

# R&S®ROMES4

## Drive Test Software

### Mobile coverage and QoS measurements in wireless communications



# R&S®ROMES4 Drive Test Software At a glance

R&S®ROMES4, the unique scanners from Rohde & Schwarz and the network problem analyzer (NPA) tool form an all-in-one solution for radio network analysis and optimization.

R&S®ROMES4 is the universal software platform for network optimization systems from Rohde & Schwarz. In combination with other test and measurement equipment such as wireless communications scanners and test mobile phones, it provides solutions for all essential tasks involved in coverage measurements, interference identification and performance measurements in wireless communications networks. Besides pure recording and visualization of test parameters, data is processed instantly and statistics are calculated in realtime.

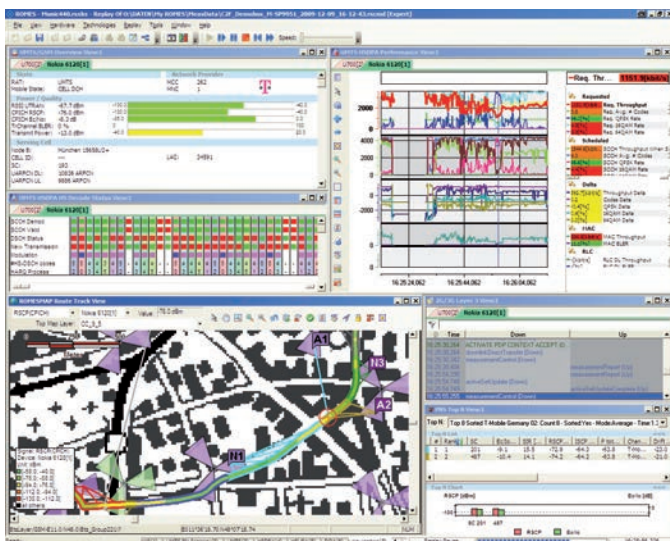
Currently, the following technologies are supported: GSM/EDGE, WCDMA/HSPA+, CDMA2000® 1xEVDO Rev. A, WLAN (IEEE 802.11b, g), WiMAX™ (IEEE 802.16e), LTE, DVB-T, DVB-H and TETRA. Standard-compliant RF level measurements can be time- and route-triggered over a very wide frequency range (9 kHz to 7 GHz).

Due to its highly modular structure, the platform can be expanded at any time for new technologies such as LTE. The test software runs under the Microsoft Windows XP™ SP3 or Windows 7 (32 and 64 bit) operating systems on a standard PC.

When R&S®ROMES4 is combined with the band-unlimited scanners of the R&S®TSMx family, the measurements help typical customers (such as network operators, regulatory authorities, service providers, chipset manufacturers and the military) complete their work quickly and easily.

## Key facts

- One software for all technologies: "all under one roof"
- Flexible software licenses reduce startup costs
- Parallel measurement with up to 12 mobile phones per license; this saves time, allowing existing resources to be utilized more effectively and saving operating expenses (OPEX)
- Use of highly accurate, fast RF test and measurement equipment (Rohde & Schwarz scanners) providing many reliable measured values and results
- Automatic evaluation after completion of measurement by means of integrated replay function or network problem analyzer, which considerably reduces OPEX
- Automatic identification of GSM interferences, resulting in a considerable OPEX reduction (up to 80% potential savings compared with standard analysis)
- Unique scanner for GSM, WCDMA, CDMA2000® 1xEVDO, WiMAX™, LTE and TETRA in all bands and decoding of broadcast information



# R&S®ROMES4

## Drive Test Software

### Benefits and key features

#### Easy operation with high flexibility

- Easy-to-use interface that adapts to the user's level of knowledge
  - Ready to use in no time, due to workspaces and projects
  - Easy system configuration with device manager and wizards
  - Support of numerous map data formats
- ▷ [page 4](#)

#### Automatic handover and neighborhood analysis

- Automatic detection of missing neighboring cells during drive
  - Improvement of network coverage
  - Indispensable for a roll-out
- ▷ [page 7](#)

#### GSM interference analysis with automatic interferer identification

- Automatic measurement and identification of interferers from the own GSM mobile radio network
  - Evaluation of BCCH and TCH channels allows full-featured analysis
  - Detection of adjacent- and co-channel interferers
- ▷ [page 8](#)

#### Numerous application tests (data throughput/DQA)

- Creation of different application jobs
  - Output of KPIs and the most important network parameters in the form of a report
- ▷ [page 10](#)

#### Full overview of layer 1 and layer 3

- Display of mobile phone activities in layer 3
  - Fast analysis in the case of an interrupted connection
  - Decoding of protocol messages for insight into network configuration
- ▷ [page 11](#)

#### Test of speech quality

- Full end-to-end measurement of how the customer would experience quality
  - Based on PESQ standard
  - Output of MOS value
- ▷ [page 12](#)

#### Parallel spectrum measurement

- Broadband spectrum measurement
  - Detection of broadband interferers, neighborhood interferences or uplink activities
- ▷ [page 13](#)

#### Determination of 2G and 3G base stations

- Creation of a base station list during a test drive
  - No active connection to base station necessary
  - Requires only scanner and GPS
- ▷ [page 14](#)

#### Indoor measurements

- Stationary or moving measurements indoors, without GPS signal
  - Combined indoor/outdoor measurements
- ▷ [page 15](#)

#### R&S®ROMES4NPA

##### In-depth analysis of network problems

- Analysis of one or more test drives according to different criteria
  - Automatic pinpointing of trouble spots and their causes using sophisticated algorithms
  - Choice of add-on modules for speech quality and data tests as well as coverage and neighborhood analysis
  - Software development kit (SDK) for generating user-specific add-on modules
- ▷ [page 16](#)

# Easy operation with high flexibility

## Easy-to-use interface that adapts to the user's level of knowledge

Featuring different user levels, R&S®ROMES4 can adapt to the user's level of knowledge. The different levels make it possible to adjust the displayed views and signals to what is most important for the individual user. This allows experienced users as well as newcomers to work more efficiently with this drive test tool.

## Ready to use in no time, due to workspaces and projects

In addition, users can create a workspace in which to store all settings and loaded drivers. At the start of a new test drive, all they need to do is load this workspace and the test system is ready to use right away. To further simplify/speed up this procedure, users can create a project. A project contains all the settings of a workspace and reduces the overall volume of the modules to be loaded when the software is started. The startup wizard makes it possible to load and start a project, workspace or test file fully automatically.

### Overview of the R&S®ROMES4 graphical user interface

The screenshot displays the R&S ROMES4 graphical user interface with several key components:

- Overview of mobile parameters:** A panel on the left showing mobile phone details for a Nokia 6120i, including RAT (UMTS), Mobile State (CELL DCH), RSCP, CPICH, and Transmit Power.
- Menu and main control:** A central control panel with various icons for navigation and data recording.
- HSDPA performance view:** A panel on the right showing HSDPA performance metrics, including Requested Throughput (151.9 kbit/s) and various throughput and error rate statistics.
- HSDPA decoding status view:** A panel below the mobile parameters showing the status of HSDPA decoding, including SCCH Demod, SCCH Valid, and SCCH Status.
- Route track with BTS symbols:** A map view at the bottom left showing the test route with various BTS symbols (A1, N1, A2, N3) and signal strength indicators.
- UMTS PN scanner:** A panel at the bottom right showing UMTS PN scanner data, including a table of Top 8 Sorted I-Mobile Germany U2 Count 8 - Sorted Yes - Mode Average - Time 1.5 s.
- L3 protocol messages:** A panel on the right showing L3 protocol messages, including ACTIVATE PDP CONTEXT ACCEPT ID, downloadDirect Transfer Down, measurementControl, and activeSetUpdate.

## Easy system configuration with device manager and wizards

Multiple wizards help users to perform application tests (e.g. an FTP download or http download) when configuring a mobile phone. In only three steps, the measurement is ready to be started.

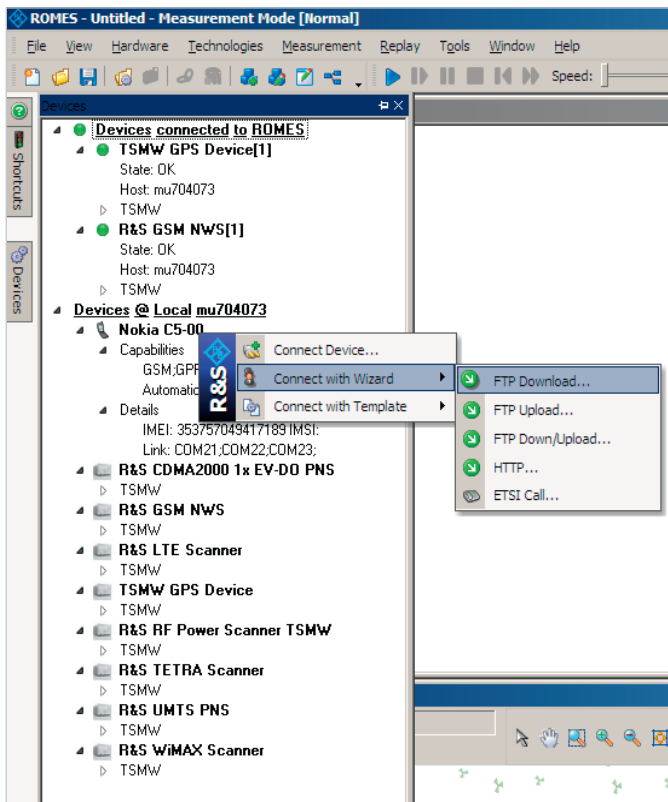
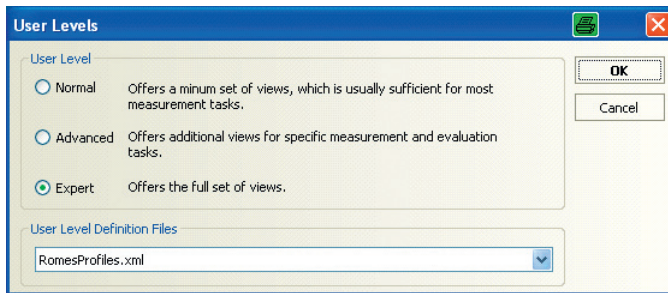
The device manager which is integrated in R&S®ROMES automatically finds all connected test mobile phones and R&S®TSMx-scanner options and displays them. With just three mouse clicks, users can configure numerous application tests such as an FTP download. After successfully loading the drivers, R&S®ROMES4 automatically opens a selection of important windows that display measured data.

## Support of numerous map data formats

In addition to the MapInfo map data format, R&S®ROMES4 also supports the optional use of maps that are based on ESRI, Map & Guide, LS telcom or CMRG. The optional support for OpenStreetMaps is new. Maps loaded online are then also available offline without the need to reload.

R&S®ROMES4 also proves flexible when it comes to licensing. The license server model enables users to rent R&S®ROMES4 licenses for a limited period of time from a license server located at the customer site. After a defined rental period, the licenses are automatically made available to be rented again. This eliminates capital investments and fits the needs of the individual user.

Selecting the user level.



R&S®ROMES device manager shows all connected instruments and allows direct access to the configuration wizard.

# Easy operation with high flexibility

In addition to an ASCII export, measurement data can also be converted to Google Earth format, making it easy for users to visualize a test drive for maps without any additional expense.

When multiple and long test drives need to be evaluated automatically for errors in the network and the cause for these errors needs to be determined, the R&S®ROMES4 network problem analyzer (NPA) is the ideal tool. The base module (for displaying ETSI key performance indicators (KPIs) and providing an overview of the data contained in the measurement files) is part of the equipment supplied with R&S®ROMES4. Optional modules for dedicated error analysis of voice or data calls automatically evaluate the causes of error and display them. A further module permits the analysis of coverage measurement data recorded with the R&S®TSMx scanners. Yet another module permits neighborhood analysis of LTE and TETRA, and will later also evaluate GSM, WCDMA and inter-RAT neighborhoods.

