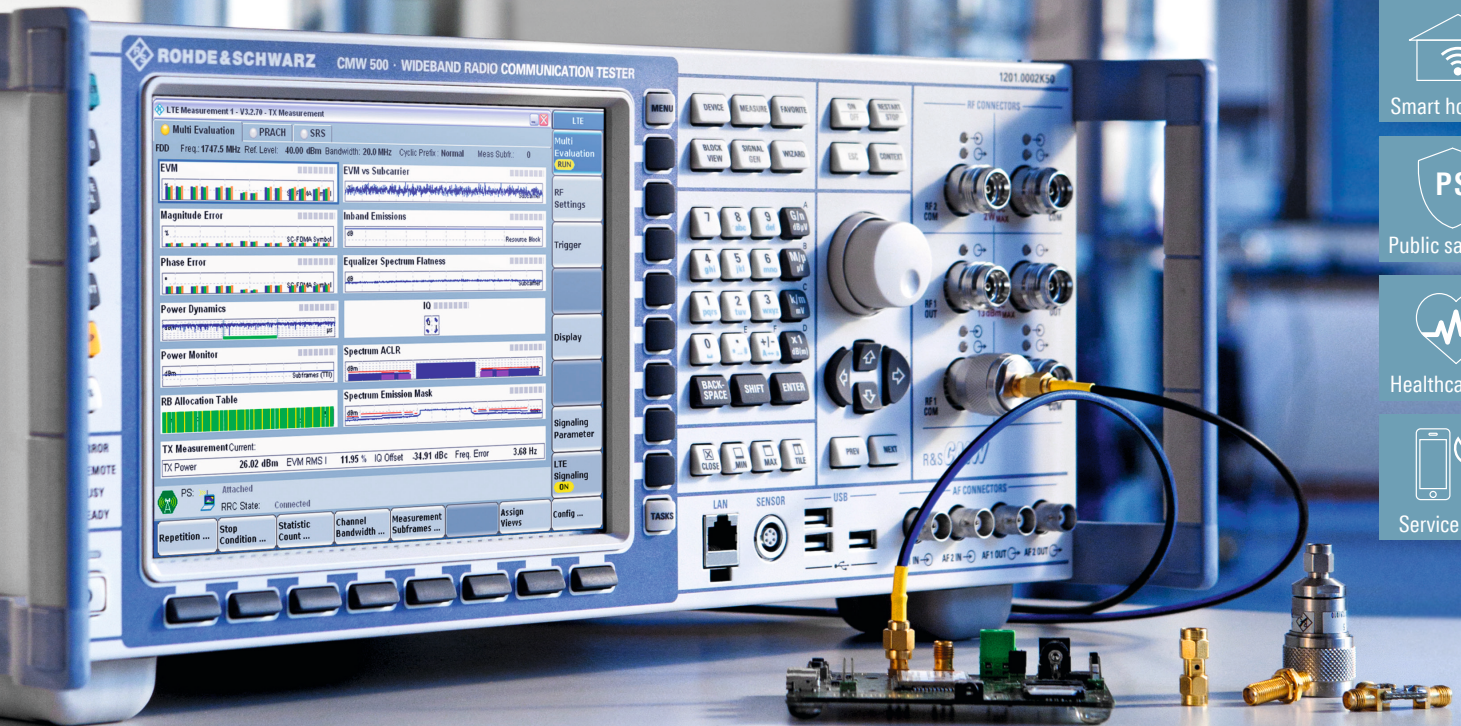


R&S®CMW

Wideband Radio Communication Tester

Platform overview



Operators



Chipsets



Internet of Things



Production



Mobile devices



Automotive



Smart home



Public safety



Healthcare



Service and repair



Contents

All-in-one test platform for wireless devices

Leading in technologies	4
One tester for all layers and all phases of product lifecycle	6
Your task – the R&S®CMW platform solution	7
One investment from product development to production	8

Application testing and typical use cases

User experience testing	10
IP application testing and traffic analysis	12
Emergency services testing	13
In-device coexistence testing	14
LTE-WLAN traffic offload	15

Radio development

Efficient signaling tester for the requirements of tomorrow	16
---	----

Protocol development

Easy protocol development and testing of any signaling scenario	18
---	----

Conformance testing for RF, protocol and RRM

Tester for GCF and PTCRB certification	20
--	----

Performance and quality optimization

Network operator acceptance testing, including OTA	22
--	----

Efficient volume production testing for wireless devices

Production solutions for multi-DUT testing	24
One-stop shopping for production, including shielded boxes	27

Powerful universal service solutions

Powerful and cost-effective RF measurements and functional tests	28
--	----

Software tools | Recommended extras

R&S®CMWrun sequencer software tool	30
R&S®CMWcards signaling and application tester	32
R&S®CMWmars multifunctional logfile analyzer	33

Additional information

Glossary	34
From pre-sale to service. At your doorstep.	35

Note: Abbreviations are defined in the glossary on page 34.

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Leading in technologies

The R&S®CMW wideband radio communication tester offers universal, efficient test solutions for all modern cellular and non-cellular standards. The R&S®CMW is the world's most widely used T&M platform for development, production and service. It meets all of the requirements for a state-of-the-art wireless communication tester. The R&S®CMW can also emulate network operation under realistic conditions for protocol and RF tests.

Rohde & Schwarz – recognized as a reliable partner for wireless test solutions

Rohde & Schwarz has long been a pioneer in the development of T&M solutions for the wireless communications market. As the market leader in T&M equipment for leading-edge LTE-A development, Rohde & Schwarz offers a universal, flexible test platform.

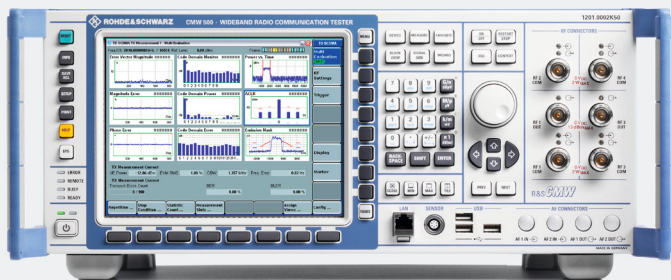
The R&S®CMW platform is continually enhanced and incorporates extensive experience gained through long-term relationships with chipset and wireless device manufacturers.

The R&S®CMW platform offers the very latest LTE enhancements and all legacy technologies in a single compact tester, making it ideal for testing mobile devices such as smartphones and tablets as well as base stations. It is also an excellent platform for testing the diverse requirements of networked products in the automotive, health-care, smart home and other IoT segments.

Platform overview – preconfigured models

R&S®CMW500

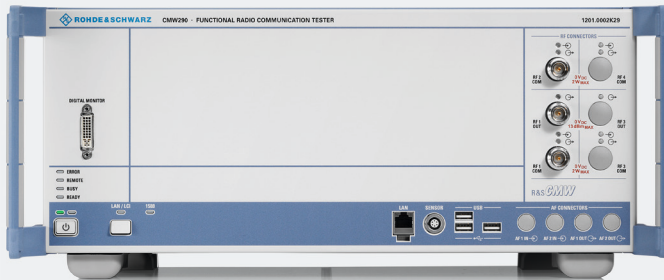
The all-in-one test platform



The R&S®CMW500 wideband radio communication tester is the universal test platform for RF integration and protocol development. It is available as the R&S®CMW500 callbox and the R&S®CMW500 protocol tester. The R&S®CMW500 includes a fully integrated end-to-end data solution that permits comprehensive IP throughput and quality measurements. Thanks to the internal fading simulator, it is easy to perform tests under realistic propagation conditions. The R&S®CMW500 can be used in all phases – from product development to production to service. It is the solution with the widest range of supported technologies.

R&S®CMW290

The compact RF tester for basic functional tests



The R&S®CMW290 functional radio communication tester is the cost-effective compact version of the R&S®CMW500. The tester is the right instrument for users who need to measure fundamental RF characteristics or verify the functionality of wireless devices. The R&S®CMW290 provides service companies with a high-quality, customized, automated test environment for functional input and output tests. Powerful network emulation allows IoT/M2M system integrators to functionally test module integration and custom IP applications.

Numerous advantages of the future-ready R&S®CMW all-in-one platform

The user-friendly R&S®CMW platform efficiently performs all measurement tasks – from complex lab tests to production line testing with its extremely stringent speed and reliability requirements.

While the high-end R&S®CMW500 covers the entire spectrum, the R&S®CMW290 is a cost-effective, compact version for standard measurements and functional tests. The R&S®CMW100 and R&S®CMW270 testers have been optimized for production and non-cellular connectivity applications.

The R&S®CMW platform includes a wide variety of hardware and software options to ensure the best fit for every T&M requirement. Unique software tools that extend the range of functions are also available. The R&S®CMW platform covers the entire T&M spectrum with a single instrument.

One tester for all technologies

1 Versatile hardware platform

- ▮ 6 GHz support
- ▮ Internal fading
- ▮ Internal server for E2E testing

2 Multi-RAT signaling

- ▮ LTE, WCDMA/HSPA+, GSM/GPRS/EGPRS
- ▮ CDMA2000® 1xRTT/EV-DO, TD-SCDMA
- ▮ WLAN, Bluetooth®

3 LTE-Advanced

- ▮ 4 DL CC up to 8x2 MIMO fading, 2 UL CA
- ▮ FDD/TDD joint operation, 256QAM DL
- ▮ LTE-U/LTE-LAA, LTE-D, LTE-D2D, LTE-MTC, PS-LTE

4 WLAN signaling support

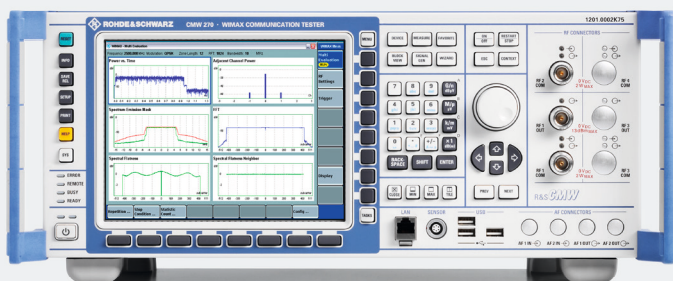
- ▮ LTE-WLAN traffic offload
- ▮ WLAN E2E and access point testing
- ▮ In-device coexistence tests with other technologies

5 Outstanding features for production solutions

- ▮ Multi-DUT testing for up to 8 devices
- ▮ Chipset support for all major suppliers
- ▮ Support of cellular, Bluetooth®, WLAN and IEEE 802.15.4 (ZigBee) technologies

R&S®CMW270

The expert for all non-cellular technologies



The R&S®CMW270 wireless connectivity tester is a cost-effective alternative for development, production and service. The non-cellular specialist offers features comparable to those of the R&S®CMW500. It supports Bluetooth®, WLAN and broadcast technologies.

R&S®CMW100

The compact RF tester for production



The R&S®CMW100 communications manufacturing test set is based on the R&S®CMW platform. The flexible RF interface permits simultaneous testing of up to eight RF ports. The R&S®CMW100 remote control and measurement concepts are compatible with the R&S®CMW500. Both testers also use the same methods for optimizing test time and capacity utilization. The R&S®CMW100 can be used to cost-effectively calibrate and verify wireless devices in non-signaling mode (analyzer/generator).

One tester for all layers and all phases of product lifecycle

Just a single investment in the R&S®CMW provides users with test solutions for the entire product lifecycle. All layers are covered – from RF to protocol to IP application.

One tester for the entire product lifecycle

The modular R&S®CMW platform covers all test requirements in all phases of the product lifecycle. With just one basic investment, a wireless device can be tested over its entire lifecycle – from development to certification and network optimization to production and service. An existing configuration can easily be modified to handle other T&M tasks.

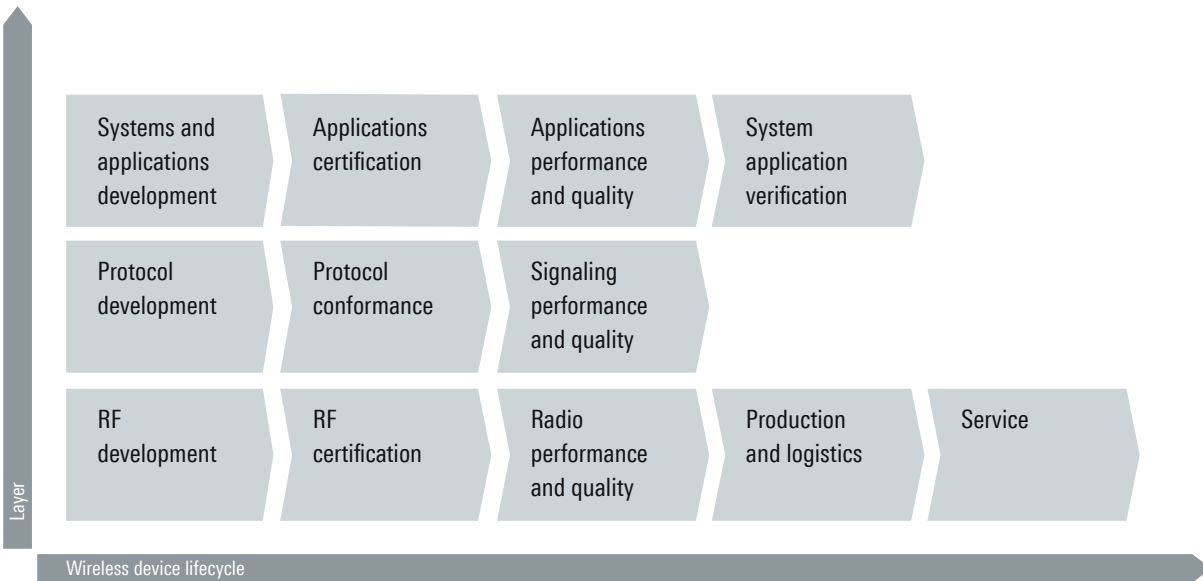
Tests for all layers of the OSI model

The R&S®CMW combines RF and protocol tests in a single instrument. The R&S®CMW is all that is needed for RF tests, E2E measurements and OTT analysis in line with the OSI layer model.

