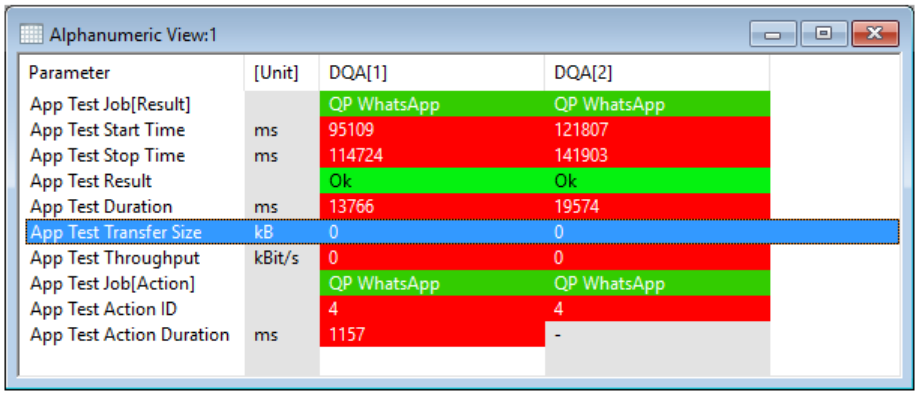


Figure 6-623: App test signals in alphanumeric view

DQA message view

The QP WhatsApp job signals are shown in the DQA Message View. The following figure shows the sequence of QP WhatsApp messages related to results of testing the send messagings.

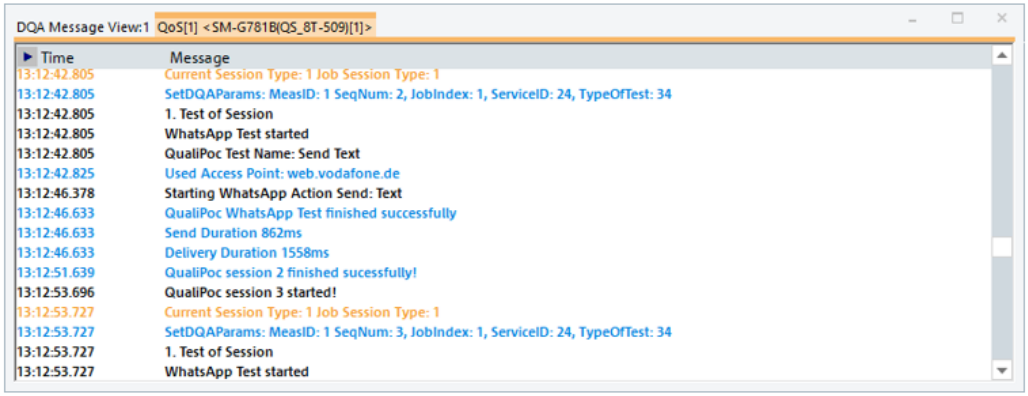


Figure 6-624: Messages related to results of QP WhatsApp messaging send test

For the signals, refer to the "Description of R&S ROMES4 signals" document.

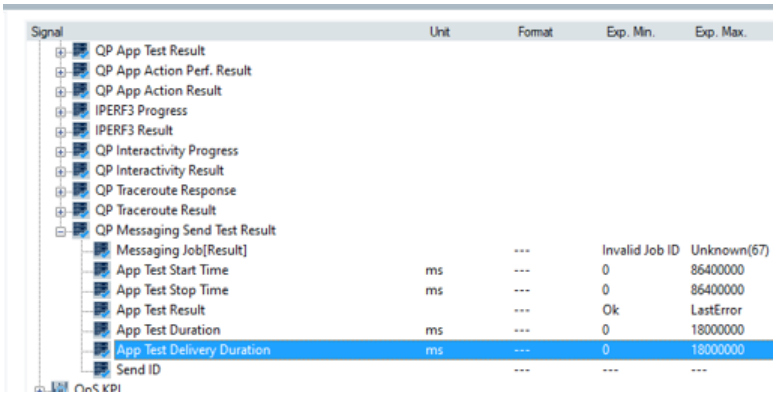


Figure 6-625: Configurations of signals for QP WhatsApp messaging send test

6.5.2.11 Mobile

DQA SMS send

SMS Send job is supported by the DQA.

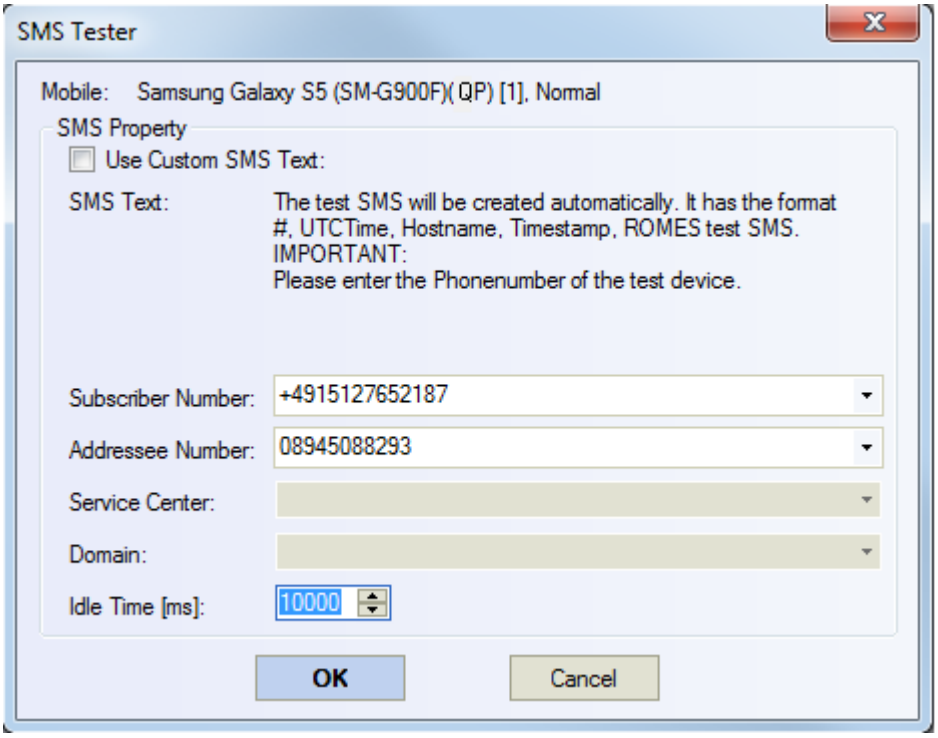


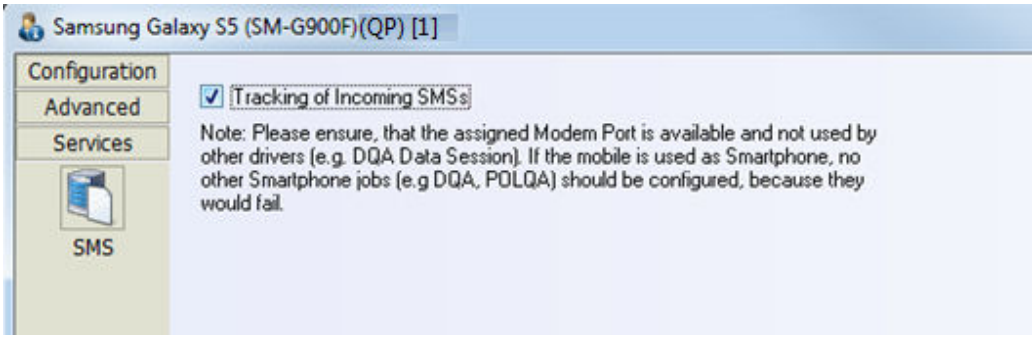
Figure 6-626: SMS job for smartphones tester

"Service Center" and "Domain" are dimmed. These entries are not available, as the QualiPoc handles the job, that is, these parameters are taken from internal smartphone settings and therefore do not need configuration.

SMS receive

Other smartphone with SQ interface (that is, with QualiPoc) can receive SMS sent by the mobile involved in SMS Send job.

"Tracking of Incoming SMSs" must be checked in the SMS page of the mobile device. In this case, no other smartphone jobs are configured for the mobile, because they would fail.



Auto dialing

The configuration of an auto dialing job with QualiPoc is unchanged. The configurations for the Voice Call MOC and MTC are shown in the following figures.

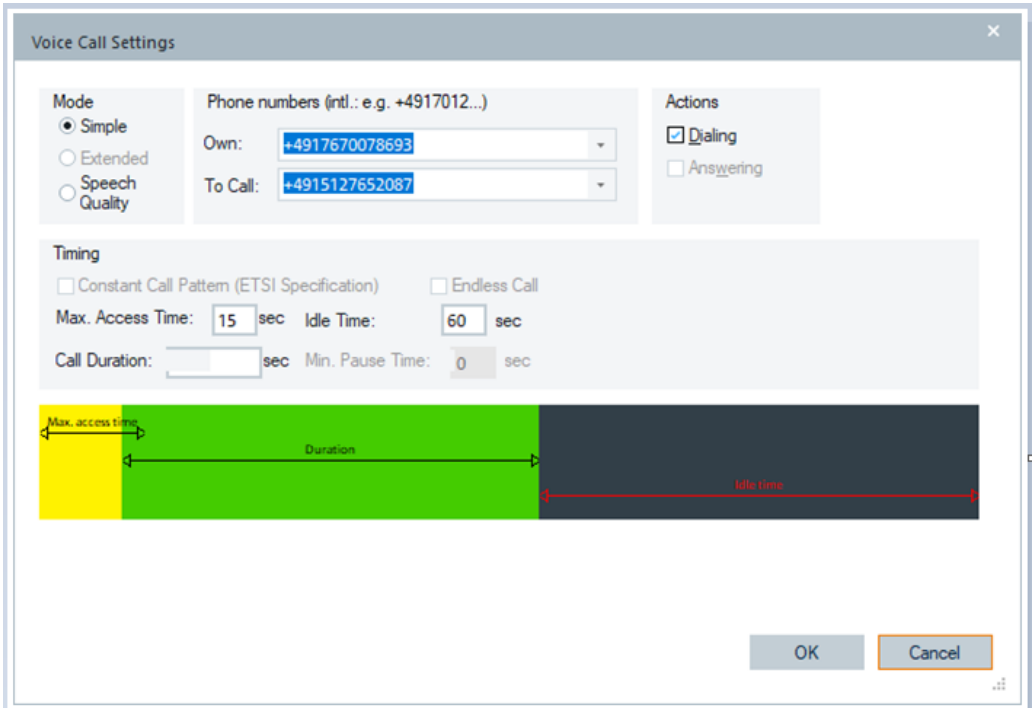


Figure 6-627: Auto dialing activated - voice call MOC

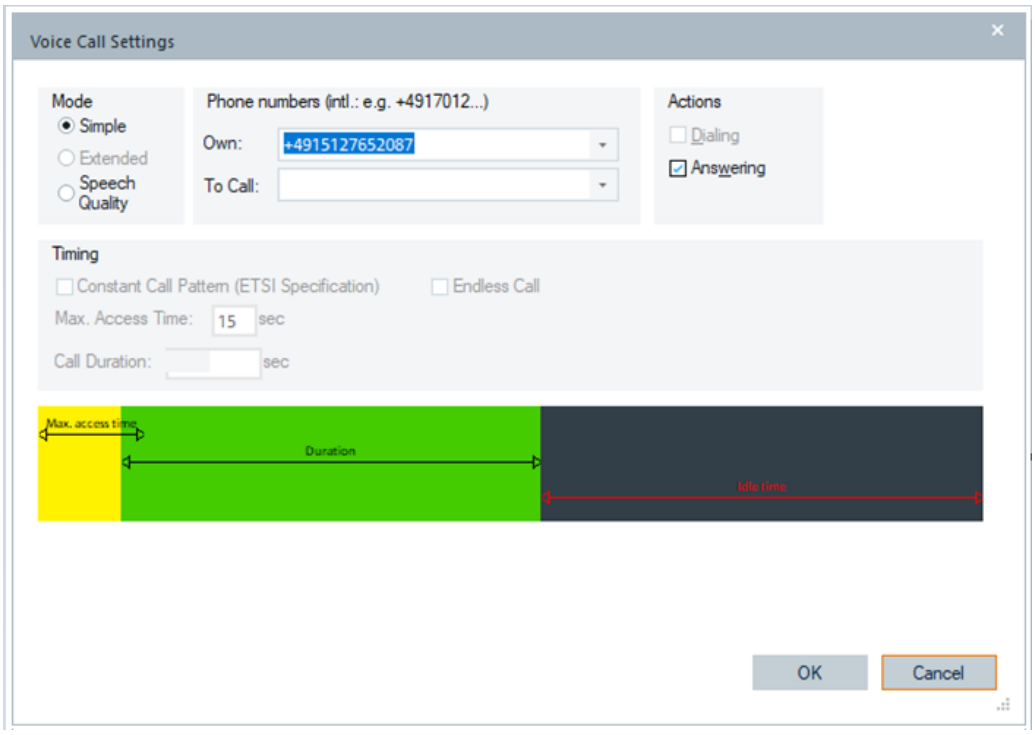


Figure 6-628: Auto answering activated - voice call MTC

If auto answering is selected, no other jobs are possible in the job list. The "Available Jobs" list is empty in this case.

QP network forcing

The Network Forcing job is available as a DQA job if the mobile is loaded as fully integrated device. The forcing job must be placed before the QP Session Start job.

QP network forcing job configuration

Technology and band forcing are available.

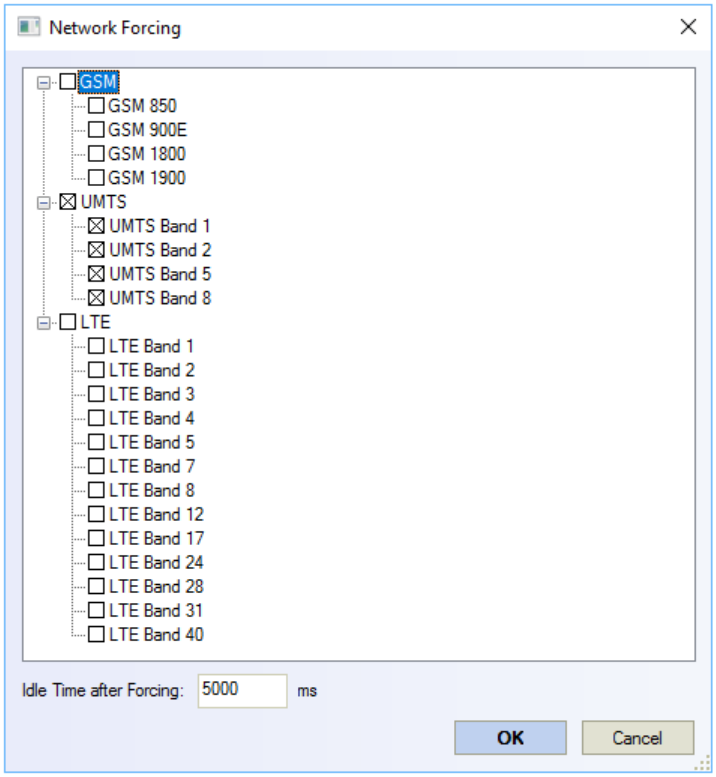


Figure 6-629: Technologies and bands for NTW forcing test

After the forcing, the QualiPoc rests in idle mode for a defined time.

6.5.2.12 Batch for fully integrated devices

The description of the Batch job in Chapter 6.5.1.4, "Configuration menus for the DQA jobs", on page 1891 applies for the fully integrated devices having the following limitations.

- Value in the "Count" column can only be changed for a defined Batch job.
- Batch cannot contain other Batch jobs.

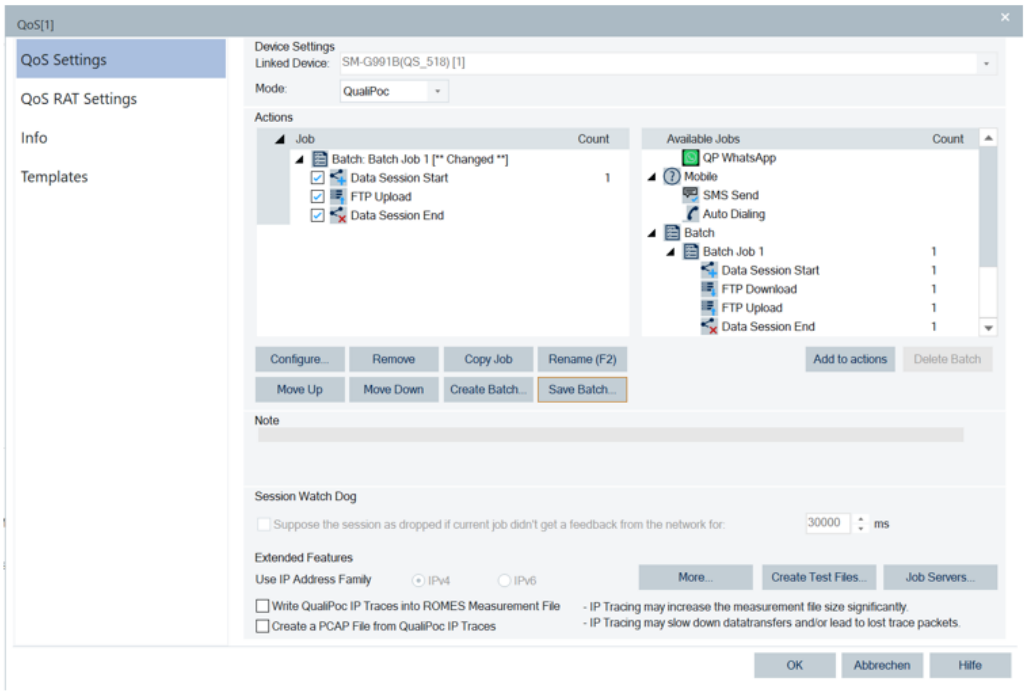


Figure 6-630: Batch job on fully integrated device

The "QoS Settings" page allows existing batches to edit and to save them.

While saving the batch, you are asked to enter a new name or keep the name and overwrite the existing batch.

If you want to leave the page while there is an unsaved modified batch in the configuration, you are prompted to auto-save the batch with a new name. Instead, you can choose to stay on the page.

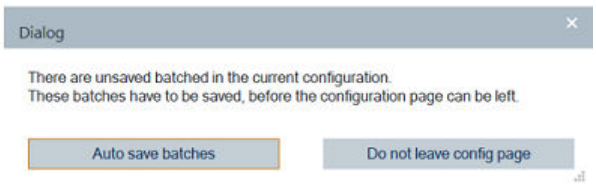


Figure 6-631: Dialog to save unsaved batch

Auto-save checks the name of the original batch. If the batch has a number in its name, this number is increased until it is unique. In the previous screenshot, the “Batch Job 1” is saved to “Batch Job 2”. If a batch with this name already exists, it is stored as “Batch Job 3”.

6.5.2.13 QualiPoc status events and signals

There are events and signals aiming to follow the state of the fully integrated devices.

The corresponding event helps you get alarms whenever the connection to a device is lost or a QualiPoc job fails.

The status events and signals can be found in the "GSM Event" and the "GSM" available signals branch, respectively.

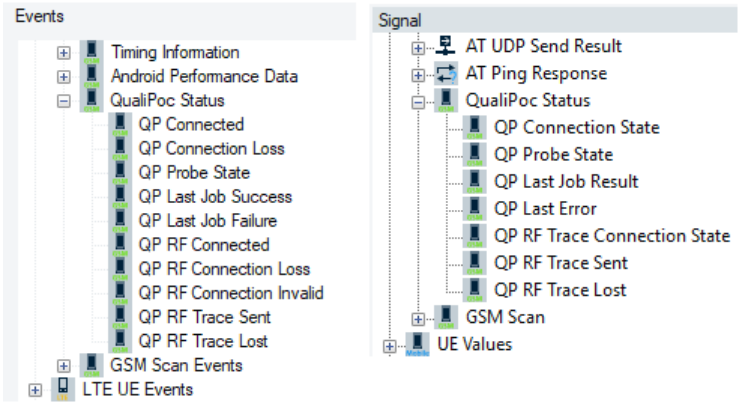


Figure 6-632: QP status events and signals

For the QualiPoc status signals, see the "Description of R&S ROMES4 Signals" document.

6.5.3 DQA jobs with iOS-based smartphones

R&S ROMES4 supports DQA jobs with smartphones using iOS operating system - iPhones 13/14 are supported. Data and voice test configuration can be done in R&S ROMES4, which controls iPhone, pushes jobs and run tests on iPhone.

To support mentioned functions, the necessary option for iPhone has to available on the R&S ROMES4 side.

On the iPhone side, do the following actions:

- Prepare iPhone with a special build, which provides access to the modem and Qualcomm diagnostic port on the Windows PC.

- Pair iPhone via Bluetooth with your Windows PC.

- Install the iPhone App called R&S ROMES Probe iOS App in the iPhone, see Chapter 6.5.3.3, "R&S ROMES probe iOS app", on page 2054. The application is free of charge available in the AppStore.

- Start manually the R&S ROMES Probe iOS App on the iPhone.

- Supported iPhone 13 and 14 with iOS 16.

- The Windows PC clock and iPhone clock have to be in sync. The maximum allowed offset is 60 seconds.

Connect iPhone via cable to the PC where R&S ROMES4 is running (the same approach as for QualiPoc Probes). The service/tool called iPhoneConnector App handles connection to the iPhone over Bluetooth.

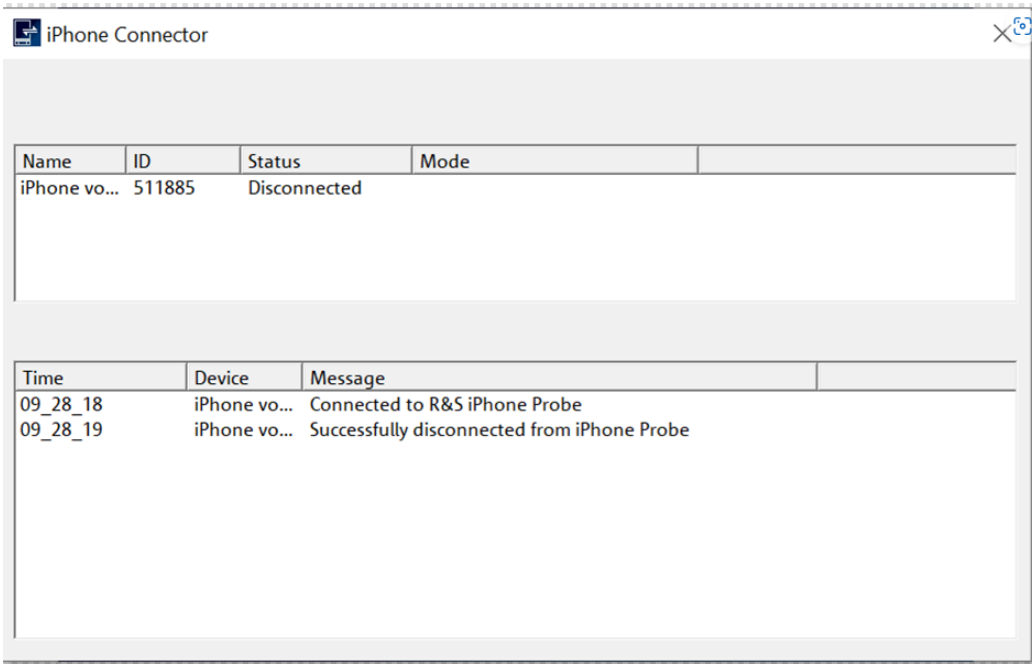


Figure 6-633: iPhone Collector page

If the necessary option is available, the iPhoneConnector App starts during the R&S ROMES4 start-up. The iPhone App connects through Bluetooth to the iPhoneConnector App, which is connected to the R&S ROMES4 application. If the last 6 digits of the IMEI match, R&S ROMES4 shows the phone as iPhone.

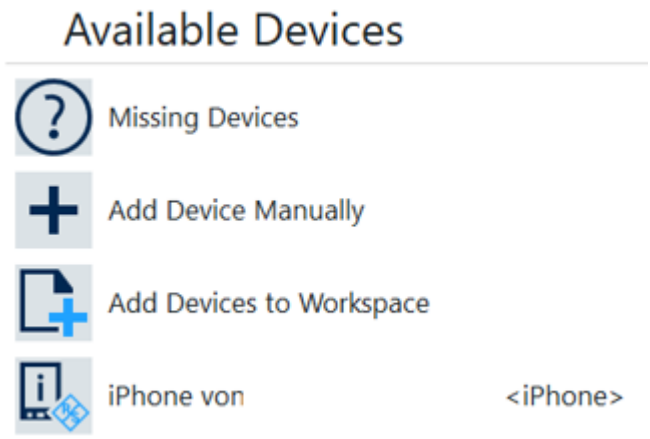


Figure 6-634: Recognized iPhone in Available Devices pane

Figure 6-635: iPhone symbol

If R&S ROMES4 does not detect the phone as the iPhone, check if the last six digits of the IMEI are correct. The R&S ROMES4 GUI shows them on the Welcome sheet. Also ensure the R&S ROMES Probe app is running foreground and that the Bluetooth connection is established.

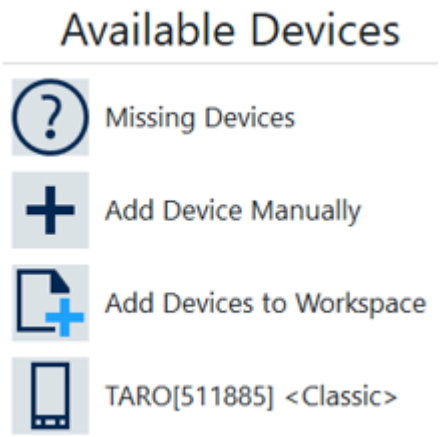


Figure 6-636: Not recognized device

The iPhoneConnector App is put into the Windows Tray by default.

6.5.3.1 DQA jobs with iPhone

The following DQA jobs are supported by the iPhone, i.e. by the R&S ROMES Probe iOS App installed in the iPhone.

- AT Command
  The Airplane Mode On and Off jobs correspond to AT Command jobs.
- Voice Call outgoing (MOC)
- HTTP Download
- HTTP Upload
- Ping
- Iperf3

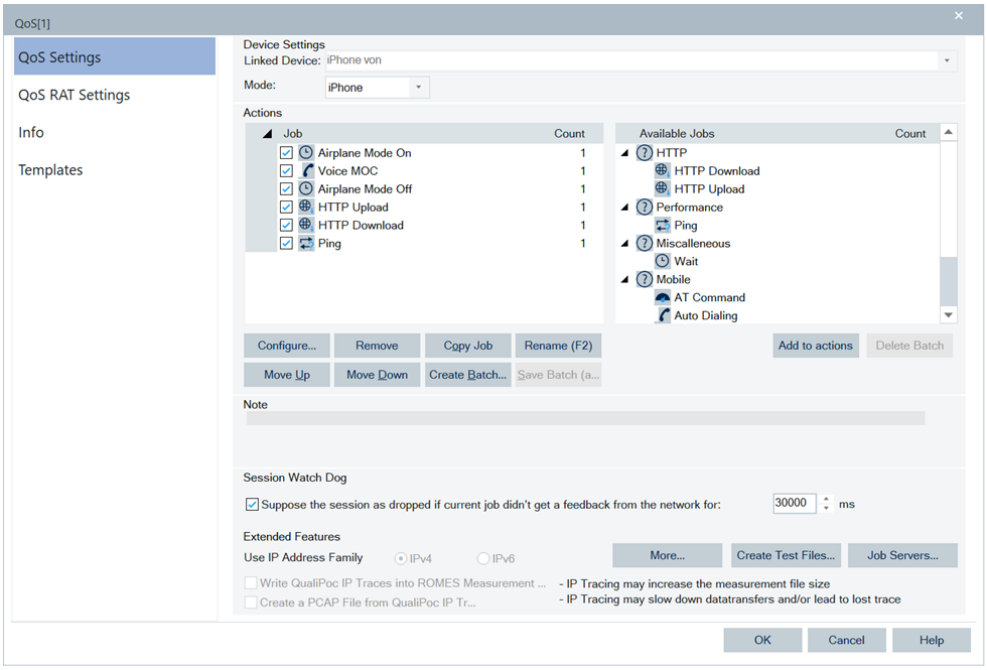


Figure 6-637: iPhone mode selection in QoS setting

The listed jobs can be combined in any order. The Session Start/Stop jobs are not necessary for an iPhone.
After loading iPhone into R&S ROMES4, the iPhone mode is visible offering all available jobs. A job configuration and execution is analog to the QualiPoc UE jobs configuration.
The settings for Iperf3 job for QualiPoc and iPhone operation mode reflect the different options of the Iperf3 binary.

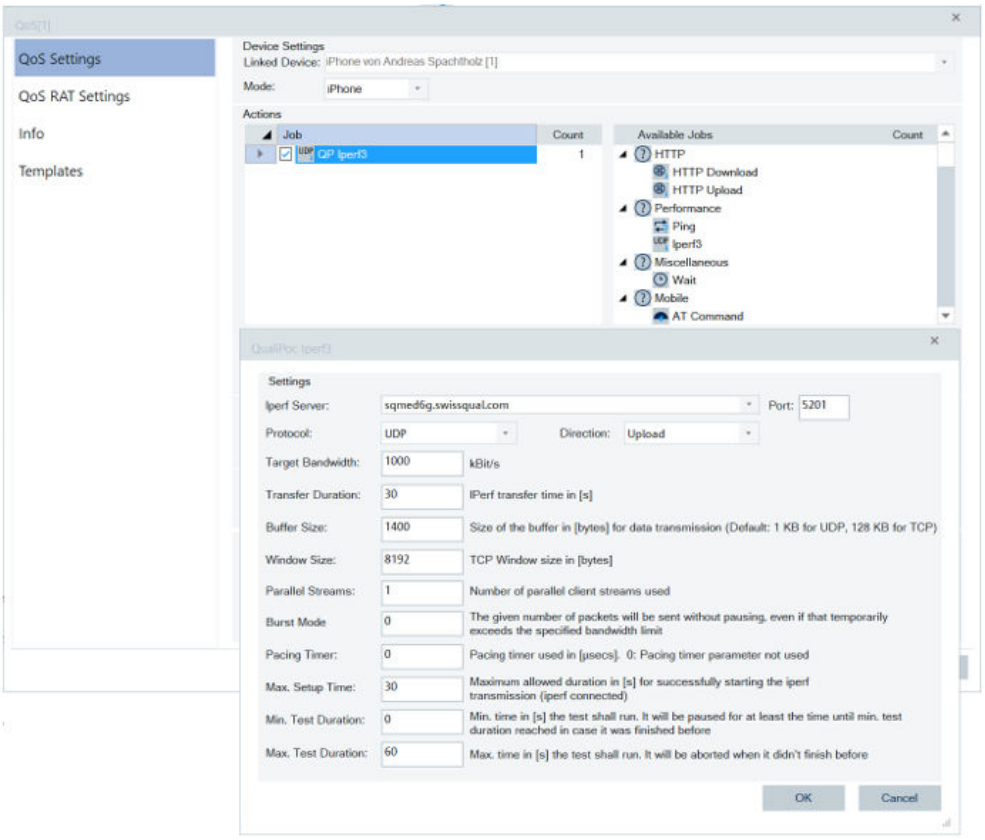


Figure 6-638: Settings of Iperf3 job of iPhone

For Auto Answering, the iOS Auto Answer feature can be used.

6.5.3.2 IMS support

There is a limited IMS message support by the iPhone by default.

Although the call life cycle can be followed, not all messages are available. If the network does not use IPSec, R&S ROMES4 can be used to get all IMS messages. Active the "VoLTE" > "Use ROMES IMS Stack Tracing based in IP Tracing" option in the Qualcomm devices configuration page to obtain all IMS messages.

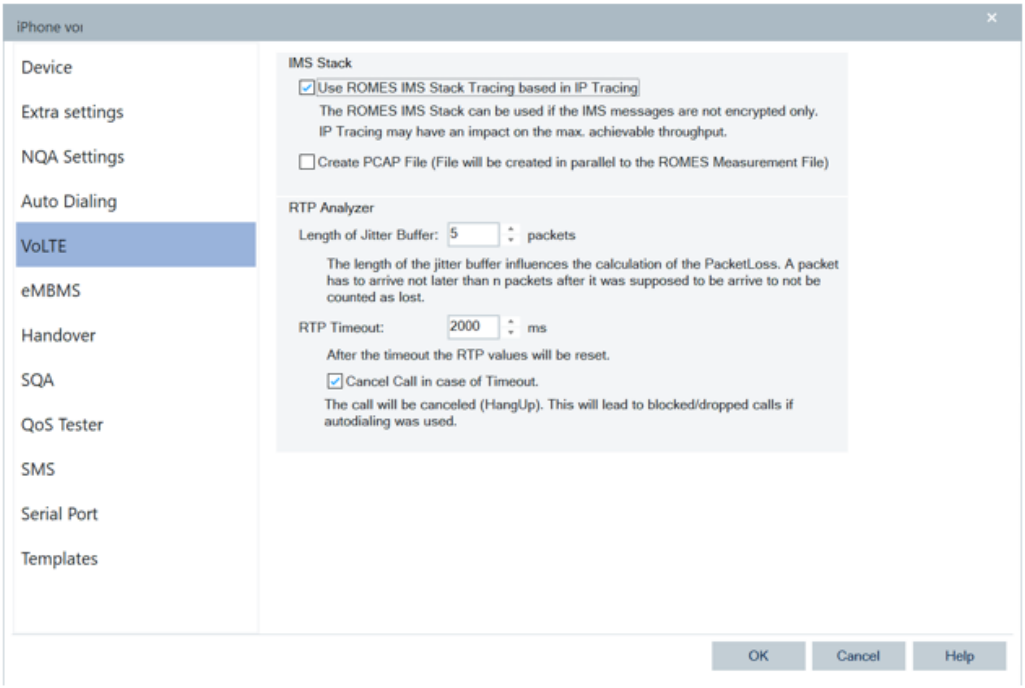


Figure 6-639: iPhone VOI configuration page of Qualcomm devices

6.5.3.3 R&S ROMES probe iOS app

The R&S ROMES probe iOS app can be downloaded from the iOS app store. After downloading the app and before the app is used with R&S ROMES4, the ROMES ID has to be configured in the app. This ID is the last 6 digits of the IMEI of the phone.

To get the app configuration screen where you can enter the ROMES ID, click the “gear” icon on the iPhone's screen.

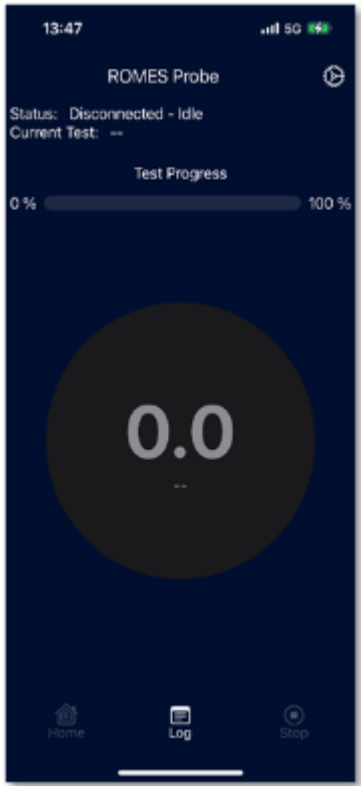


Figure 6-640: iPhone screen showing the installed app

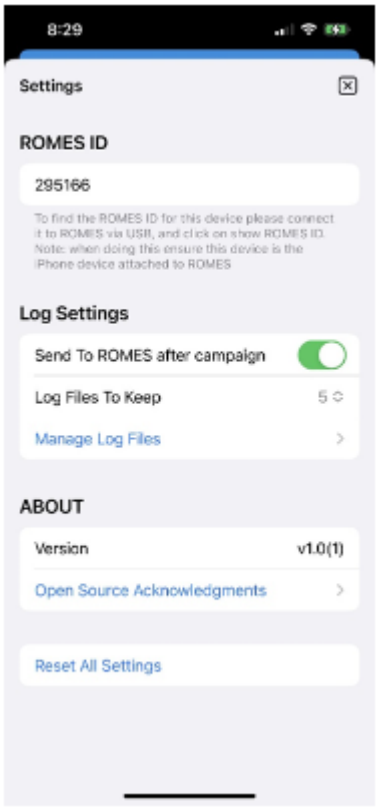


Figure 6-641: Setting screen of an iPhone

Until the ROMES ID is filled in, R&S ROMES4 does not show the iPhone app as connected.

The R&S ROMES Probe app currently supports the following test:

- Ping
- HTTP Download
- HTTP Upload
- Voice

Test results

Clicking the "HOME" button at the bottom of the application screen shows the current test results screen.

The application screen shows the following entries:

- "Status": the current connection status and application status

- "Current Test": The name of the currently active test

- "Test Progress": The progress of the current test from 0% to 100%

- "Test Results": The colored graphic (box) in the middle of the screen shows the results of the current throughput test.

Figure 6-642: Tess progress

The successful test result "OK" is displayed in a green results box. The unsuccessful results are displayed in the red box containing also the reason for the failure of the test.

Click the "Stop" button to stop the currently running test. This action stops the campaign on the phone only, not on R&S ROMES4.

Log screen

Click the "Log" button at the bottom of the application (highlighted in the previous figure) to bring up the active log.

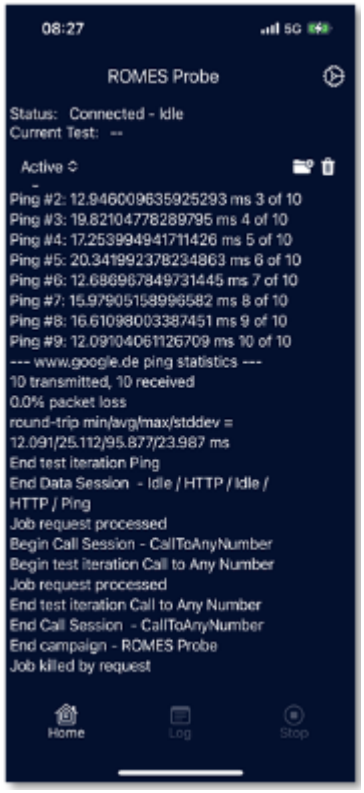


Figure 6-643: Ping test results

The log file drops-down at the top of the screen of an iPhone. By default, the active log file is shown. The contents of the drop-down is all log files currently stored by the application. This action is only available when a campaign is not in progress.

Click the “trash can icon” to delete currently displayed log. If the "Active" log file is displayed, this deletion action clears the active log file. If a prior log file is chosen, then that log file is deleted from the disk.

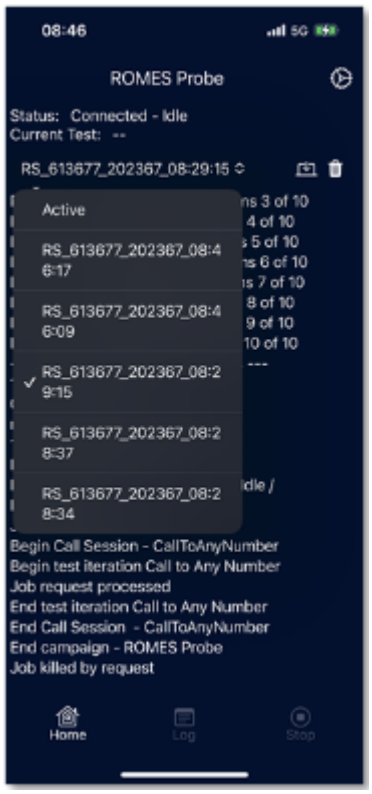


Figure 6-644: Selected Active log of ROMES Probe

Click the “file folder” icon to save the active log file to disk.

The “file folder” icon is only displayed on the screen when the active log file is displayed.

Click the “lap top" icon to send the currently displayed log file to R&S ROMES4. The file is stored in the ROMES log file directory.

The “lap top" icon is displayed on the screen when a log file stored on disk is displayed.

Configuration settings

The figure Figure 6-641 shows the entries in "Settings" that have to be set.

As mentioned, the "ROMES ID" is 6 characters of the phones IEMI. Enter this ID before the app is connected to R&S ROMES4.

The "Log Settings" entry includes the following settings:

- "Send to ROMES after campaign": If turned on, the current application is sent to R&S ROMES4 after the measurement campaign to include it into the SQC file.

- "Log Files to Keep": At the conclusion of each campaign, the contents of the current log is saved to disk. This setting stands for the number of log files that the application

has to keep. When the number of log files reaches this number, the oldest log is deleted.

The "Manage Log Files" entry displays the following when clicked.

- "Log Files": Shows the list of log files saved to disk. Clicking the “trash can” icon deletes the selected log file, see the previous figure.

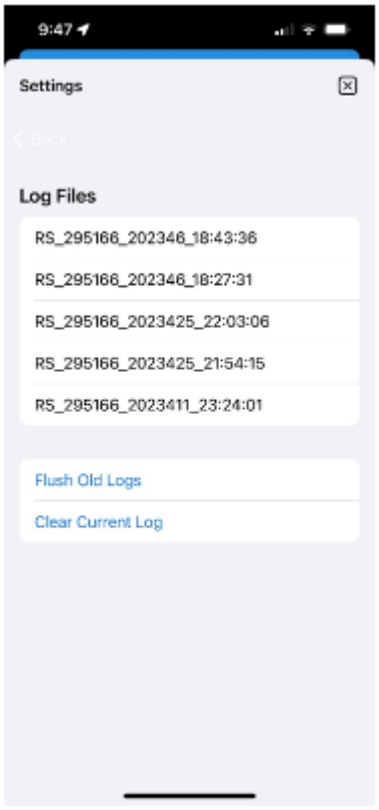


Figure 6-645: Managed log files screen

- "Flush Old Logs": Deletes all log files saved to disk.

- "Clear Current Log": Clears the contents of the active log.

The "ABOUT" entry shows the version of the application in the "Version" line and where to find the open-source acknowledgment for the file in the "Open Source Acknowledgement".

The "Reset All Settings" resets all settings in the application to the default values.

6.5.4 DQA KPIs aggregation in KPI generator

The implementation phase of KPI generator includes the aggregation of the following KPIs on ETSI_B basis:

- Dial Up Time (Data Call Access Time)
- PDP Context Activation Time
- DNS Resolution Time

- Setup Time (Service Setup Time)
- Mean Data Rate (FTP, HTTP, UDP, EMAIL)
- PING RTT
- FTP / HTTP / UDP / EMAIL IP Setup Time
- FTP / HTTP / UDP / EMAIL IP Access Failure Ratio
- FTP / HTTP / UDP / EMAIL IP Session Failure Ratio

Usage of the original KPI definition file `kpi.xml` (as delivered by Rohde&Schwarz) is necessary due to KPI definition ID numbers.

Minimum R&S ROMES4 4.70 version should be used for measuring. All measurement files before R&S ROMES4 4.70 version are evaluated in classical mode of operation from the DQA frames (KPI generator not used). This is reported as ‘Info’ within the "Analysis Messages".

6.6 Navigation

R&S ROMES4 uses two different methods to determine the geographic coordinates of a measurement position:

- For ordinary outdoor applications, a GPS receiver is used to detect the satellite signals of the Global Positioning System (GPS).
- In areas where no GPS signals can be detected, e.g. inside closed buildings, the position is defined by means of a user-defined map.

The navigation drivers U-Blox and the R&S TSME GPS which run the U-Blox devices for navigation, support U-Blox chip NEO-M9V. The U-Blox chip NEO-M9V supports up to 4 GNSS in parallel. The supported GNS are GPS, Galileo, GLONASS and Beidou. If the NEO-M9V chip is detected, the configuration switches to this 4 GNSS setting.

Navigation and indoor drivers and their configurations are described in the following sections.

6.6.1 GPS devices

The R&S ROMES4 measurement system supports different GPS devices to be used as the GPS receivers.

A GPS device is loaded by selecting one GPS device out of offered devices in the "Navigation" branch of the "Hardware" > "Hardware Configuration" > "Available Devices" pane. The configuration menus of the loaded GPS devices are explained in the next chapters.

Navigation devices (ublox and TSME GPS) support also Blox chip NEO-M9V. This uBlox chip NEO-M9V supports up to 4 global navigation satellite systems (GNSS) in parallel. These systems are GPS, Galileo, GLONASS and Beidou. If this chip NEO-M9V is detected, the configuration switches to the 4 GNSS setting.

6.6.1.1 Supported GPS device types

Table 6-26: GPS supported devices

GPS devices	Description of supported devices
NMEA GPS	All GPS receivers supporting the NMEA ("National Marine Electronics Association") protocol.
U-Blox GPS	U-Blox driver enables the U-Blox protocol with enhanced setting possibilities supported by the GPS receivers R&S TSMX-PPS GPS MODULE.
R&S TSME GPS	Internal GPS receiver of the R&S TSME
R&S HE300 GPS	R&S HE300 active directional antenna w/wo integrated GPS receiver, see Chapter 6.6.1.6, "R&S HE300 GPS compass", on page 2080
MAVLink	Drons, see Chapter 6.6.1.7, "MAVLink", on page 2081

Each R&S ROMES4 configuration provides also the GPS simulator. The "Simulator GPS" option assigns fictitious geographic information to a set of measurement data so that they can be displayed in the "ROMESMAP Route Track View". A GPS receiver is not required.

6.6.1.2 GPS configuration menus

The GPS device configuration menus offer device-specific settings. Click the devices command line of the "Hardware" menu which is available when a device used as GPS receiver is loaded.

6.6.1.3 NMEA GPS

The R&S ROMES4 NMEA device version supports the following NMEA protocol versions: GSA, GGA, RMC, ZDA. Protocol versions not listed here are ignored. The format of the NMEA data depends on the protocol version.

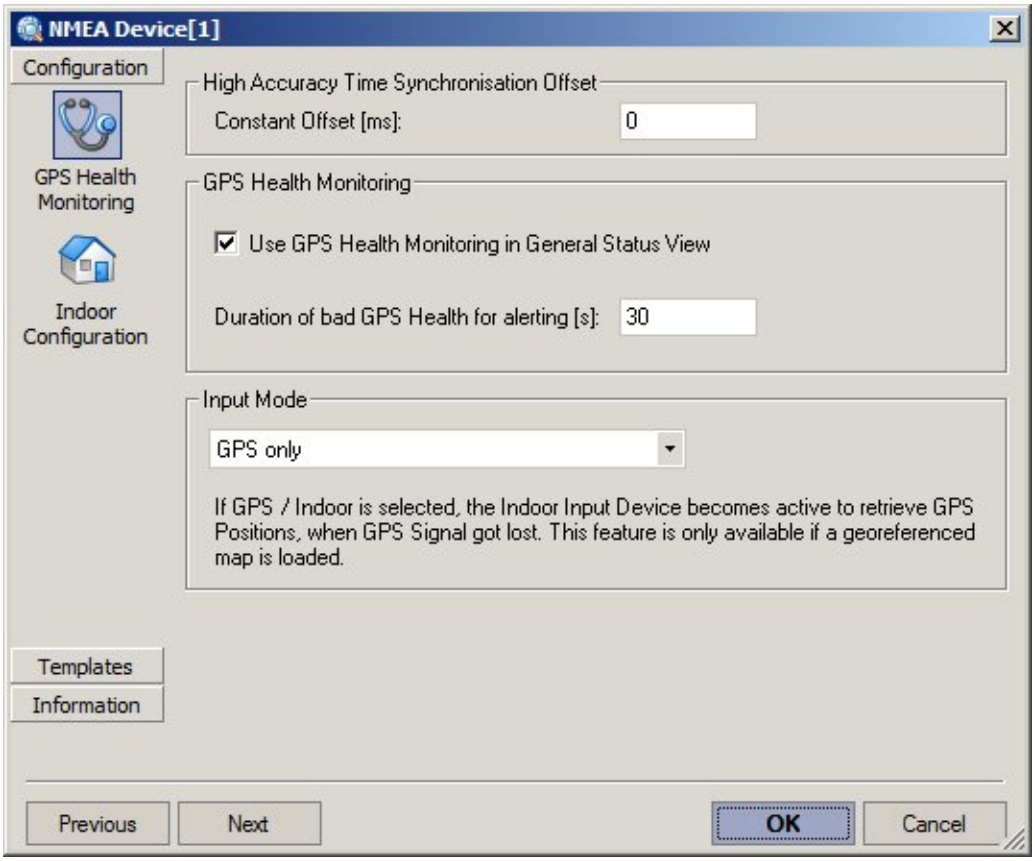


Figure 6-646: NMEA configuration: GPS Health Monitoring

The following example shows a comparison of the RMC, GGA and VTG (not supported) protocols:

```
$GPRMC,144732,A,4807.530037,N,01136.650214,E,0,144,070800,001.0,E*76

$GPGGA,144732,4807.530037,N,01136.650214,E,1,09,1.1,546.6,M,46.8,M,,*4F

$GPVTG,144,T,069.3,M,0,N,0,K*5D

$GPRMC,144733,A,4807.530037,N,01136.650214,E,0,144,070800,001.0,E*77

$GPGGA,144733,4807.530037,N,01136.650214,E,1,09,1.1,546.6,M,46.8,M,,*4E

$GPVTG,144,T,080.7,M,0,N,0,K*5E

$GPRMC,144734,A,4807.530037,N,01136.650214,E,0,144,070800,001.0,E*70

$GPGGA,144734,4807.530037,N,01136.650214,E,1,09,1.1,546.7,M,46.8,M,,*48

$GPVTG,144,T,074.7,M,0,N,0,K*55

...
```

GPS health monitoring

The "GPS Health Monitoring" tab switches health monitoring in the "General Status View" on or off. Also, the tab offers the possibility to adjust the synchronization between PC and GPS time, see "NMEA device information" on page 2066. Transmission time causes delays in milliseconds. If the delay is known, higher accuracy can be reached by setting the "Constant Offset". Such accuracy is only important for Video Quality Analysis.

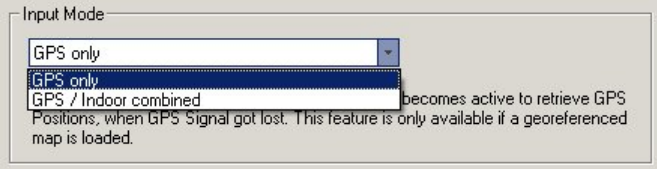


Figure 6-647: NMEA configuration input

Bad GPS health means that the GPS signal received is low. Bad health situations can frequently occur during an ordinary test trip, e.g. if the vehicle crosses an underpass or a tunnel. If "Use GPS Health Monitoring" is active, the bad health situations cause a warning message. The message is displayed in the "General Status View", providing that they last longer compared to the time selected in the "Duration of bad GPS Health" field.

Furthermore, GPS and Indoor can work together in combined mode. Therefore, define it within the "Input Mode" area. If configured, Indoor becomes active when the GPS signal gets lost. For this mode, the indoor input works only in measurement mode "Continuous Measurement" and navigation mode "Stream Input".

Mode "GPS / Indoor combined"

This mode is only available when a georeferenced map is loaded.

Indoor configuration

The "Indoor Input" tab is used to select the measurement and navigation mode and allows waypoints to configure. It is only active if the "GPS / Indoor combined" input mode is selected in the "GPS Health Monitoring".

For the explanation of the settings refer to Chapter 6.6.2.2, "Indoor input configuration – setup", on page 2083.

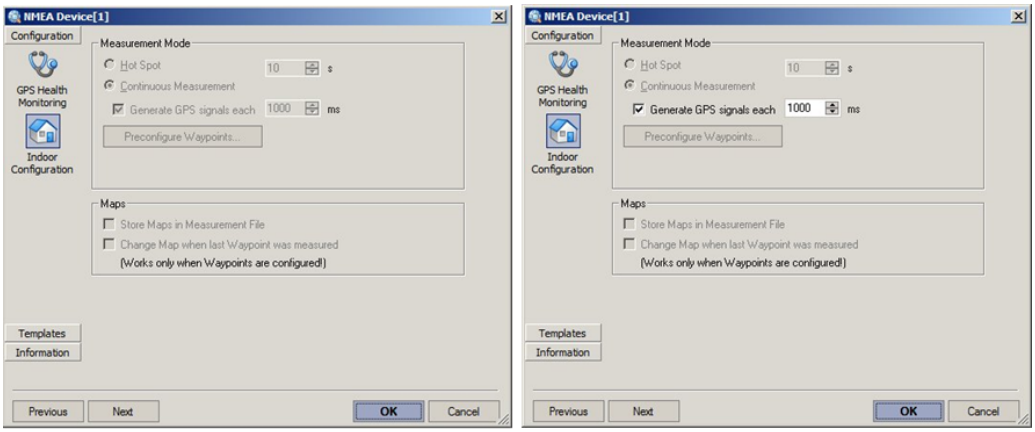


Figure 6-648: Indoor Configuration tab, input mode „GPS only“ and input mode "GPS / Indoor combined"

Templates

The "Templates" tab let you store the current device configuration as a template, list, load or delete the device templates. It is provided for many test devices and is identical for all them.

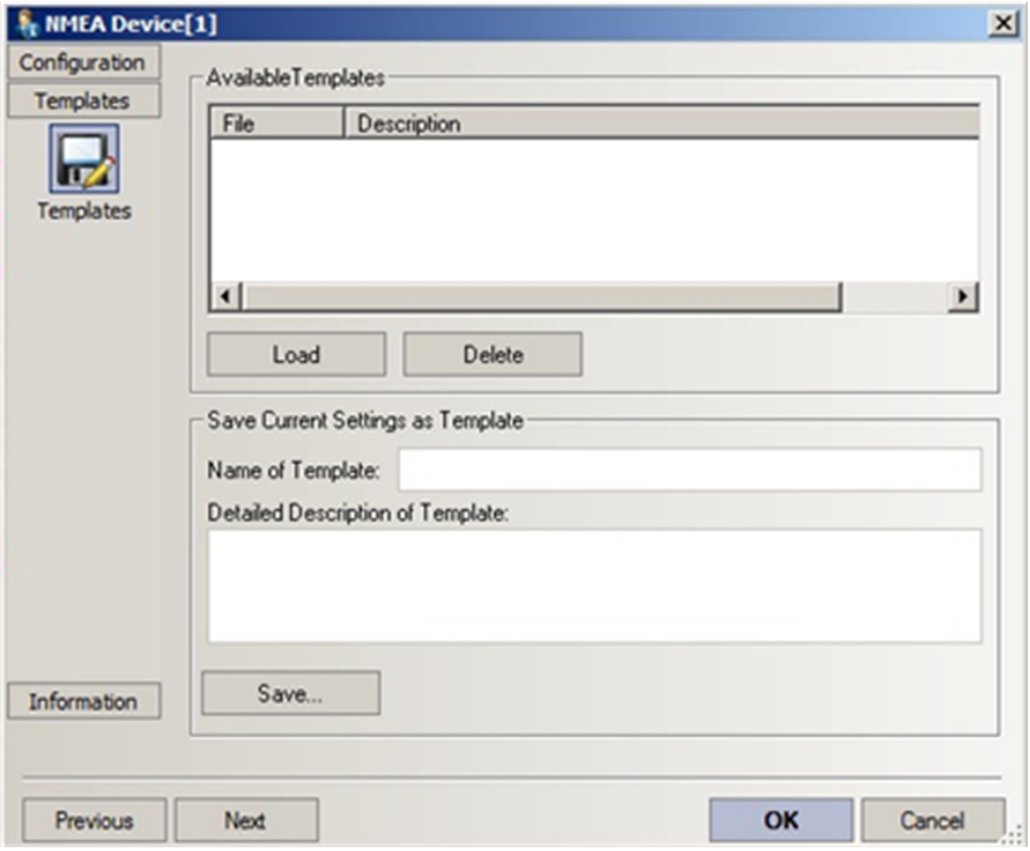


Figure 6-649: NMEA Configuration - Templates

NMEA device information

The NMEA "Navigation Driver" page displays information on the current device version.

If the "GPS Time and Initial Position" box is checked, the system time is synchronized with the GPS time so that the PC clock can be set to the accurate GPS clock. The validity of the received time is checked before the system time is set.

NMEA devices take the time from the RMC sentence. Set the data valid flag to 'A' before the system time is updated. This setting implies that the measurement can be started only after a string containing the time information has been received. This time delay can be avoided by switching off the correction and starting the measurement immediately. No other configuration settings are required.

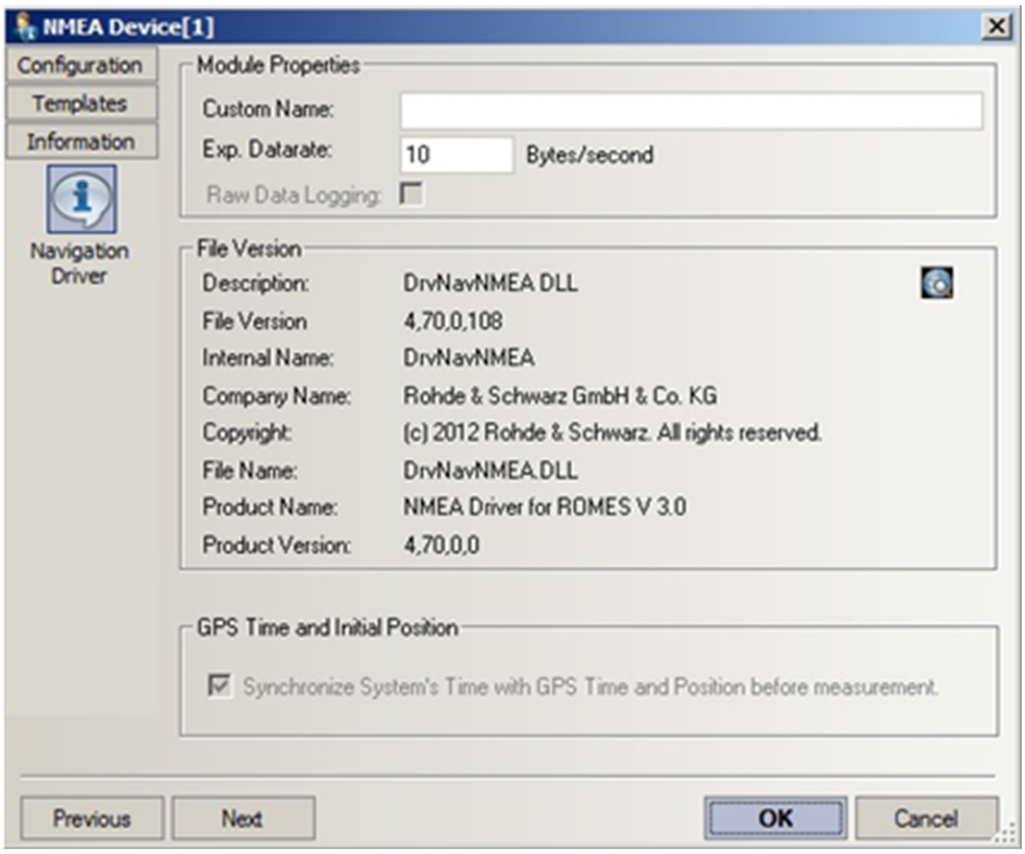


Figure 6-650: NMEA Configuration - Navigation Driver

R&S ROMES4 detects any NMEA device at the selected COM port. If not, check the COM port and the device power supply.

6.6.1.4 UBLOX GPS

The U-Blox device supports the GPS receiver R&S TSMX-PPS and R&S TSMX-PPS2. Also other devices based on U-Blox chipsets which have virtual serial port can be supported.

Disconnecting and connecting the USB cable is detected by R&S ROMES4, the U-Blox device is configured automatically. If a measurement is running, the recording of GPS data continues.

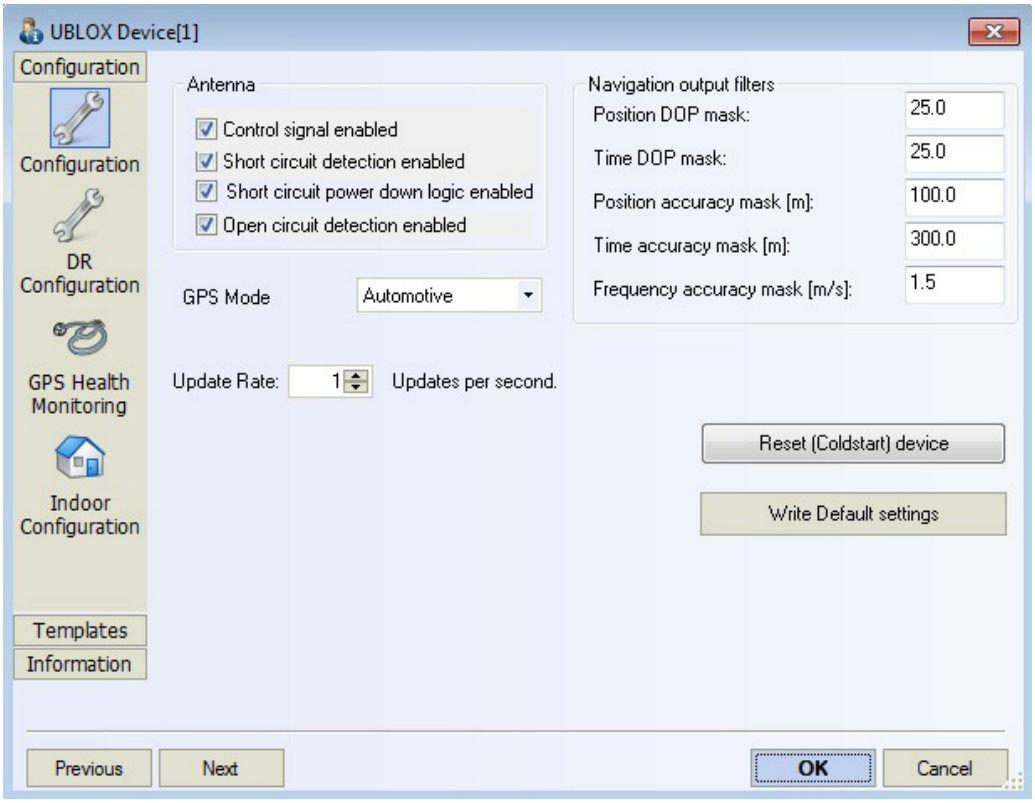


Figure 6-651: UBLOX Device - Configuration

The R&S ROMES4 U-Blox device disables the output of the NMEA messages on the device. To use the device again with NMEA protocol, it must be re-enabled with the u-center software from U-Blox (www.ublox.com). This software can be found on the R&S ROMES4 DVD in
`\Firmware & Drivers\GPS Receiver\ublox TSMX-PPX\u-center\.`

U-Blox configuration

The "UBLOX Device" configuration menu configures the loaded U-Blox device. With this protocol, it is possible to set the navigation output filters.

The "Configuration" tab enables the following to configure:

Antenna

When the GPS antenna is not correctly connected, you are warned about if this option is enabled in the device configuration. Following fault reports can be enabled:

- Control signal
- Short circuit detection
- Short circuit power down logic

- Open circuit detection

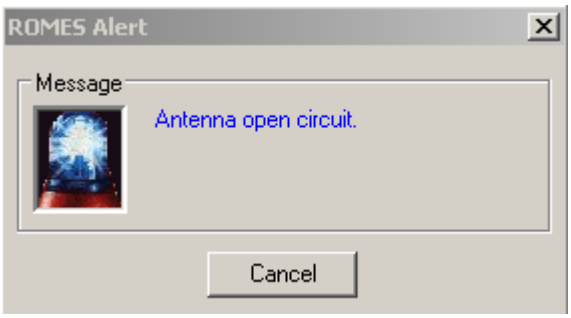


Figure 6-652: Example of a R&S ROMES4 Alert popup message

GPS mode

Eight different modes for the GPS are available:

- Portable
  Applications with low acceleration, for example, portable devices; suitable for most situations.
  - Max Altitude [m]: 12000
  - Max Velocity [m/s]: 310
  - Max Vertical Velocity [m/s]: 50
  - Sanity check type: Altitude and Velocity
  - Max Position Deviation: Medium
- Stationary
  Used in timing applications (antenna must be stationary) or other stationary applications.
  - Velocity restricted to 0 m/s
  - Zero dynamics assumed
  - Max Altitude [m]: 9000
  - Max Velocity [m/s]: 20
  - Sanity check type: Altitude and Velocity
  - Max Position Deviation: Small
- Pedestrian
  Applications with low acceleration, for example, how a pedestrian would move; low acceleration is assumed.
  - Max Altitude [m]: 9000
  - Max Velocity [m/s]: 30
  - Max Vertical Velocity [m/s]: 20
  - Sanity check type: Altitude and Velocity
  - Max Position Deviation: Small
- Automotive (recommended for drive tests)
  Default setting for ADR (Automotive Dead Reckoning). Used for applications with equivalent dynamics to those ones of a passenger car; low vertical acceleration is assumed.

  - Max Altitude [m]: 6000 (5000 for firmware versions 6.00 and below)
  - Max Velocity [m/s]: 84 (62 for firmware versions 4.00 to 5.00)
  - Max Vertical Velocity [m/s]: 15
  - Sanity check type: Altitude and Velocity
  - Max Position Deviation: Medium
- Sea
  Recommended for applications at sea, with zero vertical velocity; zero vertical velocity is assumed.
  - Max Altitude [m]: 500
  - Max Velocity [m/s]: 25
  - Max Vertical Velocity [m/s]: 5
  - Sanity check type: Altitude and Velocity
  - Max Position Deviation: Medium
- Airborne 1 G
  Used for applications with a higher dynamic range and vertical acceleration than a passenger car.
  - Max Altitude [m]: 50000
  - Max Velocity [m/s]: 100
  - Max Vertical Velocity [m/s]: 100
  - Sanity check type: Altitude
  - Max Position Deviation: Large
- Airborne 2 G
  Recommended for typical airborne environment. No 2D position fixes supported.
  - Max Altitude [m]: 50000
  - Max Velocity [m/s]: 250
  - Max Vertical Velocity [m/s]: 100
  - Sanity check type: Altitude
  - Max Position Deviation: Large
- Airborne 4 G
  Only recommended for extremely dynamic environment. No 2D position fixes supported.
  - Max Altitude [m]: 50000
  - Max Velocity [m/s]: 500
  - Max Vertical Velocity [m/s]: 100
  - Sanity check type: Altitude
  - Max Position Deviation: Large

Navigation output filters

- Position Dilution of precision (DOP) mask
- Time DOP mask
- Position accuracy mask [m]
- Time accuracy mask [m]

- Frequency accuracy mask [m/s]

Reset Button

- **Reset (Coldstart) device**
  Click the button "Reset (Coldstart) device" shuts down and resets the device. Resetting the device commands a total erasing of all stored data. This reset is called the cold start. Achieving all the needed info needs several seconds and is normally not necessary.

Write Default Settings Button

- **Write Default settings**
  Writing default settings take a valid U-Blox default configuration on the U-Blox chip and write over the actual configuration. Writing default settings helps easy return to a valid and working configuration.

Update Rate

- **Update Rate**
  The "Update Rate" slider is limited by the maximum update rate that the U-Blox chip can deliver. This update rate can be from 1Hz up to 20 Hz. The U-Blox chips with the enabled ADR functionality have maximum rate of 1 Hz only.

ADR configuration (R&S TSMX-PPS2 only)

The R&S TSMX-PPS2 has a built-in Automotive Dead Reckoning (ADR) feature. Even in tunnels or building canyons with bad or missing GPS coverage, the last valid position is extrapolated using distance and angle information from a gyroscope and a speed/direction pulse input from the vehicle.

The gyroscope for heading information is already embedded in the R&S TSMX-PPS2. Fed the vehicle tachometer pulses and the direction indication via the accessory sensor cable into the SENSOR IN port.

For using an R&S TSMX-PPS2 together with car sensors, we recommend a UBLOX flash version 7.03 or higher. Contact Rohde & Schwarz for a firmware update.

Attention: ADR positioning does not work or is incorrect if the polarity setting is erroneous.

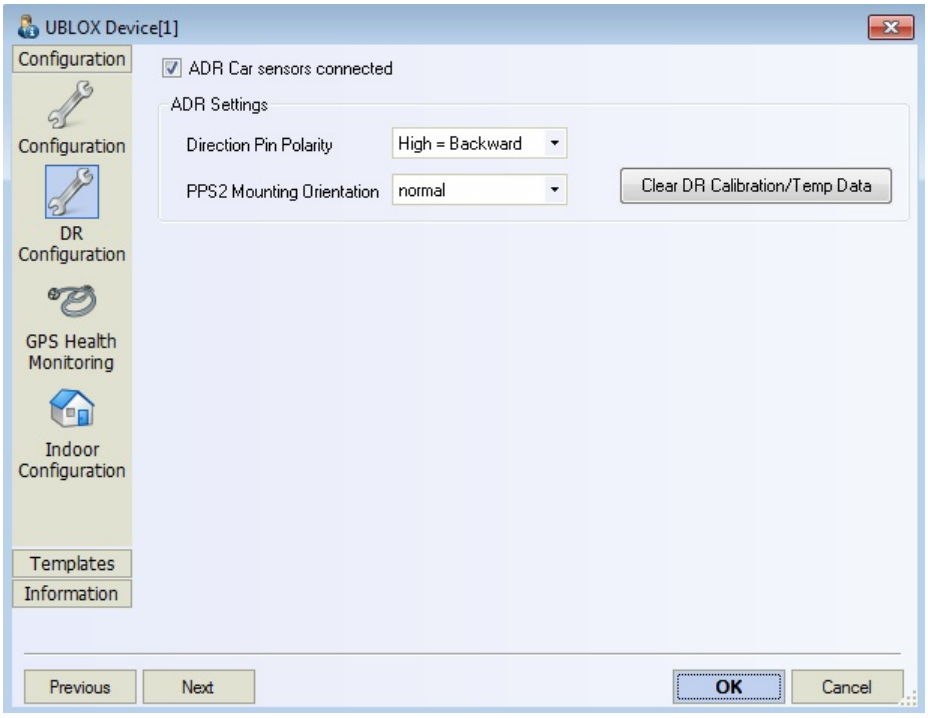


Figure 6-653: UBLOX Device - DR configuration

ADR Car Sensors Connected

Checking the "ADR Car sensors connected" enables the ADR functionality on the chip (only available with R&S TSMX-PPS2).

Direction Pin Polarity

The polarity depends on the reverse gear light signal and can be a high-level signal forward direction or backward direction. A correct setting can be seen at GPS Info view during a measurement.

PPS2 Mounting Orientation

As the gyroscope is placed on the UBLOX chip, it is necessary to know which mounting position the R&S TSMX-PPS2 has. Referring to the R&S TSMX-PPS2 operating manual, the PPS2 normal (strict horizontal) and upside down mounting position is possible.

- Set to "normal" if the R&S TSMX-PPS2 lettering can be seen from the top.
- Set to "upside down" if the R&S TSMX-PPS2 lettering is on the bottom side.

For optimum ADR performance, the system needs to learn from the internal sensors (gyro) and from the provided vehicle signals (speed & direction). Sometimes, for example when changing the vehicle or the sensors or when the GPS shows bad positioning data, it can be helpful to reset this calibration data by using the "Clear DR Calibration/ Temp Data" button.

As a result a new calibration is done.

In case the UBLOX chip has no ADR capability (e.g. R&S TSMX-PPS) all the ADR settings are disabled.

TSMX-PPS2 and UBLOX device navigation

As the TSMX-PPS2 device needs a correct information how the box is mounted in the vehicle and what the polarity of the backlight signal is, these must be set through the driver configuration. A wrong configuration prohibits a proper dead reckoning calibration.

Usually the TSMX-PPS2 is mounted in a car. If a R&S ROMES4 measurement is started with the uBlox device and a TSMX-PPS2, the device tries to improve its calibration status during movement. Whenever the calibration status for the tacho pulses and for the gyro is both coarse calibration or fine calibration, the configuration is written into the registry.

A wrong initial setting of direction pin polarity and PPS2 mounting orientation never reach a sufficient calibration state. Later at each load of the uBlox device, the registry searches for this configuration and uses it as a default. Of course, an existing workspace can overwrite this configuration.

This feature applies only for R&S TSMX-PPS2 device and if the "ADR Car sensors connected" functionality is enabled and the backlight signal is wired.

GPS health monitoring

The "GPS Health Monitoring" tab lets switch health monitoring in the "General Status View" on or off. Also, the tab offers the possibility to adjust the synchronization between PC and GPS time, see "Navigation driver information" on page 2074. Transmission time causes delays in milliseconds. If the delay is known, a higher accuracy can be reached by setting the "Constant Offset". This is only important for Video Quality Analysis.

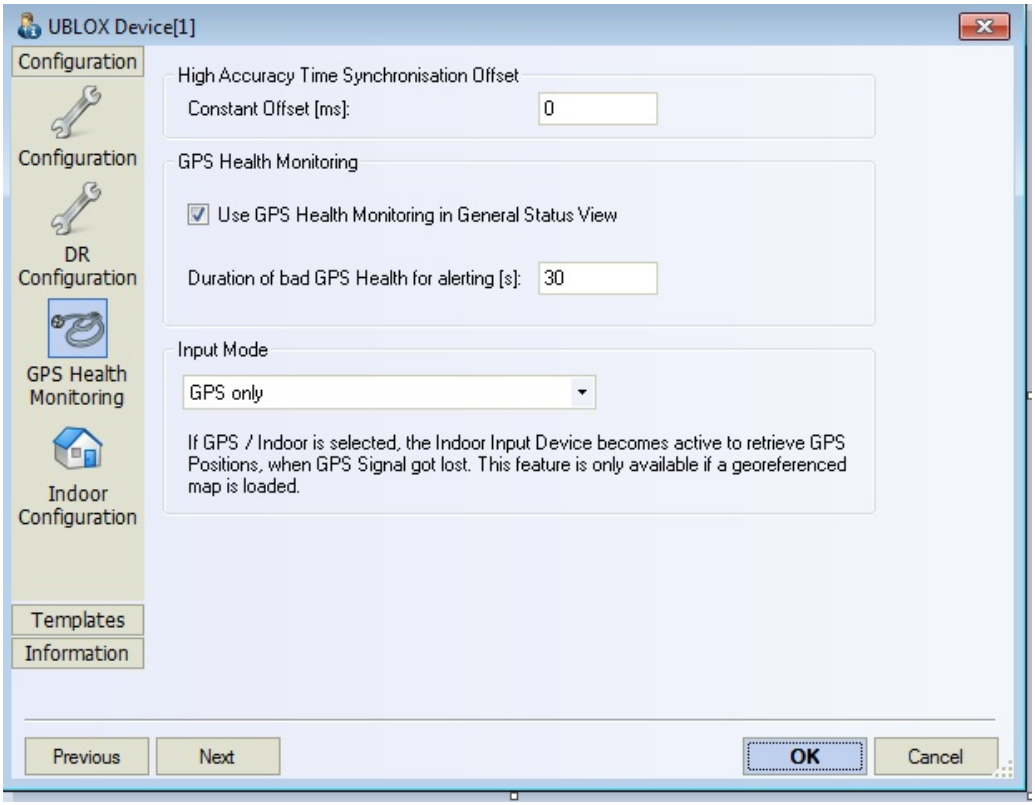


Figure 6-654: UBlox configuration - GPS Health Monitoring

Bad GPS health means that the GPS signal received is low. Bad health situations can frequently occur during an ordinary test trip, for example, if the vehicle crosses an underpass or a tunnel. If "Use GPS Health Monitoring..." is checked, bad health situations cause a warning message to be displayed in the "General Status View", provided that they last longer than the time selected in the "Duration of bad GPS Health..." entry field.

Furthermore GPS and Indoor can work together in combined mode.

The possible input modes are:

- GPS only
- GPS / Indoor

Therefore, define it within the "Input Mode" area. If configured as GPS / Indoor, indoor becomes active when the GPS signal is lost. For this mode, the indoor input works only in the measurement mode "Continuous Measurement" and the navigation mode "Stream Input".

Indoor configuration

The "Indoor Input" configuration menu lets select the measurement and the navigation mode and allows waypoints to configure. It is only active if the "GPS / Indoor combined" input mode is selected in the "GPS Health Monitoring".

For the explanation of the settings refer to Chapter 6.6.2, "Indoor input device - INDOOR", on page 2083.

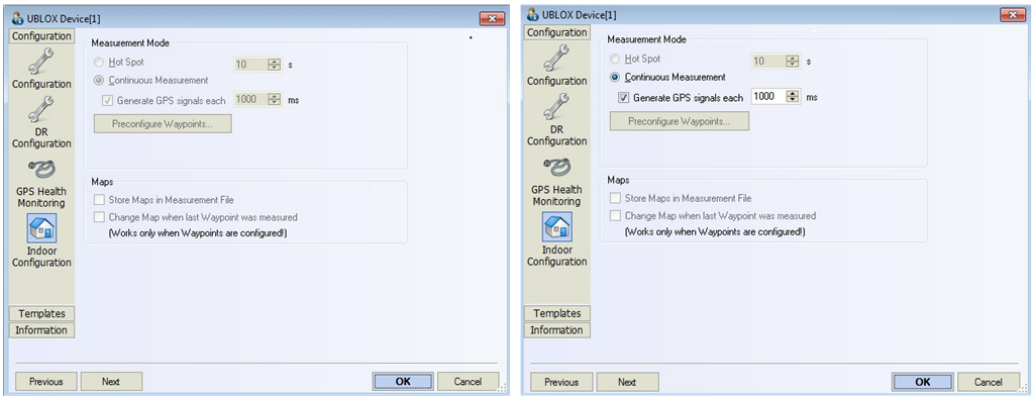


Figure 6-655: Indoor configuration tab, Input Mode „GPS only“ and Input Mode "GPS / Indoor"

Templates

The "Templates" tab let you store the current device configuration as a template, list, load or delete device templates. It is provided for many test devices and is identical for all them.

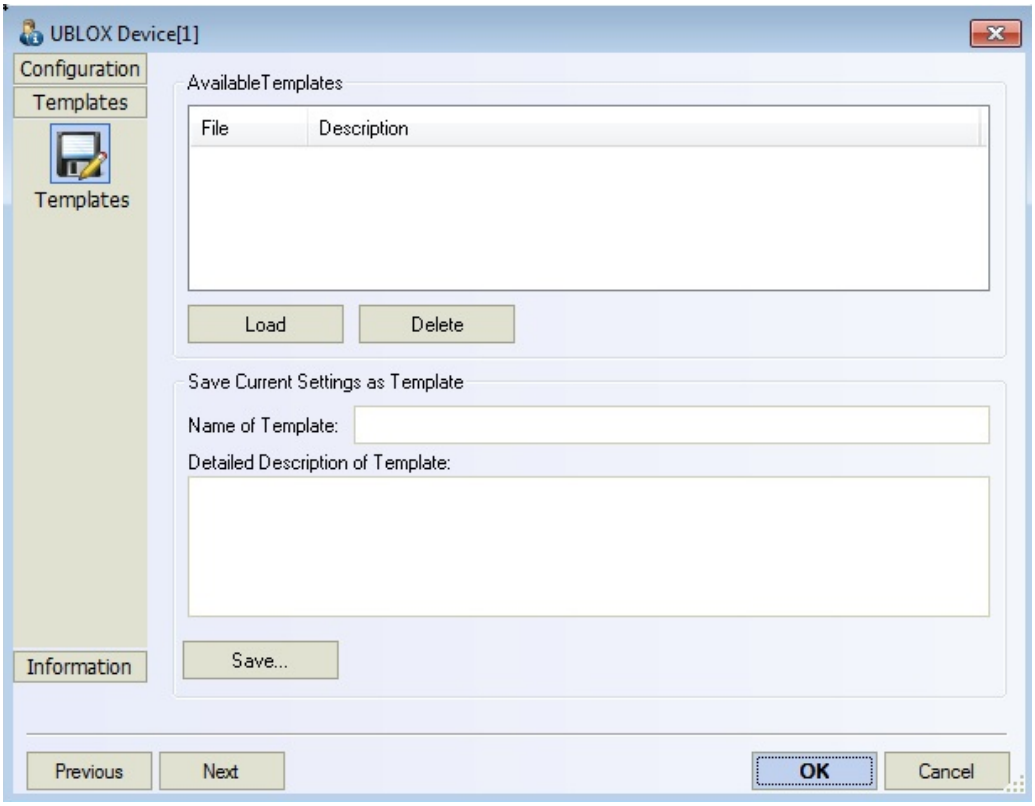


Figure 6-656: UBlox Configuration - Templates

Navigation driver information

The U-Blox "Navigation Driver" page displays information on the current driver version.

If the "GPS Time and Initial Position" box is checked, the system time is synchronized with the GPS time so that the PC clock can be set to the accurate GPS clock. The validity of the received time is checked before the system time is set.

U-Blox devices take the time form the sentence TIMEUTC. The accuracy has to be at least 0.1 seconds before the system time is updated. This accuracy implies that the measurement can be started only after a string containing the time information has been received. This time delay can be avoided, however, by switching off the correction and starting the measurement immediately. No other configuration settings are required.

The "Navigation Driver" tab displays information on the current device version. Messages such as "GPS bad health condition" or "Antenna open circuit" are displayed in the "General Status View".

The system detects any U-Blox device at the selected COM port. If not, check the COM port and the device power supply.

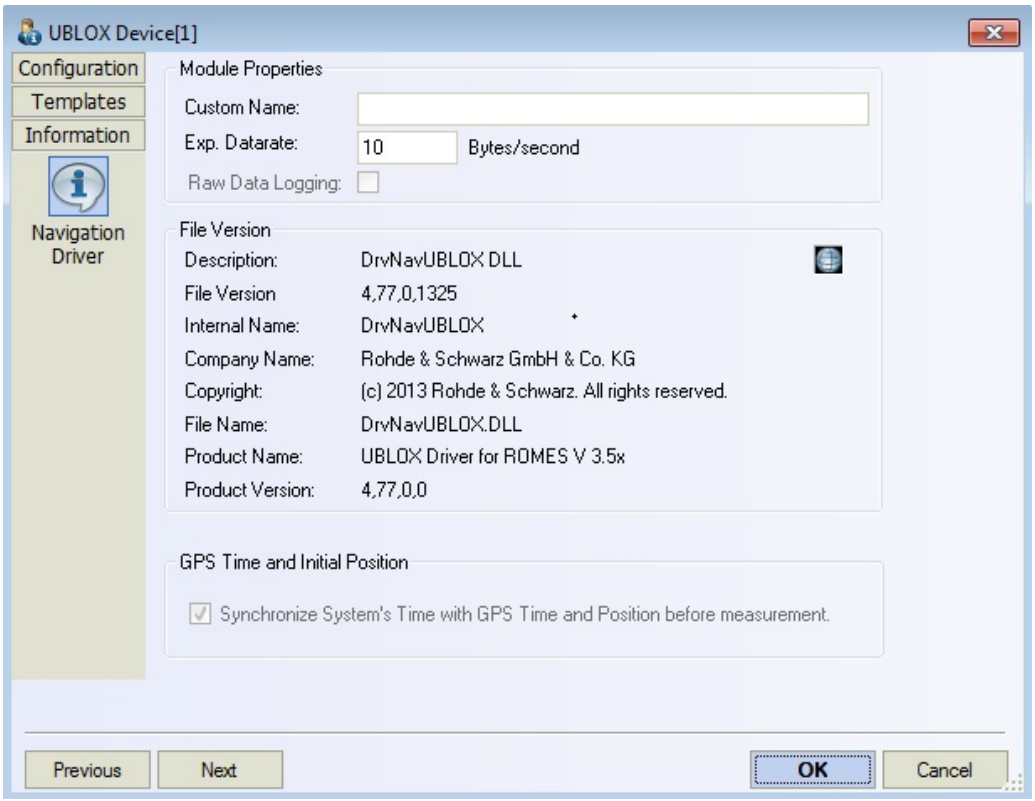


Figure 6-657: UBLOX Configuration - Navigation Driver

Configuration settings and information regarding the used hardware are displayed in the Measurement File Info.

Example: Measurement file Info layout

```
================================================
[GPS, Ver. 4.76]
Type:          UBLOX Device
Ellipsoid:           WGS84
Hardware Version:                    u-blox 6
Chip Version:                           LEA-6R
Protocol Version:                    7.03
ROM Version/Flash Version:        6.02 / 7.03
Features:                               GPS; DR;

Position DOP mask:                   25.0
Time DOP mask:                       25.0
Position accuracy mask:           100.0 m
Time accuracy mask:                  300.0 m
Frequency accuracy mask:          1.5 m/s
DGPS timetag rounding disabled.
GPS mode:                               Automotive
Antenna control signal enabled.
Antenna short circuit detection enabled.
Antenna short circuit power down logic enabled.
Antenna open circuit detection enabled.
Car sensors are not connected.

Driven Area:    48°8'34"N (Lat. up left)
                11°36'31"E (Long. up left)
                48°6'11"N (Lat. bottom right)
                11°45'32"E (Long. bottom right)
================================================
```

6.6.1.5 R&S TSME GPS

Installation of the R&S TSME GPS device is explained in Chapter 6.6.1, "GPS devices", on page 2061.

The following figure shows the R&S TSME GPS device configuration.

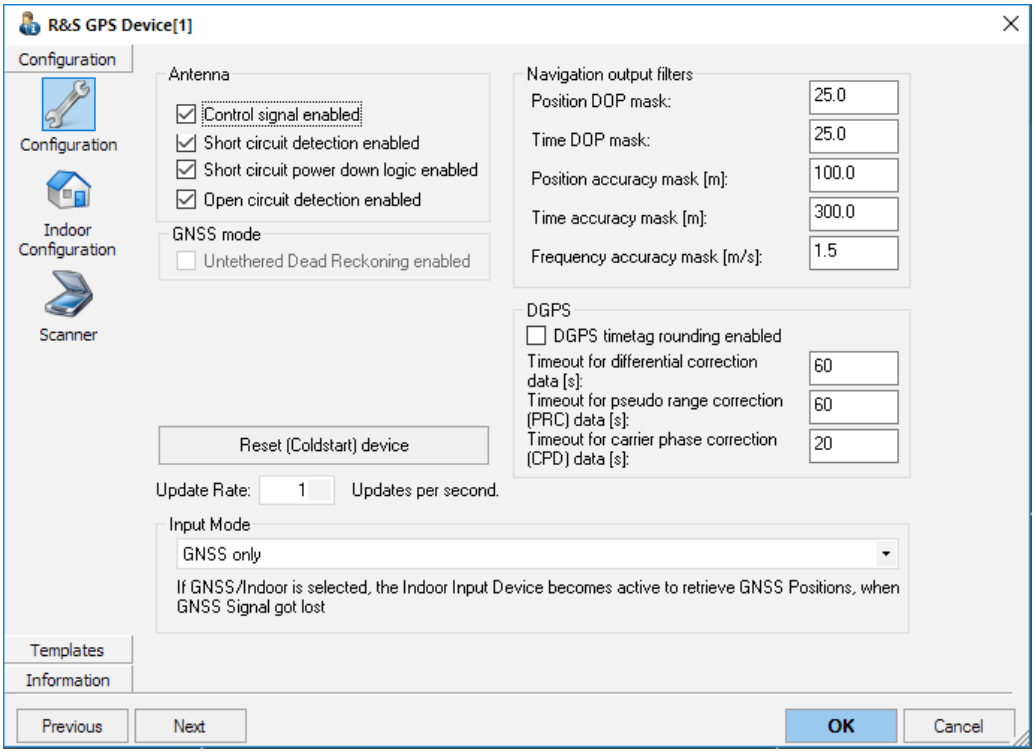


Figure 6-658: R&S TSME GPS Device - Configuration

It is possible to set the navigation output filters.

The update rate with the R&S TSME GPS device is one per second.

The following figure shows the R&S TSME6 scanner configuration page which allows to configure the GNSS mode. Tick the "Untethered Dead Reckoning enabled" check-box to configure the GNSS mode.

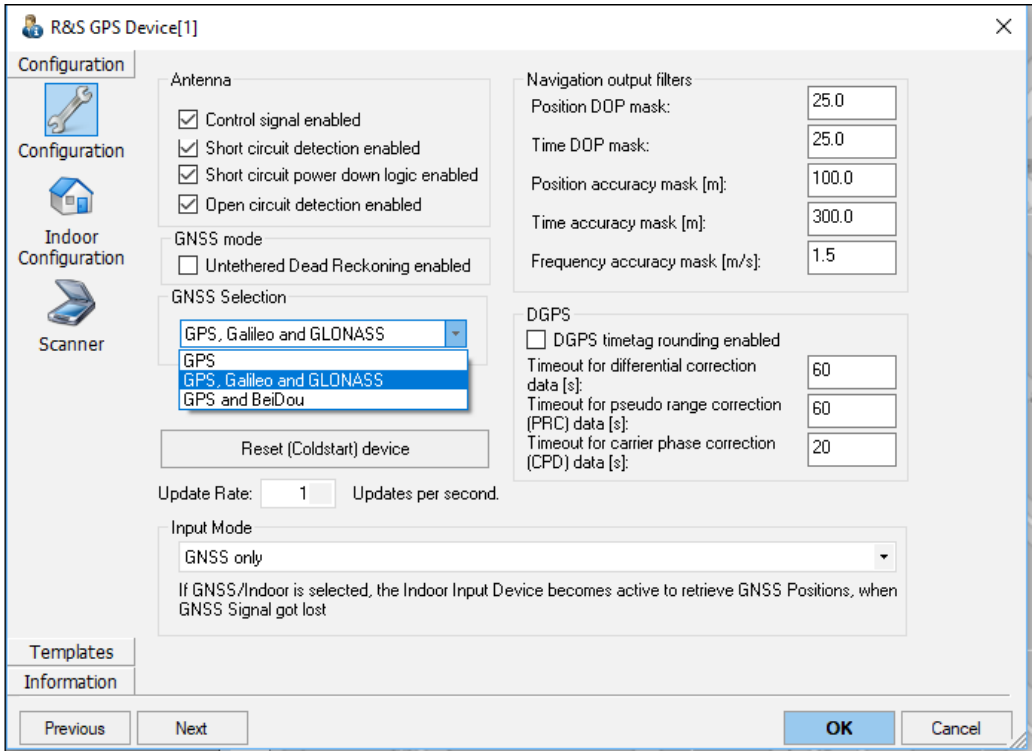


Figure 6-659: R&S TSME6 GPS Device - Configuration

Click the "Untethered Dead Reckoning enabled" checkbox to get more precise GPS positions. For details, refer to https://www.u-blox.com/en/dead-reckoning.

Configuration

The "Configuration" tab lets you configure the following:

Antenna

Incorrect connected GPS antenna is reported to you if the option to report the case is enabled in the device configuration page. Following fault reports can be enabled:

- Control signal
- Short circuit detection
- Short circuit power down logic
- Open circuit detection

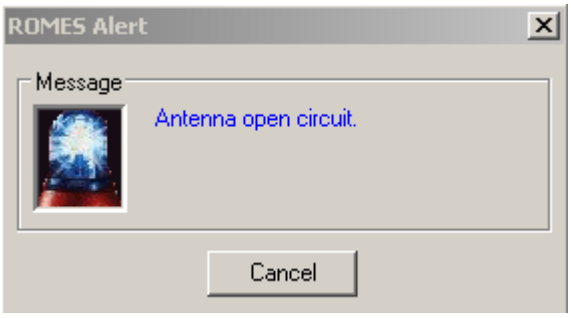


Figure 6-660: Example of a R&S ROMES4 Alert popup message

GNSS Mode

GNSS mode is active for R&S TSME GPS if the "Untethered Dead Reckoning enabled" checkbox is ticked in the R&S TSME6 mode.

GNSS selection

The drop-down "GNSS Selection" box offers the selection of a satellite positioning system.

Navigation output filters

- Position Dilution of precision (DOP) mask
- Time DOP mask
- Position accuracy mask [m]
- Time accuracy mask [m]
- Frequency accuracy mask [m/s]

DGPS

- DGPS time tag rounding enabled
- Timeout for differential correction data [s]
- Timeout for pseudo range correction (PRC) data [s]
- Timeout for carrier phase correction data (CPD) [s]

Reset Button

- "Reset (Coldstart) device"
  Click the "Reset (Coldstart) device" button to shut down and reset the device.

Update Rate

Enter the update rate of the GPS device. It can be set between 1 and 5 position updates per second.

Input Mode

It is available for all drivers. For the R&S TSME the user can select between:

- "GNSS only"

- "GNSS/Indoor"

Indoor configuration

If the "Indoor Configuration" tab is clicked, the same window opens as that one shown in Chapter 6.6.1.3, "NMEA GPS", on page 2062.

Scanner tab

Click the "Scanner" tab to get the information on configured device and the running software version.

6.6.1.6 R&S HE300 GPS compass

The R&S HE300 GPS compass is an active directional antenna.

Two variants of the R&S HE 300 antenna are available.

- R&S HE300 Var03 with built-in compass and GPS
- R&S HE300 Var02 with no electronic compass and no GPS, but with magnetic compass

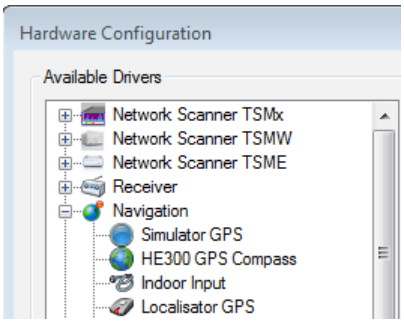


Figure 6-661: Some available navigation devices

If the R&S HE300 Var03 is used, the antenna cable feeds a scanner or receiver. The USB adapter transfers GPS position and compasses heading data from the antenna to the connected PC. There are no drivers for antennas in R&S ROMES4. The R&S HE300 device covers the part of a compass and GPS.

The R&S ROMES4PAN option is necessary to use the R&S HE300 Var03.

If the R&S HE300 Var02 (without electronic compass/GPS) is used, the HE300 device is not required and cannot be loaded.

Driver and option ID are not necessary to use the R&S HE300 Var02.

The "Direction" signal shows the compass value. GPS data, if available, are signaled as longitude and latitude.

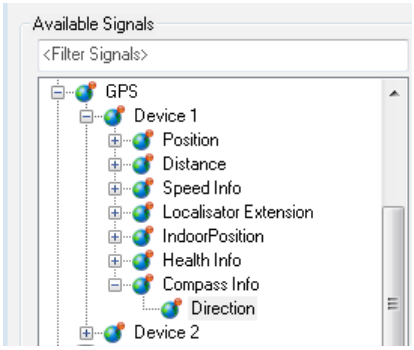


Figure 6-662: Compass info for GPS

The electronic compass also detects the roll and pitch values. Validity of direction only applies for roll and pitch values between -59° and 59°.

How to use the antenna: refer to "R&S HE300 Manual"

Configuration of R&S HE300 GPS compass

If the GPS is in a bad receiving condition, deactivate "Use GPS Health Monitoring in General Status View" in the "GPS Health Monitoring" page. This prevents from nagging about health alert.

If floor plans are used, select the GPS / Indoor combined option in the "Input Mode" field.

6.6.1.7 MAVLink

The drones are used more and more for QualiPoc and scanner measurements to get the reliable altitude information. The reliable altitude information is a key for identification of coverage holes or interference. To send messages between ground stations and drone, MAVLink is commonly used protocol. It is an open-source protocol.

R&S ROMES4 supports MAVLink data from a serial port. The R&S ROMES4 MAVLink GPS device reads MAVLink data packets from any COM port.

Configure a drone that sends out the required MAVLink messages. For GPS data, MAVLink message #33 is used.

6.6.1.8 GPS simulator

The "Simulator GPS" menu configures the GPS simulator and shows the current file version.

Position

The "Position" tab lets you select the geographical start position, the speed and direction of the measurement curve on the map. Some attributes can be assigned to the measurement data via this menu also.

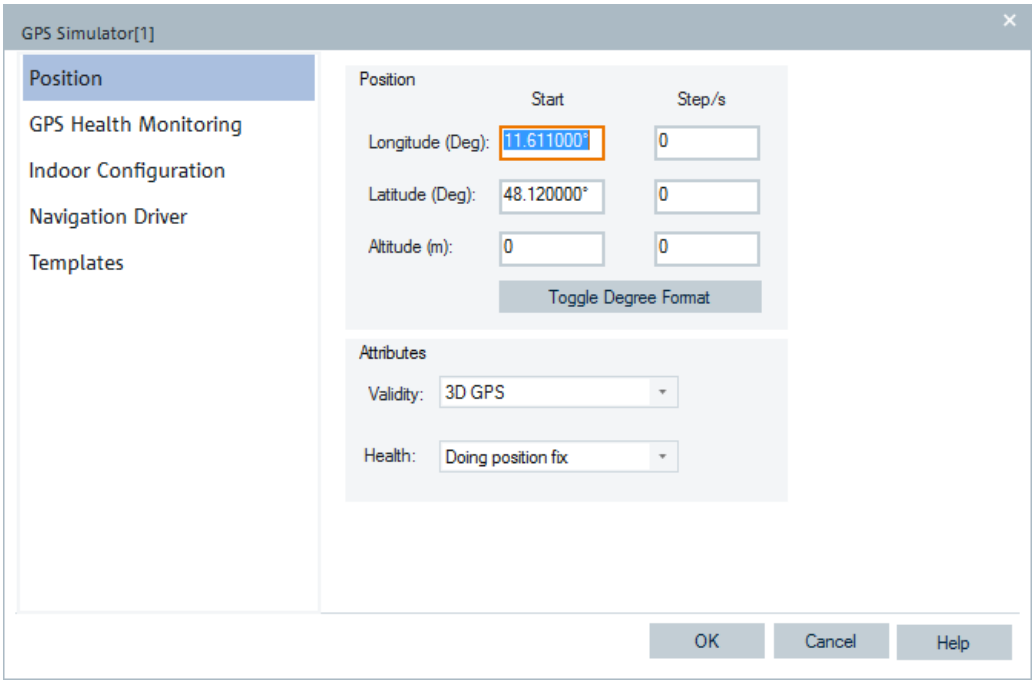


Figure 6-663: GPS Simulator configuration

- "Position"
  The panel defines the position of the measurement data on the map:
  - "Start"
    The first measurement point is assigned the three geographic coordinates in the "Start" column. If the data is displayed in the "Route Track View", then the "Altitude" coordinate does not contribute to the representation but is shown in the "GPS Info" view.
  - "Step/s"
    The three coordinates in the "Step/s" column define the geographical distance of a data point from another that was recorded 1 s earlier. The "Altitude" coordinate is not considered. The ratio between "Longitude" and "Latitude" determines the angle of the measurement curve on the map; the sum of the squares of both values is proportional to the square of the speed of the measurement curve on the map.
- "Attributes"

The panel assigns a (fictitious) "Validity" and "Health" value to the measurement. Both values are shown in the "GPS Info" view.

GPS health monitoring

For the "GPS Health Monitoring" tab, see "GPS health monitoring" on page 2064.

Navigation driver

The "Navigation Driver" tab displays information on the current GPS simulator version, see "NMEA device information" on page 2066.

6.6.2 Indoor input device - INDOOR

The option R&S ROMES4IND and the "ROMESMAP Route Track View" are necessary to use the "Indoor Input" device.

The Indoor Input device is used for measurements in areas where no GPS navigation signal is available, that is, inside buildings.

The "ROMESMAP Route Track View" is used to visualize the measurement route, see ROMESMAP route track view.

