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FIG 1   The Radio Network Analyzer R&S ® TSMU, used inhouse together with the UMTS test phone Qualcomm 6200 and *Bluetooth*™ *) GPS receiver on a tablet PC.

Following the introduction of the UMTS PN Scanner R&S ® TS 5K51C [1] a year ago, Rohde & Schwarz is now setting new standards in performance, precision and speed for mobile phone measurements in 3GPP networks with the next phase in development – the compact and universally implementable UMTS Radio Network Analyzer R&S ® TSMU.

Radio Network Analyzer R&S ® TSMU

Performance giant in compact format sets new standards

Greater performance in even less space

The R&S ® TSMU and the accompanying R&S ® ROMES-US 2 UMTS software stand out particularly because of the following features:
◆ Multitechnology capability (2G / 3G) in a single instrument
◆ Parallel PN scanning of up to 12 RF channels in one mobile radio band
◆ Time-variant spectrum analysis from 15 MHz to 3 GHz parallel to PN code measurements
◆ All measurements done at top speed, dynamic range and precision (see page 7 for specifications)
◆ Efficient control with Coverage Measurement Software R&S ® ROMES [2]
◆ Also for inhouse use due to portability and low energy consumption
◆ Automatic application-specific firmware adaptation (FPGA and software)

The R&S®TSMU consists of an RF receiver for 100 kHz to 3 GHz, a processor board with a field programmable gate array (FPGA) core, a power PC and a power supply unit with an input voltage range from 9 V to 18 V.

On the processor board, the IF data of the RF receiver is collected, synchronized, filtered and forwarded to the controller via the FireWire interface (IEEE 1394). Within the controller, the data is further processed by Measurement Software R&S®ROMES and then recorded and displayed with the measurement results of the GPS receiver and the UMTS mobile telephone.

The compact and robust housing indicates the various operating states by means of LEDs. Connections for antenna, GPS, distance trigger, FireWire and power supply are located at the rear (FIGs 1 and 2).

uted within the instrument allow exact corrections of measurements in different temperature ranges as soon as the instrument is switched on; the basic frequency of the R&S®TSMU can additionally be tracked together with the measured UMTS time frames or, even more precisely, with a GPS seconds pulse sequence. A 256 Mbyte to 2 Gbyte compact flash memory can be used to store comprehensive calibration and measurement data.

To achieve the best possible RF characteristics for the R&S®TSMU at minimum size and low power consumption, components from the newest Rohde & Schwarz spectrum analyzers were used. For these special tasks in the R&S®TSMU, their noise figure for measurements of weak antenna signals was reduced and the IF bandwidth for the measurement of 3GPP signals was enlarged.

The R&S®TSMU is the new hardware platform for almost any application involving mobile radio network optimization. Its architecture is already designed for expansions to HSDPA, GSM / GPRS, cdma2000, TD-SCDMA and CW. The required firmware is automatically loaded by Measurement Software R&S®ROMES via the FireWire interface.

In-depth radio network analysis with test mobile phones

Specifically the combination of the R&S®TSMU with UMTS test mobile phones (FIG 1) provides an exceptional tool for in-depth analysis of air interface problems. Test mobile phones provide a limited picture of the RF situation in the network. The R&S®TSMU enriches the information from the mobile phone with a complete RF analysis that can be used to find the cause of the prob- ▶

Better properties through state-of-the-art technology

The R&S®TSMU is one of the first instruments in the world that uses the new VIRTEX-II PRO™ DSP technology for optimum signal processing and instrument control.

The RF receiver is directly controlled by hardware components in the FPGA unit of the VIRTEX-II PRO™, allowing the system to respond extremely quickly to changes in reception in mobile use. Given the minimum delays between the on-chip power PC and the FPGA as well as the broadband data connection to the controller, it was possible – together with distributed DSP algorithms – to achieve higher measurement rates than in its predecessor. The 64 Mbyte signal memory ensures that weak interfering UMTS signals can be found, and it is required in order to prevent ghost code results. Four thermometers distrib-