Versatile test options, including simulation of non-ideal conditions

The R&S®CMW is the basis for testing user experience and applications such as battery life and OTA/OTT. The combination of complex IP analysis and simultaneous emulation of a variety of wireless technologies, including 2G, 3G and LTE, makes the tests possible. These technologies are emulated to test wireless devices under both ideal and non-ideal conditions. Non-ideal operation is simulated using additional IP impairments or internal fading.

R&S®CMW platform covering the entire lifecycle of wireless devices



Your task – the R&S®CMW platform solution

Battery life testing

Test of DUT current drain

End-to-end communications testing

Users experience tests, including voice, video, IP data transfer and OTT

Meeting IoT connectivity requirements

Efficient solutions for cellular technologies and WLAN, Bluetooth® LE, ZigBee

Flexible production solution

Including fast RF calibration and verification of chipsets from different vendors

TX and RX measurements

Automated solution for 3GPP/3GPP2 conformance RF measurements with R&S®CMWrun



Inter-RAT

Simple device tests (from RF to protocol) during transitions from one technology to another

LTE-WLAN traffic offloading

Video and E2E tests for rerouting traffic from LTE to WLAN and back

Preconformance and conformance testing

GCF and PTCRB validated test cases complying with 3GPP and OMA standards for certification of wireless devices

Roaming solutions

Simulation of worldwide roaming tests

Protocol testing

For all OSI layers, including sample test scenarios

One investment from product development to production

Different applications place different demands on testers. Development requires the simulation of networks with standardized cellular and non-cellular call processing sequences. Production requires short test times and high precision.

Realistic test conditions for module development and integration

When developing wireless devices, it is essential to test the communications interface under realistic network conditions. The R&S®CMW emulates the base station for all technologies required to test these devices.

The radio access network and the core network are implemented for each technology to be tested. The R&S®CMW handles all protocol layers – from the physical layer to the application itself. Signaling messages are dynamically created at runtime and are adapted to the DUT's requirements as needed.

The R&S®CMW can be configured down to the smallest detail, enabling users to define scenarios and achieve reproducible results. RF parameters as well as the signaling protocols themselves are tested for compliance with the specification. Multiple communications standards can be run at once to simulate handover scenarios and interference situations.

Use of the R&S®CMW platform for wireless technologies						
Technology	RF generator	RF analyzer	Network emulation	Protocol testing	End-to-end application testing	Fading support
Cellular technologies						
LTE-A	•	•	•	•	•	•
WCDMA/HSPA+	•	•	•	•	•	•
GSM/GPRS/EGPRS	•	•	•	•	•	•
CDMA2000® 1xRTT, CDMA2000® 1xEV-DO	•	•	•	• (inter-RAT LTE)	•	•
TD-SCDMA	•	•	•	• (conformance tests)	•	•
Non-cellular technologies						
WLAN IEEE 802.11 a/b/g/n	•	•	•	• (offloading use cases)	•	
WLAN IEEE 802.11 p/ac	•	•				
Bluetooth® (BR/EDR/LE)	•	•	• (LE in direct test mode)			
IEEE 802.15.4 (ZigBee)	•	•				
Broadcast technologies						
GNSS (GPS, Glonass, Beidou)	•					
DVB-T	•					
T-DMB	•					
CMMB	•					

R&S®CMW platform – the perfect measurement solution for IoT applications

The growing IoT markets need to test and analyze cellular and non-cellular standards. The challenge is providing this capability in a simple setup with only one connection.

The R&S®CMW platform offers a unique combination of cellular and non-cellular network emulations. Users can effectively implement a wide variety of measurement tasks with a single investment in equipment, training and adaptation costs.

The R&S®CMW can be used to test handover within a technology or between technologies. Separate LTE and WLAN signaling allows detailed analysis of LTE WLAN traffic offload. A simple setup suffices for all phases – from protocol development to functional testing.

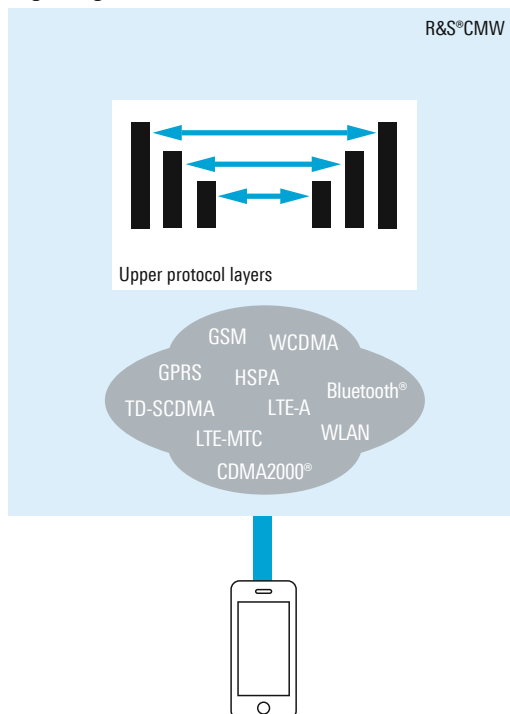
The increasing number of standards in a mobile device can be a cause of poor transmission quality. The R&S®CMW can also solve this problem. The in-device coexistence test analyzes mutual interference and desensitization between the standards.

Powerful solutions for special production test requirements

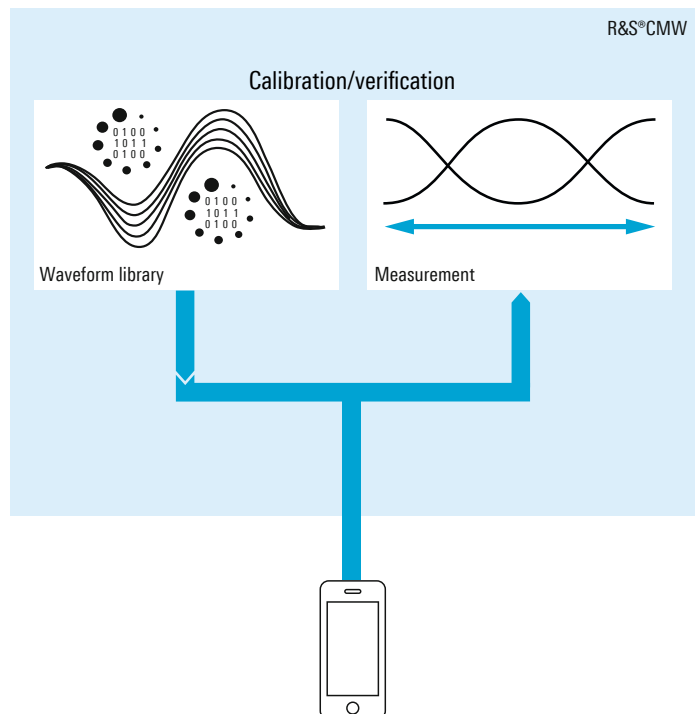
Rohde&Schwarz is a global leader in optimizing production processes for wireless devices. The T&M expert offers cost-efficient solutions to meet user requirements. Examples include different modes to reduce test time, optimize processes (capacity utilization) and test up to eight RF ports in parallel. These optimizations fulfill the demand for high measurement accuracy and performance. The non-signaling mode (transmitter and receiver mode) is primarily used in production environments. Non-signaling mode is mainly for receiver and transmitter tests, which are performed using the internal RF generator and RF analyzer.

Wireless device testing

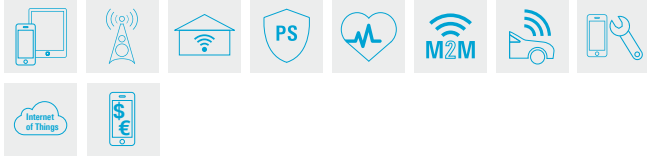
Signaling mode



Non-signaling mode/ transmitter and receiver mode



User experience testing



The R&S®CMW test platform can be used to perform, document and evaluate complex user experience tests under simulated, yet realistic conditions. An R&S®CMW tester combined with the R&S®CMWrun automation tool provides an enormous test bandwidth that is unmatched on the market.

User experience testing scenarios

The proliferation of wireless devices has led to enormous growth in global IP traffic. At the same time, users are demanding better audio quality, video streaming and data transmission. Network operators, device manufacturers and app developers need to ensure and optimize a certain quality of experience (QoE) for the wide variety of services based on these functions. A number of different parameters are used for optimization, such as the signaling traffic per app (end-to-end traffic), the number of bytes (IP) consumed per app and the impact on the battery life.

Audio testing and voice over LTE (VoLTE) performance testing

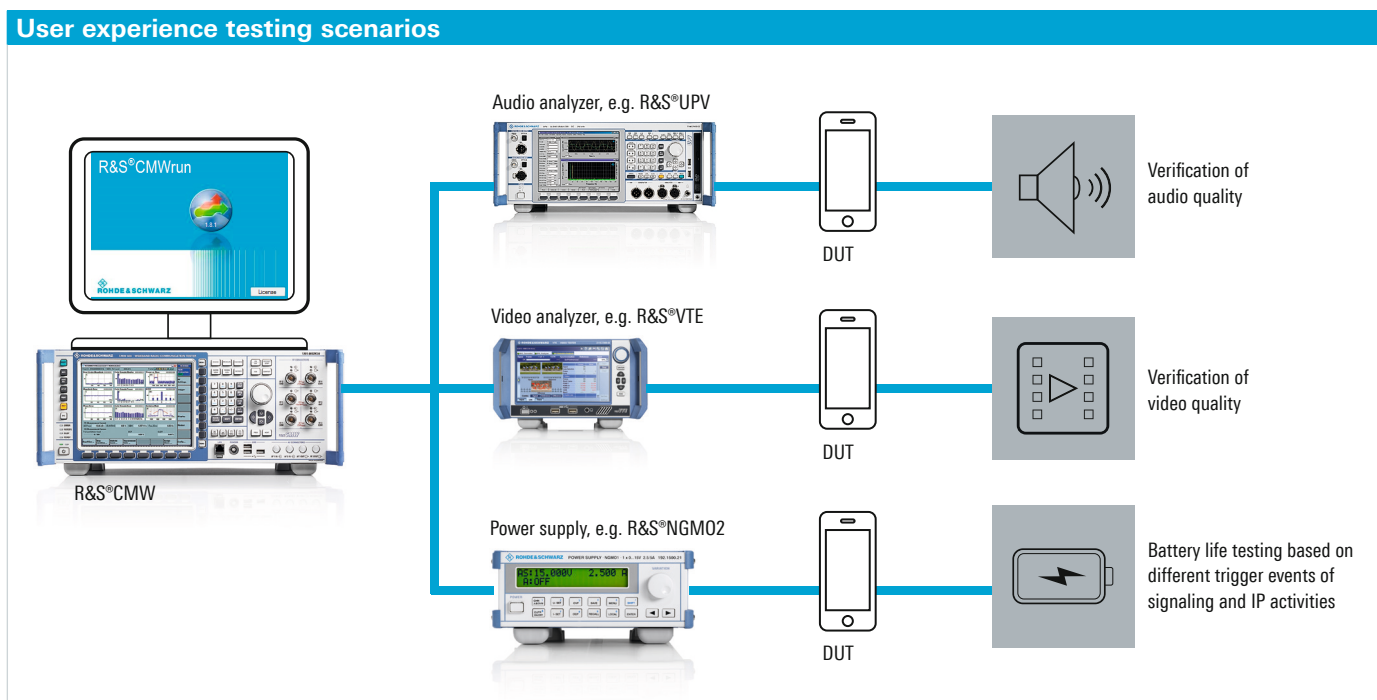
The audio quality of VoLTE and legacy standards (GSM, WCDMA, CDMA2000®) depends on several network and DUT factors. Examples include radio conditions, packet loss, packet delay, jitter and jitter distribution. Another challenge is the fact that all current LTE network deployments are optimized for data service, but not for voice. Voice transmission has to be optimized afterwards.