## Completely configured test mobile phone in just three steps

The image displays three sequential screenshots of the 'Wizard for Nokia C5-00' software interface, illustrating the three steps to configure a test mobile phone. Each window includes a 'Device' information section at the bottom: Device: Nokia C5-00 [1], Normal; IMEI: 353757049417189; IMSI: [blank].

- Step 1:** The first window prompts the user to verify the summary of the wizard. It shows 'FTP Download' settings: Hardware Mobile Driver, Provider Name (Vodafone D2), APN (web.vodafone.de), FTP Settings URL (ftp://cms.rohde-schwarz.com), File (download/10M.bin), and User (user). A 'Save as Use Case' checkbox is present.
- Step 2:** The second window asks the user to select the network provider for the data connection. It shows 'Country' set to Germany and 'Provider' set to Vodafone D2. A list of network options includes E-Plus, T-Mobile D LTE1800, T-Mobile D, and T-Mobile D LTE800. The 'Network' section has '3GPP (GSM/UMTS/LTE)' selected.
- Step 3:** The third window asks the user to specify the ftp server by ip address or name. It shows 'File' set to download/10M.bin, 'User Name' set to Anonymous, and 'Password' set to password.

# Automatic handover and neighborhood analysis

## Requirements

- R&S®ROMES4
- R&S®ROMES4HOA
- R&S®ROMES4T1Q or R&S®ROMES4T1W
- R&S®TSMx GSM/UMTS scanner
- Test mobile phone
- R&S®ROMES4GSM (GSM driver) or R&S®ROMES4WCQ (Qualcomm driver) or R&S®ROMES4WCN (Nokia driver)

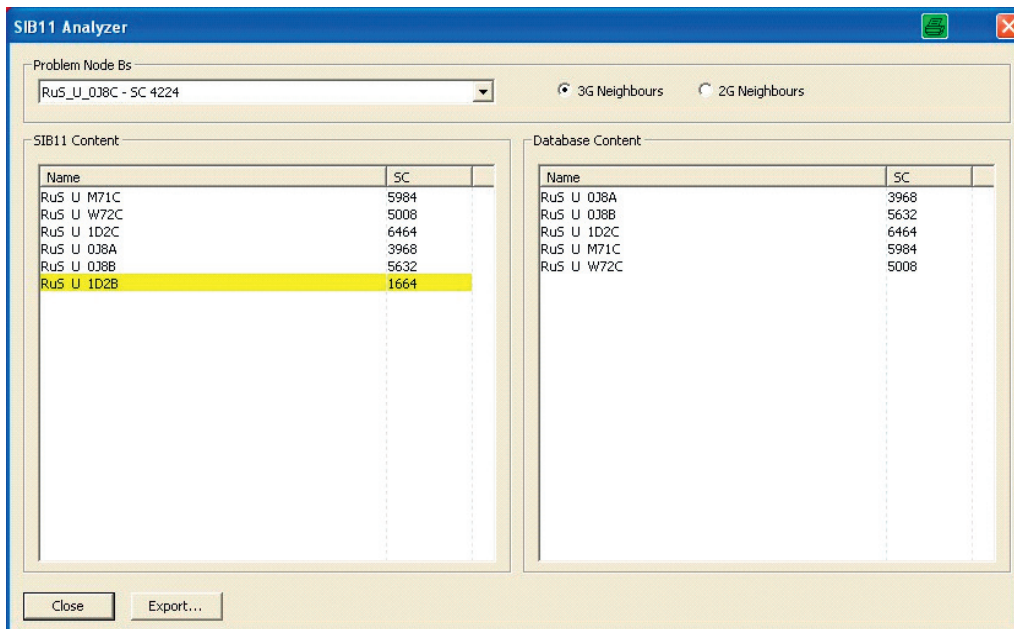
## Automatic detection of missing neighboring cells during drive

The automatic neighborhood analysis is based on a base station list and on the base stations' broadcast signals that are decoded by the R&S®TSMx scanners. These system information blocks (UMTS and LTE) or system information types (GSM) include information that is usually used by mobile phones to identify and monitor the neighboring cells. The report containing the measured values of the neighbor channels is forwarded to the base station. The base station can use this return message to prompt a handover if necessary.

## Improvement of network coverage

In contrast to the mobile phones, the R&S®TSMx scanners see all signals. These signals can be assigned to the neighboring cells referenced by mobile phones. R&S®ROMES4 is thus able to automatically compare the measured data of the scanners and the mobile phones against a base station list and identify any missing neighboring cells. These missing cells may originate during the setup of a network and, in the worst case, can cause a call cleardown.

The SIB analyzer integrated in R&S®ROMES4 compares the neighboring cells measured by the scanner against those in the base station list. Neighboring cells that were detected but do not appear in the list are marked in yellow, which indicates a missing neighborhood. This automatic neighborhood analysis works for UMTS; a comparable functionality exists for GSM. Both work in realtime. For TETRA and LTE, this functionality is included in the R&S®ROMES4 network problem analyzer, see page 16



Detecting a missing neighborhood at a glance.

# GSM interference analysis with automatic interferer identification

## Automatic measurement and identification of interferers from the own GSM mobile radio network

The R&S®ROMES4 software allows GSM interferences to be determined automatically and clearly from the own GSM network during the drive test. The actual interferers can be displayed on the underlaid street map in the "Route Track" view. This makes it considerably simpler to use the software and perform tests, reducing costs dramatically in comparison with the traditional method.

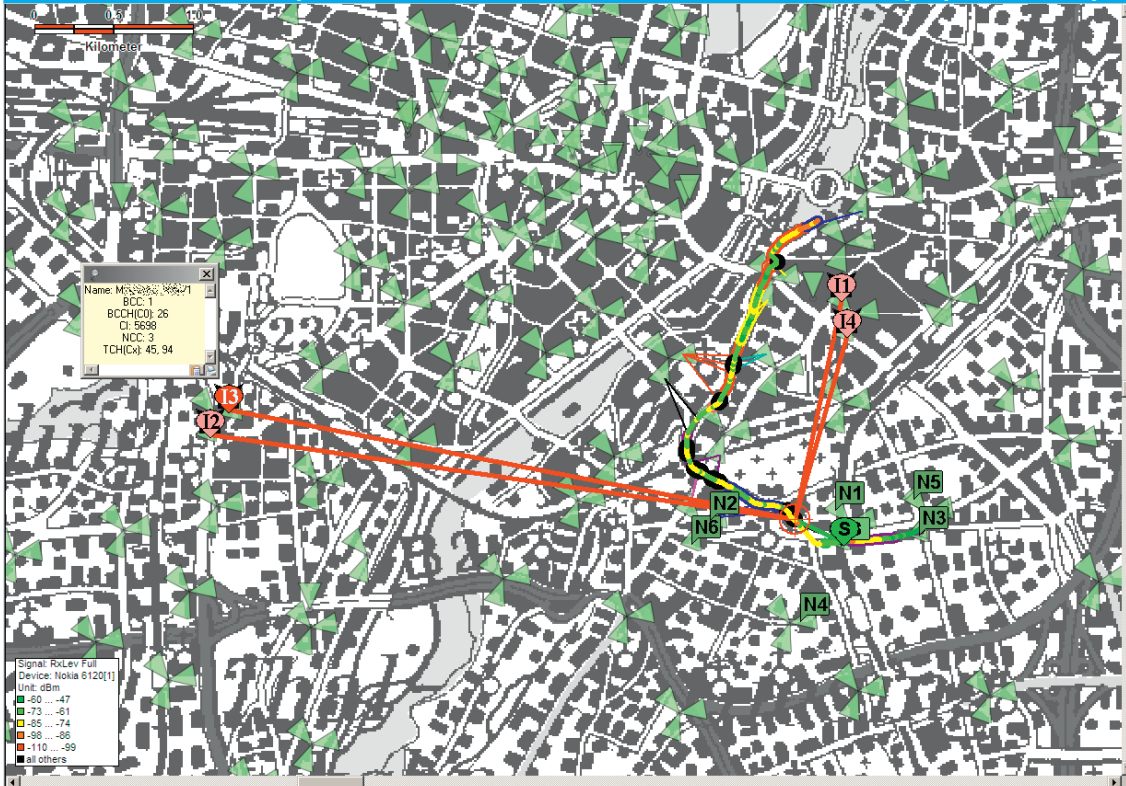
The evaluation is performed in three steps:

- Automatic detection of an interference situation (type, length, location)
- Automatic analysis of the detected interferences (test on BCCH and TCH)
- Assignment of the actual interferers on the basis of the individual interference situation and pinpointing of the interferers on the street map (interfering base station with channel indication: BCCH, TCH, adjacent channel)

### Requirements

- R&S®ROMES4
- R&S®ROMES4COI
- R&S®ROMES4T1Q or R&S®ROMES4T1W
- R&S®TSMx GSM scanner
- Test mobile phone
- R&S®ROMES4GSM (GSM driver) or R&S®ROMES4WCO (Qualcomm driver) or R&S®ROMES4WCN (Nokia driver)

### GSM interference analysis with automatic interferer identification – display on the map



The map shows the position of the interference (cross line), the cell currently providing coverage ("S") and the four actually interfering cells ("I1", "I2", "I3" and "I4"). The markings N1 to N6 show the current neighboring cells. The color of the route indicates the received signal strength of the GSM mobile phone.



To optimize the interference analysis, not only selectable trigger thresholds (e.g. RxLevFull, RxLevSub, RxQual-Full, RxQualSub, FER) are used. Some of the test mobile phones supported by the R&S®ROMES4 software also provide a C/I value for the traffic channels being used (TCH). Since the SIM connection allows the test mobile phone to see the data from only the assigned mobile radio network, and because it is not very RF-sensitive the use of high-grade scanners is absolutely essential.

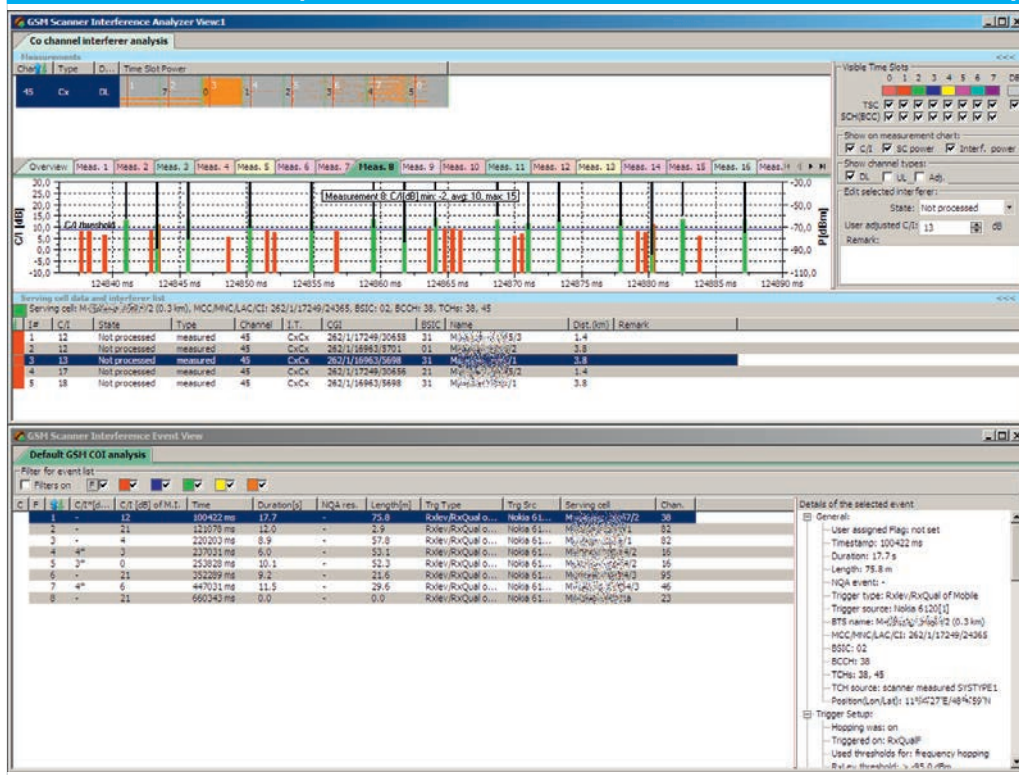
### Evaluation of BCCH and TCH channels allows full-featured analysis

The scanners (R&S®TSMW, R&S®TSMU, R&S®TSMU-x and R&S®TSMQ) are able to instantly pick up all selected RF channels (BCCH) and demodulate the BCH information. As a result, all the data of the base transceiver stations (BTS) transmitting the signals is then available. This is especially important when performing measurements in the vicinity of national borders (faulty frequency assignment, roaming, etc.).