One or more user-defined maps, for example, floorplans are used. Furthermore, it is possible to use GPS and Indoor measurement in Combined mode. That means, when the GPS signal is lost the navigation device switches to Indoor Input mode, where the waypoints are set on a map to be treated as GPS signals.

How to configure the Combined mode, see Chapter 6.6.1.3, "NMEA GPS", on page 2062.

The Indoor Input device itself does not need additional hardware.

Support of indoor navigation device

Old workspaces, created with the Indoor Navigation device, cannot be read anymore. To display the old measurement files, use the still existing earlier version of "Indoor View".

The "Indoor Navigation Control" does not exist anymore. The indoor navigation is integrated in the "ROMESMAP Route Track View".

Qualipoc/SmartBenchmarker indoor measurements

The Indoor measurements conducted directly with QualiPoc/SmartBenchmarker (`*.sqc/*.sqz` files) are fully supported for an import and replay in R&S ROMES4.

6.6.2.1 Device configuration menu INDOOR

"ROMESMAP Route Track View" is used for displaying signals of indoor measurements.

Therefore, the wanted background bitmap is loaded over the "ROMESMAP Route Track View".

Open the Indoor Input device configuration menu for all other configuration settings related to indoor measurements. To do that, select the "Indoor Input" command line in the "Hardware" menu which is available after loading the device.

6.6.2.2 Indoor input configuration – setup

The "Indoor Input" dialog is used to select the measurement and navigation mode and to configure waypoints.

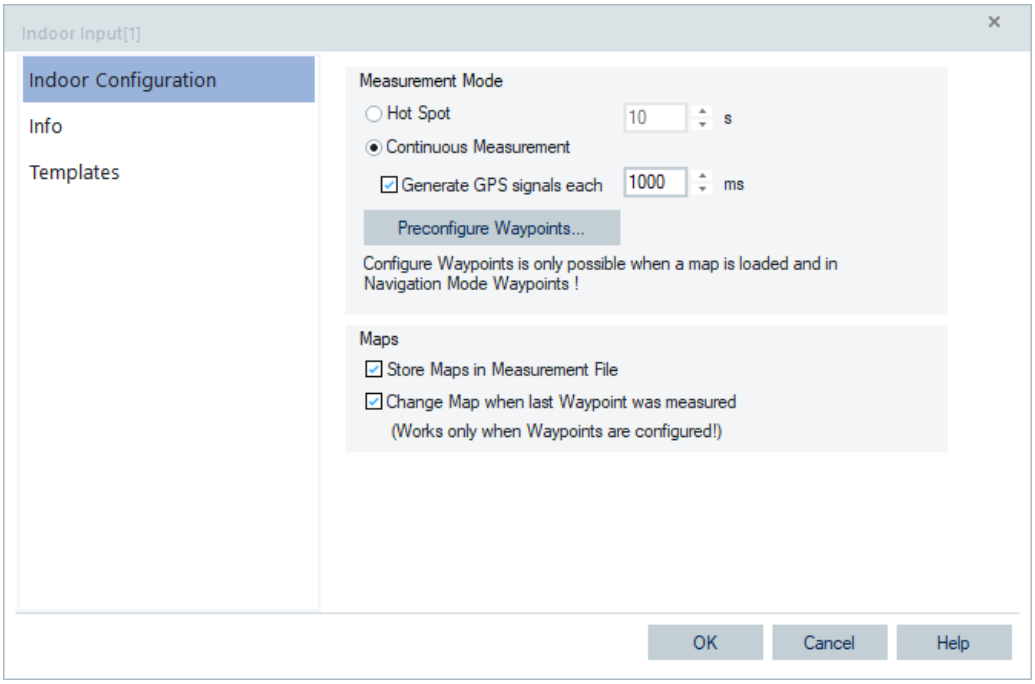


Figure 6-664: Indoor input device configuration menu

Measurement Mode
Two modes are available for indoor measurement:

- Measurement in a fixed time interval; select the "Hot Spot" option button
- Measurement that lasts for an undetermined time unless restarted explicitly; select the "Continuous Measurement" option button

Both measurement modes can be combined individually with the "Waypoints".

A waypoint defines a position of a measurement location, and is reported to the measurement system.

R&S ROMES4 offers to predefine waypoints before the measurement starts. To predefine waypoints, click the "Preconfigure Waypoints" button. Otherwise, the waypoints are set during the measurement. See also Indoor measurements in different navigation and measurement modes.

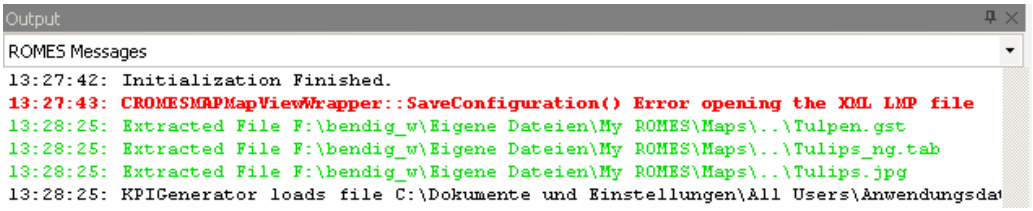
If "Generate GPS signals each ... ms" is checked, the position interpolation is running during the measurement. This interpolation is available only in the Continuous measurement mode. The frequency and the number of GPS signals define the interpolation granularity.

Click the "Preconfigure Waypoints" button to define waypoints on the current loaded indoor view of the measurement route. For details how to add, edit and remove waypoints, see Chapter 6.6.2.3, "Preconfigure waypoints", on page 2085.

Note: The "Preconfigure Waypoints" button is only active, if already an image map is loaded in the "ROMESMAP Route Track View".
How to load an image map, see Chapter 4.3.3.6, "Maps menu", on page 606.

Maps
Only available for MapInfo maps.

If "Store Maps in Measurement File" is active, all the map files of the Map Set are stored in the measurement file. Stored maps are extracted before replay is performed. In "Output" the extracted files are shown below the green colored entries, see the following figure.



Note: The mentioned setting has no impact if indoor mode is used together with GPS mode, described in NMEA GPS as combined mode (GPS/Indoor combined). The maps are not saved in the measurement file regardless of the checking the check box.

If "Change Map when last Waypoint was measured" is active, the next, not yet measured map, is activated after the last waypoint being measured. This feature is only available in the "Navigation Mode Waypoints".

OK
Applies the current configuration (if it is valid) and closes the "Indoor Input" menu.

Cancel
Discards the configurations made and closes the "Indoor Input" menu.

6.6.2.3 Preconfigure waypoints

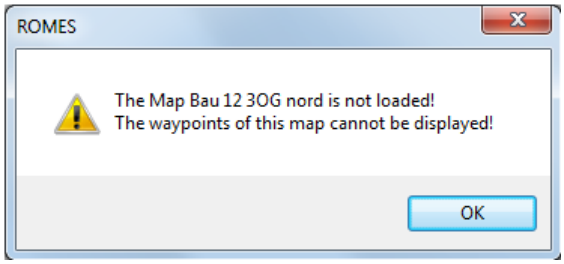
Click the "Measurement Mode" > "Preconfigure Waypoints" button to prepare waypoints for a current loaded indoor view in advance.

Figure 6-665: Indoor Input – Preconfigure Waypoints button

Always load the map first

Always add or remove the maps before configuring waypoint or measurement tasks!

If the map of a measured waypoint is not loaded in the "ROMESMAP Route Track View", a message box informs the user that the waypoint cannot be displayed. This message appears once for each map on which waypoints are created during a measurement.



► Click the button "Preconfigure Waypoints" to switch to the waypoint configuration mode.

For this purpose, the "ROMESMAP Route Track View" opens in a waypoint configuration mode and a "Waypoint Configuration" dialog appears on the right hand-side of the view.

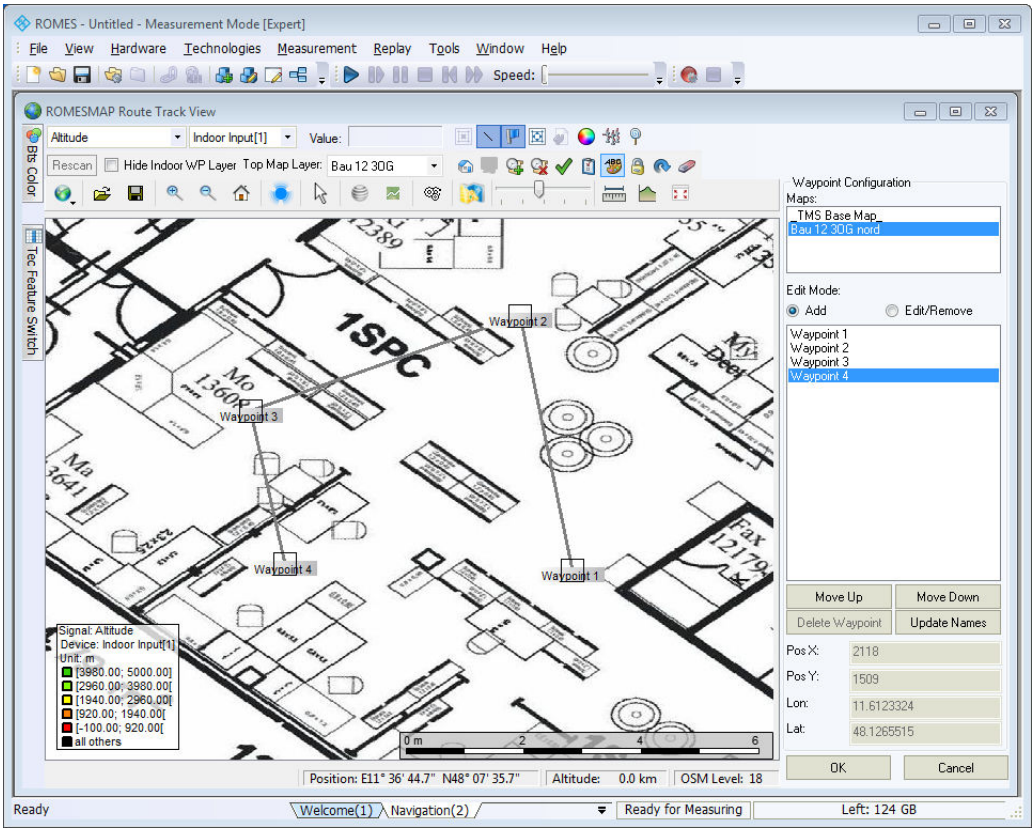


Figure 6-666: Route Track View in waypoint configuration mode

Waypoint configuration

The "Waypoint Configuration" dialog contains the following functions.

Maps

All maps of the "Map Set" are displayed in the list box. If a map is selected from the list, it is displayed in the "ROMESMAP Route Track View" and waypoints can be defined for this map. The last selected map is placed on top in the list.

The "Floorplan Changed" event makes it possible to visualize floorplan changes in the basic views.

If activated, the "Floorplan Changed" event makes floorplan changes visible in this and another R&S ROMES4 basic views. The event is activated in the "Performance" > "Available Events" > "GPS Events" >"Indoor".

Edit Mode

Defines the "clicking" mode on the map.

- **Add**
  If active, a new waypoint is created by clicking a wanted position on the map. The waypoint has the name "Waypoint" plus a continuous number. The created waypoints are shown in the list box.
- **Edit/Remove**

If active, waypoints can be moved by dragging it to another position. Furthermore, from a selected waypoint the coordinates (lon. and lat.) can be changed or a waypoint deleted by clicking the "Delete Waypoint" button.

Move Up
Moves up the selected waypoint one position.

Move Down
Moves the selected waypoint one position down.

Delete Waypoint
Removes the selected waypoint

Update Names
Updates the waypoint names using the current order. The update can be necessary after deleting a waypoint or changing their order.

How to rename a waypoint, see step-by-step explanation in section "Rename a waypoint" on page 2093.

Pos X/Pos Y
Defines the X- and Y-screen coordinates in pixel of the selected waypoint.

Lon/Lat
Specifies the longitude and the latitude of the selected waypoint. If the "Edit Mode" is set to "Edit/Remove", the coordinates are editable.

OK
The waypoint configuration mode closes and the configuration is saved in the current workspace.

Cancel
The waypoint configuration mode closes without saving the changes.

6.6.2.4 Indoor navigation - templates

The "Templates" tab stores the current device configuration as a template, lists, loads or deletes device's templates. All settings are analogous to the GSM device settings, refer to Chapter 6.4.18.8, "Templates GSM NWS", on page 1786.

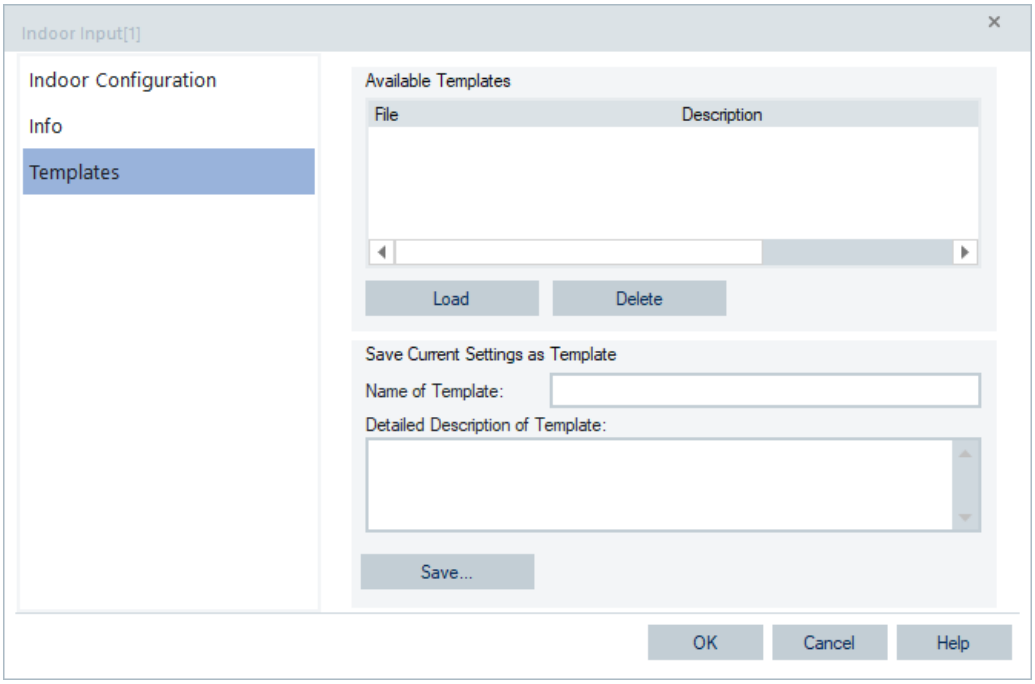


Figure 6-667: Indoor Navigation – Templates

6.6.2.5 Load maps

For loading maps, see Chapter 4.3.3.6, "Maps menu", on page 606.

Special characters are not allowed within the map name.
For example, German characters ö,ü and ä have to be transferred to oe, ue and ae; instead of `Übersicht.jpg` write `Uebersicht.jpg`.

6.6.2.6 Measurement mode INDOOR

The "Measurement Mode" panel of the Indoor Input device offers two different measurement modes, the "Hot Spot" and the "Continuous Measurement".

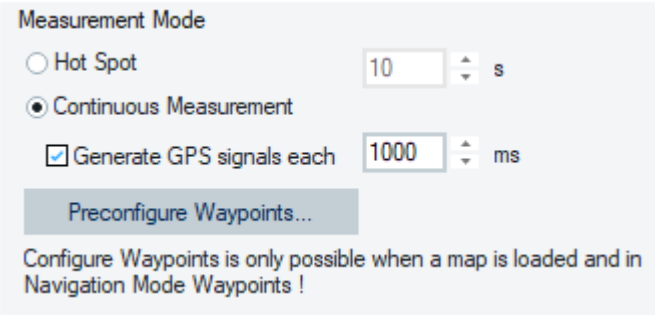


Figure 6-668: Indoor Input – Measurement Mode pane

Table 6-27: Indoor measurements in different navigation and measurement modes

Navigation Mode	Measurement Mode	
	Hot Spot (measurement with time limit)	**Continuous** (measurement without time limit)
Preconfigured Waypoints (predefined measurement points)	• Go to next waypoint • Click the waypoint button in the control menu to initiate new measurement after preset second count. The result is shown at the waypoints (discrete values)	• Go to next waypoint • Click waypoint button in the control menu to initiate new measurement The result is shown between the waypoints (color scale)
Stream Input (measurement points defined ad hoc)	• Go to next measurement point • Use mouse to mark the measurement point (current position) on the Indoor view • Click position to initiate new measurement after preset second count The result is shown at the measurement points (discrete values)	• Go to next measurement point • Use mouse to mark the measurement point on the Indoor view • Click map location to initiate new measurement. The result is shown between the measurement points (color scale)

Configure signals and test devices in advance

To see the signals and devices in "ROMESMAP Route Track View", configure them via "ROMESMAP Route Track View" > "Configuration" first, see chapter ROMESMAP route track view.

Starting an indoor measurement switches the "ROMESMAP Route Track View" to Indoor Measurement mode. The "Indoor Measurement" dialog appears at the right-hand side of the view.

The measurement dialog of the Indoor Navigation module is made more usable on touch screens by adding the “Auto Heading” feature. If this one is active, the map is rotated in a such way, that the last segment of the route is made vertical. The following figure shows the segment for the waypoint 7.

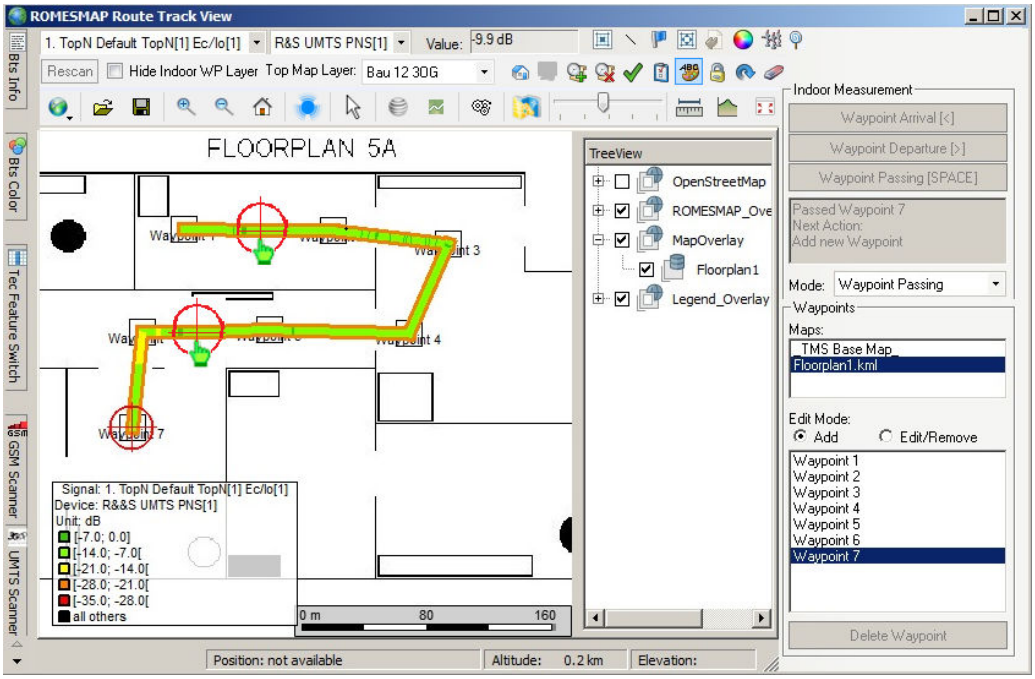


Figure 6-669: Indoor Continuous Measurement mode

The previous figure shows the possibility to jump to points between waypoints of the Indoor measurement in continuous mode. Note the marked points with the hand symbol between two waypoints in the figure. It is possible to click anywhere on the route track.

Limitation of this new function is: additional to way points, for all route via points there are timestamp values available.

If clicked between two via points, corresponding timestamp is calculated by assuming a constant speed. Therefore, the cursor marker cannot be exactly set to clicked route point.

Auto Heading enables automatically the rotating mode of the ROMESMAP Route Track View, see Rotate map on / off.

Indoor measurement control

Force Indoor
If active, forces the Indoor input in a GPS/Indoor combined measurement. This feature can avoid frequent switching Indoor on and off when there is a poor GPS quality. Switching off the Force Indoor option has only the effect when there is a good GPS.

If the GPS device runs in GPS/Indoor combined mode, the Indoor Measurement Control is always displayed.

If GPS is active and the "Force" checkbox is ticked, the position data and the GPS state are displayed in the upper right-hand part of the window.

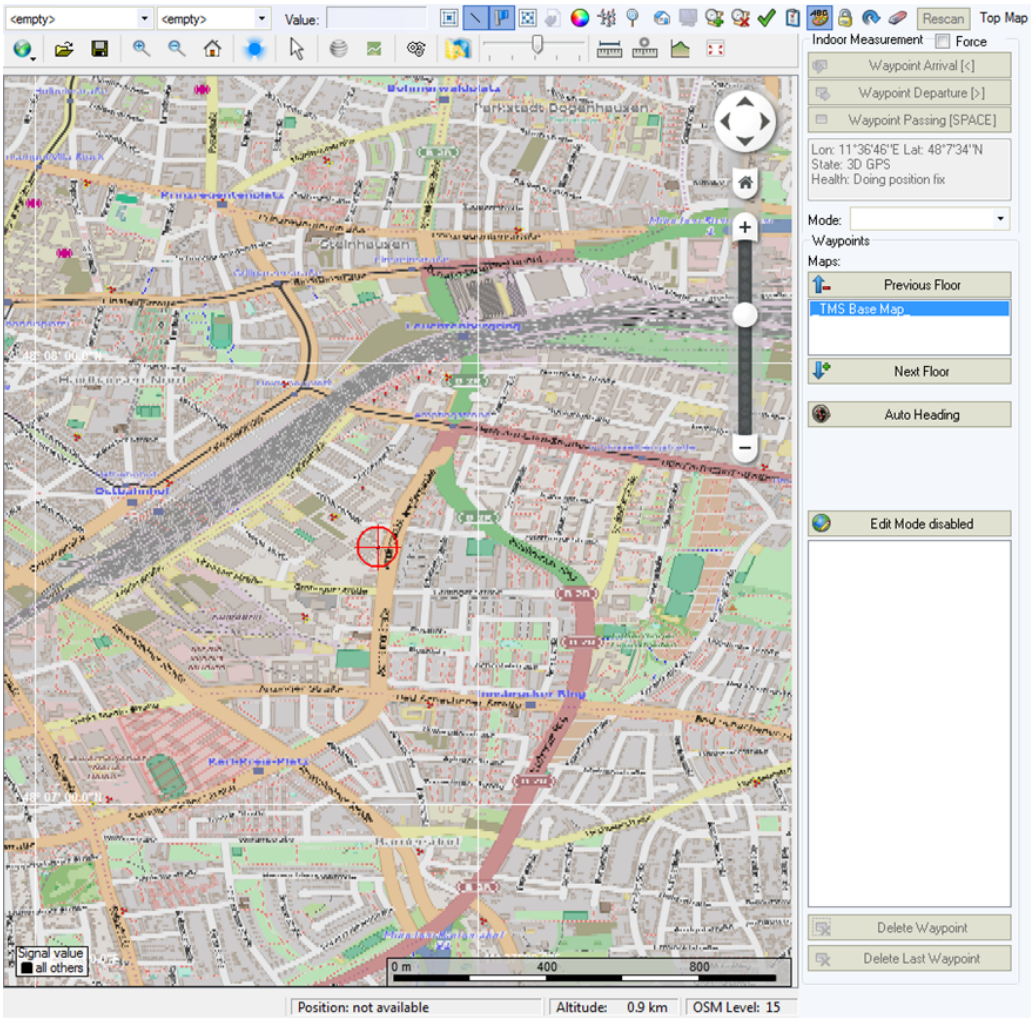
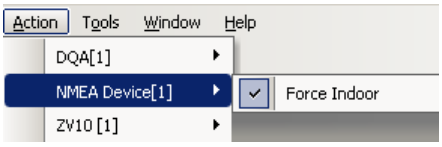


Figure 6-670: Displayed position data and GPS state

Force Indoor can be also configured in the "Action" menu during the measurement.



Action Buttons

The actions which these buttons enable depend on the measurement mode. An information field under the action buttons informs about the next action.

Mode

The "Mode" combo-box lets you select the action after adding a new waypoint. The available actions depend on the measurement mode ("Hot Spot" or "Continuous Measurement"). The action is performed only if all other waypoints were measured before adding a new waypoint.

The possible modes are:

- **No Action**
  No action is performed after adding a new waypoint.
- **Check Waypoint (only Hot Spot mode)**
  Performs the Check Waypoint action after adding a new waypoint.
- **Waypoint Arrival (only Continuous Measurement mode)**
  Performs the Waypoint Arrival action is performed after adding a new waypoint.
- **Waypoint Passing (only Continuous Measurement mode)**
  Performs the Waypoint Passing action is performed after adding a new waypoint.

Maps
All maps of the Map Set are displayed in the list box. Selecting a map displays the map on the "ROMESMAP Route Track View" and all the waypoints defined on this map. The last selected map stays on top of the list.

Edit Mode
Defines the clicking mode on the map.

- **Add**
  If "Add" is activated, a new waypoint is created by clicking a wanted position on the map. The waypoint gets the name "Waypoint" plus a continuous number. The created waypoints are shown in the list box.
- **Edit/Remove**
  The selected waypoint can be moved by dragging it to another position. The selected waypoint can be deleted using the "Delete Waypoint" button. Furthermore, via right mouse click "Show Maps Menu" the context menu for the selected waypoint is available.
  "Edit/Remove" provides the possibility to add, move or remove waypoints also in Navigation Mode Waypoints.

Delete Waypoint
Removes the selected waypoint. If the "Edit Mode" is set to "Edit/Remove", the name is editable.

Rename a waypoint

Select a waypoint in the list box and press the left mouse button more than one second on the selected item or double-click the selected item. The list box item goes into edit mode.

Rename a waypoint

1. Set "Edit Mode" to "Edit/Remove".
2. Select a waypoint in the list box.

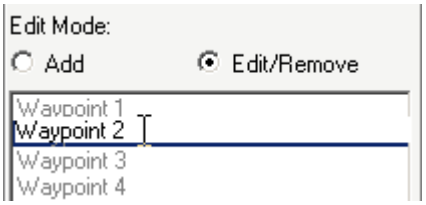


Figure 6-671: Selected waypoint is editable

3. Double-click the selected item.

   The name of the waypoint is editable now.

Rename multiple waypoints

Procedure

1. Set "Edit Mode" to "Edit/Remove".
2. Select the waypoint with the prefix that is used for all other waypoints.

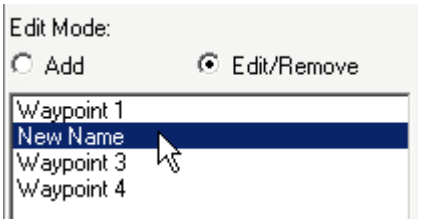
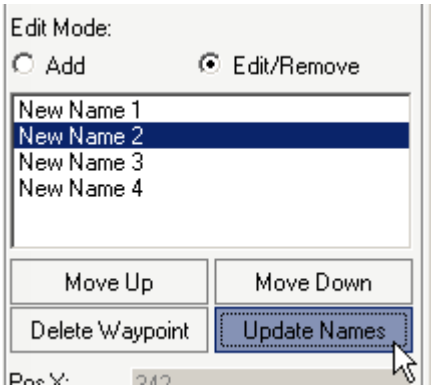


Figure 6-672: Selected waypoint is editable

   After a double-click or a single slow click, the name of the selected waypoint is editable.

3. Click "Update Names".



   All the waypoint names have the same prefix as the selected on.

Hot spot

The measurement in the "Hot Spot" mode terminates after a fixed time, but can be restarted at each measurement position (hot spot). The fixed measurement time is set in the input field of the "Hot Spot" radio button.

When the measurement is started, the "ROMESMAP Route Track View" switches to "Measurement" mode. The "Indoor Measurement" control dialog appears at the right side of the view.

As soon the action mode "Check Waypoint" is selected, the "Hot Spot Measurement" starts at once after a new waypoint was added. A histogram is shown for the selected signal at the measured waypoint.

Hot Spot histogram

If an already measured waypoint is moved or removed, the signal route and the position of the Hot Spot histogram is not updated at measurement time. The replay shows the correct routes and positions.

Depending on the "Navigation Mode" (the "Preconfigured waypoints" or "Stream input") the hot spots are either the waypoints defined before the actual measurement and stored in the waypoints configuration file ("Waypoints") or arbitrary points on the map defined during the measurement via the mouse or trackball ("Stream input").

Each measurement is initiated via the "Waypoint" button of the Indoor control view.

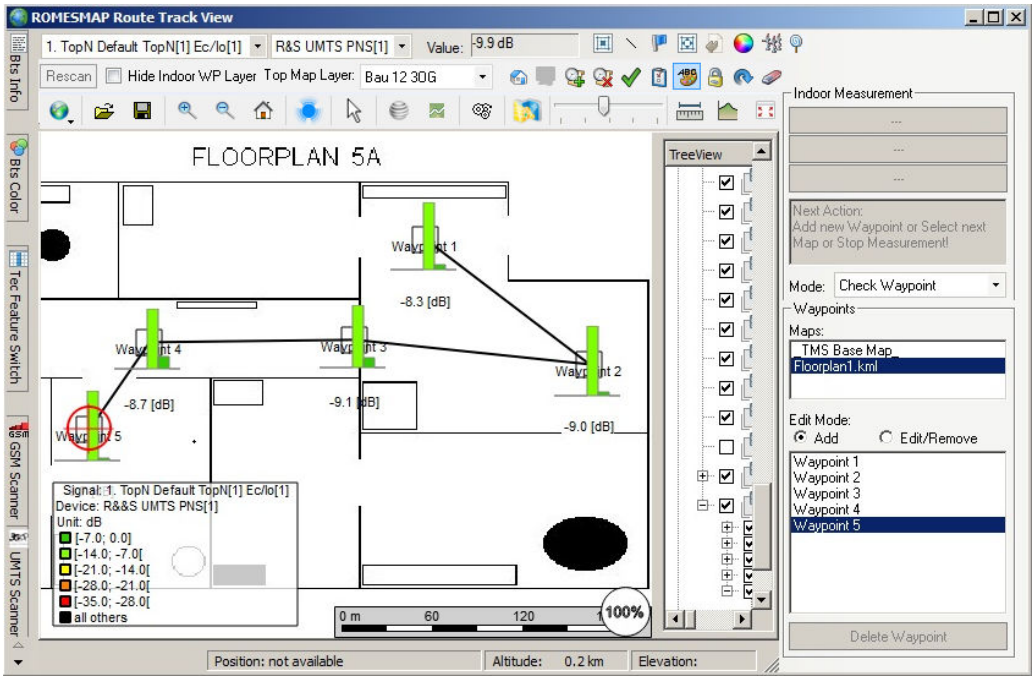


Figure 6-673: Indoor Hot Spot Measurement mode

Select next hot spot

A measurement can be started and the next hot spot can be defined only after the end of the previous measurement, i.e. after the measurement time has elapsed.

Continuous measurement

The measurement in the "Continuous Measurement" mode uses the previously defined waypoints without time limit. If the "Generate GPS signals each ... ms" checkbox is checked, the position interpolation is activated during the measurement.

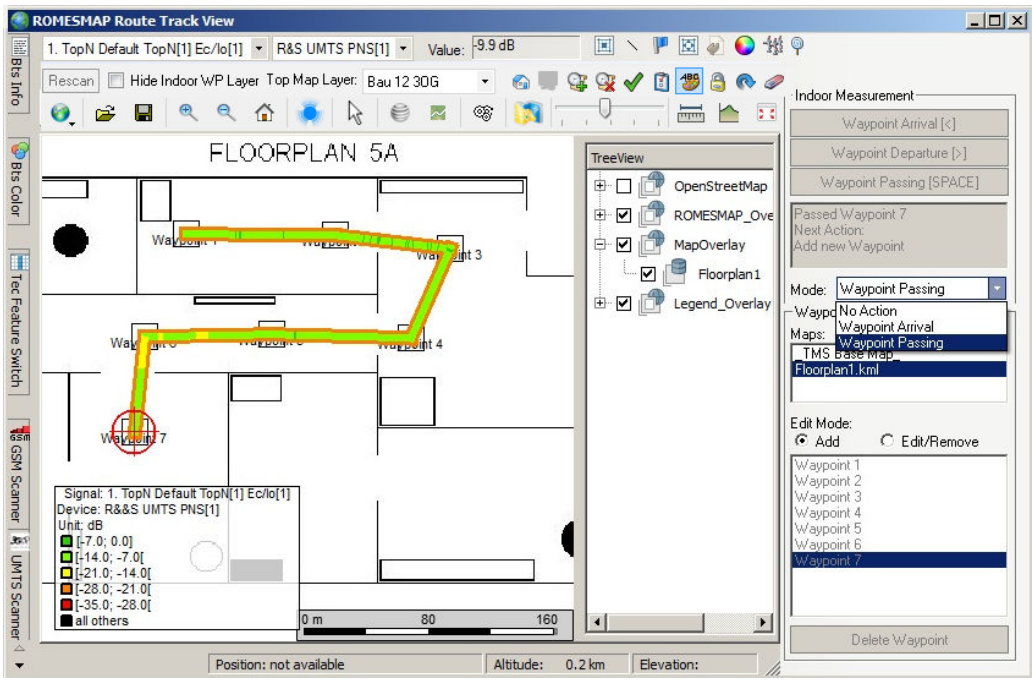


Figure 6-674: Example - Indoor Continuous Measurement mode

This interpolation is available only in "Continuous Measurement" mode. The frequency and the number of GPS signals define the interpolation granularity.

The following actions are available:

- **Waypoint Arrival**
  Arrive a waypoint and rest there.
- **Waypoint Departure**
  Left a waypoint.
- **Waypoint Passing**
  Pass a waypoint. This action is equal to the "Check Point" action of the former Indoor Navigation.

If the navigation "Mode" is set to "No Action", then the "Waypoint Passing" button has to be clicked every time the operator reaches a waypoint. If the action mode "Waypoint Arrival" or "Waypoint Passing" is selected, the selected action will be performed at once after a new waypoint was added.

Stop measurement after last Waypoint

The measurement is not stopped automatically when reaching the last waypoint. To terminate it, click the "Stop Measurement" button or the corresponding command line in the "Measurement" menu.

The interpolated positions and measurement results are not visible in the "ROMES-MAP Route Track View". They can be exported though to an ASCII file or evaluated and viewed by an appropriate `*.rscmd` evaluation and post-processing software.

7 Data processing

The chapter describes the various options for saving and exporting measurement data.

The steps taken for the data acquisition and the data analysis are independent. R&S ROMES4 uses its own standard formats (RSCMD or CMD) for measurement files but offers various options for printing results or interchanging the data with other applications:

- The `*.rscmd` or `*.cmd` files can be directly used by an appropriate measurement file evaluation and post-processing software.
- The contents of a view can be printed to a file or hard copy using the "File" > "Print" option, Chapter 3.2.15, "Print", on page 131.
- The `*.rscmd` or `*.cmd` files can be converted into other file formats and exported.
- A screenshot of the whole screen or a part of it (active window) can be generated.

- Saving data with R&S ROMES4 2098
- Exporting data 2099
- BTS list formats 2163
- Obtaining screenshots 2188
- Basic report 2188
- Evaluation of KML/KMZ data with Google Earth 2191

7.1 Saving data with R&S ROMES4

Data Recording
If a measurement starts via "Start recording" (see Chapter 3.6.2, "Start recording", on page 214), the recorded data is automatically saved under the selected file name with the extension `*.rscmd`. This format and the older format CMD provide the Replay feature. The RSCMD and the CMD format are supported by several software tools.

Take care when starting a measurement via "Start measurement" without recording, see Chapter 3.6.1, "Start", on page 213. In this case, the system asks you to enter a measurement file name. This name applies at the moment that you start recording. If there is no data to record, the file is not stored as an empty file but is deleted after the measurement is terminated.

Note: If you select an existing measurement file, it is deleted if no data is recorded, and overwritten if data is recorded.

In general, if the start measurement precedes the start recording action, the recording time starts with start the recording action. The data measured before is lost. However, whether the data is lost depends on the used device. If using the GSM Network Scanner, the data measured before start recording are written to the file.

Export
The "Export" function generates required data formats of a measurement file for the further evaluation with the applications which cannot read the original R&S ROMES4 RSCMD format.

Save Workspace
"Save Workspace" and "Save Workspace as" in the "File" menu and the corresponding floppy disk icon in the tool bar are only used for saving the workspace files (`*.rsxks`).

7.2 Exporting data

To export a measurement file, perform the following steps:

1. Select the target file format and directory
2. Select the measurement file
3. Export configuration (selection of signal parameters, export options)
4. Generate the export file

The export process is described in the following section. The configuration menus depend on the selected export file format. They are described in Chapter 7.2.4, "Export configuration menus", on page 2105.

7.2.1 Exporting data out of views in *.csv format

R&S ROMES4 supports the export of the table contents of the following views as CSV data:

- Alphanumeric View
- DQA Message View
- All Top N Views

To export a view's table content in CSV format, select "Export data as CSV" in the context menu of the view.

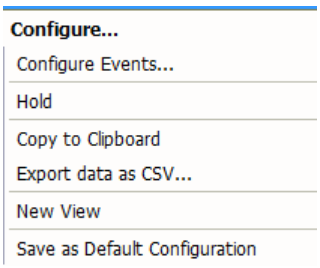


Figure 7-1: View selection for CSV export

If the table is empty or the view does not support exporting as CSV data, the entry is dimmed.

Only the columns you selected in the configuration is exported. In the first line of the generated file, the column names are listed, all following lines contain the data.

7.2.2 Export procedure

Measurement data files can be exported via "File" > "Export Measurement File(s)".

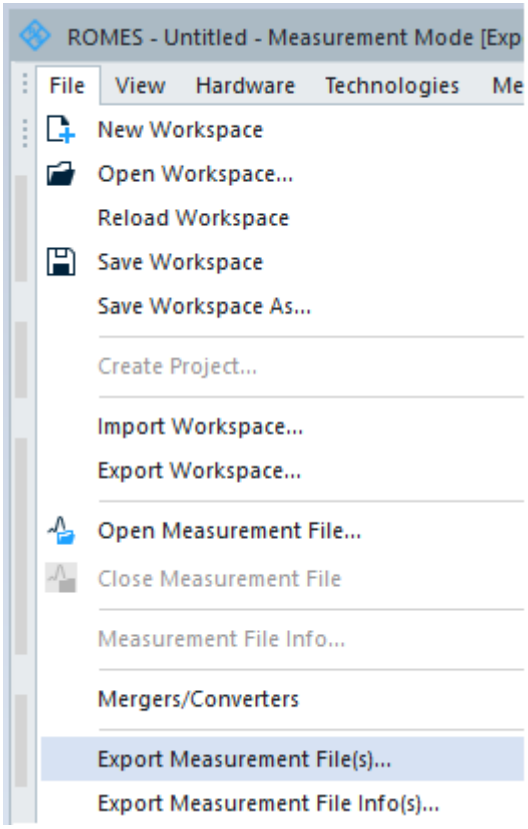


Figure 7-2: Export measurement file

The "Export Measurement File(s)" command opens the "Export measurement data" page. The page converts an arbitrary measurement file into a file of selected export format out of offered ones and stores it in a selected target directory.

Export Format
The "Export Format" pull-down list offers the file formats of the target files. Which formats are available depends on your system options. Some of the most used export file formats are here listed.

- **ASCII (`*.asc`)**
  ASCII tables, for example, for import into an MS Excel chart, see Chapter 7.2.4.1, "User-defined ASCII format (*.asc)", on page 2105.

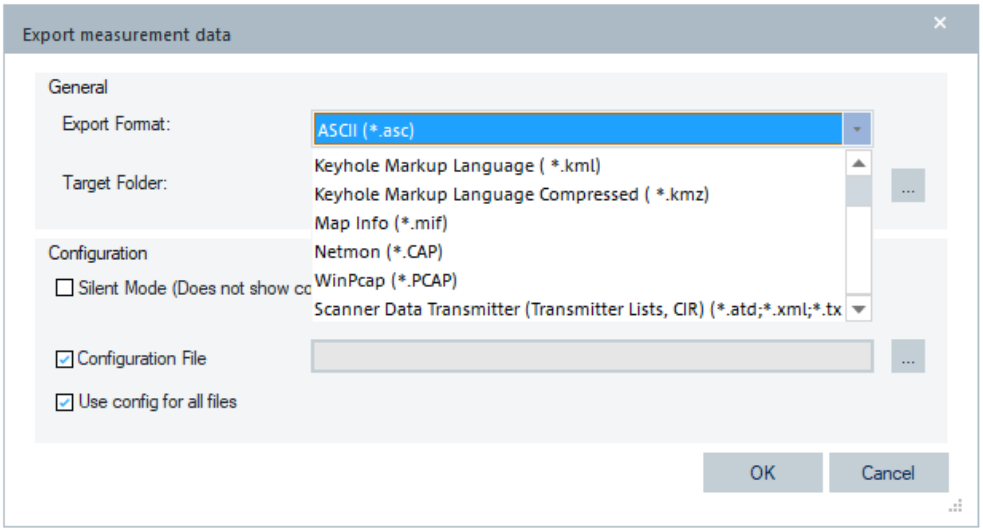
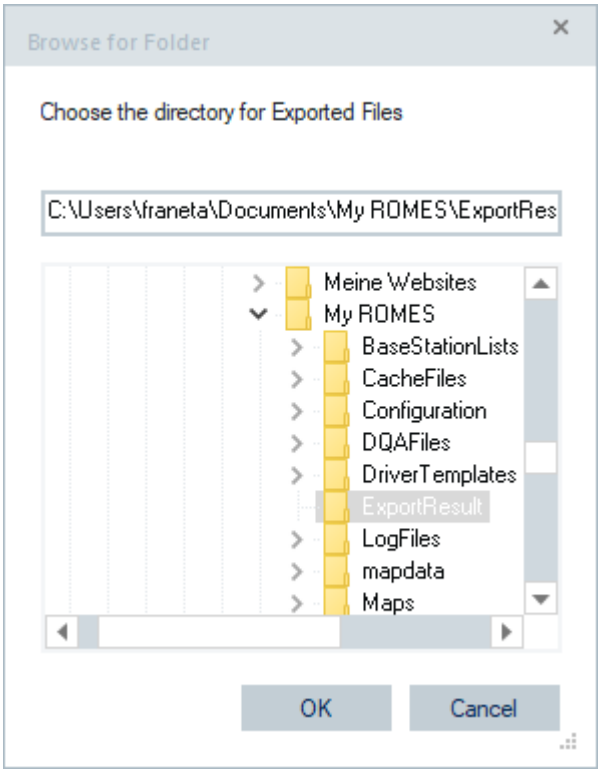


Figure 7-3: Export ASCII measurement file

- **KML/KMZ Export (`*.kml`, `*.kmz`)**
  Export measured signal data to Google Earth's Keyhole Markup Language format, either as compressed (`*.kmz`) or normal, uncompressed files (`*.kml`). The exported data can then be easily visualized and analyzed according to the position it was measured at, using the Google Earth software package, see Chapter 7.2.4.2, "Google Earth Keyhole Markup language (*.kml/ *.kmz)", on page 2120.
- **Map Info (`*.mif`)**
  MapInfo Interchange format for evaluation in MapInfo, see Chapter 7.2.4.3, "Mapinfo interchange format (*.mif)", on page 2126.
- **NetMon (`*.cap`)**
  Interchange format for evaluation of IP tracing with the Microsoft Network Monitor. The IP Tracer results can be exported to a Netmon CAP file, see Chapter 7.2.4.5, "Netmon format (*.cap)", on page 2130.
- **WinPcap (`*.pcap`)**
  A PCAP file can be loaded in a libcap based program of your choice and processed further. For more details, see Chapter 7.2.4.4, "PCap format (*.pcap)", on page 2130.
  Note: WinPCap Export is used only for exporting the measurement files generated by the versions R&S ROMES 4.63 and previous. It does not work with measurement files done with R&S ROMES 4.64 and later. For these releases, Netmon export must be used.
- **Scanner Data Transmitter (Transmitter Lists, CIR) (`*.atd`, `*.xml`, `*.txt`)**
  Used for batch export of transmitter data and CIR data. Export of the raw data of the GSM, UMTS and LTE scanner is supported, see Chapter 7.2.5, "Export scanner data", on page 2132.

Target Folder
"Target Folder" shows the current target directory for the export file. Select wanted folder via the "..." browse button.



"Browse for Folder" is composed of:

- **Directory tree**
  Overview of all available directories. A selected directory is highlighted.
- "OK"
  Closes the "Change directory" dialog by using the selected directory as the export target directory.
- "Cancel"
  Closes the "Change directory" dialog by discarding any changes.

Configuration

The "Configuration" field lets you select between the following export scenarios.

- Silent export
- Interactive export

The interactive export runs when the "Silent Mode" is inactive. For more details, see Chapter 7.2.5.2, "Interactive export", on page 2134 and Chapter 7.2.5.1, "Silent export", on page 2133.

Silent Mode ← Configuration

The export silent mode prevents displaying the messages and the configuration questions during the export. If enabled, specify a configuration file to assure a proper export configuration.

Some modules do not require special configuration (for example, PCAP export). It is not necessary to specify a configuration file in such case.

Configuration File ← Configuration
If the specified configuration file is not compatible with the selected export type, a small white cross on red sub font is displayed.

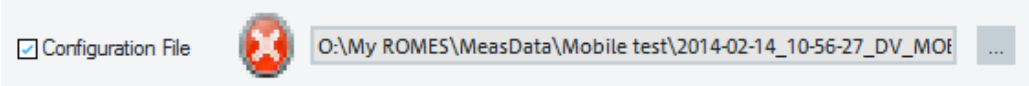


Figure 7-4: Error message: Specified configuration file is not compatible

Use configuration for all files ← Configuration
If activated, the configuration dialog is only shown for the first file to be exported and the configuration is then reused for the subsequent files export. If silent mode is selected, this approach is implicitly set.

OK
Exports a measurement file with the selected format and target directory.

"OK" opens the standard "Open" file dialog (see chapter Chapter 3.2.2, "Open workspace", on page 105) where the measurement file for exporting can be selected, followed by the "Export Configuration" menu for the file format selection.

The configuration menus depend on the export format. They are described in the following sections Chapter 7.2.4, "Export configuration menus", on page 2105.

Several measurement files can be selected simultaneously (use the SHIFT or the CTRL key) and exported to several target files. If a measurement file is already opened (for example, because an "Open Measurement File" command was executed before starting the file export), the opened file is selected by default. Otherwise, an arbitrary measurement file can be selected in "File" > "Open".

Names of the export files are assigned automatically. The extension of an exported `*.rscmd` file is replaced by the selected export format. It is possible to modify the default export file name using a "File Pre/Suffix". The "Export Info" window logs the file creation process.

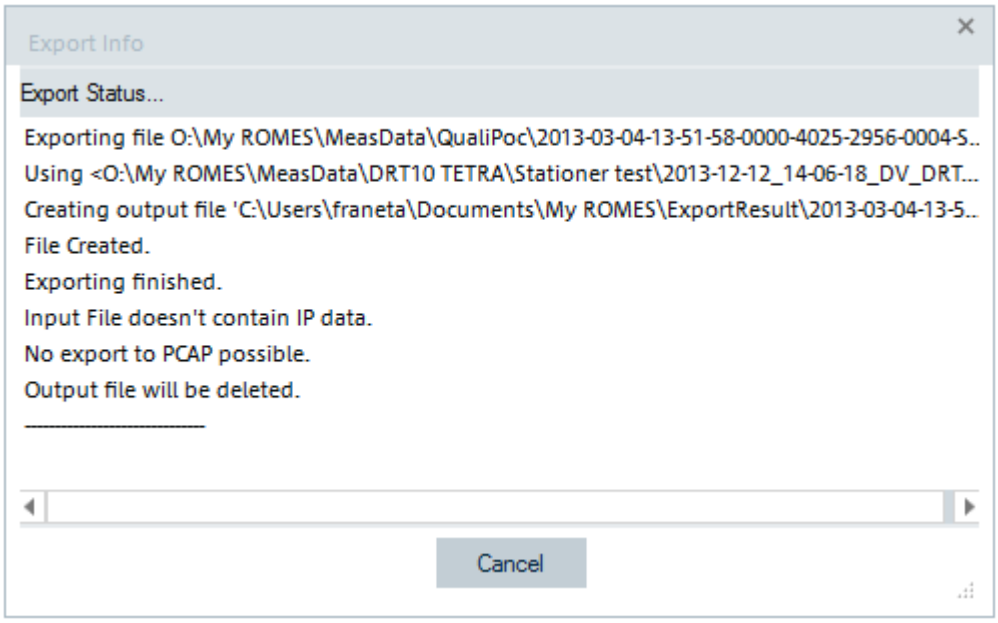


Figure 7-5: Export Info

Cancel
Cancels the file export and closes all corresponding dialogs.

7.2.3 Export info

After successful termination of the file export, or after its interruption, click "Cancel" to select one of the actions in "Export finish".

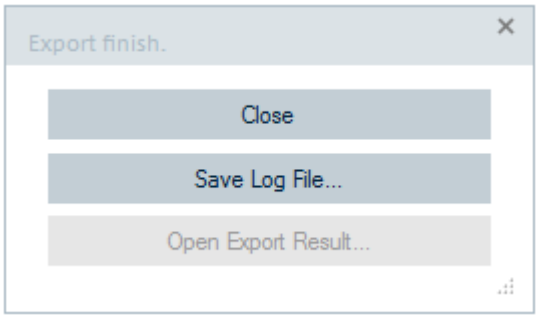


Figure 7-6: Available actions after export finish

Close
Terminates the file export without saving the logging information to a file or opening the result.

Save Log File
Saves the logging information shown in the "Export Info" window as a `*.txt` file and terminates the file export. The file name is given in the "File" dialog.

Open Export Result
Opens the generated export file using the standard application for the export file type. If no standard application is defined for the export file type, uses MS Windows Explorer to assign an appropriate application (for example, Notepad or MS Excel).

To assign an application, open the context menu for the file and select "Properties" > "General" > "Opens with" > "Change". Select the wanted application and click "OK".

7.2.4 Export configuration menus

Every export format is assigned its own "Export Configuration" menu which opens automatically during the file export.

The "Export Configuration" menus for ASCII, MIF and KML/KMZ file formats are made similar. Export of a file in some of these formats can be done in two ways. Different tabs of the "Export Configuration" menu are provided to support different export approaches.

In contrast to other configuration menus (for example, to views), the "Export Configuration" menus cannot be accessed unless a file is being exported. Switchover between the menus for different export formats is not possible. However, all selections and settings made in a particular "Export Configuration" menu are saved and can be re-used.

- User-defined ASCII format (*.asc)....2105
- Google Earth Keyhole Markup language (*.kml/ *.kmz)....2120
- Mapinfo interchange format (*.mif)....2126
- PCap format (*.pcap)....2130
- Netmon format (*.cap)....2130

7.2.4.1 User-defined ASCII format (*.asc)

With the ASC format, a user-defined ASCII measurement data table can be created. It is useful, for example, to import the data into an MS Excel chart. The file starts with a header, containing all useful information about the tour, see the example file at the end of this section.

The **"ASCII Export"** configuration dialog contains the following tabs:

- "Values"
- "Settings"
- "Export Configuration Management"
- "Advanced"

Values tab

The "Values" page shows a list of all available signals that can be displayed, if selected, in the exported measurement file (`*.rscmd` or `*.cmd`).

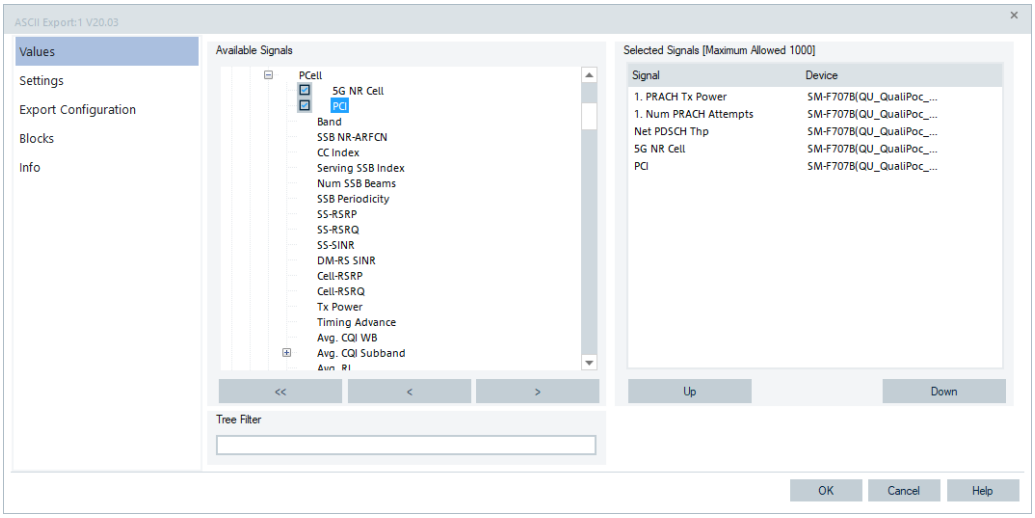


Figure 7-7: ASCII Export Configuration - Values tab

Available signals

The "Available Signals" pane displays the list of all signals of a generic (basic) view available to be selected for display in the view. A signal you select is then displayed in the "Selected Signals [Maximum Allowed <variable>]" pane.

- To select a signal for display in a view, left-mouse button click the signal (which becomes highlighted) and click ">". Alternatively, double-click the signal.
  The selected signal is then displayed in the "Selected Signals [Maximum Allowed 110]" pane. Some views, for example the "2D Chart View" or some mobile views, pop up the "Please Specify the Filter for the Signal" window request you to select filtering criteria.
- To remove a single signal from the "Selected Signals [Maximum Allowed <variable>]" pane, click "<".
- To remove all signals at once, click "<<".

Selected Signals

The list of all the signals selected for display.

The order of the signals can be changed using the "Up" and "Down" buttons. Each selected signal forms a column in the ASCII file. The order of columns is equal to the order of signals in the "Selected Signals" list.

- "Up"
  Interchange the position of the selected signal with the signal located directly above. The first signal in the list cannot be moved upwards.
- "Down"
  Interchange the position of the selected signal with the signal located directly below. The last signal in the list cannot be moved downwards.
- "Tree Filter", see Chapter 4.2, "Basic views", on page 445.

The other possibility to select multiple signals for ASCII export is via the filter dialog box, see for example "5G NR scanner Top N settings" on page 291.

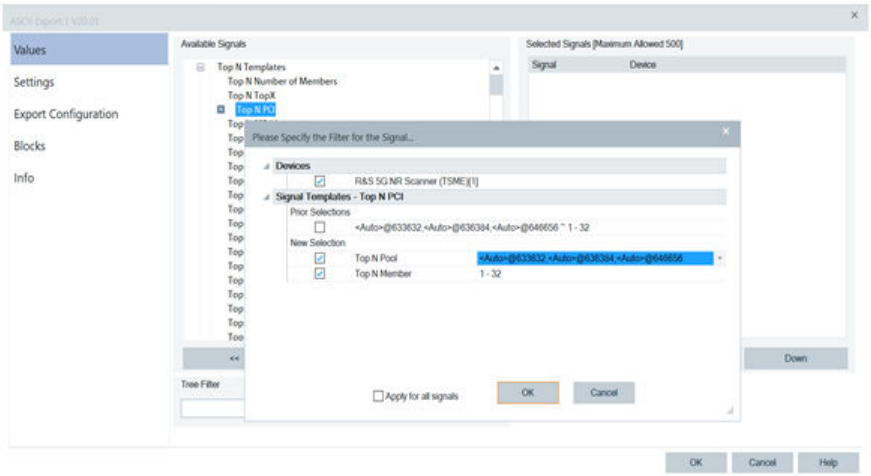


Figure 7-8: ASCII Export of multiple Top N signals

The case in the figure shows that 32 members of the three Top N pools are selected for export.

Note: LTE scanner module can export the scanner's raw data.
The "ASCII Export" supports the following LTE scanner raw data export:

- Power Raw
- SINR Raw
- SINR PSS Raw
- SINR SSS Raw

Settings tab

In the "Settings" page data selection can be refined by imposing additional selection criteria to the exported signal values. Imposing the additional selection criteria is suitable (or even inevitable) to handle large amount of data.

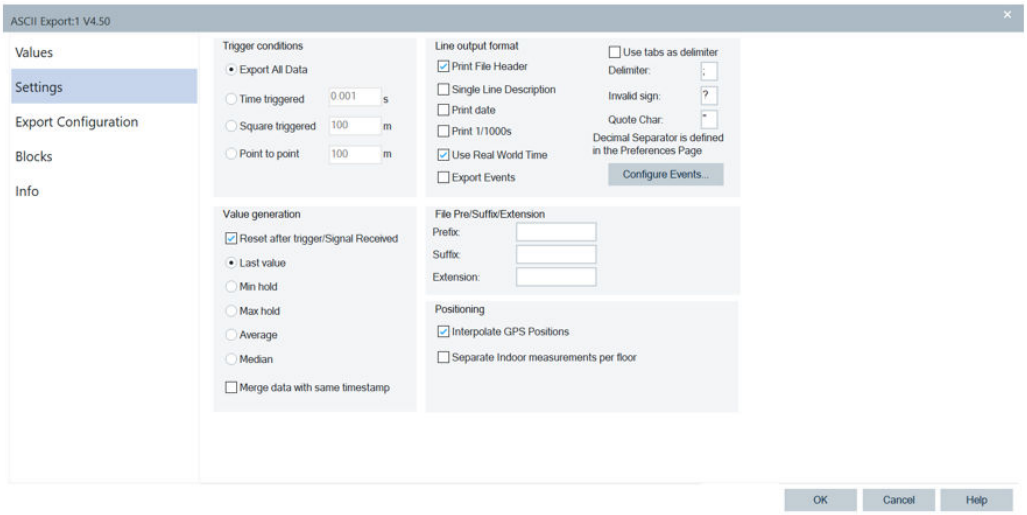


Figure 7-9: ASCII Export Configuration - Settings tab

Trigger conditions

The "Trigger conditions" pane defines a parameter interval in which exactly one value per output signal is written to the target export file.

- "Export All Data"
  No reduction of the original data - the unchanged values are exported.
- "Time triggered"
  A time interval between 0.001 s and 60 s is specified.
- "Square triggered"
  A square surface with a side length between 1 m and 10000 m is specified.
  The square triggered period is not distance-related but depends on the actual position in a field of squares. A value is generated whenever a square is left. As a consequence, the last square does not contribute to the export file.
  The amount of data collected for export value generation and the time between two trigger events can differ extremely from one square to another. In the B square of the figure below, much time is spent and many data can be collected. In C, D and E the spent time and the amount of collected data is different. The number of data points measured in a square does not have any influence on the length of the export file.

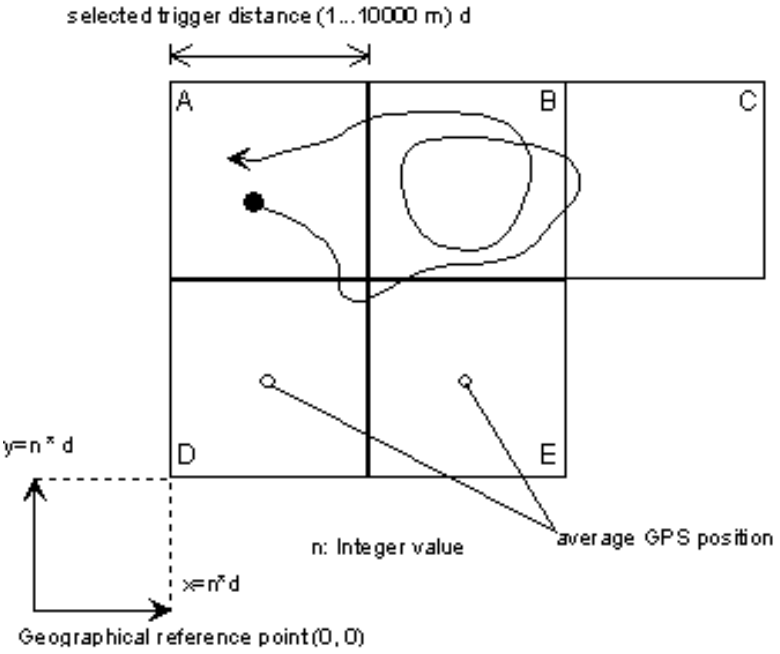


Figure 7-10: Square Trigger condition

  If large squares are defined, do not use the time stamp in combination with the average GPS position to determine the vehicle speed. Otherwise, a high error rate is generated.
- Point to point""
  A driven distance between 10 m and 1000 m is specified.

Value generation

The "Value generation" pane defines how the value exported in a trigger period is calculated. The value generation works both for "triggered" and "all data" exports.

- "Reset after trigger / Signal Received"

If checked, the buffer is cleared after each trigger period or all data export, dependent on settings in "Trigger conditions".
If unchecked, the export values (the last value, minimum, maximum, or average, whichever is selected) in each trigger period are stored in the buffer. If only invalid values are detected in one trigger period, the buffer value (the value of the previous trigger period) is exported. See the example at the end of this section.

- "Last value"
  If only invalid values are detected in one trigger period, the last valid value is exported.
- "Min hold"
  The minimum value within one trigger period is exported.
- "Max hold"
  The maximum value within one trigger period is exported.
- "Average"
  The average value within one trigger period is exported.
- "Median"
  The median value within one trigger period is exported. If the count of numbers is even (e.g. 10, 2, 5, 13), the two middle numbers (here, 5 and 10) are taken after sorting. The arithmetic average value is used (here, 7.5).
- "Merge data with same timestamp"
  This option of the ASCII Export allows the user to define handling of data with the same timestamp. The data is merged to one line or put in separate lines and printed.
  If you choose to merge data, the last entry is taken if the different values of the same timestamp for the same R&S ROMES4 signal are available.

Example: Exporting with and without reset after trigger

The export example consists of the following:

- Export of a measurement including UMTS PN and LTE scanning
- Export all data
- Interpolate GPS positions

The Rank Indicators and RSCP / RSRP of the three first ranks of each pool are selected.

```
[DESCRIPTION]
Timestamp [hh:mm:ss]
GPS\Position\Longitude [°] : [1]
GPS\Position\Latitude [°] : [1]
UMTS PNS\TOP N Pool 5\1. TOP N Pool 5 Rank[5] : [1]
UMTS PNS\TOP N Pool 5\1. TOP N Pool 5 RSCP[5] [dBm] : [1]
UMTS PNS\TOP N Pool 5\2. TOP N Pool 5 Rank[5] : [1]
UMTS PNS\TOP N Pool 5\2. TOP N Pool 5 RSCP[5] [dBm] : [1]
UMTS PNS\TOP N Pool 5\3. TOP N Pool 5 Rank[5] : [1]
UMTS PNS\TOP N Pool 5\3. TOP N Pool 5 RSCP[5] [dBm] : [1]
LTE Scan\TOP N Pool 1\1. TOP N Pool 1 TopX[1] : [1]
LTE Scan\TOP N Pool 1\1. TOP N Pool 1 RSRP[1] [dBm] : [1]
LTE Scan\TOP N Pool 1\2. TOP N Pool 1 TopX[1] : [1]
LTE Scan\TOP N Pool 1\2. TOP N Pool 1 RSRP[1] [dBm] : [1]
```

```
LTE Scan\TOP N Pool 1\3. TOP N Pool 1 TopX[1] : [1]
LTE Scan\TOP N Pool 1\3. TOP N Pool 1 RSRP[1] [dBm] : [1]
```

Note: LTE and UMTS data come asynchronously as they use different device. Therefore, when a UMTS data set is written into the export, no LTE data is present and vice versa. This asynchronous data arrival explains the question marks which represent the 'invalid' sign.

Export with "Reset after trigger"

```
[DATA]
10:50:14;7.815306;49.863769;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?    LTE data only
10:50:14;7.815306;49.863770;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?  UMTS data only
10:50:14;7.815308;49.863774;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815309;49.863780;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815311;49.863786;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?
10:50:14;7.815311;49.863786;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?
10:50:14;7.815311;49.863786;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815312;49.863792;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815314;49.863797;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815314;49.863799;?;?;?;?;?;?;?;?;?;?;?;?
10:50:14;7.815315;49.863802;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815316;49.863807;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815318;49.863813;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?
10:50:14;7.815318;49.863813;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?
10:50:14;7.815318;49.863813;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:14;7.815320;49.863819;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:15;7.815321;49.863824;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:15;7.815321;49.863824;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?
10:50:15;7.815322;49.863829;?;?;?;?;?;?;1;-85.06;2;-86.02;?;?
10:50:15;7.815324;49.863834;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:15;7.815325;49.863840;1;-69.3;2;-77.6;3;-79.0;?;?;?;?;?;?
10:50:15;7.815325;49.863840;1;-69.3;2;-89.5;3;-81.4;?;?;?;?;?;?
10:50:15;7.815325;49.863840;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:15;7.815327;49.863845;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:15;7.815328;49.863850;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:15;7.815329;49.863852;?;?;?;?;?;?;?;?;?;?;?;?
10:50:15;7.815330;49.863858;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:15;7.815331;49.863863;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:15;7.815332;49.863868;1;-69.3;2;-89.5;3;-81.4;?;?;?;?;?;?
10:50:15;7.815332;49.863868;1;-69.3;2;-89.5;3;-81.4;?;?;?;?;?;?
10:50:15;7.815332;49.863868;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:16;7.815333;49.863873;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:16;7.815334;49.863876;1;-69.3;2;-89.5;3;-81.4;?;?;?;?;?;?
10:50:16;7.815334;49.863878;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:16;7.815335;49.863883;?;?;?;?;?;?;1;-90.94;2;-88.92;?;?
10:50:16;7.815336;49.863888;?;?;?;?;?;?;1;-88.92;2;-90.94;?;?
10:50:16;7.815337;49.863893;?;?;?;?;?;?;1;-88.92;2;-90.94;?;?
10:50:16;7.815339;49.863898;1;-69.3;2;-89.5;3;-81.4;?;?;?;?;?;?
10:50:16;7.815339;49.863898;1;-69.3;2;-89.5;3;-81.4;?;?;?;?;?;?
10:50:16;7.815339;49.863901;?;?;?;?;?;?;1;-88.92;2;-90.94;?;?
10:50:16;7.815340;49.863906;?;?;?;?;?;?;1;-88.94;2;-88.10;?;?
```

```
10:50:16;7.815341;49.863911;?;?;?;?;?;?;1;-88.94;2;-88.10;?;?
10:50:16;7.815341;49.863912;?;?;?;?;?;?;?;?;?;?;?;?
10:50:16;7.815342;49.863916;?;?;?;?;?;?;1;-88.94;2;-88.10;?;?
10:50:16;7.815342;49.863921;?;?;?;?;?;?;1;-88.94;2;-88.10;?;?
```

Export without "Reset after trigger"

```
[DATA]
10:50:14;7.815306;49.863769;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815306;49.863770;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815308;49.863774;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815309;49.863780;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815311;49.863786;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815311;49.863786;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815311;49.863786;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815312;49.863792;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815314;49.863797;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815314;49.863799;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815315;49.863802;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815316;49.863807;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815318;49.863813;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815318;49.863813;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815318;49.863813;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:14;7.815320;49.863819;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:15;7.815321;49.863824;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:15;7.815321;49.863824;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:15;7.815322;49.863829;1;-69.3;2;-77.6;3;-79.0;1;-85.06;2;-86.02;3;-115.16
10:50:15;7.815324;49.863834;1;-69.3;2;-77.6;3;-79.0;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815325;49.863840;1;-69.3;2;-77.6;3;-79.0;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815325;49.863840;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815325;49.863840;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815327;49.863845;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815328;49.863850;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815329;49.863852;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815330;49.863858;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815331;49.863863;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815332;49.863868;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815332;49.863868;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:15;7.815332;49.863868;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:16;7.815333;49.863873;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:16;7.815334;49.863876;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:16;7.815334;49.863878;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:16;7.815335;49.863883;1;-69.3;2;-89.5;3;-81.4;1;-90.94;2;-88.92;3;-115.16
10:50:16;7.815336;49.863888;1;-69.3;2;-89.5;3;-81.4;1;-88.92;2;-90.94;3;-115.16
10:50:16;7.815337;49.863893;1;-69.3;2;-89.5;3;-81.4;1;-88.92;2;-90.94;3;-115.16
10:50:16;7.815339;49.863898;1;-69.3;2;-89.5;3;-81.4;1;-88.92;2;-90.94;3;-115.16
10:50:16;7.815339;49.863898;1;-69.3;2;-89.5;3;-81.4;1;-88.92;2;-90.94;3;-115.16
10:50:16;7.815339;49.863901;1;-69.3;2;-89.5;3;-81.4;1;-88.92;2;-90.94;3;-115.16
10:50:16;7.815340;49.863906;1;-69.3;2;-89.5;3;-81.4;1;-88.94;2;-88.10;3;-115.16
10:50:16;7.815341;49.863911;1;-69.3;2;-89.5;3;-81.4;1;-88.94;2;-88.10;3;-115.16
10:50:16;7.815341;49.863912;1;-69.3;2;-89.5;3;-81.4;1;-88.94;2;-88.10;3;-115.16
```

```
10:50:16;7.815342;49.863916;1;-69.3;2;-89.5;3;-81.4;1;-88.94;2;-88.10;3;-115.16
10:50:16;7.815342;49.863921;1;-69.3;2;-89.5;3;-81.4;1;-88.94;2;-88.10;3;-115.16
```

Use of "Reset after trigger" is recommended. Otherwise, the values are continuously reported although you already left the covered area.

Line output format ← Value generation
Export the data with the absolute time and date or with the relative timestamp using "ASCII Export" > "Settings". In the last case, the timestamp is the relative time since the start of measurement.

The "Line output format" pane defines the format of an ASCII table line.

- "Print File Header"
  If checked, the file header information is included in the target file. The file header comprises the information retrieved with the command, see Chapter 3.2.10, "Measurement file info", on page 115.
- "Single Line Description"
  If checked, the description of all parameters is written into a single line. The entries are separated by the "Delimiter" that is used for the data. This option is suitable for an import of the target file into MS Excel where each parameter description forms a table heading.
  If unchecked, each parameter description is written into a separate line.
- "Print date"
  If checked, the date is added to the beginning of every data line.
- "Print 1/1000s"
  The 1/1000 s data is added to every data line start.
- "Use Real World Time"
  Deactivating this check box switches to the relative timestamp output. As a consequence, the "Print date" check box is unselected and grey, the "Print 1/1000s" checkbox is selected and grey. The exported file shows the time according to the settings. The unit of the relative timestamp is in ms, see the following figure.

```
[DESCRIPTION]
Timestamp [ms]
GPS\Position\Latitude [°] : [1]
GPS\Position\Longitude [°] : [1]
GSM\Server Report\BCCH [ChanNr] : [1]
GSM\Server Report\Phone Mode : [1]
GSM\Server Report\RxLev Full [dBm] : [1]

[DATA]
4604    ?       ?       ?       Unknown ?
5024    ?       ?       966     Idle    -44
6124    ?       ?       966     Idle    -44
7614    ?       ?       966     Idle    -44
8954    ?       ?       966     Idle    -44
9504    ?       ?       966     Idle    -44
10454   ?       ?       966     Idle    -44
11394   ?       ?       966     Idle    -44
12127   50.314840       3.341850        ?       ?       Idle    ?
12704   50.314827       3.341854        966     Idle    -44
13274   50.314814       3.341857        966     Idle    -44
14594   50.314784       3.341866        966     Idle    -43
15154   50.314771       3.341870        966     Idle    -43
```

Figure 7-11: Relative timestamp

- "Export Events"
  Events included in the measurement file is included in the export file.
- "Use tabs as delimiter"

Two signals in the export file are separated by tabs. The "Delimiter" field is disabled.

- "Delimiter"
  This character separates the values of two signals in the export file. The "Delimiter" field is disabled if the "Use tabs as delimiter" option is active.
- "Invalid sign"
  The invalid sign shows that no valid value was detected.
- "Quote Char."
  The default character “ is placed at the beginning and end of the field that contains CR/LF characters (for example, L3 messages) for any ASCII export while exporting the file. This character makes it easier to parse the ASCII export files.
  Emptying the "Quote Char." field prevents ASCII export from placing a quote character in a field that contains the CR/LF characters. In an instance where the quote chart is changed to ‘ and the field otherwise contains ‘ character, those instances are changed to “.
- "Decimal Separator"
  This character has to be different from the "Delimiter" to avoid conflicts when post-processing the exported data.
- "Configure Events"
  Opens the "Preferences" >"Available Events" page, see Chapter 3.8.1.3, "Available events configuration", on page 238.

File Pre/Suffix/Extension
Defines two text strings which can be used to modify the file names and distinguish several exported files.

The prefix is inserted at the beginning of the file name, the suffix at the end:

`<file name>.asc` ⇨ *<prefix>*`<file name>`*<suffix>*`.asc`

The third option is to configure an extension for the result file of the ASCII export.

This option allows the user to choose the extension which is the most convenient for the user’s tool chain.

For example, if the next step is an analysis in Excel, choose csv as the extension. Excel opens the CSV file automatically by double clicking.

Positioning

- "Interpolate GPS Position"
  If checked, R&S ROMES4 calculates the position of each measurement record by linear interpolation of the closest position data provided by the GPS receiver. Otherwise, a position remains valid until a new GPS result is available.
  GPS position data is updated about once per second. Interpolating the positions is suitable if the measurement rate of other test devices is much larger than 1/s (for example, the CW receivers), or at high speed of a test vehicle.
  The interpolation is done with all the GPS-related parameters: latitude, longitude, altitude, distance, speed and heading.
- "Separate Indoor Measurements per Floor"
  If checked, indoor measurements are exported (ASCII Export only) by floors. That means, the feature separates the measurement data according to the floor maps, and therefore generates several export files.

Note: As floors are identified by different floor maps, it is necessary to configure these floor maps and set waypoints at measurement time to signal the floor change. If no floor maps are configured, all waypoints are on the basic map and result therefore in a single export file.

Export of several indoor floor files is the same as ordinary export, only the files' name changes into `<filename>.<floorname>.asc`. In addition, the file header shows the floor name.

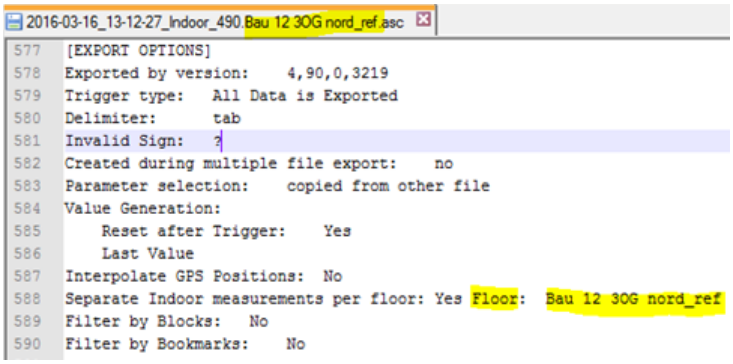


Figure 7-12: Exported indoor floor file

Measurements that hold no indoor measurement are treated as before, one export file is generated.

Switching from floor A to floor B and back to floor A results in 2 files, one for floor A and floor B.

Data older than the first floor name is dedicated to the first floor. Data which is between two floors is dedicated to the previous floor until the new waypoint on the next floor map is set.

The original export file is deleted if it concerns indoor measurements and the export files per floor have been generated.

Export configuration tab

Once the configuration dialog is shown for an export, it is possible to load and save the current configuration to or from a file. Export modules supporting that feature have this "Export Configuration" tab in their configuration setup dialog.

The dialog contains a list of files found in the default directory for export configuration (i.e. the workspace directory). Selecting an entry in the list defines the default value for the "Load" and "Save" dialogs shown when pressing the related buttons.

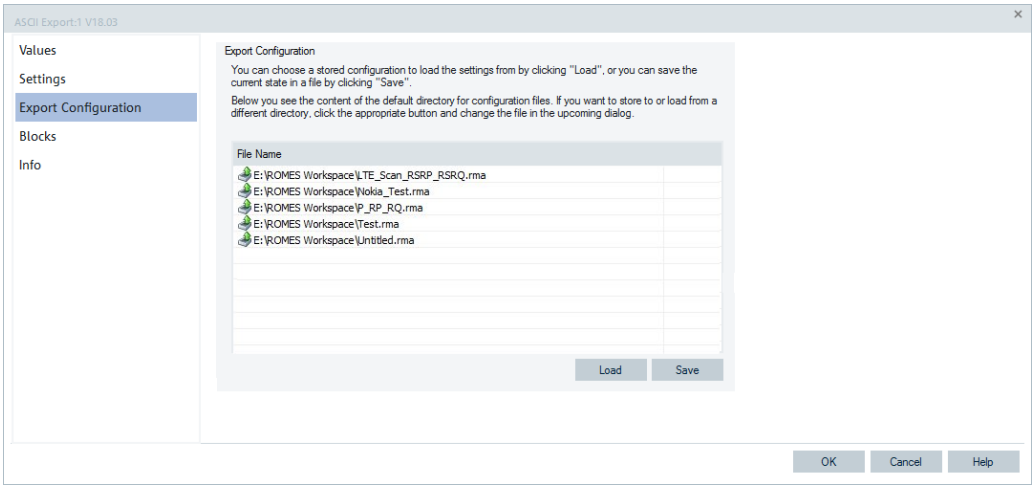


Figure 7-13: ASCII Export Configuration - Export Configuration tab

Blocks tab

The "Blocks" page shows the list of all blocks and bookmarks within a measurement file. Select block for export from the list. Measurement files recorded with R&S ROMES4 V3.22 and higher can be divided into several blocks, see Chapter 3.7.9, "Replay jump to block", on page 222. The "Blocks" page is analogue for all export formats.

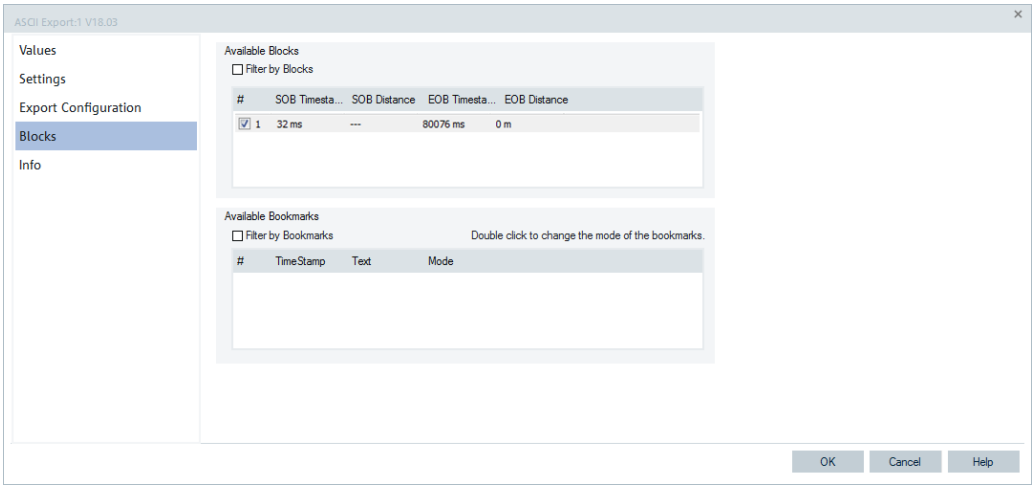


Figure 7-14: ASCII Export Configuration - Blocks tab

Info tab

The "Info" page shows information on the current ASCII export software module. The "Info" page is analogue for all export formats and is omitted in the following.

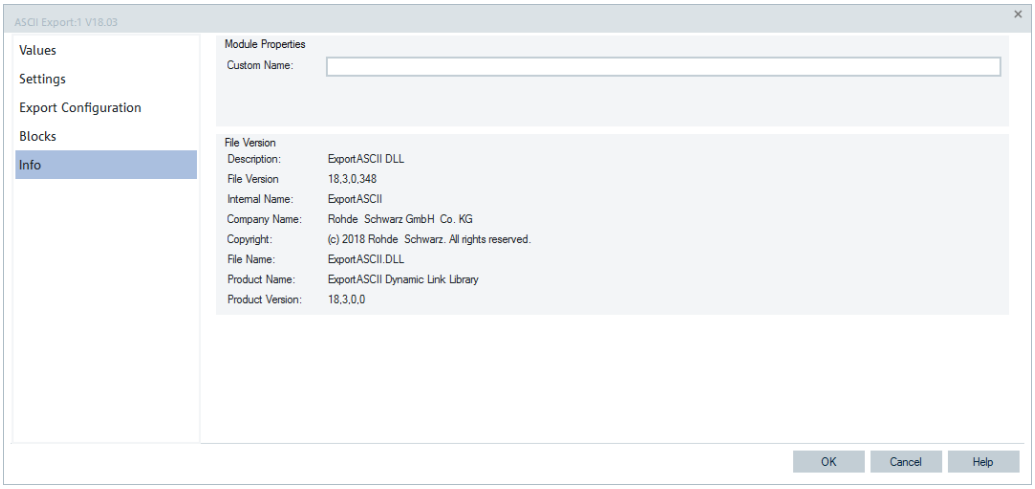


Figure 7-15: ASCII Export Configuration - Info tab

Add Top N pool settings to ASCII export header

The ASCII export header shows the Top N configurations for each R&S ROMES4 supported scanner technology, which has that type of configuration.

In the following figure this header information is highlighted.

```
[R&S GSM NWS (TSME) [1], Ver. 4.90 ALPHA 16]

Receiver:       TSME

Scanner Device: TSME (Frontend 0) @ 192.168.0.4
Material Number:    1514.6520K02
Serial Number:  100204

Software
=========================================================
FPGA Version:   03.00.01.00
FW Version: 02.00.01.38
Production Index:   6.00

Transmitterscan:
Count of all measured channels: 174
Count of channels with SCH power measurements:  174
    Selected Channels:  975 - 1023,0-124
    Network: GSM 900  +  GSM E  +  GSM R  +  GSM ER
    C/I measurement is switched ON for DL channels.

Max. measurement rate: 500.0 channels per second

Demodulation of System Information Types:
Max. Total Power Offset: 4.0 dB
Max. TSMx Load: 20 %
Types: 1, 2, 2bis, 2ter, 3(Rep: internal)

Synchronization sources:
    GPS PPS
    GSM Network
    WCDMA 3GPP Network

Antenna name:       Default_Antenna
Cable loss [dB]:        0.00
Antenna gain [dBi]:     0.00

Top N Configuration:    No of Pools:  4     Pool Configuration: Automatic
  1: [redacted]
     Count:   8         sorted:  Yes
     Interval: Dynamic T_min 2000ms Hysteresis:  0.0dB
     Value:  PSCH       Mode:  Avg
     Automatic Pool Configuration:  Create a TopN Pool for each provider.
  2: [redacted]
     Count:   8         sorted:  Yes
     Interval: Dynamic T_min 2000ms Hysteresis:  0.0dB
     Value:  PSCH       Mode:  Avg
     Automatic Pool Configuration:  Create a TopN Pool for each provider.
  3: [redacted]
     Count:   8         sorted:  Yes
     Interval: Dynamic T_min 2000ms Hysteresis:  0.0dB
     Value:  PSCH       Mode:  Avg
     Automatic Pool Configuration:  Create a TopN Pool for each provider.
  4: [redacted]
     Count:   8         sorted:  Yes
     Interval: Dynamic T_min 2000ms Hysteresis:  0.0dB
     Value:  PSCH       Mode:  Avg
     Automatic Pool Configuration:  Create a TopN Pool for each provider.
```

Figure 7-16: Example of a GSM NWS with R&S TSME and its Top N configuration

ASCII export file examples

(OT290, 1 GSM/GPRS Mobile)

```
[Measurement Info, Ver. 4.00 Rev. 1 SP 4]
Time Zone:        Westeuropäische Normalzeit
Start Of Measurement:    Monday, 11.02.2008, 20:14:36.99

Comment:        Test with AMR

Username:    John Doe
Vehicle Name:    Test Car
Vehicle ID:    M-RS 123
Num of Blocks:    1
Duration:    00:02:52 (HH:MM:SS)

================================================================

Drivers:
- Test Tool OT290[1]
- NMEA Device[1]

================================================================

[Test Tool OT290 [1], Ver 4.00]
Type:                Sagem GPRS (Firmware JY3,Bj 315)
ROMES Locking Info:
GSM Band Lock:        Off
GSM Channel Lock:        No
GSM Net:            GSM900/DCS1800
Meas. Mode:            Normal
IMEI:                08202501
Subscriber Number:
Auto Dial Timing:
 Supported RAT:        Any RAT
 Call Window:        60 sec
 Call Duration:        30 sec
 Max. Access Time:    15 sec
Call Window Offset:    0 sec
Type of Call:        Voice Call
NQA Rx Source:        Full
Number:            2000
RxLev Calibration:    No
Antenna name:         Default_Antenna
Cable loss [dB]:      0.00
Antenna gain [dBi]:     0.00
Cellbar Flag:         Normal
CBCH:             not decoded
GPRS Mobile:        Yes
Forcing Settings:
 Multi Slot Class:    No Forcing
 Coding Scheme:        No Forcing
 GPRS Auto Attach:    No Forcing
 MS Class:            No Forcing
```

```
 GSM Power Class:        No Forcing
 DCS Power Class:        No Forcing
 EFR:                Off
GSM/GPRS QoS Actions Evaluation
 1. GSM Handover:
  Timeout: 10000 ms
 2. Location Area Update:
  Timeout: 10000 ms
 3. GPRS Attach:
  Timeout: 10000 ms
 4. GPRS Detach:
  Timeout: 10000 ms
 5. Activate PDP Context:
  Timeout: 10000 ms
 6. Deactivate PDP Context :
  Timeout: 10000 ms
 7. Routing Area Update:
  Timeout: 10000 ms


Handover Analyzer
 Enabled:            No


Port Settings
1. Port:
    Type: Trace
    Name: COM1

=================================================================


[GPS Ver 4.00]

Type:        NMEA Device
Ellipsoid:        WGS84
Nav.Proc.Version:    not available
Sig.Proc.Version:    not available
Driven area:    48.128276 (Lat. up left)
        11.613015 (Long. up left)
        48.126521 (Lat. bottom right)
        11.614277 (Long. bottom right)

=================================================================

[EXPORT OPTIONS]
Exported by version:    4,0,5,163
Trigger type:        All Data is Exported
Delimiter:            ;
Invalid Sign:        ?
```

```
Created during multiple file export:    no
Parameter selection:    individual

[DESCRIPTION]
Timestamp [hh:mm:ss]
GPS\Position\Longitude [°] : [1]
GPS\Position\Latitude [°] : [1]
GSM\Server Report\MCC : [1]
GSM\Server Report\MNC : [1]
GSM\Server Report\LAC : [1]
GSM\Measurement Report\BCCH [ChanNr] : [1]
GSM\Server Report\CI : [1]
GSM\Measurement Report\BSIC : [1]
GSM\Measurement Report\RxLev Full [dBm] : [1]
GSM\Measurement Report\RxQual Full : [1]

[DATA]
20:16:01;11.613307;48.126941;262;1;34567;23;5717;32;-79;0
20:16:02;11.613119;48.126671;262;1;34567;23;5717;32;-79;0
20:16:03;11.613077;48.126606;262;1;34567;23;5717;32;-82;0
20:16:03;11.613058;48.126580;262;1;34567;23;5717;32;-82;0
```

7.2.4.2 Google Earth Keyhole Markup language (*.kml/ *.kmz)

The main use of these exported data is to display the measured signal levels on a geographical map. The KML and KMZ file format is a particular Google Earth XML file format that stores geographic annotation and visualization on existing compatible two-dimensional maps and three-dimensional Earth browsers. The file format specifies a set of features for display in Google Earth, Maps and Mobile, or any other 3D Earth browser (geo-browser) implementing the Keyhole Markup Language (KML) encoding.

Force the export of all GPS data

To force the export of the GPS data, export from the "KML Export > Available Signals" a signal associated with the R&S GPS device, such as longitude, latitude, altitude, speed, or heading, in addition to all other signals you wish to export.

The R&S ROMES4 "KML Export" automatically filters unwanted data:

- All signal data that is not positioned between two GPS measurements is deleted, since its position cannot be interpolated.
- GPS positions that are found to be unlikely are automatically deleted during export. Deleted are:
  - GPS data which usually occurs during calibration right after turning the GPS device on
  - GPS data not assigned to measured signals and irrelevant; that is, all the GPS positions measured before the first or after the last signal measurement to be exported are deleted

KML export of the ACD-based UMTS/LTE Top N pools

The KML export supports the ACD feature. The export function sorts out different UMTS and LTE Top N pools created by the "Automatic pool configuration per channel selection" feature into different sections in the KML file format. After opening the measurement file, users have to select the measurement data they want to be exported, for example, the RSRP values of the LTE Top N pool.

The file can contain the UMTS/LTE transmitter list which was created by the Position Estimator during the measurement, see Figure 7-18.

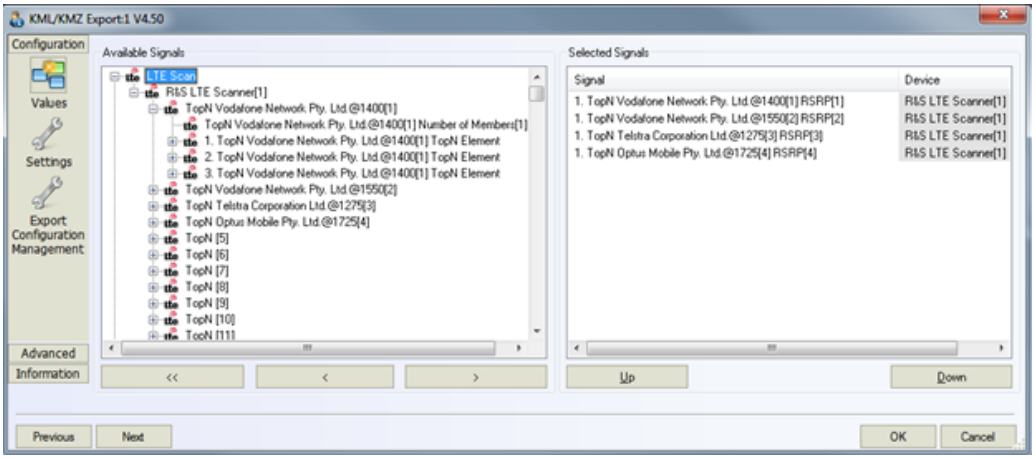


Figure 7-17: KML Export page

Press the CTRL key + the ">" button to select a Top N pool parameter. The parameter is added to all available Top N pools automatically.

KML export files configuration

The R&S ROMES4 "KML Export" configuration page contains the following tabs.

- "Values"
- "Settings"
- "Export Configuration Management"
- "Advanced"

  This tab lets users open additional configuration pages:

  – "Blocks"
  – "Information"
- "Info"

The listed tabs, excluding the "Settings" tab, open the configuration pages analogue to these tabs described in "ASCII Export", see Chapter 7.2.4.1, "User-defined ASCII format (*.asc)", on page 2105.

Values tab

Click the tab to open the page showing a list of all signals contained in the selected measurement file (`*.rscmd` or `*.cmd`).

Available signals
The "Available Signals" pane displays the list of all signals of a generic (basic) view available to be selected for display in the view. A signal you select is then displayed in the "Selected Signals [Maximum Allowed <variable>]" pane.

- To select a signal for display in a view, left-mouse button click the signal (which becomes highlighted) and click ">". Alternatively, double-click the signal.
  The selected signal is then displayed in the "Selected Signals [Maximum Allowed 110]" pane. Some views, for example the "2D Chart View" or some mobile views, pop up the "Please Specify the Filter for the Signal" window request you to select filtering criteria.
- To remove a single signal from the "Selected Signals [Maximum Allowed <variable>]" pane, click "<".
- To remove all signals at once, click "<<".

Selected Signals
List of all signals selected for display.

Note: At least one GPS device must be selected from the "Navigation Devices" to make KML export possible.

Note: Only signals with numerical values can be exported. Non-numerical signals appear as empty folders in Google Earth.

The order in the list can be changed using the two buttons placed at the bottom of this pane.

Settings tab

In "Settings" you can select the way height is displayed, the data export mode and which type of measured data are exported to the *.kml or *.kmz file.

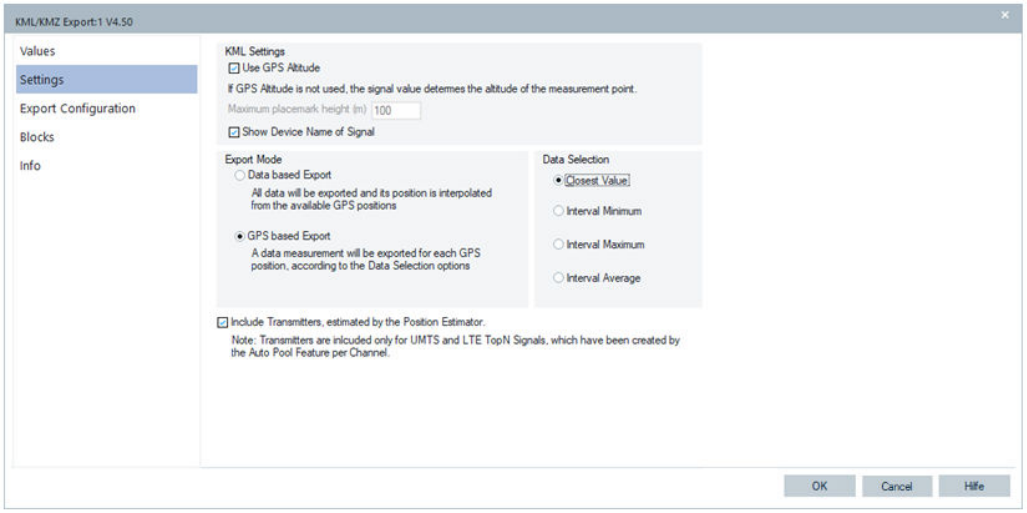


Figure 7-18: KML/KMZ Export - Settings page

Tip: Export large files in KMZ file format.

`*.kml` files can be large if many data has to be exported. Export measurement data in KMZ format in that case. The `*.kml` file can still be accessed and edited by decompressing the `*.kmz` file using a ZIP file manager.

KML Settings

- "Use GPS Altitude"
  KML export allows the GPS altitude to use as a height. The option can be used for 3D measurements, for example, with drones. Instead of using the value of the signal, the GPS altitude is used for the z-coordinate. The signal value is reflected by the color of the measurement bubble.
- "Maximum placemark height (m)"
  The maximum height that a placemark can have in Google Earth. Exported signals are extruded according to their values in the range from zero this maximum height to make the exported signals easily visible.

Export Mode

Note: For high data rates (about 20 samples/second and more), it is recommended to select GPS-based export.

The ways of exporting the captured information are:

- "Data based Export"
  Creates a placemark for each available signal measurement and interpolates its GPS position using the GPS data.

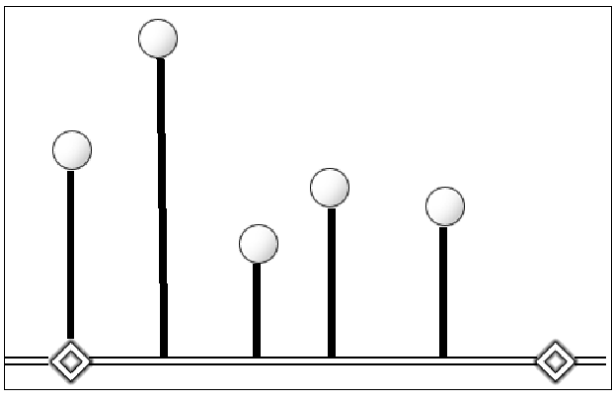


Figure 7-19: Placemark for every measured single signal

- "GPS based Export"
  Creates a placemark for every GPS measurement available and chooses its value depending on the option selected in "Data Selection", see the following section.

Data Selection

Defines how to calculate a signal value, so that the value is associated an exact GPS position. The panel is active only if the "GPS based Export" condition is selected.

- "Closest Value"
  Selects the valid measured value that lies closest to the measured GPS data, according to its timestamp.

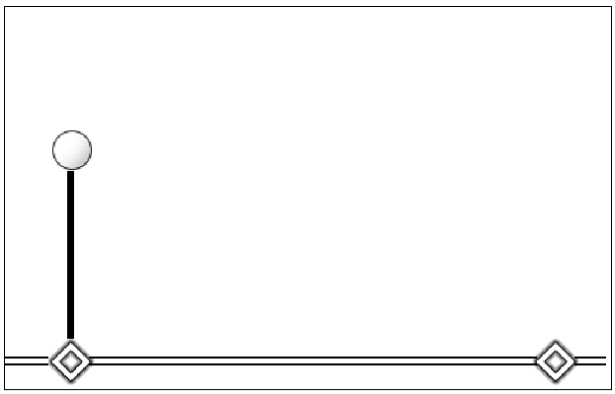


Figure 7-20: Closest Value

- "Interval Minimum"
  Shows the minimum signal value between a GPS measurement and the next one.

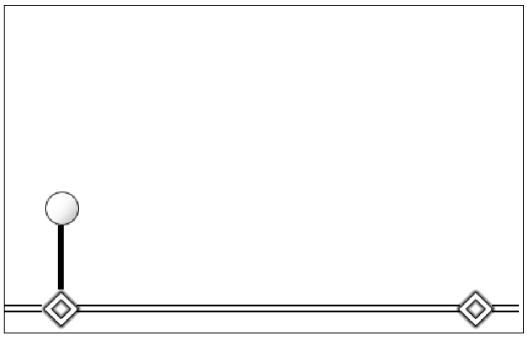


Figure 7-21: Interval Minimum

- "Interval Maximum"
  Shows the maximum signal value between a GPS measurement and the next one.

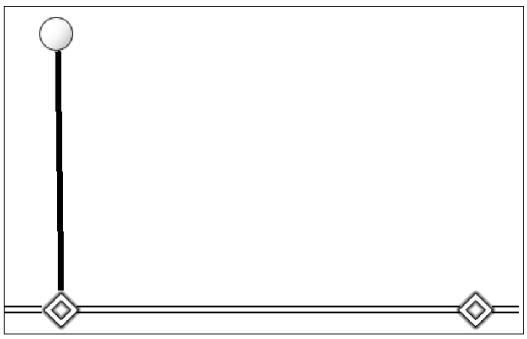


Figure 7-22: Interval Maximum

- "Interval Average"
  Shows the average of all valid signal measurements between a GPS measurement and the next one.

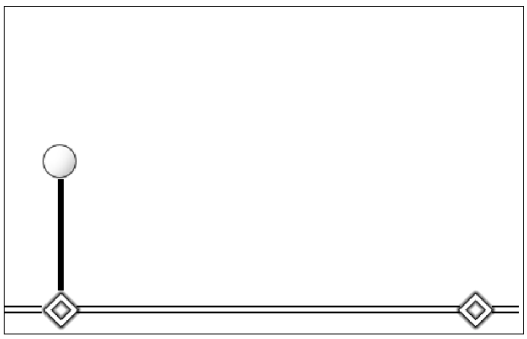


Figure 7-23: Interval Average

Include Transmitters
Select the "Include Transmitters, estimated by the Position Estimator" option if you wish to add the transmitters' positions.