Video testing

Video stability and performance are key performance indicators for E2E video streaming. They must be optimized based on a variety of standards, including LTE (FDD/TDD), WCDMA/HSPA, GSM/(E)GPRS and WLAN. Complex measurements are needed for services such as LTE Broadcast (eMBMS), which requires optimized spectral efficiency at the cell boundaries as well as low battery consumption. These measurements can be performed easily and efficiently with the R&S®CMW.

Data throughput testing

Depending on the IP data throughput (E2E performance), additional IP analyses across different layers are possible. These analyses reveal who generates how much and what E2E traffic, and how the traffic can be optimized for the various applications. The stability of the IP application can also be tested with specific IP impairments. In parallel with the E2E performance measurements, the R&S®CMW can analyze the PHY and MAC layer throughput and measure RF parameters such as EVM and UL power.



Battery life and current drain measurements

Battery power consumption is gaining in importance as a criterion in the analysis of chipsets, IoT modules and mobile devices. With an increasing number of apps constantly running on smartphones, there is a risk that not enough battery power is left for voice calls, hence the implementation of creative features such as discontinuous reception (DRX), which is a power saving mode in LTE intended to greatly improve battery life. However, the application behavior needs to be tested and analyzed in a controlled, emulated network environment.

Another possible test scenario is the correlation between current drain and signaling or IP activities. Specific signaling trigger events as well as IP activity trigger events from the R&S®CMW500 built-in IP analysis are displayed in a current drain diagram.






Over-the-top (OTT) applications

OTT apps are active in the background and generate a periodic RRC connection to the operator. This results in additional signaling traffic, including data exchange. This traffic interferes with other applications and significantly reduces the battery life. The goal is to keep this type of signaling to a minimum.

The following measurements can be performed with the R&S®CMW and additional instruments:

- ▀ Verification of the audio quality with established algorithms such as PESQ and POLQA under fading and IP impairment conditions
- ▀ Video testing with all key performance indicators for video quality, incl. SNR/SSIM/MOS values
- ▀ Testing of VoLTE calling parallel to data throughput
- ▀ IP data throughput and analysis testing, incl. OTT

The R&S®CMWrun sequencer software tool is an all-encompassing automation tool for audio/video performance and battery life testing. Any deviations from the expected audio and video output can be automatically and precisely detected. R&S®CMWcards, the graphical test script definition tool, offers a wide range of test sequences for 3GPP signaling, including failure scenarios.

R&S®CMW500/R&S®CMWrun user experience testing for all technologies		
	Features/conditions	Metrics
Throughput testing		
 Throughput testing	<ul style="list-style-type: none"> ▀ Upload/download ▀ iPerf/FTP/UDP ▀ Browsing/streaming ▀ IP impairments and fading 	<ul style="list-style-type: none"> ▀ Throughput monitoring over time ▀ IP events over time (IP analysis) ▀ Throughput versus modulation coding schemes ▀ BLER versus modulation coding schemes
Audio performance		
 Audio performance	<ul style="list-style-type: none"> ▀ End-to-end voice quality ▀ VoLTE/circuit-switched ▀ Handovers, incl. SRVCC ▀ IP impairments and fading ▀ Real vocoding 	<ul style="list-style-type: none"> ▀ Loopback ▀ Voice quality/performance (MOS: POLQA/PESQ) ▀ Audio delay (ms) ▀ Acoustical measurements
Video analysis		
 Video analysis	<ul style="list-style-type: none"> ▀ Streaming (HTTP streaming server/DASH) ▀ Video call, incl. ViLTE (IR94) ▀ IP impairments and fading 	<ul style="list-style-type: none"> ▀ Conducted (HDMI™/MHL interface) ▀ Over the air (embedded barcode) ▀ Missing frames, frame delay, reordered frames ▀ Pixel errors ▀ Subjective quality assessment (SNR/SSIM/MOS)
Battery life testing		
 Battery life testing	<ul style="list-style-type: none"> ▀ By voice, video, data ▀ By defined profile ▀ With signaling and IP event markers 	<ul style="list-style-type: none"> ▀ Power consumption (mW) ▀ Current drain (mA) ▀ Estimated battery life (h)
Coexistence testing		
 Coexistence testing	<ul style="list-style-type: none"> ▀ WLAN RX desensitization ▀ LTE RX desensitization 	<ul style="list-style-type: none"> ▀ Desensitization by distance of aggressor (dB) ▀ Desensitization by UL power of aggressor (dB)

IP application testing and traffic analysis



Thanks to deep packet inspection (DPI), IP streams from the application software are reliably analyzed for conformity and security. IP traffic, OTT behavior and battery life can be optimized for applications and mobile devices. The R&S®CMW platform offers an efficient test environment for executing complex IP application tests for various technologies.

IP application testing under fully controlled network conditions

The IP application tests include checking the maximum possible data throughput, analysis of VoLTE performance, video streaming tests, analysis of OTT IP data traffic and much more. The R&S®CMW500 uses DPI to reliably verify

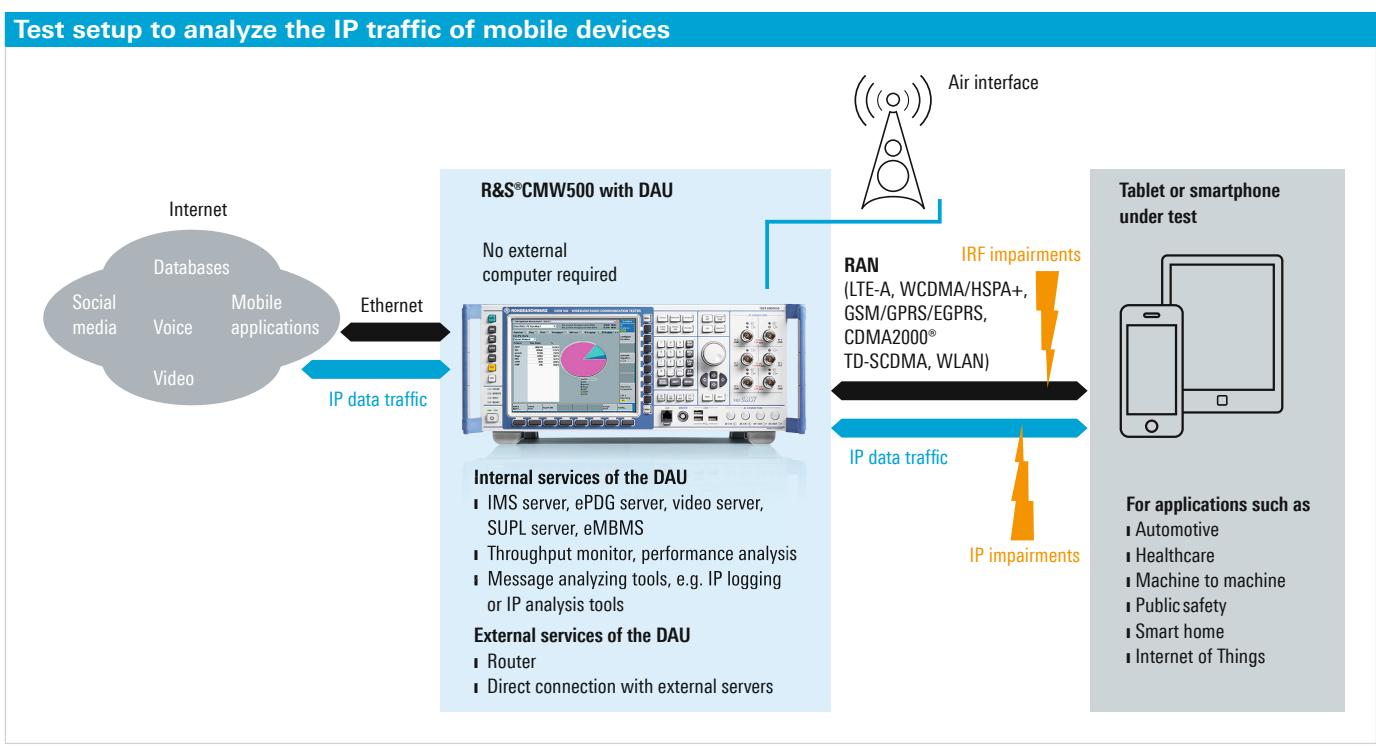
and optimize applications and services when designing a new mobile device.

A typical test setup consists of an R&S®CMW500 with integrated data application unit (DAU) that provides the IP infrastructure and preconfigured services. The DAU can function as an IMS server, a video streaming server, an SUPL server, etc. When testing user-specific services that require a dedicated server, a direct connection to the Internet is set up via Ethernet. In this case, the DAU functions as a gateway to the Internet to permit data analysis.

The DUT is connected via the air interface emulated by the R&S®CMW500. In contrast to the real world, this offers a controlled test environment in which a number of network parameters can be adjusted. Data traffic can be reproducibly analyzed under ideal conditions and also under non-ideal conditions by introducing IP impairments or fading influences.

Special test applications for IP analysis

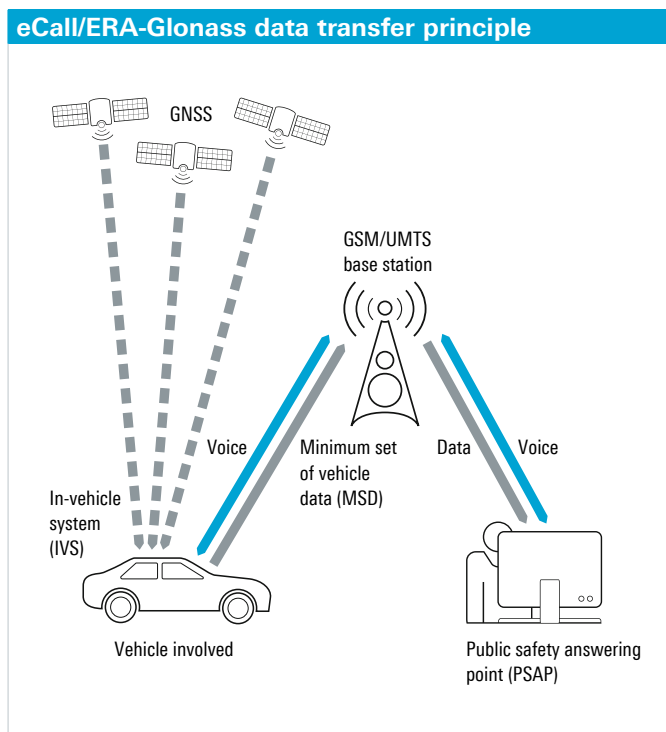
Special test applications permit in-depth analysis of an application on the IP layer. Examples include the unique R&S®CMW500 IP data analysis and IP protocol analysis, the iPerf throughput test tool and the IP logging solution. The protocols used for the connection to the Internet can be efficiently checked. Complex analyses, from RF analysis to application analysis, can be performed with a single tester.



Emergency services testing



The R&S®CMW platform offers a compact solution for automated, reliable and reproducible testing of emergency services. Intelligent telematics-based vehicle safety systems speed up emergency response times in order to save human lives.



Testing emergency call 112/911 in a laboratory environment

The R&S®CMW500 can be used to simulate a real network environment in the lab to test wireless emergency calls such as 112 or 911. For all cellular technologies, including LTE, the R&S®CMW500 supports the required emergency attach for IMS emergency calls, in case there is no SIM card inserted in the phone.

Verification of eCall/ERA-Glonass modems for automotive requirements

To ensure fast emergency response times to car accidents and to save lives, automatic emergency call systems will be mandatory in all new vehicle models. Rohde&Schwarz supports manufacturers today by offering a standard-compliant test solution for the wireless and GNSS-capable components of ERA-Glonass and eCall in-vehicle systems. This easy-to-use test solution is based on the R&S®CMW500 and the R&S®CMWrun sequencer software tool.

Wireless emergency alerts (CMAS, ETWS)

In recent years, mobile alert systems have become important in cellular communications systems. They are used to inform the public about emergencies in case of disasters. Governments and authorities broadcast important messages to quickly inform the public about weather alerts, earthquakes, terror warnings, etc. so that people can act promptly and properly and lives can be saved.

The R&S®CMW500 offers flexible test solutions for LTE, WCDMA and GSM to verify reception of CMAS or ETWS warning messages. These messages can be quickly set up using the RF test environment. The R&S®CMWcards graphical test script tool can be used to create wireless signaling tests. The CMAS and ETWS messages can be set up and parameterized in line with the 3GPP specification and be triggered at any time in the test case. Using the R&S®CMWmars message analyzer, the signaling flow can be retrieved to pinpoint the root cause of test failures.

Automated verification of high-power UEs

High-power UE capability is extremely important for public safety (PS) applications, D2D applications and applications that use group call. High-power capability is an LTE Rel. 11 feature involving an output power of 31 dBm.

The R&S®CMW500 can efficiently verify all required transmitter and receiver tests, i.e. max. output power, ACL and power control. These measurements can be automated using the R&S®CMWrun sequencer software tool.

In-device coexistence testing



Modern communications devices support a large number of standards in a very small space, which can lead to interference due to occupying the same or adjacent frequency bands or due to harmonics. Ensuring standard-compliant operation and minimal mutual interference is crucial.

