

# All-in-one tester for WiMAX mobile

Mobile WiMAX in accordance with the IEEE 802.16e-2005 standard – the first wireless communications system based on orthogonal frequency division multiplex (OFDM) for wireless broadband access in DSL quality – is about to be implemented. As the first real all-in-one solution for cost-effective mass production of WiMAX mobile stations, the R&S®CMW270 WiMAX communication tester is being introduced at exactly the right moment.

## A single box – scalable for various applications

The certification process of WiMAX mobile stations and base stations is in full swing [1] and thus the first commercial products are about to be launched. Rohde&Schwarz has actively supported WiMAX technology by offering dedicated R&D measurement equipment [2] as well as an RF certification platform [3]. Now, the company's R&S®CMW270 WiMAX communication tester (FIG 1) is being introduced at exactly the right moment – the first real all-in-one solution for the cost-effective mass production of mobile stations.

Three functions are needed for the calibration and final testing of WiMAX mobile stations in production: test signal generation, test signal analysis and base station emulation. The new R&S®CMW270 WiMAX communication tester from Rohde&Schwarz is the first market solution that combines all these functions in a single box. The R&S®CMW270 is specially designed for testing WiMAX mobile stations based on the IEEE 802.16e-2005 standard. It offers fast measurement functions for evaluating WiMAX signals, e.g. burst power, error vector magnitude (EVM), center frequency error and spectrum flatness (FIG 2). Its integrated base station emulator allows you to check the functionality of WiMAX mobile



# station production

FIG 1 All-in-one solution for WiMAX mobile station production: The R&S®CMW270 offers high-quality, high-speed measurement engineering plus the emulation of a base station.



**WIMAX - Multi Evaluation**

**General Settings**

Frequency: 2345000000.0 Hz FFT-Size: 1024 Modulation: QPSK

Bandwidth: 10 Link Mode: Uplink Zone Length: 18

**Result Summary**

	Current	Min	Max	Average
EVM All Carriers	-45.138	-45.138	-43.871	-44.451 dB
EVM Data Carriers	-43.961	-43.961	-42.832	-43.428 dB
EVM Pilot Carriers	-49.369	-49.369	-47.115	-47.623 dB
IQ Offset	-33.638	-33.699	-32.344	-33.638 dB
Gain Imbalance	-0.010	-0.010	-0.007	-0.009 dB
Quadrature Error	-0.020	-0.035	-0.012	-0.024 °
Center Frequency Error	0.657	-2.087	0.657	-0.542 Hz
Subframe Power	-11.540	-11.548	-11.538	-11.542 dBm
Crest Factor	9.931	9.434	9.932	9.675 dB
CINR	---	---	---	---
S. Flatness O. L.	-0.357	-0.365	-0.353	-0.358 dB
S. Flatness O. U.	0.286	0.277	0.296	0.288 dB
S. Flatness I. L.	-0.218	-0.238	-0.211	-0.221 dB
S. Flatness I. U.	0.201	0.195	0.211	0.205 dB
S. Flatness Neighbor	0.039	0.033	0.055	0.041 dB

Buttons: Statistic Count..., Repetition, Config. Menu...

stations under realistic WiMAX network conditions. Its integrated general-purpose RF generator and RF power meter make it ideal for a variety of measurement tasks. Owing to the tester's two bidirectional RF connectors and a high-power output, WiMAX mobile stations can directly be connected. External RF combiners or RF relays are not required. This means you do not need extra equipment for common applications – which reduces costs for test setup while simultaneously increasing accuracy and reliability.

