

R&S®CRTU Protocol Test Platform

2G and 3G interoperability tests – from real networks to the lab

In addition to conformance tests, interoperability tests (IOT) are becoming increasingly important. R&S®CRTU users have an advantage in this respect: They can transfer these tests from real networks to the lab and perform them in an altogether quicker and more cost-efficient manner. The new R&S®ITS replay tool in conjunction with the R&S®ROMES coverage measurement software makes this possible.

For network operators and platform or chip manufacturers

Error-free operation in the real network – this is the primary requirement demanded by mobile phone users and thus also by network operators and platform or chip manufacturers. Comprehensive tests must ensure correct functioning. Since processes in real networks are often more complex than the lab simulation performed during development, interoperability tests are of major importance for development purposes and prior to the market launch of mobile phones.

IOTs are performed either in IOT labs of the network infrastructure manufacturers or in real networks under the conditions present there. However, these tests carry the disadvantage of being very expensive owing to the unavoidable costs for renting test networks.

Moreover, errors that occur due to the constantly changing general conditions in these networks (cell power, timing, load, etc.) can no longer be reproduced.

Rohde & Schwarz has therefore developed the R&S®ITS replay tool for its interoperability tool suite (ITS) [1] software application. The tool allows you to use data about conditions and scenarios that appear only once in a real network or in an IOT lab and simulate these conditions and scenarios on the R&S®CRTU protocol test platform in the lab.

From field test to simulation in the lab

However, before you can perform realistic tests in the lab, it is first necessary to carry out drive tests in real mobile radio networks. You can use the R&S®TSMx radio network

More information and data sheet at
www.rohde-schwarz.com
(search term: type designation)

REFERENCES

- [1] R&S®CRTU Protocol Test Platform: User-friendly definition of 2G and 3G signaling scenarios. News from Rohde & Schwarz (2007) No. 193, pp 21–23
- [2] R&S®TSMx Radio Network Analyzers: Radio network analyzers for all tasks and any budget. News from Rohde & Schwarz (2007) No. 192, pp 4–8
- [3] R&S®ROMES3 Coverage Measurement Software: Acquisition, analysis, and visualization of data in coverage measurements. News from Rohde & Schwarz (2000) No. 166, pp 29–32

FIG 1 Section of an export report with the public land mobile network (PLMN) ID replaced and the determination of the network mode of operation (NMO).

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FTP_Transfer.f2l.txt

Phylis2XMLExporter running using following configuration:
  Replay hardware: 1xCRTU-W
  Power replay: off
  print cell activity intervals: off
  print cell events: off
  debug level: off