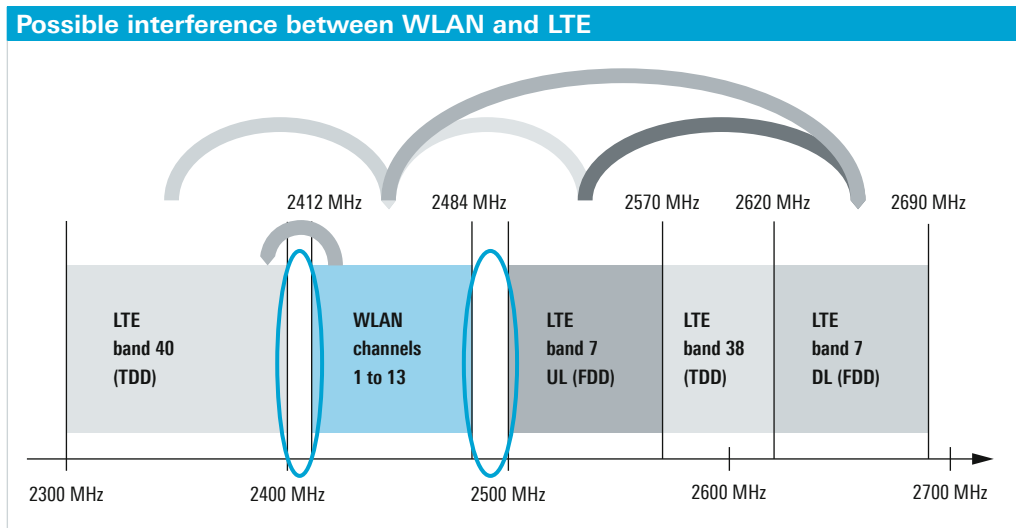
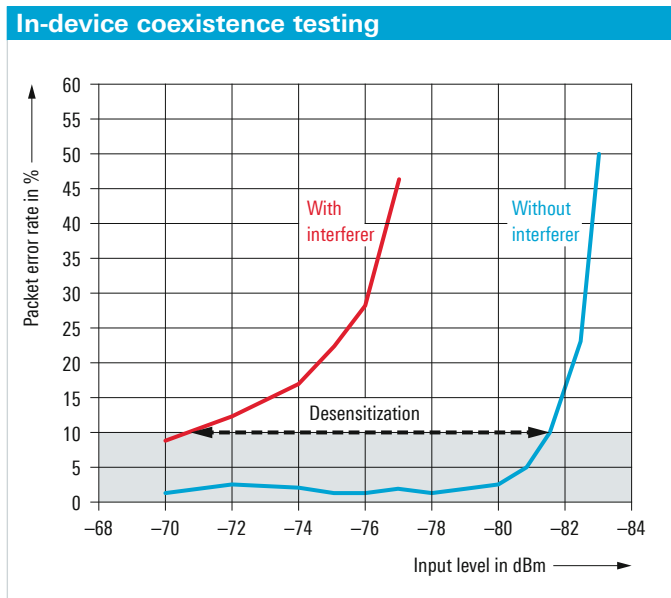
Multiple standards in one instrument

Modern communications devices can contain multiple RF systems, e.g. cellular multiband antennas for LTE-A, 3G, CDMA2000®, 2G and non-cellular technologies such as WLAN, Bluetooth® and various GNSS systems. Measurements of in-device coexistence determine the desensitization, i.e. reduction of the RX sensitivity with and without a strong interferer signal. For standard sensitivity tests, measuring the receiver error rate has been adopted as the evaluation criterion. The packet error rate (PER) is measured for WLAN, for example.

Coexistence measurements with the R&S®CMW500

The R&S®CMW500 is ideal for coexistence measurements. It provides signaling for both cellular and non-cellular technologies. It can operate two different wireless systems in parallel and can define the relative RX sensitivity measurements. In combination with a shielded chamber (e.g. R&S®TS7124 RF shielded box, R&S®CMW-Z10 RF shield box or R&S®DST200 RF diagnostic chamber), measurements can be performed in the lab with a high degree of reproducibility. The R&S®CMWrun sequencer software tool can be used to automate measurements and test reports.

The test results can be used to determine specific, effective measures for optimizing development and integration. Specific examples include improving the decoupling of the antenna system, effectively reducing the signal-to-noise ratio of the interferer and optimizing the operating mode.



LTE-WLAN traffic offload



Single-box test solution: The R&S®CMW500 with its multitechnology concept can simultaneously emulate an LTE base station and WLAN access point. As a result, the R&S®CMW500 offers a high degree of reproducibility for the various tests and solutions in a single instrument – from protocol development to functional testing.

Compact system solution in a single instrument

Cellular networks ensure comprehensive mobile service coverage, but broadband WLANs can reduce the load on cellular networks. The underlying technology is referred to as WLAN traffic offload. An important precondition for the acceptance of LTE-WLAN traffic offload is uninterrupted rerouting between the cellular standards and WLANs. The tests focus mainly on the mobile device, which must connect to both technologies.

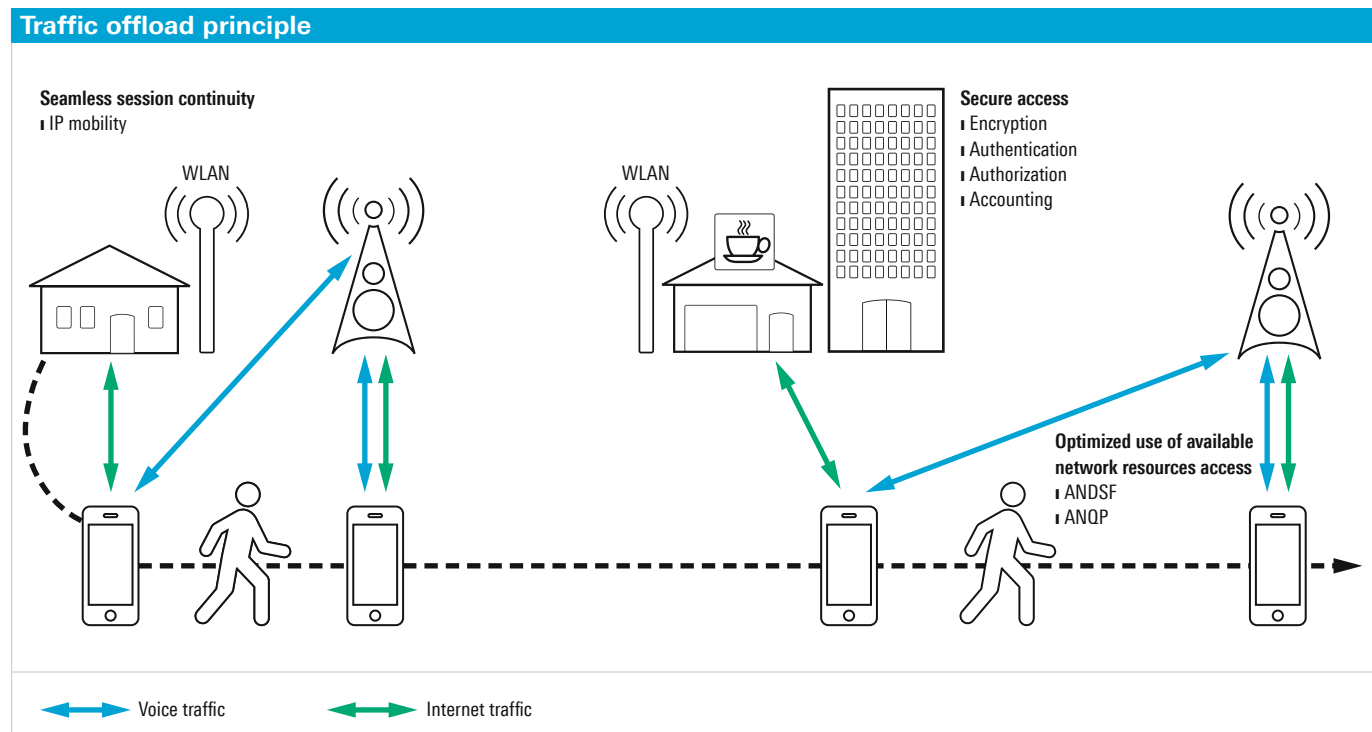
The test setup for LTE-WLAN traffic offload includes the following core components:

- Emulated LTE base station, including the LTE core network
- Emulated WLAN access point
- Gateway/firewall (ePDG) during the offload from WLAN to the LTE core network
- IMS server for implementing real-world applications such as video and voice telephony
- Message analyzer for recording all protocol messages between the DUT and the WLAN access point or LTE base station

The R&S®CMW500 integrates all of these components into one box to provide efficient test capabilities. Another advantage is the easy detection of discrepancies based on the synchronously running protocol stacks for both technologies.

Customized solutions for protocol stack development and complex functional tests

To integrate LTE and WLAN protocol stacks, the lower protocol layers need to be tested in an early development phase. With the R&S®CMW500 and the R&S®CMWcards GUI, signaling tests can be performed without any special programming knowledge. The MLAPI test scenarios can be used to program more complex tests. The R&S®CMW500 callbox is ideal for reproducible testing – from verifying the DUT's RF characteristics to functional testing. It can also efficiently perform complex tests by analyzing the LTE and WLAN protocol messages.



Efficient signaling tester for the requirements of tomorrow

Short time to market and cost reduction are the perpetual goals of every developer – from chipset development to module integration. The rapid implementation of the latest wireless technologies makes the R&S®CMW callbox a must-have for every R&D lab. Complex tests can be performed easily and with high accuracy with just one contact point thanks to multi-RAT capability, including Bluetooth® and WLAN, the integrated application server and fading simulator.

R&S®CMW callbox for complex functional, mobility and IP throughput tests

When it is necessary to test wireless devices under realistic conditions, examine physical RF parameters and E2E behavior or verify standard-compliant behavior of a DUT, the R&S®CMW callbox is the right solution. The R&S®CMW callbox is a base station emulator. It generates the signaling messaging and connects directly to the DUT. Depending on which technologies are emulated, a wide range of functional, mobility and fading tests can be performed on the DUT, primarily on the physical layer. Add-ons are available for the R&S®CMW callbox for complex IP throughput tests

Leading in LTE – always a step ahead

A single R&S®CMW setup is all that is needed to easily and economically analyze 2CC, 3CC and 4CC setups. All CA scenarios can be used in either FDD or TDD or in FDD/TDD joint operation. The R&S®CMW500 is highly flexible. LTE enhancements such as LTE-U, LTE-D, LTE-MTC and PS-LTE can be rapidly deployed.

To quickly develop the latest devices up to Cat12, Rohde&Schwarz offers R&S®CMWflexx, an extremely flexible high-end solution. The intuitive user interface supports users, e.g. when testing 4 DL CA up to 8x2 MIMO, including internal fading.

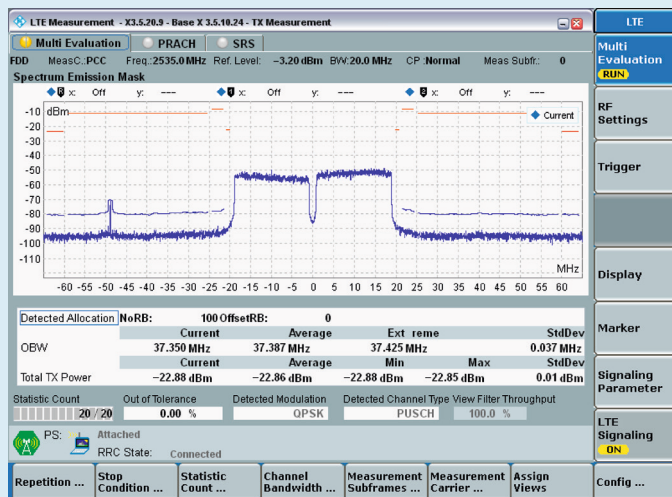
RF parametric tests including fading at the user's fingertips.



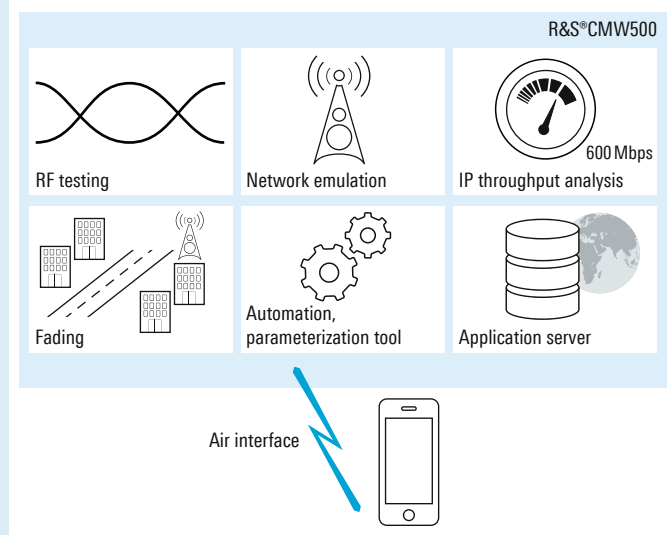
3GPP RF measurements

The design of wireless devices is increasing in complexity as the number of supported technologies and frequencies grows. It is crucial that transmitter and receiver characteristics be assessed for compliance with the 3GPP/3GPP2 standard during the development of chipsets and wireless devices. The R&S®CMW platform offers various solutions for 3GPP/3GPP2 tests.