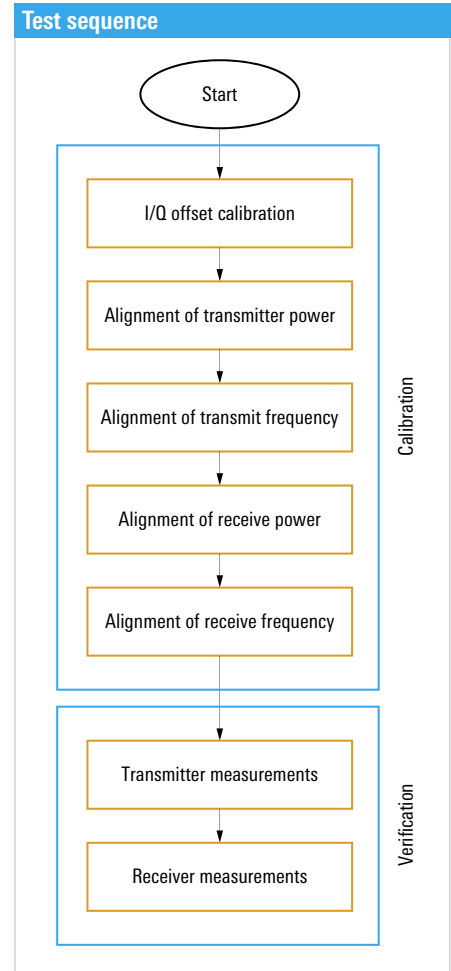
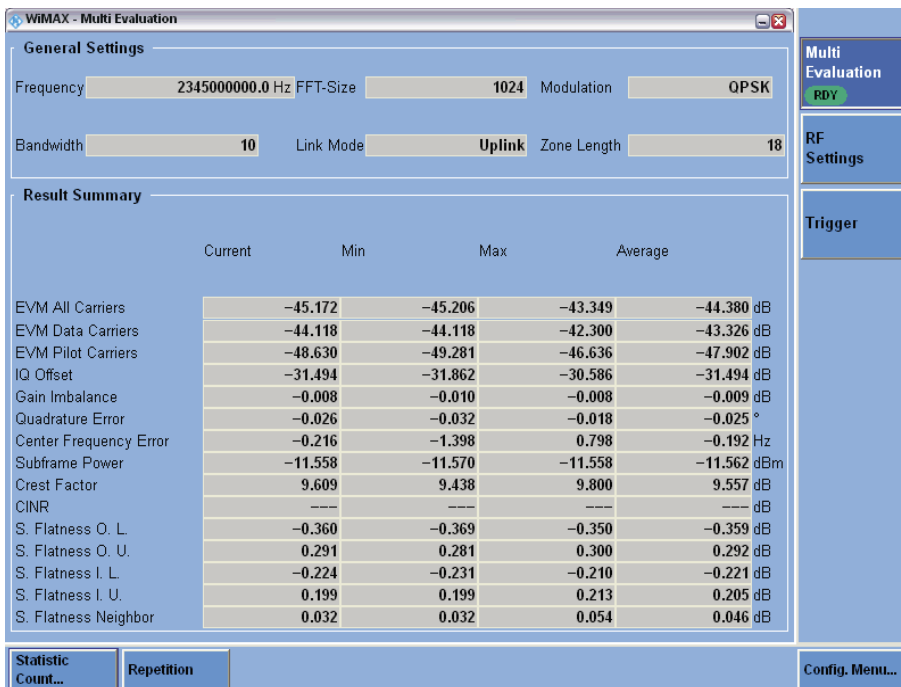
Since the R&S®CMW270 has a modular platform concept, it can be conveniently configured to meet the individual test requirements in production, service and quality assurance. Moreover, hardware and software options, e.g. for WiMAX signaling, can easily be retrofitted. A Gigabit LAN interface and a USB 2.0 interface allow remote control of the tester via an external PC. Operation via the conventional IEEE/IEC bus interface is also possible. The R&S®CMW270 can also be remote-controlled within a LAN using the Windows® XP *Remote Desktop* application.

### Non-signaling – tested and optimized calibration functions for WiMAX chipsets

An important step in the production of WiMAX mobile stations is the alignment of RF components such as RF transceiver, filter and power amplifier. These components exhibit variations in frequency and level characteristics – both in the transmit and receive path. To help ensure that the IEEE 802.16e specification with regard to RF level accuracy is met during later operation, variations must be eliminated by alignment procedures during production. This includes measuring deviations from the ideal value, finding correction values and storing the values in the mobile station. All this is usually done in the non-signaling mode. The DUT is run in a specific test mode. The required settings are performed via test commands. Many single measurements with different DUT and measuring instrument settings have to be performed both during alignment and verification (FIG 3). To automate this task, a test sequencer, which controls the calibration process, is used (FIG 4).

FIG 3 Typical test sequence for WiMAX mobile stations in non-signaling mode.

FIG 2 Measuring a WiMAX UL subframe: The R&S®CMW270 provides fast measurement functions.



In close cooperation with the leading WiMAX chipset manufacturers, the control, RF calibration and RF verification of chipsets were carried out with chipset reference designs serving as a basis and using the R&S®CMW270 as a measuring instrument. This joint effort yielded time-optimized function libraries for a variety of chipsets, and the libraries can be easily integrated into the end user's production test software.

### Signaling in realtime – tests under realistic conditions

During final testing in production, both the physical layer (PHY) and the protocol functions in the medium access control (MAC) layer of the mobile station have to be tested under

realistic conditions. This test is carried out by means of the R&S®CMW270 – which emulates a WiMAX base station – using realtime signaling. This simulation is initiated with the network entry process, during which the mobile station is checked for correct synchronization and frequency correction. After the network entry process has been completed successfully, a functional test with various test scenarios can be performed via WiMAX signaling (FIG 5).