### Detection of adjacent- and co-channel interferers

The combination of scanner and test mobile phone can even be used to measure the power in the time slots being used (TCH, TS Time Slot) and allow to identify not only interfering BCCH channels but also TCH interferers.

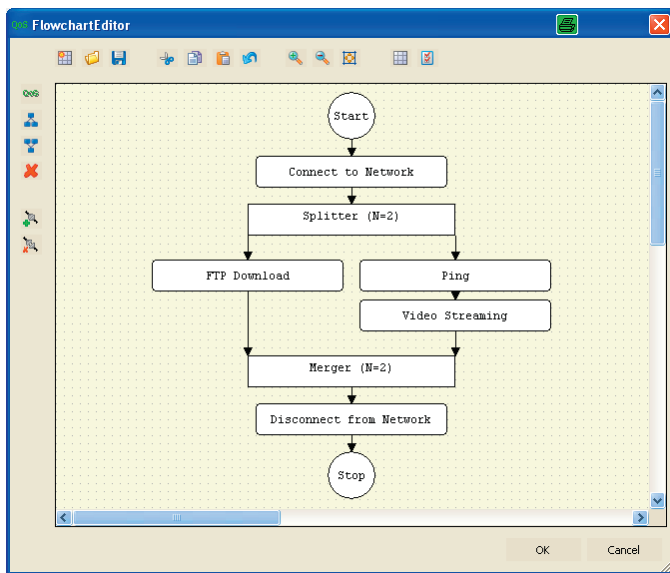
## GSM interference analysis with automatic interferer identification - detailed display



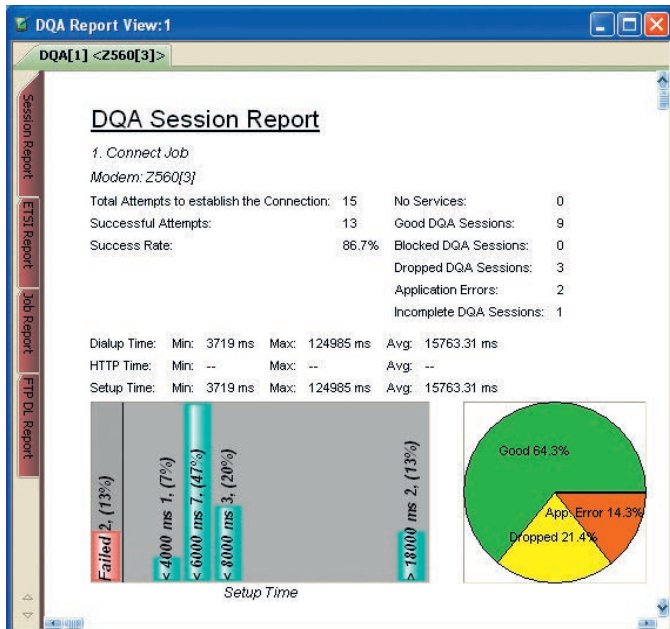
Eight interference situations were detected during the drive (bottom window). The interference that is marked and displayed on the map lasted 17.7 seconds and occurred over a distance of 75.8 m. The BCCH of the cells providing coverage is channel 38; the interference occurred on TCH 45. The top screen displays the scanner measurements from channel 45 of the cell providing coverage (green) and the measurement of the interferers (red) are displayed. The list shows the individual interferers together with the measured signal strength, as well as the identification of the cell and its distance to the location of the interference.

# Numerous application tests (data throughput/DQA)

Parallel jobs are configured with simple graphics.



The DQA report of a drive test quickly shows whether there are any trouble spots.



## Requirements

- ▮ R&S®ROMES4
- ▮ R&S®ROMES4DQA
- ▮ Test mobile phone
- ▮ R&S®ROMES4GSM (GSM driver) or R&S®ROMES4WCQ (Qualcomm driver) or R&S®ROMES4HPQ (Qualcomm HSPA+ driver) or R&S®ROMES4WCN (Nokia driver)
- ▮ R&S®ROMES4LTS (Samsung LTE driver)
- ▮ R&S®ROMES4LTQ (Qualcomm LTE driver)

## Creation of different application jobs

Increasingly more value is being placed on optimizing data services and on data throughput. This requires a tool that can be used to display and evaluate the different data measurements and packet-switched services, i.e. the data quality analyzer (DQA). The following applications are possible: SMS, e-mail (POP3 and IMAP), ping, UDP, FTP, HTTP, video streaming.

By integrating MS Internet Explorer and Outlook 2010 into R&S®ROMES4, measurements can be performed directly from the customer's perspective. The Web 2.0 functions make it possible to simulate users checking e-mails with the web browser or viewing a YouTube video, for example.

## Output of KPIs and the most important network parameters in the form of a report

An automatic realtime analysis generates multiple reports containing key benchmark data, and ETSI KPIs are calculated automatically. The integrated VLC player allows streaming of virtually any protocols; here too, relevant KPIs are provided automatically. An individual job list consisting, for example, of an FTP download, ping or video streaming can be generated. Complex runs with multiple parallel tasks are also possible. The typical behavior of an Internet user can be simulated, e.g. surfing on the Internet while downloading a mail attachment.

The KPIs reveal the most important benchmark data of a network.

Value Type	1	Seq...	Service	Value	Type	TimeStamp
L3 PDP Context Activation Failure Ratio [DL]	2.	1089	FTP	25 %	KPI	12:21:58,992
DNS Host Name Resolution Failure Ratio (per Measurement) [DL]	2.	1089	FTP	0 %	KPI	12:21:58,992
First Socket RTT [DL]	3.	1089	FTP	0 ms	KPI	12:21:58,993
First Socket RTT [DL]	3.	1089	FTP	1540563 ms	Trigger Point	12:21:58,992
First Socket RTT [DL]	3.	1089	FTP	1540563 ms	Trigger Point	12:21:58,993
Setup Time [DL]	3.	1089	FTP	32438 ms	KPI	12:22:01,002
Setup Time [DL]	1.	1089	FTP	1510141 ms	Trigger Point	12:21:58,770
Setup Time [DL]	3.	1089	FTP	1542579 ms	Trigger Point	12:22:01,002
IP-Service Access Time [DL]	3.	1089	FTP	3281 ms	KPI	12:22:02,063
IP-Service Access Time [DL]	1.	1089	FTP	1540344 ms	Trigger Point	12:21:58,770
IP-Service Access Time [DL]	3.	1089	FTP	1543625 ms	Trigger Point	12:22:02,063
Session Time [DL]	3.	1089	FTP	40188 ms	KPI	12:22:38,962
Session Time [DL]	1.	1089	FTP	1540344 ms	Trigger Point	12:21:58,770
Session Time [DL]	3.	1089	FTP	1580532 ms	Trigger Point	12:22:38,962
Access Ratio (per Measurement) [DL]	3.	1089	FTP	86 %	KPI	12:22:38,964
IP Access Ratio (per Measurement) [DL]	4.	1089	FTP	100 %	KPI	12:22:38,964
Completed Session Ratio (per Measurement) [DL]	4.	1089	FTP	76 %	KPI	12:22:38,964
Data Transfer Cut-Off Ratio [DL]	4.	1089	FTP	23 %	KPI	12:22:38,964
App Attach Failure Ratio [DL]	4.	1089	FTP	0 %	KPI	12:22:38,964
PDP Context Activation Ratio [DL]	4.	1089	FTP	100 %	KPI	12:22:38,964
L3 PDP Context Activation Failure Ratio [DL]	4.	1089	FTP	25 %	KPI	12:22:38,964
DNS Host Name Resolution Failure Ratio (per Measurement) [DL]	4.	1089	FTP	0 %	KPI	12:22:38,964
Mean User Data Rate [DL]	4.	1089	FTP	221 Kbit/s	KPI	12:22:38,965

# Full overview of layer 1 and layer 3

## Requirements

- R&S®ROMES4
- Test mobile phone
- R&S®ROMES4GSM (GSM driver) or R&S®ROMES4WCO (Qualcomm driver) or R&S®ROMES4WCN (Nokia driver)
- R&S®ROMES4LTS (Samsung LTE driver)
- R&S®ROMES4LTQ (Qualcomm LTE driver)
- R&S®ROMES4TED (Sepura TETRA driver)

## Display of mobile phone activities in layer 3

The basic functionality of R&S®ROMES4 in combination with the drivers for test mobile phones provides a large amount of information from layers 1 and 3. Users can thus see the radio conditions (GSM or WCDMA, channel, voice codec, etc.) for phone calls at a glance.

If measurements are also taken by a scanner, the scanner's measured data is displayed in the same window, allowing a direct comparison.

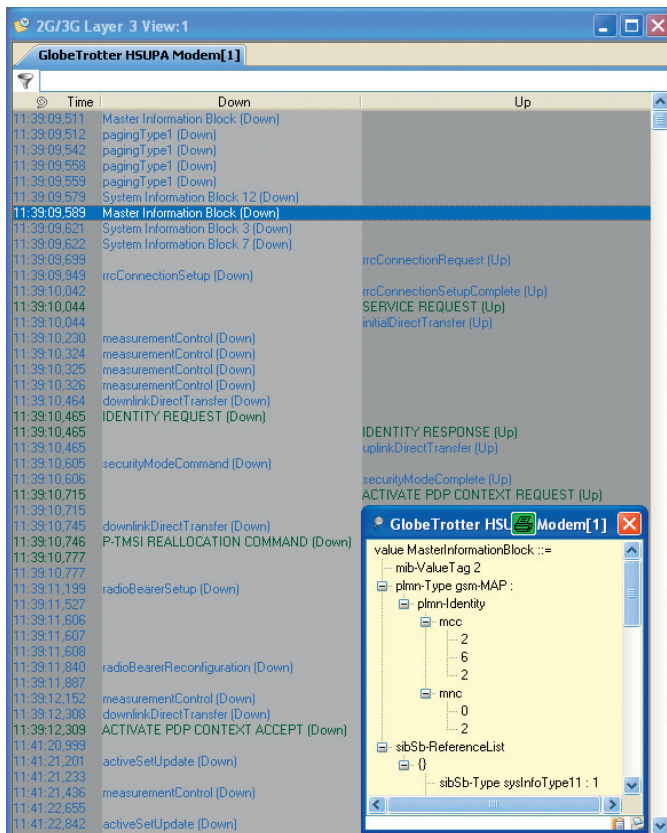
"Layer 3 View" displays all the messages, sorted by uplink and downlink. Each message is decoded and can be opened if necessary.

## Fast analysis in the case of an interrupted connection

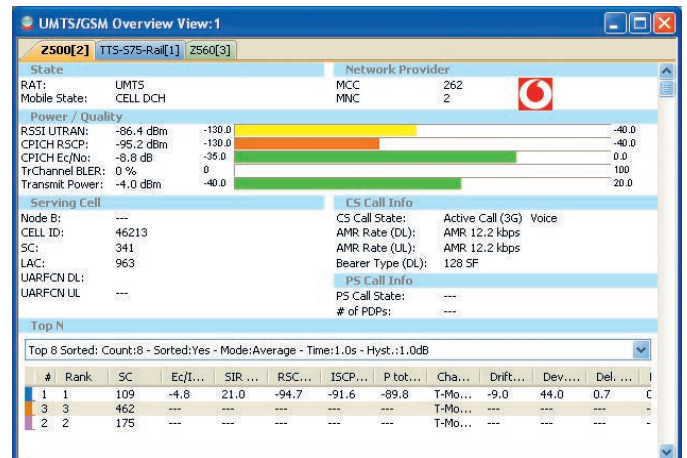
Besides the protocol messages, interrupted/blocked and successful connections are also displayed. When jumping to a trouble spot, all views will show measurements taken at this point in time. This makes it considerably easier to find the cause of a problem.