Intraband contiguous UL CA (carrier aggregation) measurements are possible in addition to standard LTE TX measurements.



Functional blocks of the R&S®CMW callbox



Supported 3GPP/3GPP2 RF TRX functional tests

Technology	TX, RX and performance measurements
LTE/LTA-A (FDD,TDD)	3GPP TS 36.521-1, chapters 6, 7, 8, 9
WCDMA (HSPA/HSPA+)	3GPP TS 34.121-1, chapters 5, 6, 7, 9, 10
GSM (GPRS/EGPRS)	3GPP TS 51.010-1, chapters 12, 13, 14
TD-SCDMA (HSPA, HSPA+)	3GPP TS 34.122-1, chapters 5, 6
CDMA2000® 1xRTT, CDMA2000® 1xEV-DO	3GPP2 C.S0011-D, chapters 3, 4 3GPP2 C.S0033-B, chapters 3, 4

Tests can be automated with a pass/fail verdict using the R&S®CMWrun software tool.

Comprehensive complex RF signaling tests based on Bluetooth® and WLAN

The R&S®CMW is the only platform to deliver all defined Bluetooth® SIG RF signaling tests in combination with other cellular technologies such as LTE-A, WCDMA, GSM, CDMA2000® and non-cellular technologies such as WLAN and GNSS. The R&S®CMWrun automation tool offers solutions for Bluetooth® BR, EDR and LE prequalification tests.

Easy testing of non-ideal signaling using the internal fading simulator

To simulate fading scenarios, 3GPP has defined various fading profiles (pedestrian, vehicular, typical urban, high-speed train, etc.). Using the R&S®CMW platform's integrated fading simulator, the user can dynamically and individually apply 3GPP profiles for the various technologies. This one-box solution makes it easy to assess receiver performance under non-ideal conditions.

These tests can be fully automated with the R&S®CMWrun software to check the devices' MIMO performance under fading conditions.

Easy protocol development and testing of any signaling scenario

The entire ecosystem of wireless devices, from the chipset to the integrated module, requires an extraordinary level of quality assurance when it comes to the functionality of the devices' protocol stack – from the PHY to the IP layer. The R&S®CMW500 protocol tester provides a complete protocol stack reference implementation of various cellular technologies such as LTE, WCDMA, TD-SCDMA, CDMA2000® and GSM. The protocol tester can be flexibly configured and tailored to create any wireless signaling test case for verification and integration of a wireless device protocol stack.

Multitechnology protocol stack testing

2G, 3G, 4G: Developers are having to prepare an increasing number of ever more complex test cases to verify that their integrated mobile device or chipset protocol stacks are specification compliant. In R&D, the R&S®CMW500 provides low-level (LLAPI) and medium-level (MLAPI) script-based programming interfaces as the first choice for compliance testing of mobile phone protocol stacks. Using complex signaling sequences and a comprehensive selection of more than 1500 predefined and industry-proven test cases, the R&S®CMW500 enables customers to reliably stress test the mobile equipment protocol stack in a reproducible lab environment.

Using lower layer tests, developers can integrate RF and physical layers of the protocol stack without using the full layer 3 (NAS, RRC) and higher layers (PDCP, IP). MLAPI simplifies core network emulation and provides a self-configuring dynamic cell setup approach by parameterizing layer 3 (NAS, RRC) message information elements to test all kinds of user equipment states. All protocol layers can be modified in accordance with 3GPP specifications, enabling the user to narrow down root cause issues in their implementation.



The R&S®CMW500 protocol tester in an R&S®CMWflexx, multi-CMW environment offering frequency support up to 6 GHz for features such as LTE-U, LTE-LAA and WLAN/3GPP interworking.

Delivering 3GPP feature requirements at an early stage

The R&S®CMW500 LTE protocol tester supports layer 1 to layer 3 protocol stack implementation based on 3GPP Rel. 8 to Rel. 12, including LTE-A features such as carrier aggregation. In addition to the generally supported LTE bandwidths from 1.4 MHz to 20 MHz, all 3GPP frequency bands in FDD and TDD up to 6 GHz can be used.

For carrier aggregation scenarios, all combinations, contiguous or non-contiguous, up to 4CC in downlink and 2CC in uplink are supported, including antenna configuration for SISO, MIMO or TX diversity. This allows maximum throughput performance tests for wireless devices up to 800 Mbps, meeting today's mobile wireless industry requirements.

- ▮ I/Q over IP mode using software-based tests
- ▮ Digital baseband fading using internal fading simulators
- ▮ Multicell and multi-RAT capability for LTE-A, GSM, WCDMA, CDMA2000®, 1xEV-DO, WLAN

Software tools to support development

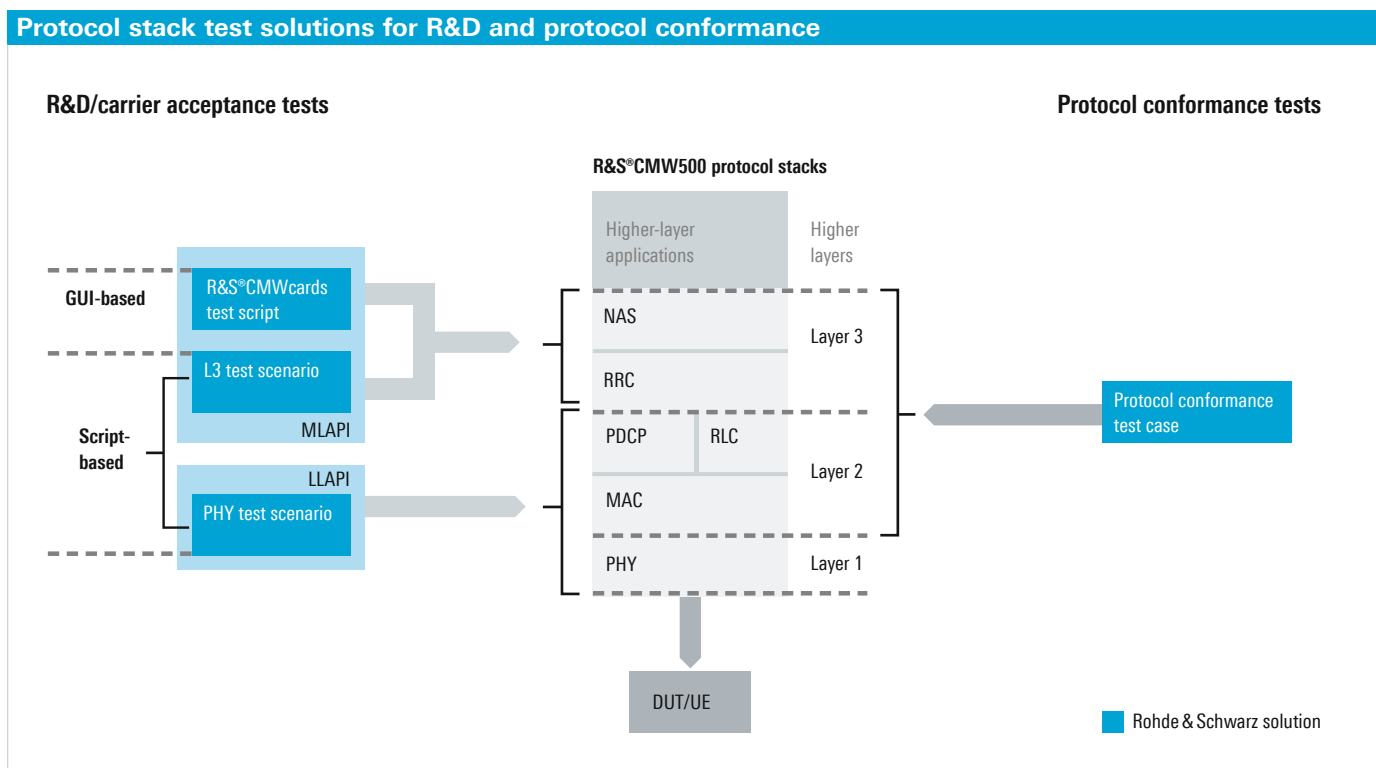
Rohde&Schwarz offers a variety of solutions for the many requirements when developing and testing communications protocols for wireless devices. These are shown in the figure below together with the reference layers of the simplified stack model implemented in the R&S®CMW500.

For protocol requirements, the R&S®CMW500 protocol tester offers a development environment for layer 1 to layer 3 signaling scenarios with automatic configuration of the layers below (LLAPI, MLAPI).

Wireless signaling tests can be simply created with the easy-to-use R&S®CMWcards graphical test script tool – no programming knowledge required.

The R&S®CMWmars message analyzer is designed for automating and analyzing the log files for all layers and all applications.

For protocol conformance requirements, the TTCN-2, TTCN-3 libraries and software tools are available for developing signaling conformance test cases. To speed up test development, the R&S®CMW500 provides an extensive library with preconfigured messages and signaling scenarios.



Tester for GCF and PTCRB certification

Official GCF or PTCRB certification requires the successful execution of a vast number of test cases. Rohde & Schwarz conformance test systems support all relevant RF, protocol and RRM test cases for LTE (FDD/TDD), WCDMA and GSM for fast and successful mobile device certification.

The Rohde & Schwarz conformance test systems are the perfect solution for in-house test labs and test houses. All systems are based on the R&S®CMW platform and can easily be mixed and matched. Thanks to this flexibility, the R&S®CMW platform provides the best possible coverage for conformance test cases. In addition, network operator specific tests and fading scenarios can be performed in line with specific requirements.

Certification scheme for wireless devices

The objective of conformance testing is to provide evidence of wireless device interoperability based on criteria developed by the global standards-making community, such as 3GPP, OMA or GSMA. Organizations like GCF and PTCRB provide the framework for a worldwide recognized wireless device certification scheme by referencing test cases from 3GPP, OMA or GSMA. This standardized certification program provides maximum assurance for wireless device interoperability.

RF conformance tests

Before a wireless device is certified in official test houses, the design can be verified under realistic conditions with a cost-optimized precertification test solution that includes transmitter and receiver tests.

Rohde & Schwarz offers different setups based on the R&S®CMW platform to run LTE-A, WCDMA or GSM tests in parallel:

- R&S®TS8980S-2: fully automated in-band test solution
- R&S®TS8980PRE: in-band and out-of-band RF test cases
- R&S®TS8980FTA-2: fully automated validated RF conformance testing

R&S®CMW platform and the test system family



R&S®CMW500
Signaling and non-signaling
RF tests, protocol conformance,
R&D



R&S®CMWflexx
RF and protocol testing for LTE-A,
e.g. 4 DL CA up to 8x2 MIMO,
including internal fading



R&S®TS8980S-2 plus interferer
Specific network operator tests,
in-band preformance tests

Additionally, the R&S®TS8980 RF test systems support RF tests in line with network operator test plans. These tests take into account special network topology scenarios, additional RF receiver and transmitter requirements and benchmarking of wireless devices.

Protocol conformance tests

The R&S®CMW500 protocol conformance tester is used by all major chipset companies, device manufacturers and test houses to verify and certify the correct signaling behavior of a wireless device. The multi-RAT concept of the R&S®CMW500 enables an industry-leading number of test cases for LTE, WCDMA, TD-SCDMA and GSM.

The R&S®CMW500 protocol conformance tester supports the following standards:

- ▮ LTE TDD/FDD, including 3CC and 4CC
- ▮ GSM, WCDMA and TD-SCDMA
- ▮ WLAN/3GPP interworking
- ▮ IMS protocol conformance
- ▮ LPP, OTDOA and eCID – for DUT positioning
- ▮ Handover testing to legacy RATs, including CDMA2000®

The state-of-the art R&S®CMW500 software tools simplify handling of the protocol tester. The Rohde&Schwarz test case explorer allows customized test campaign management and fully automated testing. Non-compliant signaling behavior can be easily detected with the R&S®CMWmars message analyzer.

RRM conformance tests

Radio resource management includes all procedures for managing radio resources in cellular networks and WLANs. The R&S®TS-RRM is the perfect solution for inter-RAT RRM test cases when developing wireless devices. The conformance test system can run fully automated validated RRM conformance test cases in the design, pre-certification and type approval phases. Network operator specific RRM tests can also be performed.

Highlights of the R&S®TS-RRM test system include:

- ▮ Standalone platform for RRM testing in line with 3GPP specifications for LTE, WCDMA and TD-SCDMA
- ▮ Modular hardware and software structure for combination with the R&S®TS8980FTA RF test system
- ▮ Optimized use of test time
- ▮ Internal fader



R&S®TS-RRM plus multi-RAT
Specific RRM network operator tests,
RRM preformance tests,
3GPP-validated RRM conformance tests



R&S®TS8980PRE out-of-band
Like the R&S®TS8980S-2 plus
out-of-band RF tests



R&S®TS8980FTA-2 plus validated tests
Like the R&S®TS8980PRE plus 3GPP-validated
RF conformance tests

Network operator acceptance testing, including OTA

In addition to certification testing schemes based on GCF and PTCRB, network operators worldwide have launched supplementary test schemes in order to verify compliance with their specific device requirements. Rohde & Schwarz helps leading network operators worldwide define meaningful test requirements and create test plans that are based on these requirements and span all areas – from RF to LBS to end-to-end performance testing.