Note: No transmitters from transmitter databases are exported.

Select GPS-based export to reduce the measurement data to one value per available GPS datum.

The exported KML has one folder per Top N. This export makes it easy to switch between the different Top N pools (respectively channels).

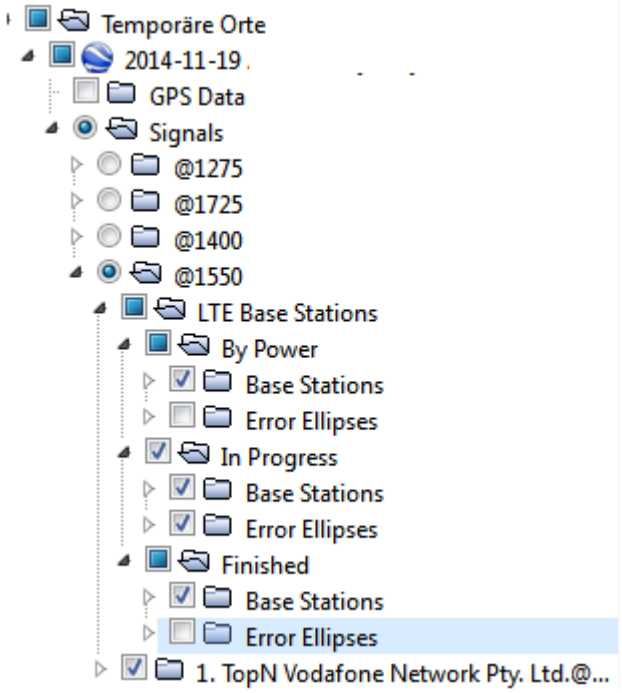


Figure 7-24: Export tree

Importing *.kml/*.kmz files to Google Earth

After finishing the export, you can view the newly created `*.kmz` / `*.kml` file using the Google Earth application, which you can download for free. Visualization of a `*.kmz` is shown in the following figure.

Figure 7-25: BTS error ellipses

1. Go to the export directory (mostly `My Documents\My ROMES\ExportResult`)
2. Double click the directory.
3. Open the file from Google Earth or a file manager.

For more information, refer to Chapter 7.6, "Evaluation of KML/KMZ data with Google Earth", on page 2191.

7.2.4.3 Mapinfo interchange format (*.mif)

MIF format is a particular ASCII file format that stores graphical information to be displayed in a MapInfo table.

The R&S ROMES4 "MIF Export" configuration dialog contains five tabs. The configuration dialogs of the "Values" and "Settings" tabs are described in the following sections.

The "Export Configuration Management", "Advanced" and "Info" tabs are analogous to tabs of the "ASCII Export" dialog, see Chapter 7.2.4.1, "User-defined ASCII format (*.asc)", on page 2105.

The export of measurement file to MapInfo MIF/MID format respects the "Preferences" > "Formats" > "Timestamp Format" settings. Timestamp is saved accordingly.

Values tab

The "Values" tab offers a list of all parameters in the selected measurement file (`*.rscmd` or `*.cmd`).

NOTE: The same list of parameters in the selected measurement file opens when choosing the tab "Advanced" instead.

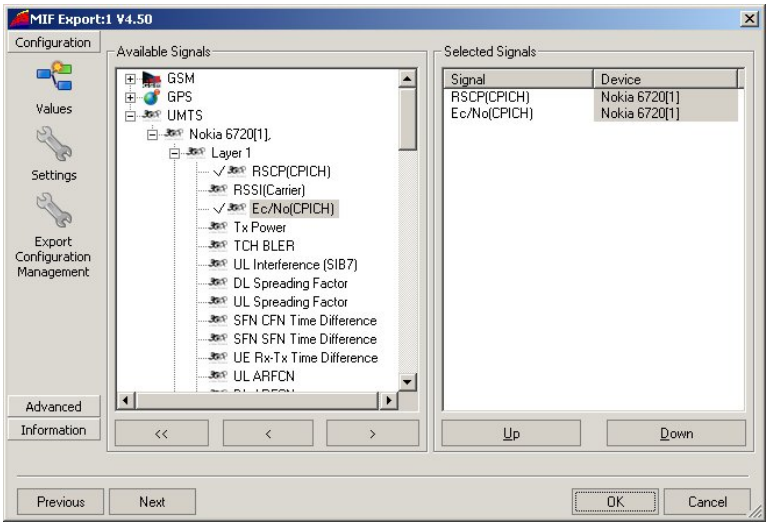


Figure 7-26: MIF Export Configuration - Values tab

Available signals

The "Available Signals" pane displays the list of all signals of a generic (basic) view available to be selected for display in the view. A signal you select is then displayed in the "Selected Signals [Maximum Allowed <variable>]" pane.

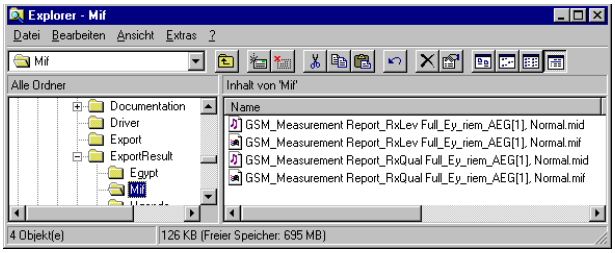
- To select a signal for display in a view, left-mouse button click the signal (which becomes highlighted) and click ">". Alternatively, double-click the signal.
  The selected signal is then displayed in the "Selected Signals [Maximum Allowed 110]" pane. Some views, for example the "2D Chart View" or some mobile views, pop up the "Please Specify the Filter for the Signal" window request you to select filtering criteria.
- To remove a single signal from the "Selected Signals [Maximum Allowed <variable>]" pane, click "<".
- To remove all signals at once, click "<<".

Selected signals

List of all signals selected for display.

The order of the list can be changed using the two buttons below.

For each selected signal, a separate `*.mif` plus a `*.mid` file is generated.



The `*.mif` file contains the file header followed by the geographic coordinates of each exported data point and the code for the symbols to be used for display in MapInfo; see description of "Settings" tab below. This file can be imported into MapInfo as described in "Importing *.mif files to mapinfo" on page 2130.

The `*.mid` file contains two columns for the exported signal values and a general signal, e.g. the time stamp associated to each signal value.

Settings tab

The "Settings" tab selects the symbols to display the data in MapInfo and the data to be exported to the `*.mif` file.

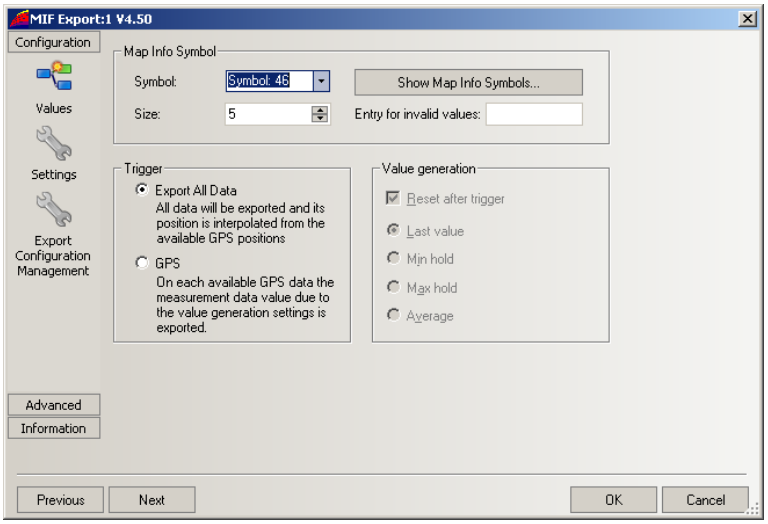
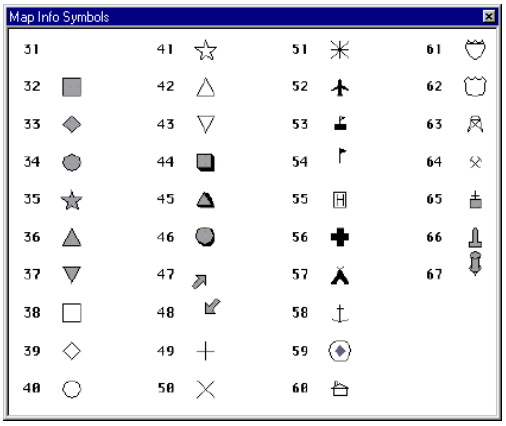


Figure 7-27: MIF Export Configuration - Settings tab

Map Info Symbol

Selects the symbol to display the data in a MapInfo view and the symbol size. The symbols can be defined with their code number ("Symbol") and "Size" or selected from a list that is opened on clicking the "Show Map Info Symbols..." buttons.



Trigger
Defines which values in the selected signals are exported and how the geographical coordinates assigned to the exported values are calculated. The following alternative options are provided:

- "Export All Data"
  Export all values of the selected signals to the `*.mif` file. Use an appropriate interpolation method to determine the position of each value from the GPS data available in the measurement file.
- "GPS"
  Export one signal value for each GPS position stored in the measurement file using the "Value generation" settings.

Value Generation
Defines how the signal value assigned to a definite GPS position is calculated. The panel is active only if the "GPS" trigger condition is set. One trigger period corresponds to the time between two consecutive GPS positions.

- "Reset after trigger"
  If the box is checked, the buffer is cleared after each trigger period. If not, the export values (for example, the last value, minimum, maximum, or average, whichever is selected) in each trigger period is stored in the buffer. If only invalid values are detected in one trigger period, the buffer value (for example, the value of the previous trigger period) is exported.
- "Last value"
  If only invalid values are detected in one trigger period, the last valid value is exported
- "Min hold"
  The minimum value within one trigger period is exported
- "Max hold"
  The maximum value within one trigger period is exported
- "Average"
  The average value within one trigger period is exported
  This option is not applied to parameters where averaging does not make a sense, for example, channel numbers or station codes.

Importing *.mif files to mapinfo

The `*.mif` file can be imported to MapInfo and converted to a MapInfo table file (`*.tab`) to be viewed in a MapInfo table. This import involves several steps:

1. Open "MapInfo" and select the "Import" command in the "Table" menu.
2. In the "Import File" dialog select the file format MIF, the `*.mif` file you want to import.
3. Press "Open" to start the file import.
4. In the "Import into Table" dialog, select a name and directory for the TAB file you want to create.
5. Press "Save."

By default, the TAB file is stored in the same directory and uses the same file name as the MIF file.

1. In the "File" menu, select "Open Table" to display an "Open Table" dialog.
2. Select the created TAB file.
3. To display all data points stored in the `*.mif` file, use the "View Entire Layer" command in the "Map" menu.

For more information, refer to the MapInfo help.

7.2.4.4 PCap format (*.pcap)

Raw packet data recorded via IPTracer module and stored in a measurement (`*.rscmd`) can be exported into the PCap file format. This file format is used by any libpcap based program, e.g. Wireshark (Ethereal) or tcpdump.

The "PCap Export" configuration dialog contains two tabs:

- "Blocks"
- "Information"

These tabs are analogous to the ASCII Export tabs, see Chapter 7.2.4.1, "User-defined ASCII format (*.asc)", on page 2105.

7.2.4.5 Netmon format (*.cap)

The NetMon (*.cap) is a successor of the WinPcap (*.pcap) since R&S ROMES4 4.64. Exporting the measurement files recorded with R&S ROMES4 4.64 and later releases is done only with NetMon (*.cap).

The raw packet data recorded via IP Tracer module and stored in a measurement (`*.rscmd`) file is exported into the CAP file format.

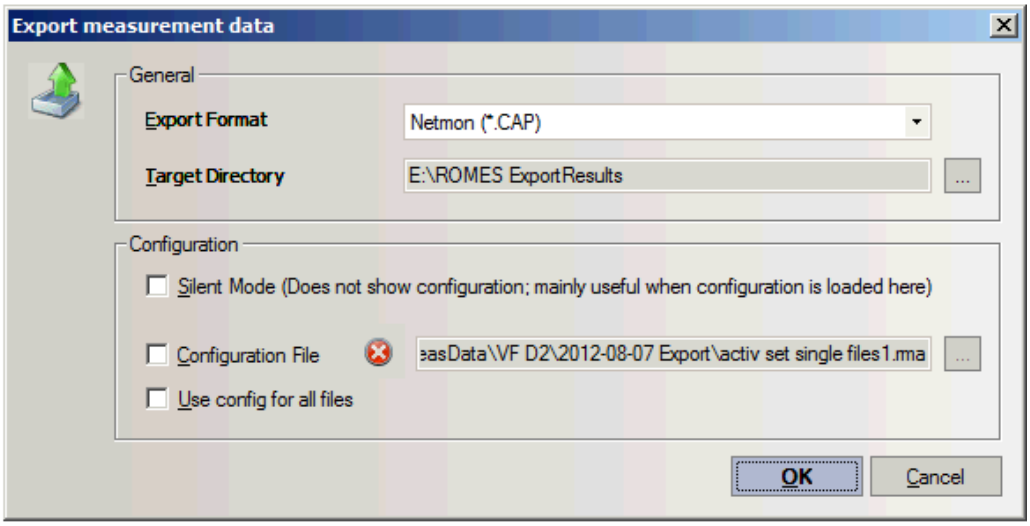


Figure 7-28: Export Netmon CAP measurement file

The "Netmon Export" configuration dialog contains two tabs:

- "Blocks"
- "Information"

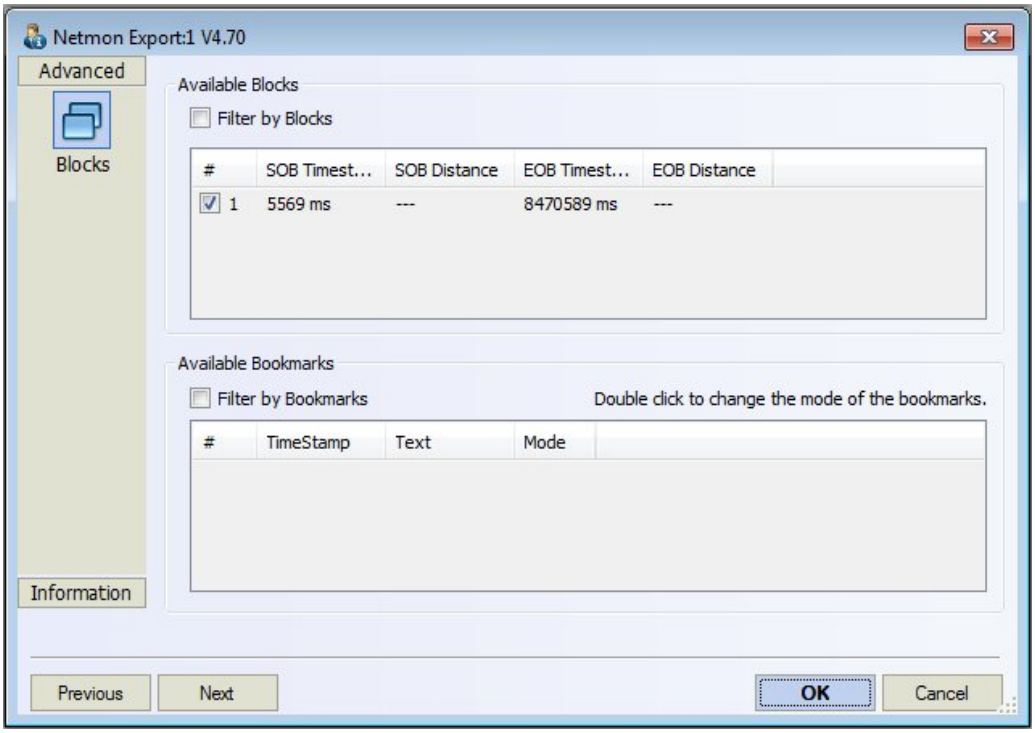


Figure 7-29: Netmon Export configuration dialog

These tabs are analogue to the ASCII Export tabs, see Chapter 7.2.4.1, "User-defined ASCII format (*.asc)", on page 2105.

7.2.5 Export scanner data

To export scanner data, click "File" > "Export Measurement File(s)" and select the export scenario for scanner data in the "Export measurement data" > "General" > "Export Format".

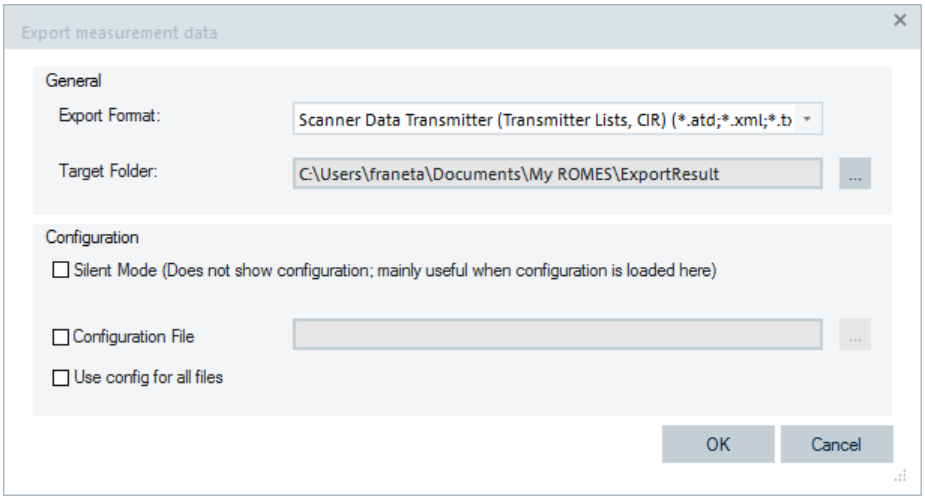


Figure 7-30: Export scanner measurement data

The scanner data export function makes batch export of the following data:

- Transmitter tree of BCH views
- Transmitter list of BCH views
- CIR export
- Scanner raw export
- Time gated measurement data

You can choose the silent or interactive export in the "Export measurement data" > "Configuration" pane. For silent export, check the "Silent Mode" check-box.

Click "OK" to confirm the selection.

The scanner export scenarios are configurable in the "ScannerData Export <version>" > "Data Selection" page, which opens upon this confirmation of the interactive export mode.

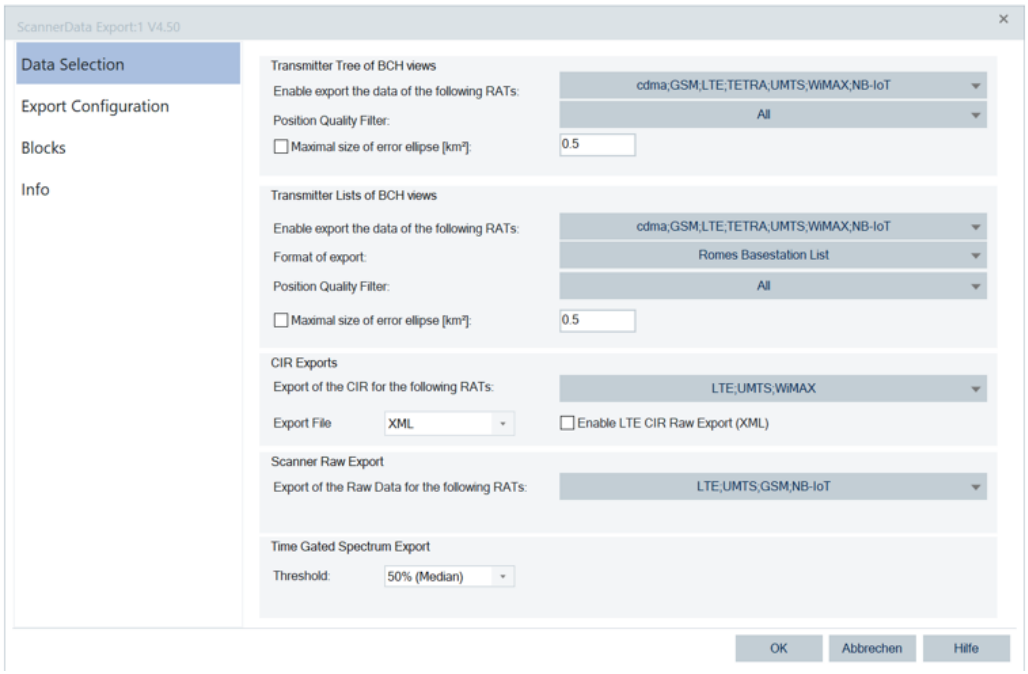


Figure 7-31: Export scanner data configuration

7.2.5.1 Silent export

For silent export, check the "Silent Mode" box and choose the previously saved export configuration file.

If a file is not defined, the last used export configuration or default export parameters are used.

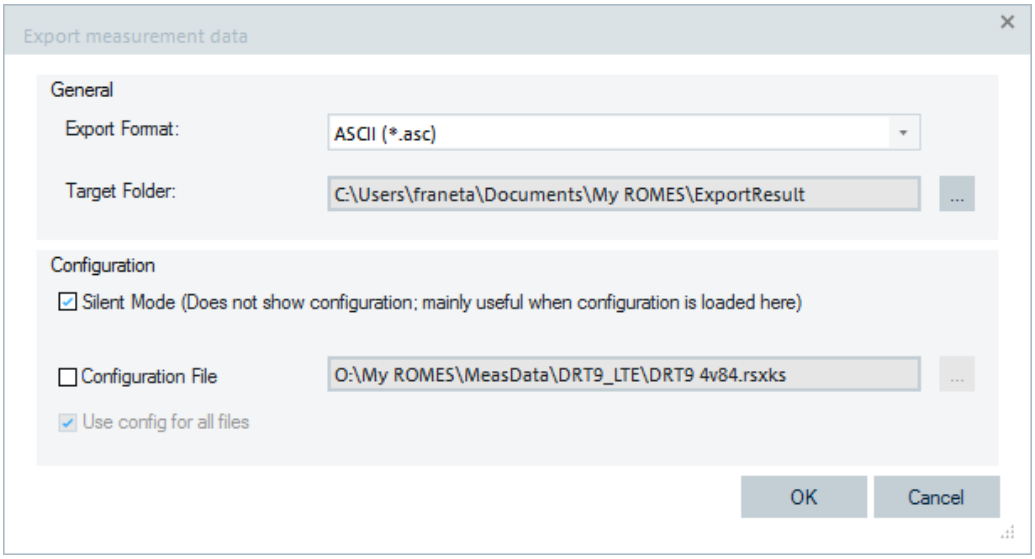


Figure 7-32: Silent export mode

7.2.5.2 Interactive export

The interactive export scenario is executed if the "Silent Mode" box is unchecked (default). In this case, the "Open" page offers to select one or more (not recommended) files for export.

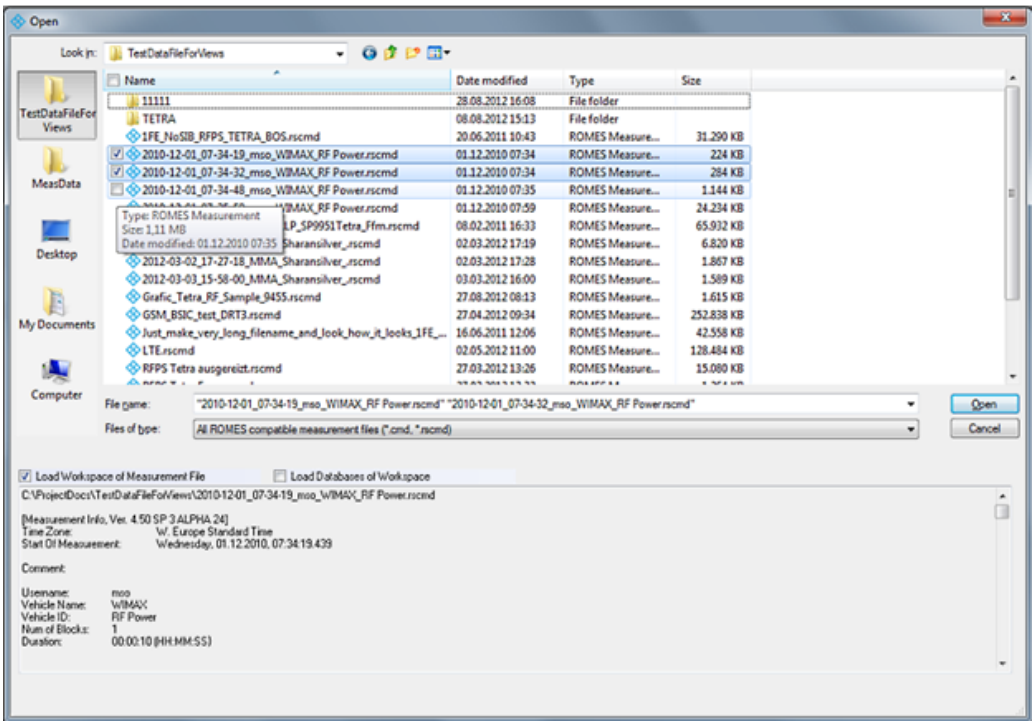


Figure 7-33: Selection of files for export

Select one (or more) files and click "Open". The "ScannerData Export <version>" configuration page displays, see Figure 7-31. You can define export parameters for all kinds of export in this page.

- "Transmitter Time of BCH Views"
  If the selected data export scenario is this one, specify RAT or select all available in the list box "cdma,GSM,LTE,TETRA,UMTS,WiMAX,NB-IoT". Further, specify the quality of position filter and the error size in the pane.
- "Transmitter LIsts of BCH Views"
  If the selected data export scenario is this one, specify RAT or select all available in the list box "cdma,GSM,LTE,TETRA,UMTS,WiMAX,NB-IoT". Further, select the format of export, the quality of position filter and the error size in the pane.
- "CIR Exports"
  The option lets you select RAT or all in the list box "LTE,UMTS,WiMAX" and the format of a CIR export file. The format can be CSV or XML. If you need the LTE CIR raw data to export, check the "Enable LTE CIR Raw Export (XML)" box. For LTE CIR raw data, see Chapter 7.2.5.7, "LTE scanner CIR raw data export", on page 2143.
  The LTE CIR and CIR peak raw data exports are based on the reference signal measurements, see Chapter 4.8.6.8, "LTE scanner reference signal CIR view", on page 1241. These data exports are only available to XML format.

The CIR and CIR peaks export files have added position data for every <ListContent> entry, see examples in the Example.

- "Scanner Raw Export"
  The option lets you select the raw data export of LTE, UMTS, GSM or NB-IoT or of all these RATs scanners.
  The Top N sorting is not applied to the exported data. Top N is exported as scanners measured the data. The output format is fixed and cannot be modified. It contains time-stamp, geographic information and the scanner data. One file is generated per RAT.
- "Time Gated Spectrum Export"
  The option lets you export scanner data of Time Gated measurements. The option's configuration allows you to disable this export or to enable it by selecting a threshold for the data. The output file has CSV format with the following columns: Date; Time; UTC; Latitude; Longitude; Altitude; Speed; Heading; #Satellites; Frequency[Hz]; Power[dBm].
  Note: The power column can contain a valid power value in dBm, a '-' for not measured, an 'u' for underflow or an 'o' for overflow.

While running the export, the CSV files are created.

At the standard export folder, a folder for each measurement file is created containing `*.csv` files per selected RATs. A file's name is created as:
`<MeasurementFileName>_<RAT>_TecRaw_<Time and Date of Export>.csv`. The file can be opened with MS Excel directly.

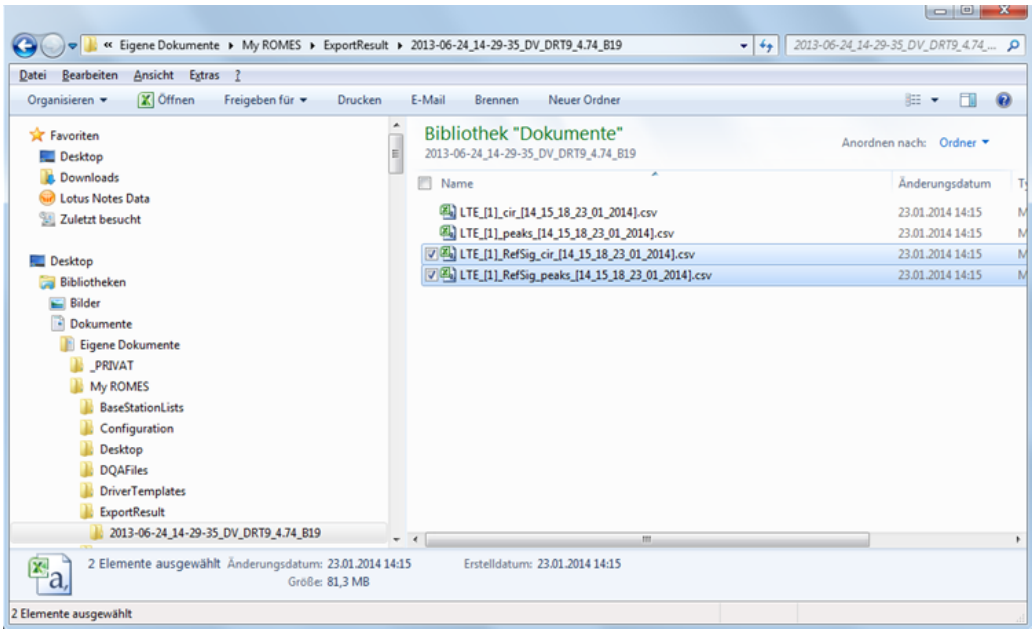


Figure 7-34: Exporting LTE CIR and peak

Consider that some export parameters are not compatible. Incompatible parameters cannot be selected.

Example:

For the KML export format of different RATs available in "Transmitter List of BCH views", the "Position Quality Filter" > "No Position"/"Position from Database" option is incompatible. Therefore, with "No Position" selected, it is not possible to select the KML format and vice versa.

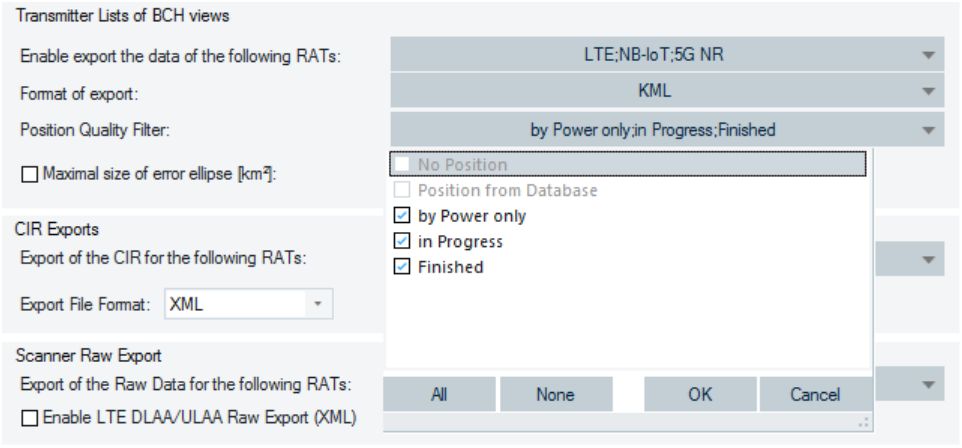


Figure 7-35: Incompatible parameters

Export of NB-IoT scanner data

NB-IoT technology is a part of the R&S ROMES4 scanner data export.

NB-IoT measurements can be chosen from the following sections of the export configuration page:

- "Transmitter Tree of BCH views"
- "Transmitter List of BCH views"
- "Scanner Raw Export"

NB-IoT is selected by default for the mentioned referenced sections.

The raw scanner data is exported in CSV format. By default, the export file `{NameOfMesurementFile}_NB-IoT_TecRaw_{DateTimeOfExport}.csv` is located at the User\Documents\My Romes\ExportResult\{NameOfMeasurmentFile}\ directory.

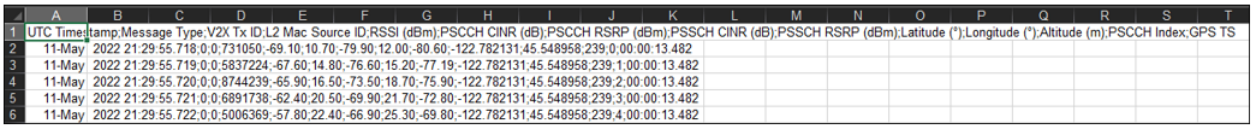
The exported data is given in the following order:

Date;Time;UTC;Latitude;Longitude;Altitude;Speed;Heading;#Sat;EARFCN;Frequency;NPCI;MCC;MNC;TAC;CI;eNodeB-ID;cellID;RSSI-Tx0;RSSI-Tx1;NSINR-Tx0;NSINR-Tx1;NRSRP-Tx0;NRSRP-Tx1;NRSRQ-Tx0;NRSRQ-Tx1;NSSS-Power;NSSS-RSSI;NSSS-CINR;

Export of C-V2X scanner data

C-V2X technology is a part of the R&S ROMES4 scanner data export.

The scanner measurement data is exported as a CSV file. The default export file name is `V2X_Message_CSV_Export.csv`.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	UTC Times	tamp;Message Type;V2X Tx ID;L2 Mac Source ID;RSSI (dBm);PSCCH CINR (dB);PSCCH RSRP (dBm);PSSCH CINR (dB);PSSCH RSRP (dBm);Latitude (°);Longitude (°);Altitude (m);PSCCH Index;GPS TS																			
2	11-May	2022 21:29:55.718;0;0;731050;-69.10;10.70;-79.90;12.00;-80.60;-122.782131;45.548958;239;0;00:00:13.482																		
3	11-May	2022 21:29:55.719;0;0;5837224;-67.60;14.80;-76.60;15.20;-77.19;-122.782131;45.548958;239;1;00:00:13.482																		
4	11-May	2022 21:29:55.720;0;0;8744239;-65.90;16.50;-73.50;18.70;-75.90;-122.782131;45.548958;239;2;00:00:13.482																		
5	11-May	2022 21:29:55.721;0;0;6891738;-62.40;20.50;-69.90;21.70;-72.80;-122.782131;45.548958;239;3;00:00:13.482																		
6	11-May	2022 21:29:55.722;0;0;5006369;-57.80;22.40;-66.90;25.30;-69.80;-122.782131;45.548958;239;4;00:00:13.482																		

Figure 7-36: C-V2X scanner measurement export

Export of 5G NR scanner data

"ScannerData Export <version>" supports both the CIR exports and raw data export for 5G NR scanner.

The 5G NR raw scanner data is exported in CSV format and the exported data are shown in the 5G NR column of the Table 7-1.

The 5G NR Scanner CIR exports are shown in the following figures.

02.07.2018;15:17:00.993;;;;;;;;24400;28155360000;257;336;41;1;-86.8;16.6;-76.7;-5.1;

02.07.2018;15:17:00.993;;;;;;;;24400;28155360000;257;892;;6;-86.8;16.7;-76.3;-4.2;

02.07.2018;15:17:00.993;;;;;;;;24400;28155360000;257;336;10;2;-86.8;14.5;-76.3;-4.3;

02.07.2018;15:17:00.993;;;;;;;;24400;28155360000;257;892;;7;-86.8;14.5;-76.8;-5.9;

Figure 7-37: 5G NR scanner CIR raw data

The exported CIR raw data in the previous figure is given in the following order:

Date;Time;UTC;Latitude;Longitude;Altitude;Speed;Heading;#Sat;GSCN;SSRef;Band;PCI;Beam;BeamMod8;RSSI;SS-SINR;SS-RSRP;SS-RSRQ;

782 ms;-;-;;336;41;-88.10;-85.13;26738.40;1.88;0.00;64547;

782 ms;-;-;;336;10;-77.71;-77.31;26738.40;2.14;0.93;64558;

782 ms;-;-;;336;43;-96.60;-94.96;26738.40;2.35;0.44;64569;

Figure 7-38: 5G NR scanner CIR export data

The CIR export data in the previous figure is given in the following order:

Timestamp;Longitude;Latitude;Color;PCI;Beam;Power [dBm];P total [dBm];SSRef[MHz];Max. Delay [µs];Time Delta [µs];BTS ID;

782 ms;-;-;;1005;0;26738.40;-82.52;-77.90;2.01;0/0 (0.00%);64192960;

782 ms;-;-;;1005;0;26738.40;-81.67;-77.90;1.76;0/0 (0.00%);64192960;

782 ms;-;-;;1005;0;26738.40;-82.18;-77.90;0.83;0/0 (0.00%);64192960;

Figure 7-39: 5G NR scanner CIR peak export data

The CIR peak export data in the previous figure is given in the following order:

Timestamp;Longitude;Latitude;Color;PCI;Beam;SS-Ref [MHz];Power [dBm];P total [dBm];Delay [µs];Match.Guard.Per.;BTS ID;

Export of 5G NR scanner TAE measurements data

The ASCII export signal filter dialog offers the additional option "ANY" for NR-ARFCN, PCI and Beam. To identify the transmitter, it is recommended to select the signals "TAE NR-ARFCN", "TAE PCI" and "TAE Beam" together with the TAE result signals. The "ANY" option allows you to get a line for every TAE measurement of the file, independent of the transmitter.

Example Result:

08:31:27;The PC clock was used to read the UTC for a received PPS;630000;393;5;0;310;06:31:26.900;8;23;8164;1595572286900008164;433;7;0;0

08:31:27;The PC clock was used to read the UTC for a received PPS;630000;393;6;0;334;06:31:27.140;7;13;8124;1595572287140008124;512;7;0;0

08:31:27;The PC clock was used to read the UTC for a received PPS;630000;393;6;0;348;06:31:27.280;10;19;8557;1595572287280008557;436;7;0;0

08:31:27;The PC clock was used to read the UTC for a received PPS;630000;393;5;0;368;06:31:27.480;8;19;8147;1595572287480008147;425;7;0;0

Export of raw scanner data

The raw scanner data exported for the RAT selected in the "Export of the Raw Data for the following RATs" is given in the following table. The first column contains data common for supported RATs.

Table 7-1: Exported raw scanner data in CSV format

All RATs exported data	GSM exported data	UMTS exported data	LTE exported data	NB-IoT export data	5G NR exported data
Measurement File Info	ARFCN	UARFCN	EARFCN	EARFCN	GSCN
Date, Time	Frequency	Frequency	Frequency	Frequency	Band
UTC	LAC	LAC	TAC	TAC	Beam
Latitude	CI	CI	CI	CI	Beammod8
Longitude	BSIC	SC	PCI	NPCI	PCI
Altitude	Total Power	RSSI	eNodeB-ID	eNodeB-ID	SSRef.
Speed	SCHPower	Ec/No (PSCH)	cellID	cellID	RSSI
Heading	C2	Ec/No (SSCH)	BWE	RSSI-Tx0;RSSI-Tx1	SS-SINR
#Sat		Ec/No	SymPerSlot	NSSS-RSSI	SS-RSRP
MCC		SIR	Power	NSSS-Power	SS-RSRQ
MNC		RSCP	SINR	NSINR-Tx0; NSINR-Tx1	SSS-RePower

All RATs exported data	GSM exported data	UMTS exported data	LTE exported data	NB-IoT export data	5G NR exported data
		ISCP	RSRP	NRSRP-Tx0 NRSRP-Tx1	SIB1 Signals: (in addition to MCC and MNC) LAC RNC-Cell ID* (Hexadecimal) R NC-Cell ID* (Decimal) RNC-Cell ID* is exported twice with indicated formats.
		Drift DevDrift	RSRQ	NRSRQ-Tx0; NRSRQ-Tx1	MIB Signals: MIB_Sfn MIB_ScsCommon30or120kHz MIB_SsbSubcarrierOffset MIB_DmrsTypeAPositionPos3 MIB_PdcchConfigSib1 MIB_CellNotBarred MIB_IntraFreqReselectionNotAllowed
		Delay Spread	4G-Drift	NSSS-CINR	DM_RS Signals: DM_RS-SINR DM_RS-RSRP DM_RS-RSRQ DM_RS-RePower
		ULI	Sigma-4G-Drift		PBCH Signals: PBCH_RS-SINR PBCH_RS-RSRP PBCH_RS-RSRQ PBCH_RS-RePower
		TimeOfArrival The R&S option Position Estimator has to be available during the measurement. The signal is analogue to the one for LTE - means the time of arrival of the UMTS signal relative to the PPs pulse. Although being optional, activate it in the "TEC for UMTS Scanner".	TimeOfArrival		PSS Signals: PSS_RS-SINR PSS_RS-RSRP PSS_RS-RSRQ PSS_RS-RePower SSS_PBCH Signals: SSS_PBCH-SINR SSS_PBCH-RSRP SSS_PBCH-RSRQ SSS_PBCH-RePower

All RATs exported data	GSM exported data	UMTS exported data	LTE exported data	NB-IoT export data	5G NR exported data
		TimeOfArrival Virtual Frame Number For UMTS and LTE, the internal virtual frame number (VFN) is available as the R&S ROMES4 signal. This value is the 10 ms frame number, which belongs to the current Time Of Arrival (ToA) value. This value allows the user to bring together the Time Of Arrival values on an absolute time (Abs. Time) scale. The absolute time value can be calculated as follows: T = ToA + VFN * 10ms , see the following example.			SS_PBCH Signals: SS_PBCH-SINR SS_PBCH-RSRP SS_PBCH-RSRQ SS_PBCH-RePower Time of Arrival (ToA) Signals ToA (PPS) ToA (CIR)
Note: To be exported, some raw data require a software and/or hardware option. If the corresponding options are not available, the column in the file is left blank.					

Example: Abs. time calculation

Time of Arrival	Virtual Frame Number	Abs. Time
0.00345	1000	10.00345
0.00346	1001	10.01346

Scanner export configuration

It is possible to save the configuration or load the previously saved configuration in the "Export Configuration Management" window, see Chapter 7.2.4.1, "User-defined ASCII format (*.asc)", on page 2105.

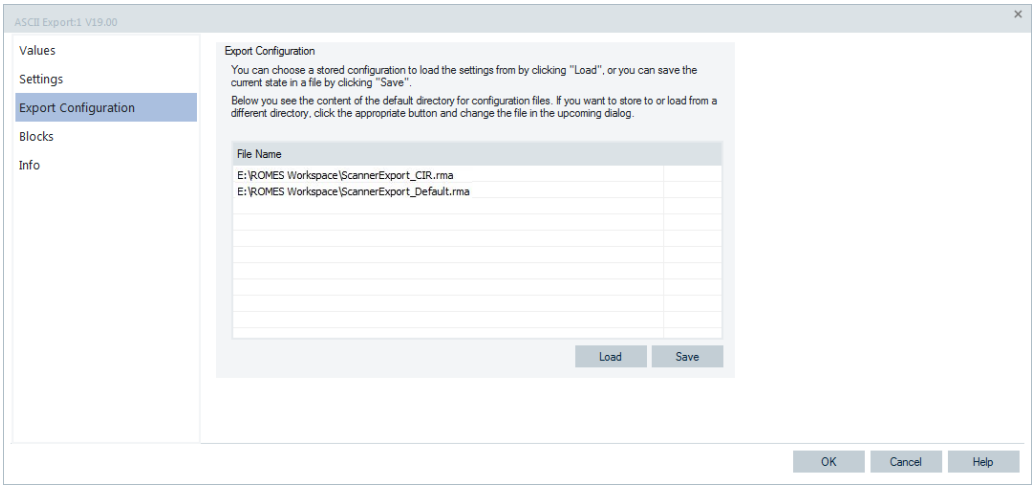


Figure 7-40: Export Configuration window

The "Load" function tests configuration and returns warning, if combination of parameters is not effective. For example, it acts when user has not defined any position filter for export, but defined RATs list, or vice versa. Click the button before you start export.

If the user loads the configuration, even clicking the "Cancel" button does not reset the export settings.

Multiple files export is not recommended in the interactive mode because user gets the export parameters dialog before export of every file. If user needs to export many files, and export parameters were saved in this dialog, it would be more effective to use silent export.

7.2.5.3 Batch export

The user also can make scanner export in the batch mode. For this mode, you need to use command string like this:

`Romes.exe -e sca -f SourceFile.rscmd -c PreSavedConfigFile.rma`, where

- `SourceFile.rscmd` is the source file with measurement data
- `PreSavedConfigFile.rma` is the existing export configuration data file.

CAUTION

Exporting scanner measurement data in batch mode

Do not forget to use **“”**, if file names or paths contain the spaces.

7.2.5.4 Export log

During a file export, independently on used export mode, R&S ROMES4 generates a log and shows it in the "Export Info" window.

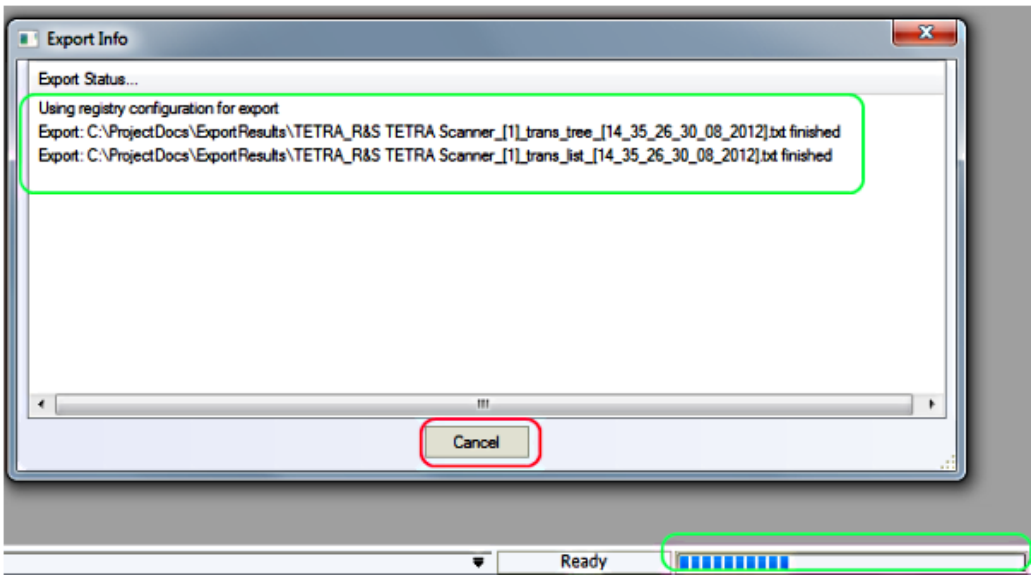


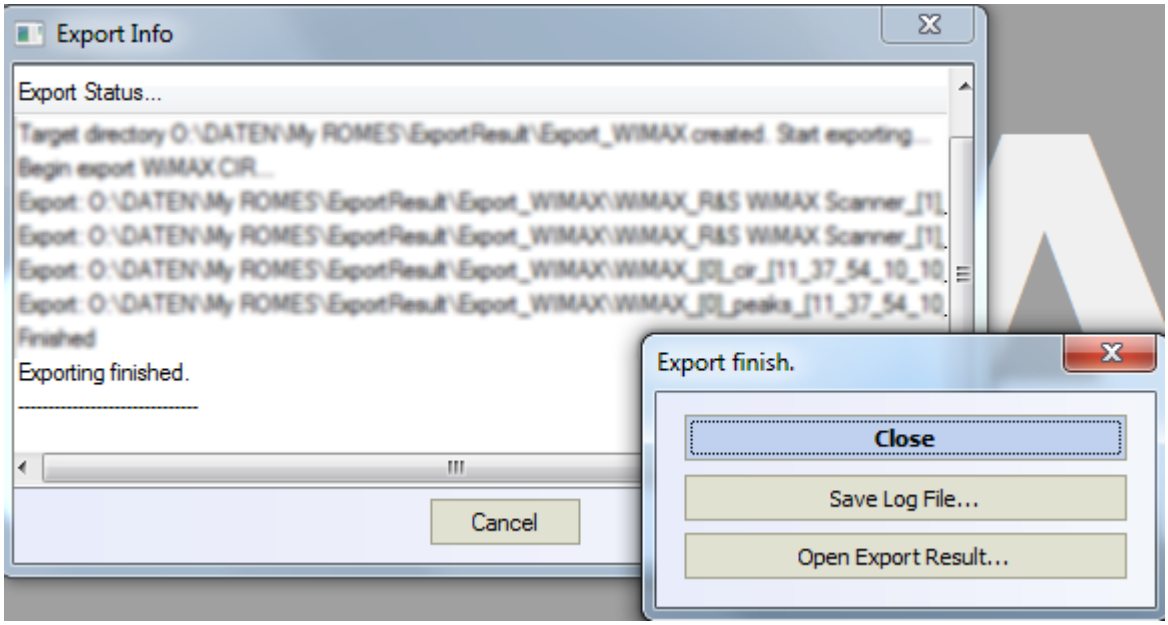
Figure 7-41: Export info

You can see the export status. The progress bar gives the information on the actual progress of the export.

To terminate export, click "Cancel".

7.2.5.5 View export results

After finishing the export process, the "Export Info" > "Export finish" dialog appears.



The possible actions are:

- Doing nothing (click "Close")
- Saving a log file for export (click "Save Log File")
- Opening all created export files (click "Open Export Result")

Export files can have a huge size and opening a file can take much time.

To open all XML files simultaneously, change the settings of those MS Windows versions which have Internet Explorer as the default viewer for XML files. Without the settings change you get only the first file opened.

Use the "Control Panel" > "Folder Options" > "Open each folder in its own window" option, see Chapter 7.2.3, "Export info", on page 2104.

7.2.5.6 Names of exported files

For every source file, R&S ROMES4 creates subdirectory with the same name into the export directory name.

Example:

Default export directory name is C:\Export.

Measurement file name is `2012-08-03_09-52-51_DV_DRT8b_4.69B15.rscmd`.

Directory C:\Export\2012-08-03_09-52-51_DV_DRT8b_4.69B15 is created, and the all export files are stored.

Names of exported files are generating using the following templates:

- **Transmitter tree export file**
  ```
  "Technology name" + "Scanner instance number" + "_trans_tree_" +
  + "[" +timestamp + "]".txt
  ```
- **Transmitter list export file**
  ```
  "Technology name" + "Scanner instance number" + "_trans_list_" +
  + "[" + timestamp + "]".extension
  ```
  Extension is:
  - `kml` for KML format
  - `txt` for R&S ROMES4 Basestation List format
- **CIR export file**
  - `"Technology name" +"[" + "Scanner instance number" +"]" + + "_cir_[" + timestamp + "].xml`
  - `"Technology name" +"[" + "Scanner instance number" +"]" + + "_peaks_[" + timestamp + "].xml`
- **LTE CIR raw data export_file**
  `"LTE_[" + "unique ID" + "]_CIR_Raw_[" +" + timestamp + "].xml`

Timestamp format is: hour_min_sec_day_month_year

All files generated by one export operation have the same timestamp as the timestamp is calculated once at the beginning of every export. A single timestamp makes sort and analysis of files easier.

7.2.5.7 LTE scanner CIR raw data export

To get the LTE scanner CIR information, which is the raw channel impulse responses, use the "File" > "Export Measurement File(s)" menu. The raw channel impulse response means one CIR per up to every 5ms.

This export does not depend on the update rate of the lists. All data is exported.

The reconstruction of the spectral channel impulse response is done as follows.

The fading channel is measured as few single paths. Each path has an amplitude a(i)=sqrt(p(i)), phase phi(i), Doppler frequency fd(i) and a delay tau(i). The CIR is measured on a bandwidth of 1.08 MHz and a 9 5ms long IQ data block, which starts at Tcir. In this block the LTE frame start at the time tau_min (minimum of the delays of all peaks). The temporal relation of the position of the reference symbols is given implicitly. The reconstruction is done for each transmit antenna (Port 0,.., Port 3) separately,

because the transmit channels are different. The reconstruction of the 12*6=72 resource elements r(t, k*15kHz) {k=-36...-1,1,...,36} is the impulse response in spectral range at time t for the bandwidth of 1.08 MHz, which is given as a TransferFunction. An IQ Block normally has a length of 100 ms, which result in (100ms / 5ms) - 1 = 19 TransferFunctions.

The phases of the exported results are only in relation to each other within one exported IQ block, called Single Measurement.

The CIRs are exported in to an XML file with the name `RSCMD-filename_LTE_CIR_Raw.xml` which is created in the ExportResult directory. The XML file is written whenever the replay was stopped. Tags and attributes of the XML file are given in the following table.

Table 7-2: Tags and attributes of the XML file

ScannerResult	**Tag**	Bunch of measurement results reported by the scanner
	Measurement_Time_s:	Start time of the measurement in seconds from start of the measurement (PC time)
	Receiver_Time_s:	Receiver internal start time of the measurement in seconds
	Device:	Id of the receiver device
SpectralCIR		Spectral Channel Impulse Response
Port		Antenna Port
	Port Number	Number of the port 0..3
	CountOfTransferFuntions	Number of transfer functions for this single measurement on this port 0..19
	Device:	Id of the receiver device
Transfer Function		Transfer function as explained above
	TransferFunctionNumber	Number of the transfer function 0..19
	Receiver_Time_s	Receiver internal time for the transfer function in seconds
Point		Point of the transfer function
	Power_dBm	Power in dBm
	Arg_Radiant	Phase in radiant
Server	**Tag**	LTE eNodeB
	PCI	Physical Cell Identity
	NumberOfSymbolsPerSlot	7 for normal CP, 6 for extended CP

	SSSToPSSRatioInDB	Measured power ratio power(SSS)/power(PSS) in dB LTE Scanner Signals
	ExpectedTimeDriftInNsPerSec	Due to observation of the arrival time of the strongest BS signal, we can calculate an expected time drift against the receiver time
	SigmaTimeDriftInNsPerSec	Expected standard deviation of the value above
	CenterRSRPinDBm	Gives the RSRP value based on the reference signal power measurement of the 6 innermost resource blocks. (1MHz BW around center frequency at symbols used for the PBCH). It is a combination of noise clipping and non-noise clipping results. (See the explanation for the Ofdm-Based and the CirBased values)
	PBCHbasedRSRQinDB	RSRQ value based on CenterRSRPinDBm and the total inband power in resource blocks used to transmit the PBCH within the 100 ms IQ data block analyzed with the scanner
	CntResourceElementsForRSRP	Number of resource elements used for RSRP measurement
	OfdmBasedCenterRSRPinDBm100	RSRP value based on the reference signal power measurement of the 6 innermost resource blocks. (1 MHz BW around center frequency at symbols used for the PBCH). The power measurement is done from the OFDM symbol without clipping of noise.
	CirBasedCenterRSRPinDBm100	RSRP value based on the reference signal power measurement based on CIR measurement and noise clipping of the 6 innermost resource blocks. (1 MHz BW around center frequency) at symbols used for the PBCH.
Power Values		Measured power of signal
PowerValue		One power value
	TimeFromStartOfBlockInNs	Time in ns of the first IQ value for the SSS power measurement from the IQ block start. This value is normally within the CP of the OFDM symbol containing the SSS. In the case that not a single symbol has been used the value is reported.

	PowerInDBm	Power of SSS signal in dBm. The PSS power can be retrieved indirect using the measured SSS / PSS power ratio. If TimeFromStartOfBlockInNs is not reported, then the power is measured for 19..20 SSS OFDM Symbols (calculated from the CIR). If we have a valid time value, the power is measured for one SSS symbol only.
	CinrDB:	CINR value in dB for the sync signals. If TimeFromStartOfBlockInNs is not reported then the CINR is measured for 19..20 S-Sync OFDM Symbols (calculated from the CIR). If we have valid values in CinrDetails for S-Sync and P-Sync, then CINR value is the average of P-SYNC and S-SYNC. If in CinrDetail only S-Sync CINR is valid, then this value is the S-Sync CINR. For details, see CinrDetailTable which is parallel to this record.
	CinrPSyncInDB:	CINR of the PSS in dB
	CinrSSyncInDB:	CINR of the SSS in dB
	AmpBasedCinrPSyncInDB	CINR of the PSS in dB based on amplitude noise. The measurement performed for this result value reduces the noise contribution that is produced by the phase noise of transmitter or receiver. If receiver or transmitter phase noise contributions cannot be neglected, the amplitude-based CINR is higher than the CINR based on the regular CINR measurement.
	AmpBasedCinrSSyncInDB	CINR of the SSS in dB based on amplitude noise.
CIR_PowerDelay		Channel Impulse Response and Power Delay
PowerDelayProfile		Power Delay Profile
	SamplingTimeInSec	Sampling time or time distance between CIR samples.

	InbandPowerInDBm	Inband power during the CIR measurement in dBm. The inband power is measured within the same band or frequency range. One or more time intervals are occupied by a special transmitted signal sequence which is used to calculate the CIR. For example, in LTE up to 20 SSS signals are used to calculate the CIR and the power delay profile. Each SSS is defined by 62 subcarriers which define the band or frequency range for the inband power measurement. The symbol time-slots of the 20 SSS define the used time intervals. So, the minimum value of the inband power measurement is the aggregate power of all components in the power delay profile. If no interference signal is present, both aggregate power and inband power are equal and the measurement errors neglected.
	AggregatePowerInDBm	Received power from all paths in dBm. Note that this power is not necessary the peak power or the sum of the power values in the power delay profile. Due to higher resolution in time delays and Doppler frequency, concerning the measured bandwidth and length of the analyzed signal, the value is different. The aggregate power is defined as the RMS power of some signals (e.g. SSS or reference signal for LTE) out of the all signals used to calculate the CIR. It corresponds to the same section as the inband power. Sometimes the aggregate power can be higher than the inband power. This case happens when a noise contribution disturbs the algorithm is a way, that the reconstructed signals have a higher power than the received signals.
	NoiseFloorInDBm	This parameter is an estimated noise floor for the CIR. Reported values below or next to the noise floor are caused or significantly influenced by noise.
Point		Point of the Power Delay Profile

	PowerInDBm	Here the time discrete power values (power samples) of the power delay profile in dBm are reported. Some power values cannot have a valid value. At the corresponding delays, the power measurement was not done or not successful. I.e. we have not been able to measure a delayed power with the methods for CIR measurement.
ComplexCIR		Complex Channel Impulse Response
	PowerOf1InDBm	For complex values, we need some scaling for the delayed power in dBm which is 10 * log10(re^2 + im^2) + PowerOf1InDBm.
Point		Point of the complex CIR
	re	Real part
	Im	Imaginary part
Peaks		List of peaks of the CIR
	NumberOfPeaks	Number of peaks in the list
Peak		Peak of the CIR
	InbandPowerInDBm	Inband power for this peak in dBm
	PeakPowerInDBm	Power of the peak in dBm
	MainDopplerInHz	A main input component for a Doppler frequency in Hz.
	CountOfGuardPeriods	CountOfGuardPeriods are various guard periods checked for the CIR peak.
	CountOfMatchingGuardPeriods	CountOfMatchingGuardPeriods = 0..CountOfGuardPeriods are various guard periods checked for the CIR peak and the signal of the peak is within the guard period.
		If 0 < CountOfMatchingGuardPeriods < CountOfGuardPeriods then there are some guard periods where the peak is in and others where the peak is outside. This case happens when the guard period position is shifted between the measured OFDM symbols.
	DopplerPhaseIn2P16	Main Doppler phase in 2^-16 (2^16 = 360ø) at the first sample or 0.

	MainDopplerFractionIn2Pm16Hz	To get a better resolution of a Doppler frequency, we can store the sub Hz part in this variable. The Doppler frequency is then MainDopplerInHz + 2^-16 * MainDopplerFractionIn2Pm16Hz.
	DelayInSec	Delay in seconds from the first sample. This delay can be in a better resolution than the sampling time from the power delay profile.

7.2.5.8 RF power scanner data export

In "ASCII Export <version>" > "Values" page select the RF Power Scan signals for export.

Apart from the current peak marker and the free marker signals, you can activate the additional four fixed marker signals for export. Exporting the signals from the "Fixed Marker" branch needs to define the fixed marker frequencies in "TEC for RF Power Scanner TSME".

For description of the fixed marker frequency signals, see "Signal settings" on page 370 and Figure 3-244.

A RF power scanner measurement can have some sweeps, for example, one for GSM900, one for GSM1800 and a scan of the UMTS band, see Figure 3-243).

If a frequency falls into the start/stop frequency of a sweep, the sweep's fixed marker is applied. Therefore, it is possible that none, one or many fixed marker frequencies are applied for a certain sweep. It is also possible that one fixed marker frequency falls into several sweeps (e.g. GSM-R and GSM900).

If no fixed marker is applied, the exported signals are signed invalid with "?".

Some signals depend on the measurement settings and cannot be valid. For example, no usage of AUTO detector results in an invalid min level, auto attenuation selection results in an invalid attenuation and preamplifier signal.

The "Output" window shows how the markers are applied on the sweeps.

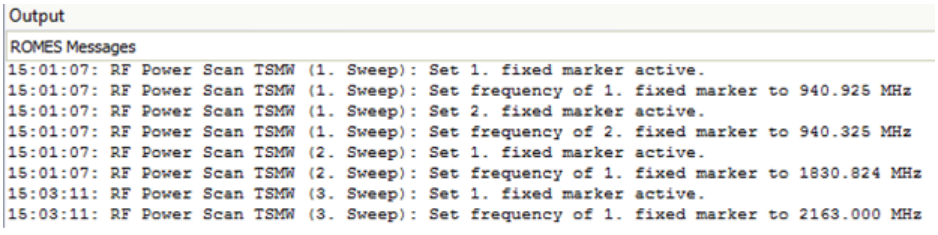


Figure 7-42: Output messages for Fixed Marker configuration

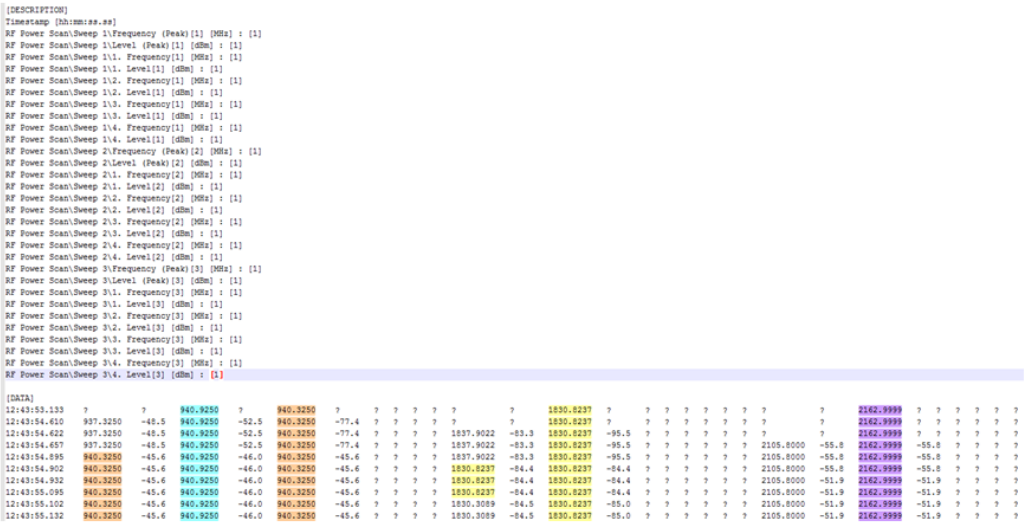


Figure 7-43: Example of an ASCII exported file

7.2.6 Exporting RF power scanner data from multiple scanners

If the RF Power Scanner is used with multiple scanners (refer to Multiple R&S TSME with RF power scanner), the "Available Signals" > "RF Power Scan" branch allows exporting the signals of all configured scanners.

Exporting the signals from the "Fixed Marker" branch needs to define the fixed marker frequencies.

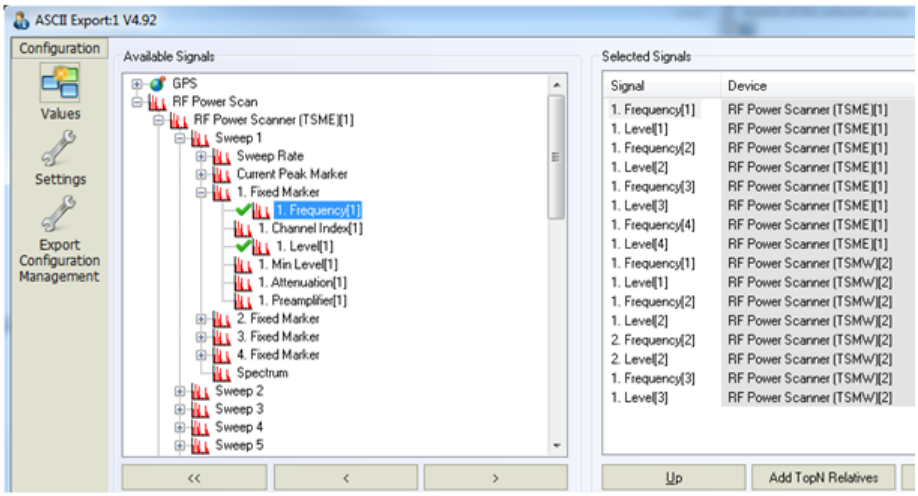


Figure 7-44: Selected multiple RF power scan signals for export

The result is an export result file. A list of the selected and exported signals is contained in the "[DESCRIPTION]" part of the result file. Here [1] and [2] denotes the device instance.

```
[DESCRIPTION]
Timestamp [dd.mm.yyyy;hh:mm:ss.ss]
RF Power Scan\Sweep 1\1. Frequency[1] [MHz] : [1]
RF Power Scan\Sweep 1\1. Level[1] [dBm] : [1]
RF Power Scan\Sweep 2\1. Frequency[2] [MHz] : [1]
RF Power Scan\Sweep 2\1. Level[2] [dBm] : [1]
RF Power Scan\Sweep 3\1. Frequency[3] [MHz] : [1]
RF Power Scan\Sweep 3\1. Level[3] [dBm] : [1]
RF Power Scan\Sweep 4\1. Frequency[4] [MHz] : [1]
RF Power Scan\Sweep 4\1. Level[4] [dBm] : [1]
RF Power Scan\Sweep 1\1. Frequency[1] [MHz] : [2]
RF Power Scan\Sweep 1\1. Level[1] [dBm] : [2]
RF Power Scan\Sweep 2\1. Frequency[2] [MHz] : [2]
RF Power Scan\Sweep 2\1. Level[2] [dBm] : [2]
RF Power Scan\Sweep 2\2. Frequency[2] [MHz] : [2]
RF Power Scan\Sweep 2\2. Level[2] [dBm] : [2]
RF Power Scan\Sweep 3\1. Frequency[3] [MHz] : [2]
RF Power Scan\Sweep 3\1. Level[3] [dBm] : [2]

[DATA]
26.10.2016;12:28:58.799 ?  ?  ?  ?  ?  ?  ?  ?  937.4000  -52.8  1845.6000  ?  ?  ?  ?  ?
26.10.2016;12:28:58.811 ?  ?  ?  ?  ?  ?  ?  ?  937.4000  -52.8  1845.6000  -55.0  ?  ?  ?  ?
26.10.2016;12:28:58.827 ?  ?  ?  ?  ?  ?  ?  ?  937.4000  -52.8  1845.6000  -55.0  ?  ?  ?  ?
26.10.2016;12:28:59.088 ?  ?  ?  ?  ?  ?  ?  ?  937.4000  -51.5  1845.6000  -55.0  ?  ?  ?  ?
```

Figure 7-45: Result file of the multiple RF Power Scan signals export

7.2.7 Export via MS Windows command line

Use the command-line to export measurement files if you do not want also to run some replay or measurements on your system.

The user-defined ASCII format ASC does not support this export approach.

General command-line export syntax:

```
[C:\RuS\ROMES4.xx\]romes.exe -e <export module> -f <measurement file(s)> [-s] [-c <export config file>] [-w <workspace file>] [-y] [-r <report file>] [-d <destination dir>]
```

Use quotation marks (" ") if blanks are in path or files names

In case blanks are in paths and/or file names, it is mandatory to use quotation marks.

In example: "`C:\User\My ROMES\MeasData\Measurement File.rscmd`"

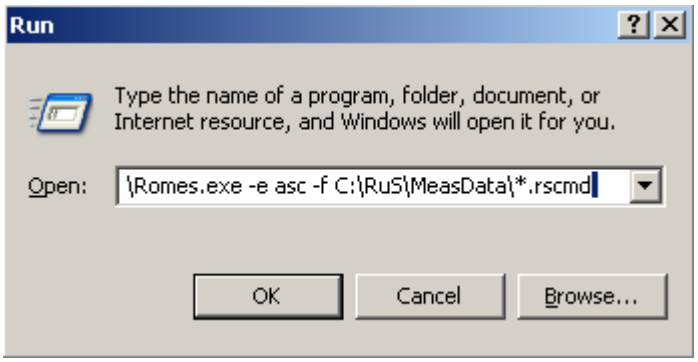
To export the data, one out of the formats MIF, ASC or CSV must be selected. Multiple selections are allowed.

If an input file name has no related output file name after the /o switch, the input file name will be used for the output file.

If more output file names than input files are specified, the spare output files are ignored. If fewer output files than input files are specified, the n given output file names are used for the first n input files. The names of remaining files are unchanged, only the default extension is used.

If the /r option is used, all text output (e.g. error messages) produced during export is diverted into a report file. If no report file name is specified, the default name `error.txt` or `export.txt` is used.

Enter the MS Windows command line into the input field of the "Run" dialog box which is accessible from "Start".



You can also start from the DOS box. Here you can also use a batch file, if desired. If you do so, start every new line with the CALL command, otherwise only the first line of the batch file is executed.

7.2.7.1 Possible R&S ROMES4 return codes for command-line export

The possible return codes, issued when R&S ROMES4 is started with command-line export parameters, are shown in the following table.

Table 7-3: R&S ROMES4 return codes

Return code	Explanation
0	Export was successful
2	File not found
5	Access denied (for example, when tried to start a second ROMES instance)
13	Invalid data (for example, the measurement file header data is invalid)
30	Read error (the properties of a measurement are not readable)
110	A specified file could not be opened (used for source and target file)

All the other MS Windows application return codes are documented in

http://msdn.microsoft.com/en-us/library/windows/desktop/ms681381(v=vs.85).aspx

7.2.7.2 Additional features for command-line export

The command-line export functionality supports the following:

- Recursive directory scan for measurement files
- Export configuration files can be specified
- Silent mode to support batch export

The valid syntax is shown below:

```
romes.exe –e <export module> -f <measurement file> [-s] [-c
<export config file>] [-w <workspace file>] [-y] [-r <report
file>] [-d <destination dir>]
```

For multiple measurements file export, the following syntax for -f option applies.

```
romes.exe –e <export module> -f <"measurement1" "measurement2"
"..."> [-s] [-c <export config file>] [-w <workspace file>] [-y]
[-r <report file>] [-d <destination dir>]
```

The given example shows the syntax for exporting two files.

```
romes.exe -e sca -f "C:\data\2021-12-25_14-12-14_test1.sqc" "C:\data\2021-12-25_
14-12-14_test2.rscmd" -c "C:\data\LTE_5G_NB-iot_PE_BTSlist.rma"
```

The command options have the meanings described in the following table.

Table 7-4: Command-line options

Option	Count	Argument	Description
-e	1	Name of an export module	Specifies which kind of export to be performed. Possible values are “asc”, “csv”, “mif”, "geo", "sca".
-f	1+	Names of the files to be exported	Specifies which files to be exported. The names are interpreted as wildcards and are used to scan recursively directories. For example, if a name “C:\Rus\ROMES4.xx\MeasData*.rscmd” is specified, all files with the suffix rscmd in the R&S ROMES4 measurement data directory and all subdirectories are exported.
-s	0/1		If this option is used, then all kinds of feedback or graphical outputs like dialog and messages boxes are suppressed. It is useful to consult the `Export.txt` file after the export has finished. Nevertheless, some windows are displayed during export, but they close automatically.
-c	0/1	Configuration File (*.rma)	Specifies which configuration file to be used to initialize the export module. The ASCII export, for example, can store the list of export parameters in that file.
-w	0/1	Workspace File	Exported configurations can be saved in a workspace as well. If a configuration file is not available, a workspace can also provide configuration. If –c is specified, this workspace function is ignored.
-y	0/1		Specifies if the default settings for the export stored in the registry to use. It is only considered if –c and –w are not set.
-r	0/1	Result Log File	The messages from the export are written in the result log file. Per default, this file is stored at .\My ROMES\LogFiles\ as `Export.txt`, for example `.\My ROMES\LogFiles\2022-01-19\12-45-11\Export.txt`. It is possible to specify another file name using this option.
-d	0/1	Output Directory	Controls where to write the export result data to. If omitted, the results are written to the same directory as the input file.

If a configuration is not specified (`-c`, `-w` or `-y`) and silent mode is enabled, the export fails sometimes (ASCII export), since the list of output parameters is missing. If –s is omitted, the standard export configuration dialog for the specific export module is displayed.

7.2.8 R&S ROMES4 IBWC exporter

7.2.8.1 General

The main use of the R&S ROMES4 IBWC exporter is to display the measured signals in iBwave Design.

The IBWC file format is a ZIP folder containing XML files, which stores geographic annotation and visualization. The format was created to exchange data between the iBwave platform and third-party tools.

To use this export, a layout plan has to be created in iBwave Design first (`*.ibw`) and exported as iBwave Collection Data (*.ibwc), see Chapter 7.2.8.2, "Create floorplan in iBwave design", on page 2158.

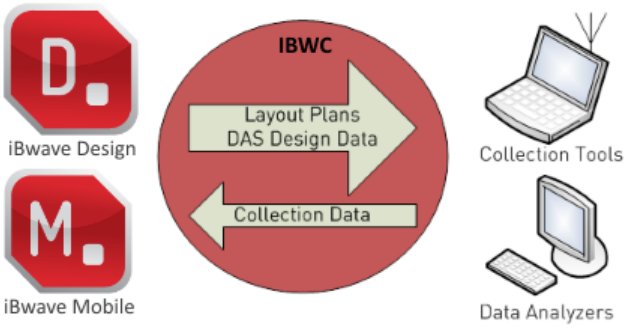


Figure 7-46: Principle of IBWC exporter

After that, it is possible to import this file as an Indoor Floorplan in R&S ROMES4, see Chapter 7.2.8.3, "Import *.ibwc file to R&S ROMES4", on page 2158, start a measurement and export the measurement back to IBWC format, see Chapter 7.2.8.4, "Export measurement files to *.ibwc file", on page 2159.

The R&S ROMES4 IBWC exporter automatically filters unwanted data.

Deleted is the following data:

- All signal data that are not positioned between two GPS measurements, since their position cannot be interpolated.
- GPS positions that are not located on a floorplan - automatically deleted during export.

The IBWC exporter exports 5G data recorded both by a mobile phone and scanner. If the 3GGP/non-3GPP specified RATs, LTE, UMTS, HSPA, GSM/CDMA2000Data, WiFi, the exporter only exports data which is recorded by a mobile phone.

The following tables list the data of different RATs that can be exported.

Table 7-5: 5G exportable data

IBWC key	Meaning	Mobile	Scanner
Time		x	x
RasterX		x	x
RasterY		x	x
PathID			
BeamID	Beam identifier	x	x
PSS_RSSI	Primary Sync Signal_Received signal strength indication [dBm]		x
PSS_RSRP	Primary Sync Signal_Received signal strength [dBm]		x
PSS_RSRQ	Primary Sync Signal_Received signal quality [dB]		x
PSS_SINR	Primary Sync Signal_Signal to Noise Ratio [dB]		x
SSS_RSSI	Secondary Sync Signal Signal strength [dBm]		x
SSS-RSRP	Secondary Sync Signal Resource Signal strength [dBm]		x
SSS_RSRQ	Secondary Sync Signal Resource Signal quality [dB]		x
SSS-SINR	Secondary Sync Signal Signal Noise Ratio [dB]		x
SSB_RSSI	Sync Signal Block Signal strength [dBm]		x
SSB_RSRP	Sync Signal Block Resource Signal strength [dBm]		x
SSB_RSRQ	Sync Signal Block Resource Signal quality [dB]		x
SSB_SINR	Sync Signal Block Signal vxy<x21Noise Ratio [dB]		x
CSI_RSSI	Channel State Information Signal strength [dBm]		
CSI_RSRP	Channel State Information Resource signal strength [dBm]		
CSI_RSRQ	Channel State Information Signal quality [dB]		
CSI_SINR	Channel State Information Signal Noise Ratio [dB]		
PBCH_RSSI	PBCH Signal strength [dBm]		x
PBCH_RSRP	PBCH Resource Signal strength [dBm]	x	x
PBCH_RSRQ	PBCH Signal quality [dB]	x	x
PBCH_SINR	PBCH Signal Noise Ratio [dB]	x	x
TimeOffset	Time offset of the TX-Transmit antenna [ms]	x	

IBWC key	Meaning	Mobile	Scanner
ss_DelaySpread	The delay spread width – the time difference between the arrival of the first SSS component to the arrival of the last multi-path component [ns]		x
PCI	Physical Cell ID	x	x
CellID	Cell identifier	x	x
MobileTxPower	UE transmit power [dBm]	x	
OperatorName	Name of the operator	x	x
OperatorMCC	Home MCC	x	x
OperatorMNC	Home MNC	x	x
TrackingAreaCode	Tracking Area Code	x	x
ChannelBW	Channel Bandwidth [MHz]		x
_5GMode	1=TDD, 2 = FDD	x	x
Modulation	1 BPSK 2, QPSK 3, 16QAM 4, 32QAM 5, 64QAM 6, 128QAM 7, 256QAM 8, 512QAM 9, 1024QAM 10, Other	x	
RankIndicator	Number (1 or more) of useful transmission layers as specified by 3GPP. A number indicates the number of MIMO streams available at this location	x	
Band	Band number of survey S	x	x
DL_ARFCN	Downlink channel number	x	x
UL_ARFCN	Uplink channel number	x	x
DL_Throughput	Downlink throughput [kbps]	x	
UL_Throughput	Uplink throughput [kbps]	x	
ChannelQualityIndicator	Channel Quality Indicator	x	
ConditionNumber	Condition Number [dB]		
OverlapServers	Number of servers in this area		

x - indicates that the IBWC exporter exports data recorded by 5G mobile phone and/or scanner.

Table 7-6: Other 3GPP RATs exportable data

Technology	Signal	Meaning
LTE	RSSI	Signal strength
	RSRP	Reference signal strength
	RSRQ	Reference signal quality
	SINR	Signal to noise and interference ratio
	MobileTxPower	UE transmit power

Technology	Signal	Meaning
	Band	Band number of survey
	DL_EARFCN	Downlink channel number
	UL_EARFCN	Uplink channel number
	PCI	Physical cell ID
	CellID	Cell identity
	DL_Throughput	Downlink throughput (kbps)
	UL_Throughput	Uplink throughput (kbps)
UMTS and HSPA	RSSI	Signal strength
	RSCP	Received signal code power
	EcNo	Signal noise ratio or Ec/Io
	MobileTxPower	UE transmit power
	Band	Band number of survey
	DL_UARFCN	Downlink channel number
	UL_UARFCN	Uplink channel number
	PSC	Primary scrambling code
	CellID	Cell identity
	DL_Throughput	Downlink throughput (kbps)
	UL_Throughput	Uplink throughput (kbps)
GSM	RSSI	Signal strength
	CtoI	Carrier to interferer ratio
	MobileTxPower	MS transmit power
	Band	Band number of survey
	ARFCN	Absolute radio frequency channel number
	CellID	Cell identity

Table 7-7: More RATs exportable data

Technology	Signal	Meaning
CDMA2000Data	RSSI	Signal strength
	Pilot	Pilot power or Ec
	EcNo	Signal noise ratio or Ec/Io
	MobileTxPower	MS transmit power
	Band	Band number of survey
	Channel	Channel number
	PN	Pseudo noise code

Technology	Signal	Meaning
	CellID	Cell identity
WiFi	RSSI	Signal strength
	SSID	Service set identifier
	Channel	Channel number
	MAC	MAC address
	DL_Throughput	Downlink throughput (kbps)
	UL_Throughput	Uplink throughput (kbps)

7.2.8.2 Create floorplan in iBwave design

Create and save a floorplan in iBwave Design.

For information on creating the floorplan in iBwave Design, refer to iBwave Design documentation.

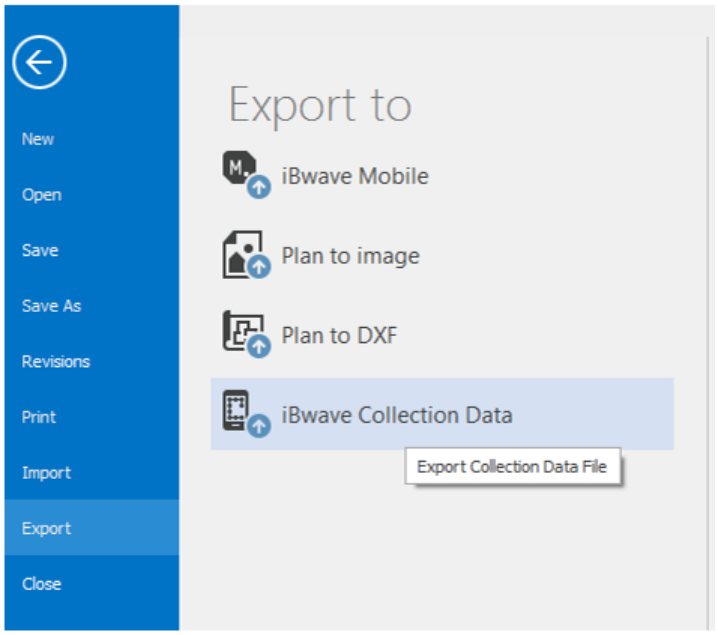


Figure 7-47: iBwave Design page "Export to"

Export the floorplan to the `*.ibwc file` format via "File" > "Export" > "iBwave Collection Data".

7.2.8.3 Import *.ibwc file to R&S ROMES4

1. Start R&S ROMES4.
2. Select "Indoor Navigation".

3. Import the `*.ibwc` file.

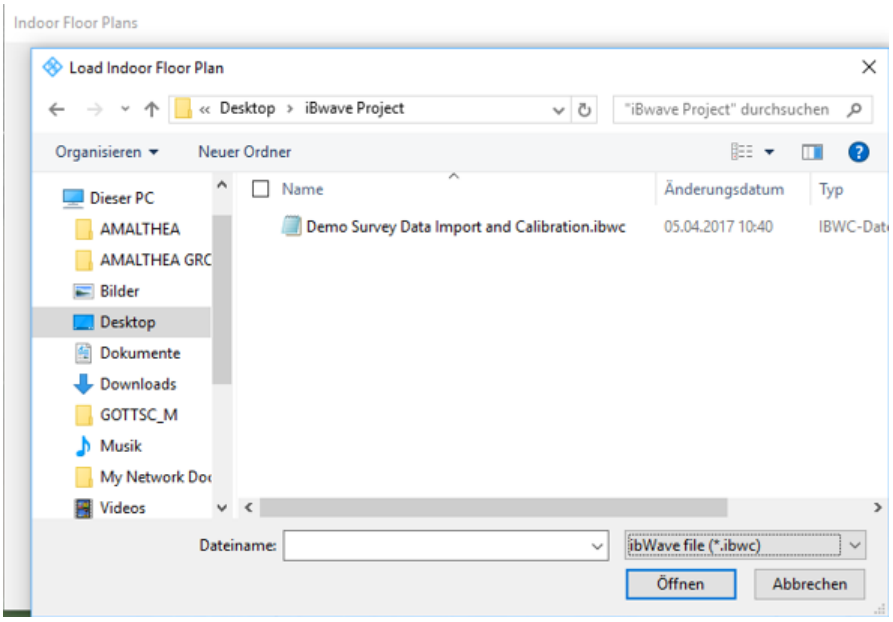


Figure 7-48: *.ibwc file selection

After importing the file, start the measurement.

7.2.8.4 Export measurement files to *.ibwc file

To export a measurement file to IBWC file format, perform the following steps.

1. Select "File" > "Export Measurement File(s)".
   The "Export measurement data" page pops-up.
2. Select the iBwave file format (*.ibwc) as export format.
3. Open the measurement file in which you have imported the iBwave file earlier.
4. Select in "Configuration" the imported *.ibwc file.
5. Select the export mode.
6. Click "OK" to start the export.

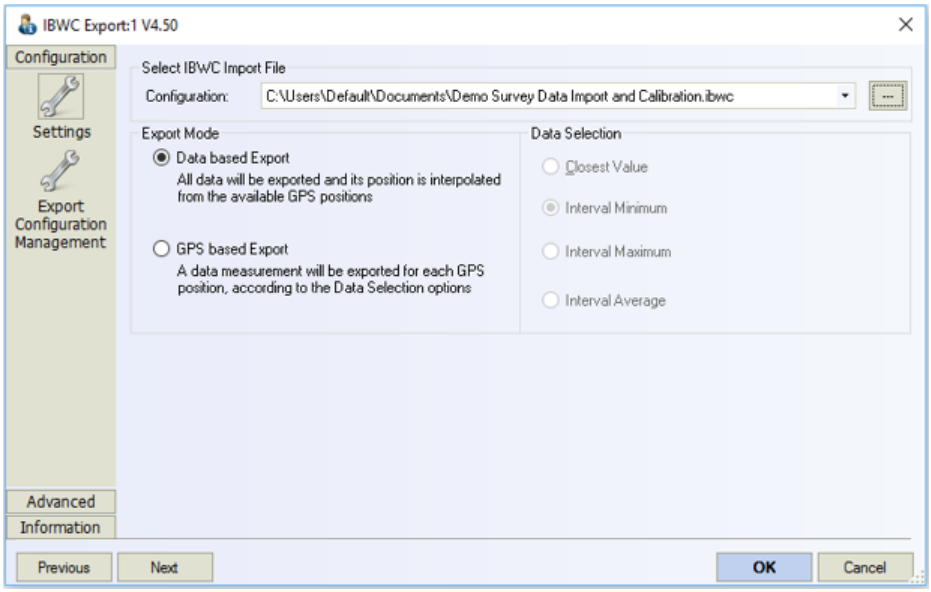


*Figure 7-49: Exporting *.ibwc file*

You can choose between the following modes in the "Export Mode" pane:

- Data-based export
  Creates a place mark for each single signal measurement available and interpolates its GPS position using the GPS data.

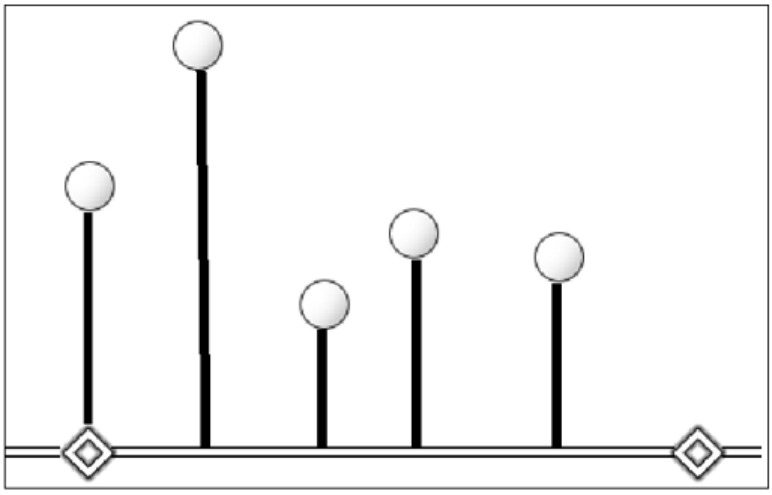


Figure 7-50: Data-based export mode

- GPS-based export
  Creates a place mark for every GPS measurement available and chooses its value depending on the option selected in "Data Selection".

The place mark value options applicable for the GPS-based export are:

- Current value
  Selects the valid measured value that lies closest to the measured GPS data, according to its timestamp.

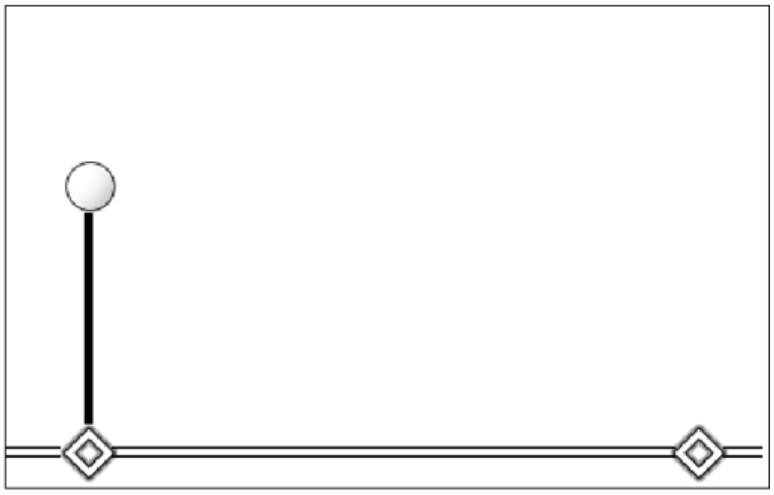


Figure 7-51: Current value of place mark

- Interval minimum
  Selects the minimum signal value between a GPS measurement and the next one.

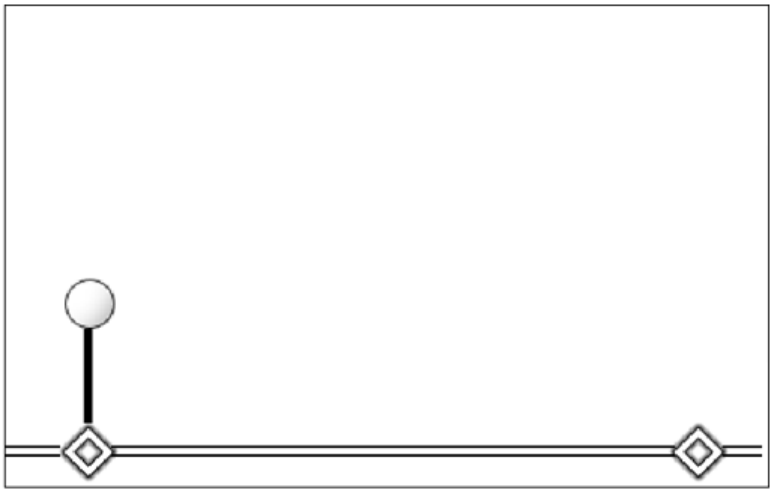


Figure 7-52: Minimum value of place mark

- Interval maximum
  Selects the maximum signal value between a GPS measurement and the next one.

Figure 7-53: Minimum value of place mark

- Interval average
  Selects the average of all valid signal measurements between a GPS measurement and the next one.

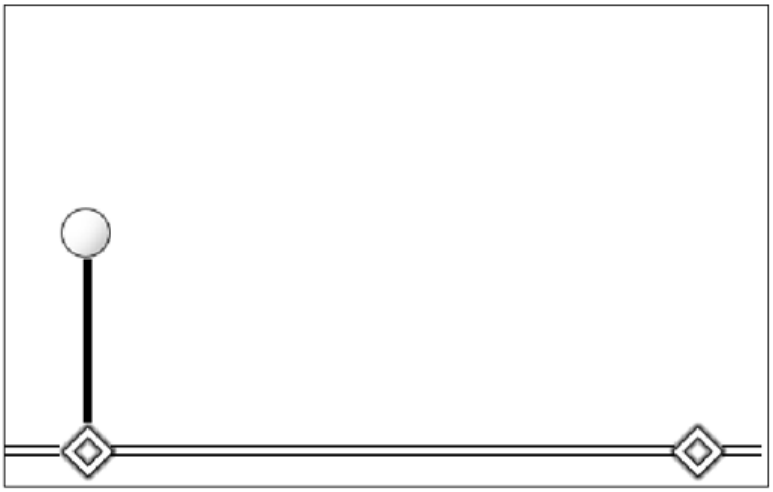


Figure 7-54: Average value of place mark

7.2.8.5 Import *.ibwc in iBwave design

Open the iBwave project file (`.ibw`) and import the `*.ibwc` file via "File" > "Import" > "iBwave Collection Data".

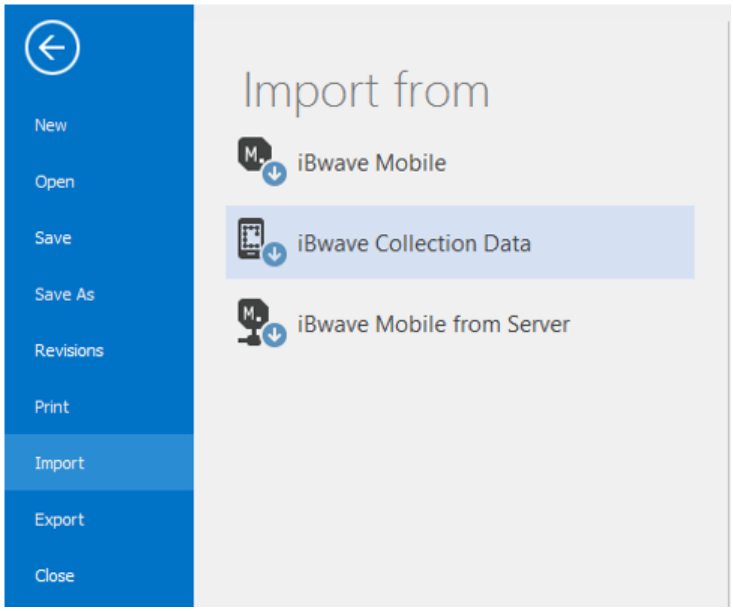


Figure 7-55: iBwaveDesign page "Import from"

7.3 BTS list formats

A BTS database is imported from a BTS list file using the "Tools" > "Transmitter Database" > "Import" page.

The BTS list files are ASCII files characterized by one of the extensions `*.atd`, `*buf`, `*.csv`,`*.cdc/CDN` or `*.vig`.

The examples for the BTS list files you can find in the C:\Users\<name>\Documents \My ROMES\BaseStationLists\samples directory.

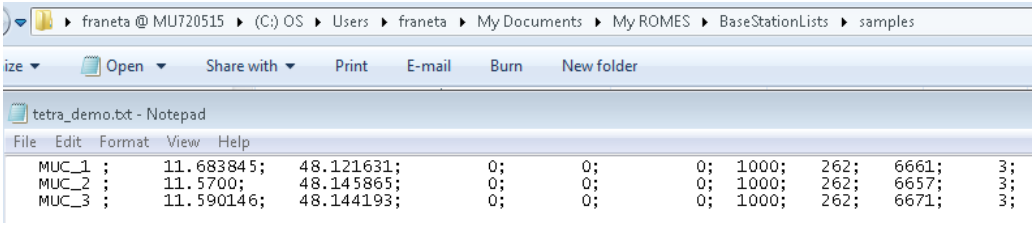


Figure 7-56: TETRA BTS file list

Some views, for example, the alphanumeric view and the ROMESMAP Route Track view and the measurement reports contain information on base stations.

File formats

The ATD BTS list file format is used and is supported with the all R&S ROMES4 software versions.

This file format can be used for GSM, WiMAX, CDMA, TETRA, UMTS, LTE and 5G NR BTS list files. The information in all BTS list files is arranged in a table. Each column of the table corresponds to a BTS parameter, each line to a particular BTS sector. The names of the BTS parameters in the file are fixed.

The BUF and VIG formats are customized. Fixed formats and not intended for general use.

As the GSM neighbor station list provides 3G and 4G neighbors for GSM transmitters, the user has to modify list of importing transmitters (TXT file) and import descriptor (ATD file). For needed modifications, see Chapter 7.3.1.8, "ATD file modification", on page 2174.

The ATD format must be used for GSM BTS, WiMAX BTS, CDMA BTS, TETRA BTS, UMTS NodeB and LTE eNodeB network data bases.

Alternatively, it is possible to write a DLL file defining a new, user-defined BTS list format, see Chapter 7.3.4, "User-defined BTS list format", on page 2185.

Identification of base stations

The assignment of different sectors to a particular BTS is based on the measured geographical position of each sector: Up to three sectors with a distance of less than 5 meters are considered to belong to the same base station. It is assumed that the 51 multiframes (T51 frames) of all sectors of the BTS are time-synchronized, i.e. that the starting time of their M51 multiframe is the same. Individual clock codes are used if asynchronous sectors or few sectors larger than three.

Update of the BTS database

The BTS list database can be updated by adding a new BTS list file. In the update process base stations that are already included in the database are replaced, and new base stations are added to the data base. Two BTSs are considered to be identical if both their geographical position and the clock codes of their sectors match.

Clock codes

Up to three sectors with a distance of less than 5 meters are considered to be time-synchronized if their clock codes are equal. A maximum of three sectors with the same position and the same clock codes are allowed.

If the BTS list database and the added BTS list file contain the same BTS with different clock codes, the system erroneously assumes that the BTS in the list file is new and adds it to the database for a second time. To avoid such a situation, an automatically generated clock code is never used. To indicate cearly whether two base stations are identical or not, their sectors are time-synchronized. There are the following choices:

- If the sectors are not synchronized, use the Cell Identity (CI) of the individual sectors as clock codes.
- If the sectors are synchronized, use the smallest of the CIs of all sectors as a common clock code.

This problem is reduced when the GSM Network Scanner decodes the Cell Identity (CI) and the complete Location Area Information (LAI). Then the comparison is taken using these values.

7.3.1 ASCII table description (*.atd) format

ATD files control the import of ASCII tables, in particular BTS/NodeB/eNodeB lists, into the R&S ROMES4.

Since the R&S ROMES4 allows flexible import of different ASCII table formats, a description format is required to explain the table attributes.

An ATD format file (`*.atd`) is a plain text file. The file can be edited with any text editor (e.g. Notepad) that does not insert format commands into the text (like MS Word does into the `*.doc` format files). The table attributes can be defined at will. However, the R&S ROMES4 uses fixed names to identify the parameters in the individual columns, see Chapter 7.3.1.6, "Column names", on page 2171.

Txt-based import of transmitters list into database

The ATD files contain (optional) description of the field “OnAir” (case sensitive) of type “utUSInt”.

The ATD file for UMTS transmitter database export with this field is shown.

```
[Main]
Type=ATD
[Table1]
Name=NODE_B_TABLE
File=umts_demo.txt
Columns_Size=20
Columns0_Name=UniqueId
Columns0_Type=utULInt
....
Columns19_Name=OnAir
Columns19_Type=utUSInt
```

As the field is optional, add it as the last column in the ATD file and the appropriate value to the end of every row of TXT file. The value in this field defines if the string in the TXT file is the subject of import or not. All strings are imported in the system if the TXT file does not contain this field.

For the field values, see Table 7-11.

Example `*.atd` files are provided in the `BTSLists` subdirectories of the R&S ROMES4 program directory.

7.3.1.1 Exporting NB-IoT base station list

When exporting the NB-IoT base station list, the SYS_TYPE column is included.

The exported `*.atd` and `*.txt` files contain SYS_TYPE definition and NB-IoT value, respectively.