In addition, a filter function in "Layer 3 View" enables users to evaluate only the messages they want to.

Layer 3 protocol messages for uplink and downlink.



Overview of all important network parameters.



# Test of speech quality

## Requirements

- R&S®ROMES4
- R&S®ROMES4SQA
- PESQ license
- Test mobile phone
- R&S®ROMES4GSM (GSM driver) or R&S®ROMES4WCQ (Qualcomm driver) or R&S®ROMES4WCN (Nokia driver) or R&S®ROMES4TEP or R&S®ROMES4TED (TETRA driver)
- Audio adapter
- Professional sound card

In recent years, the quality demands placed on wireless communications networks have become considerably more stringent. With regard to speech quality, R&S®ROMES4 offers a comprehensive end-to-end solution. The audio signal of a mobile phone is digitized by a high-quality sound card and evaluated by means of a PESQ algorithm (ITU-T P.862). The greater the difference of the transmitted voice signal to the reference signal, the poorer the speech quality. The speech quality is indicated by the mean opinion score (MOS) and can vary between "1" (poor) and "5" (very good).

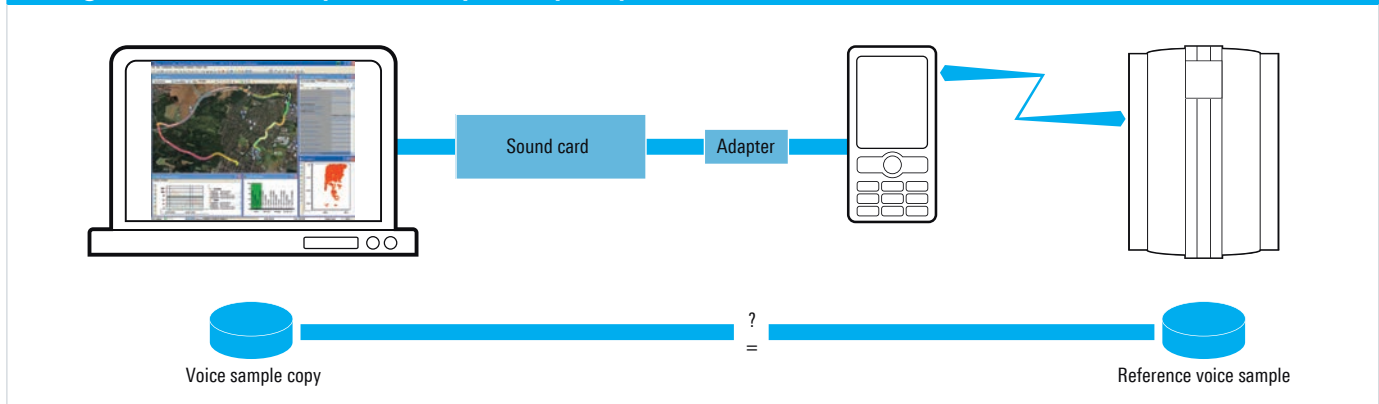
## Full end-to-end measurement of how the customer would experience quality

The measurements can be performed using a fixed-network station, usually a speech-quality server, or also using another mobile phone. The mobile phone reflects the quality as would be experienced by a customer. In contrast, a fixed-network station serves as a reference, enabling the cause of a poor MOS to be found more quickly.

## Based on PESQ standard

The R&S®ROMES4SQA speech-quality option makes it possible to measure calls for the downlink and for the uplink. For the downlink, the server replays a reference voice signal and R&S®ROMES4 evaluates this received signal. For the uplink, the R&S®ROMES4 test system replays a voice signal and the server evaluates it by using a PESQ algorithm. Following a test drive, the measured data can be merged so that the uplink and downlink measurements are available in one log file.

## Configuration of a test system for speech quality



# Parallel spectrum measurement

## Requirements

- R&S®ROMES4
- R&S®ROMES4T1Q or R&S®ROMES4T1W
- R&S®TSMx scanner with R&S®TSMU-K17 RF power scan
- R&S®TSMW scanner with R&S®TSMW-K27 RF power scan

## Broadband spectrum measurement

In combination with an R&S®TSMU/L/Q (R&S®TSMW), R&S®ROMES4 can be used to perform a spectrum scan. The user can select up to 32 frequency ranges from 80 MHz to 3 GHz (30 MHz to 6 GHz). The frequency range is not limited. R&S®ROMES4 offers different display options, e.g. envelope spectrum measurement, RMS, peak or display using a predefined channel mask. In this case, the power per channel is displayed.

By means of marker functions, dedicated frequencies can be exactly measured and changes easily detected. A marker can also be defined as a reference and compared with the maximum value.

## Detection of broadband interferers, neighborhood interferences or uplink activities

In addition, the waterfall diagram gives the user a general idea of the air interface along with a certain historical depth. This makes it very easy to locate broadband interferers or external interferences. All the user needs to do is move the mouse pointer over the waterfall diagram. At any desired spot, time stamp and frequency are displayed, enabling the user to find the center frequency of an unknown signal faster.

The spectrum function is based on an FFT analysis. Various FFT sizes allow users to set measurement bandwidths down to min. 140 Hz. The measurement accuracy can be increased by using a smaller measurement bandwidth. This procedure permits a very fast spectrum measurement without the usual sweep time of a normal spectrum analyzer. Particularly for drive tests, fast measurements are of special significance in order to achieve a sufficiently high density of results also during the drive.

A special threshold value is provided for monitoring the spectrum. Spectra that do not show any test points above this threshold value are not displayed at all. Unimportant measurement data is not recorded.

Frequency markers and the entire spectrum can be exported to an ASCII format.

## Spectrum measurement



Five user-selectable frequency ranges for spectrum measurements

Zoom display of one of the five ranges (here the first range "0" from 80 MHz to 2.5 GHz)

Waterfall display of selected range

# Determination of 2G and 3G base stations

## Requirements

- R&S®ROMES4
- R&S®ROMES4LOC
- R&S®ROMES4T1Q or R&S®ROMES4T1W
- R&S®TSMx scanner or R&S®TSMW scanner
- R&S®TSMX-PPS (already installed in the R&S®TSMW)

## Creation of a base station list during a test drive

The R&S®TSMU/L/Q and R&S®TSMW scanners enable users to estimate the geographic position of base stations. When the R&S®TSMQ or R&S®TSMW scanner is used, the positions of GSM, WCDMA and CDMA2000® 1xEV-DO base stations can even be estimated in parallel, i.e. simultaneously.

## Requires only scanner and GPS

For the calculation algorithm, only the measurement parameters of a highly accurate GPS receiver (with output of the PPS time reference signal, already installed in the R&S®TSMW) and of the 2G and/or 3G scanner are needed.

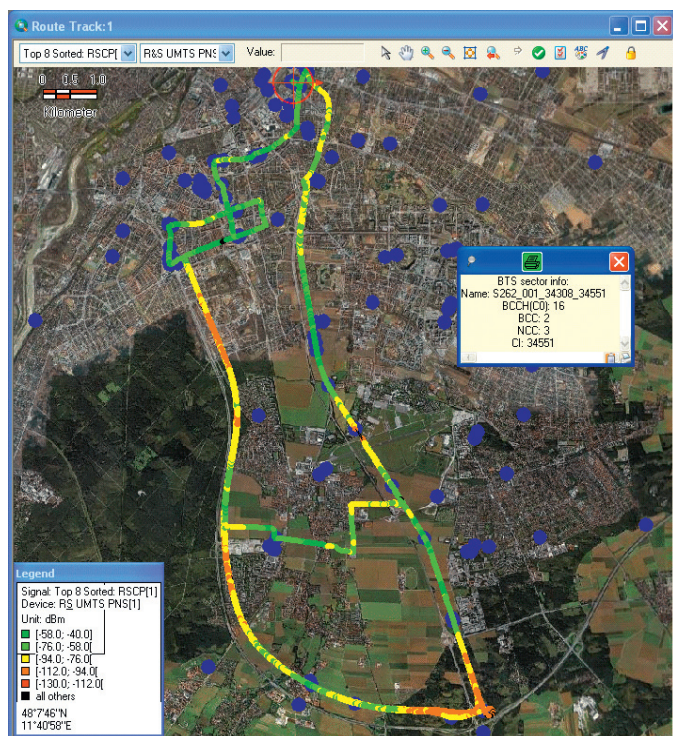
The R&S®ROMES4 software and the R&S®ROMES4LOC driver allow the scanners not only to detect the main levels of the BTS (2G: RxLev; 3G: RSCP) but also to demodulate the broadcast channel (BCH). Important time information as well as details of the transmitting BTS are thus obtained.

The maximum likelihood method is used to calculate the geographic position of the individual BTS from the measured data provided by the GPS receiver, the BCH time information and changes in the level during the test drive.

Following the test drive, the results of the calculation are exported to a base station list and the located base stations are then displayed on an overlaid street map.

Marking the BTS opens another window in which the characteristic data of the BTS is displayed.

The calculated position of a BTS lies within an error ellipse (approx. 200 m) that is also exported. Base stations whose positions have been estimated only very roughly can thus be filtered out during export.



Results of the measured geographic position of base stations using the R&S®ROMES4 software and the R&S®ROMES4LOC driver.

# Indoor measurements

## Requirements

- R&S®ROMES4
- R&S®ROMES4IND
- Test mobile phone and/or scanner
- R&S®ROMES4WCQ (Qualcomm driver) or R&S®ROMES4WCN (Nokia driver) or R&S®ROMES4LTS (Samsung LTE driver) or R&S®ROMES4LTQ (Qualcomm LTE driver) or R&S®ROMES4TEP or R&S®ROMES4TED (TETRA driver)

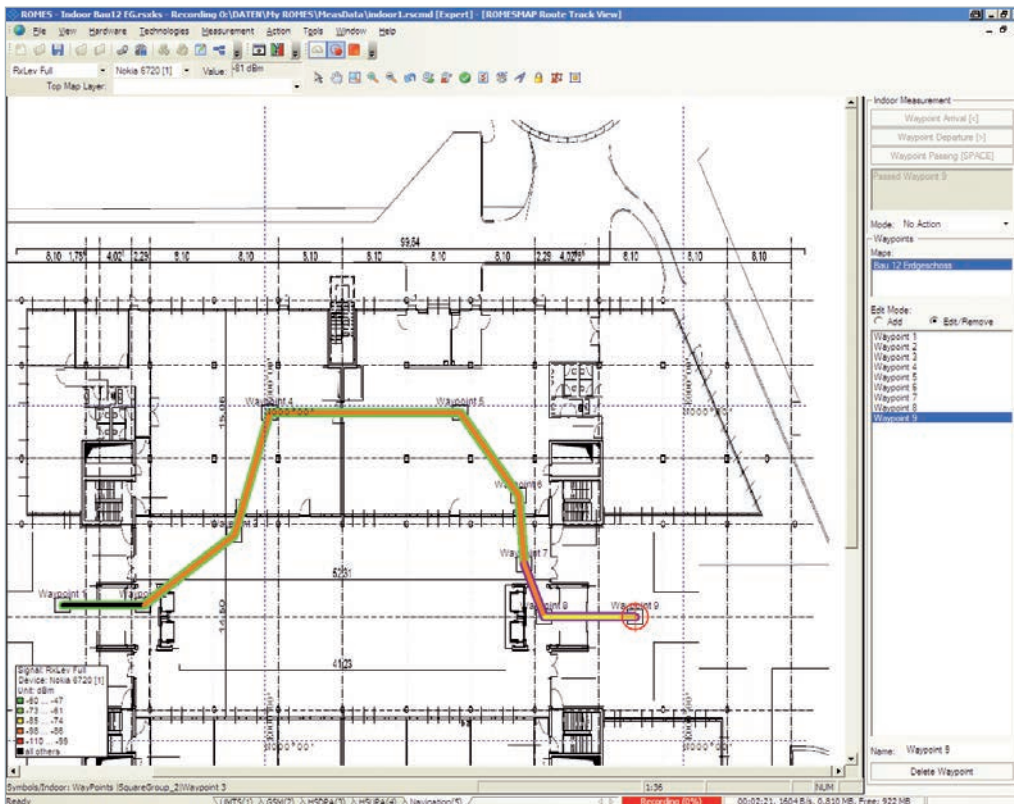
## Stationary or moving measurements indoors, without GPS signal

High-quality wireless communications coverage (primarily with regard to data traffic) inside buildings, e.g. at airports, shopping malls and exhibition halls is becoming more important. Since GPS reception indoors is possible only to a limited extent or not at all, an alternative to conventional navigation display (GPS data on a map) must be found.