FIG 2   Rear view of the R&S®TSMU with synchronization and pulse input (top right), antenna socket and two FireWire connectors for cascading up to 62 R&S®TSMU analyzers on one controller. The RS-232-C interface supplies service information.
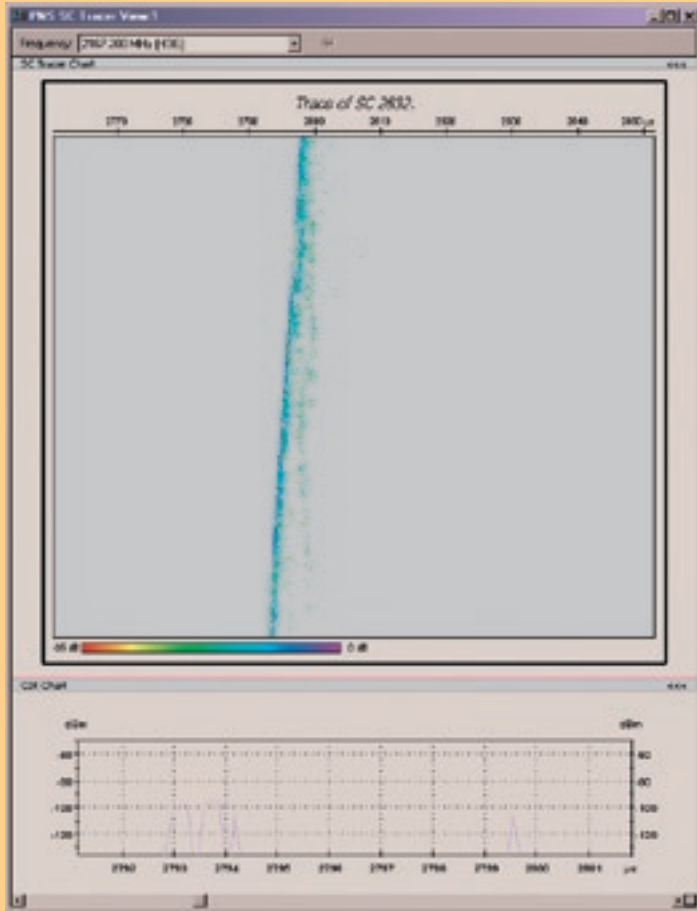
FIG 3
Channel impulse response on scrambling code 2832 with 2D and waterfall display during drive test with the R&S®TSMU. Strong reflections and time drift of the base station are clearly indicated.
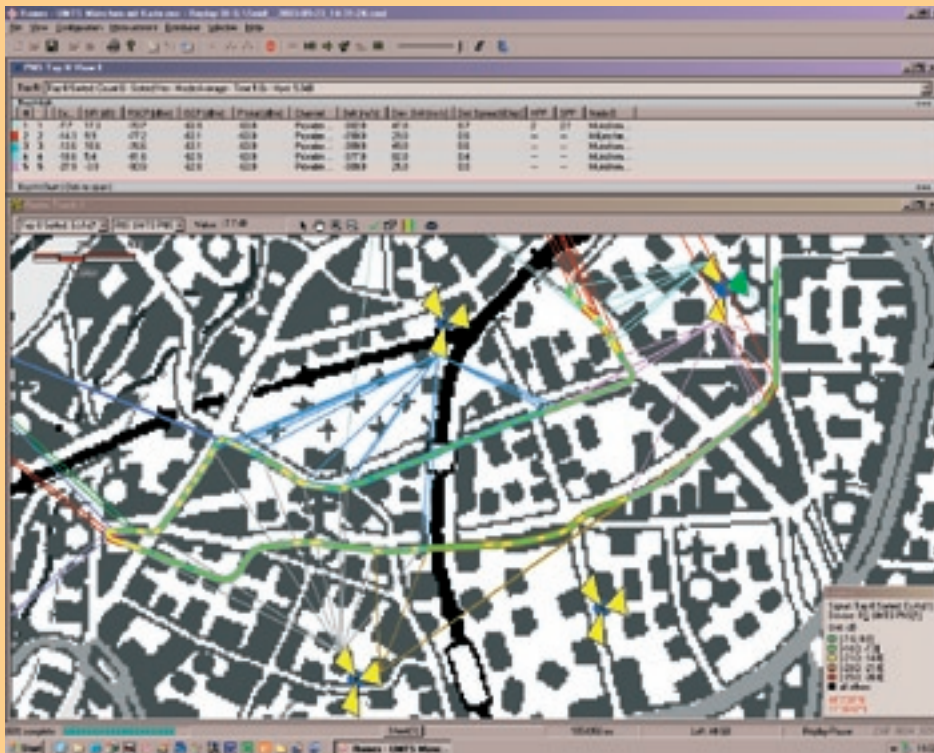
lems reported by the mobile phone. This includes interference from outside the network, defects in the base station and unavoidable differences between planning and implementation in the best server and adjacent cell relationships in the network.