The exported `*.atd` contains SYS_TYPE definition.

```
...

Columns17_Name=SYS_TYPE

Columns17_Type=utDynChar
```

The exported `*.txt` file contains NB-IoT and NPCI instead of PCI in each line.

```
;exported by ROMES NB_IoT BCCH View

;The name is either the name of the station found in the database
 or in case no station is found in the database eNodeB<eNodeBID/CellID><PhyCellID>

;Position of 0.0/0.0 mmeans unknown

;

;Name;Longitude;Latitude;PosErrorDirection;PosErrorLambda1;PosErrorLambda2;
IsDirected;Direction;Power;MaxPowerUsedForTowerEstimationbyPE;TowerID;MCC;MNC;
TAC;CellIdentity;EARFCN;PhyCellID;SYS_TYPE

eNodeB - ID:0/1 NPCI:0 (0/0);0;0;0;0;0;0;0;30;-999.0;;1;1;1;1;0;0;NB-IoT
```

7.3.1.2 Keywords for *.ndb export

The following keywords / descriptors are generated when data in a network database (`*.ndb`) file is exported to a `*.atd` BTS List file.

Table 7-8: Keywords for *.ndb export

Keyword	Description	Remarks
MainErrDir	Main direction of position uncertainty in °, 0..360, North = 0°, East=90°	For each, estimate that an error ellipse is given. This ellipse describes a two-dimensional area with 66% confidence.
PosErr1	Position uncertainty in main direction in meters.	For each, estimate that an error ellipse is given. This ellipse describes a two-dimensional area with 66% confidence.
PosErr2	Position uncertainty orthogonal to the main direction in meters.	For each, estimate an error ellipse is given. This ellipse describes a two-dimensional area with 66% confidence.
SourceST1	Source for BTS data from "System Information Type 1"	Values: INVALID, BTS_LIST, USER_EDIT, MEASURED
SourceST3	Source for BTS data from "System Information Type 3"	Values: INVALID, BTS_LIST, USER_EDIT, MEASURED

Keyword	Description	Remarks
ValidityST1 ValST1	Validity for BTS data from "System Information Type 1"	Values: IIS_VALID, TO_BE_VERIFIED
ValidityST3 ValST3	Validity for BTS data from "System Information Type 3"	Values: IIS_VALID, TO_BE_VERIFIED
TimeSector	Time for the last check of entered values for a sector in seconds since 1970	For example, time of the measurement or time of last change of BTS list files.
TimeST1	Time for the last check of "System Information Type 1" values for a sector in seconds since 1970	
TimeST3	Time for the last check of "System Information Type 3" values for a sector in seconds since 1970	

7.3.1.3 ASCII file BTS table format

The following entries are included in the BTS table format of the ASCII file.

Table 7-9: ASCII file BTS table format

Entry	Required/ Optional	Remarks
[Main]	req.	
Type=ATD	req.	
[Table{TableIndex}] TableIndex: index of table (> 0)	req.	More than one table can be imported using one ATD file. Table index is one-based, thus the first table entry is [Table1]. TableIndex numbers have to be in consecutive order. The tables after a gap are not used.
Name={TableName} TableName: name of the table, as it has to be imported and appears inside R&S ROMES4. Use only letter characters, numbers and ‚_' to form a valid table name	req.	**Attention!** SQL keywords used as ASCII table or column names cause an error when the ASCII file is loaded.

File={FilePath}
FilePath: relative or absolute file path of the ASCII table file. Relative path root is the location of the ATD file, meaning a mere file name without directory has to be located in the same directory as the ATD file.
	req.	Examples:
		`File=c:\data\cells.txt`
		`File=..\cell.asc`

Columns_Size={NumOfColumns} NumOfColumns: Number of columns of this table (>0)	req.	The table must contain at least NumOfColumns column entries; if more column entries exist, only the first NumOfColumns is used.

Entry	Required/ Optional	Remarks
Columns{ColumnIndex}_{Attrib} column attribute entry; ColumnIndex: index of column (zero based) the attribute belongs to; Attrib: attribute of column as specified below;	-	Multiple of these attribute entries belong to one column with the same index.
Columns{ColumnIndex}_Name ={ColumnName} ColumnName: name of column, as it have to be imported and appear in the data tree; use only letter characters, numbers and ‚_' to form a valid column name;	req.	**Attention!** **SQL keywords used as ASCII table or column names cause an error when the ASCII file is loaded.** **The column names must be unique to be identified by the measurement system;** see Chapter 7.3.1.6, "Column names", on page 2171.
Columns{ColumnIndex}_Type ={ColumnType} ColumnType: data type of the column (refer to reference table below)	req.	
Columns{ColumnIndex}_Size ={TypeSize} TypeSize: size of fixed size data	req. for fixed size data;	Specify it only for types „utFixedChar" and „utFixedArray"; the maximum size is 4000 Bytes.
Columns{ColumnIndex}_ boIndexed ={IndexedFlag} IndexedFlag: 0 or 1; indicating if column has an index (1) or not (0)	opt.; default 0	Selections are much faster if columns used as search criteria are indexed; thus index columns which are often used as selection or join criterion! Indexed columns need slightly more disk space.
Columns{ColumnIndex}_boPrimaryKey ={PrimaryKeyFlag} PrimaryKeyFlag: 0 or 1; indicating if column is used as primary key (1) or not (0)	opt.; default 0	All columns with primary key flag set form the primary key. Only one record with the same primary key can exist inside the database, otherwise an exception is thrown during import. (This can be used to ensure consistent data even when appending data to an already existing table.) Primary keys can also have an advantageous influence on selection performance.

The records are separated by [<NewLine>], the columns by [<TAB>].

Terminate the last line also with `<NewLine>`, otherwise it is ignored!

If an attempt is made to import an ASCII table which does not match the ATD description file, an error message describing the kind and position of the erroneous statement is produced. The error messages are self-explanatory.

7.3.1.4 Examples

Examples of the ATD files and the corresponding ASCII files.

Example 1 (General)

*.atd file

```
[Main]
Type=ATD
[Table1]
Name=CellData
File=celldata.txt
Columns_Size=5
Columns0_Name=BTS_Name
Columns0_Type=utFixedChar
Columns0_Size=25
Columns0_boIndexed=1
Columns0_boPrimaryKey=1
Columns1_Name=Longitude
Columns1_Type=utDouble
Columns1_boIndexed=1
Columns2_Name=Latitude
Columns2_Type=utDouble
Columns2_boIndexed=1
Columns3_Name=BCC
Columns3_Type=utTInt
Columns3_boIndexed=1
Columns4_Name=C0
Columns4_Type=utSInt
```

Compatible ASCII table

The following ASCII table is compatible with the example 1 *.atd file:

```
Cell1:1       12.774       50.038       2       814
Cell2:1       12.397       49.991       1       ?
Cell2:2       12.397       49.991       2       807
```

Example 2 (TETRA-specific ATD file)

*.atd file

```
[Main]
Type=ATD
[Table1]
; Mandatory
Columns0_Name=UniqueId
Columns0_Type=utULInt
; Mandatory
Columns1_Name=Name
Columns1_Type=utDynChar
Columns2_Name=Power
Columns2_Type=utDouble
Columns3_Name=PosLongitude
Columns3_Type=utDouble
Columns4_Name=PosLatitude
```

```
Columns4_Type=utDouble
Columns5_Name=PosErrorDirection
Columns5_Type=utDouble
Columns6_Name=PosErrorLambda1
Columns6_Type=utDouble
Columns7_Name=PosErrorLambda2
Columns7_Type=utDouble
Columns8_Name=IsDirected
Columns8_Type=utUTInt
Columns9_Name=Direction
Columns9_Type=utUSInt
Columns10_Name=BaseIndex
Columns10_Type=utUSInt
Columns11_Name=Channel
Columns11_Type=utULInt
Columns12_Name=FreqOff
Columns12_Type=utUSInt
Columns13_Name=MNC
Columns13_Type=utUSInt
Columns14_Name=MCC
Columns14_Type=utUSInt
Columns15_Name=LAC
Columns15_Type=utUSInt
Columns16_Name=RxLevelAccessMin
Columns16_Type=utUSInt
Columns17_Name=FastReselThreshold
Columns17_Type=utUSInt
Columns18_Name=FastReselHysteresis
Columns18_Type=utUSInt
Columns19_Name=SlowReselThreshold
Columns19_Type=utUSInt
Columns20_Name=SlowReselHysteresis
Columns20_Type=utUSInt
Columns21_Name=Neighbours
Columns21_Type=utDynChar
Columns_Size=22
File=Tetra.txt
Name=TETRATable
```

Compatible ASCII table

The following ASCII table is compatible with the example 2 *.atd file:

```
1;TETRA 1;30.0;11.6;48.11;0.0;0.0;0.0;0;0;3;3615;0;262;1000;6661;1;2;3;4;5;#1
2;TETRA 2;40.0;11.61;48.10;0.0;0.0;0.0;0;120;3;3634;0;262;1000;6658;11;12;13;14;15;#2
3;TETRA 3;20.0;11.7;48.12;0.0;0.0;0.0;0;240;3;3638;0;262;1000;6659;21;22;23;24;25;#3
3;TETRA 4;20.0;11.71;48.105;0.0;0.0;0.0;0;240;3;3750;0;262;1000;6657;21;22;23;24;25;#3
```

7.3.1.5 Attributes

The attributes must correspond to the type specified in the table description according to the following type reference:

*Table 7-10: Attributes in an *.atd file*

Type Identifier	Description	Range / Representation in ASCII table file
utInt	1 byte integer	–128 ... 127
utSInt	2 bytes integer	–32768 ... 32767
utLInt	4 bytes integer	–2147483648 ... 2147483647
utFloat	4 bytes floating point	3.4E-38 ... 3.4E+38 (7 digits) (decimal or scientific notation)
utUInt	1 byte unsigned integer	0 ... 255
utUSInt	2 bytes unsigned integer	0 ... 65535
utULInt	4 bytes unsigned integer	0 ... 4294967295
UtDouble	8 bytes floating point	1.7E-308 ... 1.7E+308 (15 digits) (decimal or scientific notation)
utFixedChar	Character string of fixed size as specified by ‚size' attribute.	In single quotes or without: ['string'] or [string] (first way is more secure); an empty string has always to be represented by ''. The string can be shorter than the given size, but must not exceed it.
utDynChar	Character string of variable size (variant by record).	Refer to utFixedChar, except that there is no size limitation other than the 4000 Bytes maximum.
utFixedArray	Array of fixed size as specified by ‚size' attribute.	Hexadecimal literal, e.g. 0x341a5bc2 for a 4 Bytes vector; all ‚size' bytes have to be specified.
utDynArray	Array of variable size (variant by record);	Hexadecimal literal, e.g. 0x341a5bc2 for a 4 Bytes vector.
utBlob	Large array of variable size (variant by record); can be bigger than 4000 Bytes.	Not supported in version 3.0.

7.3.1.6 Column names

The column names in an ATD file must be unambiguous to be clearly identified by the test system. The following names can be used for GSM BTS databases.

*Table 7-11: Column names in an *.atd file for GSM BTS*

Column Name	Type	Range	Description
UniqueId	utULInt	0 to 4294967295	Unique Identifier of the BTS sector for the database (The easiest way of providing a UniqueId is to use the line (record) number)
Longitude	utDouble	–180 to 180	Longitude of the position of the BTS

Column Name	Type	Range	Description
Latitude	utDouble	–90 to 90	Latitude of the position of the BTS
BTS_Name	utFixedChar	–	Name of BTS sector
BCC	utTInt	0 to 7 decimal	BTS Color Code
C0	utSInt	See chapter 8	C0 carrier channel number
C1 to C15	utSInt	See chapter 8	Cn carrier channel number
CI	utLInt	1 to 65535 decimal	Cell Identity
NCC	utTInt	0 to 7 decimal	Network Color Code
CC	utLInt	1 to 65535 decimal	Clock Code
Ant	utLInt	–	Antenna type
Power	utFloat	See chapter 8	EIRP power
MNC	utUSInt	0 to 999	Mobile Network Code
MCC	utUSInt	0 to 999	Mobile Country Code
LAC	utUSInt	1 to 65533 and 65535	Location Area Code
2GNC	utDynChar	–	GSM neighbor cell list for neighborhood analysis (option R&S ROMES4HOA). CI, LAC(MCC, MNC) for each neighbor cell, a # character separates two cells, e.g. 1234,5678,262,1#1238,5678,262,1#1240,5678,262,1
3GNC	utDynChar	–	UMTS neighbor cell list for neighborhood analysis (option R&S ROMES4HOA). MCC, MNC, LAC, CI for each neighbor cell, a # character separates two cells, e.g. 262,1,1234, 5678#262,1,1234,5679#262,1,1234,5680
4GNC	utDynChar	–	LTE neighbor cell list for neighborhood analysis (option R&S ROMES4HOA). MCC, MNC, TAC, ECI for each neighbor cell, e.g. 262,1,1234, 5678#262,1,1234,5679#262,1,1234,5680
Transmitter list	OnAir	0 1 -	R&S ROMES4 does not import this string R&S ROMES4 imports this string R&S ROMES4 imports this string

The MNC columns through 3GNC are required for the UMTS neighborhood analysis.

Column Name	Type	Range	Description
UniqueId	utULInt	0 to 4294967295	Unique Identifier of the BTS sector for the database (The easiest way of providing a UniqueId is to use the line (record) number)
Longitude	utDouble	–180 to 180	Longitude of the position of the BTS
Latitude	utDouble	–90 to 90	Latitude of the position of the BTS
BTS_Name	utFixedChar	–	Name of BTS sector
Base_ID	utSInt	16-bit number	Base station identification
PN	utSInt	11-bit number	Pilot code channel number
Channel	utSInt	11-bit number	CDMA channel number
SID	utLInt	15-bit number	System Identification, a number uniquely identifying a cellular or PCS system
NID	utLInt	16-bit number	Network identification, subidentifier of a system
LOCAID	utLInt	12-bit number	Received location area identity
Power	utDouble	–	Pilot channel power in dBm
Antenna	utTInt	–	Antenna type
Direction	utUSInt	0 to 360	Direction of the directed antenna in degrees

The following names can be used for UMTS Node B databases.

Table 7-12: Column names in an *.atd file for UMTS BTS

Column Name	Data Type	Range	Description
UniqueId	utULInt	0 to 4294967295	Unique Identifier of the Node B sector for the database (The easiest way of providing a UniqueID is to use the line (record) number)
PosLongitude	utDouble	–180 to 180	Longitude of the position of the Node B in degrees
PosLatitude	utDouble	–90 to 90	Latitude of the position of the Node B in degrees
NodeB_Name	utDynChar	–	Name of Node B sector
CellID	utULInt	–	Cell Identity
SC	utUSInt	0 to 8176	Scrambling Code. It must be in the range of 0… 8176, and SC modulo 16 has to be equal to 0
ARFCN	utUSInt	8000 to 12000	Channel Number
IsDirected	utUTInt	0 to 1	1: Antenna is directed 0: Antenna is omnidirectional
Direction	utUSInt	0 to 360	Direction of the directed antenna in degrees
Power	utDouble	–10 to 100	Power of CPICH in dBm
CellIDNeighborsList	utDynChar	–	Information about the cell identities of the neighbor cells; list of numbers separated by # characters, e.g. 67#861#14558.

Column Name	Data Type	Range	Description
MNC	utUSInt	0 to 999	Mobile Network Code
MCC	utUSInt	0 to 999	Mobile Country Code
LAC	utUSInt	1 to 65533 and 65535	Location Area Code
2GNC	utDynChar	–	GSM neighbor cell list for neighborhood analysis (option R&S ROMES4HOA). MCC, MNC, LAC, CI for each neighbor cell, a # character separates two cells, e.g. 262,1,1234, 5678#262,1,1234,5679#262,1,1234,5680
3GNC	utDynChar	–	UMTS neighbor cell list for neighborhood analysis (option R&S ROMES4HOA). MCC, MNC, LAC, CI for each neighbor cell, a # character separates two cells, e.g. 262,1,1234, 5678#262,1,1234,5679#262,1,1234,5680
4GNC	utDynChar	–	LTE neighbor cell list for neighborhood analysis (option R&S ROMES4HOA). MCC, MNC, TAC, ECI for each neighbor cell, e.g. 262,1,1234, 5678#262,1,1234,5679#262,1,1234,5680

In UMTS NodeB databases, the columns "UniqueID" to "Power" are mandatory. The "CellIDNeighborsList" column is optional but is also recognized by the measurement system. If it is provided, the R&S ROMES4 checks for differences between the entries and the real network. Each time the UMTS test mobile fails to detect the signal from one of the neighbor cells in the list, a "Neighbor List Alarm" is generated. The alarms can be displayed, e.g. in the "UMTS Network Analyzer View".

For the UMTS neighborhood analysis, the rows from MNC to 4GNC are required.

In general, R&S ROMES4 is not able to process data in columns with user-defined names other than the ones listed above. The UniqueID parameter is explained in Chapter 7.3.1.9, "Speeding up the import file", on page 2175 below.

7.3.1.7 Missing entries

If a value to be entered in the ASCII table file is not available, a question mark (*?*) can be used instead. R&S ROMES4 interprets question marks as missing entries, the corresponding table cells in the views and dialogs of the application are left empty.

7.3.1.8 ATD file modification

ATD file describes structure of importing TXT file. The changes which must be implemented are shown in the following table.

Table 7-13: Columns - fields and values

Field and Value	What does it mean
Columns_Size=35	Number of columns in the text file (";" uses as separator of fields.
Columns33_Name=3GNC Columns33_Type=utDynChar	Column N 33 (3G neighbor) and type of this column
Columns34_Name=4GNC Columns34_Type=utDynChar	Column N 34 (4G neighbor) and type of this column

7.3.1.9 Speeding up the import file

The R&S ROMES4 has to assign numbers to all lines of the BTS lists every time the list is opened. This time-consuming line numbering can be bypassed by adding the "UniqueID" column to the BTS list. The "UniqueID" entries (e.g. 1, 2, 3, ...) can be added with a tool like MS Excel.

Example: Modification of the ATD file

```
Columns12_Name=UniqueID
Columns12_Type=utLInt
Columns12_Size=4
Columns12_boIndexed=1
Columns12_boPrimaryKey=0
```

All numbers in the UniqueID column must be unique. Any number that is used more than once causes problems. Use a unique scheme like the line numbers from MS Excel to fill the UniqueID column.

7.3.1.10 TETRA-specific *.atd requirements

All columns not specified in the following table are added to the database for information only.

Table 7-14: Mandatory columns for all cells

Identifier	Data Type	Default Short Info Text	Default Long Info Text	Description
Name	utDynChar	Yes	Yes	Name of Cell
Longitude	utDouble	No	Yes	Geo. Position Longitude
Latitude	utDouble	No	Yes	Geo. Position Latitude

The columns in the following table describe the cell in more detail. If the importer does not use the default values, they have to be available.

Table 7-15: Cell details

Identifier	Data Type	Default Short Info Text	Default Long Info Text	Description
Power	utDouble	No	No	Max Tx. Power of Cell – Default: 30 dBm
IsDirected	utUTInt	No	No	Type of Antenna, 1: directed, 0: omni – default: omni
Direction	utUSInt	No	No	Direction of Antenna, mandatory for Antenna == 1

The following tables show the TETRA transmitter-specific columns and parameters.

The first table shows the mandatory columns and parameters for a TETRA transmitter as they identify the cell.

Table 7-16: Mandatory columns in TETRA transmitter database

Identifier	Data Type	Default Short Info Text	Default Long Info Text	Description
BaseIndex1)	utUSInt	No	No	Frequency Base Index (1..9)
Channel	utULInt	Yes	Yes	TETRA Channel Number (0…3999)
FreqOff1)	utUSInt	No	No	Frequency Offset 0: 0 KHz: all texts in R&S ROMES4 show the value 0 KHz 1: 6.25 KHz: all texts in R&S ROMES4 show the value 6.25 KHz 2: -6.25 KHz: all texts in R&S ROMES4 show the value -6.25 KHz 3: 12.5 KHz: all texts in R&S ROMES4 shows the value 12.5 KHz
MNC1)	utUSInt	No	Yes	Mobile Network Code
MCC1)	utUSInt	No	Yes	Mobile Country Code

Identifier	Data Type	Default Short Info Text	Default Long Info Text	Description
LAC	utUSInt	Yes	Yes	Location Area Code
1) Also these values are required. As they are usually the identical for all cells in the list, they are not put into the list. The import dialog allows the user put in these values directly into the GUI. If nothing is put in, the columns are mandatory in the list.				

The following table shows the columns and parameters which are optional for a TETRA transmitter.

Table 7-17: Optional columns in TETRA transmitter database

Identifier	Data Type	Default Short Info Text	Default Long Info Text	Description
RxLevelAccessMin	utUSInt	No	No	RxLevelAccessMin (0..31)
FastReselThres-hold	utUSInt	No	Yes	FastReselThres-hold(0..31)
FastReselHystere-sis	utUSInt	No	Yes	FastReselHystere-sis(0..31)
SlowReselThres-hold	utUSInt	No	Yes	SlowReselThres-hold(0..31)
SlowReselHystere-sis	utUSInt	No	Yes	SlowReselHystere-sis(0..31)
Neighbours	utDynChar	No	No	Neighbors, specified by the MCC,MNC,LAC and the Channel-Number MCC and MNC are optional The values are separated by, and the transmitters by a # e.g. 262,112,1234,1002 #262,112,1254,1005# e.g. ,,1234,1002#,, 1245,1008#

The description of the identifier "Neighbours" is not evaluated at the moment. Anyway, it is recommended to use this format at later implementation.

7.3.1.11 LTE-specific *.atd requirements

The following table shows the mandatory columns and parameters for a LTE transmitter as they identify the cell.

Table 7-18: Mandatory columns for LTE transmitter database

Identifier	Data Type	Default Short Info Text	Default Long Info Text	Description
UniqueId	utUSInt	No	No	Unique Identifier
eNodeB_Name	uTDynChar	Yes	Yes	eNodeB Name
PosLongitude	utDouble	No	No	Longitude
PosLatitude	utDouble	No	No	Latitude
PhyCellID	utUSInt	No	No	Physical Cell Identity
CellID	utULInt	Yes	Yes	Downlink Cell Identity
EARFCN	utULInt	No	No	Evolved Absolute Radio Frequency Channel Number
IsDirected	utUTInt	No	No	Type of Antenna 1: Antenna is directed 0: Antenna is omnidirectional (= default)
Direction	utUSInt	No	No	Direction of Antenna, mandatory for Antenna == 1
Power	utDouble	Yes	Yes	Power in dBm

7.3.1.12 5G NR specific *.atd requirements

The following table shows the mandatory columns and parameters for a 5G NR transmitter as they identify the cell.

Table 7-19: Mandatory columns for 5G NR transmitter database

Column No.	Identifier	Data Type	Description
2	PosLongitude	utDouble	Geo Position Longitude
3	PosLatitude	utDouble	Geo Position Latitude
5	MCC	utUSInt	Mobile Country Code
6	MNC	utUSInt	Mobile Network Code
9	NRARFCN	utULInt	Evolved Absolute Radio Frequency Channel Number
10	NCI	utULInt	Cell Identity

Table 7-20: Optional columns for 5G NR transmitter database

Column No.	Identifier	Data Type	Description
11	IsDirected	utUTInt	Type of Antenna 1: Antenna is directed 0: Antenna is omnidirectional (= default)
12	Direction	utUSInt	Direction of Antenna, mandatory for Antenna == 1
13	PhyCellID	utUSInt	Physical Cell Identity
8	CellID	utULInt	Downlink Cell Identity
0	Technology	utUSInt	RAT this cell belongs to
1	Name	utDynChar	Name of Cell
4	PosAltitude	utDouble	Geo Position Altitude
7	TAC	uiULInt	Tracking Area Code
14	Power	utDouble	Power in dBm

For 5G NR, the CellID is calculated from the last 8 bits of NCI.

Fields:

CellName	Technology	SSB-NR-ARFCN	PCI	NCI	Lon	Lat	MCC	MNC	TAC	CellId	Direction
Trial_H9	5G NR	636768	145		17.95204	59.40288					45

Definitions:

Value	Unit	Min	Max	Description
PCI		0	1023	Physical Cell ID of NR cell.
NCI				NR Cell Identity of NR Cell (36 bit). Ref 3GPP 38.300 and 38.331
CellId				CellID. Least 8 significant bits of NCI
SSB-NR-ARFCN	ARFCN-ValueNR	0	3279165	NR Absolute Radio Frequency Channel Number of the SSB to be used for this serving cell. Corresp

Figure 7-57: 5G NR CellId standard definition

7.3.2 Technology dependencies

GSM

The following columns identify a GSM cell. Those columns are mandatory for a GSM cell.

Table 7-21: Mandatory columns for all GSM cells

Identifier	Required/ Optional	Description	Remarks
BCC	req.	Base Station Color Code	0 to 7 decimal
NCC	req.	Network Color Code	0 to 7 decimal
CI	req.	Cell ID	1 to 65535 decimal
C0	req.	Channel 0 (BCCH)	-
MNC1)	req.	Mobile Network Code	0 to 999

Identifier	Required/ Optional	Description	Remarks
MCC1)	req.	Mobile Country Code	0 to 999
1) Also these values are required. As they are usually the identical for all cells in the list, they are not put into the list. The import dialog allows the user put in these values directly into the GUI. If nothing is put in, the columns are mandatory in the list.			

The following columns are not mandatory, but is used if available:

Table 7-22: Optional columns for GSM cells

Identifier	Required/ Optional	Description	Remarks
C <n>	opt.	Traffic Channels 1...n	-
CC	opt.	Clock Code	-
SyncCode	opt.	Synchronization Code	-

UMTS

The following columns identify a UMTS cell.

Table 7-23: Mandatory columns for all UMTS cells

Identifier	Required/ Optional	Description	Remarks
SC	req.	Scrambling Code	0 to 8176 Must be in the range of 0…8176, and SC modulo 16 has to be equal to 0
UARFCN	req.	UTRA Absolute Radio Frequency Channel Number	-
CI	req.	Cell Identity	-
MNC1)	req.	Mobile Network Code	0 to 999
MCC1)	req.	Mobile Country Code	0 to 999
1) Also these values are required. As they are usually the identical for all cells in the list, they are not put into the list. The import dialog allows the user put in these values directly into the GUI. If nothing is put in, the columns are mandatory in the list.			

CDMA

The following columns identify a CDMA cell.

Table 7-24: Mandatory columns for all CDMA cells

Identifier	Required/ Optional	Description	Remarks
PN	req.	PN Offset	-
Channel	req.	Channel Number	-
Bandclass	req.	Band Class	-
SID1)	req.	System ID	-

Identifier	Required/ Optional	Description	Remarks
NID1)	req.	Network ID	-
LOCAID	req.	Location Area ID	-
1) Also these values are required. As they are usually the identical for all cells in the list, they are not put into the list. The import dialog allows the user to put in these values directly into the GUI. If nothing is put in, the columns are mandatory in the list.			

The following column is not mandatory, but is used if available.

Table 7-25: Optional columns for CDMA cells

Identifier	Required/ Optional	Description	Remarks
EVDO	opt.	0: no 1xEV-DO cell 1: 1xEV-DO cell	-

WiMAX

The following columns identify a WiMAX cell.

Table 7-26: Mandatory columns for all WiMAX cells

Identifier	Required/ Optional	Description	Remarks
CentreFrequency	req.	Centre Frequency	-
Bandwidth	req.	Bandwidth	-
PreambleIndex	req.	Preamble ID	-
BaseID	req.	Base Station ID (6 Bytes)	-
Segment	req	Segment Number	-
IDCell	req	ID Cell	-

LTE

The following columns identify a LTE cell.

Table 7-27: Mandatory columns for all LTE cells

Identifier	Required/ Optional	Description	Remarks
CellID	req.	Downlink Cell Identity	-
EARFCN	req.	Evolved Absolute Radio Frequency Channel Number	-
PhyCellID	req.	Physical Cell Identity	-
UniqueId	req.	Unique Identifier	Unique Identifier of the BTS sector for the database (The easiest way of providing a UniqueID is to use the line (record) number)

TETRA

The following columns identify a TETRA cell.

Table 7-28: Mandatory columns for all TETRA cells

Identifier	Required/ Optional	Description	Remarks
BaseIndex	req.	Frequency Base Index	1..9
Channel	req.	TETRA Channel Number	0…3999
FastResel-Threshold	req.	Fast Reselection Threshold	0..31
FreqOff	req.	Frequency Offset	0: 0 KHz: all texts in R&S ROMES4 show the value 0 KHz 1: 6.25 KHz: all texts in R&S ROMES4 show the value 6.25 KHz 2: -6.25 KHz: all texts in R&S ROMES4 show the value -6.25 KHz 3: 12.5 KHz: all texts in R&S ROMES4 show the value 12.5 KHz
LAC	req	Location Area Code	1 to 65533 and 65535
MCC1)	req.	Mobile Country Code	0 to 999
MNC1)	req.	Mobile Network Code	0 to 999
RxLevelAc-cessMin	req.	RX Level Access Minimum	0..31
UniqueId	req.	Unique Identifier	Unique Identifier of the BTS sector for the database (The easiest way of providing a UniqueID is to use the line (record) number)
1) Also these values are required. As they are usually identical for all cells in the list, they are not put into the list. The import dialog allows the user to put in these values directly into the GUI. If nothing is put in, the columns are mandatory in the list.			

The following column are not mandatory, but will be used if available.

Table 7-29: Optional columns for TETRA cells

Identifier	Required/ Optional	Description	Remarks
Neighbour-CellParame-ters	opt.	Neighbours, specified by the MCC, MNC, LAC and the Chan-nelNumber.	-

7.3.3 CSV format definition for BTS list

The CSV export accepts the formats for BTS lists given in the following table. The meaning of the m/o abbreviation is mandatory and optional, respectively.

Table 7-30: GSM, UMTS, LTE and 5G CSV format definition table

Column Name (Identifier)	m/o	Description	Accepted Format
CellType	m	Specifies the type of the cell	`OperatorDefined`: The cell has been imported from an operator's cell data base file. `UserDefined`: The cell has been entered manually . `Estimated`: The cell has been estimated.
NCI	m	5G only: Cell Identity	integer number
Technology	m	RAT this cell belongs to	`GSM, gsm, Gsm` (case insensitive) `UMTS, umts, Umts` (case insensitive) `5GNR, NR, 5G`
TxName	o	Name of the cell	Text
ValidStart	m	Point in time from when this cell is considered valid	`yyyy-MM-ddThh:mm:ss` (e.g. 2015-08-05T08:00:00, see ISO8601)
ValidEnd	o	Point in time until this cell is considered valid	`yyyy-MM-ddThh:mm:ss` (e.g. 2016-08-05T07:59:59, see ISO8601)
MCC	m	Mobile Country Code	Integer number
MNC	m	Mobile Network Code	Integer number
LAC	m	GSM / UMTS only: Location Area Code	Integer number
TAC	m/o	LTE / 5G: Tracking Area Code	Integer number
ENodeBID	m	LTE only: LTE eNB ID	Integer number
CellID	m	GSM/UMTS: CID LTE: LTE Cell ID 5G: CID	Integer number
Downlink Channel Number	m	GSM: BCCH UMTS: UARFCN LTE: EARFCN 5G: NRARFCN	Integer number
Physical Cell Identifier	m	GSM: • BCC • NCC UMTS: SC LTE / 5G: PCI	Integer number
Bandwidth	o	Bandwidth of a cell, usually only relevant for LTE cells.	Floating point number [MHz]

Column Name (Identifier)	m/o	Description	Accepted Format
TechExtension	o	Technology extension	Common: unknown, none GSM only: GPRS, EGPRS UMTS only: HSDPA, HSUPA, HSPA, HSPA+ LTE only: LTEAdvanced
TrafficChannels	o	GSM only: ARFCNs of traffic channels, separated by #	Integer numbers, separated by #
BSC	o	GSM only: base station controller this cell belongs to	Text
RAC	o	GSM / UMTS only: Routing Area Code	Integer number
MSN	o	Mobile Subscriber Number	Text
RNC	o	UMTS only: Radio Network Controller **NOTE:** The name of the RNC, given by operators, available only if an operator's cell database is imported	Text
RNC_ID	o	UMTS only: Radio Network Controller Identifier	Integer number
RepeaterID	o	Repeater ID	Integer number
GeoLong	m	Longitude of the cell's geo location in WGS 84	Integer number [m]
GeoLat	m	Latitude of the cell's geo location in WGS 84	Integer number [m]
GeoAlt	m	Altitude of the cell's geo location in WGS 84	Integer number [m]
AntennaDir	o	Antenna direction / azimuth Today the reference plane for an azimuth is typically true north, measured as a 0° azimuth. Moving clockwise on a 360° circle, east has azimuth 90°, south 180°, and west 270°.	Floating point number [°]
AntennaPower	o	Power of the antenna	Text
AntennaType	o	Type of antenna	Text
Manufacturer	o	Antenna / or base station manufacturer	Text
ElectricalTilt	o	Electrical tilt of the antenna	Floating point number [°]
MechanicalTilt	o	Mechanical tilt of the antenna	Floating point number [°]
HeightAboveGround	o	Height of antenna above ground	Floating point number [m]

Column Name (Identifier)	m/o	Description	Accepted Format
GSMNeighbours	o	GCIs of GSM neighbors, separated by #	MCC MNC LAC CI#... MNC LAC CI#...(MCC taken from the column Mcc) LAC CI#...(MCC and MNC is taken from column Mcc and Mnc)
UMTSNeighbours	o	GCIs of UMTS neighbors, separated by #	MCC MNC LAC CI#... MNC LAC CI#... (MCC taken from column Mcc LAC CI#...(MCC and MNC taken from column Mcc and Mnc)
LTENeighbours	o	GCIs of LTE neighbors, separated by #	MCC MNC ENodeBId CellSubId#... MNC ENodeBId CellSubId#... (MCC taken from column Mcc) ENodeBId CellSubId#...(MCC and MNC take from columns Mcc and Mnc)
ErrorEllipseAzimuthOfLargeHalfAxis	o	Estimated cells only: the azimuth of the large half axis of the error ellipse	Floating point number [°]
ErrorEllipseLargeHalfAxis	o	Estimated cells only: the length of the large half axis of the error ellipse	Floating point number [m]
ErrorEllipseSmallHalfAxis	o	Estimated cells only: the length of the small half axis of the error ellipse	Floating point number [m]
Classification	o	Classification of the cell	`NotClassified`: The cell has not been classified. `Good`: The cell has been classified as good. `Bad`: The cell has been classified as bad.
Metric	o	Metric that is related to the classification	Floating point number with precision of 0.01.

7.3.4 User-defined BTS list format

Instead of using the TXT and ATD formats described in the previous sections, define your file formats for the BTS list. To distinguish from the standard BTS list formats, the user-defined BTS list formats must have file extensions different from `*.txt` or `*.atd`. Also, a dynamic link library (DLL) with the name `GSS_K6_Import_xxx.dll` must be written, where `xxx` is the extension of the files' format.

The DLL must contain a class (e.g. `Import`), derived from the following abstract class `AsciiImport`:

```
class AsciiImport
{ public:
  enum NEXT_LINE_STATUS {SECTOR_VALID, SECTOR_INVALID, END_OF_FILE, SKIP_SECTOR};
      AsciiImport(){};
      virtual ~AsciiImport(){};
      // Open the file "pFilename":
      virtual bool Start(char* pFilename) = 0;
      // load next sector:
      virtual NEXT_LINE_STATUS NextSector(char** ppErrorString) = 0;
      // number of the sector in the Ascii file
      virtual unsigned int* GetSectorNr() = 0;
      virtual char *GetSectorName() = 0;           // Name
      virtual double* GetLongitude() = 0;          // Longitude
      virtual double* GetLatitude() = 0;           // Latitude
      virtual unsigned short* GetBCC() = 0;        // Base station color code
      virtual unsigned short* GetChannelArray(int index) = 0;
   // index = 0 points to the C0 carrier
            // index points to TCH index
      virtual unsigned int* GetCI() = 0;           // Cell Identity
      virtual unsigned int* GetNcc() = 0;          // National color code
      virtual unsigned int* GetClockCode() = 0;    // ClockCode
      virtual double* GetPower() = 0;              // EIRP
      virtual unsigned int* GetAntennaType() = 0;  // Antenna type
      virtual double* GetDirection() = 0;          // Direction of the antenna
      virtual unsigned int* GetSyncCode() = 0; // Synchronisation Identification
      virtual unsigned short* GetLAC() = 0;             // Location area code
      virtual unsigned short* GetMNC() = 0;             // Mobile network code
      virtual unsigned short* GetMCC() = 0;             // Mobile country code };
```

The file is installed in the `Installation` subdirectory of the main directory.

The file line status is explained in the following.

- The function `bool Start(char* pFilename)` opens the ASCII file. The return value is "true“, if the file could be successfully open. If the return value is "false" the program returns to the calling menu.
- NEXT_LINE_STATUS
  Each call of the function `NEXT_LINE_STATUS NextSector(char** ppErrorString)` loads the next sector, or the first one if it is called after `Start(char* pFilename)` has been called.
- END_OF_FILE
  When the return value is `END_OF_FILE`, the DLL is deallocated and the loading of the operator information is considered to be finished.
- SECTOR_VALID
  The return value `SECTOR_VALID` implies that the sector has been loaded successfully. In this case there must be access to its data via the remaining functions pointing to them. The name of the sector, its geographical position, BCC and C0 carrier (obtained by the value of `GetChannelArray(0)`) and the sector number are mandatory. The sector number is necessary to monitor possible inconsistencies in the data. The remaining values are for additional information. If some of the latters

are not included in the sector information, the corresponding access functions must return the NULL pointer.

- SECTOR_INVALID
  The return value `SECTOR_INVALID` is used to indicate an error in loading the sector. An error message is displayed including a message in a character string, to which `ppErrorString` points. The memory of this character string must be defined and allocated in the DLL and the content of this string can be specified arbitrarily. After that error message, the loading of the operator information is stopped and the sectors already loaded are canceled.
- SKIP_SECTOR
  The return value `SKIP_SECTOR` can be used to skip a sector if, e.g., the sector contains some invalid data and is not loaded. However, the program does not stop loading the base station list but reads the next sector instead. A message is written into the file `CtoI_Reports.txt` stored in the "TestFiles" subdirectory.

The declaration of exported DLL functions is realized via the file `Import_xxx.def`, where xxx has to be replaced by the file following extension.

```
LIBRARY IMPORT_xxx.DLL
DESCRIPTION "Reading the operator info of the BTS stations"
EXPORTS
ImportConstruction    @1
ImportDestruction    @2
```

- ImportConstruction
  `ImportConstruction` is a function which takes no arguments. It allocates memory for the class "Import" and returns a pointer to this memory.
- `ImportDestruction`
  `ImportDestruction` is a function taking a reference to a pointer to "Import" as an argument and deleting the allocated memory. The return value of this function is of type `void`.

Example:

The following example of the corresponding `DLLStart.cpp` is a possible realization of the `*.txt` format file.

```
# include "ImportTxt.h"
ImportTxt* ImportConstruction()
{    return (new ImportTxt()); }
void ImportDestruction(ImportTxt* & Import)
{     if(Import != NULL)
          delete Import; }
```

The `ImportTxt.h` is the header file declaring the class.

7.4 Obtaining screenshots

R&S ROMES4 fully supports the "Print Screen" functionality familiar from many other MS Windows applications. The contents of all views can be printed to a file or sent to a printer; an extended selection of print options is available. In addition, all pages can be previewed before they are sent to the printer.

If you still wish to obtain an accurate copy of your application screen, there are different ways to obtain screenshots:

- To copy a view to the clipboard, available is for all views the "Copy to Clipboard" function via the "Configuration Menu" (right mouse click).
- Via "File Print/Print Preview" it is possible to print everything what is visible in the "View Area". The function adds date and name of the measurement file.
- Copy the whole screen to the clipboard (`<PrtSc>`) or
- Copy the active window to the clipboard (`<Alt> + <PrtSc>`)

In R&S ROMES4, the active window is always the frame application, not the individual views which are so-called child windows. Use the "Copy to Clipboard" Function for a specific view.

Now you can switch to another MS Windows application (`<Alt> + <TAB>`), like MS Word or MS PowerPoint, and insert the screenshot via `<Shift> + <Insert>`. From this application, you can also obtain hardcopies. All the screenshots in this documentation are created this way.

7.5 Basic report

R&S ROMES4 fully supports generating the basic reports for views. A basic report can be generated from the available views.

R&S RF power scan view

For technical reasons, the Spectrum History of the selected sweep is empty in the generated report.

1. Select the "Report" menu entry in the "Tools" menu.

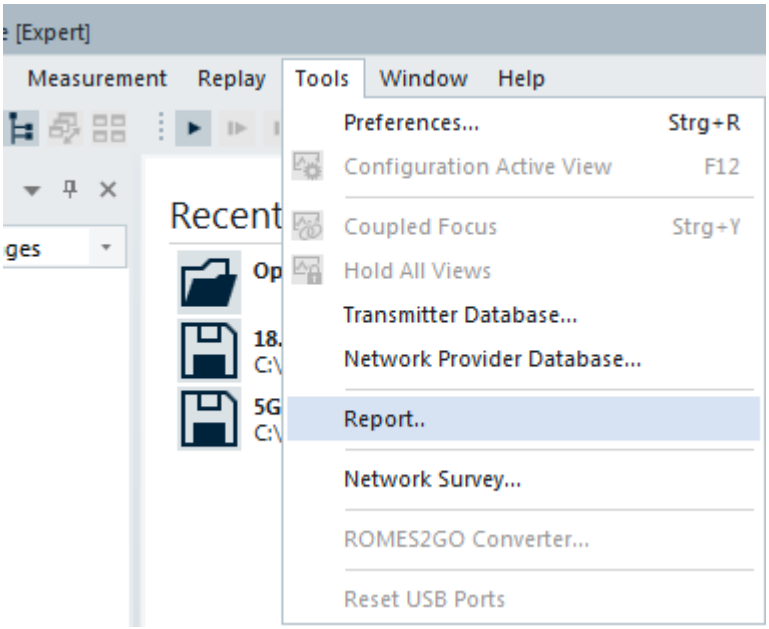


Figure 7-58: Select Tools - Report

2. The "HTML Report" dialog opens where you can specify the target directory and the name of the report.

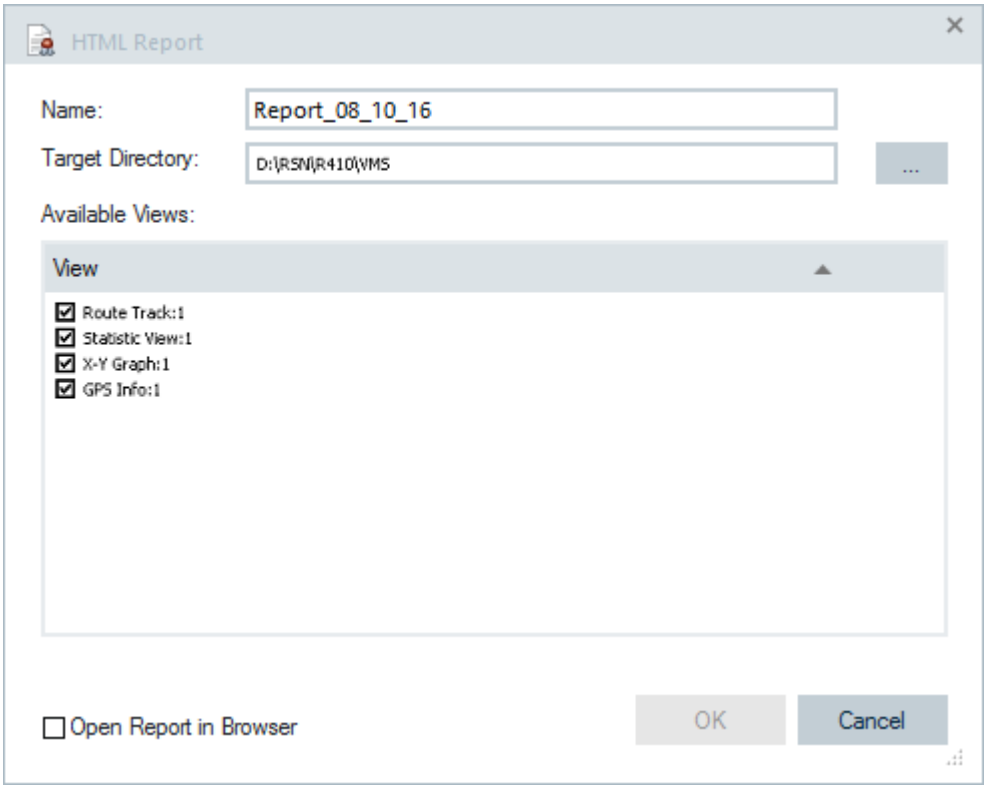


Figure 7-59: Report dialog window

A specified directory stores the measurement report. The folder name is the combination of target directory and name of the report. The dialog offers all active views by default. Disable the views which are not part of the report.

"Name"	Enter a name for a new folder where to save the report file.
"Target Directory"	Enter or select via "..." the output directory of the report. The system always creates also a new directory in the entered directory. The name of the additional directory is the target directory. The name of the report file is the combination of the name of the target directory and the name of the report.
"Available Views"	All active views are shown and by default selected. Deselect the views that have not to be part of the report.
"Open Report in Browser"	To show the generated report in the browser, check the box.

3. After entering and selecting the desired options in the "View" dialog, click "OK".

   The report is generated.

If "Open Report in Browser" was selected, the current default browser opens automatically and shows the generated report.

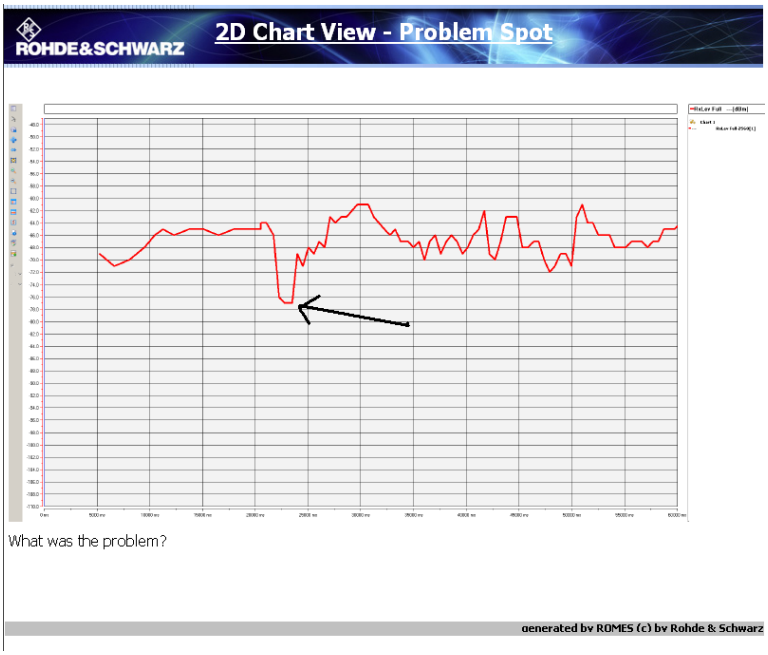


Figure 7-60: Generated reports are shown within default browser

The HTML report normally resizes the views to make the screenshot for the HTML report. For several reasons this resizing method does not work for the "Route Track View". The HTML report is adapted, so that the screenshot is taken from the "ROMES-MAP Route Track View" as it is at the point in time, when the report is generated.

7.6 Evaluation of KML/KMZ data with Google Earth

After finishing the export, you can view the newly created kmz/kml file using the Google Earth application, which you can download for free.

7.6.1 Load exported files in Google Earth

Prerequisite:

Google Earth is installed on the local PC.

Procedure:

1. Double click on the `*.kml/kmz` file to open and view it in Google Earth.
2. Opening a file creates a directory under the Places window with the same name as the file. This folder contains two subfolders, namely one for the GPS data and one for the exported signals.

Figure 7-61: Activate Places

7.6.2 Visualize data

Display GPS Data at Google Earth

1. Activate the GPS Data to visualize it on the map.

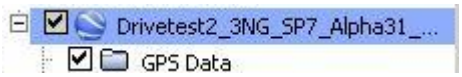


Figure 7-62: Activate GPS Data

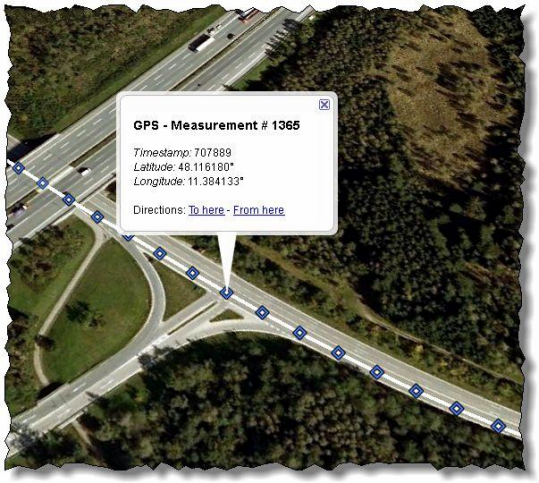


Figure 7-63: Display GPS Data

2. The viewer automatically displays and centers all the available GPS data. Each GPS measurement is shown as a blue diamond and if you zoom in, you can follow the path traveled, which is connected by white lines.

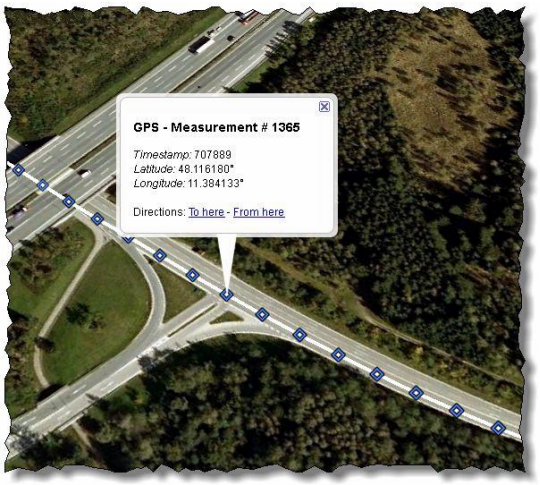


Figure 7-64: Click on a GPS entry to view more information.

Explore GPS position information

► Click on an individual GPS placemark to explore its position information and the time at which the measurement was taken (relative to the R&S ROMES4 timer).

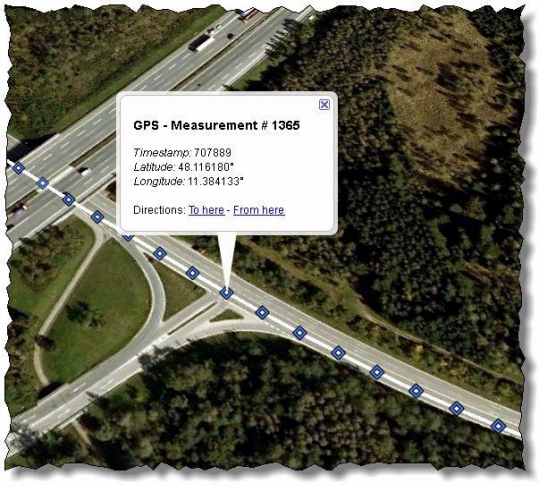


Figure 7-65: Click on a GPS entry to view more information

Visualize measured signal with placemarker

► To display a signal, simply click one from the Signals subfolder.

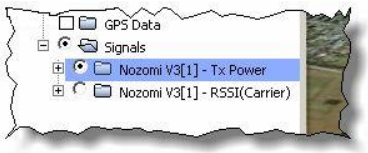


Figure 7-66: Activate Signal

Tip: View multiple signals at once
Only one signal can be viewed at a time for visibility reasons; to display multiple signals at the same time, export them to different files and open them in Google Earth simultaneously.

After clicking on a signal, its placemats are shown.

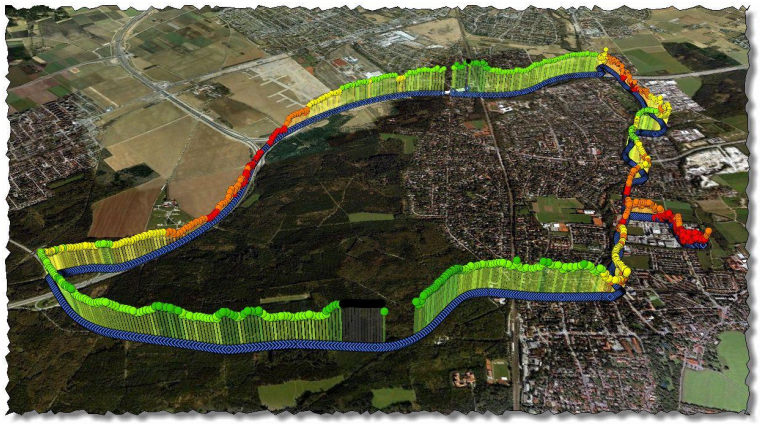


Figure 7-67: Display signal with placemarker

The height of the placemark represents the level of the signal measured at that given point. All signals are mapped linearly to the same interval from ground level to the maximum height as chosen before during R&S ROMES4 export.

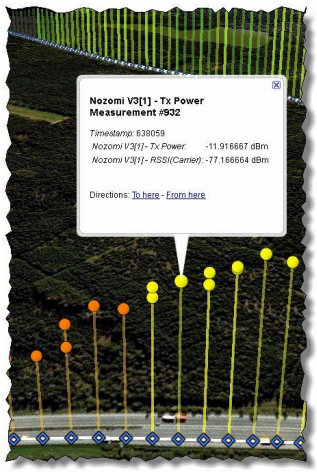


Figure 7-68: Display signal with placemarker, detailed

Color setting of a signal
The maximum, minimum and color of the signal are acquired from the R&S ROMES4 settings.

Disable the terrain level

The height of the placemarks is relative to ground level, it is thus recommended to disable the terrain level in Google Earth to make the visualization more accurate.

Inspect specific signal values

► Click a signal placemark to inspect the actual signal value measured at that GPS position. Notice that information about all signals is always available, even if only one signal is displayed.
To go to a specific placemark or to activate or deactivate single ones, it is also possible to access them by expanding the signal subfolder.

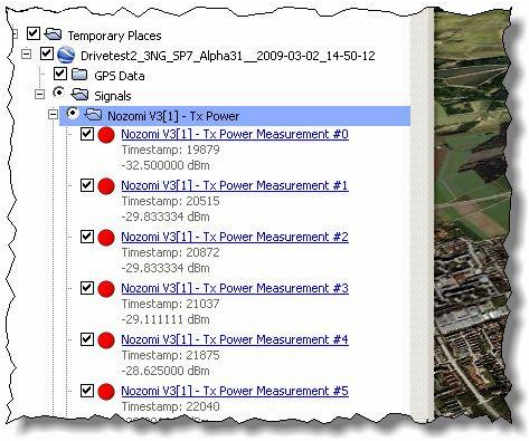


Figure 7-69: Placemark for every measured single signal

8 Installation instructions R&S ROMES4

This chapter explains how to install and uninstall R&S ROMES4 and third-party utilities that might be useful or necessary for the operation of some R&S ROMES4 components.

- Installation R&S ROMES4 2196
- Uninstall R&S ROMES4 2216
- Directory structure R&S ROMES4 2223
- Operating R&S ROMES4 without local administration rights 2224

8.1 Installation R&S ROMES4

R&S ROMES4 is software running on a controller with MS Windows operating system.

R&S ROMES4 offers the installation process execution on command line in a silent mode. For more details, see Chapter 8.1.8, "Unattended install process", on page 2213.

The distributed R&S ROMES4 software is organized in several directories:

- "AddOns" provides various applications and utilities for R&S ROMES4, for example, QualiPoc Converter and LicenseServerGui.
- "Documents" provides the current version of the R&S ROMES4 help manual in CHM format and the "ONF Overview" document of the R&S ROMES4 version-related features within the service pack.
- "Firmware & Drivers" provides the WiBu software for manual installation (only relevant if the automatic installation fails).
- "ROMES" contains the ROMES dependencies installer and the ROMES installer as a service pack.
  Note that the service packs have to be installed manually during Initial Setup. The service pack can be installed from any location on the target computer, because the required R&S ROMES4 installation directory is obtained from the MS Windows registry.
- "runtime" contains installation versions of the third-party utilities.

Table 8-1: Available devices

Devices for ...	Purpose	Installation file	Reference
Edgeport USB to 8Serial Converter	Edgeport/8 301-1002-08 USB to 8xserial Converter	`Edgeport USB to 8Serial Converter\ip4n5340.exe`	`Edgeport USB to 8Serial Converter\Readme.txt`
GPS Receiver	Various GPS receivers with USB interface	`GPS Receiver\...\...\*.exe`	`GPS Receiver\...\*.pdf`
Qualcomm Chipset	USB devices Qualcomm chipset-based mobiles (Qualcomm, Samsung,…)	`\Test Mobiles\*.exe`	`\Test Mobiles\...`

Devices for ...	Purpose	Installation file	Reference
Sound Cards	Sound Cards used for Speech Quality measurements (SQA)	`\Sound Cards\...\ *.exe (or *.zip)`	`\Sound Cards\...`
WiBu CodeMeter	Device for hardlock	`\Firmware & Drivers\ WiBu\ CodeMeterRuntime64.64.exe`	-

R&S ROMES4 supports WIBU licensing concept, enabling software licensing. WIBU licensing is needed also for SmartONE cross-licensing.

The license information and optional reconfiguration are available in the "License Info" dialog.

R&S ROMES4 and SmartBenchmarker can be integrated.

R&S ROMES4 supports multiple WiBu firm-codes for both R&S ROMES4 and Smart-Benchmarker. This support simplifies and optionally automates installation,

For multiple WiBu firm code support, see Chapter 8.1.5, "Multiple WiBu firm-codes support", on page 2208.

8.1.1 ROMES installer

R&S ROMES4 is installed with the SmartONE installer. The SmartONE installer uses the ROMES installer and the ROMES dependencies installer.

The ROMES Dependencies Installer installs Microsoft redistribution kits, Mapdata and SafeNet hardlock device. The Microsoft redistribution kits 2017 and the Codemeter are installed by the SmartONE installer and no more installed by the ROMES installer because both R&S ROMES4 and SmartBenchmarker use this software.

The standalone usage of the ROMES installer is not possible. The DVD surface is not available.

Use the Windows Explorer to navigate through the content of the delivered package.

8.1.1.1 Tech selector

The SmartONE installer is not used to choose technologies to be displayed in the R&S ROMES4 tool.

Technologies to be displayed are selected after the first start of R&S ROMES4.

After Initial Setup, if registry entry General\FRESH_INSTALLATION exists and the value is 1, the Tec Selector is launched and you can choose technology modules to be loaded.

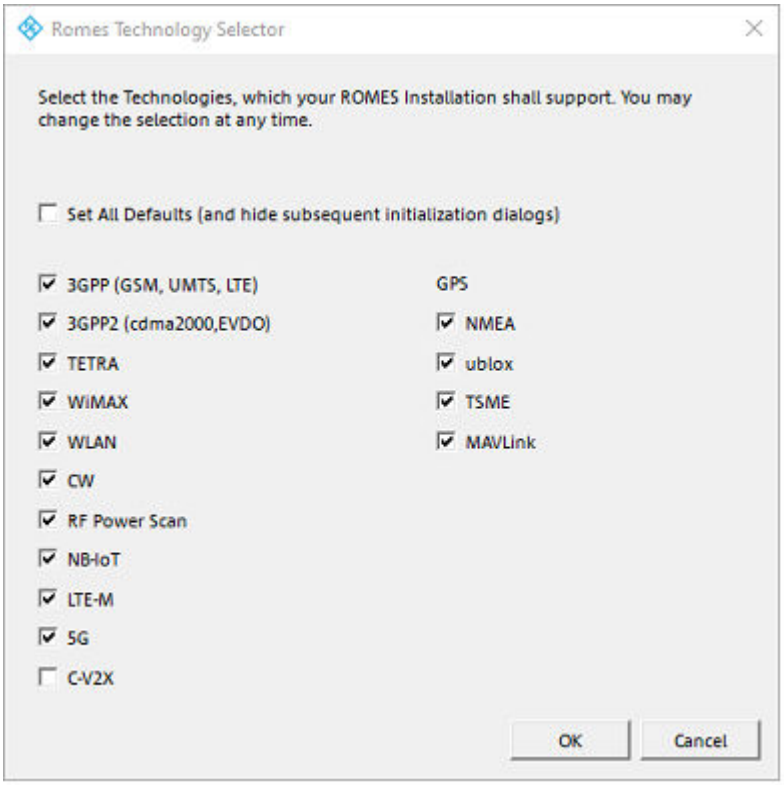


Figure 8-1: Technologies to select after Tec Selector launching

For the function of the "Set All Defaults (and hide a subsequent initialization dialogs)" flag, see Note.

If "OK" is selected, the following message is shown.

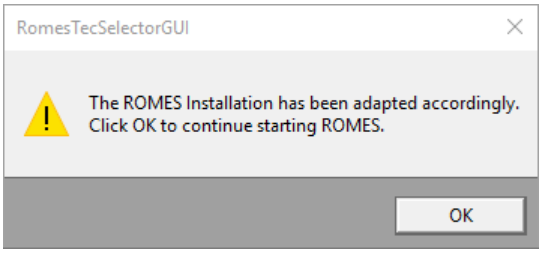


Figure 8-2: Message dialog for installation change

After running the Tech Selector, the registry entry General\FRESH_INSTALLATION is set to 0. The Tec Selector runs as needed.

If R&S ROMES4 is running in a remote controlled mode, the Tec Selector does not run.

8.1.1.2 License configuration

The existance of the WiBu license is detected during the R&S ROMES4 setup. If the license is detected, the system uses it and there is nothing to configure.

If the license is not detected, the following message pops-up.

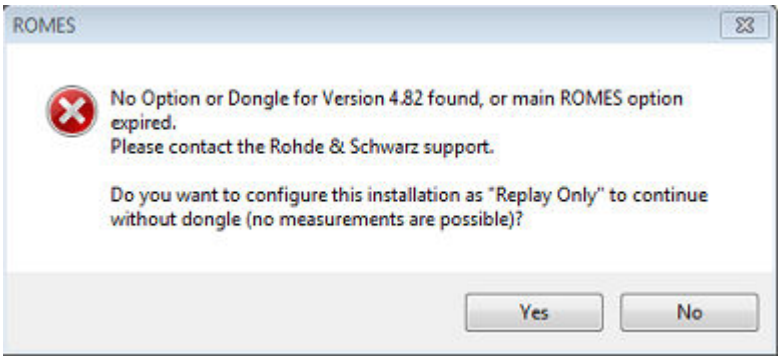


Figure 8-3: Warning message offering Read Only mode

If you click "Yes", R&S ROMES4 continues in "Read only" mode.

WiBu license can be available in two manners, installed on the PC as a soft-license or stored on a WiBu license dongle.

If a WiBu soft-license is in use, the following actions break/corrupt the WiBu license container, making the measurement software unusable:

1. R&S TSMA6/TSMA6B - Reset to factory default, restore of a user backup or image installation.

2. PC - Backup&Restore

Refer to the "R&S ROMES4_WIBU_LicenseManagement manual - 6. Troubleshooting" in case any kind of restore or image installation is necessary or the license container is already broken.

The "License Overwiew" > "Found Sales Options" shows the installed licenses. The PESQ license is the only license that can be modified, see Chapter 3.10.4, "Licenses", on page 419.

Replay

R&S ROMES4 continues with the Replay mode when you run R&S ROMES4 if WiBu license is not available and you select the "Yes" option shown in the previous screen-shot.

8.1.2 Installing R&S ROMES4 basic software

A setup program controls the software installation. All necessary settings are configured automatically during the installation process. The assumption is that you already have stored the R&S ROMES4 package on your machine.

Perform the following steps:

1. Turn on your machine and start your MS Windows operating system.
2. If the program Hardcopy is running on your machine, stop the program.
3. Start the `Romes_setup-<version>.exe` program in the subdirectory "ROMES". The R&S ROMES4 service pack installation wizard opens with a startup screen.

Figure 8-4: R&S ROMES4 installation - start

4. Click "Next" to start the installation. The "License Agreement" window opens.

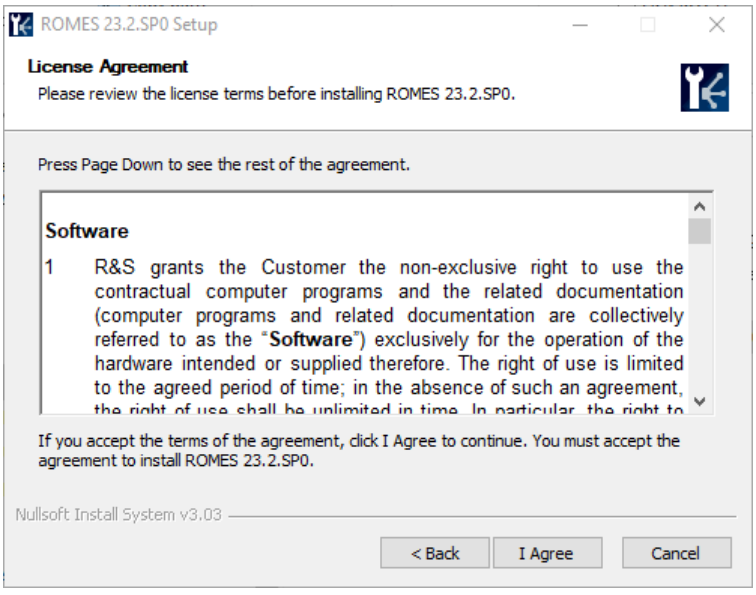


Figure 8-5: R&S ROMES4 installation - accept agreement

5. Before proceeding to the next step, read the user license agreement carefully.

6. Click "I Agree" to accept the user license agreement and to continue the installation.
7. Check the desired components for installation. It is safe to accept the default selection, shown in the following figure.

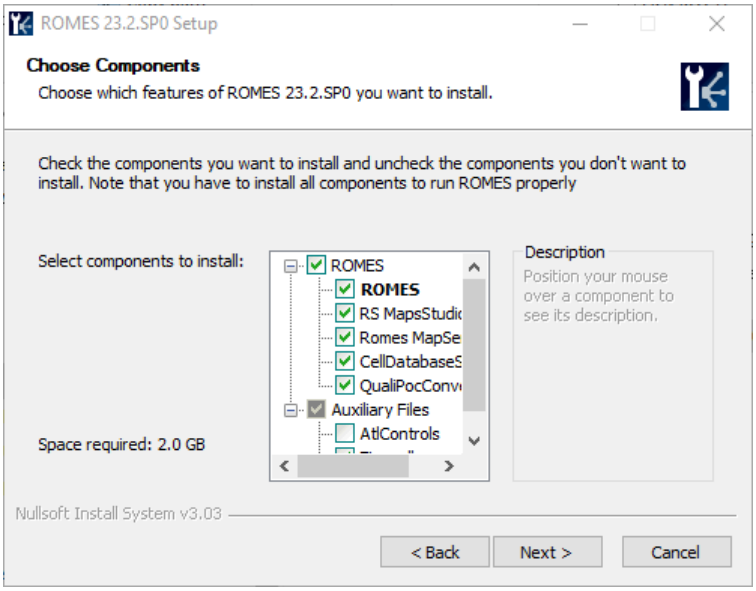


Figure 8-6: Selection of R&S ROMES4 components - default

Click "Next" to confirm your selection.

8. The "Choose Install Location" window opens.

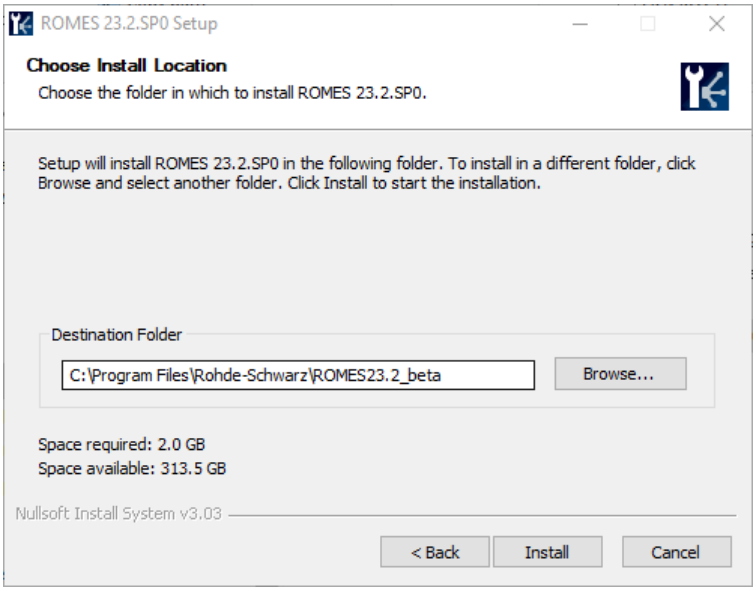


Figure 8-7: Selection of R&S ROMES4 install location - default

9. Select the desired destination folder for R&S ROMES4 installation. The installer checks for previous R&S ROMES4 installations. If one is found, the installer copies

the path to the installation directory and offers this path as the installation location. Otherwise, the default C:\Program Files\Rohde-Schwarz\ROMES<release> directory is offered. Click "Next".

10. After installing the components, the R&S ROMES4 installation continues.

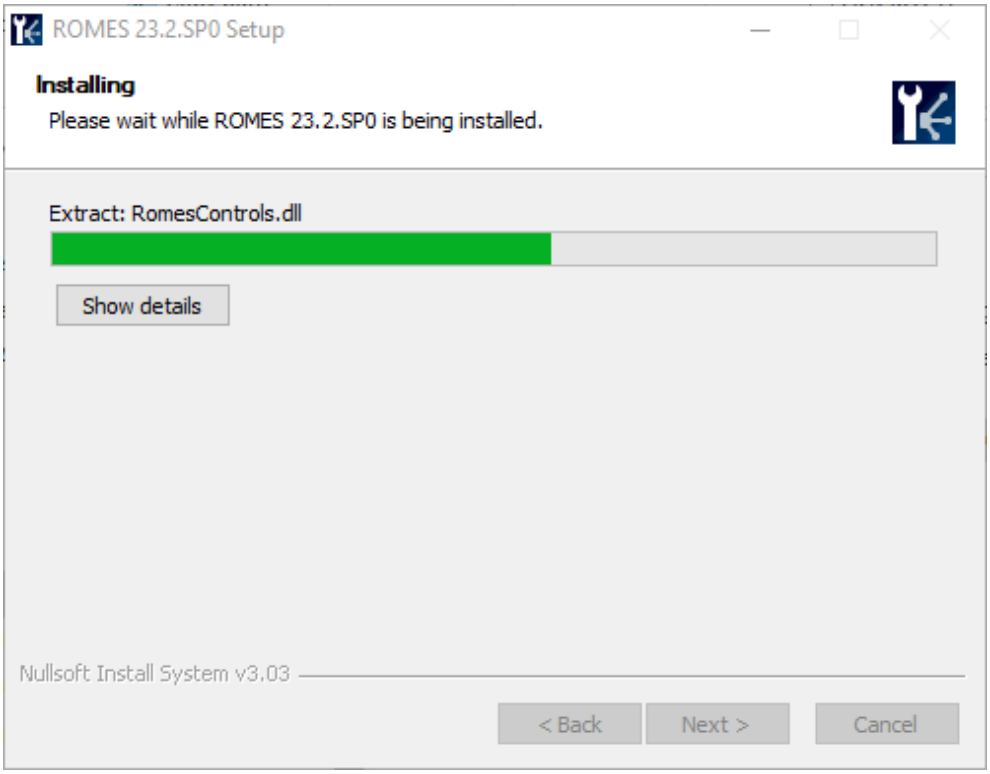


Figure 8-8: R&S ROMES4 is installing

11. The window opens showing that the installation was successful.

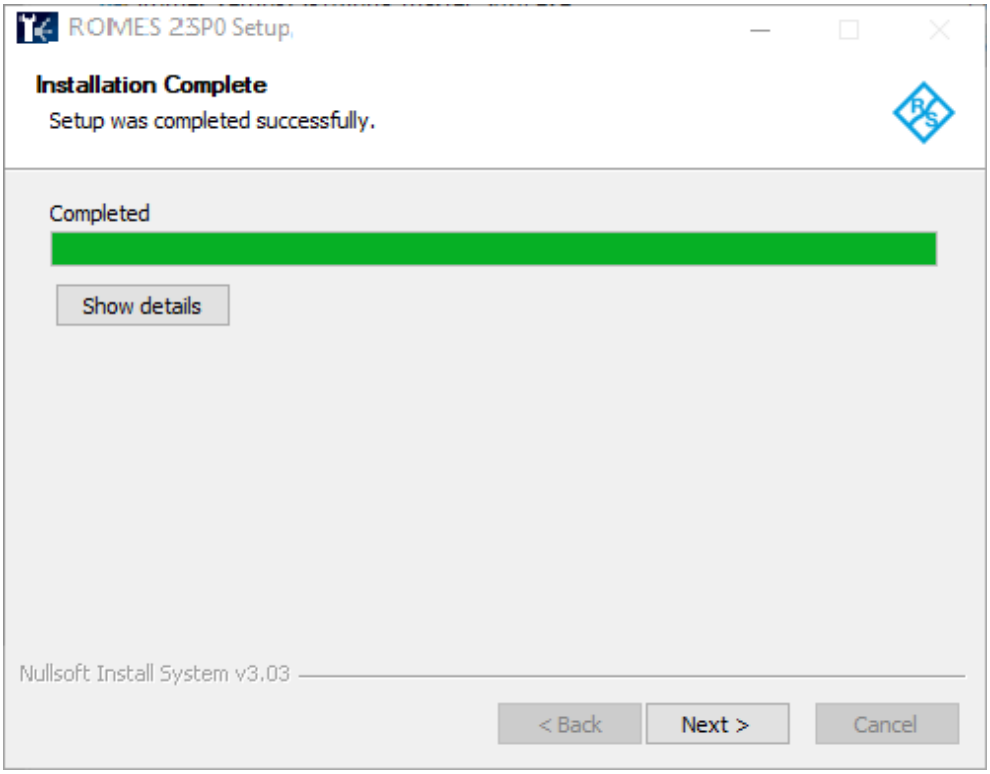


Figure 8-9: R&S ROMES4 installation - completed

The installation completion is reported.

12. Click "Next" to finish the installation.

    The R&S ROMES4 SW is installed on your computer and the set up is completed. Click "Finish" to verify the installation and close the wizard.

If you abort any of the subinstallers, the R&S ROMES4 installation also terminates.

The system reboot is mandatory after installation.

8.1.2.1 Installing components

It is safe to accept the default entries shown in the "Choose Components" window during the basic R&S ROMES4 installation.

The default installation options in the "ROMES" branch are:

- ROMES - the basic R&S ROMES4 installation
- ROMESMapServer
- CellDataBaseServer
- QualiPoc Installation

The "Auxilary Files" branch contains the Firewall installation option by default. The installation runs silently. No user interface is shown.

During the startup of the installer, R&S ROMES4 checks whether the components are already installed or need to be installed. The "Choose Component" window shows this information. If a component in the branch is not installed, the check box of the branch is checked and grayed.

If you abort any of the subinstallers, R&S ROMES4 installation also terminates.

Installing registry

This component is enabled for R&S ROMES4 installation and cannot be disabled by the user. During the registry installation, R&S ROMES4 is registered at Windows and the registry settings needed by R&S ROMES4 are installed.

The component is mandatory for any new installation or update.

Installing IEC API

This API is installed silently. No user interface is shown.

8.1.3 Installing ROMES dependencies

To install some of the R&S ROMES4 supported dependent components, proceed as following:

1. Click the `RomesDependencies_setup-<version>.exe`.

   The opening "ROMES Dependencies <version> Setup" page is shown followed by the agreement page.

2. Click "I Agree" to proceed.

   The "Choose Component" page opens letting you select the components you want to be installed.

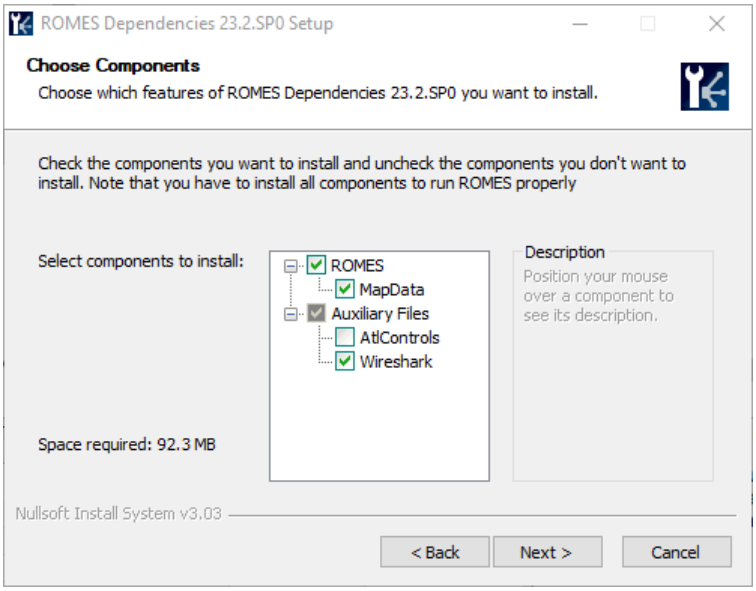


Figure 8-10: ROMES Dependencies - selecting components

3. Select the wanted components.
4. Click "Next".

   The installation process starts, showing the progress. At the 100% progress, the page about successful installation is shown.
5. Click "Next", to get the final page, click "Finish" to verify the installation.

8.1.3.1 Installing 3rd party

Libraries and utility programs such as the MFCxxx libs from Microsoft belong to this group.

Visual Studio runtime

Microsoft Visual Studio <version> C++ Runtime Library is installed silent. No user interface is shown.

1. During installation, a license agreement window appears.

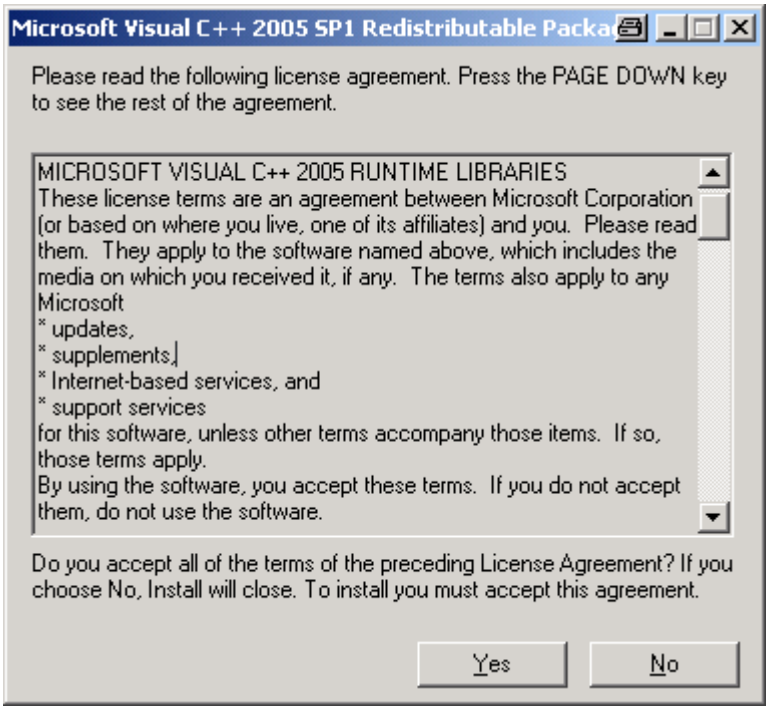


Figure 8-11: VC2005 agreement

2. Click "Yes" to continue.

   The library is installed. The ROMESDependencies installation continues to install the next component which is selected in the "Choose Component" window.

8.1.3.2 Auxiliary files

Check the "AtlControls" entry in this group.

This controller is installed silently. No user interface is shown.

8.1.4 R&S ROMES4 initial setup and configuration

The Initial Setup is used to simplify the installation and potentially automate the installation. It runs in silent mode, no message or progress information is displayed. If error occurs, the error is written in `romes.log` file.

8.1.4.1 Initial setup

If the folder C:\Users\UserName\Documents\My ROMES\InitialSetup exists, files in this folder are copied or imported when R&S ROMES4 starts. The UserName in the folder path is the user login name.

The following is valid:

- Home Directory is the folder where the R&S ROMES4 executable is located.

- My ROMES\InitialSetup refers to C:\Users\UserName\Documents\My ROMES\InitialSetup.
- File names are case insensitive.

RomesTecSelector.ini

The Tec Selector uses the `RomesTecSelector.ini` file to change the technology modules to be loaded.

If the `RomesTecSelector.ini` file is detected,

1. The file is copied to Home Directory while the existing one in Home Directory is overwritten.
2. If the entry exists, the registry entry General\FRESH_INSTALLATION is cleared, therefore the Tec Selector does not run.

PESQ file

PESQ file is a license file and is copied accordingly in the My ROMES\InitialSetup folder if detected.

The file can be browsed and changed using the "License Info" dialog, see Chapter 3.10.4, "Licenses", on page 419.

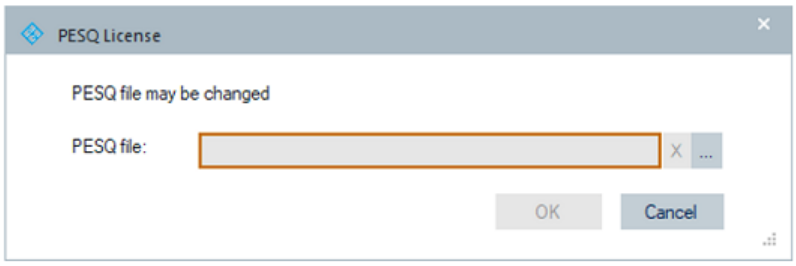


Figure 8-12: Change PESQ file

The "OK" button becomes active by selection of a PESQ file.

Press the button. The warning dialog to restart R&S ROMES4 pops-up.

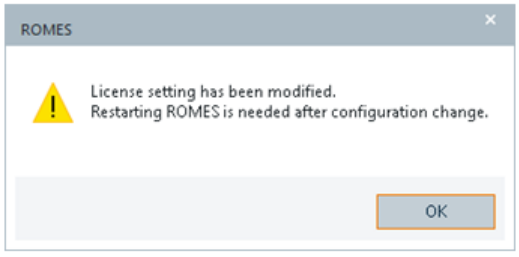


Figure 8-13: Warning dialog

SystemConfig.zip

If `My ROMES\InitialSetup\SystemConfig.zip` is detected, it is imported silently. No message or progress information is displayed for automated installation.

Rename initial setup folder

After Initial Setup is successfully done, the InitialSetup folder name is changed to InitialSetupDone.

If this folder exists, InitialSetupDoneX is tried, where X is a number from 0 to 9.

If all folder names exist, the one with earliest timestamp is overwritten. Initial Setup runs once as needed.

Error log

The Initial Setup is for automated installation and runs in silent mode. Errors if occur, are written to `RMSDBG.txt` in Home Directory.

8.1.5 Multiple WiBu firm-codes support

WiBu firm-codes both for R&S ROMES4 and SmartBanchmarker are supported.

If no firm code is detected, WiBu license is not used.

If any or both firm codes are detected, WiBu license is used.

If both firm codes are detected, the actual WiBu license coverage is the superset of both. To get the WiBu maintenance license details, see Chapter 3.10.4, "Licenses", on page 419.

8.1.6 Installing R&S ROMES4 Network Problem Analyzer

Before starting the installation, ensure that previously installed R&S ROMES4 was running so that the needed R&S ROMES4 NPA license is available.

The R&S ROMES4 NPA is installed separately by running the `npa_setup-<version>.exe` file which is a part of delivered software.

The installation is running via the installation wizard.

1. Double-click the `npa_setup-<version>.exe` file available in the ...\ROMES <version>\AddOns\NetworkProblemAnalyzer directory.

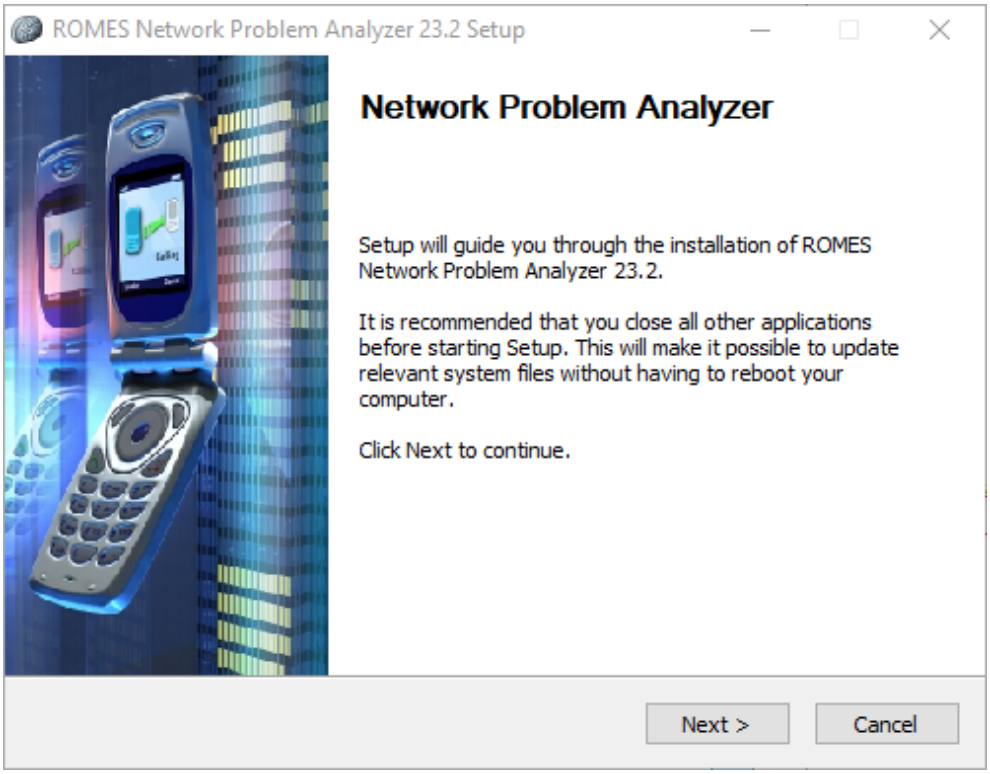


Figure 8-14: R&S ROMES4 NPA installation - start

Click "Next" to continue the installation.

The installer checks for previous R&S ROMES4 NPA <version> installations. If one is found, the installer copies the path to the installation directory and offers this location as the install location. Otherwise, the default directory `C:\Program Files\Rohde-Schwarz\ROMES<version>\NetworkProblemAnalyzer` is offered.

2. The "Choose Install Location" window opens.

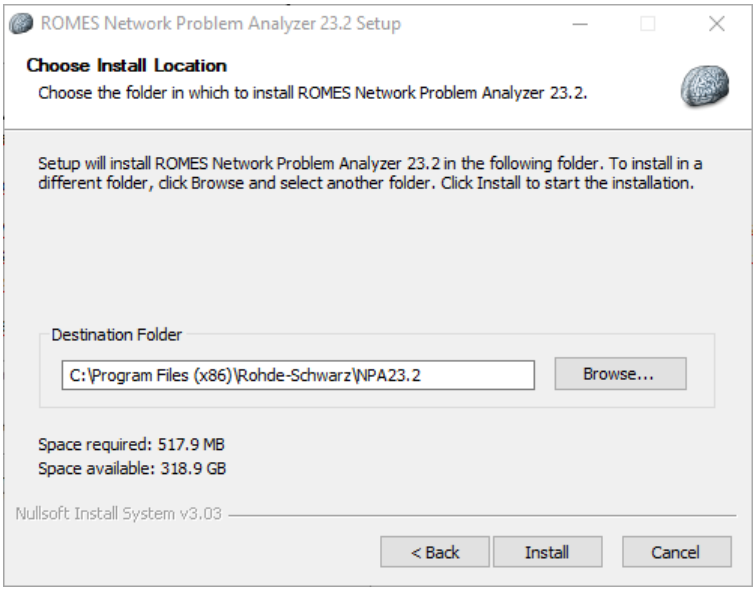


Figure 8-15: R&S ROMES4 NPA installation - choose location

3. Enter the desired destination folder for the R&S ROMES4 NPA.
   Click "Install" to start the installation.

   The installation runs and shows the installation progress.

4. The end of the R&S ROMES4 NPA installation is indicated in the "Installation Complete" window.

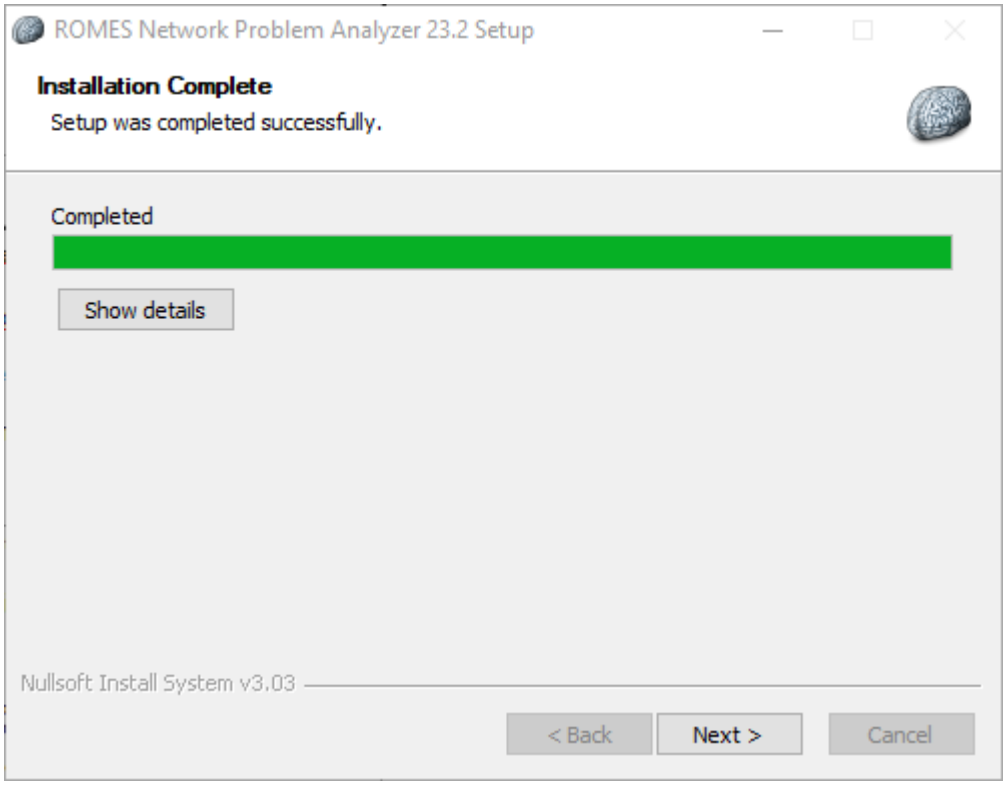


Figure 8-16: R&S ROMES4 NPA installation - successfully completed

Click "Next" to continue.

The R&S ROMES4 NPA completing installation window opens.

5. Click "Finish" to verify the installation.

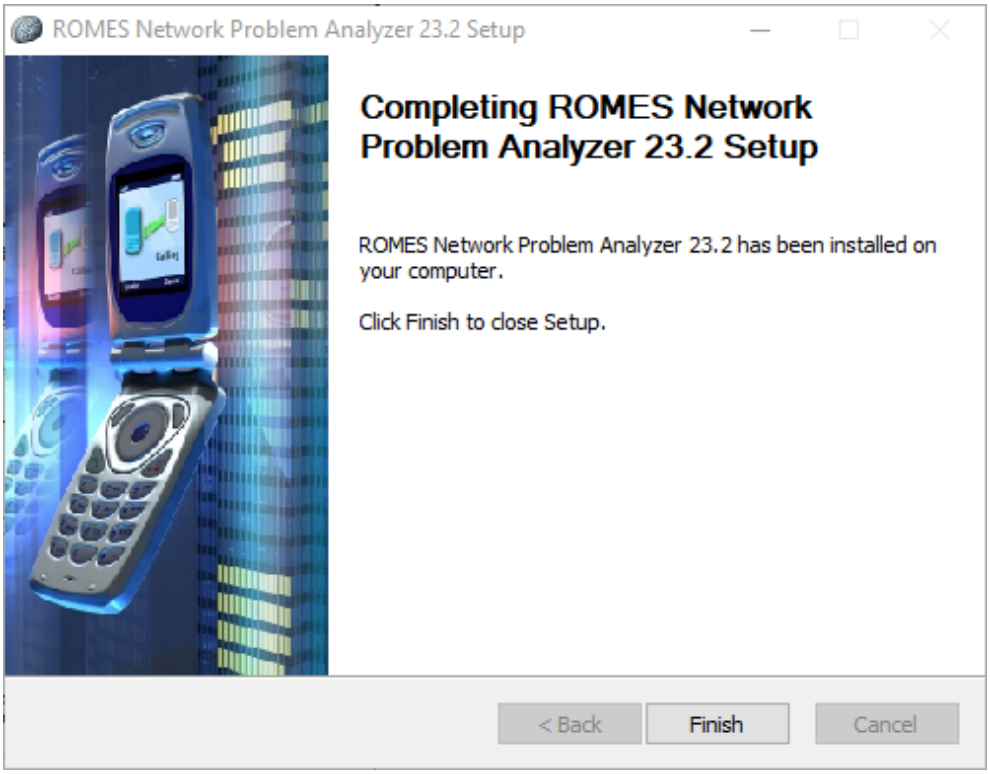


Figure 8-17: R&S ROMES4 NPA installation - finished

To use R&S ROMES4 NPA, you need the NPA license.

8.1.7 User-defined script

At the end of the R&S ROMES4 installation, a batch job `UserProg.cmd` is performed in the R&S ROMES4 section of the installer, if it exists in the same directory as the installer. The job is called with 5 parameters:

Table 8-2: UserProg.cmd job parameters

No.	Example	Description
0	`UserProg.cmd`	Name of the batch job; standard parameter of batch jobs in MS Windows.
1	`C:\Program Files\Rohde-Schwarz\ROMES<version>`	Target directory of R&S ROMES4 installation.
2	`C:\MyDocuments\My ROMES`	Target directory of stored R&S ROMES4 data (for future use).
3	`<version>`	Version of R&S ROMES4.
4	`d:\`	Path of batch.

It can be used to install files to the R&S ROMES4 directory, which are added by the IT team of the user's company.

Error handling
The return code of the batch is not checked by the installer. Therefore, error handling must be performed by the user job itself.

An example `SampleUserProg.cmd` can be found on DVD.

8.1.8 Unattended install process

It is possible to install R&S ROMES4 via a preconfigured command file. The installation process is performed silently.

An example is delivered in the R&S ROMES4 SW, as the `UnattendedInstall.cmd` file.

Example for user-defined procedure, "after" installation of R&S ROMES4
`SampleUserProg.cmd` is an example for user-defined procedure called "after installation of R&S ROMES4". The file is also a content of delivered DVD.

All system logging messages are written to a log file or returned on the command-line window.

- R&S ROMES4 installation generally checks, whether sub parts need to be installed. Parts which are already installed in the correct version, are not installed again.
- Using the command-line parameters in unattended operation, parts of installation can only be excluded from installation process.
- It is not possible, to force installation of certain components in unattended mode. To force reinstallation of some components, you need to start the installation in interactive mode.

No automatically reboot after finished installation.

8.1.8.1 Syntax

```
setup [/S]
      [/TSMx=0|1] [/Dongle=0|1] [/NETMON=0|1]
      [/QPC=0|1] [/NPA=0|1] /D=<path>
```

Parameters case-sensitive
Parameters are case-sensitive; no space allowed between the option, also before and after the sign "=" .

Return Code

The installer does not check the return code of the batch. Therefore, error handling must be performed by the user job itself.

8.1.8.2 Parameters

Table 8-3: Installation parameters

Parameter	Description
/S	Silent operation. The installer runs without any user interaction. Optional parameter. Note: - Error messages are still presented to the user. - Some subinstallers such as WinPcap and VLC player installer still require user interaction.
/D=<path>	Target directory for the installation. If not present, the default directory is used. The default directory is the programs section of the operating system. The parameter has to be the last parameter on the command line. If the path name contains blanks, no " are required.
/NETMON=<0|1>	Specifies whether to install MS Netmonitor. The /NETMON=<1> means install, <0>means do not install. If <1>, a link to page on web server of Microsoft is established for downloading.
/QPC=<0|1>	Specifies whether to install the QualiPoc Converter.
/VLC=<0|1>	Specifies whether to install the VLC player. Note: The installer of the VLC player requires user interaction, even if the user supplied the /S parameter. 0: No installation of the VLC player. 1: Installation of the VLC player. Only if it has not already been installed, or no previous version is installed. The parameter is optional. If the parameter is not available, the installer tries to install the VLC player.
/ServicePacks=<0|1>	Specifies whether the installer searches for R&S ROMES4 service packs automatically or not. 0: Installer does not search. 1: Installer searches automatically during installation setup for service packs. The parameter is optional. If not available, the installer searches automatically for R&S ROMES4 service packs.

Parameter	Description
/LicenseFiles=<0|1>	Specifies whether to install the license files. Note: It is recommended to use the option "0" and copy the license file (i.e. `PesQPesqLicenseFile.txt`) by using other programs. 0: No installation. 1: Installation of license files. The parameter is optional. If not available, the installer tries to install the license file.
/NPA=<0|1>	Specifies whether to install the Network Problem Analyzer (NPA). 0: No installation. 1: If not yet installed, the installer tries to install the NPA. The parameter is optional. If not available, the installer tries to install the NPA. Note: The NPA needs an own license key (`option_xxx.npa`). In silent installation (parameter /S), the user is not prompted for the location of the license file. Hence, the file has to be copied to the correct location by the user afterwards.
/_3GPP=<0|1>	Specifies whether to install the 3GPP packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
/QOS=<0|1>	Specifies whether to install the QoS packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
/CW=<0|1>	Specifies whether to install the CW packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
/TETRA=<0|1>	Specifies whether to install the TETRA packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
/_3GPP2=<0|1>	Specifies whether to install the 3GPP2 packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
/RFPS=<0|1>	Specifies whether to install the RFPS packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
NBIOT=<0|1>	Specifies whether to install the NB-IoT packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.

Parameter	Description
/WIMAX=<0|1>	Specifies whether to install the WiMax packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.
/WLAN=<0|1>	Specifies whether to install the WLAN packet. 0: No installation. 1: If not yet installed, the installer tries to install the packet.

Example:

```
setup [/S] [other options=0] /D=<path>
```

It can be used, to install files to the R&S ROMES4 directory, which are added by the IT team of the company.

8.2 Uninstall R&S ROMES4

In addition to the uninstall wizard, R&S ROMES4 offers an unattended uninstallation process. For more details, see Chapter 8.2.6, "Unattended uninstall process", on page 2221.

8.2.1 Uninstall wizard

To uninstall the R&S ROMES4 SW:

1. Click "Start" >"Settings" > "Apps & features" to open the list of installed software. Select "ROMES<version>" you want to uninstall.
2. The uninstallation dialog opens.

Figure 8-18: Start of uninstallation process

Click "Next" to continue.

3. A window opens showing the uninstallation path.
   Click "Next" to continue.
4. The "Choose Components" window opens.
   Check the components that you want to uninstall.