MibManipulationAgent: MIB changed MCC:MNC from (262:1) to (1:1)
Cell::verifySIB: cell=159/10836 has no SIB 1
Cell 159/10836 has not all it needs
Cell 94/10836 has all it needs
Cell::hasAllNeededMIBSIB: cell=137/10836 has no MIB
Cell 137/10836 has not all it needs
Cell::hasAllNeededMIBSIB: cell=334/10836 has no MIB
Cell 334/10836 has not all it needs
Configuration: Power replay is off
Registration (SysInfo1) Mode: NMO2
```

analyzers [2] and the R&S®ROMES coverage measurement software [3] from Rohde & Schwarz to conveniently handle these tests. R&S®ROMES records the data that is generated by the analyzer or test phone during the drive test and saves it on the hard disk (see box on page 11) in a proprietary format (*.rscmd). The data is exported and analyzed via the software's export function and combined into a field test scenario (f2l file), which is then played back to the R&S®CRTU by means of the R&S®ITS replay software option. The software generates a report that documents in detail all required changes of the scenario during the export process (FIG 1). If the measurement data is not sufficient for a simulation, the reason why the scenario cannot be simulated is automatically determined. If all prerequisites are met, R&S®ITS replay accepts the field test scenario and plays it back. By using the graphical user interface, you can also make changes to layer 3 messages, e.g. skip, copy, insert, or delete, if necessary. The tried-and-tested Message Composer from Rohde & Schwarz makes it possible to edit individual messages. As usual, result analysis is performed using the Message Analyzer (FIG 2).

Field tests in the lab

The R&S®ROMES coverage measurement software allows the initial analysis of the recorded scenarios. You can perform a virtual simulation of field tests on the PC in the lab and select and export the signaling sequences that are of interest to you. The processes executed during the export of the recorded field tests analyze the available measurement data and prepare it for R&S®ITS replay. This includes the following:

- ◆ Determination of all necessary cells and associated cell parameters (e.g. cell timing in UMTS). Cells are set up as needed and then cleared down again as well. Thus, any number of

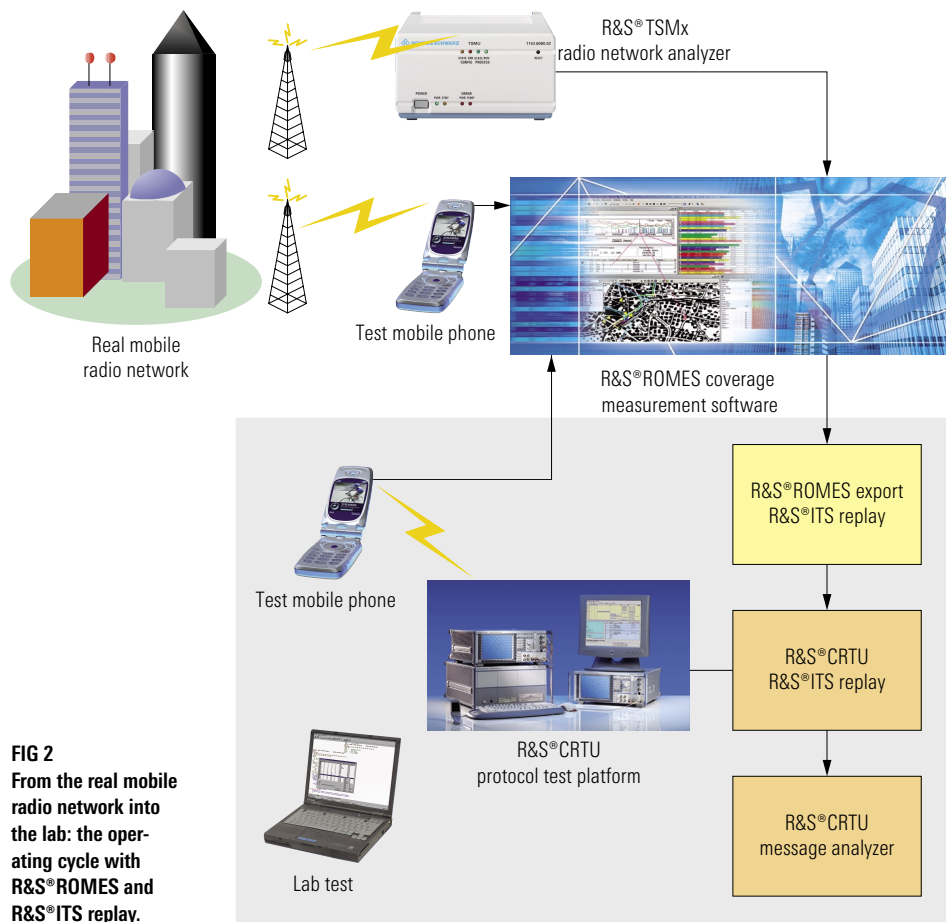


FIG 2
From the real mobile radio network into the lab: the operating cycle with R&S®ROMES and R&S®ITS replay.

cells of a scenario can be played back on the simulator.

- ◆ Determination of the necessary registration. If no registration is included in the sequence to be simulated, the actual scenario is preceded by a standard registration.
 - ◆ Export of all required layer 3 messages.
 - ◆ Export of all cell information necessary for the simulation of the cell power.