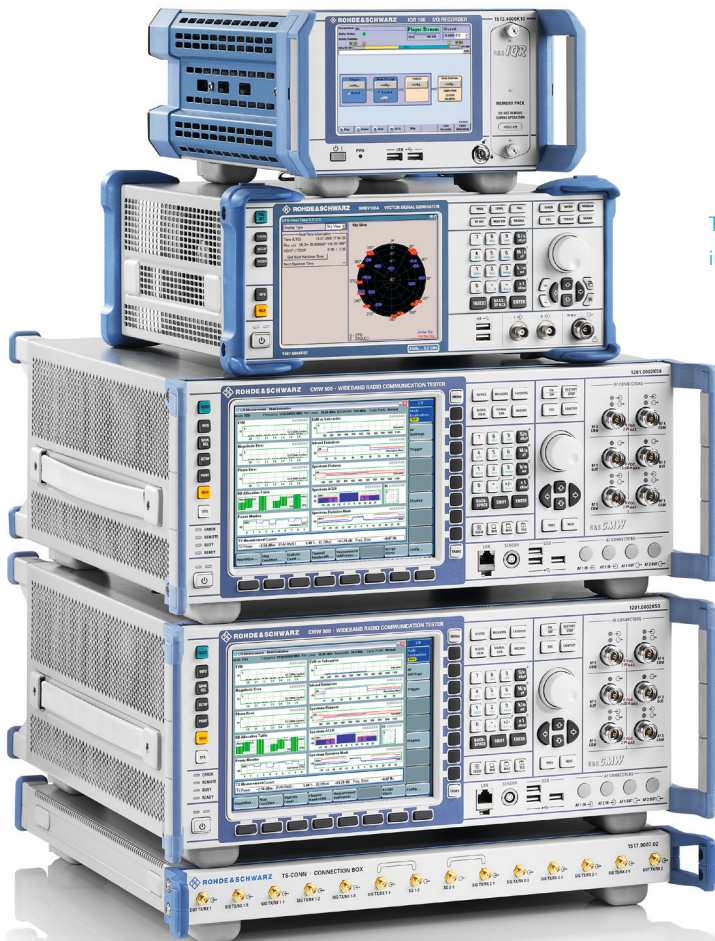
Operator-specific test solutions

Rohde & Schwarz test solutions are approved by operators and cover test requirements in line with latest network operator specifications. The test solutions are used worldwide by network operators, their suppliers and test houses for supplementary carrier-specific testing.

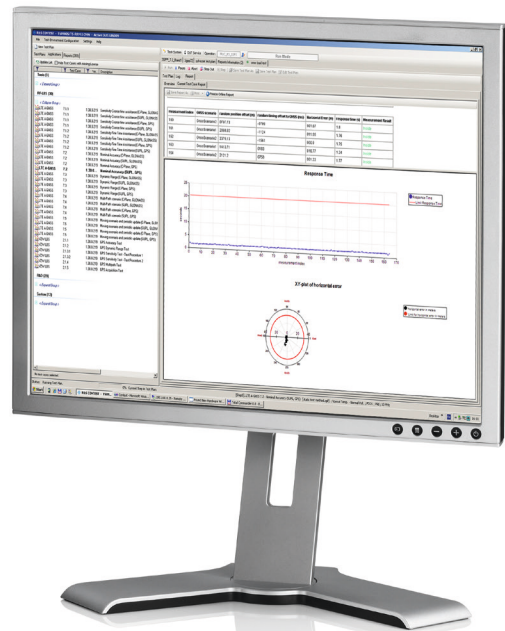
Users appreciate the easy operation and extensive automation possibilities as well as the ability to combine setups for efficient usage – an ideal entry point to network operator acceptance testing. In addition, all Rohde & Schwarz test solutions for network operator acceptance testing are a safe investment since constant updates make them ready for future test needs.

R&S®CMW500 protocol tester for interoperability tests (IOT)

The R&S®CMW500 protocol tester supports supplementary network operator protocol test cases. The compact and scalable setup, starting with one R&S®CMW500 protocol tester, covers all relevant RATs. The convenient automated solution with extensive reporting capabilities meets all network operators' supplementary protocol testing needs.



The R&S®TS-LBS advanced test system including carrier acceptance testing.



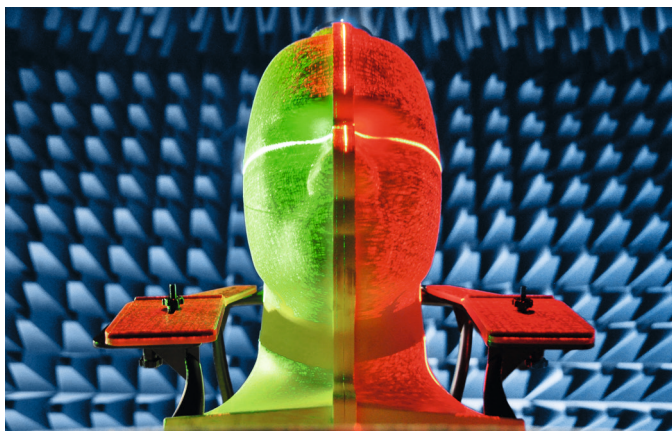
R&S®CMW-ATE for IMS, VoLTE and RCS protocol tests

The R&S®CMW-ATE is an approved test solution for IMS protocol testing, including GSMA IR92 (VoLTE and messaging), IR94 (video/ViLTE) and test cases. The compact R&S®CMW-ATE setup based on a single R&S®CMW500 protocol tester covers all network operators' supplementary test requirements. Dedicated graphical reporting of the application layer allows users to quickly and easily identify potential issues.

R&S®CMW-PQA for performance quality analysis tests

Verification of (end-to-end) performance is one of the key areas of network operators' supplementary testing. The R&S®CMW-PQA supports network operators' test plans for end-to-end data and call performance for different technologies. The basic setup, based on an R&S®CMW500 protocol tester with internal fading, can be easily updated to support multiple RATs and multiple cell scenarios as well as video performance testing and all future performance testing needs.

A phantom head simulates the human influence during OTA measurements.



R&S®TS-LBS for location based service tests

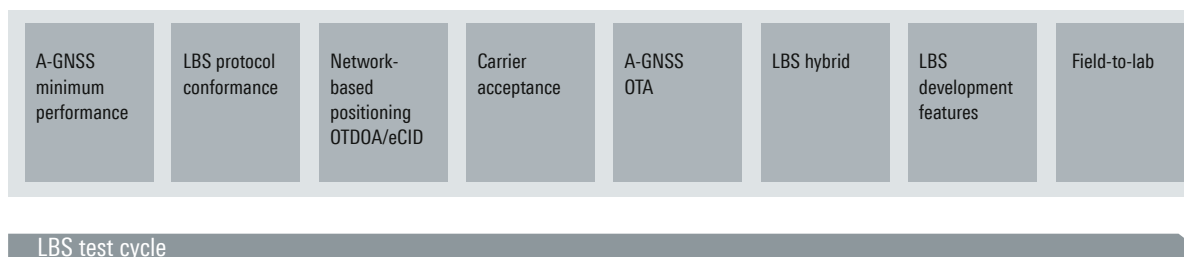
Location based services and their use in various wireless device applications have led to an increasing number of test requirements for wireless devices. In addition to covering 3GPP and OMA test requirements, the R&S®TS-LBS fully supports all network operator specific requirements related to LBS. The modular test solution allows protocol and minimum performance testing for satellite- and network-based positioning technologies. The basic setup for A-GNSS testing can easily be extended to include the powerful field-to-lab solution, which saves users cost and time by bringing real-world scenarios into the lab. The R&S®TS-LBS also supports network-based positioning methods (OTDOA/eCID), including hybrid positioning methods (combination of satellite-based and network-based).

R&S®TS8991 OTA performance test system

The R&S®TS8991 over-the-air (OTA) performance test system measures the spatial radiated antenna pattern and receiver sensitivity of a wireless device inside an anechoic chamber. The R&S®CMW500 provides a communications link to the DUT for setting the required test modes.

OTA standards are specified by network operators, CTIA and 3GPP. The test results qualify the DUT antenna performance under free space conditions and with phantoms. OTA measurements can be executed in different environments: with the compact R&S®DST200 RF diagnostic chamber (precompliance) or the larger wireless performance test chambers (WPTC).

The R&S®TS-LBS provides complete LBS test coverage in all phases



Production solutions for multi-DUT testing

Today's production lines for wireless devices require an optimal combination of flexibility, performance and capacity utilization. As the leading supplier of T&M equipment for the production of wireless devices, Rohde & Schwarz meets these stringent requirements with the R&S®CMW platform. The R&S®CMW500 wideband radio communication tester and the R&S®CMW100 communication manufacturing test set are ideal for use in production.

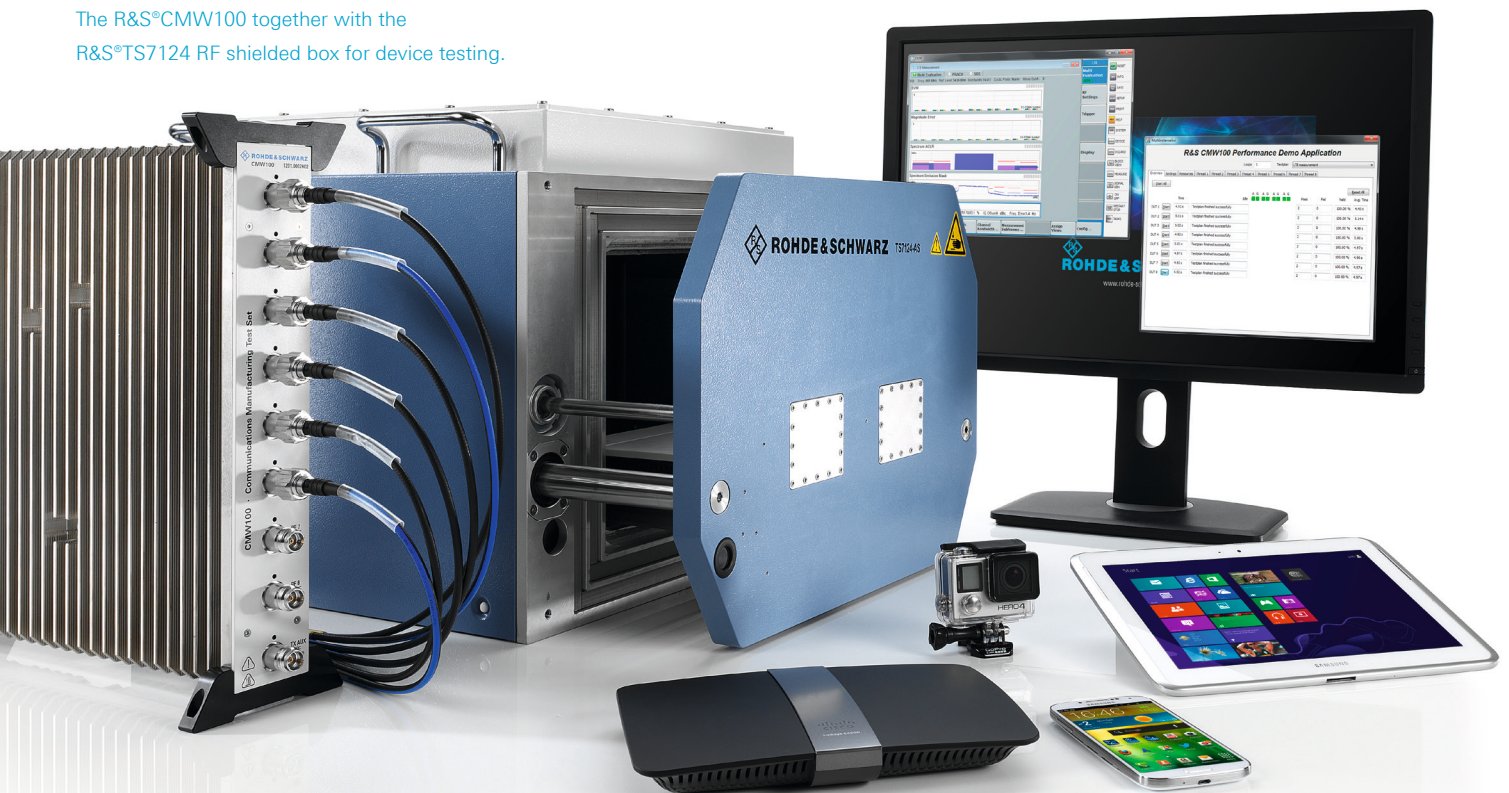
The R&S®CMW500 and the R&S®CMW100 as production test solutions

Smartphones and tablets support an increasing number of technologies and frequency bands. As a result, more transmitters, receivers and antenna paths have to be tested. Advanced production concepts need to take this growing complexity into account while simultaneously lowering costs. The demands on performance, capacity utilization and flexibility of T&M equipment are rising dramatically.