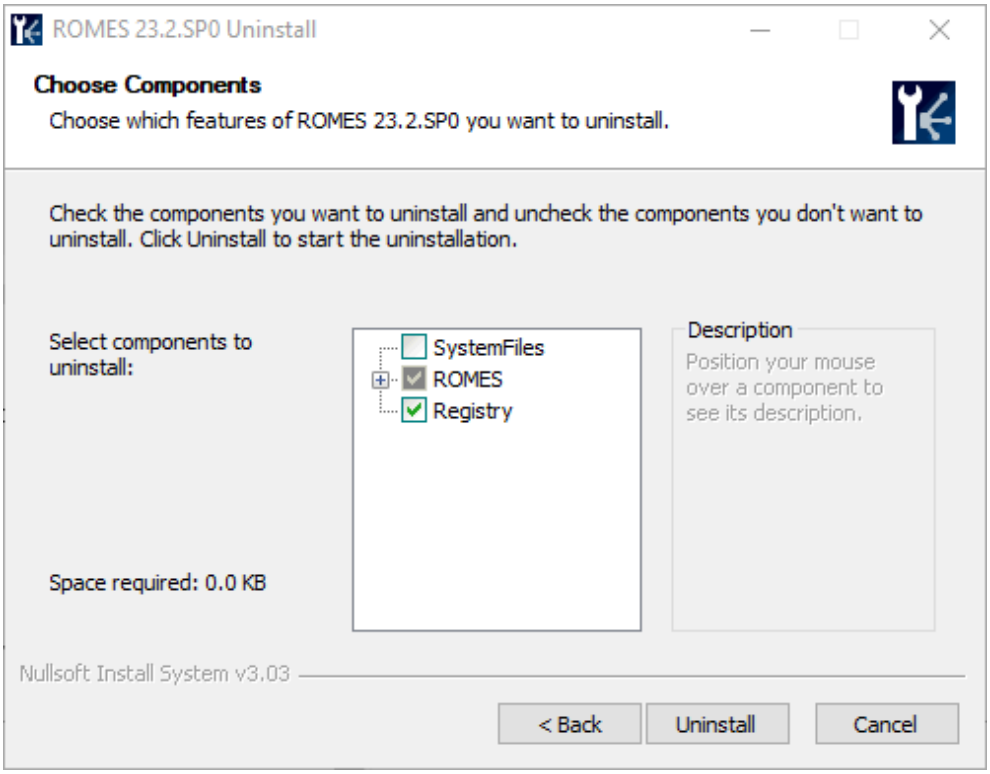


Figure 8-19: Uninstall the selected components

Click "Uninstall" to continue.

The checked components are uninstalled.

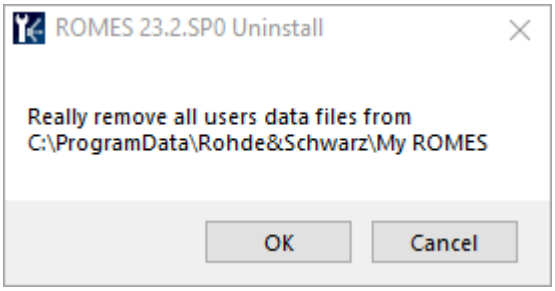
5. During the uninstallation, you can choose if you want to remove all the MapX components. Click "Yes".

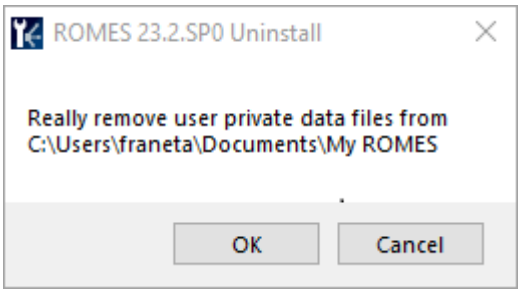
   The "Remove Shared Files" window opens.

6. Select files that you want to remove. Click "Yes to All".

   The "Remove Programs from your Computer" window opens informing you that Uninstall Shield removed MapX.
   Note: The steps 5. and 6. are performed only if the program MapX exists in a computer as being installed in some previous version of R&S ROMES4.

7. During the uninstallation, the system asks if to remove all user data files and all user private data files installed during the R&S ROMES4 installation. The corresponding dialogs pop-up if the related combo-boxes are checked in "Choose Components" > "ROMES".





Note: User data files that are in the R&S ROMES4 directory are uninstalled on request only.

8. A window appears showing that the R&S ROMES4 <version> uninstallation is completed successfully.

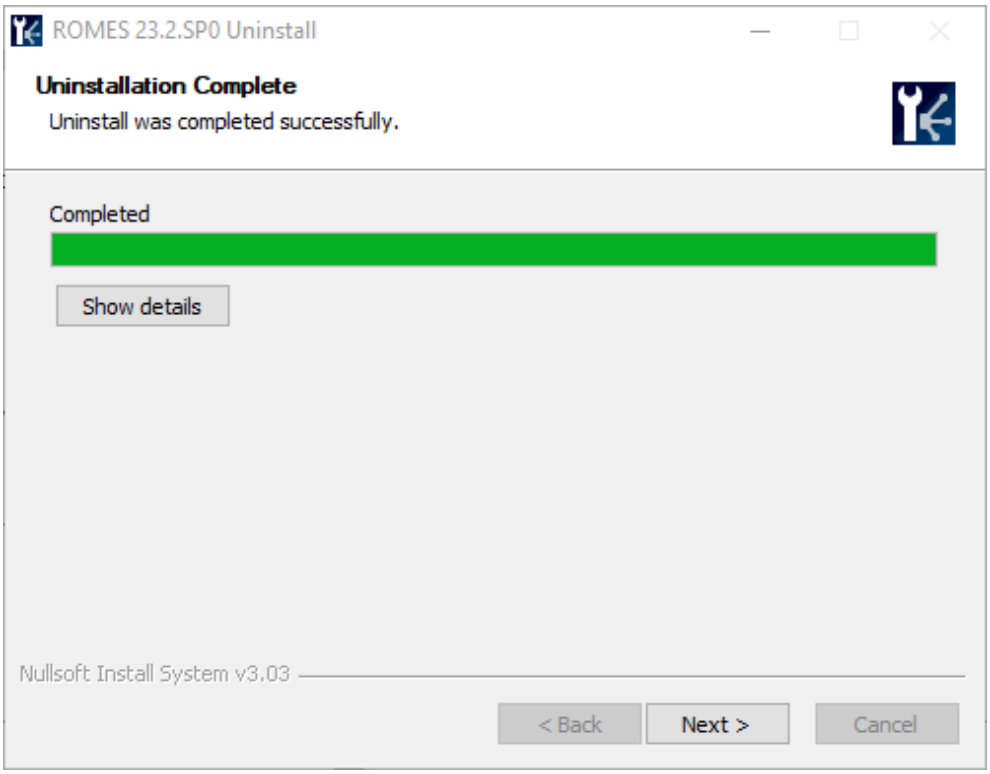


Figure 8-20: Uninstallation completed

A window appears to close the uninstallation process.

9. Click "Finish".

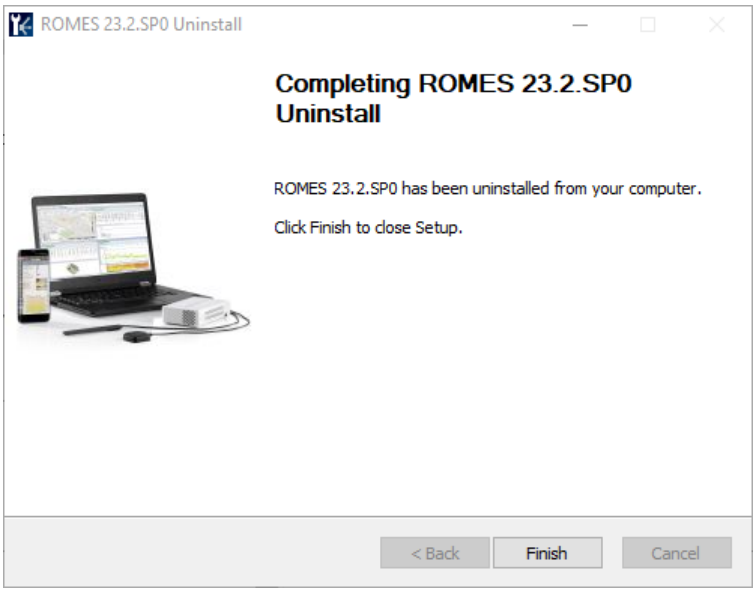


Figure 8-21: Closing the uninstallation process

The R&S ROMES4 is uninstalled and the shortcut desktop icons to start the program are removed.

Licenses are uninstalled only when user data and settings are uninstalled.

R&S ROMES4 and R&S ROMES4 NPA Uninstallation

The links to uninstaller of the R&S ROMES4 and the R&S ROMES4 NPA are removed from desktop and start menu, following the Microsoft's guide lines. As a result,R&S ROMES4 can only be uninstalled using Control Panel.

8.2.2 System files

The component "SystemFiles" defines the files which are registered and copied to the directory of Windows system.

8.2.3 Devices

Some of the hardware devices can be uninstalled in this group of registered files and copied to the directory of Windows system.

Only devices which can automatically uninstall themselves are uninstalled by the R&S ROMES4 uninstaller.

8.2.3.1 IEC API

This APT is uninstalled silently without any user interface.

8.2.4 3rd party

All 3rd party products, which can be uninstalled automatically, are available in this group.

The libraries from Microsoft are not uninstalled since many other programs rely on the presence of these libraries.

8.2.5 Registry

Registry settings are uninstalled silently without any user interface.

8.2.6 Unattended uninstall process

It is possible to uninstall R&S ROMES4 via a pre-configured command file. The uninstall process is performed silently. An example is delivered on the R&S ROMES4 DVD - `UnattendeddeInstall.cmd`.

All system logging messages are written to a log file or returned on the command-line window.

- R&S ROMES4 uninstallation generally checks, whether sub parts need to be uninstalled. The parts which were not installed before, are not uninstalled.
- Using the command-line parameters in unattended operation, some parts of installation can be excluded from uninstallation process.

8.2.6.1 Syntax

```
ROMESUnInstall [/S]
      [/TSMx=0|1] [/NPA=0|1]
```

All options are case insensitive. Space between the option and the equal sign is not allowed. Spaces are allowed (but not recommended) after the equal sign.

8.2.6.2 Parameters

Parameter	Description
/S	Silent operation. The uninstaller runs without any user interaction. It is optional parameter. **Note:** - Error messages are still presented to the user. - Some subinstallers such as WinPcap and VLC player installer still require user interaction.
/QPC=<0|1>	Specifies whether to uninstall the QualiPoc Converter.QPC= <1> means uninstall, QPC=<0> do not uninstall. The parameter is optional. If the parameter is not available, the uninstaller tries to uninstall the QualiPoc Converter.
/VLC=<0|1>	Specifies whether to uninstall the VLC player. **Note:** The uninstaller of the VLC player requires user interaction, even if the /S parameter has been supplied by the user. 0: VLC player is not uninstalled. 1: uninstall the VLC player. The parameter is optional. If the parameter is not available, the uninstaller tries to uninstall the VLC player.
/NPA=<0|1>	Specifies whether to uninstall the Network Problem Analyzer (NPA). 0: Do not uninstall NPA. 1: Uninstall the NPA. The parameter is optional. If not available, the uninstaller tries to uninstall the NPA. **Note:** The NPA needs an own license key (option_xxx.npa). In silent installation (parameter /S), the user is not prompted for the location of the license file. Hence, the file has to be copied to the correct location by the user afterwards.

Parameter	Description
`UserPrivateFiles/ =<0|1>`	Specifies whether to uninstall the user files of the current user. **Note:** - The user has to accept this operation, even if the user supplied the /S parameter. - The parameter has to be “1” for this option, as user private files are kept by default. 0: Do not uninstall user files of the current user. 1: Uninstall user files of the current user. The parameter is optional. If not available, the uninstaller does not uninstall user files of the current user.
`/AllUsers =<0|1>`	Specifies whether to uninstall the user files of all users. **Note:** The user has to accept this operation, even if the user supplied the /S parameter. - The parameter has to be “1” for this option, as user private files are kept by default. 0: Do not uninstall user files of all users. 1: Uninstall user files of all users. The parameter is optional. If not available the uninstaller does not uninstall any user file.

8.3 Directory structure R&S ROMES4

The directory structure of is compliant with the standard MS Windows structure. All user data is stored in the personal user account folder or in the Application folder. For details see the following overview table:

program	Standard folder for programs.	"c:\Program Files\Rohde-Schwarz\ROMES<*version no.*>"
user data templates	Standard folder for all users' application documents.	"c:\Documents and Settings\All Users\ Application Data\Rohde&Schwarz\My ROMES"
current user data	Standard folder for current user documents.	"c:\Documents and Settings\<me>\My Documents\ My Romes"

During startup R&S ROMES4 checks, whether the templates in the Application folder are newer than the data currently used. If the templates in the Application folders are newer R&S ROMES4 updates the data in the current user's documents folder automatically.

8.4 Operating R&S ROMES4 without local administration rights

Users without local administration rights may only use R&S ROMES4 in replay mode, unless the User Account Control (UAC) is set to "Never notify".

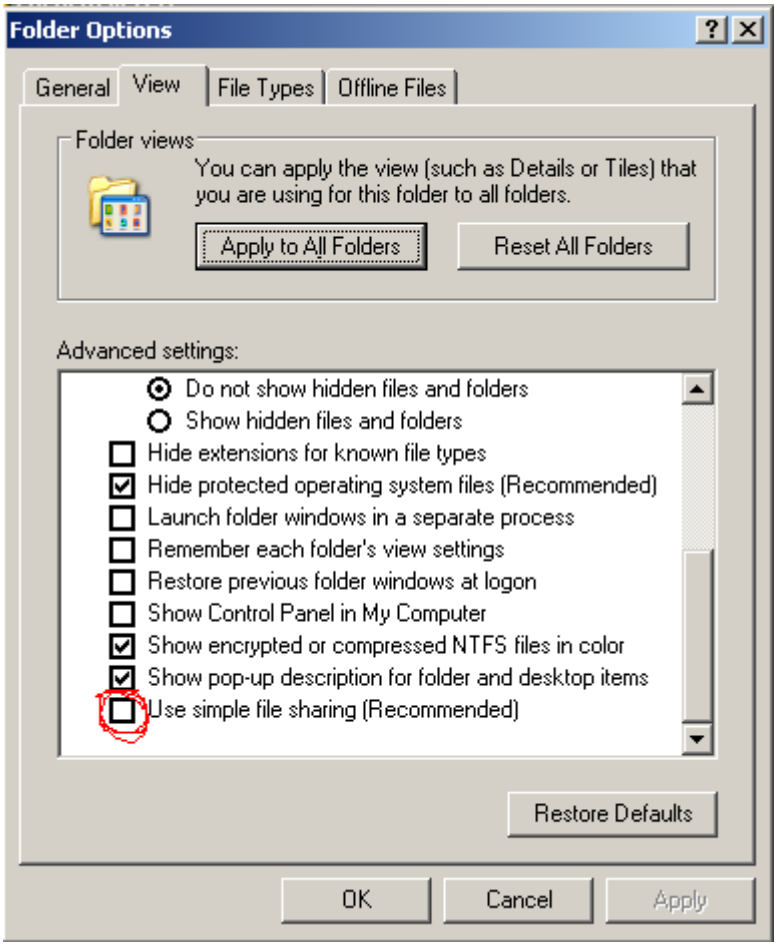
8.4.1 File sharing settings

The limited account user without local administration rights needs full file control for the following directories:

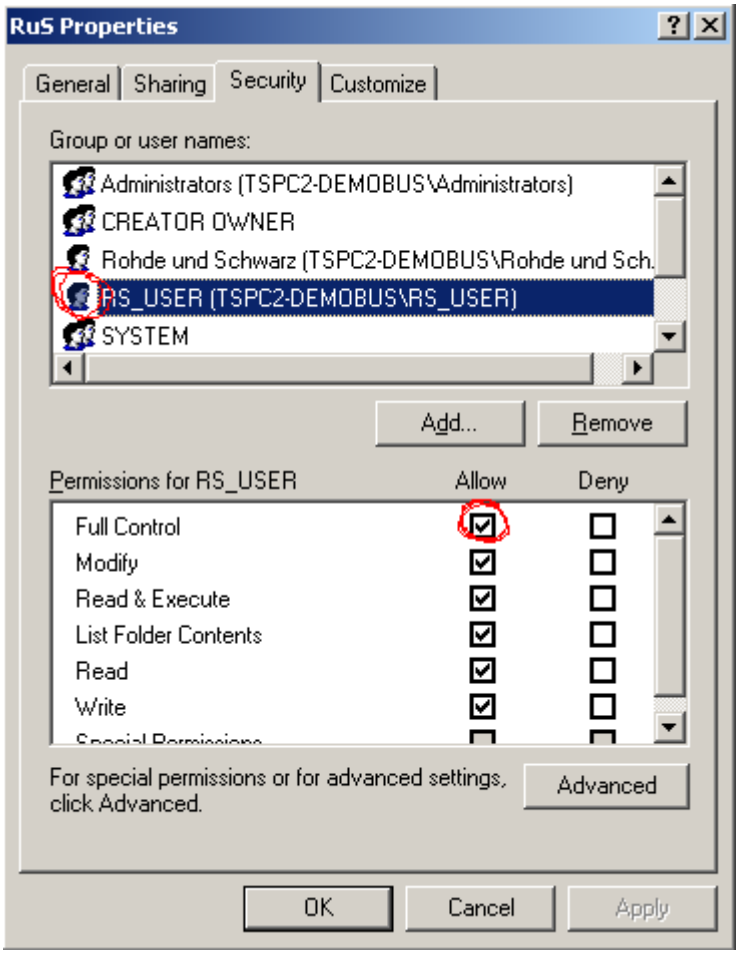
- R&S ROMES4 directory (e.g. `C:\Program Files\Rohde-Schwarz\ROMES<version no.>`)
- MapInfo directory (e.g. `C:\Program Files\MapX`)
  Note: Applies only if the program exists in a computer as being installed in some previous version of R&S ROMES.
- R&S ROMES4 temporary directory for route track modules (`C:\TEMP`)

This involves the following steps:

1. Open the Windows Explorer and select the menu item "Tools" ⇨ "Folder Options...". Select the tab "View" and scroll down until the "Use simple file sharing" list item is visible as shown below:



2. Deselect the "Use simple file sharing" checkbox and "Apply" the change.
3. Back in the Windows Explorer, select the default R&S ROMES4 directory (e.g. `C:\RuS`) and click right mouse button. In the resulting context menu, select the "Properties" entry, which leads to a dialog for the selected directory. Click the "Security" tab to obtain a dialog similar to the one shown in the following figure.



4. Select the user with limited account privileges (RS_USER in this example) in the upper list. Then select "Allow" in the "Full control" entry of the lower list. Apply the change and repeat this step for all directories listed at the beginning of this section.
5. When Step 4. is completed, modify the registry as described in the following chapter.

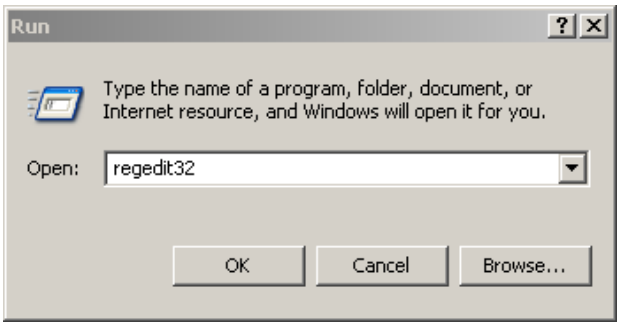
8.4.2 Registry modifications

To operate R&S ROMES4 with a limited user account, the following registry keys need to be updated:

- **ROMES Registry Key**
  `HKEY_LOCAL_MACHINE\SOFTWARE\Rohde & Schwarz`
- **MapInfo Registry Key**
  HKEY_LOCAL_MACHINE\SOFTWARE\MapInfo
  Note: Valid only if the program MapX exists in a computer as being installed in some previous version of R&S ROMES.

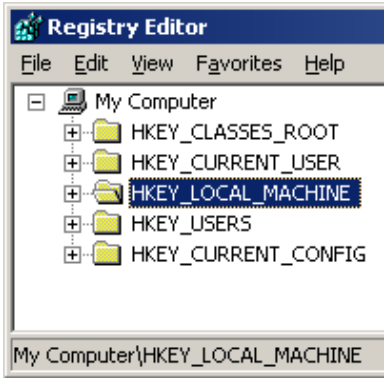
This involves the following steps:

1. Open the "Start" menu and select "Run" to obtain the following dialog.



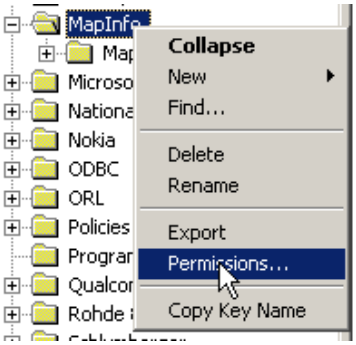
2. Type "regedit32" and click "OK" to start the MS Windows Registry editor.
   Tip: regedit32
   Do not use "regedit" as this tool does not support security settings for registry entries. Alternatively, call `C:\WINNT\SYSTEM32\regedit32.exe` from the command prompt.

   The Registry Editor starts with a window similar to the following:

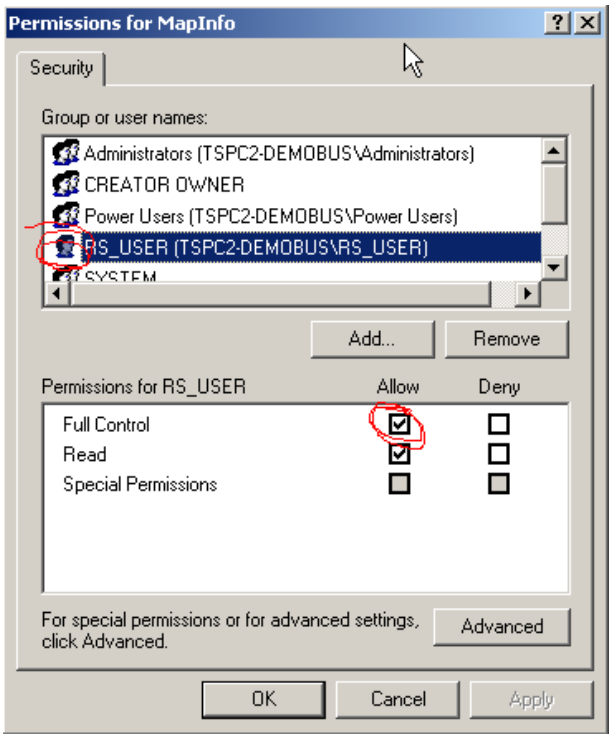


3. Click `HKEY_LOCAL_MACHINE`, then `SOFTWARE`.

4. In the `SOFTWARE` list, locate the `Rohde & Schwarz` and `MapInfo` items (valid only if the program MapX exists in a computer as being installed in some previous version of R&S ROMES).
   . Right-click an item to obtain a context menu like the following.



5. Select "Permissions" to open the following dialog:



6. In the upper list, select the user with limited account privileges (RS_USER in this example). Then select "Allow" in the "Full control" list item of the lower list. Apply the change and repeat this step for all Software items listed at the beginning of this section.
   These changes allow the full functionality of the R&S ROMES4 software in the context of a limited user account.

9 R&S ROMES4 KPI generator

The measurement procedure and the KPI calculation in R&S ROMES4 is separated. At the measurement time only trigger points (TPs) – and no KPIs - are stored in a `*.rscmd` file.

KPIs calculation is based on these trigger points and is separated and postponed. During the measurement or at replay the KPIs are formed according to the calculation method which is defined in a KPI definition file.

This has a big advantage as the calculation method is changeable, adaptable and extensible for specific customer requests. Therefore no new measurement is necessary if any new KPI calculation is needed.

- KPI definition file and KPI export definition file 2229
- KPI definition - how to define a KPI 2239
- Trigger point definitions 2243
- R&S ROMES4 KPI Description 2312

9.1 KPI definition file and KPI export definition file

This document defines the format of the XML file, which is responsible for the generation of the KPIs in the KPI Generator. It defines also the format of the XML file, which is responsible for the layout of the KPI export tables.

- Introduction 2229
- KPI definition file 2230
- KPI export definition file 2235

9.1.1 Introduction

The calculation method is defined in a KPI definition file in XML format. A basic definition file is delivered with the R&S ROMES4 installation for calculating all common KPIs, which R&S ROMES4 has calculated in previous versions.

This basic definition file can be found usually at
`[RomesApplicationData]\configuration\KPI.xml`

This documentation will describe all the parameter used by a KPI definition. For an example how to define own KPIs see [4].

The result of a KPIs calculation is shown in the KPI Generator View.

These calculated KPIs can be exported to a CSV file and are shown in the KPI Export Result View.

What KPI data should be exported and how the data should be formatted is described in another XML file usually named `KPIExport.xml`. For example Calculation of aver-

ages, minimum, maximum over sessions and the whole measurement are possible in the export.

A basic definition file is delivered with the R&S ROMES4 installation for exporting common KPIs.

However, applying an own modified KPI definition file is only possible if the option ROMES4KPI has been ordered.

This basic export definition file can be found usually at
`[RomesAppliciationData]\configuration\ KPIExport.xml`

This documentation will describe all the parameter used by a KPI export definition and may help to configure the export to the user's needs.

9.1.1.1 References

[1] Chapter 9.3, "Trigger point definitions", on page 2243

[2] `KPIExport.xml`

[3] `KPI.xml`

[4] Chapter 9.2, "KPI definition - how to define a KPI", on page 2239

9.1.2 KPI definition file

This document defines the format of the XML file, which is responsible for the generation of the KPIs in the KPI Generator.

Trigger points generated by the R&S ROMES4 software are used to calculate KPIs.

Whenever a trigger point appears, the KPI generator checks in the definition if this trigger point is part of any defined KPI. If so, either a KPI will be initiated (started) or a KPI will be finished (stop TP or error TP).

As the definition of the KPI is written in the `KPI.xml` file, the user has the possibility to change either the start and stop trigger points for a wanted KPI or he may invent or strip off the KPI list to his needs. However, applying an own modified KPI definition file is only possible if the KPI Generator option ID is available.

NOTICE

All tags, attributes and values are case sensitive! Wrong or not specified tags and attributes may lead to an error message. As a result of an error the KPI generator functionality may be declined.

9.1.2.1 File specification

Main tag

The complete XML file has to be enclosed into the tag <kpi_generator>.

Example:

```
<kpi_generator>
.....
</kpi_generator>
```

Triggerpoint definition

The tag <triggerpoint> allows the user to specify all the trigger points which may be used for generating KPIs. Trigger points are generated by several modules in the R&S ROMES4 software, for example, from DQA, SQA and the L3 messages from GSM, UMTS, and another RATs. Each trigger point has an unique ID, all IDs are defined at [1]. These 64 bit trigger point IDs are used as follows:

Attribute	Allowed Values	Description
name	String, default “”	Name of the triggerpoint [1]
id	Integer, default -1	ID of triggerpoint, a 64bit ID [1]

Both attributes are not mandatory, but it makes no sense to define a trigger point without an unique ID and a characteristic name.

Example:

```
<triggerpoint name="GMM ATTACH REQUEST" id="0x000008010018044C"></triggerpoint>
<triggerpoint name="FTP login request" id="0x00002107050408A6"></triggerpoint>
```

Having many trigger points defined but using only few of them for KPI calculation does not matter. Also order of trigger points and KPIs is not important.

KPI

The tag <kpi> specifies a KPI definition.

It describes the type of KPI and its behaviour in a certain situation. Important info is what trigger point in which role leads to initiate a KPI (role="start") or finishes a KPI (role="stop" or role="error").

A special KPI which updates periodically its value can be achieved via the type=”SPECIAL” in combination with trigger point role=”periodic”. Whenever this periodic trigger point appears, the KPI is finished.

Some pre conditions and post actions give more power and flexibility to the system.

Example:

```
<kpi name="Attach Setup Time" id="0201" type="DURATION" unit="ms"
timeout="15000" session="true" reinitiate="false">
    <triggerpoint role="start" id="0x000008010018044C"></triggerpoint>
```

```
    <triggerpoint role="stop" id="0x010008020018044C"></triggerpoint>
    <triggerpoint role="error" id="0x010008040018044C"></triggerpoint>
</kpi>
```

Attribute	Allowed Values	Description
name	String default ""	Name of the KPI, editable, is used later to display this text
id	Integer default -1	ID of KPI, a unique number, editable, is used to identify the KPI. Should be a unique number over all KPI ids.
type	RATE	The result of the KPI is the ratio of (v2-v1)/(t2-t1), where v is value, t is timestamp given with the TP start and TP stop.
	DURATION default	Duration in ms between occurrence of TP start until TP stop
	BOOLEAN	The occurrence of the TP stop leads to a success (true) result, while a TP error or a timeout leads to a failed (false) result.
	NEG_BOOLEAN	Inverse to BOOLEAN
	SPECIAL	The result is the value of the given trigger point. Needs a TP in role= “periodic”
	SINGLE	A single trigger point generates a KPI.
timeout	Integer default -1	Timeout in ms. If a KPI was started and the time has elapsed without any occurrence of a TP in the role stop or error, the KPI is finished by timeout. -1 if no timeout applied
session	bool default false	A KPI can depend on a session or not. If a KPI depends on a session, it will be calculated only, if a session is open. During a session only generic TP or TPs belonging to the session will be accepted. A session can be opened by initiating a CS call or by DQA connect.
unit	String default ""	Unit of the KPI result if type=”BOOLEAN” or “NEG_BOOLEAN” a unit=”%” results in 0..100%, a unit=”” results in Failed/Ok

Attribute	Allowed Values	Description
reinitiate	bool default false	Allows reinitiating a KPI or not If it is not allowed, a 2nd start TP for this pending KPI is ignored or leads to a KPI finished by timeout. If it is allowed, a 2nd start TP for this pending KPI finishes this KPI by an error TP and initiates a new KPI.
action	none default	Action is only possible if type=”BOOLEAN” or “NEG_BOOLEAN” perform no action
	closeSession	close Session if KPI is finished
	closeSessionOnFailure	close session if KPI is finished by error TP
	closeSessionOnSuccess	close session if KPI is finished by stop TP
alias	Text, Default empty	Alias text for the KPI values, only valid with type SPECIAL, The format is as follows: (value,Text) (value,Text) (value,Text) e.g. alias="(0|Good)(1|Blocked)(2|Dropped)(3|No Service)"

Both attributes name and id are not mandatory, but it makes no sense to define a KPI without a unique ID and a characteristic name.

Triggerpoint role

Important and mandatory are the trigger points which initiate and finish a KPI. For that the trigger points must be named and must have a certain role.

A trigger point in the role start initiates a KPI.

A trigger point in the role stop finishes a KPI.

A trigger point in the role error finishes a KPI in a negative way.

A trigger point in the role=”periodic” in combination with type=”SPECIAL” gives the possibility to update the value of a certain KPI periodically.

Attribute	Allowed Values	Description
role	start	TP which initiates a KPI
	stop	TP which initiates a KPI
	error	TP which finishes a KPI in a negative way

Attribute	Allowed Values	Description
role	periodic	If type=”SPECIAL” TP leads immediately to a KPI
id	integer	ID of triggerpoint, a 64bit ID[1]

Rules:

Only one triggerpoint role=”start” is allowed, many (at least one) role=”stop” may be used, triggerpoint role=”error” is optional, many roles=”error” may happen.

The first stop trigger point or error trigger point which occurs finishes the KPI.

Alternatively one triggerpoint role=”periodic” may happen.

Preconditions

If the calculation of a KPI depends on former KPIs, the tag `<preconditions>` can be used. It holds `0..N <precondition>`.

Example:

```
<preconditions>
    <precondition id="0200" result="false" optional="true"></precondition>
    <precondition id="0202" result="false"></precondition>
</preconditions>
```

A KPI is only calculated if the KPI’s result (identified by precondition id) of all preconditions is fulfilled.

Precondition

All preconditions must be fulfilled to calculate the KPI.

A precondition is fulfilled if a KPI with this id has the wanted result.

A precondition must be fulfilled if optional=”false” or optional=”” attribute is not present.

If a precondition is optional=”true”, its existence is not mandatory, that means if the KPI is not existent, the precondition is fulfilled. But if the KPI is existent, the precondition result will be taken into account.

Attribute	Allowed Values	Description
id	Integer default -1	ID of KPI, an unique number
result	bool default true	expected result to fulfill precondition
optional	bool default false	Denotes if this precondition is optional or mandatory

Take care that the ID of KPI used for precondition is existent. Otherwise an error message comes up.

A precondition makes only sense if the KPI used for precondition is type=”BOOLEAN” or “NEG_BOOLEAN”. Otherwise an error message comes up.

9.1.3 KPI export definition file

This document defines the format of the XML file, which is responsible for the layout of the KPI export tables.

NOTICE

All tags, attributes and values are case sensitive! Wrong or not specified tags and attributes may lead to an error message. As a result of an error the KPI export functionality may be declined.

9.1.3.1 File specification

Main tag

The complete XML file has to be enclosed into the tag `<kpi_export>`.

Example:

```
<kpi_export>
.....
</kpi_export>
```

Export configuration

The tag `<configuration>`allows the user to specify some general settings.

Attribute	Allowed Values	Description
cell_delimeter	Any character	The character which separates the cells
decimal_delimeter	, or .	The delimeter of decimal numbers

Example:

```
<configuration cell_delimiter=";" decimal_delimiter=","></configuration>
```

Table

The tag `<table>`specifies a table object.

Example:

```
<table>
...
</table>
```

Row

The tag <row>specifies a row object within a table object.

It is mandatory to have both row types "header" and "sessions" in a table.

A header must consist of a

```
<row type="header">
        <cell type="TEXT" value="My Header"></cell>
</row>
```

with one column which denotes the main headline.

And it must consist of a

```
<row type="header">
    <cell type="TEXT" value="Session"></cell>
    <cell type="TEXT" value="Timestamp"></cell>
    <cell type="KPINAME" value="0300" subtype="AVG"></cell>
    ...
</row>
```

with multiple columns which denotes the headlines for each column.

Optional empty lines may be inserted and will be seen only if exported to a file.

```
<row type="header"></row>        <!-- an empty line for export to a file -->
```

Attribute	Allowed Values	Description
type	header	This will be printed once and is used for headlines or comments. Only cells of the types TEXT, KPI-NAME are allowed.
	session	This row will be printed N times for each session. N is the number of sessions [3]. Only cells of the types SESSION, KPI are allowed.

Example using <row type="header">:

```
<table>
    <row type="header">
        <cell type="TEXT" value="MyHeader"/>
    </row>
    <row type="header"/> <!-- an empty line for export to a file -->
    <row tpye="header">
        <cell type="TEXT" value="Session"/>
        <cell type="TEXT" value="TimeStamp"/>
        <cell type="KPINAME" value="0300" subtype="AVG"/>
        <!-- print name of KPI ID 300 and append text "AVG" -->
        ...
    </row>

    <row type="sessions">
```

```
    ...
    </row>
</table>
```

Cell

The cell tag <cell>and its object define the content of the table.

Attribute	Allowed Values	Description
type	TEXT	Fixed text.
	KPINAME	Name of a KPI [3], value define the ID of the KPI
	KPI	The result of the KPI.
	SESSION	Properties of the session will be printed, see subtype
value	Depends on type	
type="KPINAME" type="KPI" type="META"	Integer	IDof KPI [3]
type="TEXT"	String	String which has to be printed
type="SESSION"	String	ID of session
subtype	Depends on type	
type="SESSION"	ID	ID of session
type="KPINAME"	AVG	(AVG) will be appended to the KPIs name.
	MIN	(MIN) will be appended to the KPIs name.
	MAX	(MAX) will be appended to the KPIs name.
	SUM	(SUM) will be appended to the KPIs name.
	COUNT	(COUNT) will be appended to the KPIs name.
	AVG_PER_SESSION	(AVG-S) will be appended to the KPIs name.
	MIN_PER_SESSION	(MIN-S) will be appended to the KPIs name.
	MAX_PER_SESSION	(MAX-S) will be appended to the KPIs name.
	SUM_PER_SESSION	(SUM-S) will be appended to the KPIs name.
	COUNT_PER_SESSION	(COUNT-S) will be appended to the KPIs name.

Attribute	Allowed Values	Description
type="KPI"	META	META data [1] will be displayed
	AVG	The cell will be filled with the cumulative average of the KPI value over all sessions. Only allowed in rows with type=”session”
	MIN	The cell will be filled with the cumulative minimum of the KPI value over all sessions. Only allowed in rows with type=”session”
	MAX	The cell will be filled with the cumulative maximum of the KPI value over all sessions. Only allowed in rows with type=”session”
	SUM	The cell will be filled with the sum of the KPI values over all sessions. Only allowed in rows with type=”session”
	COUNT	The cell will be filled with the number of KPI values over all sessions. Only allowed in rows with type=”session”
	AVG_PER_SESSION	The cell will be filled with the cumulative average of the KPI values over one session. Only allowed in rows with type=”session”
	MIN_PER_SESSION	The cell will be filled with the cumulative minimum of the KPI values over one session. Only allowed in rows with type=”session”
	MAX_PER_SESSION	The cell will be filled with the cumulative maximum of the KPI values over one session. Only allowed in rows with type=”session”
	SUM_PER_SESSION	The cell will be filled with the sum of the KPI values over one session. Only allowed in rows with type=”session”
	COUNT_PER_SESSION	The cell will be filled with the number of KPI values over one session. Only allowed in rows with type=”session”
	TIMESTAMP_START	The timestamp of the start trigger point will be printed. The timestamp is given in milliseconds from the start of the measurement.

Attribute	Allowed Values	Description
	SESSION_ID	Associated Session ID of the KPI, if applicable
key	String	META data key e.g. URL, File-Name, … see [1].
precision	Integer	Precision of the calculated value
average_mode	String	Average mode for subtype AVG and AVG_PER_SESSION Values: • sample_based (default): average will be calculated by the sum of the sample value divided by the number of samples • time_based: average will be calculated be the sum of the product of DeltaValue*Delta-Time, between two trigger points divided by DeltaTime between the last and the first trigger point.

Example using `<row type="sessions">`:

```
<table>
    ...
    <row type="sessions">
        <cell type="SESSION" subtype="ID"/>
        <cell type="KPI" subtype="TIMESTAMP_START" value="200"/>
        <cell type="KPI" value="200"/>
        <cell type="KPI" value="201"/>
        <cell type="KPI" value="202"/>
        <cell type="KPI" value="203"/>
        <cell type="KPI" value="204"/>
        <cell type="KPI" subtype="AVG" value="0201" precision="1"/>
        <cell type="KPI" subtype="AVG" value="0203" precision="1"/>
    </row>
</table>
```

9.2 KPI definition - how to define a KPI

A KPI (key performance indicator) is a kind of performance measurement. Usually a start trigger point initializes a KPI while a stop trigger point finishes that KPI.

To define a proper KPI, it must be clear what trigger points meet the requirements. Each trigger point has at least a timestamp and a kind of value which depends on the kind of trigger point.

Easily durations can be calculated by timestamp[stop] - timestamp[start]. Or rates which are calculated by value[stop] - value[start] / duration. Also if the pure appearance of a trigger point signals success or error it can be used to signal a boolean result (true or false).

Next consideration is what kind of result the KPI should have. Some pre conditions and post actions give more power and flexibility to the system.

- References....2240
- Example: defining trigger points....2240
- Example: defining a KPI definition....2241

9.2.1 References

[1] Chapter 9.3, "Trigger point definitions", on page 2243

[2] Chapter 9.1, "KPI definition file and KPI export definition file", on page 2229

[3] `KPI.xml`

9.2.2 Example: defining trigger points

For example, we want to define a KPI which signals the success of a GSM HAND-OVER.

The initiation of a GSM handover is signaled by the L3 command RR HANDOVER COMMAND.

It is sent by the network to the mobile and will be answered from the mobile by either RR HANDOVER COMPLETE or if failed with RR HANDOVER FAILED.

As all L3 and RRC messages lead to a trigger point we can use this for KPI calculation.

First we must define a trigger point in `KPI.xml`. According to [2] the syntax is

```
<triggerpoint name="String of TP" id="ID of trigger point"/>
```

Parameter	Description
String of TP	An editable name which is used later to display this text.
ID of trigger point	A characteristic number which is unique in the whole system. It is a 64bit ID, see [1] for how to build that ID.

For a GSM Trigger point we need to have a look into the 3GPP specification TS 4.018 ch. 9.1 and ch. 10.4. It shows that the protocol discriminator of RR Radio Resource is 0x06 and the message type of HANDOVER COMMAND is 0x2B.

Further we know that HANDOVER COMMAND is a GSM L3 message (0x03) and comes in downlink.

As described in [1], the 64bit ID is build of:

Bytes 1 – 2	(the least significant byte) has always the value 0x044C, built by the frame number.
Byte 3	built by the frame record number, in this case 0x03 for GSM L3 message.

Byte 4:	CS data call, 0x10
Bytes 5 – 6:	Message ID built from Transaction identifier, protocol discriminator and message type - in our case 0x062B
Byte 7:	not used, always 0x00
Byte 8:	The lowest bit is set for data downlink or uplink direction. In our case set to 0x01 for downlink direction

This results in the 64bit trigger point ID 0x01 00 062B 00 03 044C which is unique for GSM HANDOVER COMMAND

Put that info into the xml format:

```
<triggerpoint name="GSM HANDOVER COMMAND"
id="0x0100062B0003044C" />
```

NOTICE

All tags, attributes and values are cas sensitive! Wrong or not specified tags and attributes may lead to an error message.

Similar to GSM HANDOVER COMMAND the 64bit IDs for the stop trigger points are:

```
<triggerpoint name="GSM HANDOVER COMPLETE"
id="0x0000062C0003044C" />
```

```
<triggerpoint name="GSM HANDOVER FAILED"
id="0x000006280003044C" />
```

Please note that both come in uplink direction (0x00) and the message IDs thus are different.

Write these xml tags into the file `KPI.xml`.

9.2.3 Example: defining a KPI definition

Next step in our example is defining a KPI which signals the success of a GSM HANDOVER.

A typical KPI definition is:

```
<kpi name=" String of KPI " id=" ID of KPI " timeout="5000" type="BOOLEAN">
    <triggerpoint role="start" id=" ID of trigger point "></triggerpoint>
    <triggerpoint role="stop" id=" ID of trigger point "></triggerpoint>
    <triggerpoint role="error" id=" ID of trigger point "></triggerpoint>
</kpi>
```

A KPI definition is enclosed by the tag `<kpi>`.

Parameter	Description
String of KPI	An editable name which is used later to display this text.
ID of KPI	An editable number which is used to identify the KPI. It should be a unique number over all KPI IDs.
timeout="5000"	Specifies the time in ms when a KPI is assumed to be timed out. If a KPI was started and the time has elapsed without any occurrence of a trigger point in the role stop or error, the KPI is finished by timeout. If the duration between start and stop can not be estimated and therefore no timeout makes sense, either timeout="-1" or no timeout="" statement (default -1) suppress the time out check.
notimeout=""	The statement (default -1) suppress the time out check.
type=""	Specifies how and what KPI result should be calculated. Some key words are possible, see [2].
type="BOOLEAN"	Specifies that the occurrence of the trigger point in the role stop leads to a success result, while a trigger point in the role error or a timeout leads to a failed result.

Some more attributes not named here specify some pre conditions and post actions and give more power and flexibility to the system.

Important and mandatory are the trigger points which initiate and finish a KPI. For that the trigger points must be named and have a certain role.

A trigger point in the role start initiates a KPI.

A trigger point in the role stop finishes a KPI.

A trigger point in the role error finishes a KPI in a negative way.

A KPI definition needs exactly one start trigger point but may have several stop trigger points or error trigger points. The first stop trigger point or error trigger point which occurs finishes the KPI.

Back to the example:

1. Enter the wanted name and set the ID.
2. Set timeout and type.
3. Enter the 64bit trigger point ID of trigger point GSM HANDOVER COMMAND for the start condition.
4. Enter the 64bit trigger point ID of GSM HANDOVER COMPLETE for the stop condition and the 64bit trigger point ID of GSM HANDOVER FAILED for the error condition

   This info results in the following xml format:

```
<kpi name="GSM Handover Success" id="0001" timeout="5000" type="BOOLEAN">
    <triggerpoint role="start" id="0x0100062B0003044C"></triggerpoint>
    <triggerpoint role="stop" id="0x0000062C0003044C"></triggerpoint>
    <triggerpoint role="error" id="0x000006280003044C"></triggerpoint>
</kpi>
```

Write these xml tags into the file `KPI.xml`

9.2.3.1 Functionality

Whenever a trigger point with the id 0x0100062B0003044C (which signals GSM HANDOVER COMMAND) occurs, a KPI will be initiated.

- If within 5000ms a trigger point with the id 0x0000062C0003044C occurs, the KPI will be finished with result success (true).
- If within 5000ms a trigger point with the id 0x000006280003044C occurs, the KPI will be finished with result failed (false).
- If no stop or error trigger point occurs within 5000ms, the KPI will be finished with result timeout.

9.3 Trigger point definitions

- 64Bit trigger point IDs....2243
- Trigger point meta data keys....2268
- Value types....2268
- Trigger point description....2269

9.3.1 64Bit trigger point IDs

The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	The phylis frame number
Byte 3:	The record number of the frame
Byte 4 - 8:	Technology specific

9.3.1.1 DQA trigger points

Byte 1 – 3 have always the value 0x0408a6, built by the phylis frame number 2214 and the record number 4 of the frame 2214.

Byte 4:	The Service ID 0x00 Not used 0x01 Not used 0x02 Not used 0x03 Not used 0x04 HTTP 0x05 FTP 0x06 ICMP 0x07 POP3 0x08 SMTP 0x09 Video Streaming 0x0A Service Independent 0x0B IMAP 0x0C not used 0x0D SMS 0x0E not used 0x0F UDP
Byte 5 - 6:	Trigger point identifier
Byte 7:	Service Flags 0x00 Service Link Direction unspecified 0x01 Service Link Direction down 0x02 Service Link Direction up 0x03 Service Link Direction bidirectional (e.g. FTP DL/UL) 0x04 Trigger Point excluded from KPI Calculation, when Service Link Direction unspecified. (FTP Multi Job only) 0x05 Trigger Point excluded from KPI Calculation, when Service Link Direction down. (FTP Multi Job only) Example: 0x01052004050408A6 (TP ID 2004) is not used for KPI Calculation 0x06 Trigger Point excluded from KPI Calculation, when Service Link Direction up. (FTP Multi Job only) Example: 0x00062006050408A6 (TP ID 2006) is not used for KPI Calculation
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

Example: Device sends ATD Command for Connection Request:

```
0x 00 00 1001 0A04 08a6
  8  7  6 5  4 3  2 1 - Byte
```

Device trigger points

Trigger Point Identifier	Description
0x1001	Device sends ATD Command for Connection Request. 64bit ID: 0x 00 00 1001 0A04 08a6
0x1002	Connection completed 64bit ID: 0x 01 00 1002 0A04 08a6
0x1003	Connection failed 64bit ID: 0x 01 00 1003 0A04 08a6
0x1004	Connection HTTP Check Start 64bit ID: 0x 00 00 1004 0A04 08a6
0x1005	Connection HTTP Check Completed 64bit ID: 0x 01 00 1005 0A04 08a6
0x1006	Connection HTTP Check failed 64bit ID: 0x 01 00 1006 0A04 08a6
0x1007	Connection Dialup Completed 64bit ID: 0x 01 00 1007 0A04 08a6
0x1008	Connection Dialup Failed 64bit ID: 0x 01 00 1008 0A04 08a6
0x1009	Connection Dialup was canceled by user 64bit ID: 0x 01 00 1009 0A04 08a6
0x1010	QualiPoc / SQ Andoid Session Started 64bit ID: 0x 01 00 1010 0A04 08a6
0x1011	QualiPoc / SQ Andoid Session Finished 64bit ID: 0x 01 00 1011 0A04 08a6
0x1012	Modem COM port opened 64bit ID: 0x 00 00 1012 0A04 08a6
0x1013	CS Connection Request 64bit ID: 0x 00 00 1013 0A04 08a6
0x1014	CS Connection Completed 64bit ID: 0x 00 00 1014 0A04 08a6
0x1015	CS Connection Failed 64bit ID: 0x 00 00 1015 0A04 08a6
0x1016	Circuit 109 ON 64bit ID: 0x 00 00 1016 0A04 08a6
0x1017	Circuit 109 OFF 64bit ID: 0x 00 00 1017 0A04 08a6
0x1101	Disconnect Start 64bit ID: 0x 00 00 1101 0A04 08a6

Trigger Point Identifier	Description
0x1102	Disconnect Completed 64bit ID: 0x 01 00 1102 0A04 08a6
0x1103	Disconnect Failed 64bit ID: 0x 01 00 1103 0A04 08a6
0x1201	CS Call Connection Loss 64bit ID: 0x 00 00 1201 0A04 08a6

Service application trigger points

Trigger Point Identifier	Description
0x2001	Service Socket Connect Request 64bit ID for HTTP: 0x 00 01 2001 0404 08a6 64bit ID for FTP DL: 0x 00 01 2001 0504 08a6 64bit ID for POP3: 0x 00 01 2001 0704 08a6 64bit ID for IMAP: 0x 00 01 2001 0B04 08a6 64bit ID for UDP DL: 0x 00 01 2001 0F04 08a6 64bit ID for HTTP: 0x 00 02 2001 0404 08a6 64bit ID for FTP UL: 0x 00 02 2001 0504 08a6 64bit ID for SMTP: 0x 00 02 2001 0804 08a6 64bit ID for UDP UL: 0x 00 02 2001 0F04 08a6
0x2002	Service Socket Connect Completed 64bit ID for HTTP: 0x 01 01 2002 0404 08a6 64bit ID for FTP DL: 0x 01 01 2002 0504 08a6 64bit ID for POP3: 0x 01 01 2002 0704 08a6 64bit ID for IMAP: 0x 01 01 2002 0B04 08a6 64bit ID for FTP DL: 0x 01 01 2002 0F04 08a6 64bit ID for HTTP UL: 0x 01 02 2002 0404 08a6 64bit ID for FTP UL: 0x 01 02 2002 0504 08a6 64bit ID for SMTP: 0x 01 02 2002 0804 08a6 64bit ID for UDP UL: 0x 01 02 2002 0F04 08a6
0x2003	Service Socket Connect Failed 64bit ID for HTTP: 0x 01 01 2003 0404 08a6 64bit ID for FTP DL 0x 01 01 2003 0504 08a6 64bit ID for POP3: 0x 01 01 2003 0704 08a6 64bit ID for IMAP: 0x 01 01 2003 0B04 08a6 64bit ID for UDP DL: 0x 01 01 2003 0F04 08a6 64bit ID for HTTP UL: 0x 01 02 2003 0404 08a6 64bit ID for FTP UL: 0x 01 02 2003 0504 08a6 64bit ID for SMTP: 0x 01 02 2003 0804 08a6 64bit ID for UDP UL: 0x 01 02 2003 0F04 08a6

Trigger Point Identifier	Description
0x2004	Service receives the first data packet containing content on the data socket. 64bit ID for HTTP: 0x 01 01 2004 0404 08a6 64bit ID for FTP DL 0x 01 01 2004 0504 08a6 64bit ID for POP3: 0x 01 01 2004 0704 08a6 64bit ID for IMAP: 0x 01 01 2004 0B04 08a6 64bit ID for UDP DL: 0x 01 01 2004 0F04 08a6 64bit ID for HTTP UL, FTP UL, SMTP, UDP UL: n.a.
0x2005	Service Timeout while receiving the data packet containing content on the data socket 64bit ID for HTTP: 0x 01 01 2005 0404 08a6 64bit ID for FTP DL 0x 01 01 2005 0504 08a6 64bit ID for POP3: 0x 01 01 2005 0704 08a6 64bit ID for IMAP: 0x 01 01 2005 0B04 08a6 64bit ID for UDP DL: 0x 01 01 2005 0F04 08a6 64bit ID for HTTP UL, FTP UL, SMTP, UDP UL: n.a.
0x2006	Service sends the first data packet containing content on the data socket 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL: n.a. 64bit ID for HTTP UL: 0x 01 02 2006 0404 08a6 64bit ID for FTP UL: 0x 01 02 2006 0504 08a6 64bit ID for SMTP: 0x 01 02 2006 0804 08a6 64bit ID for UDP UL: 0x 01 02 2006 0F04 08a6
0x2007	Service failure while sending the first data packet containing content on the data socket 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL: n.a. 64bit ID for HTTP UL: 0x 01 02 2007 0404 08a6 64bit ID for FTP UL: 0x 01 02 2007 0504 08a6 64bit ID for SMTP: 0x 01 02 2007 0804 08a6 64bit ID for UDP UL: 0x 01 02 2007 0F04 08a6
0x2008	Service receives the last data packet containing content on the data socket 64bit ID for HTTP: 0x 01 01 2008 0404 08a6 64bit ID for FTP DL: 0x 01 01 2008 0504 08a6 64bit ID for POP3: 0x 01 01 2008 0704 08a6 64bit ID for IMAP: 0x 01 01 2008 0B04 08a6 64bit ID for UDP DL: 0x 01 01 2008 0F04 08a6 64bit ID for HTTP UL, FTP UL, SMTP, UDP UL: n.a.

Trigger Point Identifier	Description
0x2009	Service didn't receive the last data packet containing content on the data socket 64bit ID for HTTP: 0x 01 01 2009 0404 08a6 64bit ID for FTP DL 0x 01 01 2009 0504 08a6 64bit ID for POP3: 0x 01 01 2009 0704 08a6 64bit ID for IMAP: 0x 01 01 2009 0B04 08a6 64bit ID for UDP DL: 0x 01 01 2009 0F04 08a6 64bit ID for HTTP UL, FTP UL, SMTP, UDP UL: n.a.
0x2010	Service did send the last data packet containing content on the data socket 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL: n.a. 64bit ID for HTTP UL: 0x 01 02 2010 0404 08a6 64bit ID for FTP UL: 0x 01 02 2010 0504 08a6 64bit ID for SMTP: 0x 01 02 2010 0804 08a6 64bit ID for UDP UL: 0x 01 02 2010 0F04 08a6
0x2011	Service didn't send the last data packet containing content on the data socket 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL: n.a. 64bit ID for HTTP UL: 0x 01 02 2011 0404 08a6 64bit ID for FTP UL: 0x 01 02 2011 0504 08a6 64bit ID for SMTP: 0x 01 02 2011 0804 08a6 64bit ID for UDP UL: 0x 01 02 2011 0F04 08a6
0x2012	Service sends DNS Request 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL, Ping: 0x 00 01 2012 0A04 08a6 64bit ID for FTP UL, SMTP, UDP UL: 0x 00 02 2012 0A04 08a6
0x2013	Service receives a Host Address from a DNS Request 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL, Ping: 0x 01 01 2013 0A04 08a6 64bit ID for HTTP UL, FTP UL, SMTP, UDP UL: 0x 01 02 2013 0A04 08a6
0x2014	Service didn't receive a Host Address from a DNS Request 64bit ID for FTP DL, POP3, IMAP, HTTP, UDP DL, Ping: 0x 01 01 2014 0A04 08a6 64bit ID for HTTP UL, FTP UL, SMTP, UDP UL: 0x 01 02 2014 0A04 08a6

Trigger Point Identifier	Description
0x2101	FTP Service started 64bit ID for FTP DL: 0x 00 01 2101 0504 08a6 64bit ID for FTP UL: 0x 00 02 2101 0504 08a6
0x2102	FTP Service stopped successfully 64bit ID for FTP DL: 0x 01 01 2102 0504 08a6 64bit ID for FTP UL: 0x 01 02 2102 0504 08a6
0x2103	FTP Service failed 64bit ID for FTP DL: 0x 01 01 2103 0504 08a6 64bit ID for FTP UL: 0x 01 02 2103 0504 08a6
0x2104	FTP Control Socket Connect Request 64bit ID for FTP DL: 0x 00 01 2104 0504 08a6 64bit ID for FTP UL: 0x 00 02 2104 0504 08a6
0x2105	FTP Control Socket Connect Completed 64bit ID for FTP DL: 0x 01 01 2105 0504 08a6 64bit ID for FTP UL: 0x 01 02 2105 0504 08a6
0x2106	FTP Control Socket Connect Failed 64bit ID for FTP DL: 0x 01 01 2106 0504 08a6 64bit ID for FTP UL: 0x 01 02 2106 0504 08a6
0x2107	FTP Login Request 64bit ID: 0x 00 00 2107 0504 08a6
0x2108	FTP Login Success 64bit ID: 0x 01 00 2108 0504 08a6
0x2109	FTP Login Failure 64bit ID: 0x 01 00 2109 0504 08a6
0x2110	FTP Send List Command 64bit ID for FTP DL: 0x 00 01 2110 0504 08a6 64bit ID for FTP UL: n.a.
0x2111	FTP Reception of Directory List succeeded 64bit ID for FTP DL: 0x 01 01 2111 0504 08a6 64bit ID for FTP UL: n.a.
0x2112	FTP Reception Directory List failed 64bit ID for FTP DL: 0x 01 01 2112 0504 08a6 64bit ID for FTP UL: n.a.
0x2113	FTP Logout Request 64bit ID: 0x 00 00 2113 0504 08a6
0x2114	FTP Logout Completed 64bit ID: 0x 01 00 2114 0504 08a6
0x2115	FTP Parallel Download Transfer started 64bit ID: 0x 01 01 2115 0504 08a6

Trigger Point Identifier	Description
0x2116	FTP Parallel Download Transfer succeeded 64bit ID: 0x 01 01 2116 0504 08a6
0x2117	FTP Parallel Download Transfer failed 64bit ID: 0x 01 01 2117 0504 08a6
0x2118	FTP Parallel Upload Transfer started 64bit ID: 0x 00 02 2118 0504 08a6
0x2119	FTP Parallel Upload Transfer succeeded 64bit ID: 0x 01 02 2119 0504 08a6
0x2120	FTP Parallel Upload Transfer failed 64bit ID: 0x 01 02 2120 0504 08a6
0x2201	Ping Sequence Start 64bit ID: 0x 00 01 2201 0604 08a6
0x2202	Ping Sequence Stop 64bit ID: 0x 01 01 2202 0604 08a6
0x2203	ICMP Echo Request. 64bit ID: 0x 00 01 2203 0604 08a6
0x2204	ICMP Echo Reply 64bit ID: 0x 01 01 2204 0604 08a6
0x2205	ICMP Echo Reply Failure 64bit ID: 0x 01 01 2205 0604 08a6
0x2301	HTTP Service Start 64bit ID: 0x 00 01 2301 0404 08a6
0x2302	HTTP Service Stop 64bit ID: 0x 01 01 2302 0404 08a6
0x2303	HTTP sends the first GET command 64bit ID: 0x 00 01 2303 0404 08a6
0x2304	HTTP Object Request 64bit ID: 0x 00 01 2304 0404 08a6
0x2305	HTTP Object Received 64bit ID: 0x 01 01 2305 0404 08a6
0x2306	HTTP Object Error 64bit ID: 0x 01 01 2306 0404 08a6
0x2307	HTTP Send PUT / POST command 64bit ID: 0x 00 02 2307 0404 08a6
0x2308	HTTP Send PUT / POST command failed 64bit ID: 0x 01 02 2308 0404 08a6
0x2309	HTTP Send PUT / POST command succeeded 64bit ID: 0x 01 02 2309 0404 08a6

Trigger Point Identifier	Description
0x2311	WEB 2.0 Action Start 64bit ID: 0x 00 01 2311 0404 08a6
0x2312	WEB 2.0 Action Completed 64bit ID: 0x 01 01 2312 0404 08a6
0x2313	WEB 2.0 Action Failed 64bit ID: 0x 01 01 2313 0404 08a6
0x2321	HTTP Capacity Test start 64bit ID for DL: 0x 00 01 2321 0404 08a6 64bit ID for UL: 0x 00 02 2321 0404 08a6 64bit ID for DL/UL: 0x 00 03 2321 0404 08a6
0x2322	HTTP Capacity Test (DL, UL, DL/UL) complete 64bit ID for DL: 0x 01 01 2322 0404 08a6 64bit ID for UL: 0x 01 02 2322 0404 08a6 64bit ID for DL/UL: 0x 01 03 2322 0404 08a6
0x2401	SMTP Service Start 64bit ID: 0x 00 02 2401 0804 08a6
0x2402	SMTP Service succeeded 64bit ID: 0x 01 02 2402 0804 08a6
0x2403	SMTP Service failed 64bit ID: 0x 01 02 2403 0804 08a6
0x2404	SMTP Authentication Request 64bit ID: 0x 00 02 2404 0804 08a6
0x2405	SMTP Authentication Success 64bit ID: 0x 01 02 2405 0804 08a6
0x2406	SMTP Authentication Failure 64bit ID: 0x 01 02 2406 0804 08a6
0x2407	Reception of the SMTP Reply Code 250 for the HELO command 64bit ID: 0x 01 02 2407 0804 08a6
0x2408	Reception of the SMTP Reply Code 250 for the HELO command failed 64bit ID: 0x 01 02 2408 0804 08a6
0x2409	Sending the SMTP MAIL FROM command 64bit ID: 0x 00 02 2409 0004 08a6
0x2410	Reception of the SMTP Reply Code 250 for the EOM command 64bit ID: 0x 01 02 2410 0804 08a6
0x2411	Reception of the SMTP Reply Code 250 for the EOM command failed 64bit ID: 0x 01 02 2411 0804 08a6

Trigger Point Identifier	Description
0x2501	POP3 Service Start 64bit ID: 0x 00 01 2501 0704 08a6
0x2502	POP3 Service succeeded 64bit ID: 0x 01 01 2502 0704 08a6
0x2503	POP3 Service failed 64bit ID: 0x 01 01 2503 0704 08a6
0x2504	POP3 Authentication Request 64bit ID: 0x 00 01 2504 0704 08a6
0x2505	POP3 Authentication Success 64bit ID: 0x 01 01 2505 0704 08a6
0x2506	POP3 Authentication Failure 64bit ID: 0x 01 01 2506 0704 08a6
0x2507	Sending the POP3 RETR command 64bit ID: 0x 00 01 2507 0704 08a6
0x2601	IMAP Service Start 64bit ID: 0x 00 01 2601 0B04 08a6
0x2602	IMAP Service succeeded 64bit ID: 0x 01 01 2602 0B04 08a6
0x2603	IMAP Service failed 64bit ID: 0x 01 01 2603 0B04 08a6
0x2604	IMAP Authentication Request 64bit ID: 0x 00 01 2604 0B04 08a6
0x2605	IMAP Authentication Success 64bit ID: 0x 01 01 2605 0B04 08a6
0x2606	IMAP Authentication Failure 64bit ID: 0x 01 01 2606 0B04 08a6
0x2607	Sending the IMAP FETCH command 64bit ID: 0x 00 01 2607 0B04 08a6
0x2608	Reception of the IMAP FETCH OK response 64bit ID: 0x 01 01 2608 0B04 08a6
0x2609	Reception of the IMAP FETCH OK response failed 64bit ID: 0x 01 01 2609 0B04 08a6
0x2801	VLC Streaming Start 64bit ID: 0x 00 01 2801 0904 08a6
0x2802	VLC Streaming succeeded 64bit ID: 0x 01 01 2801 0904 08a6
0x2803	VLC Streaming failed 64bit ID: 0x 01 01 2803 0904 08a6

Trigger Point Identifier	Description
0x2804	VLC Stream Open Start 64bit ID: 0x 00 01 2804 0904 08a6
0x2805	VLC Stream Open succeeded 64bit ID: 0x 01 01 2805 0904 08a6
0x2806	VLC Stream Open failed 64bit ID: 0x 01 01 2806 0904 08a6
0x2807	VLC Stream Playing Start 64bit ID: 0x 00 01 2807 0904 08a6
0x2808	VLC Stream Playing succeeded 64bit ID: 0x 01 01 2808 0904 08a6
0x2809	VLC Stream Playing failed 64bit ID: 0x 01 01 2809 0904 08a6
0x2810	VLC Stream Reproduction Cut Off Ratio 64bit ID: 0x 01 01 2810 0904 08a6
0x5101	Point of time the customer sends his SMS to the SMS Centre 64bit ID: 0x 00 02 5101 0D04 08a6
0x5102	Point of time the mobile equipment receives the confirmation from the SMS Centre 64bit ID: 0x 01 02 5102 0D04 08a6
0x5103	The mobile equipment did not receive the confirmation from the SMS Centre 64bit ID: 0x 01 02 5103 0D04 08a6

TCP/IP trigger points

The TCP/IP trigger points are only available when the IP Tracer was started.

Trigger Point Identifier	Description
0x3001	Sending the first SYN on data socket 64bit ID for HTTP: 0x 00 01 3001 0404 08a6 64bit ID for FTP DL: 0x 00 01 3001 0504 08a6 64bit ID for POP3: 0x 00 01 3001 0704 08a6 64bit ID for IMAP: 0x 00 01 3001 0B04 08a6 64bit ID for FTP UL: 0x 00 02 3001 0504 08a6 64bit ID for SMTP: 0x 00 02 3001 0804 08a6
0x3002	Reception of the ACK from the SYN/ACK of a Service Data Socket 64bit ID for HTTP: 0x 00 01 3002 0404 08a6 64bit ID for FTP DL: 0x 00 01 3002 0504 08a6 64bit ID for POP3: 0x 00 01 3002 0704 08a6 64bit ID for IMAP: 0x 00 01 3002 0B04 08a6 64bit ID for FTP UL: 0x 00 02 3002 0504 08a6 64bit ID for SMTP: 0x 00 02 3002 0804 08a6
0x3003	Reception of the first Data packet containing content 64bit ID for HTTP: 0x 00 01 3003 0404 08a6 64bit ID for FTP DL: 0x 00 01 3003 0504 08a6 64bit ID for POP3: 0x 00 01 3003 0704 08a6 64bit ID for IMAP: 0x 00 01 3003 0B04 08a6 64bit ID for FTP UL, SMTP: n.a.
0x3004	Sending first Data packet containing content 64bit ID for FTP DL, POP3, IMAP, HTTP: n.a. 64bit ID for FTP UL: 0x 00 02 3004 0504 08a6 64bit ID for SMTP: 0x 00 02 3004 0804 08a6
0x3005	Reception of the last Data packet containing content. 64bit ID for HTTP: 0x 00 01 3005 0404 08a6 64bit ID for FTP DL: 0x 00 01 3005 0504 08a6 64bit ID for POP3: 0x 00 01 3005 0704 08a6 64bit ID for IMAP: 0x 00 01 3005 0B04 08a6 64bit ID for FTP UL, SMTP: n.a.
0x3006	Sent the last Data packet containing content 64bit ID for FTP DL, POP3, IMAP, HTTP: n.a. 64bit ID for FTP UL: 0x 00 02 3006 0504 08a6 64bit ID for SMTP: 0x 00 02 3006 0804 08a6
0x3007	Sending DNS Request 64bit ID for FTP DL, POP3, IMAP, HTTP, Ping: 0x 00 01 3007 0A04 08a6 64bit ID for FTP UL, SMTP: 0x 00 02 3007 0A04 08a6

Trigger Point Identifier	Description
0x3008	Reception of a Host Address from a DNS Request 64bit ID for FTP DL, POP3, IMAP, HTTP, Ping: 0x 01 01 3008 0A04 08a6 64bit ID for FTP UL, SMTP: 0x 01 02 3008 0A04 08a6
0x3009	Reception of a Host Address from a DNS Request failed 64bit ID for FTP DL, POP3, IMAP, HTTP, Ping: 0x 01 01 3009 0A04 08a6 64bit ID for FTP UL, SMTP: 0x 01 02 3009 0A04 08a6
0x3101	Sending the first SYN on FTP control socket 64bit ID for FTP DL: 0x 00 01 3101 0504 08a6 64bit ID for FTP UL: 0x 00 02 3101 0504 08a6
0x3102	Reception of the ACK from the SYN/ACK of a FTP control socket 64bit ID for FTP DL: 0x 01 01 3102 0504 08a6 64bit ID for FTP UL: 0x 01 02 3102 0504 08a6
0x3103	Sending the FTP RETR command 64bit ID for FTP DL: 0x 00 01 3103 0504 08a6 64bit ID for FTP UL: n.a.
0x3104	Sending the FTP STOR command 64bit ID for FTP DL: n.a. 64bit ID for FTP UL: 0x 00 02 3104 0504 08a6
0x3201	Sending an ICMP request 64bit ID: 0x 00 01 3201 0604 08a6
0x3202	Reception of an ICMP Reply 64bit ID: 0x 01 01 3202 0604 08a6
0x3203	Reception of an ICMP reply failed 64bit ID: 0x 01 01 3203 0604 08a6
0x3301	Sending the first HTTP GET command 64bit ID: 0x 00 01 3301 0404 08a6
0x3302	Sending the first HTTP PUT / POST command 64bit ID: 0x 00 02 3302 0404 08a6
0x3401	Sending the SMTP HELO command 64bit ID: 0x 00 02 3401 0804 08a6
0x3402	Reception of the SMTP Reply Code 250 for the HELO command 64bit ID: 0x 01 02 3402 0804 08a6

Trigger Point Identifier	Description
0x3403	Sending the SMTP MAIL FROM command 64bit ID: 0x 00 02 3403 0804 08a6
0x3404	Reception of the SMTP Reply Code 250 for the EOM command 64bit ID: 0x 01 02 3404 0804 08a6
0x3405	Sending the SMTP QUIT command 64bit ID: 0x 00 02 3405 0804 08a6
0x3501	Sending the POP3 RETR command 64bit ID: 0x 00 01 3501 0704 08a6
0x3502	Sending the POP3 QUIT command 64bit ID: 0x 00 01 3502 0704 08a6
0x3601	Sending the IMAP FETCH command 64bit ID: 0x 00 01 3601 0B04 08a6
0x3603	Reception of the IMAP FETCH OK response 64bit ID: 0x 01 01 3603 0B04 08a6

9.3.1.2 SQA trigger points

Byte 1 - 3:	Have always the value 0x0004 08a6, built by the phylis frame number 2214 and the frame record 4.
Byte 4:	Service ID 0x00 Voice Telephony
Byte 5 - 6:	Trigger point identifier.
Byte 7:	Service Flags 0x01 Downlink, values calculated by Local Client 0x02 Uplink, values calculated by Remote Client
Byte 8:	not used. Always 0x00 for uplink, 0x01 for downlink

Example: MOS value calculated by a SQA local client

```
0x 00 01 4001 0004 08a6
    8  7  6 5  4 3  2 1 - Byte
```

Trigger Point Identifier	Description
0x4001	Reception of a MOS Value from the SQA measurement engine 64bit ID for SQA Downlink: 0x 01 01 4001 0004 08a6 64bit ID for SQA Uplink: 0x 01 02 4001 0004 08a6
0x4010	Playback of the set speech sample started at the SQA measurement engine 64bit ID for the SQA Uplink: 0x 01 02 4010 0004 08a6
0x4011	Pause after the speech sample started at the SQA measurement engine 64bit ID for the SQA Uplink: 0x 01 02 4011 0004 08a6

9.3.1.3 GSM/GPRS trigger points

Trigger points from mobile L3 messages are generically built from the L3 message ID. For that the 3GPP mobile radio interface layer 3 specification is needed. See 3GPP TS 24.008 and 3GPP TS 4.018.

Table 9-1: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x044C, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, for example: 0x03 for GSM L3 message 0x18 for GPRS GMM message
Byte 4:	0x10, CS Data Call
Byte 5 - 6:	Message ID build from Transaction identifier, protocol discriminator and message type. See 3GPP TS 24.008 Kap. 10 and 3GPP TS 4.018 Kap. 9.1
Byte 7:	Not used, always 0x00
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

Example: CM service request

This message is sent by the mobile station to the network to request a service for the connection management sublayer entities, e.g. circuit switched connection establishment, supplementary services activation, short message transfer, location services. See 9.2.9/3GPP TS 24.008.

Message type: CM SERVICE REQUEST

Significance: dual

Direction: mobile station to network

```
0x 00 00 0524 0003 044C
    8  7  6 5  4 3  2 1 - Byte
```

More Example:

GSM HANDOVER COMMAND	0x0100062B0003044C
CC ALERTING	0x010003010003044C
GMM ATTACH REQUEST	0x000008010018044C
GMM ATTACH ACCEPTED	0x010008020018044C
SM PDP CONTEXT ACTIVATION REQUEST	0x00000A010018044C

9.3.1.4 Other GSM trigger points

RLC throughput

RLC downlink

Trigger Point ID:	0x0100000000016044C
Value:	Kbit/s
Description:	Point in time; when the GSM device sends a new RLC throughput calculation, the given value was calculated between the trigger point and this.

RLC uplink

Trigger Point ID:	0x0000000000016044C
Value:	Kbit/s
Description:	Point in time, when the GSM device sends a new RLC throughput calculation, the given value was calculated between the trigger point and this.

9.3.1.5 UMTS layer 3 trigger points

Trigger points from UMTS mobile RRC messages are generic built from the RRC message ID.

Table 9-2: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x2134, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, e.g 0x19 for RRC message
Byte 4:	Not used, always 0x00
Byte 5:	Message type/choice. See 3GPP TS 25.331

Byte 6:	Channel type UMTS PDU ID See table below
Byte 7:	Once more the channel type UMTS PDU ID, see the following table.
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

Example: ACTIVE SET UPDATE

This message is used by UTRAN to add, replace or delete radio links in the active set of the UE.

RLC-SAP: AM or UM

Logical channel: DCCH

Direction: UTRAN to UE

From 3GPP TS 25.331

DL-DCCH-MessageType::=CHOICE {

activeSetUpdate ActiveSetUpdate, // 1

assistanceDataDelivery AssistanceDataDelivery, //2

...

```
0x 00 01 0101 0019 2134
  8  7  6 5  4 3  2 1 - Byte
```

More Example:

UL_DCCH activeSetUpdateComplete: 0x0102020100192134

UL_DCCH activeSetUpdateFailure: 0x0102020200192134

UMTS PDU ID	UMTS channel type	UMTS PDU ID	UMTS channel type
0x01	DL DCCH Message PDU	0x20	SysInfoType14 PDU
0x02	UL DCCH Message PDU	0x21	SysInfoType15 PDU
0x03	DL CCCH Message PDU	0x22	SysInfoType15 1 PDU
0x04	UL CCCH Message PDU	0x23	SysInfoType15 2 PDU
0x05	PCCH Message PDU	0x24	SysInfoType15 3 PDU
0x06	DL SHCCH Message PDU	0x25	SysInfoType15 4 PDU
0x07	UL SHCCH Message PDU	0x26	SysInfoType15 5 PDU

UMTS PDU ID	UMTS channel type	UMTS PDU ID	UMTS channel type
0x08	BCCH FACH Message PDU	0x27	SysInfoType16 PDU
0x09	BCCH BCH Message PDU	0x28	SysInfoType17 PDU
0x0A	HandoverToUTRAN-Command PDU	0x29	SysInfoType18 PDU
0x0B	InterRATHandoverInfo PDU	0x2A	SysInfoTypeSB1 PDU
0x0C	RRC FailureInfo PDU	0x2B	SysInfoTypeSB2 PDU
0x0D	UE RadioAccessCapabi-lityInfo PDU	0x2C	TFC Subset ID With3b PDU
0x0E	MasterInformationBlock PDU	0x2D	TFC Subset ID With5b PDU
0x0F	SysInfoType1 PDU	0x2E	TFC Subset ID With10b PDU
0x10	SysInfoType2 PDU	0x2F	ToTargetRNC Container PDU
0x11	SysInfoType3 PDU	0x30	TargetRNC ToSour-ceRNC Container PDU
0x12	SysInfoType4 PDU	0x31	SRNC RelocationInfo v3h0ext IEs PDU
0x13	SysInfoType5 PDU	0x32	DL CCTrChTPCList PDU
0x14	SysInfoType6 PDU	0x33	MCCH Message PDU
0x15	SysInfoType7 PDU	0x34	MSCH Message PDU
0x16	SysInfoType8 PDU	0x35	SysInfoType5bis PDU
0x17	SysInfoType9 PDU	0x36	InterRATHandoverInfo r3 add ext IEs PDU
0x18	SysInfoType10 PDU	0x37	RRCConnectionSetup-Complete r3 add ext IEs PDU
0x19	SysInfoType11 PDU	0x38	UECapabilityInformation r3 add ext IEs PDU
0x1A	SysInfoType12 PDU	0x39	UE CapabilityContainer IEs PDU
0x1B	SysInfoType13 PDU	0x3A	UL PhysChCapabili-tyFDD r6 PDU
0x1C	SysInfoType13 1 PDU	0x3B	Event1b r6 PDU
0x1D	SysInfoType13 2 PDU	0x3C	MBMS PreferredFreqRe-quest r6 PDU
0x1E	SysInfoType13 3 PDU	0x3D	SysInfoType11bis PDU
0x1F	SysInfoType13 4 PDU	0x3E	C RNTI PDU

UMTS PDU ID	UMTS channel type	UMTS PDU ID	UMTS channel type
		0x3F	U RNTI PDU
		0x40	InitialUE Identity PDU
		0x41	V INITIAL UE IDENTITY PDU
		0x42	RB WithPDCP InfoList PDU

9.3.1.6 Other UMTS trigger points

RLC throughput

RLC downlink

Trigger Point ID:	0x01000000005D2134
Value:	Kbit/s
Description:	Point in time; when the UMTS device sends a new RLC throughput calculation, the given value was calculated between the trigger point and this.

RLC uplink

Trigger Point ID:	0x00000000005E2134
Value:	Kbit/s
Description:	Point in time; when the UMTS device sends a new RLC throughput calculation, the given value was calculated between the trigger point and this.

9.3.1.7 LTE RRC trigger points

Trigger points from mobile LTE RRC messages are generic built from the RRC message ID.

Table 9-3: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x2149, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, e.g 0x08 for RRC message
Byte 4:	Not used, always 0x00
Byte 5:	Choice, see 3GPP TS36.331 chapter 6.2.1
Byte 6:	Channel PDU (e.g. UL-DCCH Message,…), see table below

Byte 7:	0x00 for RRC
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

Table 9-4: RRC PDU IDs

PDU ID	PDU
0x01	BCCH BCH
0x02	BCCH DL SCH
0x03	PCCH
0x04	DL CCCH
0x05	DL DCCH
0x06	UL CCCH
0x07	UL DCCH
0x0A	MIB
0x0B	SIB1
0x0C	SIB2
0x0D	SIB3
0x0E	SIB4
0x0F	SIB5
0x10	SIB6
0x11	SIB7
0x12	SIB8
0x13	SIB9
0x14	SIB10
0x15	SIB11
0x1E	PHICH Configuration
0x1F	RACH ConfigCommon
0x23	PUCCH ConfigCommon
0x24	PhysicalCellIdentity
0x25	TDD_Configuration
0x26	RRC_TransactionIdentifier
0x27	UL_AM_RLC
0x28	DL_AM_RLC
0x29	UL_UM_RLC
0x2A	DL_UM_RLC

PDU ID	PDU
0x2B	PDCP_Configuration
0x2C	C_RNTI
0x2D	PUCCH_ConfigDedicated
0x2E	AntennaInformationDedicated
0x2F	MeasGapConfig
0x30	PRACH_Configuration
0x31	AntennaInformationCommon
0x32	RACH_ConfigDedicated
0x33	IntegrityProtAlgorithm
0x34	CipheringAlgorithm
0x35	RRCConnectionInfo_rs
0x36	UE_EUTRA_Capability
0x37	MMEC
0x38	PUSCH_ConfigCommon
0x39	PUSCH_ConfigDedicated
0x40	SoundingRS_UL_ConfigCommon
0x41	DRX_Config
0x42	CQI_ReportConfig
0x43	SoundingRS_UL_ConfigDedicated
0x44	SchedulingRequestConfig
0x45	VarMeasConfig
0x46	UplinkPowerControlCommon
0x47	UplinkPowerControlDedicated
0x48	ARFCN_ValueEUTRA
0x49	PLMN_Identity
0x4A	CellIdentity
0x4B	DRB_Identity
0x4C	CellsTriggeredList
0x4D	VarMeasReportList
0x4E	VarShortMAC_Input

Example:rrcConnectionRequest

Table 9-5: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	0x2149
Byte 3:	0x08 for RRC message
Byte 4:	Not used, always 0x00
Byte 5:	0x02, see 3GPP TS36.331 chapter 6.2.1
Byte 6:	0x06, UL-CCCH
Byte 7:	0x00, RRC
Byte 8:	0x00 for uplink

→0x0000060200082149

9.3.1.8 LTE EPS-NAS trigger points

Trigger points from mobile LTE EPS-NAS messages are generic built from the message ID.

Table 9-6: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x2149, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, e.g 0x08 for EPS-NAS message
Byte 4:	Not used, always 0x00
Byte 5:	Message Type, see 3GPP TS24.301 chapter 9.8
Byte 6:	0x02 for EMM, 0x01 for SM
Byte 7:	Not used, always 0x00
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

Example: TrackingAreaUpdateRequest

Table 9-7: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	0x2149
Byte 3:	0x08 for RRC message
Byte 4:	Not used, always 0x00
Byte 5:	0x48, see 3GPP TS24.301 chapter 9.8
Byte 6:	0x02, EMM
Byte 7:	0x00
Byte 8:	0x00 for uplink

→0x0000024800082149

9.3.1.9 Other LTE trigger points

RLC throughput

RLC downlink

Trigger Point ID:	0x01000000001D2149
Value:	Kbit/s
Description:	Point in time; when the LTE device sends a new RLC throughput calculation, the given value was calculated between the trigger point and this.

RLC uplink

Trigger Point ID:	0x00000000001E2149
Value:	Kbit/s
Description:	Point in time; when the LTE device sends a new RLC throughput calculation, the given value was calculated between the trigger point and this.

RACH messages

RACH trigger

Trigger Point ID:	0x0x0000000000182149
Description:	Point in time, when the RACH procedure was triggered.

RACH message 1

Trigger Point ID:	0x0x0000000000232149
Description:	Point in time, when the RACH Message 1 was received.

RACH message 2

Trigger Point ID:	0x0x0000000000242149
Description:	Point in time, when the RACH Message 2 was received.

RACH message 3

Trigger Point ID:	0x0x0000000000252149
Description:	Point in time, when the RACH Message 3 was received.

9.3.1.10 TETRA layer 3 triggerpoints

Trigger points from mobile TETRA Layer 3 messages are generic built from the message ID.

Table 9-8: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x0C1C, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, e.g 0x07 for layer 3 message
Byte 4:	Not used, always 0x00
Byte 5:	PDU Type, see ETSI TS 100 392-2
Byte 6:	Protocol Discriminator, see ETSI TS 100 392-2, chapter 18.5.21
Byte 7:	Not used, always 0x00
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

Example:D-SETUP

Table 9-9: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	0x0C1C
Byte 3:	0x07 for layer 3 message
Byte 4:	not used, always 0x00
Byte 5:	0x07, PDU Type, see ETSI TS 100 392-2, chapter 14.8.28
Byte 6:	Protocol Discriminator, see ETSI TS 100 392-2, chapter 18.5.21
Byte 7:	0x00
Byte 8:	0x01 for downlink

→0x100020700070C1C

9.3.1.11 Cdma2000 layer 3 triggerpoints

Trigger points from mobile cdma2000 Layer 3 messages are generic built from the message ID.

Table 9-10: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x0708, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, e.g 0x09 for cdma layer 3 message
Byte 4:	Not used, always 0x00
Byte 5 - 6:	Message ID
Byte 7:	ChannelID, see table below
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

cdma2000 Channel	**Channel ID**
Sync Channel	1
Access Channel	2
Paging Channel	3
Forward Traffic Channel	4
Reverse Traffic Channel	5
Forward CSCH	6
Reverse CSCH	7
Forward DSCH	8
Reverse DSCH	9

9.3.1.12 EVDO layer 3 triggerpoints

Trigger points from mobile EVDO Layer 3 messages are generic built from the message ID.

Table 9-11: The 64bit (8Byte) ID has the following byte structure in right to left order:

Byte 1 - 2:	Have always the value 0x0708, built by the phylis frame number.
Byte 3:	Has always the value, built by the frame record number, e.g 0x2F for EVDO layer 3 message
Byte 4:	Not used, always 0x00
Byte 5 - 6:	Message ID

Byte 7:	ChannelID, see table below
Byte 8:	The lowest bit is set for data down link direction. Currently possible values: 0x00 for uplink, 0x01 for downlink

EVDO Channel	**Channel ID**
Access Channel	0
Reverse Traffic Channel	1
Control Channel	2
Forward Traffic Channel	3
Control Broadcast Channel	4

9.3.2 Trigger point meta data keys

URL	HTTP URL, FTP URL e.g. http://cms.rohde-schwarz.com ftp://cms.rohde-schwarz.com
IP_Address	An IP Address in IPv4 or IPv6 Format
UserName	The Username for authentication to a service
FileName	File name (e.g. the FTP server file to download
ErrorText	An error text of a failure trigger point
HTTPHeaderText	The HTTP header Text of a received HTTP Object
EMailAddress	Email Address
GeneralInfo	A general information to a trigger point

9.3.3 Value types

9.3.3.1 Boolean

Success state of the reached trigger point; 1 means trigger point reached successfully.

9.3.3.2 Duration

Current elapsed time of service in ms.

9.3.3.3 Rate

Date rate in bytes per second of a DQA job.

9.3.3.4 MOS

SQM MOS value

9.3.3.5 Bytes

The amount of transferred bytes at the reached trigger point.

9.3.3.6 Special

-

9.3.3.7 Percentage

A ratio calculated by a R&S ROMES4, for example, cut-off ratio.

9.3.4 Trigger point description

Used symbol "-" in the following tables means:

- n/a (not applied) in "Used by ETSI"
- no meta data is generated in "Used Meta Data"

9.3.4.1 DQA

Service independent connection trigger points

Device sends ATD command for connection request

Trigger Point ID:	0x1001
Used by ETSI:	A,B
Value Type:	Boolean
Used Meta Data:	-
Description:	Mobile sends the ATD Command for the connction request.

Connection completed

Trigger Point ID:	0x1002
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Connection Completed before possibly HTTP Check

Connection failed

Trigger Point ID:	0x1003
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Connection failed

Connection HTTP check start

Trigger Point ID:	0x1004
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Connection HTTP Check Start

Connection HTTP check completed

Trigger Point ID:	0x1005
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Connection HTTP Check completed. Optional, only available if activated in the Connect Job

Connection HTTP check failed

Trigger Point ID:	0x1006
Used by ETSI:	-
Value Type:	Boolean

Used Meta Data:	ErrorText
Description:	Connection HTTP Check failed. Optional, only available if activated in the Connect Job

Connection dialup completed

Trigger Point ID:	0x1007
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Connection Dialup completed. The dialup is completed after the HTTP Check. If no HTTP Check was defined, it is the same as 0x1002.

Connection dialup failed

Trigger Point ID:	0x1008
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Connection Dialup failed. The dialup is failed after the HTTP Check. If no HTTP Check was defined, it is the same as 0x1003.

Connection dialup canceled

Trigger Point ID:	0x1009
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Connection Dialup was canceled by user.

QualiPoc / SQ android session started

Trigger Point ID:	0x1010
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	A QualiPoc or SQ Android session has started

QualiPoc / SQ android session finished

Trigger Point ID:	0x1011
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	A QualiPoc or SQ Android session has finished.

Modem COM port opened

Trigger Point ID:	0x1012
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Open Modem COM port successfully completed.

CS connection request

Trigger Point ID:	0x1013
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Device sends ATD Command for Circuit Switched Connection Request.

CS connection completed

Trigger Point ID:	0x1014
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Response from ATD Command for Circuit Switched call is successful (CONNECT).

CS connection failed

Trigger Point ID:	0x1015
Used by ETSI:	-
Value Type:	Boolean

Used Meta Data:	Error Text
Description:	Response from ATD Command for CS call has failed.

Circuit 109 ON

Trigger Point ID:	0x1016
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Modem signals transition of circuit 109 (DCD, RLSD) to ON.

Circuit 109 OFF

Trigger Point ID:	0x1017
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Modem signals transition of circuit 109 (DCD, RLSD) to OFF.

Disconnect start

Trigger Point ID:	0x1101
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Disconnect stated.

Disconnect completed

Trigger Point ID:	0x1102
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Disconnection completed successfully

Disconnect failed

Trigger Point ID:	0x1103
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Diconnect failed.

CS call connection loss

Trigger Point ID:	0x1201
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Connection is lost.

General service trigger points

The following trigger points are used by different services.

Socket connect request

Trigger Point ID:	0x2001
Used by ETSI:	A, B
Value Type:	Chapter 9.3.3.5, "Bytes", on page 2269
Used Meta Data:	URL
Description:	The data socket tries to establish a connection to a Host.

Socket connect completed

Trigger Point ID:	0x2002
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	
Description:	The data socket connection has been established successfully.

Socket connect failed

Trigger Point ID:	0x2003
Used by ETSI:	A, B

Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	The data socket connection has failed.

Service receives the first data packet containing content on the data socket

Trigger Point ID:	0x2004, 0x3003
Used by ETSI:	A
Value Type:	Bytes
Used Meta Data:	
Description:	The first data packet arrives from the service server on the data socket.

Service timeout while receiving the first data packet containing content on the data socket

Trigger Point ID:	0x2005
Used by ETSI:	A
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	Waiting for the first data packet from the service server timed out.

Service sends the first data packet containing content on the data socket

Trigger Point ID:	0x2006, 0x3004
Used by ETSI:	A
Value Type:	Bytes
Used Meta Data:	
Description:	Sending the first data packet to the service server on the data socket.

Service failure while sending the first data packet containing content on the data socket

Trigger Point ID:	0x2007
Used by ETSI:	A
Value Type:	Bytes

Used Meta Data:	ErrorText
Description:	Sending the first data packet to the service server on the data socket failed.

Service receives the last data packet containing content on the data socket

Trigger Point ID:	0x2008, 0x3005
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	
Description:	The last data packet arrives from the service server on the data socket.

Service didn’t receive the last data packet containing content on the data socket

Trigger Point ID:	0x2009
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	Service didn’t receive the last data packet containing content on the data socket.

Service did send the last data packet containing content on the data socket

Trigger Point ID:	0x2010, 0x3006
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	
Description:	The last data packet was sent to the service server on the data socket.

Service didn’t send the last data packet containing content on the data socket

Trigger Point ID:	0x2011
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	Service didn’t send the last data packet containing content on the data socket.

HTTP capacity test (DL) start

Trigger Point ID:	0x2010, 0x3006
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	
Description:	The last data packet was sent to the service server on the data socket.

Sending the first SYN on a data socket

Trigger Point ID:	0x3001
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	
Description:	Sending the first SYN on data socket.

Reception of the ACK from the SYN/ACK of a service data socket

Trigger Point ID:	0x3002
Used by ETSI:	A, B
Value Type:	Bytes
Used Meta Data:	
Description:	Reception of the ACK from the SYN/ACK of a Service data socket.

Service sends DNS request

Trigger Point ID:	0x2012, 0x3007
Used by ETSI:	Yes
Value Type:	Boolean
Used Meta Data:	URL (only available for 0x2012)
Description:	Service sends DNS Request.

Service receives a host address from a DNS request

Trigger Point ID:	0x2013, 0x3008
Used by ETSI:	Yes
Value Type:	Boolean

Used Meta Data:	IP_ADDRESS
Description:	Service receives a Host Address from a DNS Request.

Service didn’t receive a host address from a DNS

Trigger Point ID:	0x2014, 0x3009
Used by ETSI:	Yes
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Service didn’t receive a Host Address from a DNS Request.

Service dependent trigger points

Flow FTP download

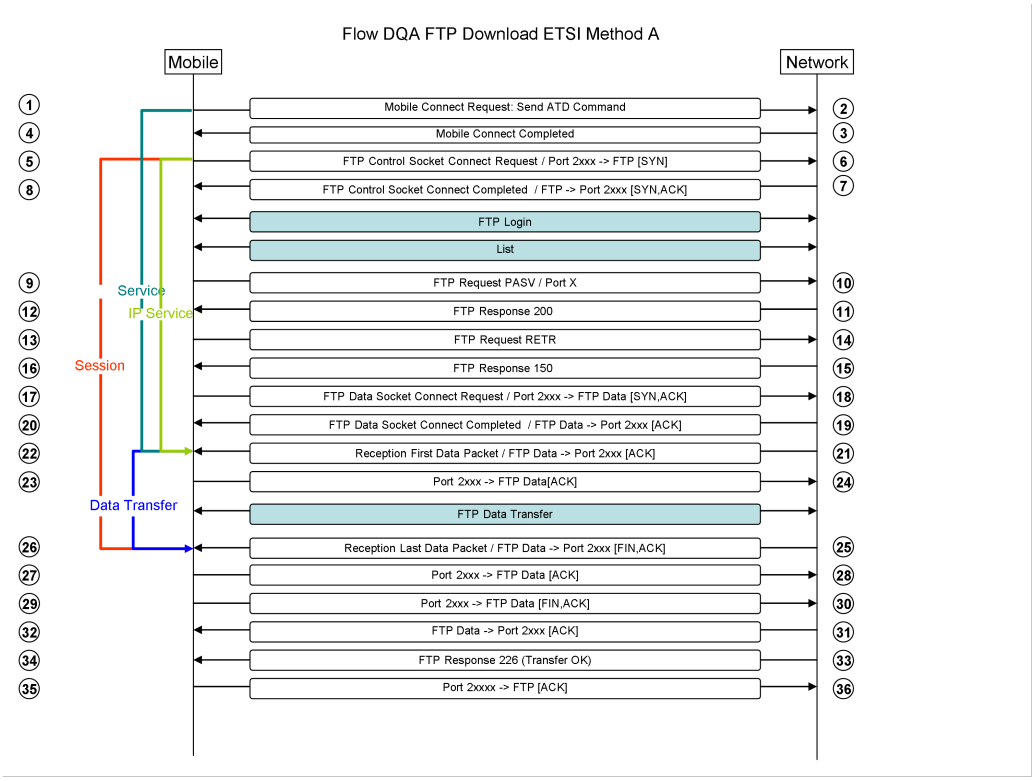


Figure 9-1: Flow DQA FTP Download ETSI Method A

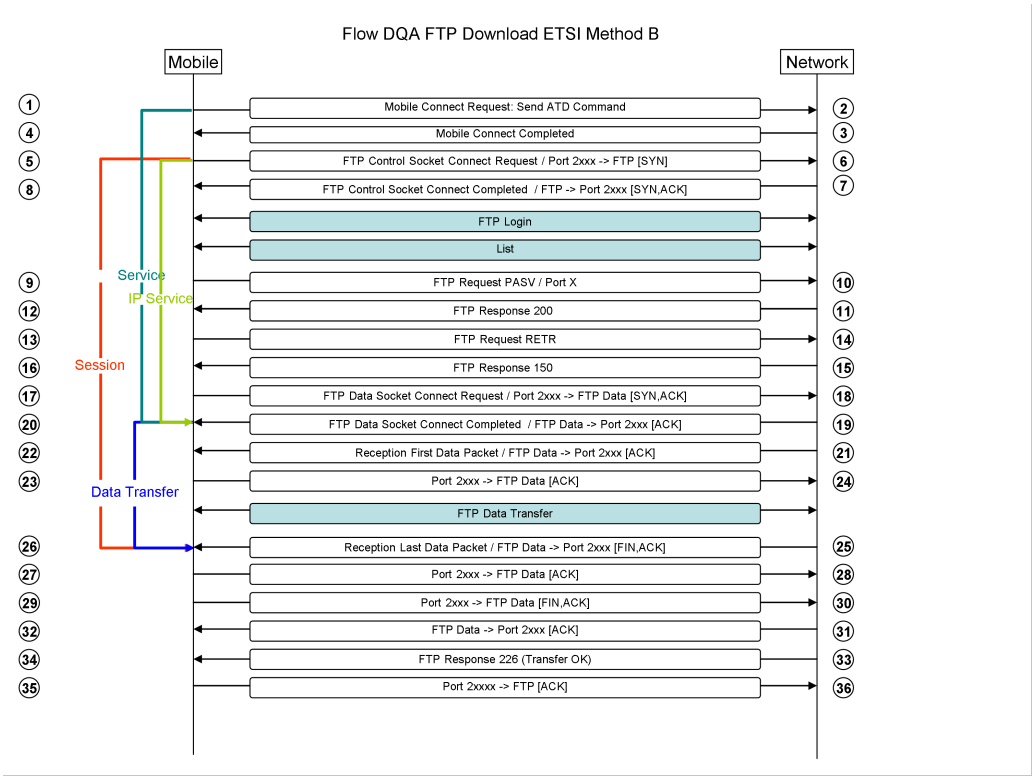


Figure 9-2: Flow DQA FTP Download ETSI Method B

Flow FTP upload

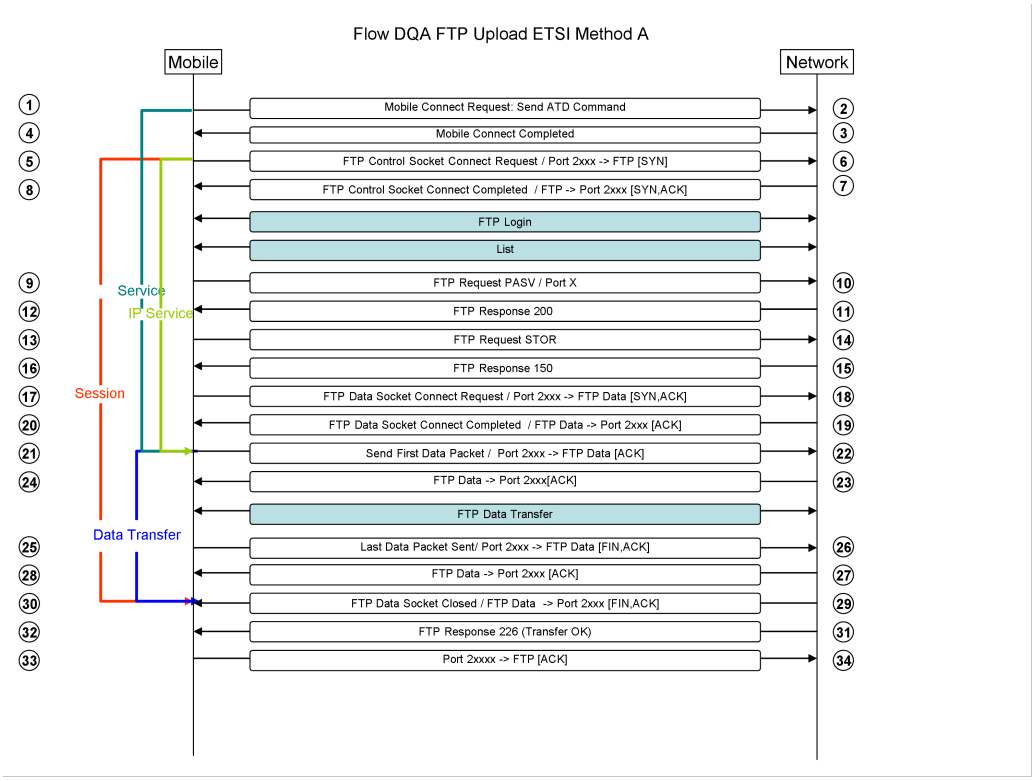


Figure 9-3: Flow DQA FTP Upload ETSI Method A

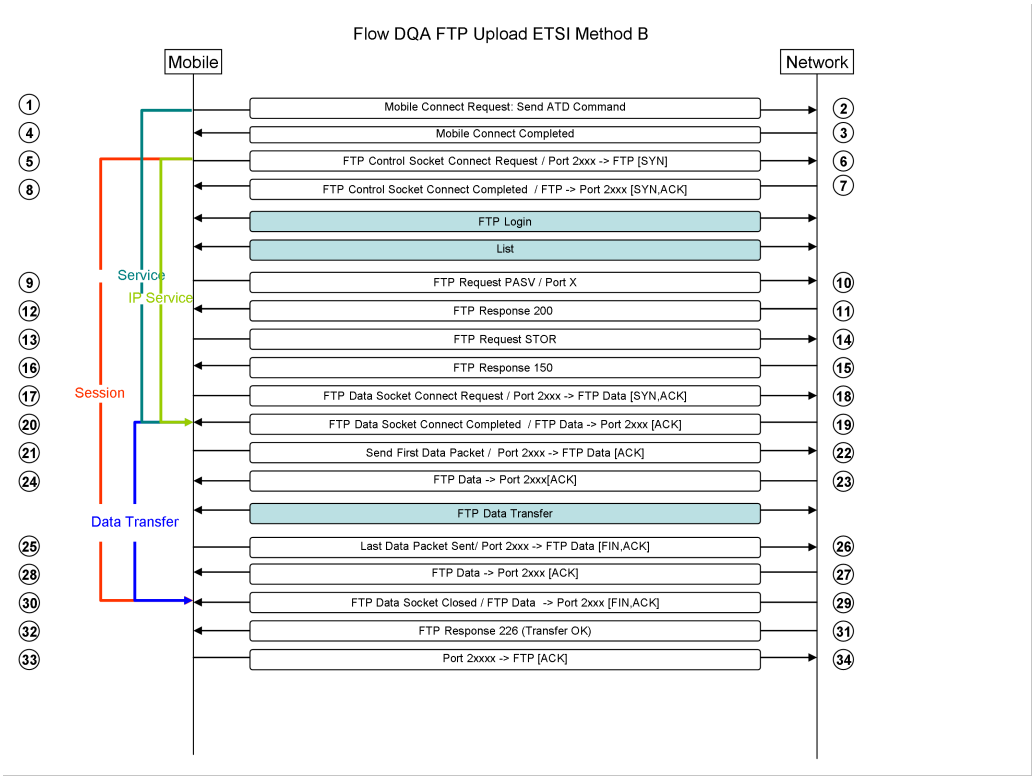


Figure 9-4: Flow DQA FTP Upload ETSI Method B

FTP used service independent / general service trigger points

FTP DL TP 1, FTP DL TP 1:

0x1001 : Device sends ATD Command for Connection Request.