## Combined indoor/outdoor measurements

The R&S®ROMES4IND indoor driver option of R&S®ROMES4 provides a separate means of navigation that makes it possible to display positions on a floor plan. Measurements can be taken at specific points (hot spots, e.g. in conference rooms) or along a specific path (continuous, e.g. in a corridor). Combined DUTs (comprising buildings and outdoor areas such as a company's premises) can be optimally surveyed and georeferenced. The software also displays a smooth transition to areas covered by GPS. The use of different layers is a very simple solution to handling multiple stories. The complete integration of the indoor functionality into the R&S®ROMES4 map display makes operation intuitive.

The R&S®ROMES4 data format is also supported by the indoor planning tool from iBwave.



Floor-plan display in hot spot mode.

# R&S®ROMES4NPA

## In-depth analysis of network problems

### Requirements

- ▮ R&S®ROMES4NPA (included in R&S®ROMES4)
- ▮ R&S®ROMES4N11
- ▮ R&S®ROMES4N15
- ▮ R&S®ROMES4N17
- ▮ R&S®ROMES4N20
- ▮ R&S®ROMES4N51

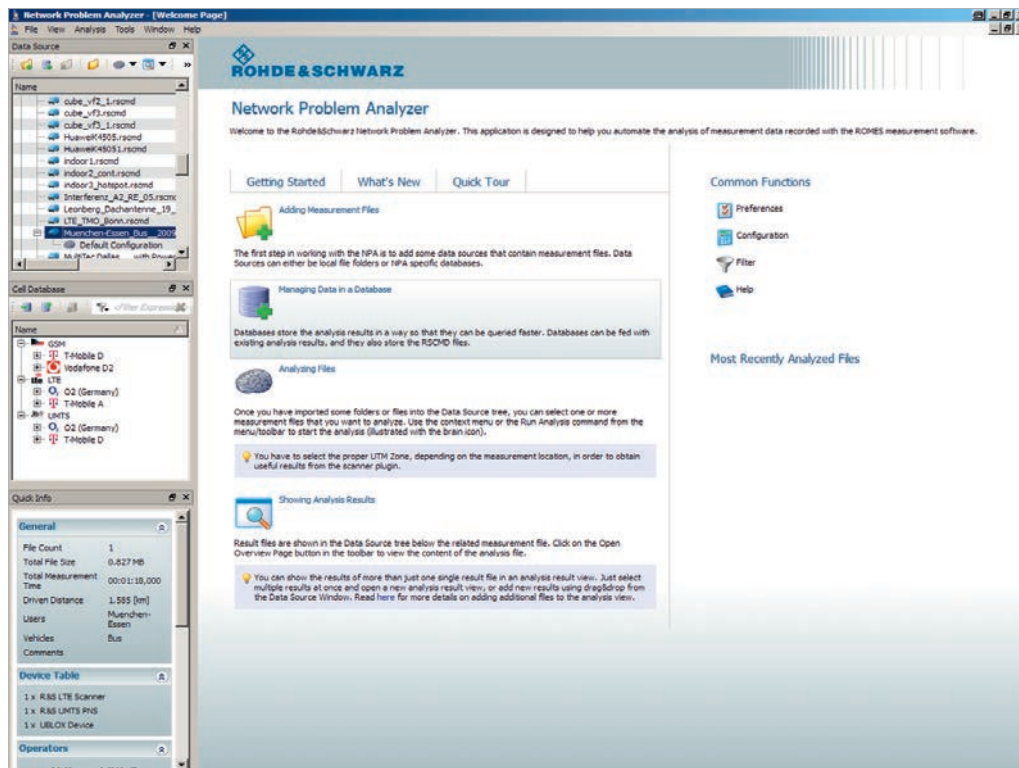
### Analysis of one or more test drives according to different criteria

The sheer volume of recorded data makes individual and manual analysis impossible. The data is therefore analyzed by R&S®ROMES4NPA, which then outputs a list of all detected trouble spots and displays them on a map using Google Maps or OpenStreetMap. Maps that have once been loaded are then also available offline. In addition, R&S®ROMES4NPA indicates the cause of the problem.

### Automatic pinpointing of trouble spots and their causes using sophisticated algorithms

The easy-to-use interface guides the user through the process, from reading in the measured data (from one or more test drives) and selecting the analysis criteria to retrieving the automatically generated list of trouble spots.

- ▮ Right-clicking a problem automatically opens R&S®ROMES4 and positions the replay of the measurement file just ahead of the trouble spot in question so that the user can perform a detailed check if required
- ▮ Automatic generation of printable HTML report that provides a clear overview of the result. Export to Excel allows easy processing of the data
- ▮ (Automatic) processing of the list (in XML format) by means of other tools after saving it in a database (R&S®ROMES4N51) if required:



Start screen of R&S®ROMES4NPA.



The measurement data is analyzed according to specific criteria that depend on the modules selected. In all modules, the analysis criteria can be adapted to user-specific limit values and settings.

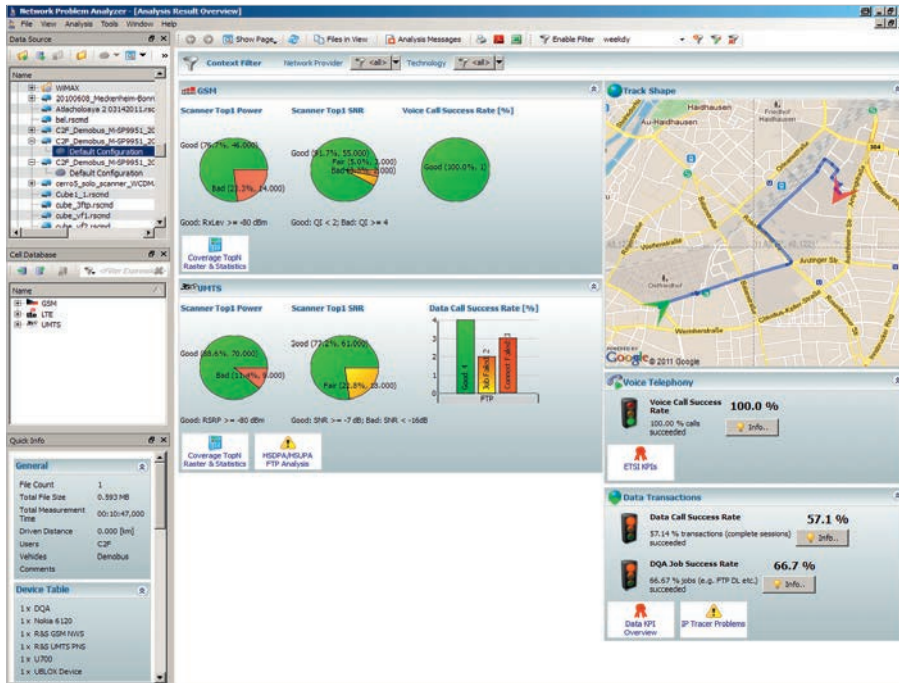
The basic R&S®ROMES4NPA package includes the following modules:

- NQA (network quality analyzer) for voice calls, basic module including KPIs
- DQA (data quality analyzer) for PS data connections, basic module including KPIs
- Generic signals (for user-selectable linking of signals)

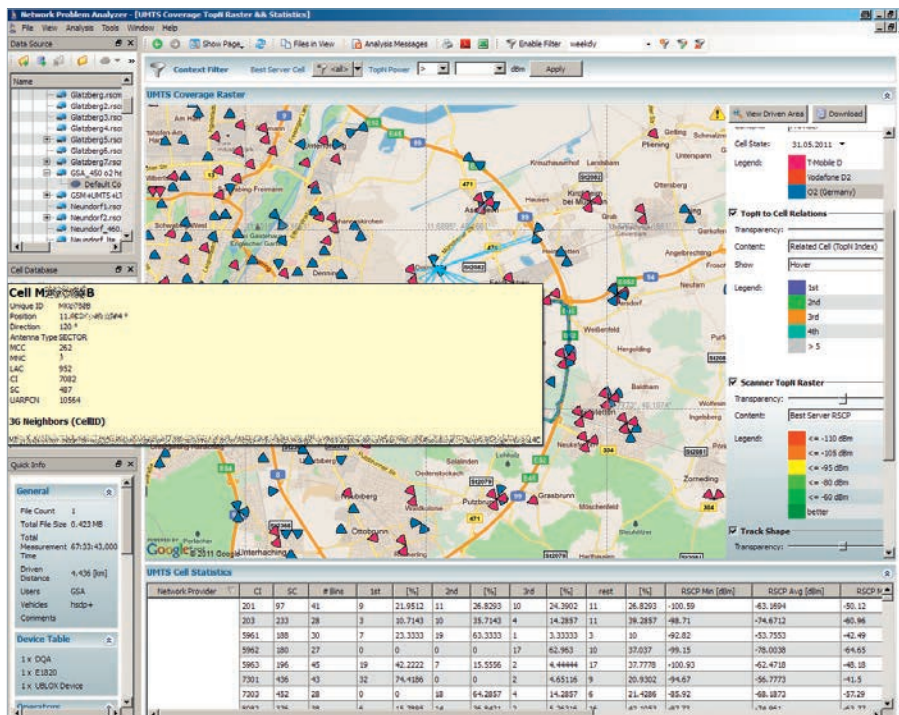
## Choice of add-on modules for speech quality and data tests as well as coverage and neighborhood analysis

The following add-on modules are available as options:

- R&S®ROMES4N11: NQA for GSM/WCDMA/TETRA voice calls, expansion for problem spot detection. Analysis of voice calls for network problems out of more than 140 different problem categories; listing of the problem spots together with type and cause of problem
- R&S®ROMES4N20: data module for EDGE, HSPA+ and LTE data links including problem spot detection. Specific analysis of high-speed data links for achievable data rates and analysis of potential problems as well as the



Initial overview of a scanner measurement content.



Display of all neighbors of a cell.

IP data analyzer for analyzing IP-based data traffic and associated problems. When IP-based data services are used, e.g. web browsing or e-mail, this module analyzes the results and shows problem spots and their cause. A comprehensive collection of different analyses is available especially for LTE.

■ R&S®ROMES4N15: coverage module with display of coverage data on a raster map. Coverage data (GSM, WCDMA, CDMA2000® 1xEV-DO, TETRA or LTE) measured with the Rohde & Schwarz scanners is rasterized and displayed on the map using Google Maps or OpenStreetMap. This makes the generation of coverage plots an easy task. Likewise, optimizations can be checked by means of a before-and-after comparison.