 - ◆ Inclusion of real time sequences.
 - ◆ Simulation of security algorithms.
- Since the algorithms used in the network are proprietary, R&S®ITS replay uses a standardized test-purpose universal subscriber identity module (USIM) and the algorithms based on the TS34.108 test specification.

After an export has been performed, these and many other processes ensure that a field test scenario that can run on the R&S®CRTU is generated without manual interaction. You can thus press the start button of the R&S®ITS replay application and the simulation will begin. The result is saved together with the simulated scenario and managed in a result overview. In contrast to tests in real networks, these scenarios are reproducible.

Two modes for various requirements

To take the various requirements into account, there are two different ways of playing back an R&S®ITS replay scenario (FIG 3).

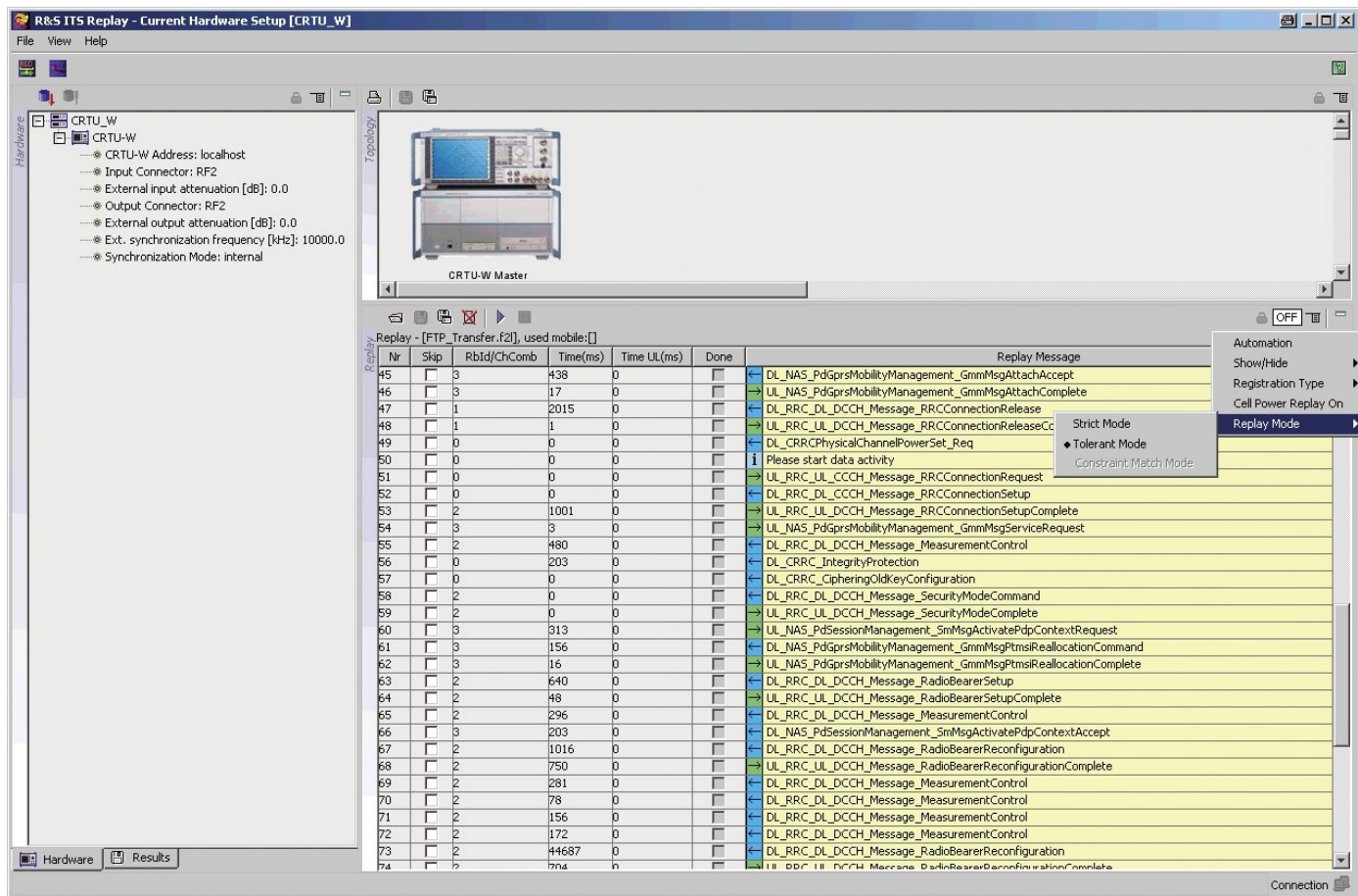


FIG 3 R&S®ITS replay: Its graphical user interface provides all functions that are necessary for flexibly playing back field test scenarios in the lab.

- In **Strict Mode**, the simulator expects every single message present in R&S®ITS replay exactly as it was received when recorded in the real network. If a message is missing or an unexpected message is received, the scenario will be immediately terminated. You can thus reproduce network scenarios in the lab with absolute sequence accuracy.

In contrast, **Tolerant Mode** provides flexibility in the sequence as well as in the order the messages arrive. This is advantageous when different mobile phones behave slightly differently and the R&S®ITS replay scenarios are used for regression tests on various types of mobile phones.

In both modes, you can also activate *Constraint Matching*, which allows the bit-accurate comparison of complete uplink messages on the basis of individual messages.

Another important point for reproducing a field scenario in the lab is the simulation of the cell power on the R&S®CRTU. In many cases, it may be sufficient to simulate only the signaling process in order to detect a mobile phone malfunction. To handle cases where the transmit power of the cells has a decisive impact, R&S®ITS replay can also adapt the power of the most important cells every 100 ms in accordance with the recorded cell power. However, in this special case the mobile phone should be placed in a shielded chamber, since the interfer-

ing effects in the lab would otherwise distort the result.

In addition to interactive operation, R&S®ITS replay of course also supports automatic tests. In this case, the R&S®CRTU handles the task of operating the mobile phone by means of software remote control.