FTP DL TP 17, FTP UL TP 17:

0x2001 : Socket Connect Request

0x3001 : Sending the first SYN on data socket

FTP DL TP 20, FTP UL TP 20:

0x2002 : Socket Connect Completed

0x3002 : Reception of the ACK from the SYN/ACK of a Service Data Socket

0x2003 : Socket Connect Failed

FTP UL TP 21;

0x2006 : Service did send the first data packet containing content on the data socket

0x3004 : Sending first Data packet containing content (TCP/IP)

0x2007 : Service didn’t send the first data packet containing content on the data socket

FTP DL TP 22

0x2004 : Service receives the first data packet containing content

0x2005 : Service Timeout while receiving the data packet containing content on the data socket

0x3003 : Reception of the first Data packet containing content (TCP/IP)

FTP UL TP 25

0x2010 : Service did send the last data packet containing content on the data socket

0x3006 : Sending last Data packet containing content (TCP/IP)

0x2011 : Service didn't send the last data packet containing content on the data socket

FTP DL TP 26

0x2008 : Service receives the last data packet containing content

0x3005 : Reception of the last Data packet containing content (TCP/IP)

0x2009 : Service didn't receive the last data packet containing content

TPs not in Flow:

0x2012 : Service sends DNS Request

0x3007 : Sending DNS Request (TCP/IP)

0x2013 : Service receives a Host Address from a DNS Request

0x3008 : Reception of a Host Address from a DNS Request (TCP/IP)

0x2014 : Service didn't receive a Host Address from a DNS Request

FTP service start

Trigger Point ID:	0x2101
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	URL, FileName
Description:	The FTP Service started

FTP service stopped successfully

Trigger Point ID:	0x2102
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	0x2102
Description:	The FTP Service stopped successfully

FTP service stopped with failure

Trigger Point ID:	0x2103
Used by ETSI:	-

Value Type	Boolean
Used MetaData:	ErrorText
Description:	The FTP Service stopped with Failure

FTP control socket connect request

Trigger Point ID:	0x2104
Used by ETSI:	A, B
Value Type	Boolean
Used MetaData:	IP_ADDRESS
Description:	The FTP Control socket tries to establish a connection to a Host.
TP No in FTP DL:	5
TP No in FTP UL:	5

FTP control socket connect completed

Trigger Point ID:	0x2105
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	
Description:	The FTP Control socket connection has been established successfully.
TP No in FTP DL:	8
TP No in FTP UL:	8

FTP control socket connect failed

Trigger Point ID:	0x2106
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	ErrorText
Description:	The FTP Control socket connection has failed.
TP No in FTP DL:	8
TP No in FTP UL:	8

FTP login request

Trigger Point ID:	0x2107
Used by ETSI:	-

Value Type	Boolean
Used MetaData:	URL, UserName
Description:	The FTP login request

FTP login success

Trigger Point ID:	0x2108
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	
Description:	The FTP login completed successfully.

FTP login failure

Trigger Point ID:	0x2109
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	ErrorText
Description:	The FTP login failed

FTP send list command

Trigger Point ID:	0x2110
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	FileName
Description:	Send the FTP LIST command to retrieve the file size of the requested file. Only available for the first run of a FTP download job in the job list of a DQA session.

FTP receive directory list succeeded

Trigger Point ID:	0x2111
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	-
Description:	Received the directory entry from the FTP Send List Command to retrieve the file size.

FTP receive directory list failed

Trigger Point ID:	0x2112
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	ErrorText
Description:	Didn't receive the directory entry from the FTP Send List Command to retrieve the file size.

FTP logout request

Trigger Point ID:	0x2113
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	URL
Description:	The FTP logout request

FTP logout completed

Trigger Point ID:	0x2114
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	-
Description:	The FTP logout completed

FTP parallel download transfer start

Trigger Point ID:	0x2115
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	-
Description:	The timestamp when the first FTP job in the job list starts the data transfer.

FTP parallel download transfer succeeded

Trigger Point ID:	0x2116
Used by ETSI:	-
Value Type	Bytes

Used MetaData:	-
Description:	All FTP jobs in the job list have completed the transfer successfully. The timestamp is taken from the job which completed the data transfer at least.

FTP parallel download transfer failed

Trigger Point ID:	0x2117
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	ErrorText
Description:	At least one FTP job in the job list has not completed the transfer successfully.

FTP parallel upload transfer start

Trigger Point ID:	0x2118
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	-
Description:	The timestamp when the first FTP job in the job list starts the data transfer.

FTP parallel upload transfer succeeded

Trigger Point ID:	0x2119
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	-
Description:	All FTP jobs in the job list have completed the transfer successfully. The timestamp is taken from the job which completed the data transfer at least.

FTP parallel upload transfer failed

Trigger Point ID:	0x2120
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	ErrorText
Description:	At least one FTP job in the job list has not completed the transfer successfully.

Sending the first SYN on FTP control socket

Trigger Point ID:	0x3101
Used by ETSI:	A, B
Value Type	Bytes
Used MetaData:	-
Description:	Sending the first SYN on FTP control socket
TP No in FTP DL:	5
TP No in FTP UL:	5

Reception of the ACK from the SYN/ACK of a FTP control socket

Trigger Point ID:	0x3102
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	-
Description:	Reception of the ACK from the SYN/ACK of a FTP control socket
TP No in FTP DL:	8
TP No in FTP UL:	8

Sending the FTP RETR command

Trigger Point ID:	0x3103
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	-
Description:	reception of Sending the FTP RETR command
TP No in FTP DL:	13

Sending the FTP STOR command

Trigger Point ID:	0x3104
Used by ETSI:	-
Value Type	Bytes
Used MetaData:	-
Description:	reception of Sending the FTP STOR command
TP No in FTP UL:	13

Used ping service independent / general service trigger points

None

Ping sequence start

Trigger Point ID:	0x2201
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	URL
Description:	Start of Ping sequence

Ping sequence stop

Trigger Point ID:	0x2202
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	
Description:	Stop of Ping sequence

ICMP echo request

Trigger Point ID:	0x2203, 0x3201
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	IP_ADDRESS
Description:	Ping sends an ICMP echo request

ICMP echo reply

Trigger Point ID:	0x2204, 0x3202
Used by ETSI:	-
Value Type	Boolean
Used MetaData:	
Description:	Ping receives an ICMP echo reply

ICMP echo reply failure

Trigger Point ID:	0x2205, 0x3203
Used by ETSI:	-
Value Type	Boolean

Used MetaData:	
Description:	Error while receiving an ICMP echo reply

Flow HTTP download

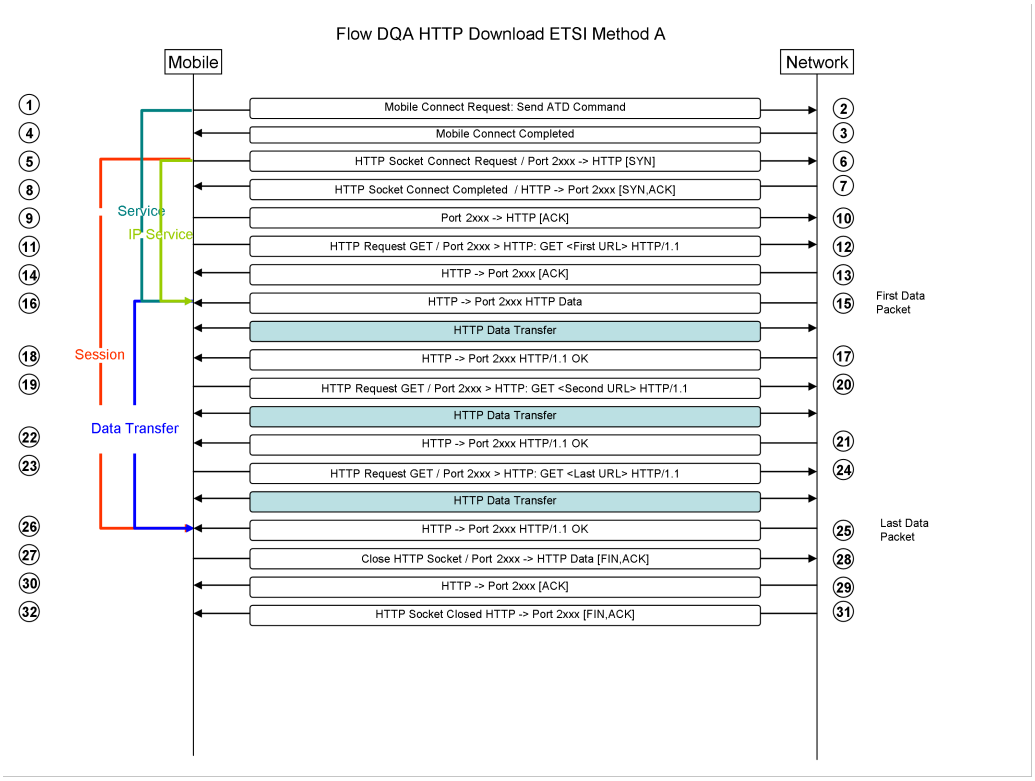


Figure 9-5: Flow DQA HTTP Download ETSI Method A

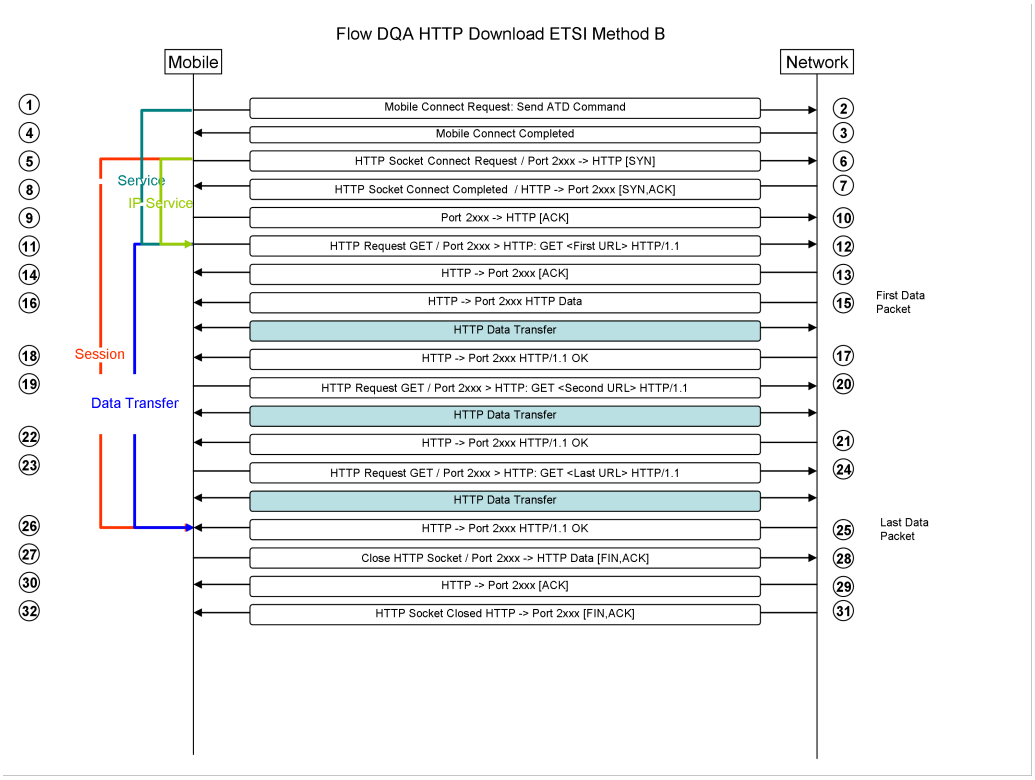


Figure 9-6: Flow DQA HTTP Download ETSI Method B

HTTP download used service independent / general service trigger points

TP 1 :

0x1001: Device sends ATD Command for Connection Request.

TP 5:

0x2001: Socket Connect Request

0x3001: Sending the first SYN on data socket

TP 8:

0x2002: Socket Connect Completed

0x3002: Reception of the ACK from the SYN/ACK of a Service Data Socket

0x2003: Socket Connect Failed

TP 16

0x2004: Service receives the first data packet containing content

0x2005: Service Timeout while receiving the data packet containing content on the data socket

0x3003: Reception of the first Data packet containing content (TCP/IP)

TP 26

0x2008: Service receives the last data packet containing content

0x3005: Reception of the last data packet containing content (TCP/IP)

0x2009: Service didn't receive the last data packet containing content

TPs not in Flow:

0x2012: Service sends DNS Request

0x3007: Sending DNS Request (TCP/IP)

0x2013: Service receives a Host Address from a DNS Request

0x3008: Reception of a Host Address from a DNS Request (TCP/IP)

0x2014: Service didn't receive a Host Address from a DNS Request

HTTP service start

Trigger Point ID:	0x2301
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	URL, see Chapter 9.3.2, "Trigger point meta data keys", on page 2268
Description:	Start of an HTTP download

HTTP service stop

Trigger Point ID:	0x2302
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	End of the Start of an HTTP download

HTTP sends first GET command

Trigger Point ID:	0x2303, 0x3301
Used by ETSI:	B
Value Type:	Bytes
Used Meta Data:	-
Description:	HTTP sends the first GET command.
TP in Flow:	11

HTTP object request

Trigger Point ID:	0x2304
Used by ETSI:	-

Value Type:	Bytes
Used Meta Data:	URL
Description:	Request HTTP object download of an HTML page
TP in Flow:	Between 10 and 11

HTTP object received

Trigger Point ID:	0x2305
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	HTTP object of an HTML page received successfully
TP in Flow:	18,22 ...

HTTP object error

Trigger Point ID:	0x2306
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	Error while receiving an HTTP object of an HTML page.
TP in Flow:	18,22 ...

HTTP sending PUT / POST command

Trigger Point ID:	0x2307, 0x3302
Used by ETSI:	B
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the PUT or POST command
TP in Flow:	11

HTTP sending PUT / POST command failed

Trigger Point ID:	0x2308
Used by ETSI:	B
Value Type:	Bytes
Used Meta Data:	-

Description:	Sending the PUT or POST command failed.
TP in Flow:	11

HTTP sending PUT / POST command succeeded

Trigger Point ID:	0x2309
Used by ETSI:	B
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the PUT or POST command succeeded.
TP in Flow:	11

HTTP capacity (DL) test time

Trigger Point ID:	0x2321
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Sending the PUT or POST command succeeded.
TP in Flow:	11

WEB 2.0 action start

Trigger Point ID:	0x2311
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	GeneralInfo
Description:	Start of a WEB 2.0 Action
TP in Flow:	

WEB 2.0 action completed

Trigger Point ID:	0x2312
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	A WEB 2.0 Action completed successfully.
TP in Flow:	

WEB 2.0 action failed

Trigger Point ID:	0x2313
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	A WEB 2.0 Action failed.
TP in Flow:	

HTTP capacity test start

Trigger Point ID:	0x2321
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Start HTTP capacity test in DL, UL directions and bidirectional

HTTP capacity test stop

Trigger Point ID:	0x2322
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Stop HTTP capacity test in DL, UL directions and bidirectional

Flow SMTP

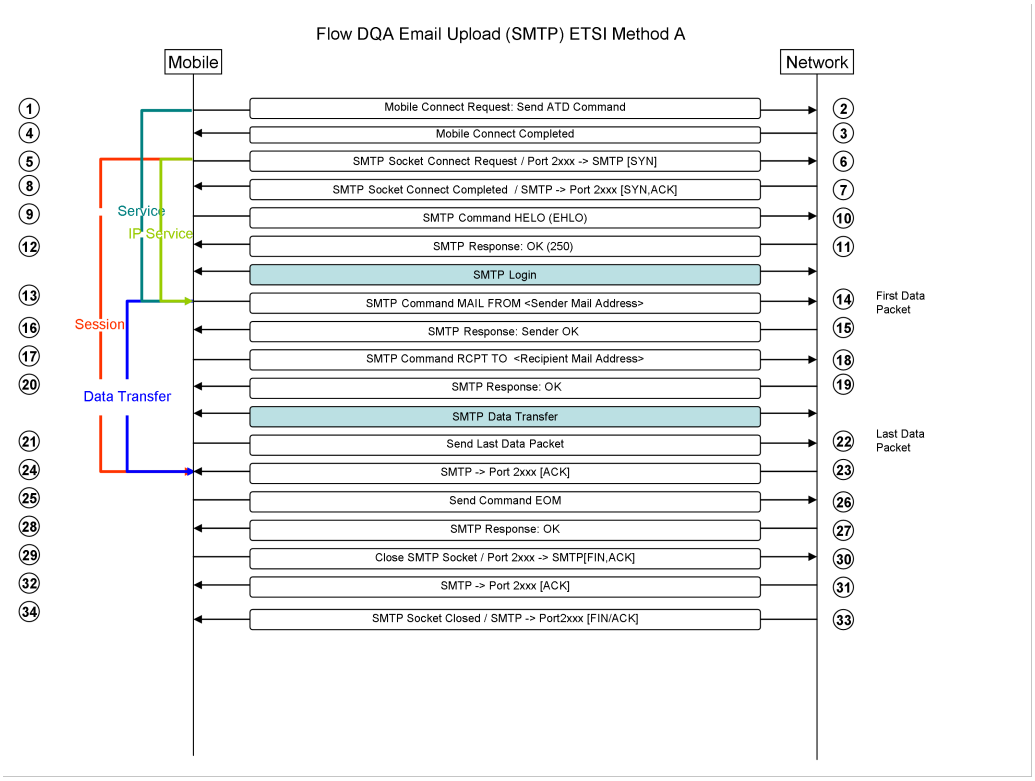


Figure 9-7: Flow DQA Email Upload (SMTP) ETSI Method A

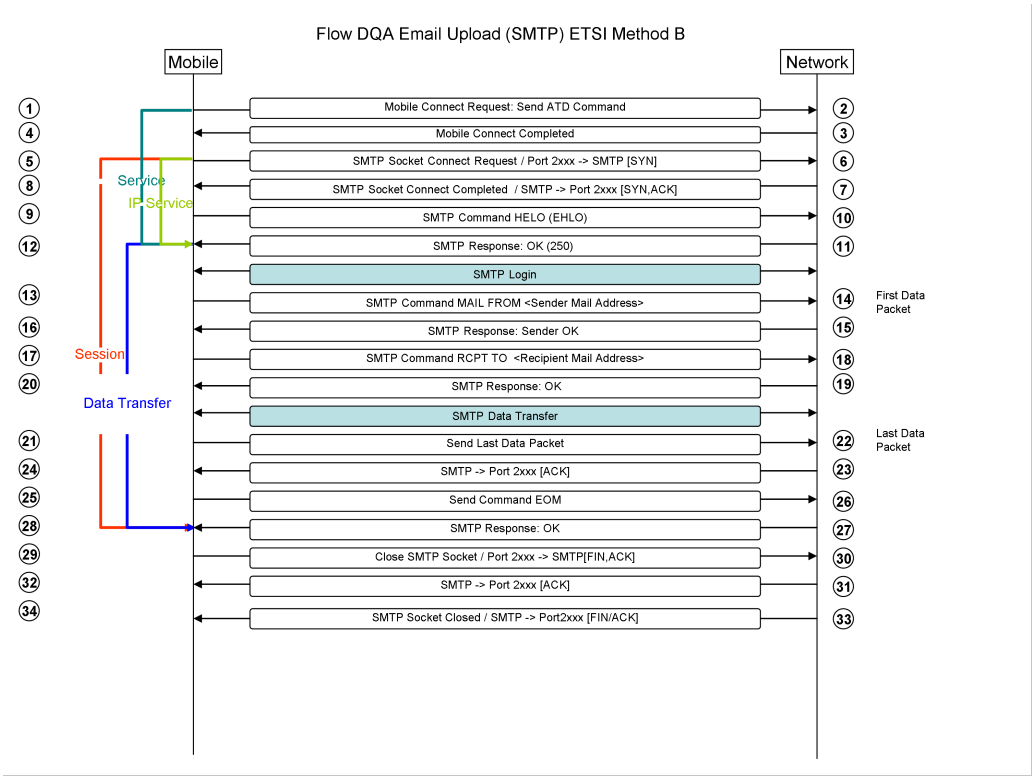


Figure 9-8: Flow DQA Email Upload (SMTP) ETSI Method B

STMP used service independent / general service trigger points

TP 1 :

0x1001 : Device sends ATD Command for Connection Request.

TP 5:

0x2001 : Socket Connect Request

0x3001 : Sending the first SYN on data socket

TP 8:

0x2002 : Socket Connect Completed

0x3002 : Reception of the ACK from the SYN/ACK of a Service Data Socket

0x2003 : Socket Connect Failed

TP 13:

0x2006 : Service did send the first data packet containing content on the data socket

0x3004 : Sending first Data packet containing content (TCP/IP)

0x2007 : Service didn't send the first data packet containing content on the data socket

TP 21:

0x2010 : Service did send the last data packet containing content on the data socket

0x3006 : Sending last Data packet containing content (TCP/IP)

0x2011 : Service didn't send the last data packet containing content on the data socket

TPs not in Flow:

0x2012 : Service sends DNS Request

0x3007 : Sending DNS Request (TCP/IP)

0x2013 : Service receives a Host Address from a DNS Request

0x3008 : Reception of a Host Address from a DNS Request (TCP/IP)

0x2014 : Service didn't receive a Host Address from a DNS Request

SMTP trigger points

SMTP Service Start

Trigger Point ID:	0x2401
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	EmailAddress
Description:	Start of a SMTP service

SMTP Service Stopped Successfully

Trigger Point ID:	0x2402
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	SMTP service stopped successfully.

SMTP Service Stopped with Failure

Trigger Point ID:	0x2403
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	SMTP Service stopped with failure.

SMTP Authentication Request

Trigger Point ID:	0x2404
Used by ETSI:	-

Value Type:	Bytes
Used Meta Data:	UserName
Description:	SMTP authentication request

SMTP Authentication Success

Trigger Point ID:	0x2405
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	
Description:	SMTP authentication succeeded.

SMTP Authentication Failure

Trigger Point ID:	0x2406
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	SMTP authentication failed.

Sending the SMTP HELO Command

Trigger Point ID:	0x3401
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the SMTP HELO command
TP in Flow:	9

Reception of the SMTP Reply Code 250 for the HELO Command

Trigger Point ID:	0x2407, 0x3402
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	Reception of the SMTP reply code 250 for the HELO command
TP in Flow:	12

Reception of the SMTP Reply Code 250 for the HELO Command Failed

Trigger Point ID:	0x2408
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	Reception of the SMTP reply code 250 for the HELO command failed.
TP in Flow:	12

Sending the SMTP MAIL FROM Command

Trigger Point ID:	0x2409, 0x3403
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the SMTP MAIL FROM command
TP in Flow:	13

Reception of the SMTP Reply Code 250 for the EOM Command

Trigger Point ID:	0x2410, 0x3404
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	Reception of the SMTP reply code 250 for the EOM command
TP in Flow:	28

Reception of the SMTP Reply Code 250 for the EOM Command Failed

Trigger Point ID:	0x2411
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	Reception of the SMTP reply code 250 for the EOM command failed.
TP in Flow:	28

Sending the SMTP QUIT Command

Trigger Point ID:	0x3405
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	
Description:	Sending the SMTP QUIT command.

Flow POP3

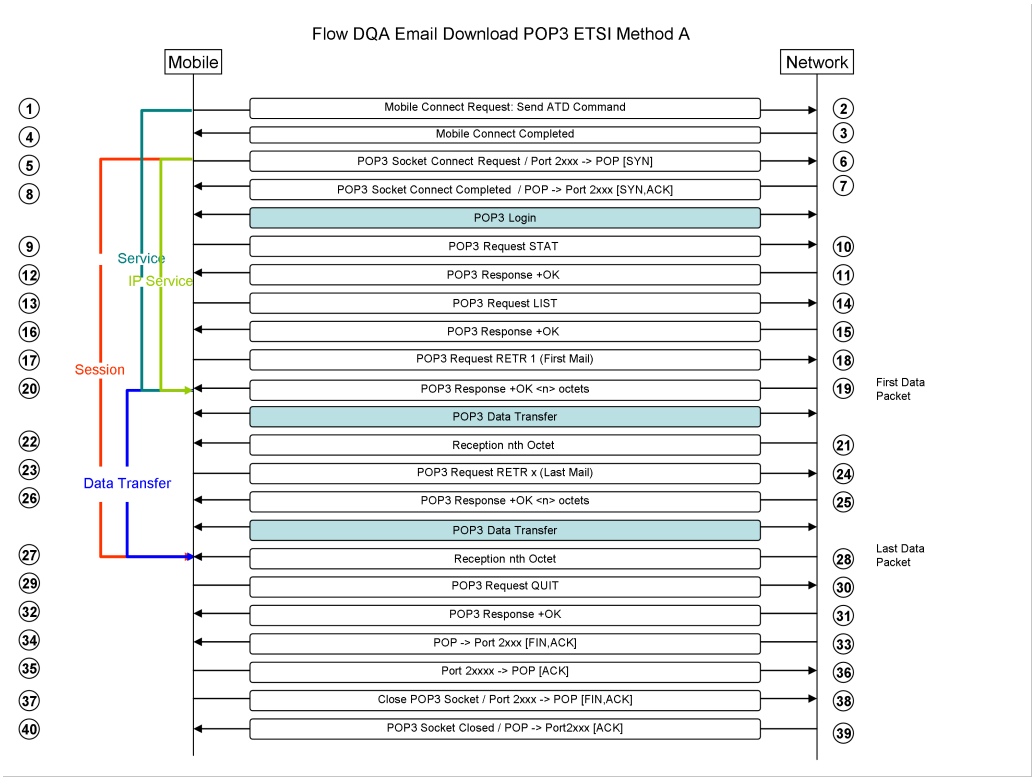


Figure 9-9: Flow DQA Email Download POP3 ETSI Method A

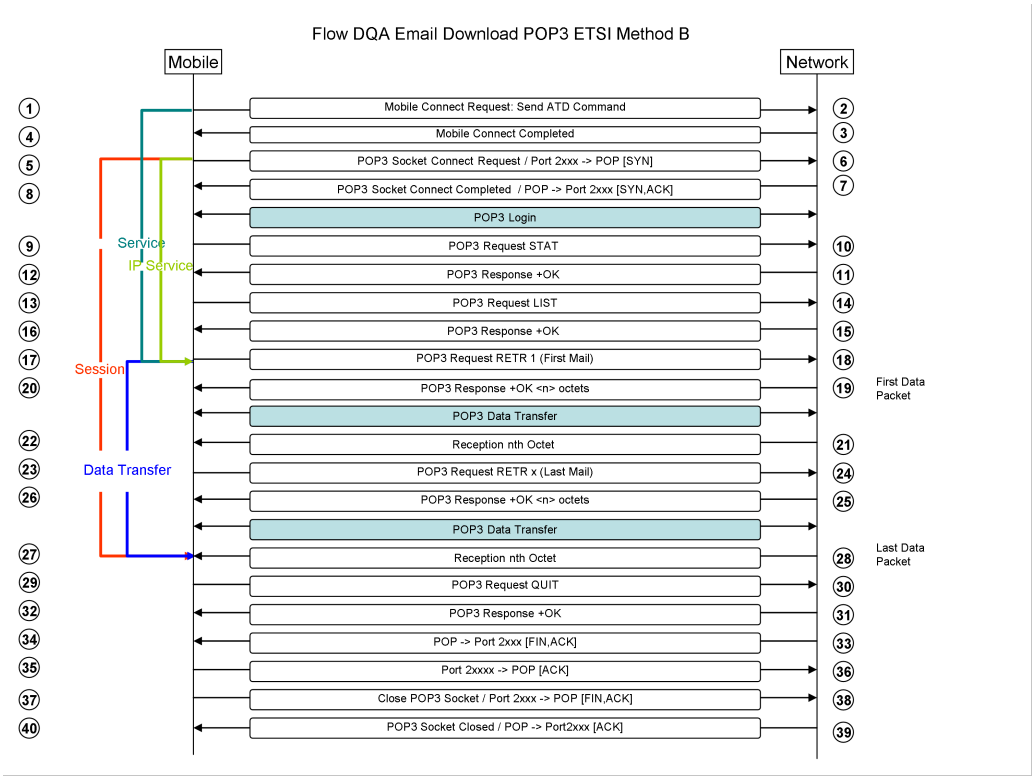


Figure 9-10: Flow DQA Email Download POP3 ETSI Method B

Used POP3 service independent / general service trigger points

TP 1 :

0x1001 : Device sends ATD Command for Connection Request.

TP 5:

0x2001 : Socket Connect Request

0x3001 : Sending the first SYN on data socket

TP 8:

0x2002 : Socket Connect Completed

0x3002 : Reception of the ACK from the SYN/ACK of a Service Data Socket

0x2003 : Socket Connect Failed

TP 20

0x2004 : Reception of the first data packet containing content

0x2005 : Service Timeout while receiving the data packet containing content on the data socket

0x3003 : Reception of the first Data packet containing content (TCP/IP)

TP 28

0x2008 : Service receives the last data packet containing content

0x3005 : Reception of the last Data packet containing content (TCP/IP)

0x2009 : Service didn't receive the last data packet containing content

TPs not in Flow:

0x2012 : Service sends DNS Request

0x3007 : Sending DNS Request (TCP/IP)

0x2013 : Service receives a Host Address from a DNS Request

0x3008 : Reception of a Host Address from a DNS Request (TCP/IP)

0x2014 : Service didn't receive a Host Address from a DNS Request

POP3 trigger points

POP3 Service Start

Trigger Point ID:	0x2501
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	EMailAddress
Description:	Start of a POP3 service

POP3 Service Stopped Successfully

Trigger Point ID:	0x2502
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	POP3 service stopped successfully.

POP3 Service Stopped with Failure

Trigger Point ID:	0x2503
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	POP3 service stoppped with failure.

POP3 Authentication Request

Trigger Point ID:	0x2504
Used by ETSI:	-

Value Type:	Bytes
Used Meta Data:	UserName
Description:	POP3 authentication request

POP3 Authentication Success

Trigger Point ID:	0x2505
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	
Description:	POP3 authentication succeeded.

POP3 Authentication Failure

Trigger Point ID:	0x2506
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	POP3 authentication failed

Sending the POP3 RETR Command

Trigger Point ID:	0x2507, 0x3501
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the POP3 RETR command
TP in Flow:	17

Sending the POP3 QUIT Command

Trigger Point ID:	0x3502
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the POP3 QUIT command
TP in Flow:	29

Flow IMAP

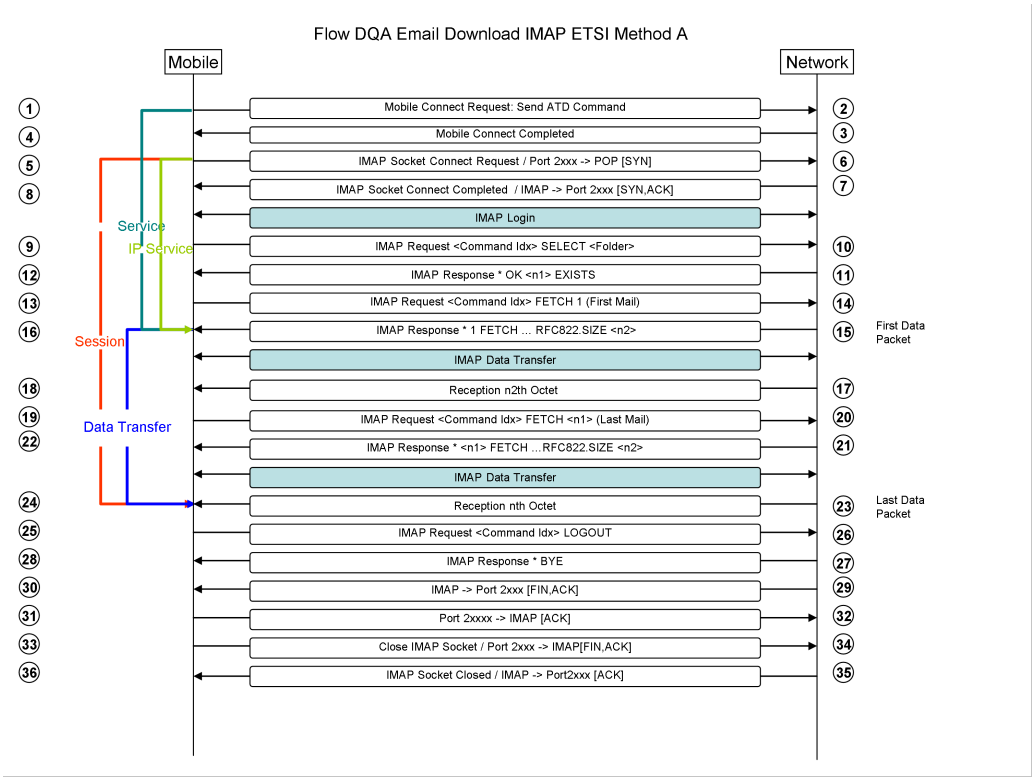


Figure 9-11: Flow DQA Email Download IMAP ETSI Method A

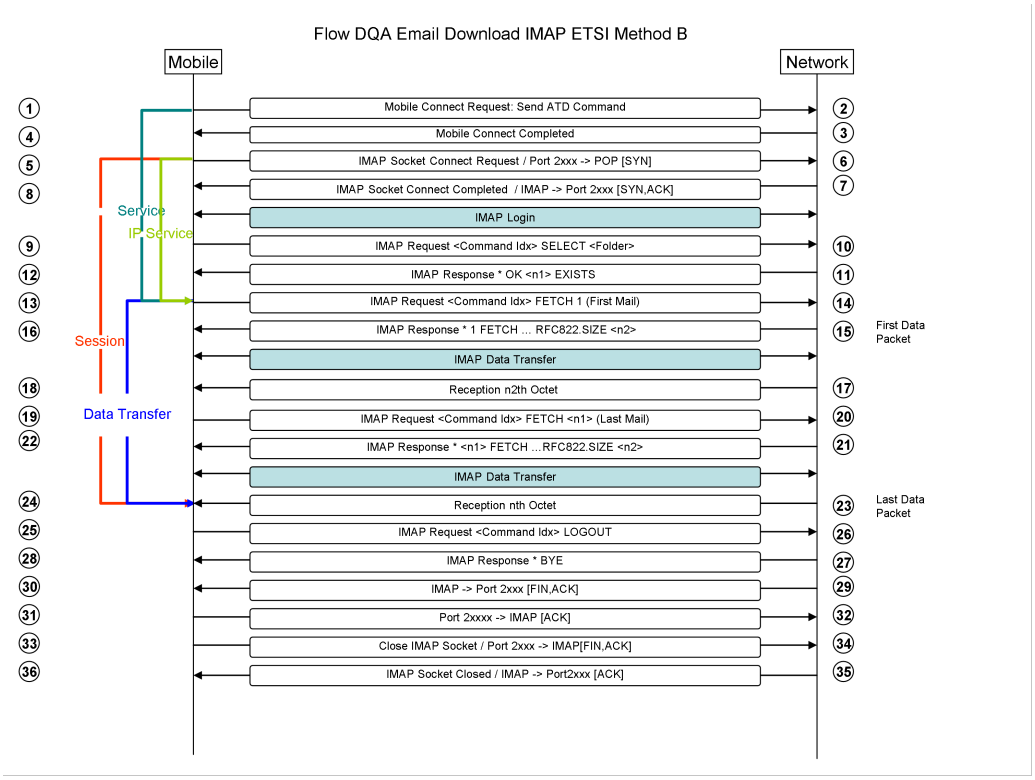


Figure 9-12: Flow DQA Email Download IMAP ETSI Method B

IMAP Used Service Independent / General Service Trigger Points

IMAP used service independent / general service trigger points

TP 1 :

0x1001 : Device sends ATD Command for Connection Request.

TP 5:

0x2001 : Socket Connect Request

0x3001 : Sending the first SYN on data socket

TP 8:

0x2002 : Socket Connect Completed

0x3002 : Reception of the ACK from the SYN/ACK of a Service Data Socket

0x2003 : Socket Connect Failed

TP 16

0x2004 : Reception of the first data packet containing content

0x2005 : Service Timeout while receiving the data packet containing content on the data socket

0x3003 : Reception of the first Data packet containing content (TCP/IP)

TP 24

0x2008 : Service receives the last data packet containing content

0x3005 : Reception of the last Data packet containing content (TCP/IP)

0x2009 : Service didn't receive the last data packet containing content

TPs not in Flow:

0x2012 : Service sends DNS Request

0x3007 : Sending DNS Request (TCP/IP)

0x2013 : Service receives a Host Address from a DNS Request

0x3008 : Reception of a Host Address from a DNS Request (TCP/IP)

0x2014 : Service didn't receive a Host Address from a DNS Request

IMAP trigger points

IMAP Service Start

Trigger Point ID:	0x2601
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	EMailAddress
Description:	Start of a IMAP service

IMAP Service Stopped Successfully

Trigger Point ID:	0x2602
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	-
Description:	IMAP service stopped successfully.

IMAP Service Stopped with Failure

Trigger Point ID:	0x2603
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	IMAP service stopped with failure.

IMAP Authentication Request

Trigger Point ID:	0x2604
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	UserName
Description:	IMAP authentication request

IMAP Authentication Success

Trigger Point ID:	0x2605
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	
Description:	IMAP authentication succeeded.

IMAP Authentication Failure

Trigger Point ID:	0x2606
Used by ETSI:	-
Value Type:	Bytes
Used Meta Data:	ErrorText
Description:	IMAP authentication failed.

Sending the IMAP FETCH Command

Trigger Point ID:	0x2607, 0x3601
Used by ETSI:	B
Value Type:	Bytes
Used Meta Data:	-
Description:	Sending the IMAP FETCH command
TP in Flow:	13

Reception of the IMAP FETCH OK Response

Trigger Point ID:	0x2608, 0x3602
Used by ETSI:	A
Value Type:	Bytes
Used Meta Data:	-

Description:	Reception of the IMAP FETCH OK response
TP in Flow:	16

Reception of the IMAP FETCH OK Response Failed

Trigger Point ID:	0x2609
Used by ETSI:	A
Value Type:	Bytes
Used Meta Data:	-
Description:	Reception of the IMAP FETCH OK reponse failed.
TP in Flow:	16

Video streaming with VLC

Used Service Independent and General Service Trigger Points

0x1001 : Device sends ATD Command for Connection Request

VLC Streaming Start

Trigger Point ID:	0x2801
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	URL
Description:	Start of a VLC streaming job

VLC Streaming Succeeded

Trigger Point ID:	0x2802
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	
Description:	VLC streaming job stopped successfully.

VLC Streaming Failed

Trigger Point ID:	0x2803
Used by ETSI:	-
Value Type:	Boolean

Used Meta Data:	ErrorText
Description:	VLC streaming job stopped with failure.

VLC Stream Open Start

Trigger Point ID:	0x2804
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	
Description:	VLC start of opening a stream

VLC Stream Open Succeeded

Trigger Point ID:	0x2805
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	
Description:	Opening of a stream succeeded.

VLC Stream Open Failed

Trigger Point ID:	0x2806
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Opening of a stream failed.

VLC Stream Playing Start

Trigger Point ID:	0x2807
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	
Description:	Start of playing a stream

VLC Stream Playing Succeeded

Trigger Point ID:	0x2808
Used by ETSI:	-

Value Type:	Boolean
Used Meta Data:	
Description:	Playing a stream succeeded.

VLC Stream Playing Failed

Trigger Point ID:	0x2809
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	ErrorText
Description:	Playing a stream failed.

VLC Stream Reproduction Cut Off Ratio

Trigger Point ID:	0x2810
Used by ETSI:	-
Value Type:	Percentage
Used Meta Data:	ErrorText
Description:	The stream reproduction cut off ratio calculated by the VLC

9.3.4.2 Voice calls and SQA

Reception of a MOS value

Trigger Point ID:	0x4001
Used by ETSI:	-
Value Type:	MOS
Used Meta Data:	
Description:	Reception of a MOS value calculated by a SQA local client or remote client.

Start dialing

Trigger Point ID:	0x4002
Used by ETSI:	-
Value Type:	-

Used Meta Data:	NUMBER
Description:	Point in time, when the NQA State Machine within ROMES starts the dial process.

Voice call connected

Trigger Point ID:	0x4003
Used by ETSI:	-
Value Type:	-
Used Meta Data:	-
Description:	Point in time, when the NQA State Machine detects, that the Voice Call was connected.

Voice call NQA result

Trigger Point ID:	0x4004
Used by ETSI:	-
Value Type:	Result (0|Good), (1|Blocked), (2|Dropped), (3|No Service)
Used Meta Data:	-
Description:	Point in time, when the NQA State Machine generates the result for the voice call test case.

Playback of speech sample started

Trigger Point ID:	0x4010
Used by ETSI:	-
Value Type:	-
Used Meta Data:	-
Description:	Point in time, when the SQA measurement engine sends the set speech sample to the audio output device to start playback.

Pause after speech sample started

Trigger Point ID:	0x4011
Used by ETSI:	-
Value Type:	-
Used Meta Data:	-
Description:	Point in time, when the SQA measurement engine pauses, after the speech sample has completed playback.

9.3.4.3 SMS

Initiate sending a SMS

Trigger Point ID:	0x5101
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	NUMBER
Description:	Point of time the customer sends his SMS to the SMS center.

Receiving acknowledgement of the SMSC

Trigger Point ID:	0x5102
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	Point of time the mobile equipment receives the confirmation from the SMS center.

Receiving acknowledgement of the SMSC failure

Trigger Point ID:	0x5103
Used by ETSI:	-
Value Type:	Boolean
Used Meta Data:	-
Description:	The mobile equipment did not receive the confirmation from the SMS center.

9.4 R&S ROMES4 KPI Description

This chapter describes how the KPIs shown in the R&S ROMES KPI View are calculated. The differentiation is made for the most of the listed group of KPIs between those derived in accordance to ETSI or R&S ROMES.

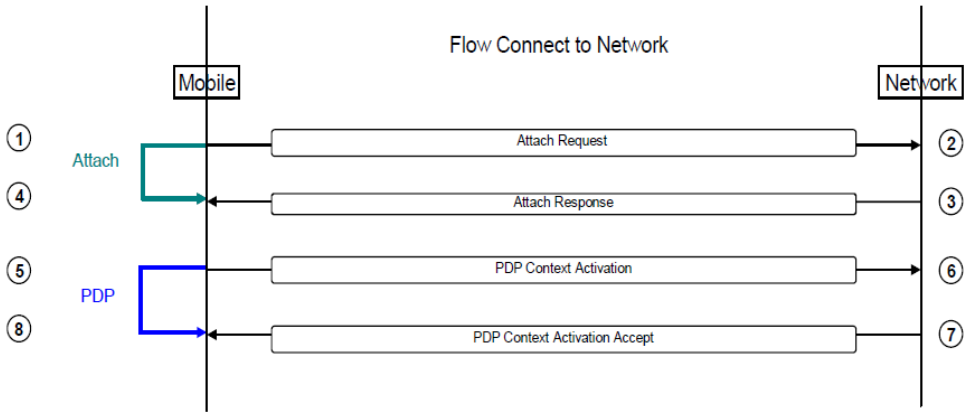
The chapter is divided in the following parts depending on what the performance the KPIs are related to.

- Service Independent KPIs
- FTP Download KPIs
- FTP Upload KPIs

- HTTP Download KPIs
- E-Mail Download POP3 KPIs
- E-Mail Download IMAP KPIs

9.4.1 Service Independent KPIs

9.4.1.1 ETSI Connect to Network KPIs



Network Unavailability [%]

Before a connect job can start, the network availability is checked. This parameter is the proportion of unsuccessful network availability checks and the total number of network availability checks.

$$Network\ Unavailability\ [\%] = \frac{\#\ of\ unsuccessful\ network\ availability\ checks}{\#\ of\ network\ availability\ checks} \times 100$$

Attach Failure Ratio [%]

The attach failure ratio describes the probability that a subscriber cannot attach to the PS network.

$$Attach\ Failure\ Rate\ [\%] = \frac{\#\ of\ unsuccessful\ attach\ attempts}{\#\ of\ all\ attach\ attempts} \times 100$$

Trigger Points

Start: [TP 1]

Mobile sends the attach request message.

Stop: [TP 4]

Mobile receives the attach accept message.

Attach Setup Time [ms]

This attach setup time describes the time period needed to attach to the PS network.

Setup Time [ms] = t attach complete [ms] – t attach request [ms]

Trigger Points

Start: [TP 1]

Mobile sends the attach request message.

Stop: [TP 4]

Mobile receives the attach accept message.

PDP Context Activation Failure Ratio [%]

The PDP context activation failure ratio denotes the probability that the PDP context cannot be activated. It is the proportion of unsuccessful PDP context activation attempts and the total number of PDP context activation attempts.

$$\text{PDP Context Activation Failure Ratio}\,[\%] = \frac{\#\,of\ unsuccessful\ PDP\ context\ activation\ attempts}{\#\ of\ all\ PDP\ context\ activation\ attempts} \times 100$$

Trigger Points

Start: [TP 5]

Mobile sends the PDP context activation request message.

Stop: [TP 8]

Mobile receives the PDP context activation accept message.

PDP Context Activation Time [ms]

This parameter describes the time period needed for activating the PDP context.

PDP Context Activation Time [ms] = t pdp context activation accept [ms] – t pdp context activation request [ms]

9.4.1.2 R&S ROMES4 PDP Context Activation Ratio KPI

The PDP context activation ratio denotes the probability that the PDP context can be activated. It is the proportion of successful PDP context activation attempts and the total number of PDP context activation attempts.

$$\text{PDP Context Activation Ratio}\ [\%] = \frac{\#\,of\ successful\ PDP\ context\ activation\ attempts}{\#\ of\ all\ PDP\ context\ activation\ attempts} \times 100$$

Trigger Points

Start: [TP 5]

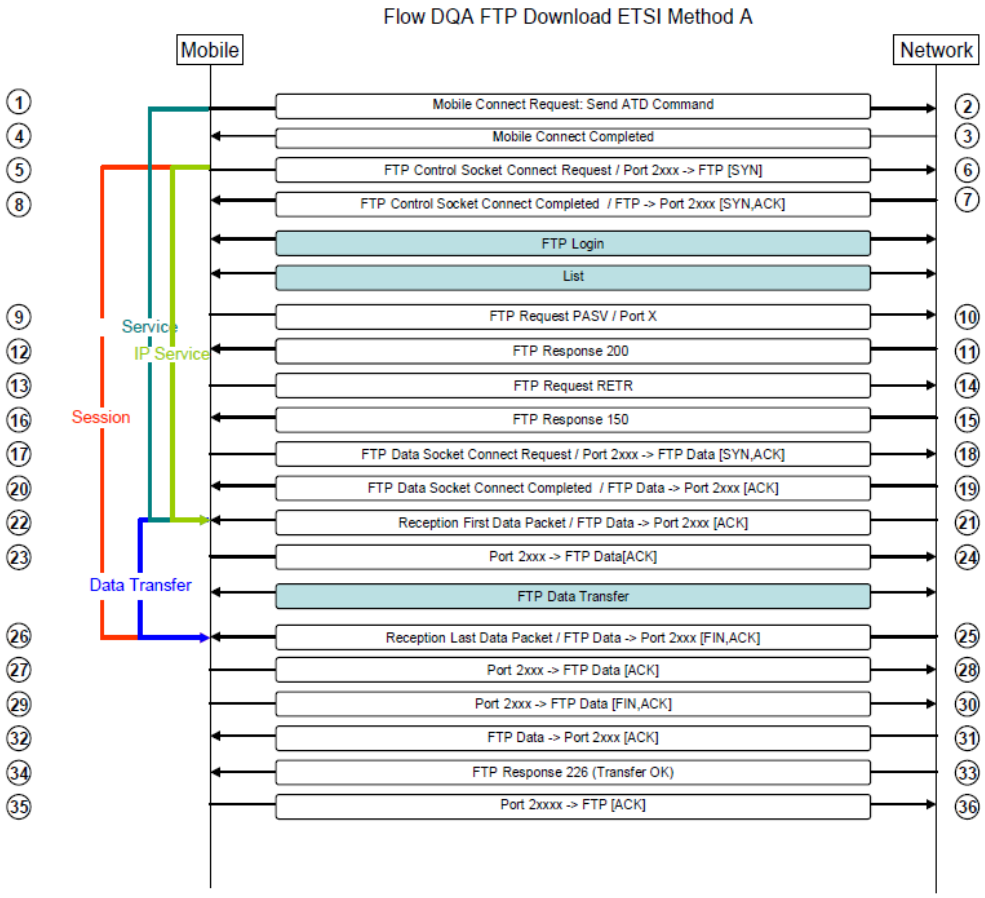
Mobile sends the PDP context activation request message.

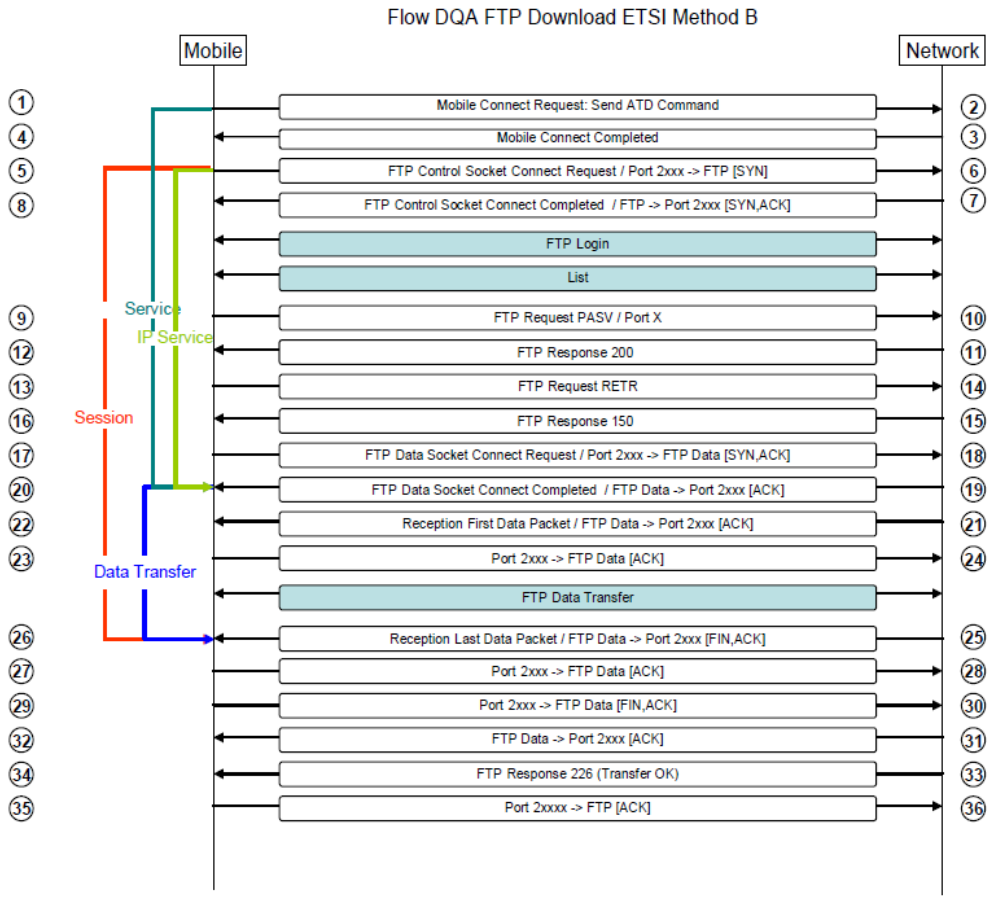
Stop: [TP 8]

Mobile receives the PDP context activation accept message.

9.4.2 FTP Download KPIs

9.4.2.1 ETSI FTP Download KPIs





Service Accessibility Ratio [%]

The service accessibility ratio denotes the probability that a subscriber can establish a PDP context and access the service successfully.

$$Service\ Accessibility\ Ratio\ [\%] = \frac{\#\ of\ Successful\ attempts}{Total\ \#\ of\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 22]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Setup Time [ms]

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Setup Time [ms] = first data packet received [ms] – dialup connection initiated [ms]

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 22]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

IP – Service Access Ratio [%]

The IP-service access ratio denotes the probability that a subscriber can establish an IP connection to the server of a service successfully.

$$IP\ Service\ Access\ Ratio\ [\%] = \frac{\#\ of\ Unsuccessful\ service\ accesses}{Total\ \#\ of\ \ service\ access\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 22]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

IP – Service Setup Time [ms]

The IP-service setup time is the time period needed to establish an IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

IP Service Setup Time [ms] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 22]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Completed Session Ratio [%]

The completed session ratio is the proportion of completed sessions and sessions that were started successfully.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Completed\ sessions}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 26]

Reception of the last data packet containing content.

Session Time [ms]

The session time is the time period needed to successfully complete a data session.

Session Time [ms] = session end [ms] – session start [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 26]

Reception of the last data packet containing content.

Mean Data Rate [kBit/s]

After a data connection has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

$$Mean\ Data\ Rate\,[kBit/s] = \frac{User\ data\ transferred\ bits\,[kBit]}{End\ data\ transfer\,[ms] - start\ data\ transfer\,[ms]} \times 1000$$

Trigger Points

ETSI Method A:

Start: [TP 22]

Reception of the first data packet containing content.

Stop: [TP 26]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK] (Data Socket).

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Stop: [TP 26]

Reception of the last data packet containing content.

Data Transfer Cut-off Ratio [%]

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

$$Data\ Transfer\ Cut-off\ Ratio[\%] = \frac{\#\ of\ Incomplete\ data\ transfer}{\#\ of\ Successfully\ started\ data\ transfers} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 22]

Reception of the first data packet containing content.

Stop: [TP 26]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK] (data socket).

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Stop: [TP 26]

Reception of the last data packet containing content.

Round Trip Time [ms]

The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. For this measurement the service must already be established.

IP Service Setup Time [s] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 7]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP control socket connection.

9.4.2.2 R&S ROMES FTP Download KPIs

Transfer Time [ms]

The transfer time is the time span between start and end of the data transfer. Although this is not an ETSI KPI, the time calculation depends on the selected ETSI method, because this transfer time is used to calculate the Mean Data Rate KPI.

Transfer Time [ms] = transfer end [ms] – transfer start [ms]

Trigger Points

ETSI Method A:

Start: [TP 22]

Reception of the first data packet containing content.

Stop: [TP 26]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK] (Data Socket).

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Stop: [TP 26]

Reception of the last data packet containing content.

Session Failure Ratio [%]

The session failure ratio is the proportion of not sessions with failure and all successfully started sessions.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Sessions\ with\ failures}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

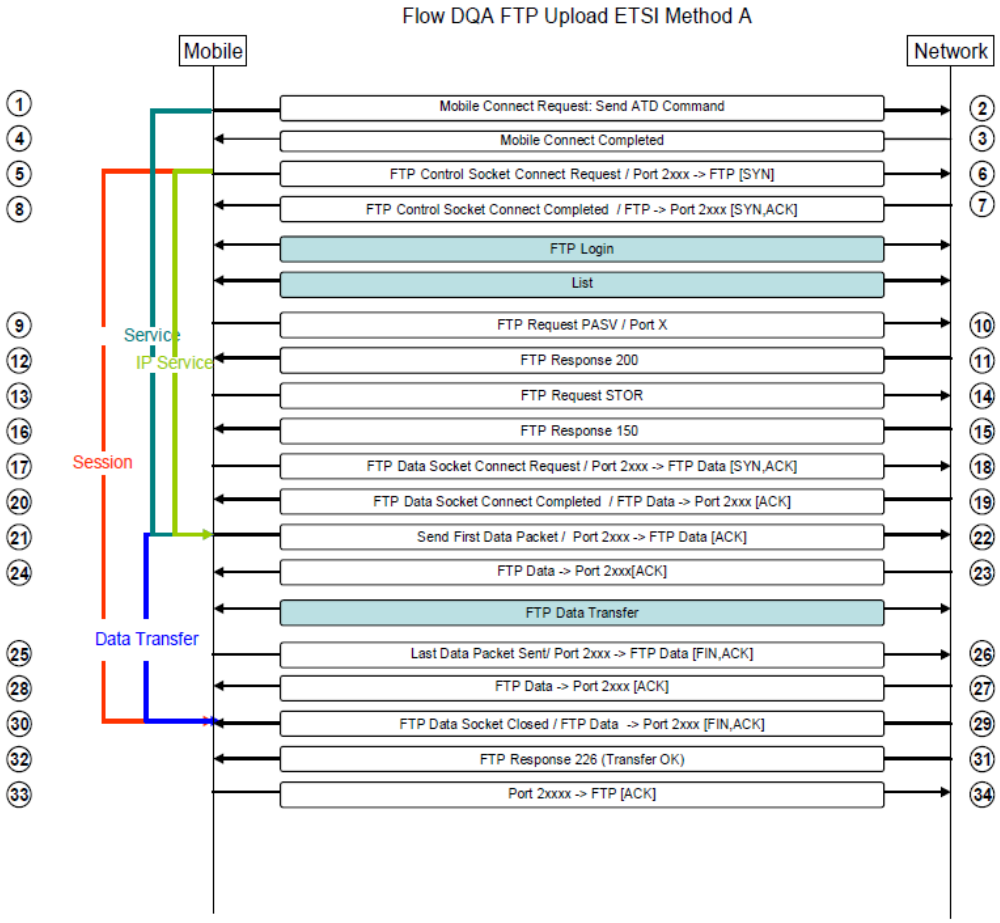
- KPI calculation without IP Tracer: FTP control socket connect request.

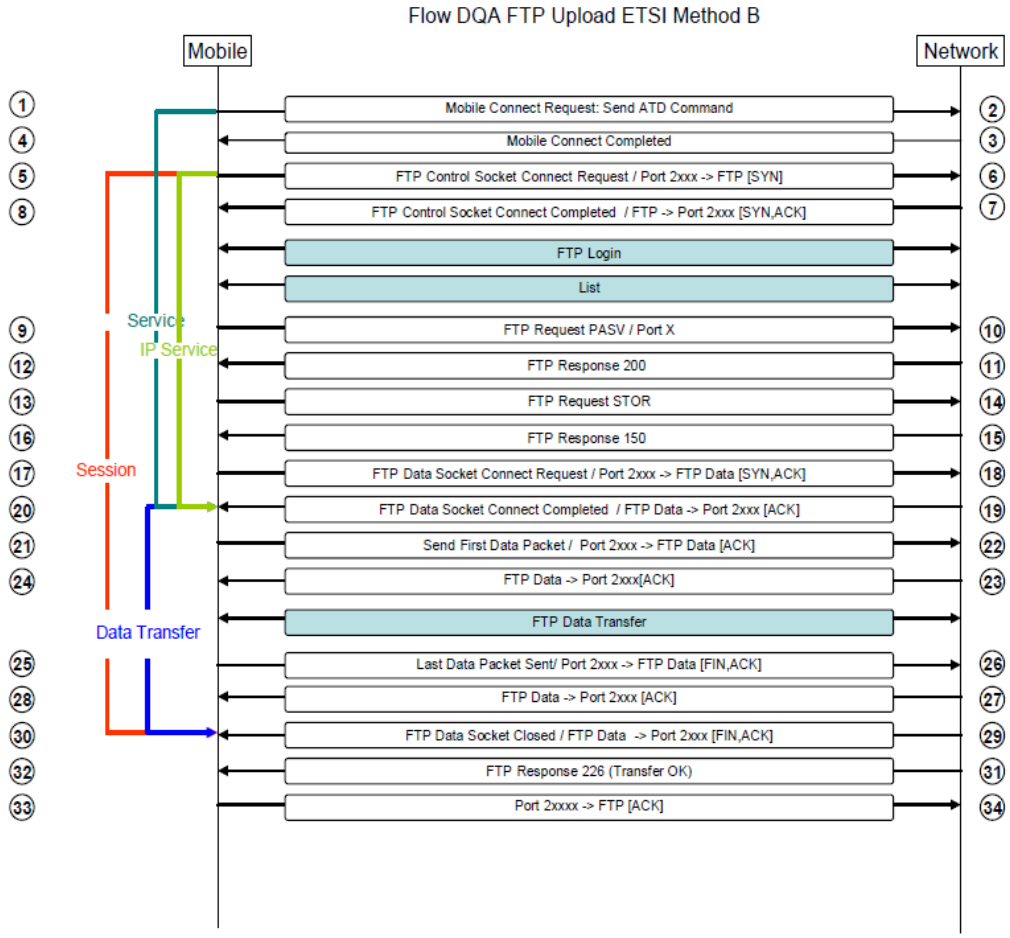
Stop: [TP 26]

Reception of the last data packet containing content.

9.4.3 FTP Upload KPIs

9.4.3.1 ETSI FTP Upload KPIs





Service Accessibility Ratio [%]

The service accessibility ratio denotes the probability that a subscriber can establish a PDP context and access the service successfully.

$$Service\ Accessibility\ Ratio\ [\%] = \frac{\#\ of\ Successful\ attempts}{Total\ \#\ of\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 21]

Sending of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Setup Time [ms]

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Setup Time [ms] = first data packet sent [ms] – dialup connection initiated [ms]

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 21]

Sending of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

IP – Service Access Ratio [%]

The IP-service access ratio denotes the probability that a subscriber can establish an IP connection to the server of a service successfully.

$$IP\ Service\ Access\ Ratio\ [\%] = \frac{\#\ of\ Unsuccessful\ service\ accesses}{Total\ \#\ of\ service\ access\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 21]

Sending of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

IP – Service Setup Time [ms]

The IP-service setup time is the time period needed to establish an IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

IP Service Setup Time [ms] = sending of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 21]

Sending of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK]

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Completed Session Ratio [%]

The completed session ratio is the proportion of completed sessions and sessions that were started successfully.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Completed\ sessions}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 30]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP data socket closed.

Session Time [ms]

The session time is the time period needed to successfully complete a data session.

Session Time [ms] = session end [ms] – session start [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 30]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP data socket closed.

Mean Data Rate [kBit/s]

After a data connection has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

$$Mean\ Data\ Rate\,[kBit/s] = \frac{User\ data\ transferred\ bits\,[kBit]}{End\ data\ transfer\,[ms] - start\ data\ transfer\,[ms]} \times 1000$$

Trigger Points

ETSI Method A:

Start: [TP 21]

Sending of the first data packet containing content.

Stop: [TP 30]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP data socket closed

ETSI Method B:

Start: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK] (Data Socket).

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Stop: [TP 30]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP data socket closed.

Data Transfer Cut-off Ratio [%]

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

$$Data\ Transfer\ Cut-off\ Ratio[\%] = \frac{\#\ of\ Incomplete\ data\ transfer}{\#\ of\ Successfully\ started\ data\ transfers} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 21]

Sending of the first data packet containing content.

Stop: [TP 30]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP Data Socket closed

ETSI Method B:

Start: [TP 20]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK] (data socket).

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Stop: [TP 30]

KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

KPI calculation without IP Tracer: FTP Data Socket closed.

Round Trip Time [ms]

The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. For this measurement the service must already be established.

IP Service Setup Time [s] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 7]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK].

- KPI calculation without IP Tracer: Successful FTP control socket connection.

9.4.3.2 R&S ROMES FTP Upload KPIs

Transfer Time [ms]

The transfer time is the time span between start and end of the data transfer. Although this is not an ETSI KPI, the time calculation depends on the selected ETSI method, because this transfer time is used to calculate the Mean Data Rate KPI.

Transfer Time [ms] = transfer end [ms] – transfer start [ms]

Trigger Points

ETSI Method A:

Start: [TP 21]

Sending of the first data packet containing content.

Stop: [TP 30]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP Data Socket closed

ETSI Method B:

Start: [TP 20]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: Successful FTP data socket connection.

Stop: [TP 26]

- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

- KPI calculation without IP Tracer: FTP data socket closed.

Session Failure Ratio [%]

The session failure ratio is the proportion of not sessions with failure and all successfully started sessions.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Sessions\ with\ failures}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

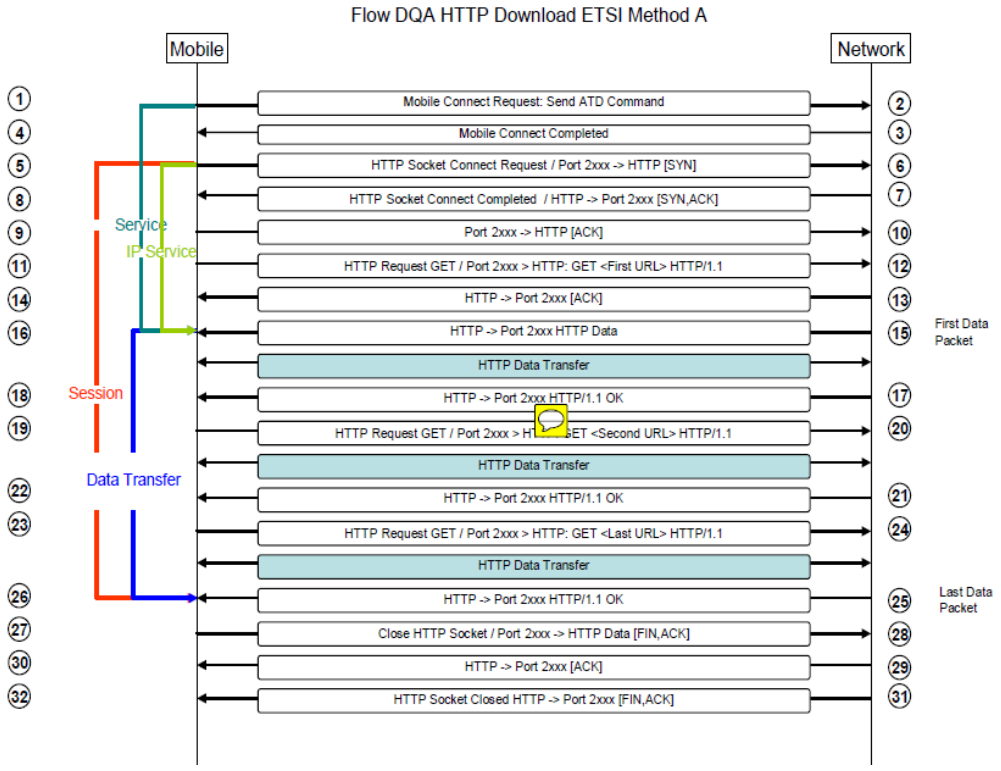
Stop: [TP 30]

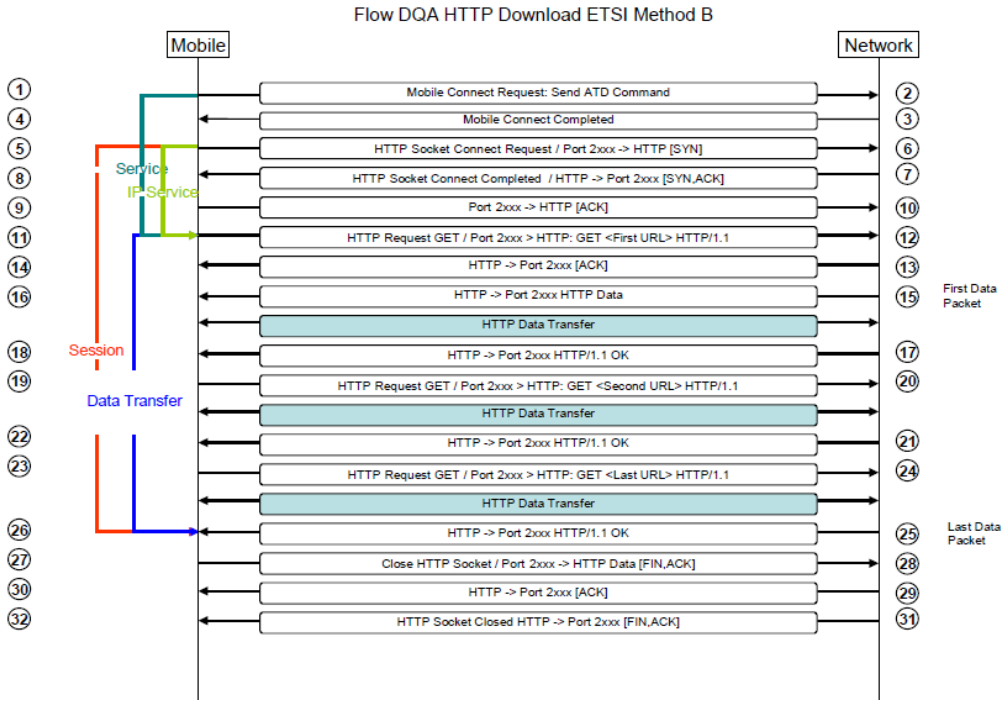
- KPI calculation with IP Tracer: Reception of the [FIN, ACK] for the last data packet containing content.

KPI calculation without IP Tracer: FTP data socket closed.

9.4.4 HTTP Download KPIs

9.4.4.1 ETSI HTTP Download, WEB 2.0 KPIs





Service Accessibility Ratio [%]

The service accessibility ratio denotes the probability that a subscriber can establish a PDP context and access the service successfully.

$$Service\ Accessibility\ Ratio\ [\%] = \frac{\#\ of\ Successful\ attempts}{Total\ \#\ of\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 11]

Sending of the first GET command.

Setup Time [ms]

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Setup Time [ms] = first data packet received [ms] – dialup connection initiated [ms]

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 11]

Sending of the first GET command.

IP – Service Access Ratio [%]

The IP-service access ratio denotes the probability that a subscriber can establish an IP connection to the server of a service successfully.

$$IP\ Service\ Access\ Ratio\ [\%] = \frac{\#\ of\ Unsuccessful\ service\ accesses}{Total\ \#\ of\ service\ access\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP socket connect request.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP socket connect request.

Stop: [TP 11]

Sending of the first GET command.

IP – Service Setup Time [ms]

The IP-service setup time is the time period needed to establish an IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

IP Service Setup Time [ms] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP socket connect request.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP socket connect request.

Stop: [TP 11]

Sending of the first GET command.

Completed Session Ratio [%]

The completed session ratio is the proportion of completed sessions and sessions that were started successfully.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Completed\ sessions}{Total\ \#\ of\ \ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP control socket connect request.

Stop: [TP 26]

Reception of the last data packet containing content.

Session Time [ms]

The session time is the time period needed to successfully complete a data session.

Session Time [ms] = session end [ms] – session start [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP socket connect request.

Stop: [TP 26]

Reception of the last data packet containing content.

Mean Data Rate [kBit/s]

After a data connection has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

$$Mean\ Data\ Rate\,[kBit/s] = \frac{User\ data\ transferred\ bits\,[kBit]}{End\ data\ transfer\,[ms] - start\ data\ transfer\,[ms]} \times 1000$$

Trigger Points

ETSI Method A:

Start: [TP 16]

Reception of the first data packet containing content.

Stop: [TP 26]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 11]

Sending of the first GET command.

Stop: [TP 26]

Reception of the last data packet containing content.

Data Transfer Cut-off Ratio [%]

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

$$Data\ Transfer\ Cut-off\ Ratio\,[\%] = \frac{\#\ of\ Incomplete\ data\ transfer}{\#\ of\ Successfully\ started\ data\ transfers} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 16]

Reception of the first data packet containing content.

Stop: [TP 26]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 11]

Sending of the first GET command.

Stop: [TP 26]

Reception of the last data packet containing content.

Round Trip Time [ms]

The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. For this measurement the service must already be established.

IP Service Setup Time [s] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: FTP control socket connect request.

Stop: [TP 7]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK].

- KPI calculation without IP Tracer: Successful HTTP socket connection.

9.4.4.2 R&S ROMES HTTP Download, WEB 2.0 KPIs

Transfer Time [ms]

The transfer time is the time span between start and end of the data transfer. Although this is not an ETSI KPI, the time calculation depends on the selected ETSI method, because this transfer time is used to calculate the Mean Data Rate KPI.

Transfer Time [ms] = transfer end [ms] – transfer start [ms]

Trigger Points

ETSI Method A:

Start: [TP 16]

Reception of the first data packet containing content.

Stop: [TP 26]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 11]

Sending of the first GET command.

Stop: [TP 26]

Reception of the last data packet containing content.

Session Failure Ratio [%]

The session failure ratio is the proportion of not sessions with failure and all successfully started sessions.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Sessions\ with\ failures}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: HTTP control socket connect request.

Stop: [TP 26]

Reception of the last data packet containing content.

9.4.4.3 HTTP Capacity Test KPIs

The HTTP Capacity Test KPIs are releated to the Downlink, Uplink and Downlink and Uplink transfer time. The transfer time is a time elapsed between the transfer starts and transfer ends in miliseconds.

Capacity (DL) Test Time

```
<kpi/>

<kpi name="HTTP Capacity Test (DL) Time" id="3201" timeout="-1" type="DURATION"
 session="true" reinitiate="false" unit="ms" >

<triggerpoint role="start" id="0x00012321040408A6"></triggerpoint>

    <triggerpoint role="stop" id="0x01012322040408A6"></triggerpoint>

<kpi/>
```

Capacity (UL) Test Time

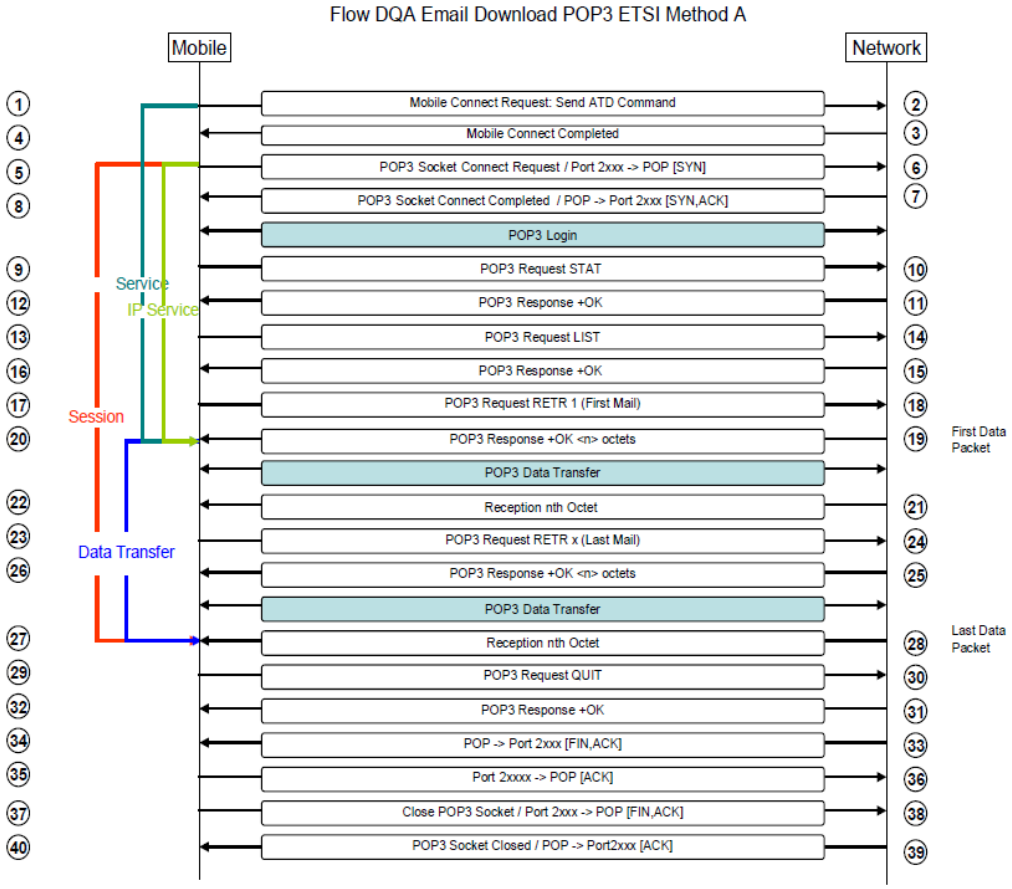
```
<kpi/>

<kpi name="HTTP Capacity Test (UL) Time" id="3202" timeout="-1" type="DURATION"
 session="true" reinitiate="false" unit="ms" >

<triggerpoint role="start" id="0x00022321040408A6"></triggerpoint>

    <triggerpoint role="stop" id="0x01022322040408A6"></triggerpoint>

<kpi/>
```

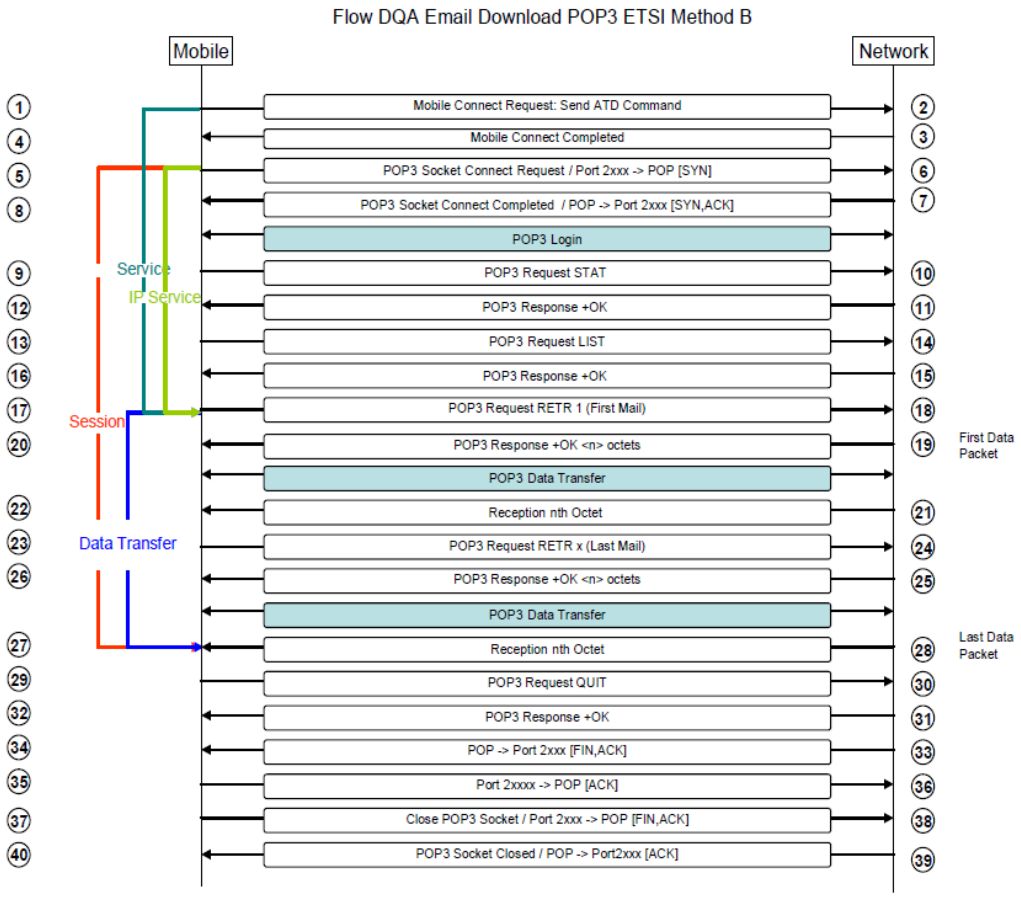
Capacity (DL/UL) Test Time

```
<kpi/>

<kpi name="HTTP Capacity Test (DL/UL) Time" id="3203" timeout="-1" type="DURATION"
 session="true" reinitiate="false" unit="ms" >

<triggerpoint role="start" id="0x00032321040408A6"></triggerpoint>

    <triggerpoint role="stop" id="0x01032322040408A6"></triggerpoint>

<kpi/>
```

9.4.5 E-Mail KPIs

9.4.5.1 ETSI E-Mail Download POP3 KPIs





Service Accessibility Ratio [%]

The service accessibility ratio denotes the probability that a subscriber can establish a PDP context and access the service successfully.

$$Service\ Accessibility\ Ratio\ [\%] = \frac{\#\ of\ Successful\ attempts}{Total\ \#\ of\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 20]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 17]

Send RETR command.

Setup Time [ms]

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Setup Time [ms] = first data packet received [ms]– dialup conncetion initiated [ms]

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 20]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 17]

Send RETR command.

IP – Service Access Ratio [%]

The IP-service access ratio denotes the probability that a subscriber can establish an IP connection to the server of a service successfully.

$$IP\ Service\ Access\ Ratio\ [\%] = \frac{\#\ of\ Unsuccessful\ service\ accesses}{Total\ \#\ of\ service\ access\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

Stop: [TP 20]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

Stop: [TP 17]

Send RETR command.

IP – Service Setup Time [ms]

The IP-service setup time is the time period needed to establish an IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

IP Service Setup Time [ms] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

Stop: [TP 20]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 control socket connect request.

Stop: [TP 17]

Send RETR command.

Completed Session Ratio [%]

The completed session ratio is the proportion of completed sessions and sessions that were started successfully.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Completed\ sessions}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

Stop: [TP 27]

Reception of the last data packet containing content.

Session Time [ms]

The session time is the time period needed to successfully complete a data session.

Session Time [ms] = session end [ms] – session start [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

Stop: [TP 27]

Reception of the last data packet containing content.

Mean Data Rate [kBit/s]

After a data connection has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

$$Mean\ Data\ Rate\,[kBit/s] = \frac{User\ data\ transferred\ bits\,[kBit]}{End\ data\ transfer\,[ms] - start\ data\ transfer\,[ms]} \times 1000$$

Trigger Points

ETSI Method A:

Start: [TP 20]

Reception of the first data packet containing content.

Stop: [TP 27]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 17]

Send RETR command.

Stop: [TP 27]

Reception of the last data packet containing content.

Data Transfer Cut-off Ratio [%]

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

$$Data\ Transfer\ Cut-off\ Ratio[\%] = \frac{\#\ of\ Incomplete\ data\ transfer}{\#\ of\ Successfully\ started\ data\ transfers} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 20]

Reception of the first data packet containing content.

Stop: [TP 27]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 17]

Sending of the RETR command.

Stop: [TP 27]

Reception of the last data packet containing content.

Round Trip Time [ms]

The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. For this measurement the service must already be established.

IP Service Setup Time [s] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

Stop: [TP 7]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK].

- KPI calculation without IP Tracer: Successful POP3 socket connection.

9.4.5.2 R&S ROMES E-Mail Download POP3 KPIs

Transfer Time [ms]

The transfer time is the time span between start and end of the data transfer. Although this is not an ETSI KPI, the time calculation depends on the selected ETSI method, because this transfer time is used to calculate the Mean Data Rate KPI.

Transfer Time [ms] = transfer end [ms] – transfer start [ms]

Trigger Points

ETSI Method A:

Start: [TP 20]

Reception of the first data packet containing content.

Stop: [TP 27]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 17]

Sending of the RETR command.

Stop: [TP 27]

Reception of the last data packet containing content.

Session Failure Ratio [%]

The session failure ratio is the proportion of not sessions with failure and all successfully started sessions.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Sessions\ with\ failures}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: POP3 socket connect request.

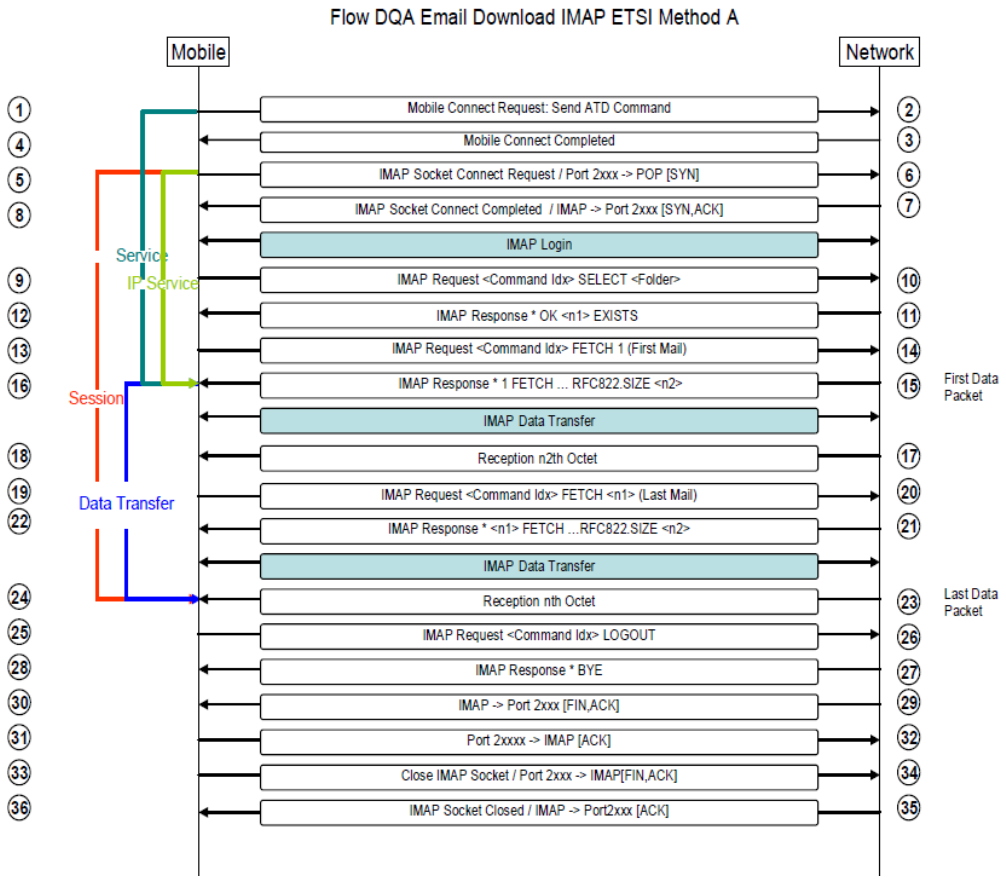
Stop: [TP 27]

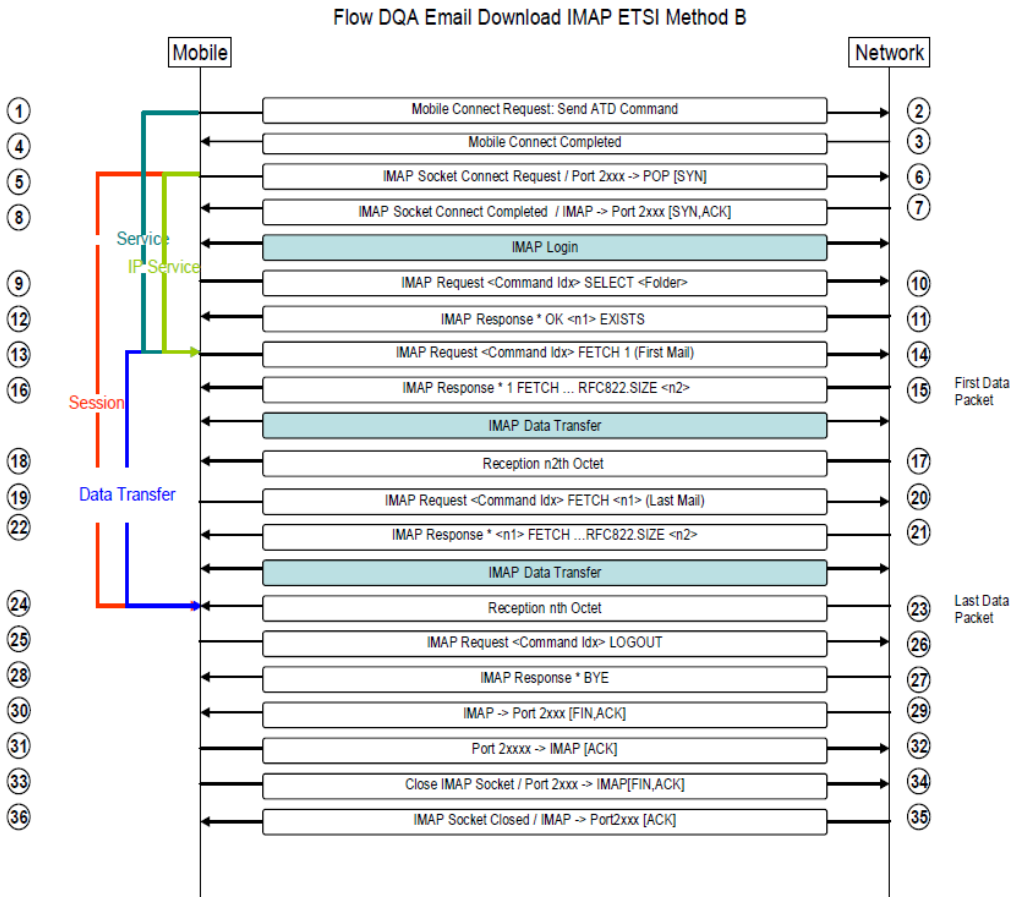
Reception of the last data packet containing content.

9.4.6 E-Mail KPIs

9.4.6.1 ETSI E-Mail Download IMAP KPIs

ETSI does not define calculations for IMAP. Due to that, the trigger points for IMAP are calculated with the ETSI methods A/B equivalent to the POP3 protocol.


Flow DQA Email Download IMAP ETSI Method A
Mobile
Network
Mobile Connect Request: Send ATD Command
Mobile Connect Completed
IMAP Socket Connect Request / Port 2xxx -> POP [SYN]
IMAP Socket Connect Completed / IMAP -> Port 2xxx [SYN,ACK]
IMAP Login
IMAP Request <Command Idx> SELECT <Folder>
IMAP Response * OK <n1> EXISTS
IMAP Request <Command Idx> FETCH 1 (First Mail)
IMAP Response * 1 FETCH .... RFC822.SIZE <n2>
First Data Packet
IMAP Data Transfer
Reception n2th Octet
IMAP Request <Command Idx> FETCH <n1> (Last Mail)
IMAP Response * <n1> FETCH ...RFC822.SIZE <n2>
IMAP Data Transfer
Reception nth Octet
Last Data Packet
IMAP Request <Command Idx> LOGOUT
IMAP Response * BYE
IMAP -> Port 2xxx [FIN,ACK]
Port 2xxxx -> IMAP [ACK]
Close IMAP Socket / Port 2xxx -> IMAP[FIN,ACK]
IMAP Socket Closed / IMAP -> Port2xxx [ACK]
Service
IP Service
Session
Data Transfer



Service Accessibility Ratio [%]

The service accessibility ratio denotes the probability that a subscriber can establish a PDP context and access the service successfully.

$$Service\ Accessibility\ Ratio\ [\%] = \frac{\#\ of\ Successful\ attempts}{Total\ \#\ of\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 13]

Send FETCH command.

Setup Time [ms]

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Setup Time [ms] = first data packet received [ms]– dialup conncetion initiated [ms]

Trigger Points

ETSI Method A:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 1]

ATD command from the mobile to the network.

Stop: [TP 13]

Send FETCH command.

IP – Service Access Ratio [%]

The IP-service access ratio denotes the probability that a subscriber can establish an IP connection to the server of a service successfully.

$$IP\ Service\ Access\ Ratio\ [\%] = \frac{\#\ of\ Unsuccessful\ service\ accesses}{Total\ \#\ of\ \ service\ access\ attempts} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 13]

Send FETCH command.

IP – Service Setup Time [ms]

The IP-service setup time is the time period needed to establish an IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

IP Service Setup Time [ms] = reception of first data packet [ms] – first [SYN] sent [ms]

Trigger Points

ETSI Method A:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 16]

Reception of the first data packet containing content.

ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP control socket connect request.

Stop: [TP 13]

Send FETCH command.

Completed Session Ratio [%]

The completed session ratio is the proportion of completed sessions and sessions that were started successfully.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Completed\ sessions}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 24]

Reception of the last data packet containing content.

Session Time [ms]

The session time is the time period needed to successfully complete a data session.

Session Time [ms] = session end [ms]– session start [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 24]

Reception of the last data packet containing content.

Mean Data Rate [kBit/s]

After a data connection has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

$$Mean\ Data\ Rate\,[kBit/s] = \frac{User\ data\ transferred\ bits\,[kBit]}{End\ data\ transfer\,[ms] - start\ data\ transfer\,[ms]} \times 1000$$

Trigger Points

ETSI Method A:

Start: [TP 16]

Reception of the first data packet containing content.

Stop: [TP 24]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 13]

Send FETCH command.

Stop: [TP 24]

Reception of the last data packet containing content.

Data Transfer Cut-off Ratio [%]

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

$$Data\ Transfer\ Cut-off\ Ratio\,[\%] = \frac{\#\ of\ Incomplete\ data\ transfer}{\#\ of\ Successfully\ started\ data\ transfers} \times 100$$

Trigger Points

ETSI Method A:

Start: [TP 16]

Reception of the first data packet containing content.

Stop: [TP 24]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 13]

Send FETCH command.

Stop: [TP 24]

Reception of the last data packet containing content.

Round Trip Time [ms]

The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. For this measurement the service must already be established.

IP Service Setup Time [s] = reception of first data packet [ms]– first [SYN] sent [ms]

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 7]

- KPI calculation with IP Tracer: Reception of the [ACK] from the [SYN, ACK].

- KPI calculation without IP Tracer: Successful IMAP socket connection.

9.4.6.2 R&S ROMES E-Mail Download IMAP KPIs

Transfer Time [ms]

The transfer time is the time span between start and end of the data transfer. Although this is not an ETSI KPI, the time calculation depends on the selected ETSI method, because this transfer time is used to calculate the Mean Data Rate KPI.

Transfer Time [ms] = transfer end [ms] – transfer start [ms]

Trigger Points

ETSI Method A:

Start: [TP 16]

Reception of the first data packet containing content.

Stop: [TP 24]

Reception of the last data packet containing content.

ETSI Method B:

Start: [TP 13]

Send FETCH command.

Stop: [TP 24]

Reception of the last data packet containing content.

Session Failure Ratio [%]

The session failure ratio is the proportion of not sessions with failure and all successfully started sessions.

$$Completed\ Session\ Ratio\ [\%] = \frac{\#\ of\ Sessions\ with\ failures}{Total\ \#\ of\ started\ sessions} \times 100$$

Trigger Points

ETSI Method A / ETSI Method B:

Start: [TP 5]

- KPI calculation with IP Tracer: First [SYN] sent.

- KPI calculation without IP Tracer: IMAP socket connect request.

Stop: [TP 24]

Reception of the last data packet containing content.

10 Messages

This chapter describes the messages shown during database maintenance procedures. Some of the choice list dialogs do not appear during measurement, they are only shown during manual database manipulations. Those messages are written to the file `CtoI_Reports.txt` in the `TestFiles` subdirectory of the R&S ROMES4 main directory.

- Message dialogs 2352
- Choice list dialogs 2352

10.1 Message dialogs

- "DB Init: Database Init OK": A database has been successfully loaded.
- "DB Init: Init Failed": The database could not be loaded. See the accompanying choice list dialog for details.
- "DB Init: Transmitter Scan is nonlinear": There are several Transmitter Scan values out of the allowed deviation. See the accompanying choice list dialog for details.

The other message dialogs are self explanatory.

10.2 Choice list dialogs

10.2.1 Message #1: Info – Unexpected network type

```
Message #1      Info
                Unexpected network type
                Database: DCS1800
                BTS_INFO frame: GSM
                Abort
```

Reason

A database was loaded which contains a network type different from the one chosen in the "network" field in the "DB Settings/Query" dialog.

Effect

The new database was not loaded.

10.2.2 Message #2: Info – Missing DLL

```
Message #2      Info
                Missing DLL
                No DLL GSS_K6_Import_... is available in the path
                Abort
```

Reason

If the user takes the opportunity to write a dynamical linked library (DLL) to define the load-ing of a network operator file of its own format this DLL must be in the main directory or in a directory being in the path so that automatic loading is possible.

Effect

The database is not created or updated.

10.2.3 Message #3: Info - Skip sector...

```
Message #3      Info
                Skip sector <nr> (name)
                Abort
                Suppress  this message for the next sectors
                OK
```

Reason

If the user takes the opportunity to write a dynamical linked library (DLL) to define the loading of a network operator file of its own format (see chapter 5) and has defined a situation where loading yields the return value SKIP_SECTOR this message appears, showing the sector number <nr> and, if defined, the sector name.

Effect

Abort selected: The database remains unchanged.

Suppress this message for the next sectors: During loading of the ASCII file, this message is not shown anymore on screen. Instead, all subsequent messages are written into the file `Dummy.chl` in the subdirectory `TestFiles`.

OK selected: This sector is not loaded, but the program continues loading the next sector.

10.2.4 Message #4: Format error wrong BCC

```
Message #4      Format error
                Wrong BCC
                At value: 8
                In line 33
```

```
BTS1 | 22.33454 | 44.5666 | 8 | 120 | 34 | 77
Abort
```

Reason

Format error was found in ASCII text.