■ R&S®ROMES4N17: neighborhood analysis module for automatic classification of neighborhood relationships into the following categories:

- (Potentially) missing neighbor: a cell with high signal strength and good quality (both thresholds can be set) has been measured but is not contained in the currently defined neighbors
- Unused neighbor: a cell is configured as neighbor but has not been detected during measurement
- Approved neighbor: a cell has been classified as a (potentially) missing neighbor and is at the same time already included in the neighbor list.

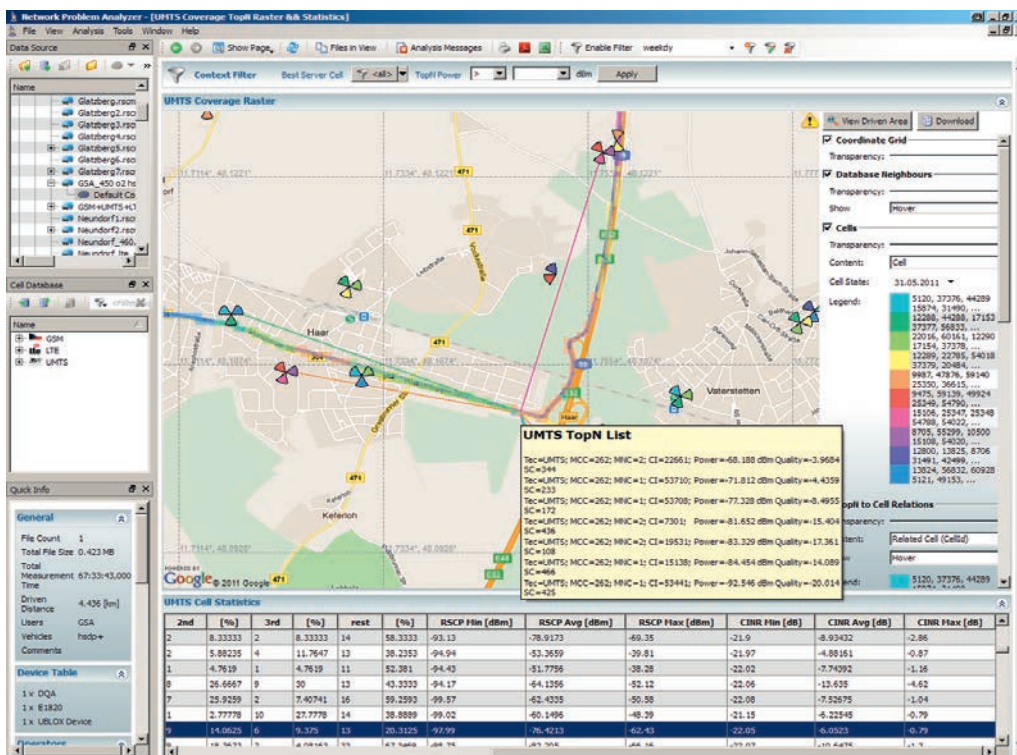
This analysis is currently available in R&S®ROMES4NPA for LTE and TETRA. The GSM and WCDMA neighborhood analysis in R&S®ROMES4 will soon also be available in R&S®ROMES4NPA and will be expanded for inter-RAT handover.

A further way to evaluate analysis results in greater detail is to use sophisticated filter algorithms (e.g., for examining only one driver/one cell or only specific times or days of the week). The Context Filter algorithm added to R&S®ROMES4NPA makes this is even easier and faster.

### Software development kit (SDK) for generating user-specific add-on modules

A comprehensively documented software development kit (SDK) is provided as an option allowing users with specific knowledge in mobile radio networks and programming skills to generate their own add-on modules for any types of analysis. If multiple drive tests are selected, the user can draw statistical conclusions about quality in the measured areas. A comparison between various network operators in the same area is also possible (benchmarking).

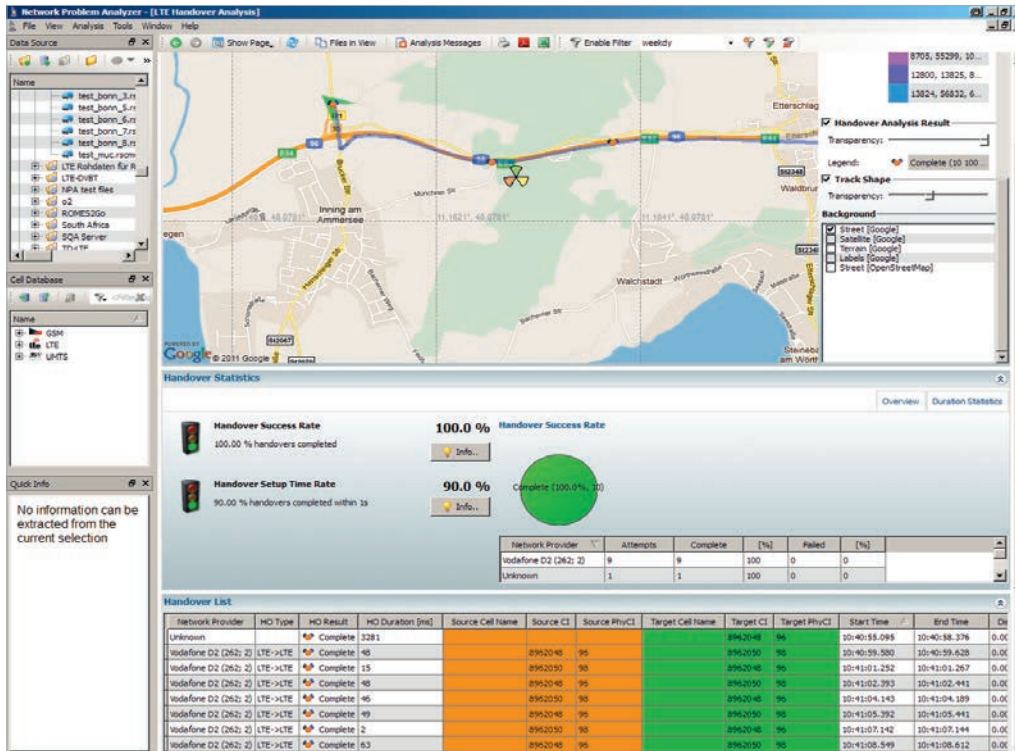
A local database (R&S®ROMES4N51, based on SQLite; also runs on laptops) can store measurement data and the R&S®ROMES4NPA analysis results. This information can be aggregated and queried in accordance with diverse criteria such as specific areas, times, technologies, etc.



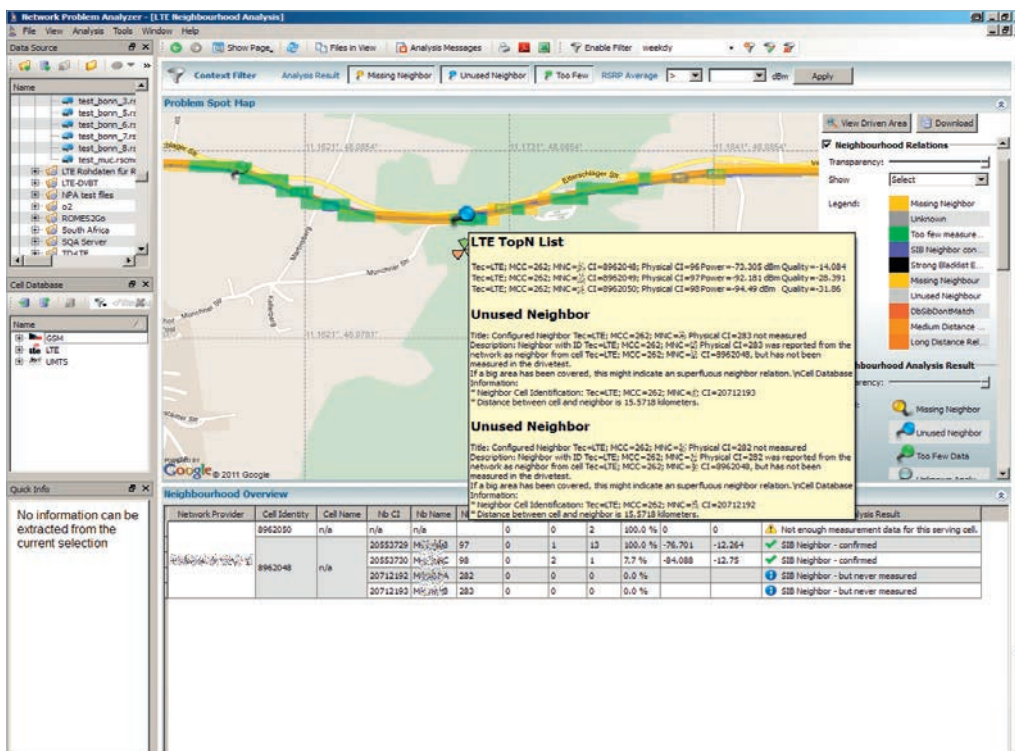
Display of the cells providing coverage on the map.

R&S®ROMES4NPA considerably helps to save time and reduce costs by automatically analyzing the measured data. Optimizing the results no longer requires time-consuming manual checks and analysis of data that may not even contain any problems.

Due to its sophisticated algorithms, R&S®ROMES4NPA is a very effective tool for finding the causes of existing problems. More in-depth analyses can be performed at any time. A large amount of measured data can be automatically processed in a minimum amount of time and on an identical basis; reports – for management and for general documentation – are generated without the user having to take action.



LTE handover analysis: map, KPIs and detailed listing.



LTE neighborhood analysis: map, listing of the actual, possible and unused neighbors of several cells.

# System configuration for different application scenarios

R&S®ROMES4 and the connected measuring equipment (test mobile phones, R&S®TSMx scanners, etc.) can be used and delivered in the following configurations:

- ▮ User-specific cabling/configured by customer
- ▮ As a test suitcase
- ▮ As a backpack, especially for indoor measurements
- ▮ As a turnkey test vehicle

Backpack.



User-specific cabling.



Turnkey test vehicle.



Test suitcase.



# System components

Technology	GSM driver	Qualcomm GSM and UMTS driver	Nokia GSM and UMTS driver	Qualcomm CDMA2000® 1xEV-DO driver	Samsung LTE driver Qualcomm LTE driver	TETRA TEP driver TETRA TED driver	R&S®TSMW driver	R&S®TSMU/L/Q driver
GSM/GPRS	•	•	•				•	•
EDGE	•	•	•				•	•
WCDMA Rel. 99		•	•				•	•
HSPA+		•	•				•	•
CDMA2000® 1xEV-DO				•			•	•
WiMAX™ IEEE 802.16e							•	
LTE					•		•	
Spectrum							•	•
CW power								•
TETRA						•	•	

A list of test mobile phones supported by R&S®ROMES4 is separately available.

# System requirements

## Recommended:

- ▮ Intel Core i5 or i7
- ▮ 2 Gbyte RAM
- ▮ 80 Gbyte hard disk
- ▮ DVD-ROM drive
- ▮ USB 2.0/Firewire interfaces und LAN interface
- ▮ 15" monitor with a resolution of 1024 × 768
- ▮ Microsoft Windows 7 32 bit/64 bit or XP SP3

## Recommended notebook

- ▮ Dell Latitude E6520

# Applications

## Example 1: LTE

### Requirements

- R&S®ROMES4
- R&S®ROMES4DQA
- R&S®ROMES4LTS (Samsung LTE driver)
- R&S®ROMES4LTQ (Qualcomm LTE driver)
- R&S®ROMES4T1W (scanner driver)
- R&S®TSMW scanner

### Coverage analysis with the R&S®TSMW scanner

This essential analysis determines whether an LTE signal of sufficient strength is available at the test site. The results can be displayed in an easy-to-read manner with the R&S®ROMES4 software by using a TopN View and plotted on a map. As a signal strength, the R&S®TSMW delivers either the RSRP value or the power of the P-SCH/S-SCH channels. In addition to signal strength, the reference signal received quality (RSRQ) and the signal to interference-plus-noise ratio (SINR) are displayed for every cell as well as the reference signal to interference-plus-noise ratio parameter. If one of these values is too low, this indicates interferences, intermodulation or other types of disturbance. In this case, the R&S®TSMW and R&S®ROMES4 offer a more detailed cause analysis.