Broad areas of use

The R&S®TSMU can be used either as a portable model with a tablet PC and GPS or it can be installed in special test vehicles for high-performance solutions. The specific application determines which system solution is preferred.

The portable model with tablet PC (FIG 1) is ideal in all cases where flexible use either indoors or outdoors is required. The R&S®TSMU and a controller allow convenient measurements in buildings and a series of vehicles.

When installed in a briefcase together with the controller and test mobile phones, the R&S®TSMU can be moved as frequently as needed, making it ideal for use in vehicles and for quasi-stationary measurements indoors.

A common application is the integration of the analyzer into 19" racks of drive test expert systems, where several instruments — e.g. for simultaneous measurements in GSM and UMTS networks — are interlinked and combined with a large number of test mobile phones and test receivers.

The sandwich design of the scanner also allows installation in robust autonomous systems (e.g. in the trunk of taxis).

… and the tried-and-tested R&S®ROMES software

The extremely flexible and powerful Measurement Software

FIG 4   Drive test with the R&S®TSMU in best server/TOP-N display. The colour of the route marks the E_c/I_o value of the best server. The contour of the route has the scrambling code colour. Each line from the test vehicle to a base station shows a change in the best server in the colour of the new scrambling code.

R&S®ROMES [2], which is used for all coverage measurement systems from Rohde & Schwarz, is part of all applications of the analyzer. This software is used to control one or more R&S®TSMU analyzers, a GPS system and UMTS test mobile phones as well as to display, store and evaluate measurement data (FIGs 3 and 4). R&S®ROMES can be operated easily and intuitively using the convenient tools of the Windows® user interface such as "drag and drop". The software is completely modular in design, and any technology or device driver can be added by loading and configuring it. This concept represents a particularly sound investment, because the operating philosophy remains the same while the software can be updated to keep pace with new mobile radio generations.

Summary

Rohde & Schwarz is setting new standards in coverage measurement with its universal UMTS Radio Network Analyzer R&S®TSMU. The intelligent combination of the instrument with test mobile phones enables maximum information to be determined from the air interface, making complicated tasks in mobile radio networks much easier. The R&S®TSMU is leading the way in the areas of network planning, network setup, optimization, quality assurance and service.

Wolf-Dietrich Seidl; Otmar Wanierke

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More information and data sheet at www.rohde-schwarz.com (search term: TSMU)
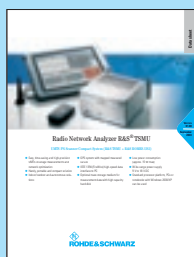
REFERENCES
[1] PN Scanner R&S®TS 5K51C – Turbo for UMTS network optimization. News from Rohde & Schwarz (2002) No. 176, pp 4–9
[2] Coverage Measurement Software R&S®ROMES3 – Acquisition, analysis and visualization of data in coverage measurements. News from Rohde & Schwarz (2000) No. 166, pp 29–32

Condensed data of the R&S®TSMU

Frequency	
Frequency range	100 kHz to 3 GHz
Frequency stability (GPS-synchronized)	0.01 ppm
Time stability (GPS-synchronized)	10^{-11}
Analog IF bandwidth (−3 dB)	4.4 MHz
Scanner	
Synchronization time (high dynamic mode)	
12 PN codes	90 ms
Synchronization time (high speed mode)	
5 PN codes	10 ms
Code power measurement (high speed mode)	−116 dBm to −20 dBm
(high dynamic mode)	−124 dBm to −20 dBm
Dynamic range (high speed mode)	20 dB
(high dynamic mode)	29 dB
Level uncertainty (−12 dB $<E_c/I_0$ <0 dB)	<1.5 dB
Adjacent channel rejection	>65 dB; typ. >70 dB
General data	
Connections	2 × FireWire IEEE 1394, 6-pin, 400 Mbit/s
	RF IN, N female, 50 Ω
	RS-232-C
	DC IN, 9 V to 18 V DC
	PULSE IN, BNC, GPS PPS
	PULSE IN/OUT, BNC distance trigger
	SMARTCARD port for compact flash cards with 256 Mbyte to 2 Gbyte
Temperature range	+0°C to +45°C
Vibration	40 g shock spectrum
Quality standard	ISO 9000
Operating voltage	9 V to 18 V DC (<1 A at 12 V)
Dimensions (W × H × D)	150 mm × 80 mm × 170 mm
Weight	1.5 kg