Effect

The database remains unchanged.

Remarks

The error is specified in more detail by the name (here BCC), the value (here 8), the line number in the text file (here 33, where caption line is line number 0) and the contents of the complete line.

10.2.5 Message #5: Info - Line buffer ...

```
Message #5      Info
                Line buffer too small while reading antenna type list
                Abort
```

Reason

The length of one line in the antenna type list text file exceeds 256 bytes.

Effect

The database remains unchanged.

Remarks

The end-of-line character is Line Feed (= 0x0A)

10.2.6 Message #6: Info - More than 3 ...

```
Message #6      Info
                More than 3 sectors at one position with the same clock code.
                Ok
```

Reason

The database can handle up to 3 synchronized sectors at one position. If more than 3 sec-tors at one position share the same clock code, the PCSD will try to separate the sectors by their name. If that is not possible a message occurs.

Effect

The database remains unchanged.

10.2.7 Message #7: Info - Skip invalid position...

```
Message #7      Info
                Skip invalid position value:
                34.5566 -> 34.5578
                11.2345 -> 11.4345
                22.2 km (distance) > 0.6 km (max. range)
                Ok
                All
```

Reason

Before processing any Transmitter Scan data the system checks whether a valid position value was obtained during the last 3 evaluated seconds. A position value is valid if it lies inside a circle of radius r = 100 m + 120 km/h * (t - t1) around the position measured at time t1. Message no. 10 indicates that an invalid position value was detected.

Effect

OK selected:

The indicated position value will be skipped.

All selected:

The indicated position value and all subsequent invalid position values will be skipped.

Remarks

Parameters displayed:

position measured at time t1 (here: 34.5566, 11.2345)

invalid position at time t (here: 34.5578, 11.4345)

distance between the position values (here: 22.2 km)

allowed distance (here: 0.6 km)

10.2.8 Message #8: Info - Measurement not related...

```
Message #8      Info
                Measurement not related to database.
                Ok
```

Reason

No Transmitter Scan was assigned to a BTS in the database.

Effect

The database remains unchanged.

Remarks

Possible reasons

- The GPS was not working properly during the Transmitter Scan. In this case no position data for the Transmitter Scan are found and an assignment to a BTS is not possible.
- The Transmitter Scan was performed in an area for which no BTSs are available in the database
- The network has been provided with a new channel configuration, but the database has not been updated with this new configuration.
- If there is a finite reset probability per month for a BTS, the total reset probability might be above a threshold where an assignment is still reasonable. In this case, a new database should be created.

10.2.9 Message #9: Info - Start time...

```
Message #11     Info
                Start time evaluation failed.
                Ok
```

Reason

Synchronization between previous Transmitter Scans and the new one failed.

Effect

The database remains unchanged.

Remarks

No common BTSs were found or the reset probability for the BTSs found was too high.

10.2.10 Message #10: Different timing...

Example 1

```
Message #12     Different timing for one base station:
                BTS_A1 [25: 7 ]
                [ C0:BCC]    Probability  T51(TS)/us  Distance/km  Power/dBm
                [ 25: 7 ]    99.7%        011234      3.5          -77
                [ 25: 7 ]    98.4%        123567      4.7          -88
                Do not use 1st measurement.
                Do not use 2nd measurement.
                Do not use either measurement.
```

BTS_A1 [25: 7]	BTS name [C0: BCC]
[C0:BCC]	Channel and BCC of measurement value
Probability	Probability that the measurement belongs to the given BTS

T51(TS)/us	Synchronization time of the T51 frame within the Transmitter Scan. Note: This time (TS) is not the time in the database because the start time of the Transmitter Scan file was not evaluated while this message was produced.
Distance/km	Distance of measurement to the BTS
Power/dBm	Received power in Transmitter Scan

Example 2

```
Message #12     Different timing for one base station:
                BTS_B1 [27: 7 ]
                BTS_B2 [33: 7 ]
                BTS_B3 [49: 3 ]
                [ C0:BCC]    Probability  T51(dB)/us  Distance/km  Power/dBm
                [ 33: 7 ]    99.3%        055534      3.5          -61
                [ 49: 3 ]    97.4%        177777      4.7          -85
                Do not use 1st measurement.
                Do not use 2nd measurement.
                Do not use either measurement.
```

BTS_B1 [27: 7] BTS_B2 [33: 7] BTS_B3 [49: 3]	Names of synchronized sectors and [C0: BCC] information.
[C0:BCC]	Channel and BCC of measurement value
Probability	Probability that the measurement belongs to the given BTS (one of the sectors)
T_{51}(dB)/us	Synchronization time of the T_{51} frame within the Transmitter Scan. Note: This time (dB) is the time in the database because the start time of the Transmitter Scan file was evaluated before this message was produced.
Distance/km	Distance of measurement to the BTS
Power/dBm	Received power in Transmitter Scan

Reason

- The BTS list is not complete or the C0 channel number or BCC value has been changed.
- During the Transmitter Scan a signal from BTS A [C0, BCC] was received next to BTS B. The power of the signal was high with respect to the distance to BTS A and C0, BCC is reused for BTS B. In this case the evaluated probability value that the received signal belongs to BTS B was higher than 95%. At another location next to BTS B the signal of BTS B was received. So there are two measurements for BTS B.
- If 2 or 3 sectors are given and the measurements have been performed on different channels (as in example 2) the clock code setting for this BTS may be wrong. In this case the given sectors have the same clock code and the PCSD is forced to assign the same synchronization time to each sector. If the sectors are not synchronized, then this message is displayed.

Effect

Either the first, the second or both measurements can be discarded.

Remarks

To assign a Transmitter Scan value to a BTS the probability that the measurement belongs to the BTS is calculated and assessed. The assignment is made if this probability exceeds 95%. In the case that two measurements with different synchronization times for the T51 frames belong to the same BTS with a probability greater than 95%, message no. 13 will appear.

10.2.11 Message #11: Difficult assignment

Example 1

```
Message #13     Difficult assignment:
                TS from: 06.22.97 15.30.07  P =-88 dBm T51 = 098840
                Sector name   p(P)    p(P, T51)   d/km   T51/us
                BTS_A1       98.0%    1.5%        3.7    123456
                BTS_B2       2.0%     98.5%       17.8   098883
                Use first assignment
                Do not use first assignment
```

Example 2

```
Message #13     Difficult assignment:
                TS from: 06.22.97 15.30.07  P =-69 dBm T51 = 05789
                Sector name   p(P)   p(P, T51)   d/km   T51/us
                BTS_A1       98.0%   3.5%        3.7    123456
                TS_B2        2.0%    96.5%       19.5   ---
                Use first assignment
                Do not use first assignment
```

TS from: 06.22.97 15.30.07	Date and time of the measurement
P = -88 dBm	Measured power
T_{51} = 098840	Measured synchronization time for T_{51} frame
Sector name	Name of the sector of both BTSs the measurement may belong to
p(P)	Probability of received power
p(P, T_{51})	Probability of received power and T_{51} synchronization time
d/km	Distance from the measurement position to the location of BTS
T_{51}/us	Last synchronization time value assigned to the BTS

Reason

In both examples, the first given BTS has the higher power probability, whereas the second has the higher probability with respect to power and time.

In example 1 it is highly probable that the measurement belongs to the BTS_B2 due to the matching of the old and new measured T51 time.

In example 2 the new measured T51 value does not match the value in the database for BTS_A1. For the BTS_B2 no previous synchronization time measurement exists. This is why the probability p(P, T51) for BTS_B2 is higher than for BTS_A1.

Effect

Example 1:

<Do not use first assignment> may be a good choice.

Example 2:

If it is positively known that BTS_A1 was hit by a reset between the last and the new Transmitter Scan, or if it is not probable that the signal from BTS_B2 was received with a power of –67 dBm at a distance of 19.5 km, then it may be the right choice to assign the measurement value to BTS_A1 by selecting <Use first assignment>.

Remarks

To assign a Transmitter Scan to a BTS, two probabilities p(P) and p(P, T51) will be evaluated if some BTSs already have synchronization time values obtained from other measurements in the same Transmitter Scan file or other measurements in the database.

The probability p(P) takes into account the received power and position of the measurement and location, transmitted power, antenna type and direction for all the BTSs listed in the database which match the C0 and BCC of the Transmitter Scan.

For the probability p(P, T51) will be used in addition to the measured synchronization time of the T_{51} frame and the probability function for this synchronization time for each BTS which depend on the existence of a previous T51 measurement, the age of this measurement, the drift of the BTS and the reset probability. In case that p(P) and p(P, T_{51}) contradict each other, message no. 13 will be produced.

10.2.12 Message #12: Info - ... sectors were...

```
Message #14     Info
                ... sectors were discarded in the validation of its values
                Ok
```

Reason

After reading a base station list, the program checks, whether the entries are consistent (e.g. channel 150 does not denote a valid channel). If the data are not consistent, a message appears in the K6 Message View window for each sector containing such inconsistent data.

Effect

These sectors are not included in the database.

11 R&S ROMES4 remote control

R&S ROMES4 Remote Control function requires the R&S ROMES4RCO option.

The chapter describes commands and messages supported by the R&S ROMES4 Remote Control IP Socket application.

- R&S ROMES4 IP remote control - getting started 2360
- Remote control commands 2365
- Available devices and measurement engines 2374
- Measurement engines 2377
- Remote control messages 2379

11.1 R&S ROMES4 IP remote control - getting started

The chapter describes the following tasks:

- Setting up a remote connection to R&S ROMES4 using the PuTTY tool. Use http://www.putty.org/ to download the tool.
- Performing an ACD task
- Retrieving the Top N lists for GSM, UMTS and LTE.

11.1.1 Setting up R&S ROMES4 remote connection

1. Install R&S ROMES4 software.
   Ensure that the necessary options for doing the aforementioned tasks are available.
2. If IP socket is used, set the DWORD (32-bit) registry key *RemoteSocket* to 1 in `HKEY_CURRENT_USER\Software\Rohde & Schwarz\ROMES4<version>\General\RemoteSocket`.

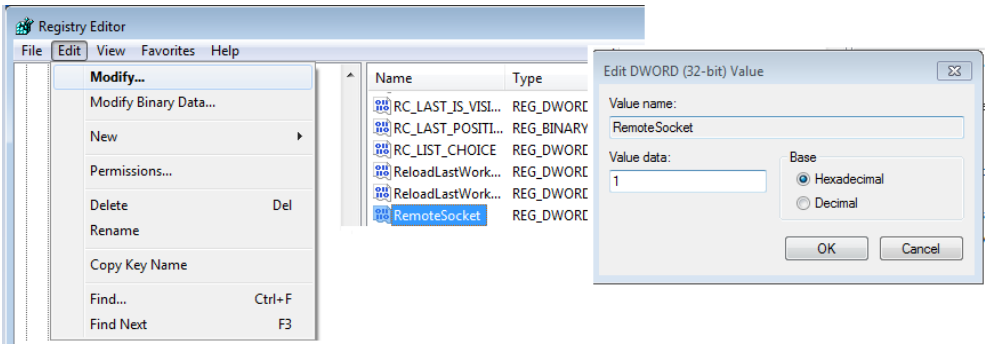


Figure 11-1: RemoteSocket key setting

Note: If the registry key "RemoteSocket" is set, all startup dialogs of the R&S ROMES4 user interface (UI) are disabled. To have all UI dialogs enabled again

after using R&S ROMES4 as remote controlled, delete the RemoteSocket key from the registry again.
By default, R&S ROMES4 listens on port 8084. To change the port number, create the WORD (32-bit) registry key *RemoteSocketPort* and modify the key's value with wanted port number in `HKEY_CURRENT_USER\Software\Rohde & Schwarz\ROMES4<version>\General\RemoteSocketPort`.

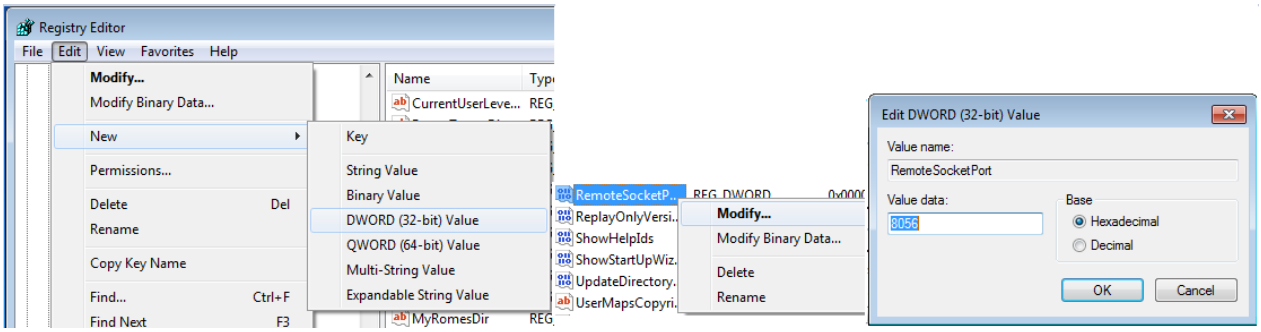


Figure 11-2: RemoteSocketPort creation and modifying the port value

3. Setup first the Top N pool for GMS, UMTS and LTE, respectively in "TEC for...". Check if the pools for the mentioned technologies are set to manual pool configuration. The manual pool configuration handles all detected cells without filtering.

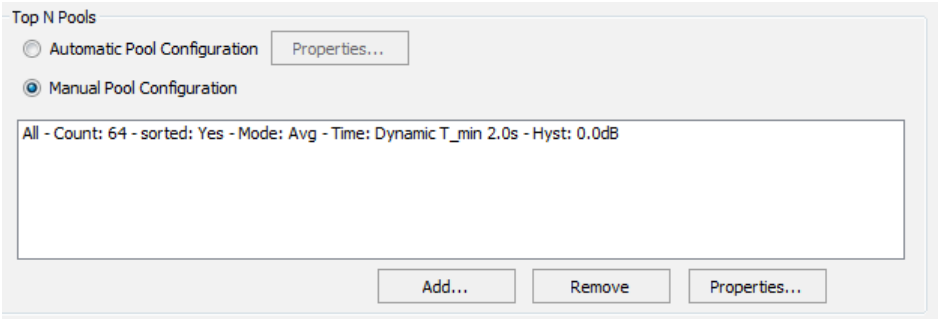


Figure 11-3: Selection of manual Top N pool configuration

4. In order to get the information about the best server for different technologies, use signal sets (Top N pool signals for GSM, UMTS and LTE). These signal sets give the value for the first Top N pool for each technology. On how to create these signal sets, refer to Chapter 11.2.1.3, "Measurement data command", on page 2370.
5. Start PuTTY; select the values for the "Connection type", "Host Name (or IP address)" and "Port" parameters as shown in the figure Figure 11-4.

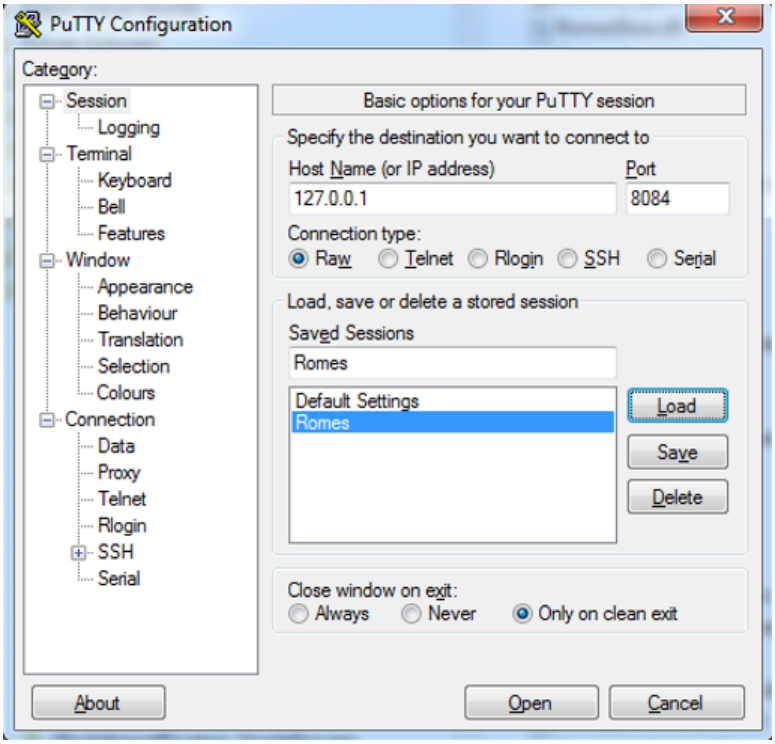


Figure 11-4: PuTTY configuration

6. Press the "Open" button.

   The remote connection to R&S ROMES4 by using PuTTY application is established now. The PuTTY window becomes black and the R&S ROMES4 window shows the red "Remote" pane in the status bar as the indication of the established remote connection.

11.1.2 Doing mesurement tasks

11.1.2.1 ACD and top n measurement for LTE, UMTS and GSM on selected bands with best server information

Example:

Perform the ACD measurement for LTE on bands 3, 7 and 20, for GSM on bands 900 and 1800 and for UMTS on band 1. The corresponding command is

```
Wizard ACD smart LTE@3,7,20 GSM@900,1800 UMTS@1.
```

Once the command is entered and the "Return" button is pressed, R&S ROMES4 starts configuring the measurement task automatically and responds with "OK".

1. To register the client for getting ACD measurement data, execute the command `Register Data ACD`.
2. To get additionally the Top N data for each technology, load the corresponding signal sets you have created under the step 4. of the procedure explained in the Chapter 11.1, "R&S ROMES4 IP remote control - getting started", on page 2360.
   Choose 1 second for the update rate.
   Load GSM as set 0, UMTS as set 1 and LTE as set 2. The commands are `SignalSet Load GSM_TopN.xml 0 2`, `SignalSet Load UMTS_TopN.xml 1 2` and `SignalSet Load LTE_TopN.xml 2 2`, respectively.
3. To register now the client for receiving the measured values of all signal sets, execute the command `Register Data SIGNALSET`.
4. After getting the "OK" response, start the measurement with the `meas` command

   PuTTY receives the incoming measurement data as defined by the ACD report and the signal sets:
   Data SIGNALSET2
   458;1;262;21009;-80.10;10.92;-100.26;-11.17;1815.00;1300;103602/0;456;-;-;-;-87.39;5.59;-107.58;-18.49;1815.00;1300;-;457;-;-;-;-101.87;-20.09;-117.28;-28.19;1815.00;1300;-;155;-;-;-;-99.96;-11.39;-114.95;-20.00;1815.00;1300;
   Data SIGNALSET0
   12;2;262;890;26012;76;-39.04;30;1;262;17249;5717;6;-39.84;101;1;262;17249;5718;15;-48.96;11;2;262;890;24023;72;-50.80;14;1;262;17249;51172;37;-56.80;93;1;262;17249;5716;36;-58.40;49;1;262;17249;30640;37;-61.44;36;1;262;17249;29232;20;-61.92;23;1;262;17249;51170;13;-62.08;41;1;262;17249;51244;24;-64.72;22;1;262;17249;26953;7;-66.08;85;1;262;17249;27671;1;-69.92;21;1;262;17216;53081;5;-70.64;27;1;262;17216;64680;35;-70.72;98;1;262;17249;58191;7;-71.28;15;-;-;-;-;12;-72.24;25;-;-;-;-;35;-72.56;21;-;-;-;-;34;-72.88;39;-;-;-;-;35;-73.36;40;1;262;17249;15098;11;-74.00;99;1;262;17249;32995;4;-74.80;82;1;262;17249;62961;3;-75.60;32;-;-;-;-;12;-75.84;22;-;-;-;-;22;-76.08;33;-;-;-;-;15;-76.24;124;1;262;17249;62965;34;-77.04;95;1;262;17249;15177;31;-77.44;94;1;262;17216;26963;20;-79.20;39;-;-;-;-;2;-79.36;19;-;-;-;-;7;-79.60;87;1;262;17249;30641;10;-80.24;33;-;-;-;-;17;-80.56;124;-;-;-;-;36;-81.20;97;-;-;-;-;34;-83.12;83;-;-;-;-;23;-85.28;716;7;262;51044;30069;77;-85.28;97;-;-;-;-;76;-86.56;686;7;262;51044;10067;77;-87.44;638;7;262;51047;50041;75;-88.56;77;2;262;890;26013;45;-90.80;79;-;-;-;-;32;-92.88;616;3;262;32619;62539;36;-92.96;986;3;262;32129;35980;37;-93.68;52;-;-;-;-;57;-93.76;74;2;262;890;23461;33;-94.48;63;2;262;890;22482;60;-94.88;993;3;262;32129;35960;37;-95.52;9;2;262;821;31592;57;-97.36;62;2;262;890;19612;41;-97.68;981;3;262;32619;54659;32;-97.84;731;2;262;890;26016;46;-100.96;811;3;262;32619;849;35;-101.68;620;3;262;32129;27290;31;-103.76;695;-;-;-;-;75;-103.92;770;-;-;-;-;33;-106.32;746;-;-;-;-;53;-106.40;-;-;-;-;-;-;-106.32;-;-;-;-;-;-;-106.40;
   Data SIGNALSET1

130;0;1;262;17352;21011;-41.5;10836;-3.1;-44.6;-44.4;130;0;1;262;17352;21012;-41.4;10812;-2.9;-44.4;-44.5;475;0;2;262;952;26016;-92.6;10588;-6.7;-99.3;-93.7;475;0;2;262;952;26012;-91.1;10564;-11.7;-102.8;-91.4;475;0;2;262;952;26019;-87.7;10612;-11.4;-99.1;-88.0;422;0;-;-;-;-;-91.9;10639;-15.5;-107.5;-92.0;483;0;-;-;-;-;-91.3;10564;-20.4;-111.7;-91.4;483;0;-;-;-;-;-87.5;10612;-23.1;-110.6;-87.5;418;0;-;-;-;-;-91.8;10639;-22.0;-113.8;-91.8;85;0;-;-;-;-;-91.1;10564;-21.6;-112.8;-91.2;483;0;-;-;-;-;-92.5;10588;-22.1;-114.7;-92.5;228;0;-;-;-;-;-87.3;10612;-27.1;-114.4;-87.3;
Data SIGNALSET0
30;2;262;890;26012;76;-38.56;30;1;262;17249;5717;6;-37.04;101;1;262;17249;5718;15;-47.12;11;2;262;890;24023;72;-50.56;14;1;262;17249;51172;37;-56.32;93;1;262;17249;5716;36;-56.24;49;1;262;17249;30640;37;-62.08;36;1;262;17249;29232;20;-60.64;23;1;262;17249;51170;13;-61.76;41;1;262;17249;51244;24;-63.60;22;1;262;17249;26953;7;-65.84;85;1;262;17249;27671;1;-67.12;21;1;262;17216;53081;5;-70.48;27;1;262;17216;64680;35;-70.72;98;1;262;17249;58191;7;-70.00;15;-;-;-;-;12;-80.72;25;-;-;-;-;35;-72.56;21;-;-;-;-;34;-71.84;39;-;-;-;-;35;-74.96;40;1;262;17249;15098;11;-74.00;99;1;262;17249;32995;4;-70.08;82;1;262;17249;62961;3;-73.76;32;-;-;-;-;12;-72.64;22;-;-;-;-;22;-76.08;33;-;-;-;-;15;-76.88;124;1;262;17249;62965;34;-77.04;95;1;262;17249;15177;31;-76.96;94;1;262;17216;26963;20;-76.80;39;-;-;-;-;2;-71.44;19;-;-;-;-;7;-80.80;87;1;262;17249;30641;10;-78.48;33;-;-;-;-;17;-80.56;124;-;-;-;-;36;-79.68;97;-;-;-;-;34;-82.08;83;-;-;-;-;23;-85.28;716;7;262;51044;30069;77;-84.56;97;-;-;-;-;76;-84.32;686;7;262;51044;10067;77;-86.56;638;7;262;51047;50041;75;-88.56;77;2;262;890;26013;45;-90.08;79;-;-;-;-;32;-91.36;616;3;262;32619;62539;36;-92.32;986;3;262;32129;35980;37;-92.00;52;-;-;-;-;57;-92.64;74;2;262;890;23461;33;-93.20;63;2;262;890;22482;60;-94.88;993;3;262;32129;35960;37;-95.20;9;2;262;821;31592;57;-98.16;62;2;262;890;19612;41;-97.12;981;3;262;32619;54659;32;-94.72;731;2;262;890;26016;46;-102.24;811;3;262;32619;849;35;-101.68;620;3;262;32129;27290;31;-103.04;695;-;-;-;-;75;-104.72;770;-;-;-;-;33;-106.32;746;-;-;-;-;53;-106.40;-;-;-;-;-;-;-106.32;-;-;-;-;-;-;-106.40;
Data SIGNALSET2
458;1;262;21009;-79.86;11.53;-100.02;-11.22;1815.00;1300;103602/0;456;-;-;-;-88.19;4.64;-108.18;-19.38;1815.00;1300;-;457;-;-;-;-101.60;-19.90;-117.34;-28.54;1815.00;1300;-;155;-;-;-;-100.23;-11.17;-115.39;-20.84;1815.00;1300;
Data ACD "LTE,Band 3 (FDD),20000000,true,1815000000,-" "UMTS,Band I (DL),4200000,true,2112800000,-" "UMTS,Band I (DL),4200000,true,2117600000,-" "UMTS,Band I (DL),4200000,true,2122400000,-" "UMTS,Band I (DL),4200000,true,2127800000,-" "UMTS,Band I (DL),4200000,true,2147600000,-" "UMTS,Band I (DL),4200000,true,2162400000,-" "UMTS,Band I (DL),4200000,true,2167200000,-"

The values in the SIGNALSET are the same as those obtained for them by the Alpha-numeric view. The units for the signals depend on settings.

To stop the measurement, execute the `stp` command.

11.2 Remote control commands

This chapter describes the supported commands of the application. The commands have a long and a short form.

The following applies for the remote control commands:

- The client application is responsible to call the only commands, which are allowed at a certain R&S ROMES4 mode
- The command text has to be transferred as an ANSI text, using the provided data structure
- The commands via socket have to be sent with a CR LF at the end. CR LF will trigger the command execution at the R&S ROMES4 side
- All strings which contain spaces have to be put into “ ”, for example, `"C:\Users\someone\Documents\My ROMES\MeasData"`
- Commands are case sensitive
- The "SendMessage" function of the client software will return a message after R&S ROMES4 has completed the required action. It will return TRUE, if the command has been recognized (NOT necessarily executed successfully) and FALSE, if not recognized

11.2.1 Supported commands

The following commands are supported:

- General commands
- Wizard commands
- Measurement Data commands
- Autostart commands

11.2.1.1 General commands

New workspace

```
NewWorkspace
NewW
```

Creates a new workspace.

Load measurement file path

```
LoadMeasurementFile path [true\false]
LdM path [true\false]
```

Loads the measurement file from the given path and scans the file or not. If no second parameter is given, the file is scanned by default.

Scan time interval

```
ScanTimeInterval StartTime EndTime
cT StartTime EndTime
```

Scans an open measurement file partially from the start to the end time.

Spool to timestamp command

```
SpoolToTimestampCommand TargetTime
```

Spools an open measurement file to the target timestamp (coupled focus).

Load workspace path

```
LoadWorkspace path
LdW path
```

Loads the workspace from the given path.

Save workspace path

```
SaveWorkspace path
SvW path
```

Saves the workspace to the given path or overwrites current one, if no path is given.

Start recording

```
StartRecording <path> [auto]
rec <path> [auto]
```

Starts the measurement and recording with the given measurement file name or generates a filename automatically if none is given.

If auto is set and the given file name already exists, than SME will add a suffix n (<path>_nnn.rscmd>) to the filename.

Start measuring

```
StartMeasuring <path>
meas <path>
```

Starts the measurement without recording with the given measurement file name or generates a filename automatically if none is given.

Start recording ex

```
StartRecordingEx <path>
recEx <path>
```

Starts the measurement and recording with the given mandatory measurement filename.

If the given filename already exists, than the SME will add a suffix n (<path>_nnn.rscmd>) to the filename.

Reaching a file split limit (either duration or file size) a split is done and a new file `<path>.nnn.mmm.rscmd` is started.

Changing from measurement (mesEx) to recEx <path> a split is done and a new file `<path>.nnn.mmm.rscmd` is started using the new <path>. As each new `*.rscmd` inherits the header info and the mandatory history, the newly started `*.rscmd` has a certain start size which is about >=300KB.

Start measuring ex

```
StartMeasuringEx
measEx
```

Starts the measurement without recording, generates a filename automatically.

For example, started R&S ROMES4 in SME mode generates a file named `...\\2018-08-14_13-49-08_SME.rscmd`

Reaching a file split limit (either duration or file size) a split is done and a new file `<path.nnn.mmm.rscmd` is started.

Changing from recording (recEx <path>) to measEx the recorded `*.rscmd` file is closed and a split is done. A new file `<path>.nnn.mmm.rscmd` is started using the auto generated filename for measuring. As each new `*.rscmd` inherits the header info and the mandatory history, the newly started `*.rscmd` has a certain start size which is about >=300KB. The `*.rscmd` is not growing while state is measuring.

Stop

```
Stop
stp
```

Stops the measurement.

Register

```
Register <ModeChange> <OutputView>

reg <ModeChange> <OutputView>
```

Registers the caller to get messages for R&S ROMES4 Mode Changes and/or updates the R&S ROMES4 Output View.

During the registration the current mode will be reported.

```
Register ModeChange
ModeChange Idle Idle
OK
```

Deregister

```
Deregister <ModeChange> <OutputView>

dereg <ModeChange> <OutputView>
```

Deregisters the caller to get messages for R&S ROMES4 Mode Changes and/or updates the R&S ROMES4 getOutput View.

Get system info

```
Get SystemInfo
```

The command allows the user to retrieve information about the system. This information includes:

- Version of measurement server
- State of the system
- State of the systems device scanner
- accEngineState: accumulate state of engines. This is the result of the "or" of all engine states.

```
Get SystemInfo
SystemInfo 131 BINARY
<SystemInfo>
<Version>4.89.0.2930</Version>
<SystemState>Idle</SystemState>
<HardwareScan>Finished</HardwareScan>
<accEngineState>00</accEngineState>
</SystemInfo>OK
```

Prepare shutdown

```
PrepareShutdown
```

Call this function before you stop the R&S ROMES4 process.

Set comment

```
Set Comment <any Text>
```

It is possible to set comments remotely (the same as done with CTRL+F12 from the GUI) during recording measurement data. If the SME is not recording the command, it will return an error.

Set logging

```
Set Logging [On/Off] <Path>
```

This command allows the host process to enable a log file. "On" enables the logger, "Off" disables the logger. For "On" it is possible to specify the logfile with path. If no path is specified, the default SME logging path is used.

For example

```
Set Logging On
Set Logging On C:\mylogfilefolder\smelog.txt
Set Logging Off
```

11.2.1.2 Wizard commands

Wizard type

```
Wizard <Type> <Type specific Argumentlist>
wiz <Type> <Type specific Argumentlis>
```

Executes the wizard with the given argument list.

Type	Comment
ACD	Automatic Channel Detection Wizard Argument list is: [**smart**|simple] [low|medium|high] [gps|pe] [IP@a.b.c.d][L3]<Tec1@Bands1> <Tec2@Bands2>... **smart**|simple: smart: Use RF Power scanner, simple: ACD without assistance of RF Power scanner, has to test every channel low|medium|high: ACD sensitivity; more fast or more sensitive measurement gps|pe: gps: use GPS pe: use position estimator and use GPS IP@a.b.c.d: try tool load device with IP address a.b.c.d L3: if the L3 command is added, the Layer 3 Message feature will be activated Tec: LTE, NBIOT, UMTS, GSM, 3GPP2, 5G_NR Bands: 1,2,3,4 (see Configure Command) Bands GSM: 450,480,850,900,1800,1900 For example Wizard ACD smart pe LTE@3,7,20 GSM@900,1800 UMTS@1

Configure ACD

```
Configure ACD <Tec> <Bands>
Cfg ACD <Tec> <Bands>
```

Configures the ACD of a certain technology with the given bands. The caller has to ensure that the drivers are loaded correctly. No list of <Tec> <Bands> is allowed. Use separate commands instead.

Table 11-1: Supported technologies

Tec	Remark
LTE	LTE ACD Bands are the LTE Bands N, for example, to enable Bands 2,4,6 use the `Config ACD LTE 2,4,6` command
NBIOT	NB-IoT ACD Bands are the LTE Bands N, for example, to enable Bands 2,4,6 use the `Configure ACD NBIOT 2,4,6` command Be aware that scanning NB-IoT a LTE scanning is also necessary and bands of LTE must be similar with bands of NB-IoT
UMTS	UMTS ACD Bands are the UMTS Bands N, for example, to enable Bands I,II,VI use the `Config ACD UMTS 1,2,6` command

Tec	Remark
3GPP2	cmda/EVDO ACD Bands are the 3GPP2 Band Class N, for example, to enable Band Classes 0,1,10 use the `Config ACD 3GPP2 0,1,10` command
TETRA	TETRA ACD Bands are the N-the TETRA Block. Each block has 50MHz. Block 0 is 300 MHz to 350MHz, Block 1 is 350MHz to 400MHz, and so on. For example, to scan the frequencies from 350MHz to 450MHz use the `Config ACD TETRA 5,6` command
WiMAX	WiMAX ACD Bands are specified by the start frequency. The following bands are currently supported: 23: 2.3 GHz - 2.4 GHz 25: 2.5 GHz - 2.6 GHz 3.3: 3.3 GHz - 3.4 GHz 34: 3.4 GHz - 3.5 GHz 35: 3.5 GHz - 3.6 GHz 57: 5.725 GHz - 5.85 GHz
5G_NR	5G NR ACD Bands are specified in TS38101-1/-2. Currently only bands are allowed which are below 6GHz, bands from FR2 are not supported. Following bands are currently supported: n1.. n79 but there are many not defined! For example use the `Configure ACD 5G_NR 3,5` command

Special ACD configuration commands

- `Configure ACD TrackingRatePerChannel <Rate>`
  Sets the target scan rate per channel of the tracking scanners to the given rate in Hertz.
  For example
  `Configure ACD TrackingRatePerChannel 0.1`
- `Configure ACD SaveTemplates <true|false>`
  Enables or disables saving templates.

11.2.1.3 Measurement data command

Register data

`Register Data <Type> <Subtype>`

An application can register to receive measurement data. Currently supported measurements are listed in the following table.

Table 11-2: Supported measurement types

Type	Source	Report Format
ACD	ACD Measurement Identified Spectra of the Blind-ScanFrame will be reported Subtype not used	Data ACD <"Tec,Band,Bandwidth,BWTrue,Frequency,Flags">,... For example, "LTE,3,10000000,true,1815000000,-"
SIGNALSET	R&S Signals and Events If subtypes is given, only the corresponding signalset is registered	• Signals The report format depends on the specified signal-set. The number of the reported set is appended to the SIGNALSET keyword. Data SIGNALSET0 a;b;c;d; • Events All events will be forwarded to the client in the following format: Data EVENT timestamp;Source;Name;Info

Deregister data

```
Deregister Data <Type> <Subtype>
```

Deregisters the corresponding data handler; stands for the same measurement data previously mentioned.

Signal set load

```
SignalSetLoad <File.xml> <Number> <UpdateRate>
```

Loads the signal set from `*.xml` files.

The file has to be located in the CurrentUser\My Documents\MyRomes\RemoteSignalSets folder.

The given number is assigned to the signal set. If a signal set with this number has been loaded earlier, it will be replaced. The update rate specifies how often the data is reported. The given number will be multiplied by 500 ms.

For example, `SignalSet Load "MyFile.xml" 0 2` means signals in the `MyFile.xml` file will be stored in the signal set 0 and their values will be reported once a second.

Signal set reset

```
SignalSet Reset
```

Unloads all signal sets.

Loading a workspaces resets the complete signal set configuration. All required sets have to be configured again.

Signal set file format and creation

The signal set file is a xml file with the following format:

```
<?xml version="1.0" encoding="iso-8895-1"?>
<romes>
```

```
        <section name="CRomesSignalRemoteReport_0">
                <value name="Count">2</value>
                <value name="Device0">0</value>
                <value name="Device1">0</value>

                <value name="Object0">LTE_SCAN-TOP_N_0-TOP_N_CELL_ID_0</value>
                <value name="Object1">LTE_SCAN-TOP_N_0-TOP_N_MNC_0</value>
        </section>
</romes>
```

The section name is fixed to CRomesSignalRemoteReport_0.

The value of the item Count is the number of containing signals. For each signal Device<n> and Object<n> items are expected to be present in the file.

The Device<n> defines the driver from which the signal is taken. The Device0 means that the signal is produced from the first instance (driver). The Device1 means the signal is produced from the second driver.

The Object<n> defines the ROMES Signal ID. The ID of a signal can be obtained from the ToolTip for a certain signal in the "ROMES Signal Tree" or by the exported "Descriprion of R&S ROMES4 Signals" document (Help Menu), which contains all R&S ROMES4 signals.

The file has to be located in the <Current User>\Document\My ROMES\RemoteSignalSets folder.

R&S ROMES4 offers an easy way to create such file. It is described in the following procedure.

1. Drag and drop all required signals from the "Signal Tree" to the "Alphanumeric View".
2. Click the "Export Remote Control Signal Set" command to export the file.

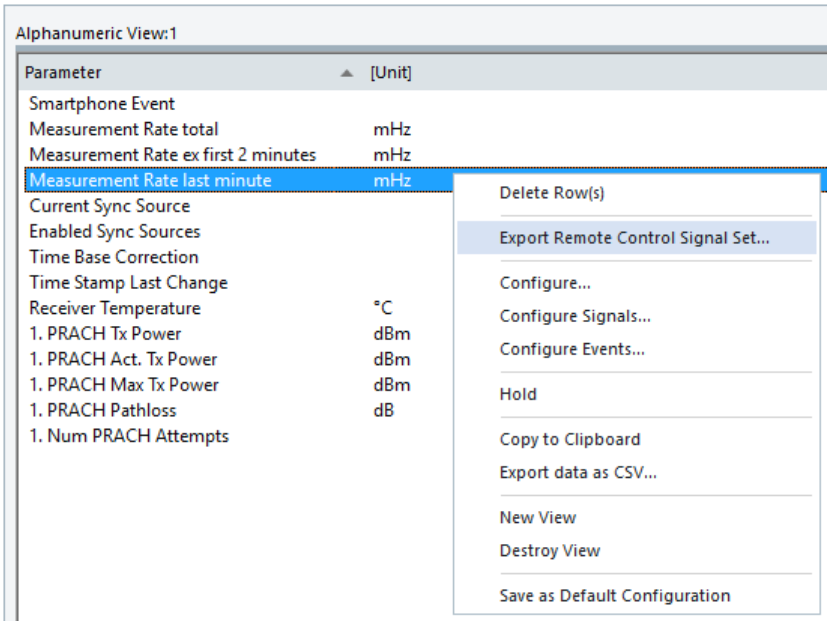


Figure 11-5: Exporting signal set for remote control

3. Enter a name, which can be used as the filename and click "Create".

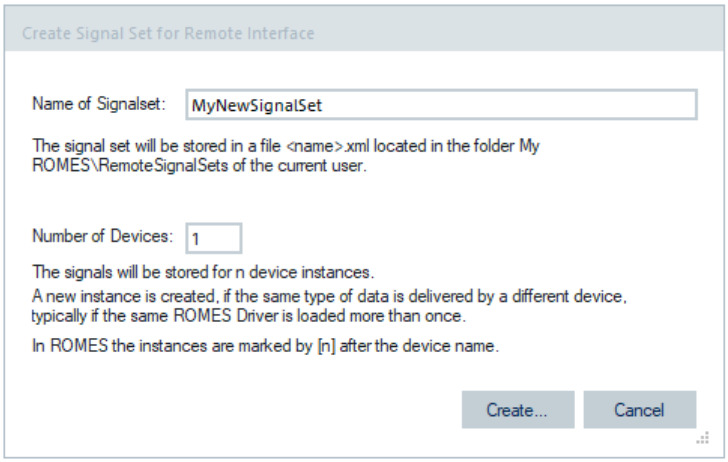


Figure 11-6: Naming the xml file

The file is exported and stored in the aforementioned folder under the given name.

Register binary

```
Register Binary <Type>
```

An application can register to receive binary phylis frames of certain types.

The registration means deletion of the frame IDs in the current list and filling it with the IDs of this command.

Type	Source	Report Format
Binary	R&S ROMES4 Measurement	Example: Register Binary 8000 8100 the command forwards all produced frames with ID 8000 and 8100 to a client. *Binary Length S<binary data>E*

Deregister binary

```
Deregister Binary
```

Removes all subscribed data ID from the list.

Request

```
Get <Type> <SubType> <Mode> <Instance>
```

The client can pool the information types listed in the table.

Table 11-3: Types of information

Type	SubType	Mode	Instance	Report Format
BCH	GSM, UMTS, LTE, 3GPP2, TETRA, WiMAX	0 (default): no reporting of BCH messages 1: BCH messages included	Instance of scanner device 0 (default)	Example: Request BCH GSM 0 The reported result in XML format has the following tags: • Provider • Channel • Transmitter • Message Requested BCH GSM *instance XML Content*
ACD				Example: Request ACD The result, which represents the content of the identified spectra blocks in the R&S ROMES. ACD Status View is reported in XML format.

11.2.1.4 Autostart commands

It is possible to define Remote Control commands which are executed each time R&S ROMES4 starts up and after a workspace is loaded. Just put the commands into the `RemoteIPAutostart.txt` file which has to be placed in the <My Documents>\My ROMES\configuration folder.

11.3 Available devices and measurement engines

11.3.1 Get devices

```
Get DEVICES
```

This command requests the list of currently connected devices. The list contains all devices and their capabilities. It is the responsibility of the host application to check the available options of the devices before loading and/or configuring the measurement engines.

For example

```
Get DEVICES
<ScannerType="TSME (FrontEnd:1)" ID="192.168.0.2@MU724954" Serial="100582">
<Connection>192.168.0.2@MU724954</Connection>
<TSMEInfo>
<FrontEnd>0</Frontend>
<TimeBase>0</TimeBase>
<SyncMask>0</SyncMask>
</TSMEInfo>


<NrOfRx>1</NrOfRx>
<Options>
<Bands>
<Band Min="375" Max="435>TETRA</Band>
<Band Min="445" Max="475>TETRA</Band>
<Band Min="865" Max="881>TETRA</Band>
<Band Min="910" Max="926>TETRA</Band>
</Bands>
<Applications>
<Option id="0">Demo 18 months (0)</Option>
</Applications>


</Options>
</Scanner>
OK
```

11.3.2 Get engines

```
Get ENGINES
```

The engines are the actual use cases which can be performed using one of the connected devices. The list of the engines contains the name of the engine, its ID and a list of devices which can be used with the measurement engine.

- ID: Unique ID of the engine; other commands refer to this ID

- Name: User-friendly name of the engine

- Type: Type of engine

Table 11-4: Type of engine

Type	Technology
1000	GPS
8001	UMTS Scanner
8003	cdma/EVDO Scanner
8005	GSM Scanner
8011	WiMAX Scanner
8013	LTE Scanner
8015	RF Power Scanner
8017	TETRA Scanner
8023	CW Receiver
8025	5G NR Scanner
8027	NB-IoT Scanner

For example

```
Get ENGINES
Engines List 1088 BINARY
<Engines>
<Engine ID="5_R&amp;S_LTE_Scanner_0" Name="TSME LTE" Type="8013">
<Device ID="1" Address="192.168.0.2@MU724954">
<MIMO>False</MIMO>
<eMBMS>True</eMBMS>
<ACD>True</ACD>
</Device>
<Device ID="2" Address="192.168.0.3@MU724954">
<MIMO>False</MIMO>
<eMBMS>True</eMBMS>
<ACD>True</ACD>
</Device>
</Engine>
<Engine ID="5_DrvGsmMws_1" Name="TSME GSM" Type="8005">
<Device ID="1" Address="192.168.0.2@MU724954">
<ACD>True</ACD>
</Device>
<Device ID="2" Address="192.168.0.3@MU724954">
<ACD>True</ACD>
</Device>
</Engine>
<Engine ID="5_R&amp;S_RF_Power_Scanner_TSME_0" Name="TSME RF Power Scanner"
Type="8015">
<Device ID="1" Address="192.168.0.3@MU724954">
<ACD>True</ACD>
</Device>
<Device ID="2" Address="192.168.0.3@MU724954">
```

```
<ACD>True</ACD>
</Device>
</Engine>
<Engine ID="5_DrvUMTS_PNS_1" Name="TSME WCDMA" Type="8001">
<Device ID="1" Address="192.168.0.3@MU724954">
<ACD>True</ACD>
</Device>
<Device ID="2" Address="192.168.0.3@MU724954">
<ACD>True</ACD>
</Device>
</Engine>
</Engines>
```

11.4 Measurement engines

11.4.1 Engine load

```
Engine LOAD <Device ID>
```

This command loads a measurement engine into R&S ROMES4. If it succeeds, R&S ROMES4 returns the instance ID of the loaded engine. The <Device ID> is optional if only one device is available for the measurement engine.

The return string is `Engine LOADED <Engine ID> <Instance ID>`.

For example

```
Engine LOAD 5_DrvGsmNws_1
Engine LOADED 5_DrvGsmNws_1 1009200560
```

11.4.2 Engine unload

```
Engine LOAD <Instance ID>
```

Unloads an engine.

For example

```
Engine UNLOAD 1009200560
Engine unloaded
```

11.4.3 Get loaded engines

```
Get LOADEDENGINES
```

The command reports a list of the currently loaded measurement engines.

For example

```
Get LOADEDENGINES
LoadedEngines List 165 BINARY
<LoadedEngines>
<LoadedEngine ID="9585294002" Type="8013">
<Device ID="1"/>
<State Level="0" Info="Device reconnected">OK</State></LoadedEngine>
</LoadedEngines>
OK
```

The information about the states can be as listed in the table.

Table 11-5: Device states

Element	Value	Remark
Level	0 1 2	OK Warning Error
Info	Text	Information about the last action on the device
Value	Timout Bad condition Connection lost Low data rate Error	Measurement engine run into a timeout Bad receiving condition of device (GPS) Used device lost its connection to the computer Measurement engine delivers less data than expected Measurement engine reported an error

11.4.4 Engine CFG set

```
EngineCFG Set <ID>
```

The message is sent whenever the engine with the corresponding ID has been reconfigured.

11.4.5 Engine state changed

```
Engine <ID>STATECHANGED <OldState> <NewState>
```

The message is sent whenever the state of the engine has changed. The <states> are given as hexadecimal numbers. The meaning of the bits is listed in the table.

Bit	Meaning
0	Timeout
1	Bad condition of GPS signal
2	Connection to hardware lost
3	Device delivers less data as expected

Bit	Meaning
4	Other error
5	R&S TSME is currently in reconnection state

11.5 Remote control messages

This chapter concerns the R&S ROMES4 Remote Control messages.

11.5.1 Supported messages

Supported messages are sent by R&S ROMES4.

11.5.1.1 Mode change

```
ModeChange <OldMode> NewMode>
```

The following table shows the available modes.

Mode	Remark
NotInitialized	R&S ROMES4 is starting
Idle	No driver, no measurement file loaded
FileOpening	A measurement file is about to be opened
FileOpen	Measurement file open
ReadyForMeasurement	At least one driver is loaded, no measurement file open
Replay	Replay is active
ReplayPause	Replay is in Pause state
Measurement	Measurement without recording is active
Reporting	Recording is active
Exporting	Exporting is active

11.5.1.2 Output view

```
Output view <Text>
```

11.5.1.3 System health

```
SystemHealth <Text> <State>
```

This message has not to be requested.

The systems health is checked once a minute. The message is sent whenever one of the following system checks fails.

Type	State	Remark
Memory	Warning	System is running out of memory, but can continue to work
	Alarm	System memory is critically low. Most probably, the system will fail in the next minutes
DiskSpace	Low	System is running out of disk space
	Critical	System's disk space is too low, the measurement will be stopped
Measurement	Bitmaps as HexNumber, for example, 1F The meaning of bits is: • Bit 0: Timeout • Bit 1: Bad Condition • Bit 2: Connection Lost Bit • 3: Low Data Rate Bit • 4: Any other error	For example, 0C means that at least one of the drivers lost its connection to the device and at least one driver does not deliver the expected amount of data

12 Appendix

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12.1 5G NR scanner Top N signals mapping

The columns in the "5G NR Scanner Top N View" > "List" are created automatically from Top N signals.

The following tables list the columns of the signals in the "5G NR Scanner TopN View".

Table 12-1: Columns of the default Top N signals in the List pane

Top N signal column name	Column visible by default	Prior Top N signal column name
Color	yes	Color
#	yes	#
Top X	yes	Top X
PCI	yes	PCI
SSB Idx	yes	SSB Idx
Internal ID	no	Internal ID
SSB Idx ModB	no	Not in prior view
SSB Count	no	Not in prior view
RSSI	yes	RSSI
Dec. SS-RSRP	no	Not in prior view
Dec.SS-SINR	no	Not in prior view
Dec. SS-RSRQ	no	Not in prior view
SS-RSRP	yes	SS-RSRP
SS-SINR	yes	SS-SINR
SS-RSRQ	yes	SS-RSRQ
SS-SPL	no	Not in prior view
SS-RePower	yes	SS-RePower
NR-ARFCN	yes	NR-ARFCN
Band	no	Not in prior view
SS-Ref	yes	SS-Ref
ToA(PSS)	no	Not in prior view
ToA(CIR)	no	Not in prior view
GF-Inter	yes	Not in prior view
GF-Intra	yes	Not in prior view
Adjusted ToA(PSS)	no	Not in prior view

To visualize a column of an optional Top N signal in the "List", select the signal first in the "TEC for 5G NR Scanner" settings. The column is then available in the "List".

The default status of these signals branches in the "Signal Tree" is:

ON - present in the "Signal Tree"

OFF - not present in the "Signal Tree"

Table 12-2: Columns of the optional Top N signals in the List pane

Optional Top N signal column name	"Signal Tree" default status	Column visible by default	Prior optional Top N signal column name
DM-RSRP	OFF	no	DM-RSRP
DM-SINR	OFF	no	DM-SINR
DM-RSRQ	OFF	no	DM-RSRQ
DM-RSLP	OFF	no	Not on prior view
DM-RePower	OFF	no	DM-RePower
PBCH-RSRP	OFF	no	PBCH-RSRP
PBCH-SINR	OFF	no	PBCH-SINR
PBCH-RSRQ	OFF	no	PBCH-RSRQ
PBCH-SPL	OFF	no	Not on prior view
PBCH_RePower	OFF	no	PBCH_RePower
PS-RSRP	OFF	no	PS-RSRP
PS-SNR	OFF	no	PS-SINR
PS-RSRQ	OFF	no	PS-RSRQ
PS-SPL	OFF	no	Not on prior view
PS-RePower	OFF	no	PS-RePower
SS-PBCH-RSRP	OFF	no	SS-PBCH-RSRP
SS-PBCH-SINR	OFF	no	SS-PBCH-SINR
SS-PBCH-RSRQ	OFF	no	SS-PBCH-RSRQ
SS-PBCH-SPL	OFF	no	Not on prior view
SS-PBCH-RePower	OFF	no	SS-PBCH-RePower
SSB-RSRP	OFF	no	SSB-RSRP
SSB-SINR	OFF	no	SSB-SINR
SSB-RSRQ	OFF	no	SSB-RSRQ
SSB-SPL	OFF	no	Not on prior view
SSB-RePower	OFF	no	SSB-RePower
MIB-system FrameNumber	OFF	no	MIB-system FrameNumber
MIB-subCarrierSpacinfCommon	OFF	no	MIB-subCarrierSpacinfCommon
MIB-ssb-SubCarrierOffset	OFF	no	MIB-ssb-SubCarrierOffset
MIB-dmrs-TypeA-Position	OFF	no	MIB-dmrs-TypeA-Position
MIB-pdcch-ConfigSIB1	OFF	no	MIB-pdcch-ConfigSIB1

Optional Top N signal column name	"Signal Tree" default status	Column visible by default	Prior optional Top N signal column name
MIB-cellBarred	OFF	no	MIB-cellBarred
MIB-intraFreqReselection	OFF	no	MIB-intraFreqReselection
k-SSB	OFF	no	k-SSB
gNodeB Name	ON	no	gNodeB Name
gNodeB Distance	ON	no	gNodeB Distance

If an optional signal is not configured for display in the "Signal Tree" >" 5G NR Scan", it is not displayed in "5G NR Scanner Top N View" > "List".

Table 12-3: Columns of the default Top N signals in the Details pane

Top N signal column name	Column visible by default	Prior optional Top N signal column name
PCI	yes	PCI
SSB IDx	yes	SSB IDx
Internal ID	no	Internal ID
RSSI	yes	RSSI
SS-RSRP	yes	SS-RSRP
SS-SINR	yes	SS-SINR
SS-RSRQ	yes	SS-RSRQ
SS-RePower	yes	SS-RePower

Table 12-4: Columns of the optional Top N signals in the Details pane

Optional Top N signal column name	Column visible by default	Prior optional Top N signal column name
DM-RSRP	no	DM-RSRP
DM-RSINR	no	DM-RSINR
DM-RSRQ	no	DM-RSRQ
DM-RePower	no	DM-RePower
PBCH-RSRP	no	PBCH-RSRP
PBCH-SINR	no	PBCH-SINR
PBCH-RSRQ	no	PBCH-RSRQ
PBCH-RePower	no	PBCH-RePower
PS-RSRP	no	PS-RSRP
PS-SINR	no	PS-SINR
PS-RSRQ	no	PS-RSRQ

Optional Top N signal column name	Column visible by default	Prior optional Top N signal column name
PS-RePower	no	PS-RePower
SS-PBCH-RSRP	no	SS-PBCH-RSRP
SS-PBCH-SINR	no	SS-PBCH-SINR
SS-PBCH-RSRQ	no	SS-PBCH-RSRQ
SS-PBCH-RePower	no	SS-PBCH-RePower
SSB-RSRP	no	SSB-RSRP
SSB-SINR	no	SSB-SINR
SSB-RSRQ	no	SSB-RSRQ
SSB-RePower	no	SSB-RePower
MIB-systemFrameName	no	MIB-systemFrameName
MIB-subCarrierSpacingCommon No MIB-subCarrierSpacingCommon	no	MIB-subCarrierSpacingCommon No MIB-subCarrierSpacingCommon
MIB-ssb-SubCarrierOffset	no	MIB-ssb-SubCarrierOffset
MIB-dmrs-TypeA-Position	no	MIB-dmrs-TypeA-Position
MIB-pdcch-ConfigSIB1	no	MIB-pdcch-ConfigSIB1
MIB-cellBarred	no	MIB-cellBarred
MIB-intraFreqReselection	no	MIB-intraFreqReselection

12.2 LTE scanner Top N signals mapping

The "LTE Scanner Top N View" columns are associated with signals. The signal names usually match the signal names in signal tree, but some of the names do not match.

The following table shows mapping of the TopN View signal names to the signal names in the signal tree. This mapping lists only the mismatched names.

Table 12-5: Top N signals names mapped to signal tree signal names

Top N signal name	Signal tree - signal names have prefix "Top N"
WB RSSI Min	WB RSSI (min)
WB RSSI	WB RSSI (max)
WB RSRP	WB RSRP (NC) (max)
WB RSRQ	WB RSRQ (NC) (max)
WB RS SINR	WB SINR (max)
Dist. (km)	eNodeB Dist.
Mode	Frame Struc. Type

Top N signal name	Signal tree - signal names have prefix "Top N"
Amp.SINR P-Sync	SINR PSS based on Amp Noise
Amp.SINR P-Sync	SINR SSS based on Amp Noise
Cue	Cue-Lev

12.3 NB-IoT scanner Top N signals mapping

The columns in the "NB-IoT Scanner Top N View" > "List" are created automatically from Top N signals.

If an optional signal is not configured for display in the "Signal Tree", it will not be displayed in "NB-IoT Scanner Top N View" > "List".

The following tables list the columns of the signals in the "NB-IoT Scanner Top N View".

Table 12-6: Columns of default Top N signals in the List pane

Top N signal column name	Column visible by default	Prior Top N signal column name
Color	yes	Color
#	yes	#
Top X	yes	Top X
Decision NSSS Power	no	Not in prior view
Decision NSSS CIR	no	Not in prior view
Decision NRSSI	no	Not in prior view
NPCI	yes	NPCI
NRSSI	yes	NRSSI
NSS CINR	yes	NSSS CINR
NSSS Power	yes	NSSS Power
NPSS Power	no	NPSS Power
NPSS CINR	no	NPSS SINR
Frame ToA (GPS PSS)	no	Frame ToA (GPS PSS)
Frame ToA (internal)	no	Frame ToA (internal)
Center Frequency	yes	Center Frequency
NRSRP (Tx0)	yes	NRSRP (Tx0)
NRSRQ (Tx0)	yes	NRSRQ (Tx0)
NRS CINR (Tx0)	yes	NRS CINR (Tx0)

Top N signal column name	Column visible by default	Prior Top N signal column name
NRS RSSI (Tx0)	yes	NRS RSSI (Tx0)
NRSRP (Tx1)	yes	NRSRP (Tx1)
NRSRQ (Tx1)	yes	NRSRQ (Tx1)
NRS CINR (Tx1)	yes	NRS CINR (Tx1)
NRS RSSI (Tx1)	yes	NRS RSSI (Tx1)
Frame Struct. Type	yes	Not in prior view
Cyclic Prefix	yes	Not in prior view

To visualize a column of an optional Top N signal in the "List", select the signal in the "TEC for NB-IoT Scanner" settings first. The column is then available in the "List".

The default status of these signals branches in the "Signal Tree" is:

ON - present in the "Signal Tree"

OFF - not present in the "Signal Tree"

Table 12-7: Columns of the optional Top N signals in the List pane

Optional Top N signal column name	"Signal Tree" default status	Column visible by default	Prior optional Top N signal column name
eNodeB Name	ON	no	eNodeB Name
eNodeB Dist.	ON	no	Dist.(km)
EARFCN	OFF	yes	EARFCN
EC(28)	OFF	yes	EC(28)
EC(20/8)			EC(20/8)
MCC	OFF	yes	MCC
MNC	OFF	yes	MNC
TAC	OFF	yes	TAC
Provider	OFF	yes	Provider
Add. PLMNs	OFF	yes	Add. PLMNs

12.4 LTE-M scanner Top N signals mapping

The columns in the "LTE-M Scanner Top N View" > "List" are created automatically from Top N signals.

If an signal is not configured for display in the "Signal Tree" > "LTE-M Scan", it is not displayed in "LTE-M Scanner Top N View" > "List".

The following tables list the columns of the signals in the "LTE-M Scanner Top N View".

Table 12-8: Columns of the Top N signals in the List pane

Top N signal column name	Column visible by default	Prior Top N signal column name
Color	yes	Color
#	yes	#
Top X	yes	Top X
Decision Avg. BR-SINR	no	Not in prior view
Decision Avg. BR-RSRP	no	Not in prior view
Decision Avg. BR-RSRQ	no	Not in prior view
PCI	yes	PCI
RSSI	yes	RSSI
Center Frequency	yes	Center Frequency
EARFCN	yes	EARFCN
Internal CellID	no	Internal CellID
Total BR-RSSI	yes	Total BR-RSSI
Avg. BR-RSRP	yes	Avg. BR-RSRP
Avg. BR-RSRQ	yes	Avg. BR-RSRQ
Avg. BR-SINR	yes	Avg. BR-SINR
NB Index	no	NB Index
NB Count	no	NB Count

Table 12-9: Columns of the Top N signals in the Details pane

Top N signal column name	Column visible by default	Prior optional Top N signal column name
PCI	yes	PCI
NB Index	yes	NB Index
Internal CellID	no	Internal CellID
NB RB Offset	no	NB RB Offset
BR-RSSI	yes	BR-RSSI
BR-RSRQ	yes	BR-RSRQ
BR-SINR	yes	BR-SINR
BR-RSRP	yes	BR-RSRP

12.5 UMTS scanner Top N signals mapping

The columns in the "UMTS Scanner Top N View" > "List" are created automatically from the Top N signals.

The following tables list the columns of the signals in the "UMTS Scanner Top N View".

Table 12-10: Columns of the Top N signals in the List pane

Top N signal column name	Column visible by default	Prior Top N signal column name
Color	yes	Color
#	yes	#
Rank	yes	Rank
Decision Ec/Io	no	Not in prior view
Decision RSCP	no	Not in prior view
SC	yes	SC
RNCID	yes	RNCID
SC-ID	no	Not in prior view
Channel	yes	Channel
UARFCN	no	Not in prior view
Ec/Io [dB]	yes	Ec/Io [dB]
SIR [dB]	yes	SIR [dB]
RSCP [dBm]	yes	RSCP [dBm]
ISCP [dBm]	yes	ISCP [dBm]
P total [dBm]	yes	P total [dBm]
HPP	yes	HPP
SPP	yes	SPP
CI	yes	CI
LAC	yes	LAC
MCC	yes	MCC
MNC	yes	MNC
Provider	yes	Not in prior view
Node B Name	yes	Node B
Node B Dist (km)	yes	Dist (km)
ULI [dBm]	yes	ULI [dBm]
Delay Spread [Chip]	yes	Not in prior view
Drift [ns]	yes	Drift [ns]
Std.Dev.Drift	yes	Not in prior view

Table 12-11: Columns of the optional Top N signals in the List pane

Optional Top N signal column name	Column visible by default	Prior Top N signal column name
P(PSCH)	yes	Not in prior view
P(SSCH)	yes	Not in prior view
Ec/Io(PSCH)	yes	Not in prior view
Ec/Io(SSCH)	yes	Not in prior view
Doppler	yes	Not in prior view
Code Group	yes	Not in prior view
Cue-Qual	yes	Not in prior view
Cue-Lev	yes	Not in prior view
NR	yes	NR
Add. PLMNs	yes	Add. PLMNs
Frame Time of Arrival Offset to PPS	yes	Not in prior view
Frame Number of Arrival Offset to PPS	yes	Not in prior view

If an optional signal is not configured for display in the "Signal Tree" > "UMTS Scan", it is not displayed in "UMTS Scanner Top N View" > "List".

12.6 4G/5G RRC events

The following table gives the complete list of the currently supported 4G/5G RRC events.

Table 12-12: 4G/5G RRC events

Event	RAT	Description
RRC Setup Attempt	LTE/LTE CA	LTE RRC connection establishment attempt
RRC FullConfig	LTE/LTE CA	LTE RRC Connection reconfiguration with full configuration option
RRC Reconfiguration Complete	LTE/LTE CA	LTE RRC connection reconfiguration complete
RRC Reestablishment Attempt	LTE/LTE CA	LTE RRC connection reestablishment attempt
RRC Release	LTE/LTE CA	LTE RRC connection release
Handover Attempt LTE PCell	LTE	LTE PCell intra-frequency handover attempt, single carrier configuration

Event	RAT	Description
IF Handover Attempt LTE PCell	LTE	LTE PCell inter-frequency handover attempt, single carrier configuration
MCG Handover Attempt LTE PCell	LTE CA	LTE PCell intra-frequency handover attempt with SCell configuration (CA)
MCG IF Handover Attempt LTE PCell	LTE CA	LTE PCell inter-frequency handover attempt with SCell configuration (CA)
MCG Release LTE SCell	LTE CA	LTE MCG release of SCell
MCG Add LTE SCell	LTE CA	LTE MCG addition of SCell
eNB to MeNB Handover Attempt LTE PCell	LTE/LTE CA	LTE PCell reconfiguration with handover to 5G ENDC
MeNB to eNB Handover Attempt LTE PCell	LTE-5G ENDC	MN LTE PCell reconfiguration with handover from 5G ENDC to LTE
eNB to MeNB Change LTE PCell	LTE/LTE CA	LTE PCell reconfiguration from LTE to 5G ENDC
MeNB to eNB Change LTE PCell	LTE-5G ENDC	MN LTE PCell reconfiguration from 5G ENDC to LTE
MN Handover Attempt w. SN change	LTE-5G ENDC	MN LTE PCell handover with SN 5G NR PSCell change
MN Handover Attempt wo. SN change	LTE-5G ENDC	MN LTE PCell handover without SN 5G NR PSCell change
MN Release w. SN Release	LTE-5G ENDC	MN LTE PCell release from 5G ENDC con-figuration
SN Release NR PSCell	LTE-5G ENDC	SN 5G NR PSCell release from MN LTE PCell
SN Addition NR PSCell	LTE/LTE CA	SN 5G NR PSCell addition related with LTE PCell reconfiguration from LTE to 5G EN-DC MN
SN Re-Addition NR PSCell	LTE-5G ENDC	SN 5G NR PSCell re-addition to 5G ENDC MN
SN Change NR PSCell Inter-gNB	LTE-5G ENDC	SN 5G NR PSCell change inter-gNB with sync and security key change
SN Change NR PSCell Intra-gNB	LTE-5G ENDC	SN 5G NR PSCell change intra-gNB without sync and security key change
DSS Setup NR PSCell	LTE-5G ENDC	SN 5G NR PSCell configuration with LTE DSS carrier
DSS Release NR PSCell	LTE-5G ENDC	SN 5G NR PSCell release from LTE DSS carrier
SN Release NR SCell	LTE-5G ENDC	SCell release from SN 5G NR PSCell

Event	RAT	Description
SN Addition NR SCell	LTE-5G ENDC	SCell addition to SN 5G NR PSCell
SN Modification NR MeasConfig	LTE-5G ENDC	SN 5G NR measurement configuration modification
SN Modification NR RB	LTE-5G ENDC	SN 5G NR Radio Bearer modification
SCG Failure NR SCG	LTE-5G ENDC	NR SCG failure reported by UE
Fake SCG Failure NR SCG	LTE-5G ENDC	NR SCG failure faked by UE to trigger RAN to release 5G NR
IRAT LTE-NR Redirection Attempt	LTE->5G NR IRAT	LTE RRC release with redirection to 5G NR carrier
IRAT Handover Type 5GC-to-EPC-R15	5G NR -> LTE IRAT	UE CN change from 5GC to EPC related with 5G NR to LTE inter-system handover
RB AddMod LTE MCG RLC	LTE	Data Radio Bearer addition or reconfiguration of RLC entity in LTE MCG
RB AddMod LTE MCG PDCP	LTE	Data Radio Bearer addition or reconfiguration of E-UTRA PDCP entity in LTE MCG
RB AddMod LTE MCG NR-PDCP	LTE	Data Radio Bearer addition or reconfiguration of NR PDCP entity in LTE MCG
RB AddMod LTE MCG Split PDCP	LTE	Split Data Radio Bearer addition or reconfiguration of NR PDCP entity in LTE MCG
RB Release LTE MCG RLC	LTE	Data Radio Bearer release of RLC entity in LTE MCG
RB Release LTE MCG PDCP	LTE	Data Radio Bearer release of PDCP entity in LTE MCG
RB AddMod NR SCG RLC	LTE-5G ENDC	Data Radio Bearer addition or reconfiguration of RLC entity in 5G NR SCG
RB AddMod NR SCG PDCP	LTE-5G ENDC	Data Radio Bearer addition or reconfiguration of PDCP entity in 5G NR SCG
RB AddMod NR SCG Split PDCP	LTE-5G ENDC	Split Data Radio Bearer addition or reconfiguration of NR PDCP entity in 5G NR SCG
RB AddMod NR SCG Split PDCP UL	LTE-5G ENDC	Uplink Split Data Radio Bearer configuration of NR PDCP entity in 5G NR SCG

12.7 5G RRC events

The following table gives the complete list of the currently supported 5G RRC events.

Table 12-13: 5G RRC events

Event	RAT	Description
RRC Setup Attempt	5G NR	5G NR RRC connection establishment attempt
RRC FullConfig	5G NR	5G NR RRC connection reconfiguration with full configuration option
RRC Reconfiguration Complete	5G NR	5G NR RRC connection reconfiguration complete
RRC Reestablishment Attempt	5G NR	5G NR RRC connection reestablishment attempt
RRC Release	5G NR	5G NR RRC connection release
RRC Reject	5G NR	5G NR RRC connection reject
Handover Attempt	5G NR	5G NR PCell intra-frequency handover attempt
IF Handover Attempt	5G NR	5G NR PCell inter-frequency handover attempt
MCG Release NR SCell	5G NR CA	5G NR MCG release of SCell
MCG Addition NR SCell	5G NR CA	5G NR MCG addition of SCell
DSS Setup NR SCell	5G NR CA	5G NR MCG SCell configuration with LTE DSS carrier
DSS Release NR SCell	5G NR CA	5G NR MCG SCell release from LTE DSS carrier
SN Addition NR PSCell	5G NR-NR DC	SN 5G NR PSCell addition to 5G NR MN
SN Release NR SCell	5G NR-NR DC	SCell release from SN 5G NR PSCell
SN Addition NR SCell	5G NR-NR DC	SCell addition to SN 5G NR PSCell
IRAT NR-LTE Handover Attempt	5G NR->LTE IRAT	5G NR to LTE inter-system handover attempt
IRAT NR-LTE Redirection Attempt	5G NR->LTE IRAT	5G NR RRC release with redirection to LTE carrier
RB AddMod NR MCG PDCP	5G NR	Data Radio Bearer addition or reconfiguration of NR PDCP entity in 5G NR MCG

12.8 GSM channels and power classes

There are various types of channels.

The traffic channel (TCH) serves to carry data, the control channel (CCH) to carry signaling and synchronization data.

There are three types of control channel: broadcast channels are used to carry mobile station frequency corrections (FCCH = frequency correction channel), for frame synchronization (SCH = synchronization channel) and to carry information about the mode in operation at the base station (BCCH = broadcast control channel). General control channels (CCCH = common control channel) carry information about the communication network set-up. Purpose-related control channels (DCCH = dedicated control channels) encode the exchanges between the base station (BS) and the mobile station (MS).

Channel coding with error recognition and correction causes redundancies in the utilizable data. Channel coding may raise the bandwidth requirements, but it also raises the signal interference resistance and therefore lowers the power requirement.

The language coder on the TCH delivers 260 bit per 20 ms (13 kbit/s) to channel coding. The first 182 bits (class 1 bits) are far more important than the rest of the data (78 bit, class 2 bits) as far as their content is concerned. The first 50 bits in class 1 are further protected with 3 parity bits (class 1a bits). The remaining bits in class 1 are called class 1b bits. Three sensibility classes stem from this.

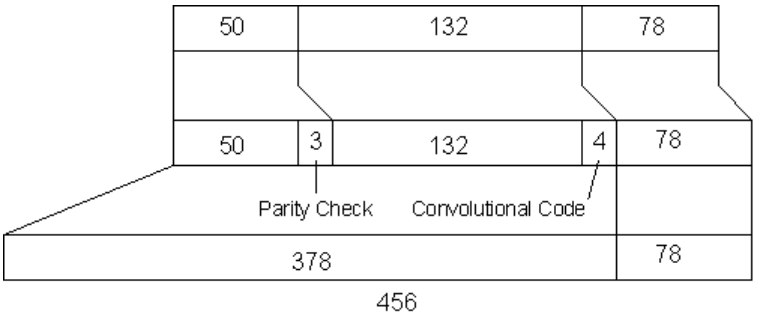


Figure 12-1: GSM coded channel

All class 1 bits are coded with a Convolutional code (Viterbi-Code, R = 1/2, v = 4). 4 additional bits are allocated to each bit in class 1 whereby the additional bits form the memory of the Viterbi coder. So, a coded bit sequence of bit length 378 results from the 189 bits of class1. The bit sequence together with the 78 non-coded, class 2 bits form a block of 456 bits which are transmitted in 20 ms (22.8 kBit/s).

On the SCH (Synchronization Channel) 25-bit blocks are sequentially coded to a block length of 78 bits with a BCH code shortened to 35 bits and then analogue to the TCH.

To save the signaling data, 184 bit frames are sequentially coded to a block length of 456 bits with the fire code on a 224 bit frame length and then analogue to the TCH.

The data are then interleaved and encoded.

12.8.1 GSM channel bands and power classes

Table 12-14: Frequency ranges

Band	Subband	Uplink [MHz]	Downlink [MHz]
GSM400	GSM450	450.4 to 457.4	460.4 to 467.4
	GSM480	478.8 to 486.0	488.8 to 496.0
GSM700	GSM 750	747 to 762	777 to 792
GSM900	P-GSM900 (primary GSM)	890 to 915	935 to 960
	E-GSM (extended GSM)	880 to 890	925 to 935
	R-GSM (Railways GSM)	876 to 880	921 to 925
	ER-GSM (extended Railways GSM)	873.2 to 876	918.2 to 921
GSM1800	GSM1800	1710 to 1785	1805 to 1880
GSM850	GSM850	824 to 849	869 to 894
GSM1900	GSM1900	1850 to 1910	1930 to 1990

Table 12-15: Channel numbers (ARFCN)

(Sub)band	Uplink [MHz]	Downlink [MHz]	n Range
GSM450	450.6 + 0.2 * (n – 259)	460.6 + 0.2 * (n – 259)	259 (n (293
GSM480	479.0 + 0.2 * (n – 306)	489.0 + 0.2 * (n – 306)	306 (n (340
GSM 750	747.2 + 0.2 * (n – 438)	777.2 + 0.2 * (n – 438)	438 (n (511
P-GSM900	890 + 0.2 * n	935 + 0.2 * n	1 (n (124
E-GSM900	880.2 + 0.2 * (n – 975)	925.2 + 0.2 * (n – 975)	975 (n (1023
R-GSM900	876.2 + 0.2 * (n – 955)	921.2 + 0.2 * (n – 955)	955 (n (974
ER-GSM900	873.2 + 0.2 * (n – 940)	918.2 + 0.2 * (n – 940)	940 (n (954
GSM1800	1710.2 + 0.2 * (n – 512)	1805.2 + 0.2 * (n – 512)	512 (n (885
GSM850	824.2 + 0.2 * (n – 128)	869.2 + 0.2 * (n – 128)	128 (n (251
GSM1900	1850.2 + 0.2 * (n - 512)	1930.2 + 0.2 * (n - 512)	512 (n (810

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
1	935,2	41	943,2	81	951,2	121	959,2
2	935,4	42	943,4	82	951,4	122	959,4
3	935,6	43	943,6	83	951,6	123	959,6
4	935,8	44	943,8	84	951,8	124	959,8
5	936	45	944	85	952		
6	936,2	46	944,2	86	952,2		
7	936,4	47	944,4	87	952,4		
8	936,6	48	944,6	88	952,6		
9	936,8	49	944,8	89	952,8		
10	937	50	945	90	953		
11	937,2	51	945,2	91	953,2		
12	937,4	52	945,4	92	953,4		
13	937,6	53	945,6	93	953,6		
14	937,8	54	945,8	94	953,8		
15	938	55	946	95	954		
16	938,2	56	946,2	96	954,2		
17	938,4	57	946,4	97	954,4		
18	938,6	58	946,6	98	954,6		
19	938,8	59	946,8	99	954,8		
20	939	60	947	100	955		
21	939,2	61	947,2	101	955,2		
22	939,4	62	947,4	102	955,4		
23	939,6	63	947,6	103	955,6		
24	939,8	64	947,8	104	955,8		
25	940	65	948	105	956		
26	940,2	66	948,2	106	956,2		
27	940,4	67	948,4	107	956,4		
28	940,6	68	948,6	108	956,6		
29	940,8	69	948,8	109	956,8		
30	941	70	949	110	957		
31	941,2	71	949,2	111	957,2		
32	941,4	72	949,4	112	957,4		
33	941,6	73	949,6	113	957,6		
34	941,8	74	949,8	114	957,8		
35	942	75	950	115	958		
36	942,2	76	950,2	116	958,2		
37	942,4	77	950,4	117	958,4		
38	942,6	78	950,6	118	958,6		
39	942,8	79	950,8	119	958,8		
40	943	80	951	120	959		

Figure 12-2: Downlink channels in P-GSM900 (primary GSM)

ER-GSM Channel	f [MHz]		R-GSM Channel	f [MHz]
940	918,2		955	921,2
941	918,4		956	921,4
942	918,6		957	921,6
943	918,8		958	921,8
944	919		959	922
945	919,2		960	922,2
946	919,4		961	922,4
947	919,6		962	922,6
948	919,8		963	922,8
949	920		964	923
950	920,2		965	923,2
951	920,4		966	923,4
952	920,6		967	923,6
953	920,8		968	923,8
954	921		969	924
			970	924,2
			971	924,4
			972	924,6
			973	924,8
			974	925

Figure 12-3: Downlink channels in Railways GSM900: ER-GSM and R-GSM

E-GSM Channel	f [MHz]		E-GSM Channel	f [MHz]
975	925.2		1000	930.2
976	925.4		1001	930.4
977	925.6		1002	930.6
978	925.8		1003	930.8
979	926		1004	931
980	926.2		1005	931.2
981	926.4		1006	931.4
982	926.6		1007	931.6
983	926.8		1008	931.8
984	927		1009	932
985	927.2		1010	932.2
986	927.4		1011	932.4
987	927.6		1012	932.6
988	927.8		1013	932.8
989	928		1014	933
990	928.2		1015	933.2
991	928.4		1016	933.4
992	928.6		1017	933.6
993	928.8		1018	933.8
994	929		1019	934
995	929.2		1020	934.2
996	929.4		1021	934.4
997	929.6		1022	934.6
998	929.8		1023	934.8
999	930			

Figure 12-4: Downlink channels in extended GSM900: E-GSM

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
		551	1813	591	1821	631	1829
512	1805.2	552	1813.2	592	1821.2	632	1829.2
513	1805.4	553	1813.4	593	1821.4	633	1829.4
514	1805.6	554	1813.6	594	1821.6	634	1829.6
515	1805.8	555	1813.8	595	1821.8	635	1829.8
516	1806	556	1814	596	1822	636	1830
517	1806.2	557	1814.2	597	1822.2	637	1830.2
518	1806.4	558	1814.4	598	1822.4	638	1830.4
519	1806.6	559	1814.6	599	1822.6	639	1830.6
520	1806.8	560	1814.8	600	1822.8	640	1830.8
521	1807	561	1815	601	1823	641	1831
522	1807.2	562	1815.2	602	1823.2	642	1831.2
523	1807.4	563	1815.4	603	1823.4	643	1831.4
524	1807.6	564	1815.6	604	1823.6	644	1831.6
525	1807.8	565	1815.8	605	1823.8	645	1831.8
526	1808	566	1816	606	1824	646	1832
527	1808.2	567	1816.2	607	1824.2	647	1832.2
528	1808.4	568	1816.4	608	1824.4	648	1832.4
529	1808.6	569	1816.6	609	1824.6	649	1832.6
530	1808.8	570	1816.8	610	1824.8	650	1832.8
531	1809	571	1817	611	1825	651	1833
532	1809.2	572	1817.2	612	1825.2	652	1833.2
533	1809.4	573	1817.4	613	1825.4	653	1833.4
534	1809.6	574	1817.6	614	1825.6	654	1833.6
535	1809.8	575	1817.8	615	1825.8	655	1833.8
536	1810	576	1818	616	1826	656	1834
537	1810.2	577	1818.2	617	1826.2	657	1834.2
538	1810.4	578	1818.4	618	1826.4	658	1834.4
539	1810.6	579	1818.6	619	1826.6	659	1834.6
540	1810.8	580	1818.8	620	1826.8	660	1834.8
541	1811	581	1819	621	1827	661	1835
542	1811.2	582	1819.2	622	1827.2	662	1835.2
543	1811.4	583	1819.4	623	1827.4	663	1835.4
544	1811.6	584	1819.6	624	1827.6	664	1835.6
545	1811.8	585	1819.8	625	1827.8	665	1835.8
546	1812	586	1820	626	1828	666	1836
547	1812.2	587	1820.2	627	1828.2	667	1836.2
548	1812.4	588	1820.4	628	1828.4	668	1836.4
549	1812.6	589	1820.6	629	1828.6	669	1836.6
550	1812.8	590	1820.8	630	1828.8	670	1836.8

Figure 12-5: Downlink channels in GSM1800 / part 1

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
751	1853	791	1861	831	1869	871	1877
752	1853,2	792	1861,2	832	1869,2	872	1877,2
753	1853,4	793	1861,4	833	1869,4	873	1877,4
754	1853,6	794	1861,6	834	1869,6	874	1877,6
755	1853,8	795	1861,8	835	1869,8	875	1877,8
756	1854	796	1862	836	1870	876	1878
757	1854,2	797	1862,2	837	1870,2	877	1878,2
758	1854,4	798	1862,4	838	1870,4	878	1878,4
759	1854,6	799	1862,6	839	1870,6	879	1878,6
760	1854,8	800	1862,8	840	1870,8	880	1878,8
761	1855	801	1863	841	1871	881	1879
762	1855,2	802	1863,2	842	1871,2	882	1879,2
763	1855,4	803	1863,4	843	1871,4	883	1879,4
764	1855,6	804	1863,6	844	1871,6	884	1879,6
765	1855,8	805	1863,8	845	1871,8	885	1879,8
766	1856	806	1864	846	1872		
767	1856,2	807	1864,2	847	1872,2		
768	1856,4	808	1864,4	848	1872,4		
769	1856,6	809	1864,6	849	1872,6		
770	1856,8	810	1864,8	850	1872,8		
771	1857	811	1865	851	1873		
772	1857,2	812	1865,2	852	1873,2		
773	1857,4	813	1865,4	853	1873,4		
774	1857,6	814	1865,6	854	1873,6		
775	1857,8	815	1865,8	855	1873,8		
776	1858	816	1866	856	1874		
777	1858,2	817	1866,2	857	1874,2		
778	1858,4	818	1866,4	858	1874,4		
779	1858,6	819	1866,6	859	1874,6		
780	1858,8	820	1866,8	860	1874,8		
781	1859	821	1867	861	1875		
782	1859,2	822	1867,2	862	1875,2		
783	1859,4	823	1867,4	863	1875,4		
784	1859,6	824	1867,6	864	1875,6		
785	1859,8	825	1867,8	865	1875,8		
786	1860	826	1868	866	1876		
787	1860,2	827	1868,2	867	1876,2		
788	1860,4	828	1868,4	868	1876,4		
789	1860,6	829	1868,6	869	1876,6		
790	1860,8	830	1868,8	870	1876,8		

Figure 12-6: Downlink channels in GSM1800 / part 2

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
141	871,8	181	879,8	221	887,8
142	872	182	880	222	888
143	872,2	183	880,2	223	888,2
144	872,4	184	880,4	224	888,4
145	872,6	185	880,6	225	888,6
146	872,8	186	880,8	226	888,8
147	873	187	881	227	889
148	873,2	188	881,2	228	889,2
149	873,4	189	881,4	229	889,4
150	873,6	190	881,6	230	889,6
151	873,8	191	881,8	231	889,8
152	874	192	882	232	890
153	874,2	193	882,2	233	890,2
154	874,4	194	882,4	234	890,4
155	874,6	195	882,6	235	890,6
156	874,8	196	882,8	236	890,8
157	875	197	883	237	891
158	875,2	198	883,2	238	891,2
159	875,4	199	883,4	239	891,4
160	875,6	200	883,6	240	891,6
161	875,8	201	883,8	241	891,8
162	876	202	884	242	892
163	876,2	203	884,2	243	892,2
164	876,4	204	884,4	244	892,4
165	876,6	205	884,6	245	892,6
166	876,8	206	884,8	246	892,8

Figure 12-7: Downlink channels in GSM850

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
		551	1938	591	1946	631	1954	671	1962
512	1930,2	552	1938,2	592	1946,2	632	1954,2	672	1962,2
513	1930,4	553	1938,4	593	1946,4	633	1954,4	673	1962,4
514	1930,6	554	1938,6	594	1946,6	634	1954,6	674	1962,6
515	1930,8	555	1938,8	595	1946,8	635	1954,8	675	1962,8
516	1931	556	1939	596	1947	636	1955	676	1963
517	1931,2	557	1939,2	597	1947,2	637	1955,2	677	1963,2
518	1931,4	558	1939,4	598	1947,4	638	1955,4	678	1963,4
519	1931,6	559	1939,6	599	1947,6	639	1955,6	679	1963,6
520	1931,8	560	1939,8	600	1947,8	640	1955,8	680	1963,8
521	1932	561	1940	601	1948	641	1956	681	1964
522	1932,2	562	1940,2	602	1948,2	642	1956,2	682	1964,2
523	1932,4	563	1940,4	603	1948,4	643	1956,4	683	1964,4
524	1932,6	564	1940,6	604	1948,6	644	1956,6	684	1964,6
525	1932,8	565	1940,8	605	1948,8	645	1956,8	685	1964,8
526	1933	566	1941	606	1949	646	1957	686	1965
527	1933,2	567	1941,2	607	1949,2	647	1957,2	687	1965,2
528	1933,4	568	1941,4	608	1949,4	648	1957,4	688	1965,4
529	1933,6	569	1941,6	609	1949,6	649	1957,6	689	1965,6
530	1933,8	570	1941,8	610	1949,8	650	1957,8	690	1965,8
531	1934	571	1942	611	1950	651	1958	691	1966
532	1934,2	572	1942,2	612	1950,2	652	1958,2	692	1966,2
533	1934,4	573	1942,4	613	1950,4	653	1958,4	693	1966,4
534	1934,6	574	1942,6	614	1950,6	654	1958,6	694	1966,6
535	1934,8	575	1942,8	615	1950,8	655	1958,8	695	1966,8
536	1935	576	1943	616	1951	656	1959	696	1967
537	1935,2	577	1943,2	617	1951,2	657	1959,2	697	1967,2
538	1935,4	578	1943,4	618	1951,4	658	1959,4	698	1967,4
539	1935,6	579	1943,6	619	1951,6	659	1959,6	699	1967,6
540	1935,8	580	1943,8	620	1951,8	660	1959,8	700	1967,8
541	1936	581	1944	621	1952	661	1960	701	1968
542	1936,2	582	1944,2	622	1952,2	662	1960,2	702	1968,2
543	1936,4	583	1944,4	623	1952,4	663	1960,4	703	1968,4
544	1936,6	584	1944,6	624	1952,6	664	1960,6	704	1968,6
545	1936,8	585	1944,8	625	1952,8	665	1960,8	705	1968,8
546	1937	586	1945	626	1953	666	1961	706	1969
547	1937,2	587	1945,2	627	1953,2	667	1961,2	707	1969,2
548	1937,4	588	1945,4	628	1953,4	668	1961,4	708	1969,4
549	1937,6	589	1945,6	629	1953,6	669	1961,6	709	1969,6
550	1937,8	590	1945,8	630	1953,8	670	1961,8	710	1969,8

Figure 12-8: Downlink channels in GSM1900 / part 1

Channel	f [MHz]	Kanal	f [MHz]	Kanal	f [MHz]
711	1970	751	1978	791	1986
712	1970,2	752	1978,2	792	1986,2
713	1970,4	753	1978,4	793	1986,4
714	1970,6	754	1978,6	794	1986,6
715	1970,8	755	1978,8	795	1986,8
716	1971	756	1979	796	1987
717	1971,2	757	1979,2	797	1987,2
718	1971,4	758	1979,4	798	1987,4
719	1971,6	759	1979,6	799	1987,6
720	1971,8	760	1979,8	800	1987,8
721	1972	761	1980	801	1988
722	1972,2	762	1980,2	802	1988,2
723	1972,4	763	1980,4	803	1988,4
724	1972,6	764	1980,6	804	1988,6
725	1972,8	765	1980,8	805	1988,8
726	1973	766	1981	806	1989
727	1973,2	767	1981,2	807	1989,2
728	1973,4	768	1981,4	808	1989,4
729	1973,6	769	1981,6	809	1989,6
730	1973,8	770	1981,8	810	1989,8
731	1974	771	1982		
732	1974,2	772	1982,2		
733	1974,4	773	1982,4		
734	1974,6	774	1982,6		
735	1974,8	775	1982,8		
736	1975	776	1983		
737	1975,2	777	1983,2		
738	1975,4	778	1983,4		
739	1975,6	779	1983,6		
740	1975,8	780	1983,8		
741	1976	781	1984		
742	1976,2	782	1984,2		
743	1976,4	783	1984,4		
744	1976,6	784	1984,6		
745	1976,8	785	1984,8		
746	1977	786	1985		
747	1977,2	787	1985,2		
748	1977,4	788	1985,4		
749	1977,6	789	1985,6		
750	1977,8	790	1985,8		

Figure 12-9: Downlink channels in GSM1900 / part 2

Table 12-16: GSM power classes and output powers

	GSM900		1800/1900	
TxPower Level (PCL)	**Nominal output power / dBm**	**Power Class/ Max. output power**	**Nominal output power / dBm**	**Power Class/ Max. output power**
0	43	1 / 20 W	30	1 / 1 W
1	41		28	

	GSM900		1800/1900	
TxPower Level (PCL)	**Nominal output power / dBm**	**Power Class/ Max. output power**	**Nominal output power / dBm**	**Power Class/ Max. output power**
2	39	2 / 8 W	26	
3	37	3 / 5 W	24	2 / 0.25 W
4	35		22	
5	33	4 / 2 W	20	
6	31		18	
7	29	5 / 0.8 W	16	
8	27		14	
9	25		12	
10	23		10	
11	21		8	
12	19		6	
13	17		4	
14	15		-	
15	13		-	
16	11		-	
17	9		-	
18	7		-	
19	5		-	

GSM Phase 1: 0≤TxPower ≤15

GSM Phase 2 (since 1996): 0≤TxPower≤19

Table 12-17: Definition of RX Level and RX Quality

Value of RX Level	Corresponding signal strength		Value of RX Quality	Corresponding bit error rate
63	> –48 dBm		0	0% to 0.2%
62	–49 dBm to –48 dBm		1	0.2% to 0.4%
62	–50 dBm to –49 dBm		2	0.4% to 0.8%
...	...		3	0.8% to 1.6%
...	...		4	1.6% to 3.2%
2	–109 dBm to –108 dBm		5	3.2% to 6.4%

Value of RX Level	Corresponding signal strength		Value of RX Quality	Corresponding bit error rate
1	–110 dBm to –109 dBm		6	6.4% to 12.8%
0	< –110 dBm		7	12.8% to 100%

12.9 UMTS channels

The assignment between UMTS UARFCNs (UTRA Absolute Radio Frequency Channel Numbers) N, carrier frequency F, and frequency offset F_{offset} is defined in the 3GPP specification (TS 25.101). The following relation holds for both directions of transmission (uplink and downlink) and all operating bands:

$$N = 5 \cdot (F / MHz - F_{offset}), \quad 0.0\ MHz \le F \le 3276.6\ MHz$$

The downlink and uplink channels assigned in the operating bands I to IX are listed in the tables below. Note that in operating bands II, IV and VI additional center frequencies are specified. These additional channels are outside of the normal 200 kHz raster and are calculated with different offsets according to the formula above, they must be specified with their channel frequency. Refer to 3GPP TS 25.101 V12.2.0

Table 12-18: UTRA operating bands and channel numbers: Downlink

Operating Band	DL Frequency Band (MHz)	DL Frequency Offset (MHz)	Assigned Channels (UARFCNs)	Assigned Center Frequencies (MHz)
I	2110 to 2170	0.0	10562 to 10838	2112.4 to 2167.6
II	1930 to 1990	0.0 1850.1	9662 to 9938, Additional channels: 412, 437, 462, 487, 512, 537, 562, 587, 612, 637, 662, 687	1932.4 to 1987.6, 1932.5, 1937.5, 1942.5, 1947.5, 1952.5, 1957.5, 1962.5, 1967.5, 1972.5, 1977.5, 1982.5, 1987.5
III	1805 to 1880	1575.0	1162 to 1513	1807.4 to 1877.6
IV	2110 to 2155	1805.0 1735.1	1537 to 1738, Additional channels: 1887, 1912, 1937, 1962, 1987, 2012, 2037, 2062, 2087	2112.4 to 2152.6, 2112.5, 2117.5, 2122.5, 2127.5, 2132.5, 2137.5, 2142.5, 2147.5, 2152.5
V	869 to 894	0.0 670.1	4357 to 4458, Additional channels: 1007, 1012, 1032, 1037, 1062, 1087	871.4 to 891.6, 871.5, 872.5, 876.5, 877.5, 882.5, 887.5
VI	875 to 885	0.0 670.1	4387 to 4413, Additional channels: 1037, 1062	877.4 to 882.6, 877.5, 882.5

Operating Band	DL Frequency Band (MHz)	DL Frequency Offset (MHz)	Assigned Channels (UARFCNs)	Assigned Center Frequencies (MHz)
VII	2620 to 2690	2175 2105.1	2237 to 2563 Additional channels: 2587, 2612, 2637, 2662, 2687, 2712, 2737, 2762, 2787, 2812, 2837, 2862, 2887, 2912	2622.4 to 2687.6, 2622.5, 2627.5, 2632.5, 2637.5, 2642.5, 2647.5, 2652.5, 2657.5, 2662.5, 2667.5, 2672.5, 2677.5, 2682.5, 2687.5
VIII	925 to 960	340	2937 to 3088	927.4 to 957.6
IX	1844.9 to 1879.9	0.0	9237 to 9387	1847.4 to 1877.4
X	2110 to 2170	1490 1430.1	3112 to 3388 Additional channels: 3412 to 3687 (step 25)	2112.4 to 2167.6, 2112.5 to 2167.5
XI	1475.9 to 1500.9	736	3712 to 3812	1478.4 to 1498.4
XII	728 to 746	-37 -54.9	3837 to 3903 Additional channels: 3927, 3932, 3957, 3962, 3987, 3992	730.4 to 743.6, 730.5 to 743.5
XIII	746 to 756	-55 -64.9	4017 to 4047 Additional channels: 4067, 4092	748,4 to 753.6, 748.5 to 753.5
XIV	758 to 768	-63 -72.9	4117 to 4143 Additional channels: 4167, 4192	760.4 to 765.6, 760.5, 765.5
XIX	875 to 890	735 720.1	712 to 763 Additional channels: 787, 812, 837	877,4 to 887,6 877,5 to 887,5
XX	791 to 821	-109	4512 to 4638	793,4 to 818,6
XXI	1495,9 to 1510,9	1326	862 to 912	1498,4 to 1508,4
XXII	3510 to 3590	2580	4662 to 5038	3512,4 to 3587,6
XXV	1930 to 1995	910 674,1	5112 to 5413 Additional channels: 6292, 6317, 6342, 6367, 6392, 6417, 6442, 6467, 6492, 6517, 6542, 6567, 6592	1932,4 to 1992,6 1932,5; 1937,5; 1942,5; 1947,5; 1952,5, 1957,5; 1962,7; 1967,5; 1972,5; 1977,5; 1982,5; 1987,5; 1992,5
XXVI	859 to 894	-291	4598 to 4749	861,4 to 891,6

Operating Band	DL Frequency Band (MHz)	DL Frequency Offset (MHz)	Assigned Channels (UARFCNs)	Assigned Center Frequencies (MHz)
Free (10 kHz resolution) ⇩	80 to 3000	–	–	–
⇧ = **free**ly configurable measurement with TSMQ / TSMU / TSML-W				

Table 12-19: UTRA operating bands and channel numbers: Uplink

Operating Band	UL Frequency Band (MHz)	UL Frequency Offset (MHz)	Assigned Channels (UARFCNs)	Assigned Center Frequencies (MHz)
I	1920 to 1980	0.0	9612 to 9888	1922.4 to 1977.6
II	1850 to 1910	0.0 1850.1	9262 to 9538, Additional channels: 12, 37, 62, 87, 112, 137, 162, 187, 212, 237, 262, 287	1852.4 to 1907.6 , 1852.5, 1857.5, 1862.5, 1867.5, 1872.5, 1877.5, 1882.5, 1887.5, 1892.5, 1897.5, 1902.5, 1907.5
III	1710 to 1785	1525.0	937 to 1287	1712.4 to 1782.6
IV	1710 to 1755	1450.0 1380.1	1312 to 1513, Additional channels: 1662, 11687, 1712, 1737, 1762, 1787, 1812, 1837, 1862	1712.4 to 1752.6, 1712.5, 1717.5, 1722.5, 1727.5, 1732.5, 1737.5, 1742.5, 1747.5, 1752.5
V	824 to 849	0.0 670.1	4132 to 4233, Additional channels: 782, 787, 807, 812, 837, 862	826.4 to 846.6, 826.5, 827.5, 831.5, 832.5, 1 827.5, 842.5
VI	830 to 840	0.0 670.1	4162 to 4188, Additional channels: 812, 837	832.4 to 837.6, 832.5, 837.5
VII	2500 to 2570	2100.0 2030.1	2012 to 2338 Additional channels: 2362, 2387, 2412, 2437, 2462, 2487, 2512, 2537, 2562, 2587, 2612, 2637, 2662, 2687	2502.4 to 2567.6, 2502.5, 2507.5, 2512.5, 2517.5, 2522.5, 2527.5, 2532.5, 2537.5, 2542.5, 2547.5, 2552.5, 2557.5, 2562.5, 2567.5
VIII	880 to 915	340	4412 to 4563	882.4 to 912.6
IX	1749.9 to 1784.9	0.0	8762 to 8912	1752.4 to 1782.4
X	1710 to 1770	1135 1075.1	2887 to 3163 Additional channels: 3187 to 3462 (step 25)	1712.4 to 1767.6, 1712.5 to 1767.5

Operating Band	UL Frequency Band (MHz)	UL Frequency Offset (MHz)	Assigned Channels (UARFCNs)	Assigned Center Frequencies (MHz)
XI	1427.9 to 1452.9	733	3487 to 3587	1430.4 to 1450.4
XII	698 to 716	-22 -39.9	3612 to 3678 Additional channels: 3702, 3707, 3732, 3737, 3762, 3767	700.4 to 713.6, 700.5 to 713.5
XIII	777 to 787	21 11.1	3792 to 3818 Additional channels: 3842, 3867	779.4 to 784.6, 779.5, 784.5
XIV	788 to 798	12 2.1	3892 to 3918 Additional channels: 3942, 3967	790.4 to 795.6, 790.5, 795.5
XIX	830 to 845	770 755,1	312 to 363 Additional channels: 387, 412, 437	832,4 to 842,6 832,5; 837,5; 842,5
XX	832 to 862	-23	4287 to 4413	834,4 to 859,6
XXI	1447,9 to 1462,9	1358	462 to 512	1450,4 to 1460,4
XXII	3410 to 3490	2525	4437 to 4813	3412,4 to 3487,6
XXV	1850 to 1915	875 639,1	4887 to 5188 Additional channels: 6067, 6092, 6117, 6142, 6167, 6192, 6217, 6242, 6267, 6292, 6317, 6342, 6367	1852,4 to 1912,6 1852,5; 1857,5; 1862,5; 1867,5; 1872,5; 1877,5; 1882,5; 1887,5; 1892,5; 1897,5; 1902,5, 1907,5; 1912,5
Free (10 kHz resolution) ⇩	80 to 3000	–	–	–
⇧ = **free**ly configurable measurement with TSMQ / TSMU / TSML-W				