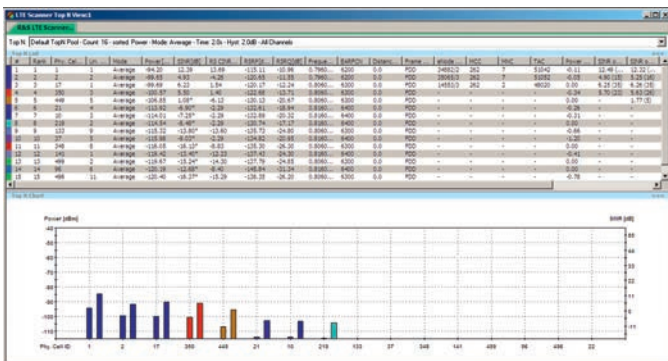
### Data throughput measurement using the LTE test mobile

R&S®ROMES4 collects scanner data and measurement data from the Qualcomm or Samsung LTE test mobile. One of the most important parameters is data throughput. If it is too low, the cause may be a low-order modulation format such as QPSK or the use of SISO rather than MIMO. A comparison with the scanner data permits further conclusions about possible causes. Interferences, multipath propagations, handover failures or also weak network coverage might be the cause of error.

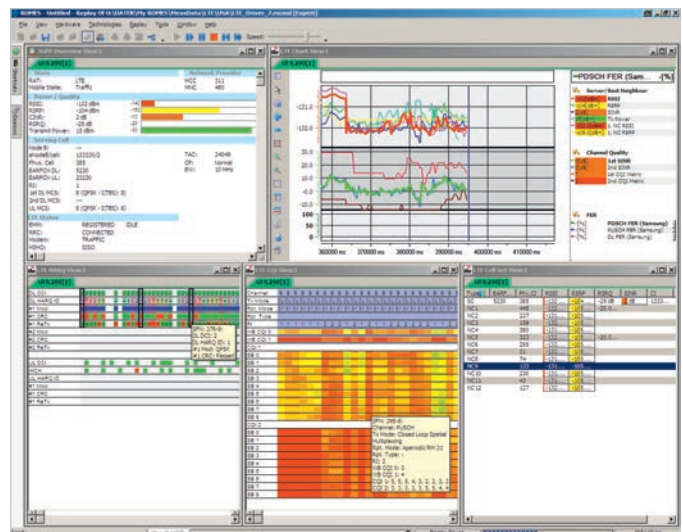
In addition to data throughput measurement, measurement data of layer 1 and layer 3 messages are recorded.

Qualcomm-based LTE mobile phones or data sticks display detailed information about individual data packages, often making just a quick glance enough to detect possible causes of error.

TopN View shows the eNodeBs signals, sorted by their strength.



Display of measurement data of a Qualcomm chipset-based LTE data stick.



## Interference analysis

LTE is a single frequency network (SFN) that is identified by a reuse factor of 1. This means that neighboring cells use the same frequency ranges. Interferences are therefore especially frequent and must be analyzed to avoid capacity losses to the greatest possible extent. This is a special challenge for T&M equipment because the interferences can also affect the T&M equipment itself.

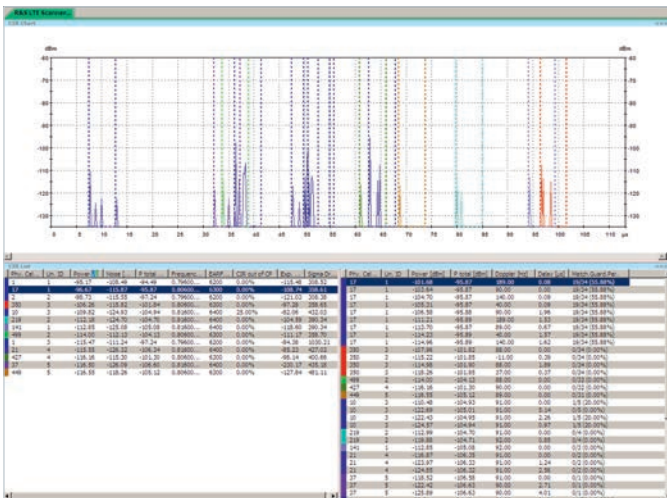
The R&S®TSMW was developed specially for this task and features an impressive C/I value of -20 dB. Therefore, even interference signals that are 20 dB weaker than the strongest signal can be measured. This makes it possible to identify the interferers and to reduce interferences.

Furthermore, the R&S®TSMW can distinguish between signals that have the same physical cell ID but come from different eNodeBs. It makes no difference whether the measurement is performed in the FDD mode or in the TDD mode.

## Cyclic prefix analysis

A special feature of the Rohde&Schwarz LTE drive test solution based on the R&S®TSMW is the channel impulse response (CIR) measurement. This involves a channel measurement performed over a period of time.

CIR View presents the channel impulse response (CIR) and all parts of the multipath propagation (echoes) together with the cyclic prefix length of a cell.



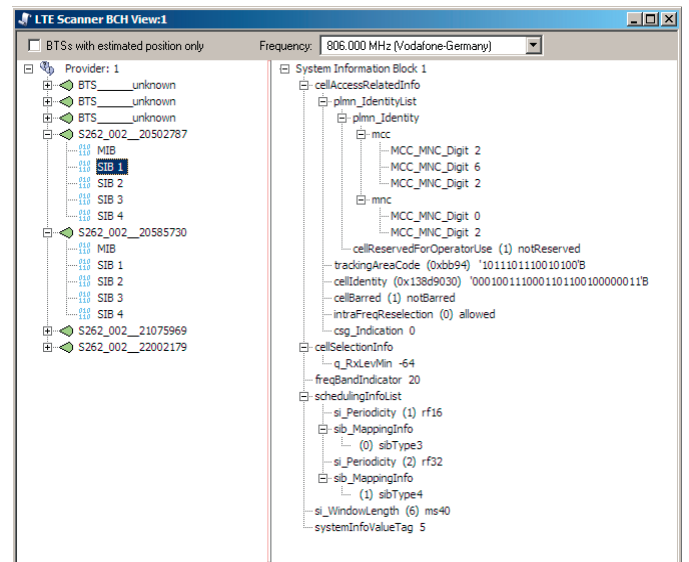
R&S®ROMES4 displays the multipath propagation of the signals – also referred to as echoes – in a power vs. time diagram. LTE as an OFDM standard has a defined frame length and a fixed guard interval, also referred to as a cyclic prefix. This value is necessary in order to wait for echoes in the receiver. A cyclic prefix that is too short or an echo that is too long can cause problems with the subsequent frames. This is referred to as intersymbol interference (ISI). This effect is indicated by a low SINR.

R&S®ROMES4 can measure the length of the cyclic prefix and match it against the multipath propagation. This enables the user to draw a conclusion about how often multipath propagation disturbs the subsequent symbol and whether a longer cyclic prefix would be better or whether the network needs to be optimized, e.g. by adding eNodeBs.

## Demodulation of the eNodeB broadcast information

The R&S®TSMW can scan LTE signals and also demodulate broadcast signals. The broadcast information is demodulated (MIB and SIBs) by previously detected eNodeBs to learn more about the base station. Based on this information, the user knows the country, the network and the cell the received signal originates from. Neighborhood relationships (intra-RAT and inter-RAT) and handover thresholds are also visible. All these values make it easier to assign the signals and to detect problem spots.

Decoding of the LTE BCH information by the R&S®TSMW LTE scanner.



# Example 2: HSPA(+)

## Requirements

- R&S®ROMES4
- R&S®ROMES4DQA
- Test mobile phone and/or scanner
- R&S®ROMES4WCQ (Qualcomm driver) or R&S®ROMES4WCN (Nokia driver)
- R&S®ROMES4HPQ (Qualcomm HSPA+ option)
- R&S®TSMQ drive test scanner or R&S®TSMW drive test scanner

Upgrading existing UMTS networks and rolling out HSPA(+) networks place highly complex demands on network optimization. In order to be successful on the market, high data rates must be reliably available. There may be diverse reasons for insufficient data throughput; they have to be uncovered and eliminated.

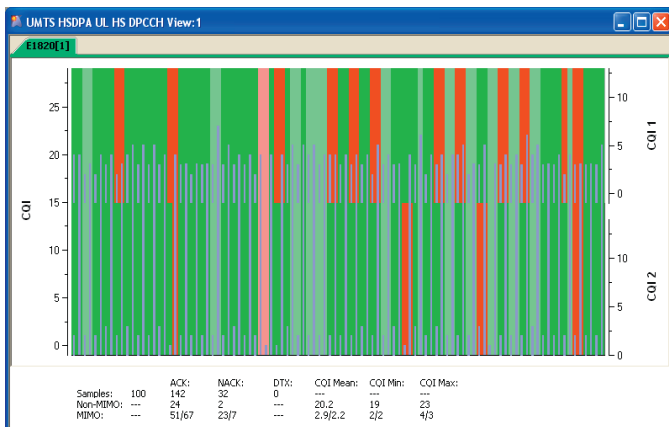
R&S®ROMES4 provides more than 15 HSDPA- and HSUPA-specific views. They show all the important parameters in a fast, straightforward manner and inform users quickly about performance.

By downloading and uploading large files from and to specific servers, R&S®ROMES4 makes it possible to perform end-to-end tests that take into account the overall infrastructure (data card – air interface – RAN – core network). Depending on the test mobile, MIMO and 64QAM messages are supported.

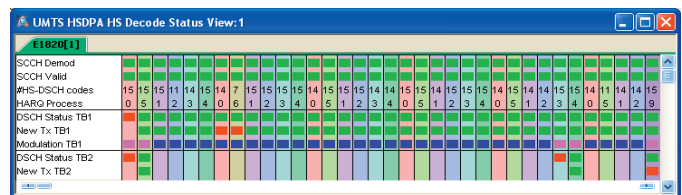
And all this can be done either for an individual network operator or for several network operators in parallel. To optimize an HSDPA network, the first thing to do is to monitor the data throughput by means of the DQA. If the throughput is too low for the network structure, the next step is a CQI measurement. If this value is too small on average, the reason may be insufficient coverage or pilot pollution. In the case of pilot pollution, the number of signals of equal strength at this location should be reduced. A scanner is especially advantageous because it can reliably detect all signals on the air interface.

A low CQI is due to a small block size and a low-order modulation. By increasing the two, the throughput rates of a network can be optimized.

Display of channel quality indication (CQI), the most important parameter.



Overview of decoded packets.



Statistical evaluation of block size versus bit error ratio.