The R&S®CMW500 as a standard production solution meets all these requirements. It is the global market leader for wireless device production tests and is used by nearly every top manufacturer.

The R&S®CMW100 communication manufacturing test set is a new trendsetting product for calibrating and verifying wireless devices. This follow-up to the R&S®CMW500 focuses on production needs.

The R&S®CMW100 together with the R&S®TS7124 RF shielded box for device testing.



The R&S®CMW100 can perform receiver and transmitter tests for cellular and non-cellular technologies. Like the R&S®CMW500, the R&S®CMW100 features high measurement accuracy. The R&S®CMW100 offers parallel testing and can be used to optimize test time and capacity utilization.

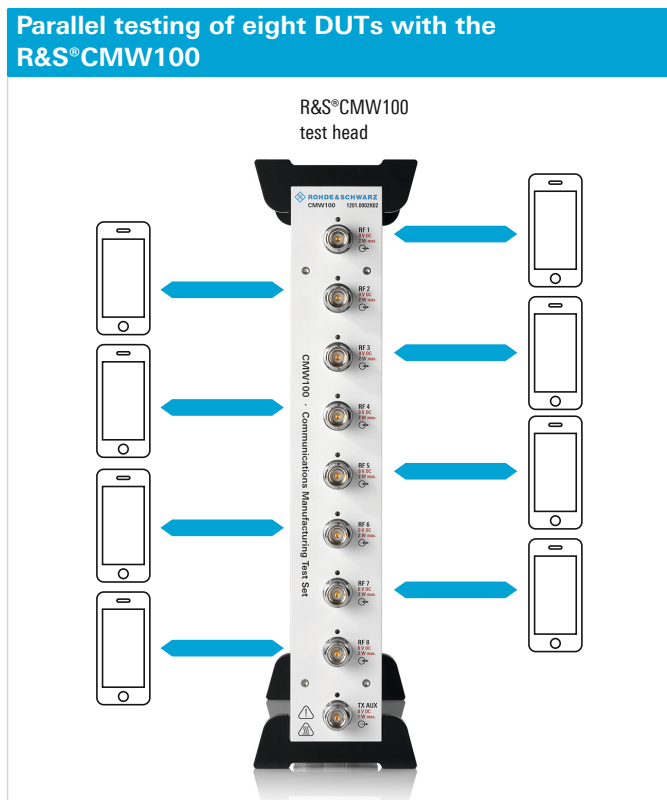
The R&S®CMW100 provides high flexibility in a minimum of space. Based on a new eco-friendly hardware concept, it features extremely low energy consumption and a very compact size. The R&S®CMW100 reduces testing costs and is ideal for use in fully automated robotic production lines.

High efficiency through parallel testing, high measurement accuracy and optimized test times

The R&S®CMW100 can test up to eight RF ports in parallel. It can be mounted either vertically or horizontally. These features offer unprecedented flexibility when designing production lines. The open architecture of the R&S®CMW100 makes it possible to quickly integrate the latest computer technologies, ensuring the best test performance – today and tomorrow.

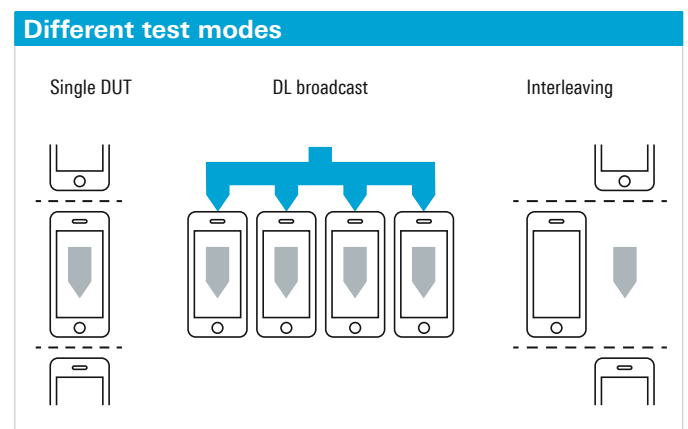
The R&S®CMW100 and the R&S®CMW500 are compatible in terms of remote control and measurement as well as test time optimization and capacity utilization. Test time optimization using DL broadcast and interleaving significantly shortens the time required for calibration and verification as compared to single-DUT testing. Customers can draw on existing implementation experience and considerably reduce development time.

The R&S®CMW100 offers high measurement accuracy as a basis for high production throughput. This accuracy results from the proven, fully automatic level, frequency and temperature compensation concept.



Optimized DUT throughput with the R&S®CMW100

	Single DUT	DL broadcast	Interleaving
Calibration (TX and RX)	100% (benchmark reference)	130%	200%
Verification (TX and RX)	100% (benchmark reference)	400%	150% to 200%



Key facts for the R&S®CMW100 communication manufacturing test set

- Turnkey R&S®CMWrun based production solution for different chipset suppliers
- Continuous frequency range up to 6 GHz
- Multitechnology solution
- Parallel testing on up to eight RF ports
- High measurement performance
- High measurement accuracy
- Support of a wide range of methods for reducing test time and maximizing capacity utilization
- Minimum space requirements and footprint
- Low weight
- Silent
- High MTBF

Benefits of the R&S®CMW100 communication manufacturing test set

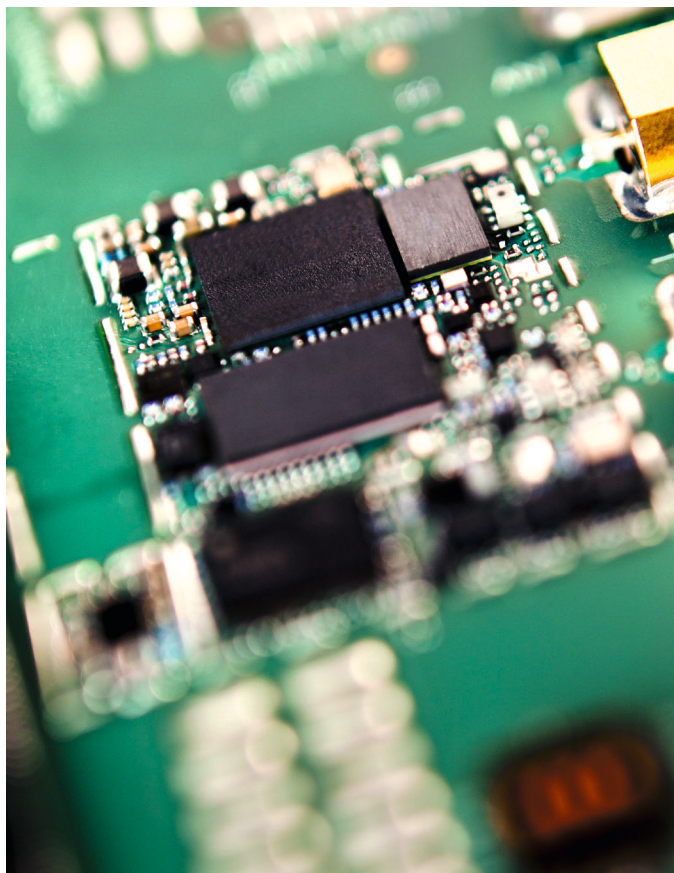
- Grow-as-you-go performance through future-oriented architecture
- High flexibility when designing production concepts thanks to horizontal or vertical mounting
- Short implementation time and ramp-up phase thanks to R&S®CMW500 compatible T&M and remote control concept
- High accuracy and throughput thanks to fully automatic level correction
- Eco-friendly due to minimal space requirements and low energy consumption

Small cell production testing ¹⁾

To more efficiently manage the LTE-A spectrum, many operators use additional small cells. Small cells are low-powered radio access nodes that operate with a shorter range within the licensed and unlicensed spectrum.

The R&S®CMW500 can be used to calibrate and verify transceivers in small cell production lines. The use of one production line for both mobile devices and small cells provides the greatest possible flexibility.

¹⁾ Planned.




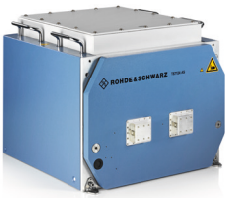

The R&S®CMW100 is ideal for use in fully automated robotic production lines.

One-stop shopping for production, including shielded boxes

Off-the-shelf solutions from one supplier

Rohde&Schwarz offers a complete solution for complex production testing. For signaling and non-signaling tests, Rohde&Schwarz is the ideal supplier for fast and reliable measurements when it comes to radiated environments. The R&S®CMW platform together with RF shielded chambers provides a compact turnkey solution for all production test cases: calibration, verification or functional tests. The wide product portfolio of RF shielded chambers allows flexible configuration to meet customer requirements.

Rohde&Schwarz also provides similar solutions for service and R&D. Different types of shielded chambers are available depending on the user's application.

Shielded boxes from Rohde & Schwarz					
Shielded box	Type	Application	Shielding effectiveness	Dimensions (W x H x D)	Handling
	R&S®CMW-Z10 RF shielded box	R&D, service: radiated measurements	> 80 dB	264 mm x 321 mm x 527 mm (10.4 in x 12.6 in x 20.7 in)	manual
	R&S®TS7124 RF shielded box	Production: radiated power and sensitivity measurements	> 80 dB	400 mm x 450 mm x 480 mm (15.7 in x 17.7 in x 18.9 in), rack integrable	automatic and manual
	R&S®DST200 RF diagnostic chamber	R&D: OTA measurements with automated 3D positioner	110 dB	760 mm x 770 mm x 695 mm (30.0 in x 30.3 in x 27.4 in)	manual

Powerful and cost-effective RF measurements and functional tests

Companies that repair or refurbish large numbers of high-quality wireless devices for resale can use the R&S®CMW platform to help ensure correct installation and/or repair of sensitive RF modules, while simultaneously reducing cost and minimizing test time. The R&S®CMW500 wideband radio communication tester and the R&S®CMW290 functional radio communication tester are ideal for service and logistics applications. Manufacturers of IoT devices use the R&S®CMW platform for functional tests.

Verifying the hardware of wireless devices

While the R&S®CMW500 is suitable for all test applications from R&D to service, the R&S®CMW290 functional radio communication tester is a leaner solution that has been optimized for typical hardware verification task and basic mobile network emulation. The R&S®CMW290 is the right instrument for users who measure fundamental RF characteristics or perform Go/NoGo checks in line with communications standards. It verifies that the DUTs comply with specifications to ensure proper operation and that they do not interfere with other electronic devices.

Automated test environment for high-volume testing

The R&S®CMW platform can be combined with the R&S®CMWrun test sequencer software as a user interface for automated tests to achieve high throughput with minimal personnel cost and a high level of operational reliability.

Comprehensive measurement of wireless devices

Adding the R&S®CMW-Z10 RF shield box and the R&S®CMW-Z11 antenna coupler extends test coverage to include the DUT's antennas and connectors. Since the tester supports all common cellular and non-cellular standards, coexistence interference between standard scan be measured.

The R&S®CMW500 in use in a service center.