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
10562	2112,4	10622	2124,4	10682	2136,4	10742	2148,4	10802	2160,4
10563	2112,6	10623	2124,6	10683	2136,6	10743	2148,6	10782	2156,4
10564	2112,8	10624	2124,8	10684	2136,8	10744	2148,8	10783	2156,6
10565	2113	10625	2125	10685	2137	10745	2149	10784	2156,8
10566	2113,2	10626	2125,2	10686	2137,2	10746	2149,2	10785	2157
10567	2113,4	10627	2125,4	10687	2137,4	10747	2149,4	10786	2157,2
10568	2113,6	10628	2125,6	10688	2137,6	10748	2149,6	10787	2157,4
10569	2113,8	10629	2125,8	10689	2137,8	10749	2149,8	10788	2157,6
10570	2114	10630	2126	10690	2138	10750	2150	10789	2157,8
10571	2114,2	10631	2126,2	10691	2138,2	10751	2150,2	10790	2158
10572	2114,4	10632	2126,4	10692	2138,4	10752	2150,4	10791	2158,2
10573	2114,6	10633	2126,6	10693	2138,6	10753	2150,6	10792	2158,4
10574	2114,8	10634	2126,8	10694	2138,8	10754	2150,8	10793	2158,6
10575	2115	10635	2127	10695	2139	10755	2151	10794	2158,8
10576	2115,2	10636	2127,2	10696	2139,2	10756	2151,2	10795	2159
10577	2115,4	10637	2127,4	10697	2139,4	10757	2151,4	10796	2159,2
10578	2115,6	10638	2127,6	10698	2139,6	10758	2151,6	10797	2159,4
10579	2115,8	10639	2127,8	10699	2139,8	10759	2151,8	10798	2159,6
10580	2116	10640	2128	10700	2140	10760	2152	10799	2159,8
10581	2116,2	10641	2128,2	10701	2140,2	10761	2152,2	10800	2160
10582	2116,4	10642	2128,4	10702	2140,4	10762	2152,4	10801	2160,2
10583	2116,6	10643	2128,6	10703	2140,6	10763	2152,6	10802	2160,4
10584	2116,8	10644	2128,8	10704	2140,8	10764	2152,8	10803	2160,6
10585	2117	10645	2129	10705	2141	10765	2153	10804	2160,8
10586	2117,2	10646	2129,2	10706	2141,2	10766	2153,2	10805	2161
10587	2117,4	10647	2129,4	10707	2141,4	10767	2153,4	10806	2161,2
10588	2117,6	10648	2129,6	10708	2141,6	10768	2153,6	10807	2161,4
10589	2117,8	10649	2129,8	10709	2141,8	10769	2153,8	10808	2161,6
10590	2118	10650	2130	10710	2142	10770	2154	10809	2161,8
10591	2118,2	10651	2130,2	10711	2142,2	10771	2154,2	10810	2162
10592	2118,4	10652	2130,4	10712	2142,4	10772	2154,4	10811	2162,2
10593	2118,6	10653	2130,6	10713	2142,6	10773	2154,6	10812	2162,4
10594	2118,8	10654	2130,8	10714	2142,8	10774	2154,8	10813	2162,6
10595	2119	10655	2131	10715	2143	10775	2155	10814	2162,8
10596	2119,2	10656	2131,2	10716	2143,2	10776	2155,2	10815	2163
10597	2119,4	10657	2131,4	10717	2143,4	10777	2155,4	10816	2163,2
10598	2119,6	10658	2131,6	10718	2143,6	10778	2155,6	10817	2163,4
10599	2119,8	10659	2131,8	10719	2143,8	10779	2155,8	10818	2163,6
10600	2120	10660	2132	10720	2144	10780	2156	10819	2163,8
10601	2120,2	10661	2132,2	10721	2144,2	10781	2156,2	10820	2164
10602	2120,4	10662	2132,4	10722	2144,4	10782	2156,4	10821	2164,2
10603	2120,6	10663	2132,6	10723	2144,6	10783	2156,6	10822	2164,4
10604	2120,8	10664	2132,8	10724	2144,8	10784	2156,8	10823	2164,6
10605	2121	10665	2133	10725	2145	10785	2157	10824	2164,8
10606	2121,2	10666	2133,2	10726	2145,2	10786	2157,2	10825	2165
10607	2121,4	10667	2133,4	10727	2145,4	10787	2157,4	10826	2165,2
10608	2121,6	10668	2133,6	10728	2145,6	10788	2157,6	10827	2165,4
10609	2121,8	10669	2133,8	10729	2145,8	10789	2157,8	10828	2165,6
10610	2122	10670	2134	10730	2146	10790	2158	10829	2165,8
10611	2122,2	10671	2134,2	10731	2146,2	10791	2158,2	10830	2166
10612	2122,4	10672	2134,4	10732	2146,4	10792	2158,4	10831	2166,2
10613	2122,6	10673	2134,6	10733	2146,6	10793	2158,6	10832	2166,4
10614	2122,8	10674	2134,8	10734	2146,8	10794	2158,8	10833	2166,6
10615	2123	10675	2135	10735	2147	10795	2159	10834	2166,8
10616	2123,2	10676	2135,2	10736	2147,2	10796	2159,2	10835	2167
10617	2123,4	10677	2135,4	10737	2147,4	10797	2159,4	10836	2167,2
10618	2123,6	10678	2135,6	10738	2147,6	10798	2159,6	10837	2167,4
10619	2123,8	10679	2135,8	10739	2147,8	10799	2159,8	10838	2167,6
10620	2124	10680	2136	10740	2148	10800	2160		
10621	2124,2	10681	2136,2	10741	2148,2	10801	2160,2		

Figure 12-10: Downlink channels in UMTS operating band I

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
9662	1932.4	9722	1944.4	9782	1956.4	9842	1968.4	9902	1980.4
9663	1932.6	9723	1944.6	9783	1956.6	9843	1968.6	9882	1976.4
9664	1932.8	9724	1944.8	9784	1956.8	9844	1968.8	9883	1976.6
9665	1933	9725	1945	9785	1957	9845	1969	9884	1976.8
9666	1933.2	9726	1945.2	9786	1957.2	9846	1969.2	9885	1977
9667	1933.4	9727	1945.4	9787	1957.4	9847	1969.4	9886	1977.2
9668	1933.6	9728	1945.6	9788	1957.6	9848	1969.6	9887	1977.4
9669	1933.8	9729	1945.8	9789	1957.8	9849	1969.8	9888	1977.6
9670	1934	9730	1946	9790	1958	9850	1970	9889	1977.8
9671	1934.2	9731	1946.2	9791	1958.2	9851	1970.2	9890	1978
9672	1934.4	9732	1946.4	9792	1958.4	9852	1970.4	9891	1978.2
9673	1934.6	9733	1946.6	9793	1958.6	9853	1970.6	9892	1978.4
9674	1934.8	9734	1946.8	9794	1958.8	9854	1970.8	9893	1978.6
9675	1935	9735	1947	9795	1959	9855	1971	9894	1978.8
9676	1935.2	9736	1947.2	9796	1959.2	9856	1971.2	9895	1979
9677	1935.4	9737	1947.4	9797	1959.4	9857	1971.4	9896	1979.2
9678	1935.6	9738	1947.6	9798	1959.6	9858	1971.6	9897	1979.4
9679	1935.8	9739	1947.8	9799	1959.8	9859	1971.8	9898	1979.6
9680	1936	9740	1948	9800	1960	9860	1972	9899	1979.8
9681	1936.2	9741	1948.2	9801	1960.2	9861	1972.2	9900	1980
9682	1936.4	9742	1948.4	9802	1960.4	9862	1972.4	9901	1980.2
9683	1936.6	9743	1948.6	9803	1960.6	9863	1972.6	9902	1980.4
9684	1936.8	9744	1948.8	9804	1960.8	9864	1972.8	9903	1980.6
9685	1937	9745	1949	9805	1961	9865	1973	9904	1980.8
9686	1937.2	9746	1949.2	9806	1961.2	9866	1973.2	9905	1981
9687	1937.4	9747	1949.4	9807	1961.4	9867	1973.4	9906	1981.2
9688	1937.6	9748	1949.6	9808	1961.6	9868	1973.6	9907	1981.4
9689	1937.8	9749	1949.8	9809	1961.8	9869	1973.8	9908	1981.6
9690	1938	9750	1950	9810	1962	9870	1974	9909	1981.8
9691	1938.2	9751	1950.2	9811	1962.2	9871	1974.2	9910	1982
9692	1938.4	9752	1950.4	9812	1962.4	9872	1974.4	9911	1982.2
9693	1938.6	9753	1950.6	9813	1962.6	9873	1974.6	9912	1982.4
9694	1938.8	9754	1950.8	9814	1962.8	9874	1974.8	9913	1982.6
9695	1939	9755	1951	9815	1963	9875	1975	9914	1982.8
9696	1939.2	9756	1951.2	9816	1963.2	9876	1975.2	9915	1983
9697	1939.4	9757	1951.4	9817	1963.4	9877	1975.4	9916	1983.2
9698	1939.6	9758	1951.6	9818	1963.6	9878	1975.6	9917	1983.4
9699	1939.8	9759	1951.8	9819	1963.8	9879	1975.8	9918	1983.6
9700	1940	9760	1952	9820	1964	9880	1976	9919	1983.8
9701	1940.2	9761	1952.2	9821	1964.2	9881	1976.2	9920	1984
9702	1940.4	9762	1952.4	9822	1964.4	9882	1976.4	9921	1984.2
9703	1940.6	9763	1952.6	9823	1964.6	9883	1976.6	9922	1984.4
9704	1940.8	9764	1952.8	9824	1964.8	9884	1976.8	9923	1984.6
9705	1941	9765	1953	9825	1965	9885	1977	9924	1984.8
9706	1941.2	9766	1953.2	9826	1965.2	9886	1977.2	9925	1985
9707	1941.4	9767	1953.4	9827	1965.4	9887	1977.4	9926	1985.2
9708	1941.6	9768	1953.6	9828	1965.6	9888	1977.6	9927	1985.4
9709	1941.8	9769	1953.8	9829	1965.8	9889	1977.8	9928	1985.6
9710	1942	9770	1954	9830	1966	9890	1978	9929	1985.8
9711	1942.2	9771	1954.2	9831	1966.2	9891	1978.2	9930	1986
9712	1942.4	9772	1954.4	9832	1966.4	9892	1978.4	9931	1986.2
9713	1942.6	9773	1954.6	9833	1966.6	9893	1978.6	9932	1986.4
9714	1942.8	9774	1954.8	9834	1966.8	9894	1978.8	9933	1986.6
9715	1943	9775	1955	9835	1967	9895	1979	9934	1986.8
9716	1943.2	9776	1955.2	9836	1967.2	9896	1979.2	9935	1987
9717	1943.4	9777	1955.4	9837	1967.4	9897	1979.4	9936	1987.2
9718	1943.6	9778	1955.6	9838	1967.6	9898	1979.6	9937	1987.4
9719	1943.8	9779	1955.8	9839	1967.8	9899	1979.8	9938	1987.6
9720	1944	9780	1956	9840	1968	9900	1980		
9721	1944.2	9781	1956.2	9841	1968.2	9901	1980.2		

Figure 12-11: Downlink channels in UMTS operating band II

The 12 additional downlink channels of the 200 MHz raster are listed in Table 12-18

Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]	Channel	f [MHz]
1162	1807,4	1231	1821,2	1300	1835	1368	1848,6	1436	1862,2	1475	1870
1163	1807,6	1232	1821,4	1301	1835,2	1369	1848,8	1408	1856,6	1447	1864,4
1164	1807,8	1233	1821,6	1302	1835,4	1370	1849	1409	1856,8	1448	1864,6
1165	1808	1234	1821,8	1303	1835,6	1371	1849,2	1410	1857	1449	1864,8
1166	1808,2	1235	1822	1304	1835,8	1372	1849,4	1411	1857,2	1450	1865
1167	1808,4	1236	1822,2	1305	1836	1373	1849,6	1412	1857,4	1451	1865,2
1168	1808,6	1237	1822,4	1306	1836,2	1374	1849,8	1413	1857,6	1452	1865,4
1169	1808,8	1238	1822,6	1307	1836,4	1375	1850	1414	1857,8	1453	1865,6
1170	1809	1239	1822,8	1308	1836,6	1376	1850,2	1415	1858	1454	1865,8
1171	1809,2	1240	1823	1309	1836,8	1377	1850,4	1416	1858,2	1455	1866
1172	1809,4	1241	1823,2	1310	1837	1378	1850,6	1417	1858,4	1456	1866,2
1173	1809,6	1242	1823,4	1311	1837,2	1379	1850,8	1418	1858,6	1457	1866,4
1174	1809,8	1243	1823,6	1312	1837,4	1380	1851	1419	1858,8	1458	1866,6
1175	1810	1244	1823,8	1313	1837,6	1381	1851,2	1420	1859	1459	1866,8
1176	1810,2	1245	1824	1314	1837,8	1382	1851,4	1421	1859,2	1460	1867
1177	1810,4	1246	1824,2	1315	1838	1383	1851,6	1422	1859,4	1461	1867,2
1178	1810,6	1247	1824,4	1316	1838,2	1384	1851,8	1423	1859,6	1462	1867,4
1179	1810,8	1248	1824,6	1317	1838,4	1385	1852	1424	1859,8	1463	1867,6
1180	1811	1249	1824,8	1318	1838,6	1386	1852,2	1425	1860	1464	1867,8
1181	1811,2	1250	1825	1319	1838,8	1387	1852,4	1426	1860,2	1465	1868
1182	1811,4	1251	1825,2	1320	1839	1388	1852,6	1427	1860,4	1466	1868,2
1183	1811,6	1252	1825,4	1321	1839,2	1389	1852,8	1428	1860,6	1467	1868,4
1184	1811,8	1253	1825,6	1322	1839,4	1390	1853	1429	1860,8	1468	1868,6
1185	1812	1254	1825,8	1323	1839,6	1391	1853,2	1430	1861	1469	1868,8
1186	1812,2	1255	1826	1324	1839,8	1392	1853,4	1431	1861,2	1470	1869
1187	1812,4	1256	1826,2	1325	1840	1393	1853,6	1432	1861,4	1471	1869,2
1188	1812,6	1257	1826,4	1326	1840,2	1394	1853,8	1433	1861,6	1472	1869,4
1189	1812,8	1258	1826,6	1327	1840,4	1395	1854	1434	1861,8	1473	1869,6
1190	1813	1259	1826,8	1328	1840,6	1396	1854,2	1435	1862	1474	1869,8
1191	1813,2	1260	1827	1329	1840,8	1397	1854,4	1436	1862,2	1475	1870
1192	1813,4	1261	1827,2	1330	1841	1398	1854,6	1437	1862,4	1476	1870,2
1193	1813,6	1262	1827,4	1331	1841,2	1399	1854,8	1438	1862,6	1477	1870,4
1194	1813,8	1263	1827,6	1332	1841,4	1400	1855	1439	1862,8	1478	1870,6
1195	1814	1264	1827,8	1333	1841,6	1401	1855,2	1440	1863	1479	1870,8
1196	1814,2	1265	1828	1334	1841,8	1402	1855,4	1441	1863,2	1480	1871
1197	1814,4	1266	1828,2	1335	1842	1403	1855,6	1442	1863,4	1481	1871,2
1198	1814,6	1267	1828,4	1336	1842,2	1404	1855,8	1443	1863,6	1482	1871,4
1199	1814,8	1268	1828,6	1337	1842,4	1405	1856	1444	1863,8	1483	1871,6
1200	1815	1269	1828,8	1338	1842,6	1406	1856,2	1445	1864	1484	1871,8
1201	1815,2	1270	1829	1339	1842,8	1407	1856,4	1446	1864,2	1485	1872
1202	1815,4	1271	1829,2	1340	1843	1408	1856,6	1447	1864,4	1486	1872,2
1203	1815,6	1272	1829,4	1341	1843,2	1409	1856,8	1448	1864,6	1487	1872,4
1204	1815,8	1273	1829,6	1342	1843,4	1410	1857	1449	1864,8	1488	1872,6
1205	1816	1274	1829,8	1343	1843,6	1411	1857,2	1450	1865	1489	1872,8
1206	1816,2	1275	1830	1344	1843,8	1412	1857,4	1451	1865,2	1490	1873
1207	1816,4	1276	1830,2	1345	1844	1413	1857,6	1452	1865,4	1491	1873,2
1208	1816,6	1277	1830,4	1346	1844,2	1414	1857,8	1453	1865,6	1492	1873,4
1209	1816,8	1278	1830,6	1347	1844,4	1415	1858	1454	1865,8	1493	1873,6
1210	1817	1279	1830,8	1348	1844,6	1416	1858,2	1455	1866	1494	1873,8
1211	1817,2	1280	1831	1349	1844,8	1417	1858,4	1456	1866,2	1495	1874
1212	1817,4	1281	1831,2	1350	1845	1418	1858,6	1457	1866,4	1496	1874,2
1213	1817,6	1282	1831,4	1351	1845,2	1419	1858,8	1458	1866,6	1497	1874,4
1214	1817,8	1283	1831,6	1352	1845,4	1420	1859	1459	1866,8	1498	1874,6
1215	1818	1284	1831,8	1353	1845,6	1421	1859,2	1460	1867	1499	1874,8
1216	1818,2	1285	1832	1354	1845,8	1422	1859,4	1461	1867,2	1500	1875
1217	1818,4	1286	1832,2	1355	1846	1423	1859,6	1462	1867,4	1501	1875,2
1218	1818,6	1287	1832,4	1356	1846,2	1424	1859,8	1463	1867,6	1502	1875,4
1219	1818,8	1288	1832,6	1357	1846,4	1425	1860	1464	1867,8	1503	1875,6
1220	1819	1289	1832,8	1358	1846,6	1426	1860,2	1465	1868	1504	1875,8
1221	1819,2	1290	1833	1359	1846,8	1427	1860,4	1466	1868,2	1505	1876
1222	1819,4	1291	1833,2	1360	1847	1428	1860,6	1467	1868,4	1506	1876,2
1223	1819,6	1292	1833,4	1361	1847,2	1429	1860,8	1468	1868,6	1507	1876,4
1224	1819,8	1293	1833,6	1362	1847,4	1430	1861	1469	1868,8	1508	1876,6
1225	1820	1294	1833,8	1363	1847,6	1431	1861,2	1470	1869	1509	1876,8
1226	1820,2	1295	1834	1364	1847,8	1432	1861,4	1471	1869,2	1510	1877
1227	1820,4	1296	1834,2	1365	1848	1433	1861,6	1472	1869,4	1511	1877,2
1228	1820,6	1297	1834,4	1366	1848,2	1434	1861,8	1473	1869,6	1512	1877,4
1229	1820,8	1298	1834,6	1367	1848,4	1435	1862	1474	1869,8	1513	1877,6
1230	1821	1299	1834,8								

Figure 12-12: Downlink channels in UMTS operating band III

12.10 CDMA2000 band classes

The band classes for CDMA2000 forward and reverse signals are defined in 3GPP2 C.S0057. Each band class contains a number of carrier frequencies and corresponding channel numbers.

The tables below list the supported band classes with the corresponding channel numbers and the formulas for calculation of center frequencies from channel numbers.

Table 12-20: Band classes for forward signals

Band Class Number	Band Class Name	Channel Number N	Center Frequency [MHz]
0	US-Cellular, Korean Cellular	1 ≤ N ≤ 799 991 ≤ N ≤ 1023 1024 ≤ N ≤ 1323	870 + 0.03 N 870 + 0.03 (N – 1023) 860.03 + 0.03 (N – 1024)
1	North American PCS	0 ≤ N ≤ 1199	1930 + 0.05 N
2	TACS Band	0 ≤ N ≤ 1000 1329 ≤ N ≤ 2047 2048 ≤ N ≤ 2108	934.9875 + 0.025 N 916.9875 + 0.025 (N – 1328) 849 + 0.025 (N – 2048)
3	JTACS Band	1 ≤ N ≤ 799 801 ≤ N ≤ 1039 1041 ≤ N ≤ 1199 1201 ≤ N ≤ 1600	860 + 0.0125 N 843 + 0.0125 (N – 800) 832 + 0.0125 (N – 1040) 838 + 0.0125 (N – 1200)
4	Korean PCS	0 ≤ N ≤ 599	1840 + 0.05 N
5	NMT-450	1 ≤ N ≤ 400 472 ≤ N ≤ 871 1039 ≤ N ≤ 1473 1536 ≤ N ≤ 1715 1792 ≤ N ≤ 2016	460 + 0.025 (N – 1) 420 + 0.025 (N – 472) 461.01 + 0.025 (N – 1024) 489 + 0.025 (N – 1536) 489 + 0.020 (N – 1792)
6	IMT-2000	0 ≤ N ≤ 1199	2110 + 0.05 N
7	Upper 700 MHz	0 ≤ N ≤ 240	746 + 0.05 N
8	1800 MHz Band	0 ≤ N ≤ 1499	1805 + 0.05 N
9	North American 900 MHz	0 ≤ N ≤ 699	925 + 0.05 N
10	Secondary 800 MHz	0 ≤ N ≤ 719 720 ≤ N ≤ 919	851 + 0.025 N 935 + 0.025 (N – 720)
11	European 400 MHz PAMR	1 ≤ N ≤ 400 472 ≤ N ≤ 871 1039 ≤ N ≤ 1473 1536 ≤ N ≤ 1715 1792 ≤ N ≤ 2016	460 + 0.025 (N – 1) 420 + 0.025 (N – 472) Reserved 489 + 0.025 (N – 136) Reserved
12	800 MHz PAMR	0 ≤ N ≤ 239	915.0125 + 0.025 N
13	IMT-2000 2.5 GHz Extension	0 ≤ N ≤ 1399	2620 + 0.05 N
14	US PCS 1900 MHz	0 ≤ N ≤ 1299	1930 + 0.05 N
15	AWS Band	0 ≤ N ≤ 899	2110 + 0.05 N
16	US 2.5 GHz Band	140 ≤ N ≤ 1459	2617 + 0.05 N
17	US 2.5 GHz Forward	140 ≤ N ≤ 1459	2617 + 0.05 N

Band Class Number	Band Class Name	Channel Number N	Center Frequency [MHz]
18	Public Safety Bands 700 MHz	0 ≤ N ≤ 240	757 + 0.05 N
19	Lower 700 MHz	0 ≤ N ≤ 360	728 + 0.05 N
20	L-Band	0 ≤ N ≤ 680	1525 + 0.05 N
21	S-Band	0 ≤ N ≤ 200 201 ≤ N ≤ 399	2190 + 0.05 N 2180 + 0.05 (N – 200)

Table 12-21: Band classes for reverse signals

Band Class Number	Band Class Name	Channel Number N	Center Frequency [MHz]
0	US-Cellular, Korean Cellular	1 ≤ N ≤ 799 991 ≤ N ≤ 1023 1024 ≤ N ≤ 1323	825 + 0.03 N 825 + 0.03 (N - 1023) 815.04 + 0.03 (N - 1024)
1	North American PCS	0 t≤ N ≤ o 1199	1850 + 0.05 * N
2	TACS Band	0 ≤ N ≤ 1000 1329 ≤ N ≤ 2047 2048 ≤ N ≤ 2108	889.9875 + 0.025 N 871.9875 + 0.025 (N - 1328) 894 + 0.025 (N - 2048)
3	JTACS Band	1 ≤ N ≤ 799 801 ≤ N ≤ 1039 1041 ≤ N ≤ 1199 1201 ≤ N ≤ 1600	915 + 0.0125 N 898 + 0.0125 (N - 800) 887 + 0.0125 (N - 1040 893 + 0.0125 (N - 1200)
4	Korean PCS	0 ≤ N ≤ 599	1750 + 0.05 N
5	NMT-450	1 ≤ N ≤ 400 472 ≤ N ≤ 871 1039 ≤ N ≤ 1473 1536 ≤ N ≤ 1715 1792 ≤ N ≤ 2016	450 + 0.025 (N - 1) 410 + 0.025 (N - 472) 451.01+ 0.02 (N - 1024) 479+ 0.025 (N - 1536) 479+ 0.025 (N - 1792)
6	IMT-2000	0 ≤ N ≤ 1199	1920 + 0.05 N
7	Upper 700 MHz	0 ≤ N ≤ 240	776 + 0.05 N
8	1800 MHz Band	0 ≤ N ≤ 1499	1710 + 0.05 N
9	North American 900 MHz	0 ≤ N ≤ 699	880 + 0.05 N
10	Secondary 800 MHz	0 ≤ N ≤ 719 720 ≤ N ≤ 919	806 + 0.025 N 896 + 0.025 (N - 720)
11	European 400 MHz PAMR	1 ≤ N ≤ 400 472 ≤ N ≤ 871 1536 ≤ N ≤ 1715	450 + 0.025 (N - 1) 410 + 0.025 (N - 472) 479 + 0.025 (N - 1536)
12	800 MHz PAMR	0 ≤ N ≤ 239	870.0125 + 0.025 N

Band Class Number	Band Class Name	Channel Number N	Center Frequency [MHz]
13	IMT-2000 2.5 GHz Extension	0 ≤ N ≤ 1399	2500 + 0.05 N
14	US PCS 1900 MHz	0 ≤ N ≤ 1299	1850 + 0.05 N
15	AWS Band	0 ≤ N ≤ 899	1710 + 0.05 N
16	US 2.5 GHz Band	140 ≤ N ≤ 1459	2495 + 0.05 N
18	Public Safety Band 700 MHz	0 ≤ N ≤ 240	787 + 0.05 N
19	Lower 700 MHz	0 ≤ N ≤ 360	698 + 0.05 N
20	L-Band	0 ≤ N ≤ 680	1626.5 + 0.05 N
21	S-Band	0 ≤ N ≤ s200 201≤N≤399	2000 + 0.05 N 2010 + 0.05 (N – 200)

12.11 Smartphone SQ measurement job file

12.11.1 Global job / call timing related parameters

The call timing and the global job parameters are given in the following tables.

Table 12-22: Call timing parameters

Parameter	Name in Ini	Explanation	Value
Task Duration	TaskDuration	Duration of task	0: Unlimited
Task Cycles	TaskCycles	Number of task cycles	0: Unlimited
Window duration	CallWndSize	Time for a Mobile Originated Calls (MOC) or Mobile Terminated Calls (MTC) window. For NetQual, MOC means A to B and MTC means B to A. Within a window, the system performs 0 or more tests calls. Such calls can either be started and terminated by the mobile unit. This parameter is extremely important and is always respected during the test session to keep the A-side and the B-side synchronized.	Integer (sec.)
First call setup delay	CSDelay	Time between the start of a new window and the first call setup.	Integer (sec.)
Call duration	CallDuration	Time between the dial command and disconnect.	Integer (sec.)
Pause duration	PauseDuration	Time in seconds between the last call termination and the next dial command.	Integer (sec.)

Parameter	Name in Ini	Explanation	Value
Guard time	GuardTime	Time in seconds before the end of the window where all ongoing calls are disconnected by the system to ensure that the next measurement window can start immediately.	Integer (sec.)
No call setup time	NoCSTime	Time before the end of the window where no new calls are started.	Integer (sec.)
Pause after failed call	PauseAfter-Failed	Time that the system uses to pause after a failed call setup. This can be different from the normal pause time between calls.	Integer (sec.)
Pause after max failed calls	PauseAfterMax-Failed	Time that the system uses to pause after a failed call setup. This can be different from the normal pause time between calls.	Integer (sec.)
Average call setup time	AverageCSTime	Time which is used to calculate the remaining time for the tests within a call. This value directly affects the total duration.	Integer (sec.)
Max call setup time	MaxCSTime	Maximum time for call setup.	Integer (sec.)
No connection time-out	NoConnec-tionTmo	If MOC or MTC calls occur within this time, the system stops.	Integer (sec.)
Alerting timeout	AlertingTimeout	Time in seconds between Channel Request and Alerting. If this value is > 0, then the call terminates if the alerting signal is not received within the specified time after a channel request. This parameter is only applicable for mobile devices.	Integer (sec.)
Use call duration to abort call	UseCallDuration	Terminates the call when the pre-configured call duration expires and makes the Dedicated Mode part of a test fixed. If you want the call to terminate after the tests are completed, clear the check mark from this box. If you uncheck the option, the duration of a test depends on the Call Setup Time and on the Calculation Time of the algorithm, both of which are not fixed. As a result, the ratio between Dedicated Mode and Idle Mode of a test is not fixed.	Integer

Table 12-23: Global job parameters

Parameter	Name in Ini	Explanation	Value
Side	Side	Defines the side for which this job file is	A; B
Use DTMF Job Transfer	UseDTMF	Defines whether DTMF Job Transfer mode is used	0: off; 1: on
Record hang-over	RecordHO	The default value is 2000 ms, however, 1000 ms is usually sufficient for mobile to land unit (M2L) calls. The record hang-over covers the signal delay on the channel. To prevent clipping at the end of the audio recordings, do not enter a value that is close to 0 ms.	Integer (ms)
MOC:MTC ratio	WndRatio	Specify the ratio of MOC windows to MTC windows. For QualiPoc speech tests, you must set this parameter to 1:0.	<Integer>:<Integer>

Parameter	Name in Ini	Explanation	Value
Max failed calls	MaxFailedCalls	Maximum number of consecutive failed calls. In the case of a failed call, the Window duration always applies. The A-side and the B-side must remain synchronized during the whole test, even if a failed call occurs. By definition, a failed call cannot be acknowledged by the B-side.	Integer
Job Name	JobName	Job file name	String
Test sequence repetition	TestSeqRepetition	Specifies how often to repeat the sequence of defined test	Integer
Allow call reestablishment	AllowCallReestablishment	Keeps the Diversity VoiceEngine open if a connection drops and waits for the mobile phone to reestablish the call, so that the measurements can continue. At the end of the call duration that you specify on the "Timing" tab, the phone drops the call. Only some network operators allow mobile phones to reestablish a dropped call In both cases, the call status changes to dropped.	Integer

12.11.2 Unit related parameters

The parameters for A and B side units are given in the following tables.

Table 12-24: A-side releated unit parameters

Parameter	Name in Ini	Explanation	Value
Unit Type	Unit_Name	Unit type ID	Integer
Unit Name	Unit_Name	Unit name	String
Computer Name	Computer_Name	Computer name.	String

Table 12-25: B-side releated unit parameters

Parameter	Name in Ini	Explanation	Value
Unit Type	Unit_Type	Unit type ID	Integer
Unit Name	Unit_Name	Unit name	String
Computer Name	Computer_Name	Computer name.	String

12.11.3 Tests related parameters

These parameters define all tests (0..n) within the job. Each parameter name is post fixed by _n whereas n is 0...<test count>.

Table 12-26: Test releated parameters

Parameter	Name in Ini	Explanation	Value
Test Name	TestName	User specified test name	String
Test Type	TypeOfTest	Type of test	String
Direction	Direction	Audio direction	0: Uplink (A->B) 1: Downlink (B->A)
Audio Reference	ReferenceSample	Reference sample used	0: Yes 1: No 2: Based on MOS
Save video files	WaveFileOption	Specifies the settings for saving video recordings as AVI files. Be aware that these files can be quite large.	0: Yes 1: No
Save video files - MOS threshold	WaveFileFilter	If MOS is selected, then this threshold applies.	Float

12.12 Configuration of a streaming server using VLC

R&S ROMES4 supports measurements of a MP4 video stream as it is available, for example, in `www.youtube.com`.

There are several reasons not to use video streams from freely available addresses, for example:

- Availability of the site is not guaranteed
- Streaming data rate depends on the availability of the server, not (only) on the network

R&S ROMES4 users may wish to maintain a video streaming server on their own server. In the following is described how to set up a server for this purpose. The server may run on a Linux system, such as Red-Hat, CentOS or Ubuntu. This document assumes an Ubuntu 64 bit system, version 14.04 (LTS). The server may also run on a Windows system, such as MS Windows 7, Windows 8, Windows Server 2008 etc.

This document assumes the MS Windows10, 64 bits system.

12.12.1 Pre-requisites

Dependent on operating system, the following has to installed

- **Linux**
  - Ubuntu 14.04 LTS
  - VLC (out of the box)
- **Windows**

  - Windows 10, 64 bits system
  - VLC (source: `http://www.videolan.org`)

- **Both systems**
  A mpeg-4 video to stream. A sample is provided on the R&S ROMES DVD (RS_test_and_measurement.mp4).

12.12.2 Installation of VLC

- **Linux**
  Run as root `apt-get install vlc`
- **Windows**
  1. Download the installer for `http://www.videolan.org`, currently `vlc-2.1.5-win32.exe`
  2. Start the program and accept all defaults

12.12.3 Configure the stream

12.12.3.1 Linux

1. Copy the video to a directory, for example, the ~/RS_stream
2. Create a file named `stream.vlm` with the following contents:
   - `# VLC media player VLM command batch`
   - `# http://www.videolan.org/vlc/`
   - `# start vlc as root wit`
   - `# vlc-wrapper --ttl 12 -vvv --color -I telnet --telnet-password v --rtsp-host 0.0.0.0 --rtsp-port 5554 --vlm stream.vlm`

   New `rs_test vod` enabled
   Setup `rs_test input RS_test_and_measurement.mp4`

   Start the server as a root with (one line)
   `vlc-wrapper --ttl 12 -vvv --color -I telnet --telnet-password <your-password> --rtsp-host 0.0.0.0 --rtsp.port 5554 --vlm stream.vlm`

You should change the RTSP port and the telnet password according to your needs. A sample bash script can be found on DVD in directory `vlc\linux\` as `start_vlc_server`.

The script must be located in the same directory as the MP4 file.

12.12.3.2 Windows

1. Copy the video to a directory, for example, the ~/RS_stream
2. Create a file named `stream.vlm` with the following contents:
   - `# VLC media player VLM command batch`
   - `# http://www.videolan.org/vlc/`

   New `rs_test vod` enabled
   Setup `rs_test input RS_test_and_measurement.mp4`

   Start the server as a root with (one line)
   ```
   vlc --ttl 12 -vvv --color -I HTTP --http-password
   <your-password> --http-port 8080 --rtsp-host 0.0.0.0
   --rtsp-port 5554 --vlm stream.vlm
   ```

You should change the RTSP port, HTTP port and the http password according to your needs. A sample DOS script can be found on DVD in directory `vlc\windows\` as `start_vlc_server.cmd` as well as a sample configuration file `stream.vlm`.

The script must be located in the same directory as the MP4 file.

The server can only be stopped by killing it via the task explorer.

12.12.3.3 Remark

The http port and password are not really needed as the HTTP interface is not used in our example.

If the rtsp-host is set to 0.0.0.0, all network card with all addresses are used. To restrict the server to on LAN card only, enter the card's address.

12.12.4 Test the stream

On both systems, the stream can be tested via the command line, by entering

```
vlc rtsp://127.0.0.1:5554/rs_test
```

On Windows you may need to enter the vlc name fully qualified, for example

```
"%ProgramFiles(x86)%\VideoLAN\VLC\vlc.exe"
```

Alternatively, start vlc interactively

1. Select "Media > Open Network Stream" (CTLR-N)
2. Enter "“rtsp://127.0.0.1:5554/rs_test"

if you start vlc on a remote PC, you need to enter the correct IP-address for the server PC.

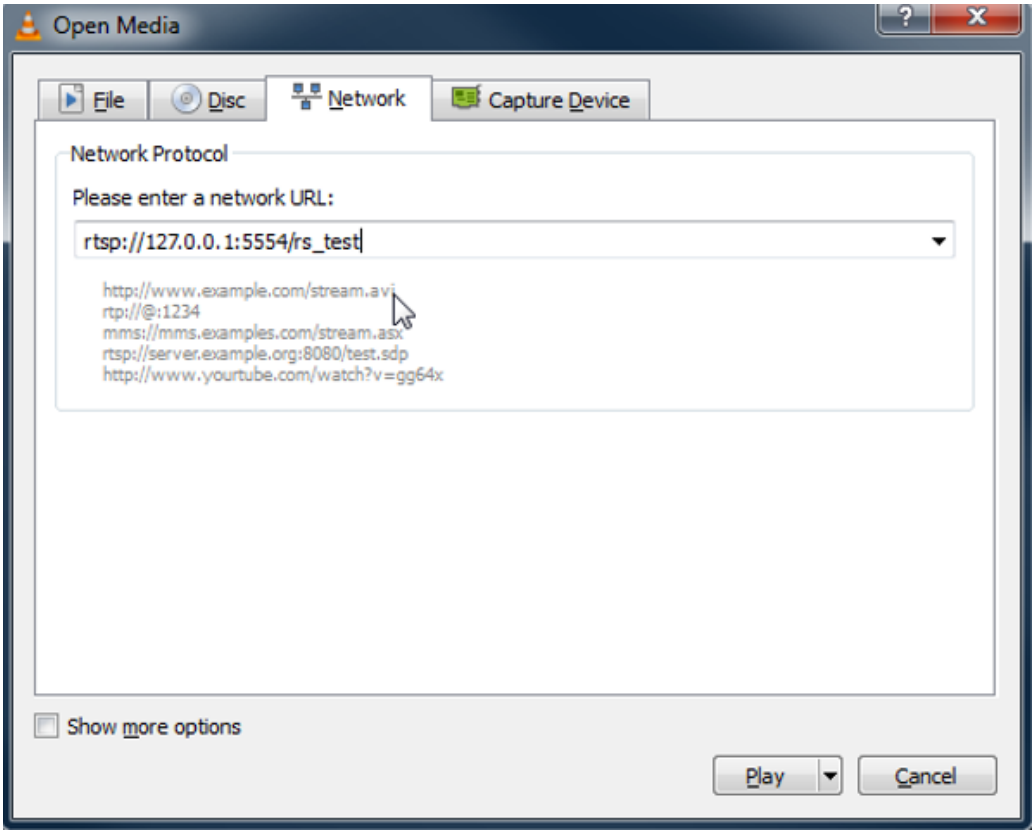


Figure 12-13: Server PC IP address

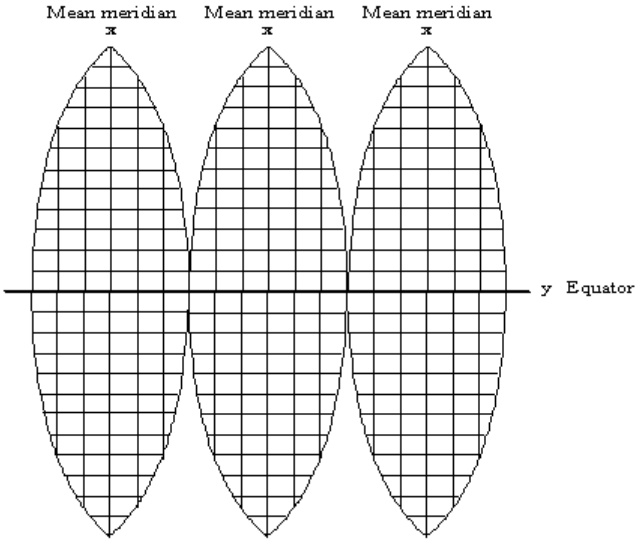
12.12.5 Firewall settings

You need to open the firewall for udp-port 5554 to enable remote access to the server.

12.13 Coordinate systems

The measured field strength values can be displayed in a variety of coordinate systems, depending on the needs of the user. Digitized data on the location coordinates can be obtained with a GPS system or with a digitizer, which is moved over an appropriate land map.

12.13.1 Gauß coordinate systems



The mathematical principles for this type of coordinate system were developed by Gauß, and its adaptation for practical application was completed by Krüger. This projection can be seen more or less as a cylindrical projection on a quadrature axis, where a cylinder is rotated over the earth ellipsoid at right angles to the rotational axis of the ellipsoid. The surface of the earth is then translated through a central projection to the inside of the cylinder. The position of the cylinder is chosen in such a manner that a tangential meridian forms a distortion-free straight line. The equator, perpendicular to the meridian, also forms a straight line. As distance from the tangential meridian increases, there is some distortion. This is also noticeable in the representation of the earth's surface to the east and to the west of the tangential meridian.

To keep the distortion as low as possible, the projection is limited to a strip 1.5° to the side of the tangential meridian (for this reason also referred to as the mean or main meridian). An ellipse is thus created on the surface of the cylinder, the extremities of which are the poles. The entire surface of the earth is divided into 60 meridian strips, which, by "opening up" the cylinder, can be represented as follows:

12.13.1.1 The gauß-krüger system

With the Gauß quadrature axis projection the surface of the earth can be represented on one level in meridian strips. The mean meridian is represented by the y-axis (abscissa) and the equator by the x-axis (ordinate). Both axes are perpendicular to each other. The result is a rectangular coordinate system in each meridian strip (cf. diagram above). The abscissa to the north of the equator are vertical values, the ordinates to the east of the mean meridian are horizontal values.

To avoid negative values for the ordinates, every main meridian is given the value of 500000 meters. As a means of identification, this is prefaced by its degree of longitude divided by three.

To reduce to acceptable values the distortions occurring as distance from the tangential meridian increases, strip systems were introduced in Germany which assume the

degrees of longitude (meridians) at 6°, 9°, 12°, etc. to be main meridians true to longitude and represent them as abscissa axes. Every partial system has an extension of 1.5 degrees of longitude in both directions (approx. 100 km).

A point which is 30500 m to the west of the mean meridian at 6° is assigned the horizontal value

500000 m - 30500 m = 469500 m.

12.13.1.2 UTM system

The Universal Transversal Mercator projection (UTM) is a transversal cylindrical projection used mainly for NATO and USA military maps. The UTM system covers the earth between 80° north and south with 60 meridian systems (zones). The main meridians of each zone lying at 3°, 9°, 15°, etc. are numbered from west to east, beginning with the mean meridian at 177° west. In each zone intervals of approx. 8° are selected and marked with capital letters, beginning at 80° south. All of the fields produced in this way are then divided by grids with round 100 km values in the x and y directions from the mean meridian to form squares with a width of 100 km. These squares are marked with two letters according to their row and column position. Coordinates are then used to determine an exact position within one of the squares. The coordinates are marked E (east, corresponding to y or the horizontal value) and N (north, corresponding to x or the vertical value). The resulting structure is a universal grid.

12.13.2 Coordinate system of the east european states

For average-scale maps the East European states use Gauß-Krüger meridian systems with a longitudinal extension of 6° and a mean meridian true to longitude on the basis of Krassovskij earth ellipsoid. For maps with scales of 1:5000 and more, strips of 3° are used.

12.13.3 Geographical grid

In the geographical grid positional information is given by measuring the degrees of longitude and latitude in degrees, minutes and seconds.

12.13.4 Decimal grid

In the decimal grid positional information is given by measuring the degrees of longitude and latitude in decimal figures.

Glossary: Abbreviations and terms

A

A3: Authentication Algorithm A3

A5/1: Encryption Algorithm A5

A5/2: Encryption Algorithm A5

A8: Algorithm A8

AACH: Access Assignment Channel, TETRA

AB: Access Burst

AC: Access Class (C0 to C15) or
Application Context

ACC: Automatic Congestion Control

ACCH: Associated Control Channel

ACD: Automatic Channel Detection

ACK: Acknowledgement

ACM: Address Complete Message

ACU: Antenna Combining Unit

ADB: Android Debugging Bridge

ADC: Administration Centre or
Analogue to Digital Converter

ADN: Abbreviated Dialling Number

ADPCM: Adaptive Differential Pulse Code Modulation

AE: Application Entity

AEC: Acoustic Echo Control

AEF: Additional Elementary Functions

AGCH: Access Grant Channel

Ai: Action indicator

AMR: Adaptive Multi Rate (speech coding)

ANR: Automated Neighbor Relation

AoCC: Advice of Charge (Charging), supplementary service

AoCI: Advice of Charge Information, supplementary service

API: Application Programming Interface

APK file: Android Package file format

ARFCN: Absolute Radio Frequency Channel Number

ARQ: Automatic Request for Retransmission

ASCI: Advanced Speech Call Items

ASE: Application Service Element

ASN.1: Abstract Syntax Notation One

AT: Acceptance Test or Access Terminal (WiMAX) or ATtention (the prefix that informs modem about start of a command line)

ATD: Command which establishes a data connection or voice connection to a remote modem

ATIM: Alternative Technologies Information Message, specified by 3GPP2 C.S0005-F v2.0 Spec, chapter 3.7.2.3.2.45

ATT (flag): Attach

AU: Access Unit

AuC: Authentication Centre

AUT(H): Authentication

B

BA: BCCH Allocation

BAIC: Barring of All Incoming Calls, supplementary service

BAOC: Barring of All Outgoing Calls, supplementary service

BCC: Base Transceiver Station (BTS) Colour Code

BCCH: Broadcast Control Channel

BCCH_FREQ_NCELL: Frequency of the RF carrier on which the BCCH of a neighbouring cell is transmitted

BCD: Binary Coded Decimal

BCF: Base Station Control Function

BCH: Broadcast Channel

BCIE: Bearer Capability Information Element

BCU: (See GSM 08.56 (ETS 300 595))

BER: Bit Error Ratio

BFI: Bad Frame Indication

BI: Barring of all Incoming call services

BIC-Roam: Barring of Incoming Calls when Roaming outside the HOME PLMN country, supplementary service

Bm: Full-rate traffic channel

BN: Bit Number

BO: Barring of all Outgoing Calls, supplementary service

BOIC: Barring of Outgoing International Calls supplementary service

BOIC-exHC: Barring of Outgoing international Calls except those directed to the Home PLMN Country, supplementary service

BRI: Basic Rate Interface; an ISDN interface configuration

BS: Basic Service (group) or
Bearer Service

BS_AG_BLKS_RES: Number of blocks on each common control channel reserved for access grant messages

BS_BCCH_SDCCH_C0MB: Logical variable that indicates the combination of dedicated and associated control channels on the same physical channel

BS_CC_CHANS: Number of basic physical channels supporting common control channels

BS_G_BLKS_RES: Number of blocks on each common control channel reserved for access grant messages

BS_PA_MFRMS: Number of multiframes between two transmissions of the same paging message to MSs of the same paging group

BSC: Base Station Controller

BSG: Basic Service Group

BSIC: Base Transceiver Station Identity Code

BSIC-NCELL: BSIC of a neighbour cell

BSS: Base Station Sub-system

BSSAP: Base Station System Application Part

BSSMAP: Base Station System Management Application Part

BSSOMAP: Base Station Operation and Maintenance Application Part

BTS: Base Transceiver Station

BWP: Bandwidth Part (for 5G NR)

C

C: Conditional

C-V2X: Cellular, aslo called LTE vehicle to everything

C/R: Command/Response field bit

CA: Carrier Aggregationn

CA_BAND_NUMB: Number of the frequency band that contains the cell allocation

CAI: Charge Advice Information

CBC: Cell Broadcast Centre

CBCH: Cell Broadcast Channel

CC: Country Code or
Call Control or
Component Carrier

CCBS: Completion of Calls to Busy Subscribers supplementary service

CCCH: Common Control Channel

CCCH_GROUP: Group of MSs in idle mode

CCF: Conditional Call Forwarding

CCH: Channel

CCHI: Control Channel

CCITT: Comité Consultatif International Télégraphique et Téléphonique

CCPE: Control Channel Protocol Entity

Cct: Circuit

CDF: Cumulative Distribution Function

CED: Called station identifier

CELL_RESELECT_HYSTERESIS: RXLEV Hysteresis required for cell reselection

CELL-BAR-ACCESS: Cell Access Barred

CEPT: Conférence des administrations Européennes des Postes et Telecommunications

CER: Channel Energy Response

CF: Conversion Facility or
Call Forwarding services

CFB: Call Forwarding on MS Busy supplementary service

CFC: Conditional Call Forwarding

CFNRc: Call Forwarding on MS Not Reachable supplementary service

CFNRy: Call Forwarding on MS No Reply supplementary service

CFU: Call Forwarding Unconditional supplementary service

CGI: Cell Global Identity

CHV: Card Holder Verification

CI: Cell Identity or
CUG Index

CIR: Channel Impulse Response

CKSN: Ciphering Key Sequence Number

CLI: Calling Line Identity

CLIP: Calling Line Identification Presentation, supplementary service

CLIR: Calling Line Identification Restriction, supplementary service

CM: Connection Management

CMD: Command

CMM: Channel Mode Modify

CNG: Calling tone

COI: Co-channel Interferer

COLI: Connect Line Identity

CoLP: Connected Line Identification Presentation supplementary service

CoLR: Connected Line identification Restriction supplementary service

COM: Complete

CONNACK: Connect Acknowledgement

CQI: Channel Quality Information

CRC: Cyclic Redundancy Check (3 bit)

CRE: Call Re-establishment procedure

CS: Coding Scheme or Circuit Switched

CSFB: Circuit Switched Fallback

CSPDN: Circuit Switched Public Data Network

CST: Call Setup Time

CT: Channel Tester

CUG: Closed User Group, supplementary service

CW: Continuous Waveform or
Call Waiting, supplementary service

D

DAC: Digital to Analogue Converter

DB: Dummy Burst

DBWP: Downlink Bandwidth Part (for 5G NR)

DCCH: Dedicated Control Channel

DCE: Data Circuit terminating Equipment

DCF: Data Communication Function

DCN: Data Communication Network

DET: Detach

DISC: Disconnect

DL: Data Link (layer) or
Downlink (base station to mobile)

DLCI: Data Link Connection Identifier

DLD: Data Link Discriminator

DLL: Dynamic Link Library

Dm: Control Channel (ISDN terminology applied to mobile service)

DMO: Direct Mode Operation; this is TETRA mobile radio communication between mobile radios without existing network infrastructure.

DMR: Digital Mobile Radio

DNIC: Data Network Identification Code

DNS: Domain Name System

DP: Dial/Dialled Pulse

DPI: Dots per inch

DQA: Data Quality Analysis

DSE: Data Switching Exchange

DSI: Digital Speech Interpolation

DSS: Dynamic Spectrum Sharing

DSS1: Digital Subscriber Signalling No1

DTAP: Direct Transfer Application Part

DTE: Data Terminal Equipment

DTMF: Dual Tone Multi Frequency (signalling)

DTX: Discontinuous Transmission

E

EA: External Alarms

EBSG: Elementary Basic Service Group

Ec/No: Ratio of energy per modulating bit to the noise spectral density

ECM: Error Correction Mode (facsimile)

ECT: Explicit Call Transfer, supplementary service

EEL: Electric Echo Loss

EIR: Equipment Identity Register

EIRENE: European Integrated Railway Radio Enhanced Network - System Requirements Specification made by GSM-R operators group

EL: Echo Loss

eMBMS: Evolved MBMS; LTE version of MBMS

EMM: Evolved Mobility Management

EMMI: Electrical Man Machine Interface

EN-DC: eNB-gNB Dual Connectivity

ERP: Ear Reference Point

ERR: Error

ERTMS: European Rail Traffic Management System

ESRI: Environmental Systems Research Institute

ETR: ETSI Technical Report

ETS: European Telecommunication Standard or
Extended Training Sequence

ETSI: European Telecommunications Standards Institute

EVM: Error Vector Magnitude, a measure of how accurately a radio is transmitting symbols within its constellation

F

FA: Full Allocation or
Fax Adapter

FAC: Final Assembly Code

FACCH: Fast ACCH

FACCH/F: Full rate Fast Associated Control Channel

FACCH/H: Half rate Fast Associated Control Channel

FB: Frequency correction Burst

FCCH: Frequency Correction Channel

FCS: Frame Check Sequence

FDM: Frequency Division Multiplexing

FEC: Forward Error Correction

FER: Frame Erasure Ratio

FFT: Fast Fourier Transform

FH: Frequency Hopping

FN: Frame Number

FPGA: Field Programmable Gate Array

FR: Full Rate

ftn: Forwarded-to number

G

GCC: Group Call Control

GID: Group Identifier - identification of user group

GMSC: Gateway Mobile (services) Switching Centre

GMSK: Gaussian Minimum Shift Keying (modulation)

GPA: GSM PLMN Area

GPRS: General Packet Radio Service

GSA: GSM System Area

GSCN: Carrier number in 5G NR

GSM: Global System for Mobile Communication

GSM MS: GSM Mobile Station

GSM PLMN: GSM Public Land Mobile Network

GSM-R: GSM-Railway

GT: Global Title

GTSI: Group TETRA Subscriber Identity

H

HANDO: Handover

HDLC: High Level Data Link Control

HLC: High Layer Compatibility

HLR: Home Location Register

HO_MARGIN: SDL Message name for Handover Margin

HOLD: Call Hold, supplementary service

HPLMN: Home PLMN

HPU: Hand Portable Unit

HR: Half Rate

HSN: Hopping Sequence Number

I

I: Information (frames)

IA: Incoming Access (related to closed user group, SS)

IAM: Initial Address Message

iBWP: Initial Bandwidth Part (for 5G NR)

IC: Interlock Code (CUG SS)

IC(pref): Interlock Code of the preferential CUG

ICB: Incoming Calls Barred

ICM: In-Call Modification

ID: Identification/Identity

IDN: Integrated Digital Network

IE: Information Element

IEC: International Electrotechnical Commission

IEI: Information Element Identifier

IF: Intermediate Frequency

IMEI: International Mobile (station) Equipment Identity

IMS: IP Multimedia Subsystem

IMSI: International Mobile Subscriber Identity

IN: Interrogating Node

IoT: Internet of Things

IP: Internet Protocol

IPv4: Internet Protocol version 4

ISC: International Switching Center

ISDN: Integrated Services Digital Network

ISUP: ISDN User Part (of the signalling system No.7)

ITC: Information Transfer Capability

ITS: Intelligent Transport System

ITSI: Individual TETRA Subscriber Identity

IWF: InterWorking Function

IWMSC: InterWorking MSC

IWU: InterWorking Unit

K

K: Constraint Length of the Convolutional Code

Kc: Ciphering Key

Ki: Individual subscriber authentication key (Key Identity)

KPI: Key Performance Indicator

L

L1: Layer 1

L2ML: Layer 2 Management Link

L2R: Layer 2 Relay

L2R BOP: L2R Bit Orientated Protocol

L2R COP: L2R Character Orientated Protocol

L3: Layer 3

LA: Location Area

LAA: Licensed Assisted Access

LAC: Location Area Code

LAI: Location Area Identity

LAN: Local Area Network

LAPB: Link Access Protocol Balanced

LAPDm: Link Access Protocol on the Dm channel

LCC: LAA component carrier

LCN: Local Communication Network

LE: Local Exchange

LEE: Low Estimation Error

LI: Length Indicator or
Line Identity

LLc: Low Layer compatibility

Lm: Traffic channel with capacity lower than Bm

LMSI: Local Mobile Station Identity

LPLMN: Local PLMN

LR: Location Register

LSTR: Listener Sidetone Rating

LTE: Long Term Evolution

LTP: Location Time Probability

LV: Length and Value

M

MA: Mobile Allocation

MAC: Medium Access Control

MACN: Mobile Allocation Channel Number

MAF: Mobile Additional Function

MAH: Mobile Access Hunting, supplementary service

MAI: Mobile Allocation Index

MAIO: Mobile Allocation Index Offset

MAP: Mobile Application Part

MAVLink: Micro Air Vehicle Link

MBMS: Multimedia Broadcast Multicast Service, see 3GPP TS36.300 and TS36.311

MBS: Multimedia Broadcast Multicast Service, see 3GPP TS38.300 and TS38.311

MBSFN: Multicast-broadcast single-frequency network

MCC: Mobile Country Code

MCCH: Main Control Channel for TETRA

MCI: Malicious Call Identification, supplementary service

MCS: Modulation and Coding Scheme

MD: Mediation Device

MDL: Offset of NB-IoT downlink channel number to downlink EARFCN, defined in 3GPP TS36.104 as FDL = FDL_low + 0.1(NDL – NOffs-DL) + 0.0025*(2MDL+1) or (mobile) Management (entity) Data Link (layer)

ME: Maintenance Entity or
Mobile Equipment

MEF: Maintenance Entity Function

MF: Multi-Frame

MFBI: Multifrequency Band Indication

MHS: Message Handling System

MIB: Master Information Block

MIC: Mobile Interface Controller

MIMO: Multiple-Input, Multiple-Output stands for the use of multiple antennas

MM: Man Machine or
Mobility Management

MME: Mobile Management Entity

MMI: Man Machine Interface

MNC: Mobile Network Code

MO: Mobile Originated

MOC: Mobile Originated Call

MOS: Mean Opinion Score is a test providing a numerical indication of the perceived quality from the users' perspective of received media after compression and/or transmission. The MOS is expressed as a single number in the range 1 to 5, where 1 is lowest perceived audio quality and 5 is the highest perceived audio quality measurement. MOS tests for voice are specified by ITU-T recommendation P.800.

MoU: Memorandum of Understanding

MPEG: Moving Picture Experts Group - working group formed by ISO to set standards for audio and video coding and compression, refer to DVB

MPH: (mobile) Management (entity) PHysical (layer) [primitive]

MPTY: Multi-Party, supplementary service

MR: Measurement report

MR-DC: Multi RAT-Dual Connectivity

MRP: Mouth Reference Point

MS: Mobile Station

MS_PWR_CLASS: MS Power Class; defines the power class of an MS expressed in the same way as the R parameter

MS_RANGE_MAX: Mobile Station Range Maximum; handover criterion to determine serving cell

MS_RXLEV_L: Lower Receive Level; threshold of RXLEV received from the serving BS below which either power control or handover must take place to improve the cell quality

MS_TXPWR_CONF MS: Transmitted RF Power Confirmation; parameter sent by the MS to indicate its current transmitted RF power level

MS_TXPWR_MAX_CCH: Maximum Allowed Transmitted RF Power for MSs to access the system until commanded otherwise

MS_TXPWR_REQUEST: MS Transmitted RF Power Request; parameter sent by the BSS that commands the required MS RF Power Level

MSC: Mobile Switching Centre

MSCM: Mobile Station Class Mark

MSCU: Mobile Station Control Unit

MSISDN: Mobile Station ISDN Number

MSRN: Mobile Station Roaming Number

MT: Mobile Terminated

MT (0,1,2): Mobile Termination

MTC: Mobile Terminated Call

MTM: Mobile-To-Mobile (call)

MTP: Media Transfer Protocol

MUL: Offset of NB-IoT uplink channel number to uplink EARFCN

MUMS: Multi User Mobile Station

N

N/W: Network

NB: Normal Burst or
Narrowband

NBIN: A parameter in the hopping sequence

NC0, NC1, NC2: NETWORK_CONTROL_ORDER options defining the measurement reports provided by the mobile and its cell re-selection

NCC: Network (PLMN) Colour Code

NCELL: Neighbouring Cell

NCM: Network Configuration Manager of the QualiPoc; it provides the Bluetooth connection to the R&S TSMA scanner.

NDC: National Destination Code

NDIS: Network Driver Interface Specification; an application programming interface (API) for network interface cards (NICs).

NDUB: Network Determined User Busy

NE: Network Element

NEF: Network Element Function

NET: Norme Européenne des Télécommunications

NF: Network Function

NIC: Network Independent Clocking

NID: Network ID (CDMA2000/EVDO)

NM: Network Management

NMC: Network Management Center

NMSI: National Mobile Station Identification number

NPI: Number Plan Identifier

NQA: Network Quality Analysis

NQDI: Network Quality Data Investigator

NR: New Radio, the 3GPP defined name for 5G RAN

NSA: Non-standalone, mode of operation of 5G NR

NSAP: Network Service Access Point

NSAPI: Network layer Service Access Point Identifier

NT: Network Termination or
Non Transparent

NUA: Network User Access

NUI: Network User Identification

NUP: National User Part (of signaling system No7)

NWS: Network Scanner

O

O: Optional

O&M: Operations and Maintenance

OA: Outgoing Access (CUG SS)

OACSU: Off-Air-Call-Set-Up

OBU: On Board Unit

OCB: Outgoing Calls Barred within the CUG

OD: Optional for operators to implement for their aim

OLR: Overall Loudness Rating

OMC: Operations & Maintenance Center

OML: Operations and Maintenance Link

OS: Operating System

OSI: Open System Interconnection

OSI RM: OSI Reference Model

OTA: Over The Air, protocol

P

PABX: Private Automatic Branch eXchange

PAD: Packet Assembly/Disassembly facility

PAGING_GROUP: The set of MSs monitoring a particular paging block

PCC: Primary Component Carrier

PCH: Paging Channel

PCI: Physical Cell Identity

PCM: Pulse Code Modulation

PD: Protocol Discriminator or
Public Data

PDN: Public Data Networks

PDU: Packet Data Unit

PDV: Packet Delay Variation

PEI: Peripheral Equipment Interface

PER: Packet Error Rate

PESC: Perceptual Evaluation of Speech Calls

PESQ: Perceptual Evaluation of Speech Quality

PH: Packet Handler or
PHysical (layer)

PHI: Packet Handler Interface

PI: Presentation Indicator

PIN: Personal Identification Number

PLMN: Public Land Mobile Network

PLMN_PERMITTED: PLMN permitted for handover purposes

PMI: Precoding Matrix Indicator

PNE: Présentation des Normes Européennes

PNS: Pseudo Noise Scanner

POI: Point Of Interconnection (with PSTN)

POLQA: Perceptual Objective Listening Quality Assessment;

The standard that covers models to predict speech quality by means of digital speech signal analyzis specified by ITU-T Rec. P.863. It is a successor of PESQ (ITU-T Rec. p.632).

PP: Point-to-Point

PPE: Primative Procedure Entity

PPS: Pulse per Second

PRB: Physical Resource Block

Pref CUG: Preferential CUG

PRI: Primary Rate interface; telecommunications interface standard used on an ISDN

PS: Packet Switched

PSCCH: Physical Sidelink Control Channel

PSPDN: Packet Switched Public Data Network

PSS: Primary Synchronization Signal

PSSCH: Physical Sidelink Shared Channel

PSTN: Public Switched Telephone Network

PW: Password

Q

QA: Q (Interface) Adapter

QAF: Q Adapter Function

QoS: Quality of Service

Qualcomm MTP: Qualcomm Mobile Test Platform

R

R: Value of reduction of the MS transmitted RF power relative to the maximum allowed output power of the highest power class of MS (A)

RA: Random mode request information field

RAB: Random Access Burst

RACH: Random Access Channel

RADIO_LINK_TIMEOUT: The timeout period for radio link failure; the maximum value of the radio link timer

RADIO_LINK_TIMER: Parameter which is incremented or decremented according to the success with which SACCH messages are decoded

RAND: Random Number (used for authentication)

RB: Resource Block

RBER: Residual Bit Error Ratio

RCS: Revision Control System
or
Rich Commumnications Service

REC: Railway Emergency Call
or
An error-free series of frames longer then or equal to 5 frames

Rec.: Recommendation

REJ: Reject(ion)

REL: Release

REQ: Request

RESELECT_INTERVAL_MIN: Minimum time between cell reselections

RFC: Radio Frequency Channel

RFCH: Radio Frequency CHannel

RFN: Reduced TDMA Frame Number

RI: Rank Index

RLC: Radio Link Control (GPRS)

RLP: Radio Link Protocol

RLR: Receiver Loudness Rating

RMS: Root Mean Square (value)

RNTABLE: Table of 128 integers in the hopping sequence

RPC: Remote Power Control

RPOA: Recognized Private Operating Agency

RR: Radio Resource

RRC: Radio Resource Control

RS: Reference Signal

RSCP: Receive Signal Coded Power

RSE: Radio System Entity

RSL: Radio Signalling Link

RSRP: Reference Signal Received Power (LTE)

RSS: ROMES Signal Set

RTE: Remote Terminal Emulator

RTP: Real Time Protocol

RTT: Round Trip Time

RTU: Remote Terminal Unit

RXLEV: Received Signal Level

RXLEV_ACCESS_MIN: The minimum received signal level at a MS for access to a cell

RXLEV_MIN: The minimum received signal level at a MS from a neighbouring cell for handover to be permitted

RXLEV_NCELL: Received signal level of neighbouring or current serving cell measured on the BCCH carrier

RXLEV_SERVING_CELL: Received signal level in the serving cell measured on the BCCH carrier

RXQUAL: Received Signal Quality

RXQUAL_FULL: Received signal quality assessed over the full set of TDMA frames within a SACCH block

RXQUAL_SERVING_CELL: Received signal quality of serving cell

RXQUAL_SUB: Received signal quality assessed over a subset of 12 TDMA frames

S

S/W: Software

SABM: Set Asynchronous Balanced Mode

SACCH: Slow Associated Control Channel

SACCH/C4: Slow, SDCCH/4 Associated, Control Channel

SACCH/C8: Slow, SDCCH/8 Associated, Control Channel

SACCH/T: Slow, TCH Associated, Control Channel

SACCH/TF: Slow, TCH/F Associated, Control Channel

SACCH/TH: Slow, TCH/H associated, Control Channel

SAP: Service Access Point

SAPI: Service Access Point Indicator/Identifier

SB: Synchronization Burst

SC: Service Centre (used for SMS)
or
Service Code

SCC: Secondary Component Carrier
Service Code

SCCP: Signalling Connection Control Part

SCH: Synchronization CHannel

SCN: Sub-Channel Number

SCS: Sub Carrier Spacing (5G NR)

SCS-SC: SCS Special Carrier

SDCCH: Stand-alone Dedicated Control CHannel

SDCCH/4: Stand alone Dedicated Control CHannel/4

SDCCH/8: Stand alone Dedicated Control CHannel/8

SDL: Specification Description Language

SDS: Short Data Service is TETRA data service simlar to SMS in GSM

SDU: Service Data Unit

SE: Support Entity

SEF: Support Entity Function

SFH: Slow Frequency Hopping

SI: Screening Indicator
or
Service Interworking
or
Supplementary Information (SIA Supplementary Information A)

SIB: System Information Block

SID: Silence Descriptor
or
Sector ID (CDMA2000/EVDO)

SIM: Subscriber Identity Module

SIT: System Info Type

SLR: Send Loudness Rating

SLTM: Signalling Link Test Message

SME: Short Message Entity

SMP: Smartphone Mode

SMS: Short Message Service

SMS-SC: Short Message Service - Service Centre

SMS/PP: Short Message Service/Point-to-Point

SMSCB: Short Message Service Cell Broadcast

Smt: Short message terminal

SN: Subscriber Number

SNDCP: Subnetwork Dependent Convergence Protocol

SNPN: 5G Standalone Non-Public Network

SNR: Serial Number

SOA: Suppress Outgoing Access

SP: Service Provider
or
Signalling Point
or
Spare

SPC: Signalling Point Code
or
Suppress Preferential (CUG)

SQ: SwissQual

SQA: Speech Quality Analyzer

SQC: Structured Query Language Common Code

SRES: Signed Response (authentication)

SRTM: Shuttle Radar Topography Mission

SRVCC: Single Radio Voice Call Continuity (LTE)

SS: Supplementary Service

or
System Simulator

SS7/SS#7: Signalling System No 7

SSB: Synchronisation Signal Block, related to combination of synchronization and PBSCH signals in 5G NR

SSC: Supplementary Service Control string

SSL: Secure Socket Layer

SSN: Sub-System Number

SSS: Secondary Synchronization Signal

STMR: Sidetone Masking Rating

STP: Signalling Transfer Point

SUL: Supplemental Uplink

T

T: Timer
or
Transparent
or
Type

TA: Terminal Adapter

TAC: Type Approval Code

TAF: Terminal Adaptation Function

TBF: Temporary Block Flow

TBS: Temporary Block Size

TC: Transaction Capabilities

TCH: Traffic Channel

TCH/F: A Full-rate TCH

TCH/F2.4: A Full-rate data TCH (<2.4kbit/s)

TCH/F4.8: A Full-rate date TCH (4.8kbit/s)

TCH/F9.6: A Full-rate data TCH (9.6kbit/s)

TCH/FS: A Full-rate Speech TCH

TCH/H: A Half-rate TCH

TCH/H2.4: A Half-rate data TCH (2.4kbit/s)

TCH/H4.8: A Half-rate data TCH (4.8kbit/s)

TCH/HS: A Half-rate Speech TCH

TCI: Transceiver Control Interface

TCM: Test device Containment Module

TDMA: Time Division Multiple Access

TE: Terminal Equipment

TEDS: TETRA Enhanced Data Services - the high speed data part of the ETSI TETRA Release 2 standard.

Tei: Terminal endpoint identifier

TETRA: Terrestrial Trunked Radio

TFA: Transfer Allowed

TFI: Temporary Flow Identity

TFP: Transfer Prohibited

TI: Transaction Identifier

TLV: Type, Length and Value

TMN: Telecommunications Management Network

TMSI: Temporary Mobile Subscriber Identity

TN: Timeslot Number

TON: Type Of Number

TP: Throughput

TRX: Transceiver

TS: Time Slot or
Technical Specification (see ETS) or
Teleservice

TSC: Training Sequence Code

TSDI: Transceiver Speech & Data Interface

TSM: TruckSim(ulator) Map

TTI: Transmit Time Interval

TUP: Telephone User Part (of signalling system No7)

TV: Type and Value

TXPWR: Transmit power; Tx power level in the MS_TXPWR_REQUEST and MS_TXPWR_CONF parameters

U

UAC: User access Control

UARFCN: UTRA Apsolute Radio Frequency Channel Number

UDI: Unrestricted Digital Information

UDP: User Datagram Protocol

UDUB: User Determined User Busy

UE: User Equipment, stands also as the term for test mobile

UEE: User Equipment Estimation

UI: Unnumbered Information (Frame)

UL: Uplink (mobile to base station)

UMTS: Universal Mobile Telecommunications System

UPCMI: Uniform PCM Interface (13-bit)

UPD: Up to Date

URL: Uniform Resource Locator

USB: Universal Serial Bus

USSD: Unstructured SS Data

UTM: Universal Transverse Mercator coordinate system; uses 2-dimensional Cartesian coordinate system to give the location on the surface of the Earth.

UTRA: UMTS Terrestrial Radio Access

UUS: User-to-User Signalling, supplementary service

V

V: Value

V(SD): Variable Send_State

V2X: Vehicle to everything

VAD: Voice Activity Detection

VAP: Videotex Access Point

VBCS: Voice Broadcast Service

VBS: Voice Broadcast Service, the same as previous

VC runtime: Microsoft Visual Studio (VC) C++ runtime library; 3rd party software.

VCO: Voltage Controlled Oscillator

VGCS: Voice Group Call Service

VGS: Voice Group Service

VLR: Visitor Location Register

VMSC: Visited MSC

VoNR: Voice over New Radio

VPLMN: Visited PLMN

VSC: Videotex Service Centre

VTX host: The components dedicated to Videotex service

W

WB: Wideband

WinPcap: WinPcap is an API for capturing network traffic needed by the tracing tools.

WPA: Wrong Password Attempts (counter)

WS: Work Station

X

XID: eXchange IDentifier

Glossary: GPS receiver

Symbols

2-D, 3-D: Refers to two-dimensional and three-dimensional positions. A 2-D position fix provides latitude and longitude. Altitude is assumed to be fixed. Only three satellites are required to provide a 2-D position with a user-supplied altitude. A 3-D position provides the altitude in addition to LAT/LON and requires four satellites.

A

Almanac: Data transmitted by a GPS satellite which includes orbit information on all the satellites, clock correction, and atmospheric delay parameters. This data is used to facilitate rapid SV acquisition. The orbit information is a subset of the ephemeris data with reduced accuracy.

Ambiguity: The unknown integer number of cycles of the reconstructed carrier phase contained in an unbroken set of measurements from a single satellite pass at a single receiver.

Argument of latitude: The sum of the true anomaly and the argument of perigee.

Argument of perigee: The angle or arc from the ascending node to the closest approach of the orbiting body to the focus or perigee point, as measured at the focus of an elliptical orbit, in the orbital plane in the direction of motion of the orbiting body.

Ascending node: The point at which an object's orbit crosses the reference plane (e.g. equatorial plane) from south to north.

Azimuth: A horizontal direction expressed as the angular distance between a fixed direction, say North, and the direction of the object.

B

Bandwidth: A measure of the information-carrying capacity of a signal, expressed as the width of the spectrum of that signal (frequency domain representation) in Hertz.

Baseline: The three-dimensional vector distance between a pair of stations for which simultaneous GPS data has been collected and processed with differential techniques. The most accurate GPS result.

Beat frequency: Either of the two additional frequencies obtained when signals of two frequencies are mixed. The beat frequencies are equal to the sum or difference of the original frequencies.

Bias: See Integer Bias Terms.

Binary biphase modulation: Phase changes of either 0 or 180 degrees on a constant frequency carrier (representing a binary 0 or 1 respectively). GPS signals are bi-phase modulated.

Binary pulse code modulation: Pulse modulation using a string of binary numbers (codes). This coding is usually represented by ones and zeros with definite meanings assigned to them, such as changes in phase or direction of a wave.

C

C/A code: The Coarse/Acquisition (or Clear/Acquisition) code modulated onto the GPS L1 signal. This code is a sequence of 1023 pseudo random binary bi-phase modulations on the GPS carrier at a chipping rate of 1.023 MHz, thus having a code repetition period of one millisecond. This code was selected to provide good acquisition properties.

Carrier: A radio wave having at least one characteristic (such as frequency, amplitude, phase) which may be varied from a known reference value by modulation.

Carrier beat: The phase of the signal which remains when the incoming Doppler-shifted satellite carrier signal is beat (the difference frequency signal is generated) with the nominally constant reference frequency generated in the receiver.

Carrier frequency: The frequency of the unmodulated fundamental output of a radio transmitter. The GPSL1 carrier frequency is 1575.42 MHz.

Celestial equator: The great circle that is the projection of the Earth's geographical equator of rotation onto the celestial sphere. Its poles are the North and South Celestial Poles.

Celestial meridian: That vertical circle through the elevated celestial pole. It also passes through the other celestial pole, the astronomical zenith, and the nadir.

Channel: The receiver hardware that is required to lock to a satellite, make the range measurements and collect data from the satellite.

Chip: The length of time to transmit either a zero or a one in a binary pulse code.

Chip rate: Number of chips per second (e.g., C/A code = 1.023 MHz).

Clock offset: Constant difference in the time reading between two clocks.

Code division multiple access (CDMA): A method of frequency reuse whereby many radios use the same frequency but with each one having a separate and unique code. GPS uses CDMA techniques with Gold's codes for their unique cross-correlation properties.

Conventional international origin (CIO): Average position of Earth's rotation axis during the years 1900- 1905.

Correlation-type channel: A GPS receiver channel which uses a delay lock loop to maintain an alignment (correlation peak) between the replicas of the GPS code generated in the receiver and the received code.

D

Datum: A mathematical model of the earth. Many local data model the earth for a small region: e.g., Tokyo datum, OSGB-36 (Ordnance Survey of Great Britain 1936), NAD-27(North American). Others, WGS-84, for example, model the whole earth. See also Geodetic Datum

Deflection of the vertical: The angle between the normal to the ellipsoid and the vertical (true plumb line). Since this angle has both a magnitude and a direction, it is usually resolved into two components: one in the meridian and the other perpendicular to it in the prime vertical.

Delay lock: The technique whereby the received code (generated by the satellite clock) is compared with the internal code (generated by the receiver clock) and the latter is shifted in time until the two codes match. Delay lock loops can be implemented in several ways; tau dither and early-minus-late gating.

Delta pseudo-range: See reconstructed carrier phase.

DGPS: Differential GPS operation. The use of a reference station to provide corrections using the RTCM SC-104 protocol for one or more mobile receivers. This may be carried out in real time over a telemetry link or by storing the data and post processing (see below).The accuracy of position measurement may be improved from 100 meters 2dRMSunder Selective Availability conditions to 1 - 15 meters depending on the choice of sensors and telemetry.

Differential (relative) positioning: Determination of relative coordinates of two or more receivers which are simultaneously tracking the same satellites. Static differential GPS involves determining baseline vectors between pairs of receivers. See also DGPS.

Differential processing: GPS measurements can be differenced between receivers, satellites, and epochs. Although many combinations are possible, the present convention for differential processing of GPS phase measurements is to take differences between receivers (single difference), then between satellites (double difference), then between measurement epochs (triple difference).
A single-difference measurement between receivers is the instantaneous difference in-phase of the signal from the same satellite, measured by two receivers simultaneously. A double-difference measurement is obtained by differencing the single difference for one satellite with respect to the corresponding single difference for a chosen reference satellite.

A single-difference measurement is the difference between a double difference at one epoch of time and the same double difference at the previous epoch of time.

Dilution of precision (DOP): A description of the purely geometrical contribution to the uncertainty in a position fix, given by the expression DOP = SQRT TRACE (A A) where A A is the design matrix for the instantaneous position solution (dependent on satellite-receiver geometry). The DOP factor depends on the parameters of the position-fix solution. Standard terms for the GPS application are:
GDOP:
Geometric (three position coordinates plus clock offset in the solution)
PDOP:
Position (three coordinates)
HDOP:
Horizontal (two horizontal coordinates)
TDOP:
Time (clock offset only)
VDOP:
Vertical (height only)
RDOP:
Relative (normalized to 60 seconds)

Doppler aiding: The use of Doppler carrier-phase measurements to smooth code-phase position measurements.

Doppler shift: The apparent change in frequency of a received signal due to the rate of change of the range between the transmitter and receiver. See reconstructed carrier phase.

Double-difference method: A method to determine that set of ambiguity values which minimizes the variance of the solution for a receiver pair baseline vector.

Dynamic positioning: Determination of a timed series of sets of coordinates for a moving receiver, each set of coordinates being determined from a single data sample, and usually computed in real time.

E

Earth-centered earth-fixed (ECEF): Cartesian coordinate system where the X direction is the intersection of the prime meridian (Greenwich) with the equator. The vectors rotate with the earth. Z is the direction of the spin axis.

Eccentric anomaly E: The regularizing variable in the two-body problem. E is related to the mean anomaly M by Kepler's equation: M = E - e.sinE (e stands for eccentricity).

Eccentricity: The ratio of the distance from the center of an ellipse to its focus to the semimajor axis. $e = (I - b^2/a^2)^{-0.5}$ where a and b are the semimajor and semiminor axes of the ellipse.

Ecliptic: The earth-sun orbital plane. North is the direction of the system angular momentum. Also called the ecliptic pole.

Elevation: Height above mean sea level. Vertical distance above the geoid.

Elevation Mask Angle: That angle below which satellites should not be tracked. This varies according to the task and location, e.g. for land surveying it is normally set to 15 degrees to avoid interference problems caused by buildings, trees and multipath errors. For marine navigation on the other hand, the angle can be lowered to 5 degrees. Please note that, because of the greater thickness of the ionosphere and troposphere traversed by the signal at low angles together with the increased distance of the satellite, the signal is weaker.

Ellipsoid: In geodesy, unless otherwise specified, a mathematical figure formed by revolving an ellipse about its minor axis. It is often used interchangeably with spheroid. Two quantities define an ellipsoid; these are usually given as the length of the semimajor axis, a, and the flattening, f = (a - b)/a, where b is the length of the semiminor axis. Prolate and triaxial ellipsoids are invariably described as such.

Ellipsoid height: The measure of vertical distance above the ellipsoid. Not the same as elevation above sea level. GPS receivers output position-fix height in the WGS-84 datum.

Ephemeris: A list of (accurate) positions or locations of a celestial object as a function of time. Available as "broadcast ephemeris" or as post processed "precise ephemeris." For GPS navigation purposes the broadcast ephemeris is always used and is updated every hour. It is sent as a set of 8 elements of the Keplerian orbital equation (qv) and used by the receiver to compute the instantaneous position of that satellite.

Epoch: Measurement interval or data frequency, as in making observations every 15 seconds. Loading data using 30-second epochs means loading every other measurement.

ESRI: Environmental Systems Research Institute

F

Fast switching channel: A switching channel with a sequence time short enough to recover (through software prediction) the integer part of the carrier beat phase.

Flattening: $f = (a - b)/a = I - (I - e^2)^{1/2}$ where: a = Semimajor axis b - Semiminor axis e = Eccentricity

Frequency band: A range of frequencies in a particular region of the electromagnetic spectrum.

Frequency spectrum: The distribution of amplitudes as a function of frequency of the constituent waves in a signal.

Fullwave: Term used to differentiate between measurements made with signal-squared (codeless)and code-tracking receivers. Specifically, a receiver tracking L2 P-code can make measurement using the whole L2 wavelength (23 cm): the full wave.

Fundamental frequency: The fundamental frequency used in GPS is 10.23 MHz. The carrier frequencies L1 and L2 are integer multiples of this fundamental frequency. L1 = 154F = 1575.42 MHz L2 =120F = 1227.60 MHz

G

GDOP: Geometric Dilution of Precision. The relationship between errors in user position and time and in satellite range. $GDOP^2 = PDOP^2 + TDOP^2$

Geocenter: The center of the earth.

Geodetic datum: A mathematical model designed to best fit part or all of the geoid. It is defined by an ellipsoid and the relationship between the ellipsoid and a point on the topographic surface established as the origin of datum. This relationship can be defined by six quantities, generally (but not necessarily) the geodetic latitude, longitude, and the height of the origin, the two components of the deflection of the vertical at the origin, and the geodetic azimuth of a line from the origin to some other point. The GPS uses WGS-84.

Geoid: The actual physical shape of the earth which is hard to describe mathematically because of the local surface irregularities and sea-land variations. In geodetic terms it is the particular equipotential surface which coincides with mean sea level, and which maybe imagined to extend through the continents. This surface is everywhere perpendicular to the force of gravity.

Geoid height: The height above the geoid is often called elevation above mean sea level.

GIS: Geographic Information System

GNSS: Global Navigation Satellite System

GPS: Global Positioning System, consisting of:
1) A Space Segment (up to 24 NAVSTAR satellites in 6 different orbits)
2) The Control Segment (5 monitor stations, 1 primary control station and 3 upload stations)
3) The User Segment (GPS receivers) NAVSTAR satellites carry extremely accurate atomic clocks and broadcast coherent simultaneous signals.

GPS ICD-200: The GPS Interface Control Document is a government document that contains the full technical description of the interface between the satellites and the user. GPS receivers must comply with this specification if they are to receive and process GPS signals properly.

GPS Time: The length of the second is fixed and is determined by primary atomic frequency standards. Leap-seconds are not used, as they are in UTC. Therefore, GPS time and UTC differ by a variable whole number of seconds. See also Universal Time.

Gravitational constant: The proportionality constant in Newton's Law of Gravitation: G=6.672 x 111 Nm2/K92.

Greenwich mean time (GMT): See Universal Time. They are often used interchangeably, although Universal Time is now defined as the accepted standard. Halfwave - Measurements made using L2-squared measurements. The squaring process results in only half of the original L2 wavelength being available.

H

HDOP: Horizontal Dilution of Precision. See DOP and PDOP.

HOW: Handover word; the word in the GPS message that contains time synchronization information for the transfer from the C/A code to the P-code.

I

Inclination: The angle between the orbital plane of a body and some reference plane (e.g., equatorial plane).

INS: Inertial Navigation System, which contains an inertial measurement unit (IMU).

Integer Bias Terms: The receiver counts the radio waves from the satellite, as they pass the antenna, to a high degree of accuracy. However, it has no information on the number of waves to the satellite at the time it started counting. This unknown number of wavelengths between the satellite and the antenna is the integer bias term.

Integrated Doppler: A measurement of Doppler shift frequency or phase over time.

IODE: Issue Of Data, Ephemeris. Part of the navigation data. It is the issue number of the ephemeris information. A new ephemeris is available usually on the hour. Especially important for Differential GPS operation that the IODE change is tracked at both the reference station and mobile stations.

Ionospheric delay: A wave propagating through the ionosphere [which is a non homogeneous (in space and time) and dispersive medium] experiences delay. Phase delay depends on electron content and affects carrier signals. Group delay depends on dispersion in the ionosphere as well, and affects signal modulation (codes). The phase and group delay are of the same magnitude but opposite sign.

ipar soln: Values giving the difference in each of delta X, delta Y, delta Z vector components.

J

JPO: Joint Program Office for GPS located at the USAF Space Division at El Segundo, California. The JPO consists of the USAF Program Manager and Deputy Program Managers representing the Army, Navy, Marine Corps, Coast Guard, Defense Mapping Agency and NATO.

K

Kalman Filter: A numerical method used to track a time-varying signal in the presence of noise. If the signal can be characterized by some number of parameters that vary slowly with time, then Kalman filtering can be used to tell how incoming raw measurements should be processed to best estimate those parameters as a function of time.

Keplerian orbital elements: Allow description of any astronomical orbit:
a: semimajor axis
l: right ascension of ascending node
e: eccentricity
i: inclination
o: argument of perigee
t: true anomaly

Kinematic surveying: A form of continuous differential carrier-phase surveying requiring only short periods of data observations. Operational constraints include starting from or determining a known baseline, and tracking a minimum of four satellites. One receiver is statically located at a control point, while others are moved between points to be measured.

L

L band: The radio-frequency band extending from 390 MHz to (nominally) 1550 MHz.

L1: The primary L-band signal radiated by each NAVSTAR satellite at 1575.42 MHz. The L1 beacon is modulated with the C/A and P-codes, and with the NAV message. L2 is centered at 1227.60 MHz and is modulated with the P-code and the NAV message.

Lane: The area (or volume) enclosed by adjacent lines (or surfaces) of zero phase of either the carrier beat phase signal, or of the difference between two carrier beat phase signals. On the earth's surface a line of zero phase is the locus of all points for which the observed value would be an exact integer for the complete instantaneous phase measurement. In three dimensions, this locus becomes a surface. Lane counts are used extensively also in terrestrial radio navigation systems such as Loran or Decca to define position.

LLA: A topocentric spherical coordinate system, whose coordinates are Latitude, Longitude, and Altitude. Note that altitude can be expressed with respect to any particular ellipsoid or geoid model and generally depends on the model.

M

MCX: A small RF coaxial cable antenna connector system produced by several companies, e.g. Huber & Suhner.

Mean Anomaly: M = n (t - T) where: n is the mean motion, t is the time and T is the instant of perigee passage.

Mean motion: n = 2 /P where P is the period of revolution.

Microstrip: Antenna. A two-dimensional, flat, precisely cut piece of metal foil glued to a substrate.

Monitor station: Worldwide group of stations used in the GPS control segment to monitor satellite clock and orbital parameters. Data collected here is linked to a primary station where corrections are calculated and controlled. This data is uploaded to each satellite at least once per day from an Upload Station.

Multichannel receiver: A receiver containing many independent channels. Such a receiver offers highest SNR because each channel tracks one satellite continuously.

Multipath: Interference similar to "ghosts" on a television screen which occurs when GPS signals arrive at an antenna having traversed different paths. The signal traversing the longer path will yield a larger pseudo range estimate and increase the error. Multiple paths may arise from reflections from structures near the antenna.

Multipath error: A positioning error resulting from interference between radio waves which have traveled between the transmitter and the receiver by two paths of different electrical lengths.

Multiplexing channel: A receiver channel which is sequenced through several satellite signals (each from a specific satellite and at a specific frequency) at a rate which is synchronous with the satellite message bit-rate (50 bits per second, or 20 milliseconds per bit). Thus, one complete sequence is completed in a multiple of 20 milliseconds.

N

N-type: A large diameter screwed coaxial antenna connector, normally used with RF cables such as RG213 or RG58 where the mechanical strain relief is taken through the connector.

NAD-83: North American Datum, 1983.

NAVDATA: The 1500 bit Navigation Message broadcast by each satellite at 50 bps on both L1 or L2 beacons. This message contains system time, clock correction parameters, ionospheric delay model parameters, and the vehicle'ephemeris and health. This information is used to process GPS signals to obtain user position and velocity.

NAVSTAR: The name given to GPS satellites, built by Rockwell International (Block I) or GE (Block II), which is an acronym formed from NAVigation System with Time And Ranging.

O

Observing session: The period of time over which GPS data is collected simultaneously by two or more receivers.

OGC: Open Geospatial Consortium, a standards organization for geospatial information systems

Outage: The occurrence in time and space of a GPS dilution of precision value exceeding a specified maximum.

P

P-code: The protected or precise code used on both L1 and L2 GPS beacons. This code will be made available by the DOD only to authorized users. The P-code is a very long (about 1014 bits) sequence of pseudo random binary biphase modulations on the GPS carrier at a chipping rate of 10.23 MHz which does not repeat itself for about 38 weeks. Each satellite uses a one-week segment of this code which is unique to each GPS satellite, and is reset each week.

Parity error: A digital message is composed of 1s and 0s. Parity can be defined as the sum of these bits within a word unit. A parity error results when one of the bits is changed so that the parity calculated at reception is not the same as it was at transmission of the message.

PCB: Printed Circuit Board. Reference is also made to flexible PCBs, a method of providing flexible connector ribbons to normal PCBs.

PDOP: Position Dilution of Precision, a unitless figure of merit expressing the relationship between the error in user position and the error in satellite position. Geometrically, PDOP is proportional to 1 divided by the volume of the pyramid formed by lines running from the receiver to four satellites observed. Values considered "good" for positioning are small, say 3. Values greater than 7 are considered poor. Thus, small PDOP is associated with widely separated satellites. Small PDOP is important in navigation and positioning, but much less so in surveying. PDOP is related to horizontal and vertical DOP by $PDOP^2 = HDOP^2 + VDOP^2$.

Pengee: That point in a geocentric orbit when the geometric distance is a minimum. The closest approach of a body.

Phase lock: The technique whereby the phase of an oscillator signal is made to follow exactly the phase of a reference signal by first comparing the phases of the two signals, and then using the resulting phase difference signal to adjust the reference oscillator frequency to eliminate phase difference when the two signals are next compared.

Phase observable: See reconstructed carrier phase.

Point positioning: A geographic position produced from one receiver in a stand-alone mode. At best, position accuracy obtained from a stand-alone receiver is 15-25 meters, depending on the geometry of the satellites. With Selective Availability in operation the best that can be expected is 100 meters 2dRMS.

Polar motion: Motion of the instantaneous axis of the rotation of the Earth with respect to the solid body of the Earth. Irregular but more or less circular motion with an amplitude of about 15m and a main period of about 430 days (called Chandler Wobble).

Precise positioning service (PPS): The highest level of military dynamic positioning accuracy that will be provided by GPS, based on the dual-frequency P-code and having high anti-jam and anti-spoof qualities.

Prime vertical: The vertical circle perpendicular to the celestial meridian.

PRN: Pseudorandom noise, a sequence of digital Is and 0s which appears to be randomly distributed like noise, but which can be exactly reproduced. The important property of PRN codes is that they have a low autocorrelation value for all delays or lags except when they are exactly coincident. Each NAVSTAR satellite has its own unique C/A and P pseudorandom-noise codes.

Pseudolite: A ground-based GPS transmitter station which broadcasts a signal with a structure similar to that of an actual GPS satellite.

Pseudorange: A measure of the apparent propagation time from the satellite to the receiver antenna, expressed as a distance. Pseudorange is obtained by multiplying the apparent signal-propagation time by the speed of light. Pseudorange differs from the actual range by the amount that the satellite and user clocks are offset, by propagation delays, and other errors.
The apparent propagation time is determined from the time shift required to align (correlate) a replica of the GPS code generated in the receiver with the received GPS code. The time shift is the difference between the time of signal reception (measured in the receiver time frame) and the time of emission (measured in the satellite time frame).

Pseudorange difference: See reconstructed carrier phase.

R

Range rate: The rate of change of range between the satellite and receiver. The range to a satellite changes due to satellite and observer motions. Range rate is determined by measuring the Doppler shift of the satellite beacon carrier.

RDOP: Relative Dilution Of Precision, defined as:
$(_DX^2 + _DY^2 + DZ^2)^{1/2} / _DD$

usually in units of m/cycle. Multiplying RDOP by the uncertainty of a double-difference measurement yields the spherical relative-position error.

Reconstructed carrier phase: The difference between the phase of the incoming Doppler-shifted GPS carrier and the phase of a nominally constant reference frequency generated in the receiver. For static positioning, the reconstructed carrier phase is sampled at epochs determined by a clock in the receiver.
The reconstructed carrier phase changes according to the continuously integrated Doppler shift of the incoming signal, biased by the integral of the frequency offset between the satellite and receiver reference oscillators.
The reconstructed carrier phase can be related to the satellite-to-receiver range, once the initial range (or phase ambiguity) has been determined. A change in the satellite-to-receiver range of one wavelength of the GPS carrier (19 cm for L1) will result in a one-cycle change in the phase of the reconstructed carrier.

Relative navigation: A technique similar to relative positioning except that one or both, of the points may be moving. The pilot of a ship or aircraft may need to know his position relative to a harbor or runway. A data link is used to relay the error terms to the moving vessel to allow real-time navigation.

Relative positioning: The process of determining the relative difference in position between two marks with greater precision than that to which the position of a single point can be determined. Here, a receiver (antenna) is placed over each spot and measurements are made by observing the same satellite at the same time. This technique allows cancellation (during computations) of all errors which are common to both observers, such as satellite clock errors, propagation delays, etc. See also Translocation and Differential Navigation.

Right ascension of ascending node: The angular distance measured from the vernal equinox, positive to the east, along the celestial equator to the ascending node. Typically denoted by a capital omega (Ω). Used to discriminate between orbital planes.

RTCM: Radio Technical Commission for Maritime Services. Commission set up to define a differential data link to relay GPS correction messages from a monitor station to a field user. RTCM SC-104 recommendations define the correction message format and 16 different correction message types.

S

SA: See Selective Availability SATNAV - A local term referring to use of the older TRANSIT system for satellite navigation. One major difference between TRANSIT and GPS is that the TRANSIT satellites are in low-altitude polar orbits with a 90-minute period.

Selective Availability(SA): A DoD program to control the accuracy of pseudorange measurements, whereby the user receives a false pseudorange which is in error by a controlled amount. Differential GPS techniques can reduce these effects for local applications.

Semimajor axis: One half of the major axis of an ellipse.

SEP: Spherical Error Probable, a statistical measure of precision defined as the 50th percentile value of the three-dimensional position error statistics. Thus, half of the results are within a 3-D SEP value.

Sidereal day: Time between two successive upper transits of the vernal equinox.

Simultaneous measurements: Measurements referenced to time-frame epochs which are either exactly equal, or else so closely spaced in time that the time misalignment can be accommodated by correction terms in the observation equation, rather than by parameter estimation.

Slope distance: The three-dimensional vector distance from station one to station two. The shortest distance (a chord) between two points.

Slow switching channel: A switching channel with a sequencing period which is too long to allow recovery of the integer part of the carrier beat phase.

SMA, SMB, SMC: Small diameter RF coaxial cable connectors with various fastening mechanisms. See manufacturers' catalogues for details.

Solar day: Time between two successive upper transits of the sun.

Spheroid: See ellipsoid.

Spread spectrum: The received GPS signal is a wide bandwidth, low-power signal (-1 60dBW). This property results from modulating the L-band signal with a PRN code in order to spread the signal energy over a bandwidth which is much greater than the signal information bandwidth. This is done to provide the ability to receive all satellites unambiguously and to provide some resistance to noise and multipath.

Spread spectrum systems: A system in which the transmitted signal is spread over a frequency band much wider than the minimum bandwidth needed to transmit the information being sent.

Squaring-type channel: A GPS receiver channel which multiplies the received signal by itself to obtain a second harmonic of the carrier which does not contain the code modulation. Used in so-called codeless receiver channels.

Standard positioning service (SPS): The level of dynamic- or static-positioning capability that will be provided by GPS, based on the single-frequency C/A-code. The accuracy of this service will be set at a level consistent with national security.

Static positioning: Positioning applications in which the positions of static or near static points are determined.

SV: Satellite Vehicle or Space Vehicle.

Switching channel: A receiver channel which is sequenced through a number of satellite signals (each from a specific satellite and at a specific frequency) at a rate which is slower than, and asynchronous with, the message data rate.

T

TAIP: Trimble ASCII Interface Protocol. A protocol used to interface with Trimble vehicle navigation sensors such as the Starfinder and SVeeSix. It is designed for bi-directional use with communication modems and radio data telemetry systems which have problems with binary or hexadecimal data packets. Each packet is preceded by two letters, followed by a sequence of alphanumeric information. A full specification of the protocol is contained Appended.

TANS: Trimble Advanced Navigation Sensor. A family of rugged 6 channel GPS sensors. Used also to refer to the protocol, also known as TSIP, Trimble Standard Interface Protocol (q.v.).

TDOP: Time Dilution of Precision. See DOP.

TOW: Time of week, in seconds, from midnight Sunday UTC.

Translocation: A version of relative positioning which makes use of a known position, such as a national survey authority mark, to aid in the accurate positioning of a desired point. Here, the position of the mark, determined using GPS, is compared with the accepted value. The three-dimensional differences are then used in the calculations for the second point.

Trop: Tropospheric correction. The correction applied to the measurement to account for tropospheric delay. This value is obtained from the modified Hopfield model.

True anomaly: The angular distance, measured in the orbital plane from the earth's center (occupied focus) from the perigee to the current location of the satellite (orbital body).

TSIP: Trimble Standard Interface Protocol. A binary/hex packet bi-directional protocol, also known as the TANS protocol. Used by a large number of Trimble sensors. TSIP is the subset of TANS which is recognized by all sensors except those of the 4000 series. The protocol is defined in full in the TSIP Appendix.

U

Universal time: Trimble Standard Interface Protocol. A binary/hex packet bi-directional protocol, also known as the TANS protocol. Used by a large number of Trimble sensors. TSIP is the subset of TANS which is recognized by all sensors except those of the 4000 series. The protocol is defined in full in the TSIP Appendix.
UTO:

Universal Time as deduced directly from observations of stars and the fixed numerical relationship between Universal and Sidereal Time; 3 minutes 56.555 seconds.
UTI:
UTO corrected for polar motion.
UT2:
UTI corrected for seasonal variations in the earth's rotation rate.
UTC:
Universal Time Coordinated; uniform atomic time system kept very close to UT2 by offsets. Maintained by the US. Naval Observatory. GPS time can be directly related to UTC.
UTC:
GPS = seconds. (changing constant = 7 seconds in 1991).

User range accuracy (URA): The contribution to the range-measurement error from an individual error source (apparent clock and ephemeris prediction accuracy's), converted into range units, assuming that the error source is uncorrelated with all other error sources. Values less than 10 are preferred. Block II satellites operating under Selective Availability are usually set to 32.

UTM: Universal Transverse Mercator Map Projection. A special case of the Transverse Mercator projection. Abbreviated as the UTM Grid, it consists of 60 north-south zones, each 6 degrees wide in longitude.

V

VDOP: Vertical Dilution of Precision. See DOP and PDOP.

Vernal equinox: The intersection of the celestial equator with the ecliptic, with the positive sense being from the earth to the sun, as the sun crosses the equator from south to north.

Vertical: The line perpendicular to the geoid at any point. The direction of the force of gravity at that point. Plumb line.

W

Waypoint: A reference point in physical space used for purposes of navigation, also named a landmark.

WGS-72: World Geodetic System (1972); the mathematical reference ellipsoid previously used by GPS, having a semimajor axis of 6378.135 km and a flattening of 1/298.26.

WGS-84: World Geodetic System (1984); the mathematical ellipsoid used by GPS since January 1987. The shift from WGS-72 to WGS-84 in Sunnyvale CA (370 N, 1220 W) is about 13.6 meters east, 45 meters north and 2.7 meters up.

Widelane: A linear combination of L1 and L2 observations (L1-L2) used to partially remove ionospheric errors. This combination yields a solution in about one-third the time of a complete ionosphere-free solution.

Z

Z-count: The GPS satellite clock time at the leading edge of the next data subframe of the transmitted GPS message (usually expressed as an integer number of 6 seconds).

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