The most important parameters that can be set are as follows:

- Preamble code
- MAC address
- Number of DL symbols
- OFDMA frame settings
- Modulation type and coding rate

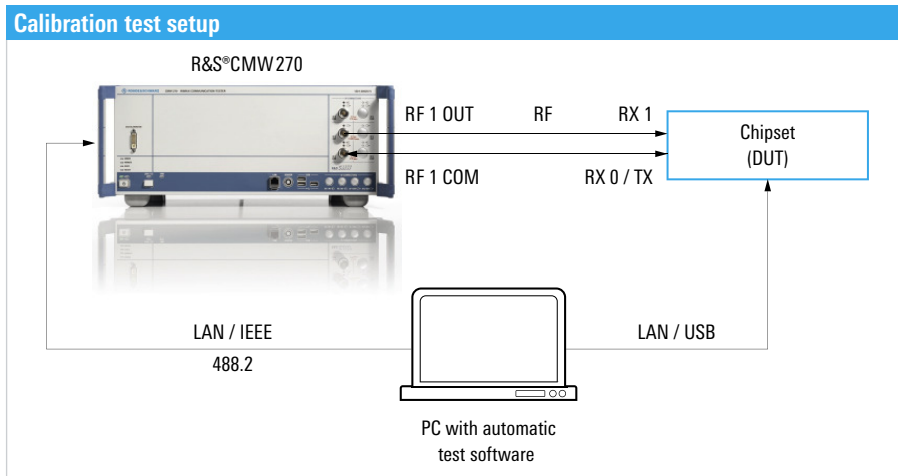


FIG 4 Basic design of an automated calibration test setup. A test sequencer controls the calibration process.

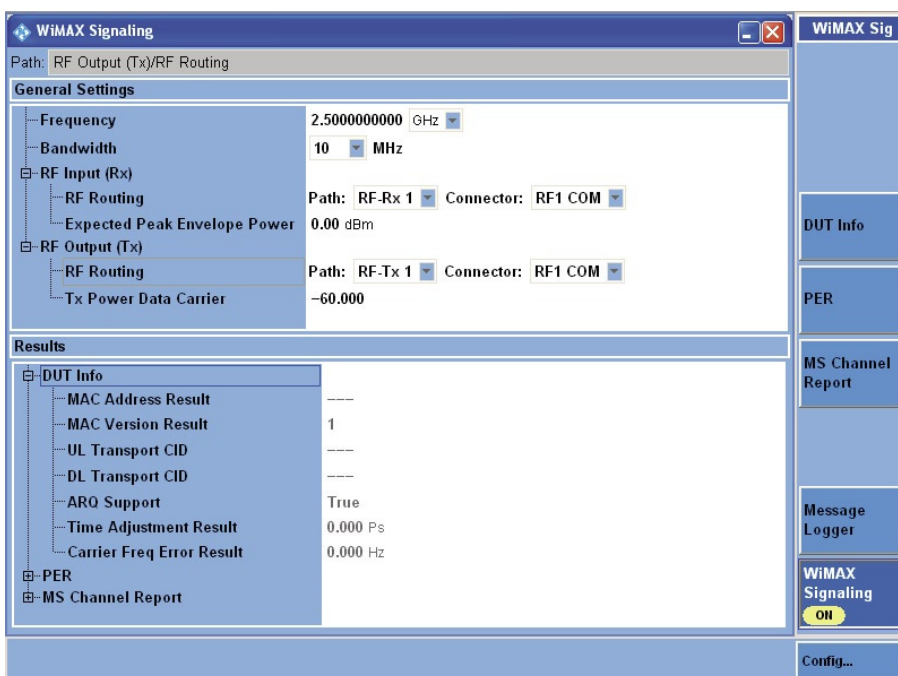


FIG 5 User interface for WiMAX signaling.