# Example 3: TETRA

## Requirements

- ▮ R&S®TSMQ drive test scanner
- ▮ R&S®TSMW-K26 TETRA option for R&S®TSMW
- ▮ R&S®ROMES4
- ▮ R&S®ROMES4T1W
- ▮ R&S®ROMES4TED
- ▮ R&S®ROMES4TEP

R&S®ROMES4 is the software platform for measurements on the TETRA air interface. Statistics, analyses, troubleshooting for coverage, quality of service and handover behavior give network operators a complete overview of the network state and help to maintain it in the best possible state. The R&S®TSMW scanner, TETRA radios and other accessories are controlled by R&S®ROMES4. For such tasks, the following capabilities are indispensable:

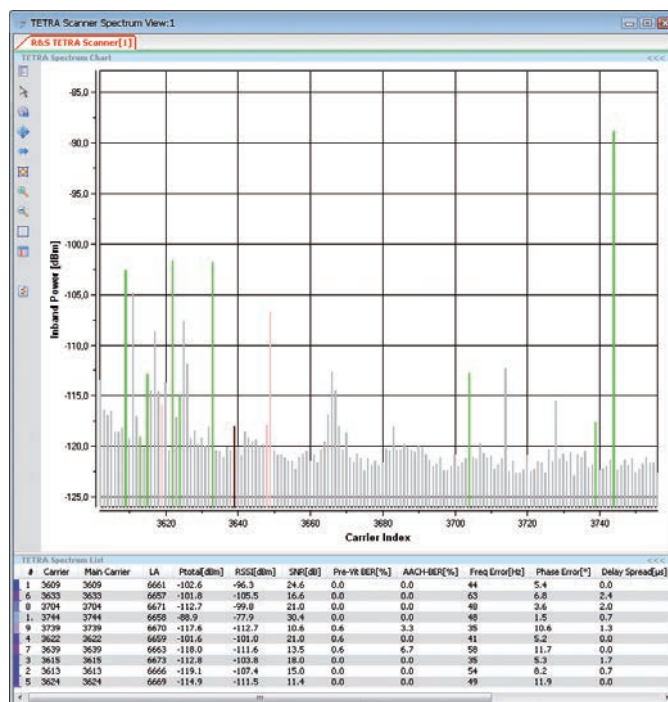
- ▮ Mobility and speed – use in vehicles, helicopters and on foot
- ▮ Highly accurate coverage measurements of TETRA networks using a passive RF scanner
- ▮ Spectrum analysis for identifying interferers
- ▮ Measurement and identification of TETRA base stations
- ▮ Subsequent problem analysis – uncovers problems in the TETRA network and analyzes them on the basis of the test data obtained with R&S®ROMES4

In the downlink, the measurements performed using the R&S®TSMW in the D-CT and D-CTT operating modes include the following:

- ▮ Frequency range 100 MHz to 1000 MHz, with parallel measurements of all channels in a 10 MHz block
- ▮ Channel resolution 25 kHz (with QPSK)
- ▮ Automatic detection of the broadcast synchronization channel (BSCH)
- ▮ Up to 20 Hz measurement rate for the carrier measurements of up to 2 × 600 channels simultaneously (10 MHz block, QPSK), with:
  - Channel number and frequency
  - Power of each base station
  - MCC, MNC, TN, FN, MFN
  - BER before Viterbi
  - AACH BER
  - Frequency error and phase error
  - SNR
  - Delay spread
  - Inband spectrum
  - Constellation diagram
  - BCH demodulation incl. decoding of neighboring cells
  - Measurement of co-channel interference
  - Channel impulse response (channel sounder)

The R&S®ROMES4TEP software option controls radios from Sepura, EADS and Motorola via the standardized PEI interface to perform call control and data transfer, to emulate user behavior in the network and to provide additional status information. The R&S®ROMES4TED software option operates with radios from Sepura and provides Layer 3 information for calculating KPIs of quality-of-service (QoS) measurements, including handover and neighborhood analysis.

The TETRA spectrum scan displays all channels in a 10 MHz band.



The R&S®ROMES4 network problem analyzer (NPA) completely supports the analysis of TETRA quality of service using R&S®ROMES4N11, R&S®ROMES4N15 for coverage and interference and R&S®ROMES4N17 for handover and neighborhoods.



# Ordering information

Designation	Type	Order No.
<b>R&amp;S®ROMES4 Drive Test Software</b>		
R&S®ROMES4 Drive Test Software Platform for Measurement and Replay	R&S®ROMES4	1117.6885.04
Software Replay Version	R&S®ROMES4REP	1117.6885.34
<b>Software maintenance contract and single software update</b>		
Software Maintenance Contract for One Year	R&S®ROMES4UPC	1510.8140.02
Single Software Update	R&S®ROMES4UPS	1510.8140.03
<b>Scanner and receiver drivers</b>		
R&S®TSMU/R&S®TSMML/R&S®TSMQ	R&S®ROMES4T1Q	1117.6885.40
R&S®TSMW	R&S®ROMES4T1W	1117.6885.02
CW Option for R&S®ROMES and Rohde & Schwarz Receivers	R&S®ROMES4CW	1117.6885.08
DVB-T/-H Option for R&S®ROMES, R&S®TSM-DVB and R&S®ETL	R&S®ROMES4DVB	1117.6885.18
<b>Test mobile phone/data card drivers</b>		
GSM	R&S®ROMES4GSM	1117.6885.20
Nokia (incl. HSDPA/HSUPA)	R&S®ROMES4WCN	1117.6885.46
Qualcomm (incl. HSDPA/HSUPA)	R&S®ROMES4WCO	1117.6885.48
Qualcomm HSPA+ Option	■ R&S®ROMES4HPQ	1513.8206.02
C2K Qualcomm CDMA2000® 1xEV-DO driver	R&S®ROMES4C2K	1117.6885.06
Wi-Fi NDIS 5.1	R&S®ROMES4WIF	1117.6885.50
LTE Samsung	■ R&S®ROMES4LTS	1117.6885.62
Qualcomm LTE	■ R&S®ROMES4LTQ	1117.6885.64
TETRA Radio Drivers (PEI)	■ R&S®ROMES4TEP	1514.5169.02
TETRA Radio Drivers (PEI) from Sepura incl. L3	R&S®ROMES4TED	1516.4201.02
<b>Special measurements and options</b>		
GSM Interference	R&S®ROMES4COI	1117.6885.56
Position Estimation	R&S®ROMES4LOC	1117.6885.32
Data Quality Analyzer for Quality-of-Service Measurements (DQA)	R&S®ROMES4DQA	1117.6885.16
Handover/Neighborhood Analysis for 3GPP (HOA/NBA 3GPP)	R&S®ROMES4HOA	1117.6885.22
Indoor Measurements	R&S®ROMES4IND	1117.6885.24
Printed Manual	R&S®ROMES4DOC	1117.6885.14
<b>Speech quality</b>		
Speech Quality P.862	R&S®ROMES4SQA	1117.6885.36
Speech Quality Server Software	R&S®ROMES4SRV	1117.6885.38
<b>Network problem analyzer</b>		
R&S®ROMES4 Network Problem Analyzer Basic Package	R&S®ROMES4NPA	1510.9276.02
NPA Extended NQA Plug-In	R&S®ROMES4N11	1510.9299.11
Coverage Plug-In	R&S®ROMES4N15	1510.9424.02
Neighborhood Analysis Plug-In	R&S®ROMES4N17	1510.9299.17
2G/3G Data Plug-In	R&S®ROMES4N20	1510.9299.20
Local Database	R&S®ROMES4N51	1510.9299.51
R&S®ROMES4 NPA SDK Plug-In	R&S®ROMES4N99	1510.9299.99

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA - USA).

“WiMAX Forum” is a registered trademark of the WiMAX Forum. “WiMAX,” the WiMAX Forum logo, “WiMAX Forum Certified,” and the WiMAX Forum Certified logo are trademarks of the WiMAX Forum.

# From pre-sale to service. At your doorstep.

The Rohde&Schwarz network in over 70 countries ensures optimum on-site support by highly qualified experts.

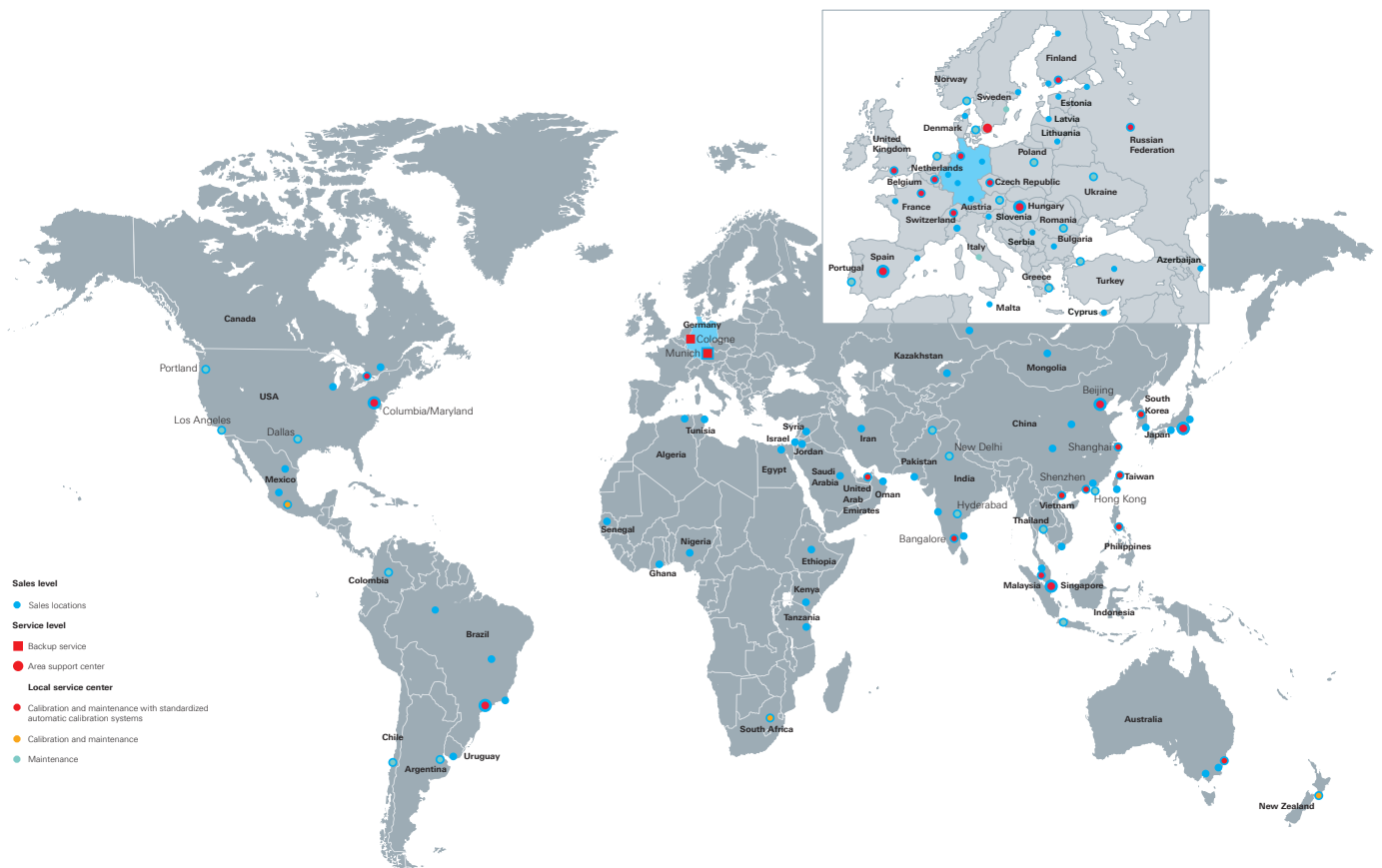
The user risks are reduced to a minimum at all stages of the project:

Solution finding/purchase

■ Technical start-up/application development/integration

■ Training

■ Operation/calibration/repair



## Service you can rely on

- | Worldwide
- | Local and personalized
- | Customized and flexible
- | Uncompromising quality
- | Long-term dependability

## About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

## Environmental commitment

- | Energy-efficient products
- | Continuous improvement in environmental sustainability
- | ISO 14001-certified environmental management system

Certified Quality System  
**ISO 9001**

## Rohde & Schwarz GmbH & Co. KG

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Regional contact

- | Europe, Africa, Middle East | +49 89 4129 12345  
[customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)
- | North America | 1 888 TEST RSA (1 888 837 87 72)  
[customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)
- | Latin America | +1 410 910 79 88  
[customersupport.la@rohde-schwarz.com](mailto:customersupport.la@rohde-schwarz.com)
- | Asia/Pacific | +65 65 13 04 88  
[customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)
- | China | +86 800 810 8228/+86 400 650 5896  
[customersupport.china@rohde-schwarz.com](mailto:customersupport.china@rohde-schwarz.com)

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG

Trade names are trademarks of the owners | Printed in Germany (as)

PD 5214.2062.12 | Version 05.00 | November 2011 | R&S®ROMES4

Data without tolerance limits is not binding | Subject to change

© 2009 - 2011 Rohde & Schwarz GmbH & Co. KG | 81671 München, Germany



5214206212