Precise and complete measurements with the R&S®TSMx

For cost and implementation reasons, the receiver sections of mobile phones are generally rather simple in design. Therefore, they can neither perform calibrated measurements of the surrounding cell environment during a field test nor analyze the large number of

surrounding cells with sufficient accuracy. This is where an R&S®TSMx radio network analyzer comes in handy – it can carry out these measurements more quickly, more thoroughly and more precisely. Irrespective of the test mobile phone, the R&S®TSMx measures the system information and power of all cells to be received. Normally, no information is lost when this is done, and the simulation in the lab corresponds even closer to the field conditions. Moreover, data from neighboring cells of other systems, e.g. GSM, can also be included in this way – even if the measurements were not performed by the DUT itself.

Nothing comparable on the market

For reproducing field tests, no other mobile radio protocol tester on the market provides a comparable solution that combines high accuracy, flexibility, and simple operation. By using the R&S®ITS replay software package presented here, you have to record the real network data only once and can simulate the scenarios in the lab with exact reproducibility, thus eliminating the high costs associated with renting test networks.

If you assemble a comprehensive test suite over an extended period, software release cycles can be significantly reduced since real network behavior can be tested systematically in the lab in advance.

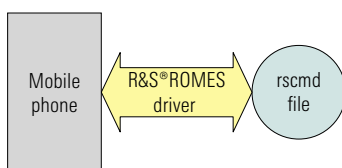
The process described here as an example of how to reproduce field tests using the R&S®CRTU and the advantages that this offers apply without any restrictions also when it comes to reproducing IOT lab tests.

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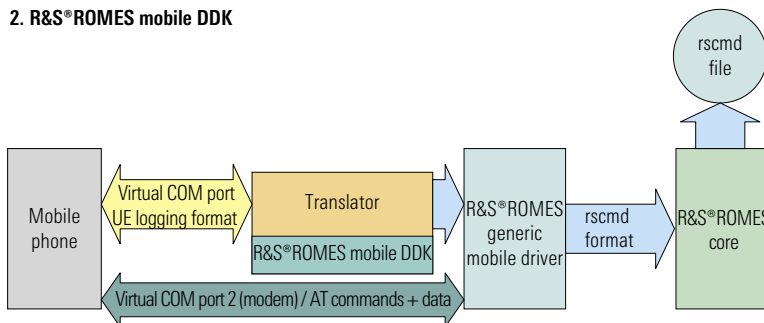
Three different ways of converting measurement data to the Rohde & Schwarz rscmd format

1. For many conventional mobile radio device platforms, Rohde & Schwarz offers drivers that allow the signaling protocols saved in the mobile phone to be used in the R&S®ROMES coverage measurement software.
2. Using the R&S®ROMES mobile driver development kit (DDK), you can develop customer-specific R&S®ROMES drivers for GSM and WCDMA.
3. Rohde & Schwarz also offers a programming interface (C++ API) for R&S®ITS replay that allows you to quickly convert protocol files of the mobile phones to the R&S®ROMES format.

1. R&S®ROMES driver



2. R&S®ROMES mobile DDK



3. R&S®ITS replay C++ API

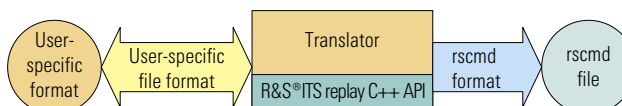


FIG 4

There are three ways of converting log data to the Rohde & Schwarz rscmd format.