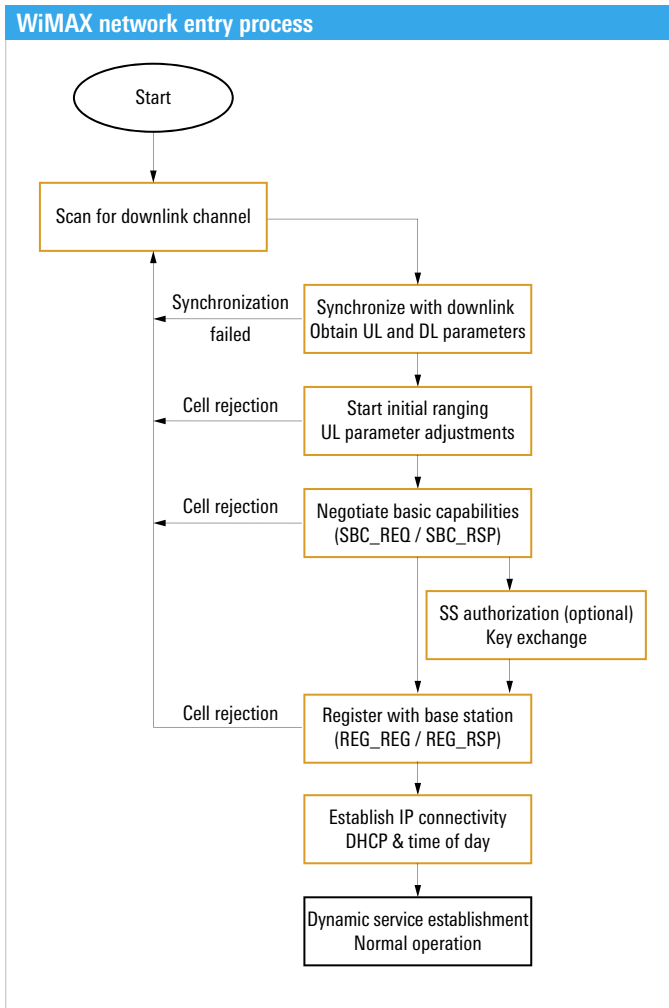


FIG 6 Message flow during network entry process.

## Message logger

During the network entry process as well as during RF verification with signaling, complex data communications take place in the physical layer and in the MAC layer of a WiMAX mobile station (FIG 6). Errors may occur, for example, during the ranging process or a connection may drop completely. The R&S®CMW270 message logger (FIG 7) records all messages between the WiMAX mobile station and the tester emulating a base station.

The message logger records the following data:

- Time stamp with 1 ms resolution
- Link direction (UL/DL)
- MAC management type (e.g. DL map, UL map, DCD, UCD)
- Connection identifier (CID)
- Status (success, continue)
- Number of bytes
- Offset frequency adjust
- Power level adjust

Signaling errors of the WiMAX mobile station can thus be recognized quickly and easily as they can be reproduced. Latencies in the message flow can immediately be recognized with the connection set up. This is due to time stamps and the display of repeated messages.

## Self test monitors hardware

Fully tailored to the requirements in production, the R&S®CMW270 WiMAX communication tester offers a built-in self-test (BIST) to monitor the internal hardware. The BIST functions are menu-controlled and allow you to perform diagnostics on the RF generator and RF analyzer. Plus, the internal bus systems of the tester as well as the plug-in modules are checked for correct function. The BIST functions can be remote-controlled and integrated into the test program. When applied regularly and combined with the statistical evaluation of results, these BIST functions will detect any deviation from the R&S®CMW270 basic functions at an early stage – an important preventive measure in avoiding the costs caused by a loss of production as a result of long downtimes.

## Well-prepared for future WiMAX requirements

The R&S®CMW270 is also fully ready to meet future WiMAX standard expansions. Owing to its continuous frequency range from 70 MHz to 6 GHz, the R&S®CMW270 already supports all current RF profiles of the WiMAX Forum®. The WiMAX IEEE 802.16e standard defines a variable signal bandwidth, where the first WiMAX products are initially specified only up to 10 MHz. Featuring a channel bandwidth of 40 MHz for the analyzer and 70 MHz for the generator, the R&S®CMW270 has enough margin to handle adjacent-channel measurements, for example. Plus, the tester is ready to accommodate a second measurement channel for testing MIMO applications.

## Summary

The R&S®CMW270 is the first comprehensive all-in-one solution for WiMAX mobile station production: a high-quality, high-speed tester together with the emulation of a WiMAX base station in a single box and a shared user interface. It can be remote-controlled and its flexible hardware and software architecture makes it ideal for the production environment. Plus, the R&S®CMW270 WiMAX communication tester is well prepared to handle future WiMAX developments such as new profiles, operating frequencies, bandwidths as well as the MIMO multiple antenna technology.

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### Abbreviations

DCD	Downlink channel descriptor
DSL	Digital subscriber line
DUT	Device under test
EVM	Error vector magnitude
MIMO	Multiple input multiple output
OFDM	Orthogonal frequency division multiplex
PER	Paket error rate
UCD	Uplink channel descriptor
WiMAX	Worldwide interoperability for microwave access

### References

- [1] R&S®TS8970 WiMAX Radio Conformance Test System – State-of-the-art: all WiMAX RF certification tests. News from Rohde & Schwarz (2007) No. 194, pp 15–17.
- [2] R&S®SMx Signal Generators / R&S®FSQ / R&S®FSL Analyzers: WiMAX goes mobile – new T&M solutions are required. News from Rohde & Schwarz (2006) No. 190, pp 24–27.
- [3] R&S®TS8970 WiMAX Radio Conformance Test System: Benchmark for the certification of WiMAX end products. News from Rohde & Schwarz (2006) No. 191, pp 26–28.

FIG 7 The message logger clearly displays the message flow of a WiMAX connection and allows convenient analysis.