Key facts for the R&S®CMW290 functional radio communication tester

- Simultaneous support of all common wireless communications standards – cellular and non-cellular up to 6 GHz on up to two channels
- Calibration of cellular devices using manufacturer-provided software
- Customizable, simple R&S®CMWrun user interface (R&S®CMW-KT050) for efficient test sequence execution
- IP data support using built-in or external custom application servers

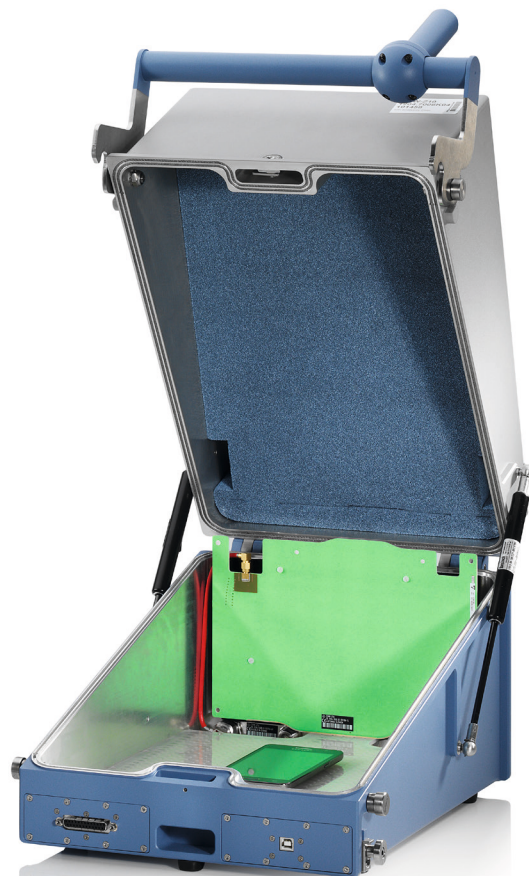
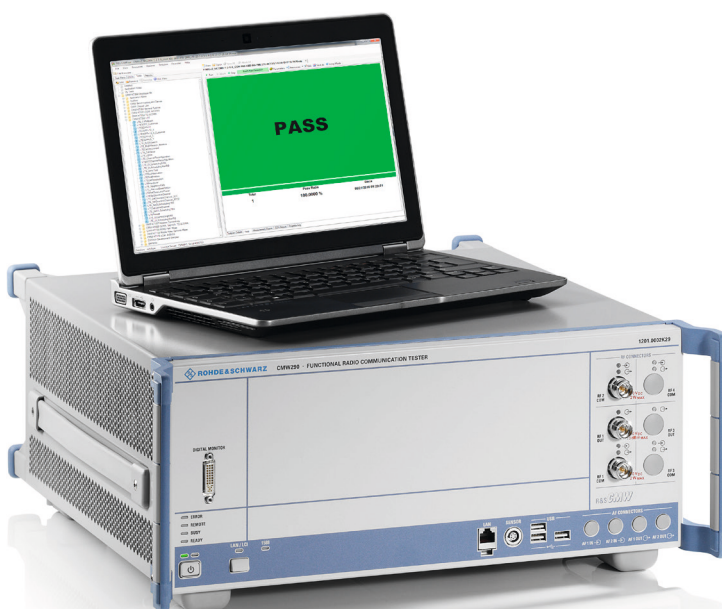
Benefits of the R&S®CMW290 functional radio communication tester

- Improved reliability through comprehensive functional tests for wireless devices
 - Multistandard coexistence tests and measurements
 - Measurements under real-world signaling conditions with clear pass/fail criteria
 - Antenna couplers for extended test coverage
- Simple configuration and operation
 - Configuration instead of programming
 - Fully configurable GUI
 - Integrated web server
- Easy integration into existing IT systems
 - Open interfaces and standard file formats
 - R&S®CMW500 remote compatibility

Functional testing for integrating IoT modules

The R&S®CMW290 is also the ideal solution for basic mobile network emulation and functional testing of integrated wireless modules in IoT communications. Not only can users verify that the RF module was correctly installed in the system, they can also verify that the IP-based applications were correctly configured by connecting the devices client software to built-in server software or forwarding IP traffic to external servers.

The perfect equipment setup for service applications: the R&S®CMW290 functional radio communication tester with the R&S®CMW-Z10 RF shield box and the R&S®CMWrun sequencer software tool for automated measurements.



R&S®CMWrun sequencer software tool

The R&S®CMWrun sequencer software tool is a ready-to-use solution for configuring test sequences by remote control. It can be enhanced with options and used for all standards supported by the R&S®CMW family – for general RF testing, preformance and superior user experience test scenarios. The R&S®CMWrun automation software meets all requirements for executing remote control test sequences on the R&S®CMW500 in R&D, quality assurance, production and service. It can handle the requirements of both current and future wireless devices.






The software engine is based on the execution of test DLLs (plug-in assemblies). This architecture allows easy and straightforward configuration of test sequences without specific programming knowledge of how to remotely control the instrument. It also provides full flexibility when configuring parameters and limits for the test items provided in the standard-specific R&S®CMWrun package options.

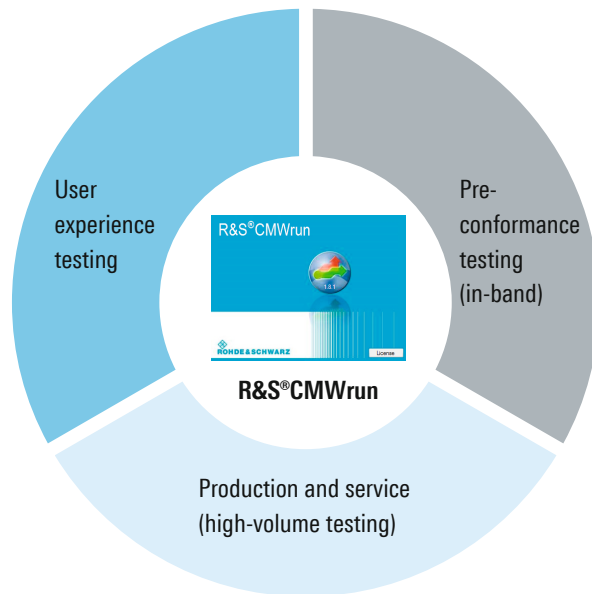
The intuitive graphical user interface makes it simple for users to test wireless devices for compliance with the 3GPP protocols for various technologies.






The applications are diverse. For example, in combined user experience tests, synchronized markers show the IP throughput and current drain at a glance. During analysis, event markers help the user optimize IP throughput and battery life.

At the end of the test, an easy-to-read test report containing limits, test results and verdict is generated. The report is available in CSV, TXT, XML and PDF format.

R&S®CMWrun use cases

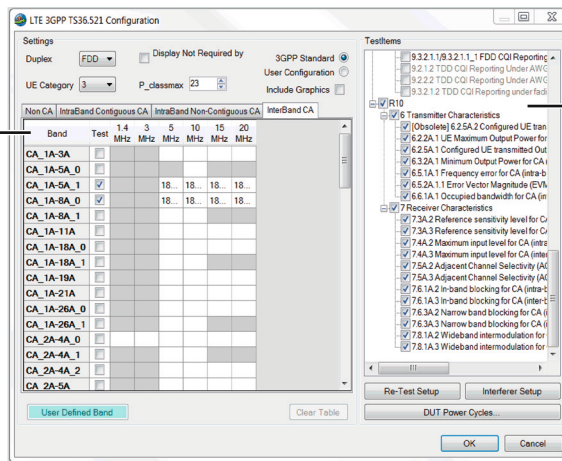
-  **Throughput testing**
-  **Audio performance**
-  **Video analysis**
-  **Battery life testing**
- MIMO** **MIMO performance testing**
-  **Coexistence testing**



- 3GPP** 3GPP TS testing (all technologies)
- 3GPP2** CDMA2000® 1xRTT/1xEV-DO
-  **Bluetooth®**
-  **eCall/ ERA-Glonass**
-  **Basic signaling with different technologies**
-  **Find attenuation routines**
-  **Chipset support in non-signaling mode**

LTE 3GPP RF preformance testing with R&S® CMWrun

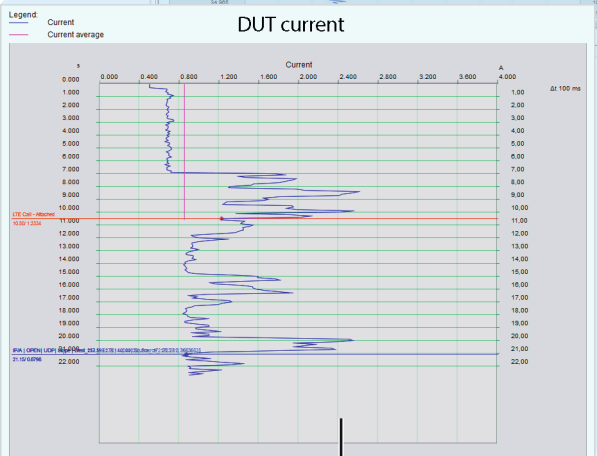
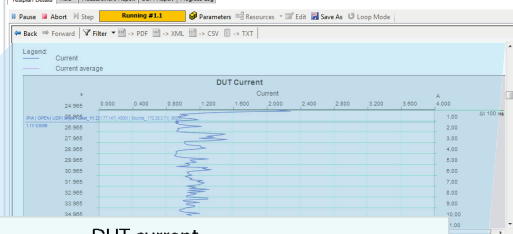
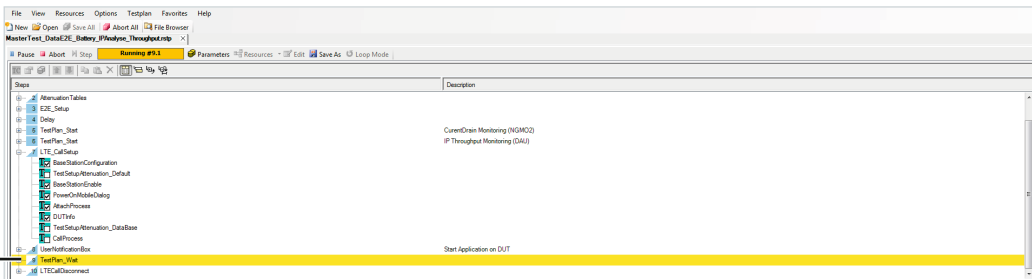
Flexible configuration of
 ■ Band
 ■ Bandwidth
 ■ Channels to be tested



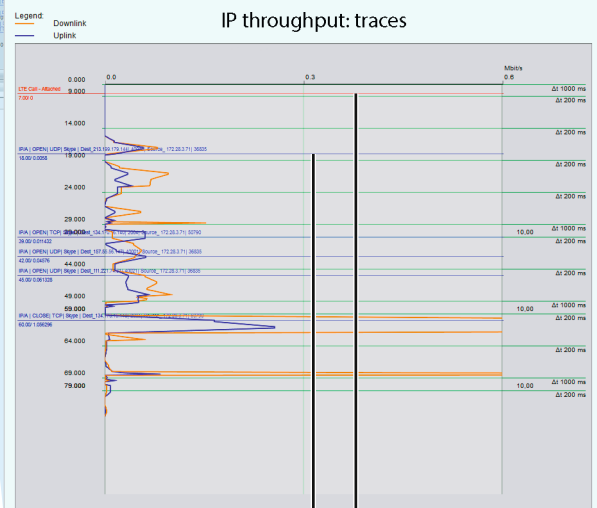
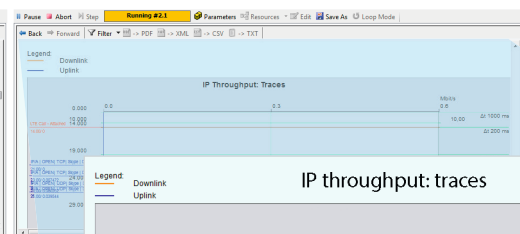
Selection of
 test cases

Battery life and IP throughput testing with IP analysis, fully automated with R&S® CMWrun

Typical test plan for E2E call



Current drain
 monitoring
 over time



Event marker
 showing activity
 at IP layer

Event marker
 showing changes
 in signaling state

R&S®CMWcards signaling and application tester

Smart network emulation for all wireless device tests

The R&S®CMWcards graphical test script definition tool lets users set up the tests they always wanted, but never had time to implement. Wireless signaling and application tests can be created on the R&S®CMW by simply setting up a hand of cards – no programming required.

Revolutionary card wizards and unique game rules guide users through setting up test sequences that fully comply with test specifications. They can rapidly reproduce signaling scenarios for various wireless communications standards.

Applications

- ▀ Protocol stack feature verification
- ▀ Regression testing
- ▀ Replication of field issues
- ▀ Roaming use cases
- ▀ Simulation of network failures and reject causes
- ▀ Data throughput and performance measurements
- ▀ Application tests (data, voice and video)

Testing scope

- ▀ Layer 3 signaling tests for 3GPP LTE (Rel. 8 to Rel. 12), WCDMA, GSM and inter-RAT
- ▀ 3GPP LTE Rel. 10 carrier aggregation
- ▀ LTE-U and LTE-LAA
- ▀ Cell selection, redirections and handovers
- ▀ IMS and VoLTE including CS fallback and SRVCC
- ▀ LTE-WLAN offload
- ▀ Evolved multimedia broadcast multicast service (eMBMS)
- ▀ Failure scenarios
- ▀ CMAS and ETWS public warning system

Key facts

- ▀ Just GUI, no programming, no code compilation
- ▀ Test creation, parameterization, execution and analysis in a single tool
- ▀ Multicell support (up to six independent cells)
- ▀ Logfile and failure cause analysis with the R&S®CMWmars message analyzer
- ▀ Full test script and DUT automation
- ▀ More than 100 sample test cases included

R&S®CMWcards sample scenario for LTE inter-RAT and multicell tests

Test case simulation

Card	MSC	UE	Network
UE	1	UE	
Network	2		Network
UE	3	UE	
Network	4		Network
UE	5	UE	
Network	6		Network

Different views for parameterization and monitoring

R&S®CMWmars multifunctional logfile analyzer

Powerful message analyzer for all R&S®CMW applications and use cases

R&S®CMWmars is the message analyzer for all R&S®CMW signaling applications. Users can efficiently analyze recorded message logfiles or trace information on the fly in realtime while a test is running. The convenient, intuitive R&S®CMWmars user interface combined with various tools and views helps users quickly narrow down the root cause of signaling protocol and lower layer problems. The multifunctional logfile analyzer provides access to all information elements of all protocol layers for LTE, WCDMA, GSM, TD-SCDMA, CDMA2000®, WLAN and Bluetooth®, including the IP layer. It is well-established as the standard analysis tool for customers such as chipset manufacturers, handset manufacturers and network operators as well as for device certification in test houses.

Key facts

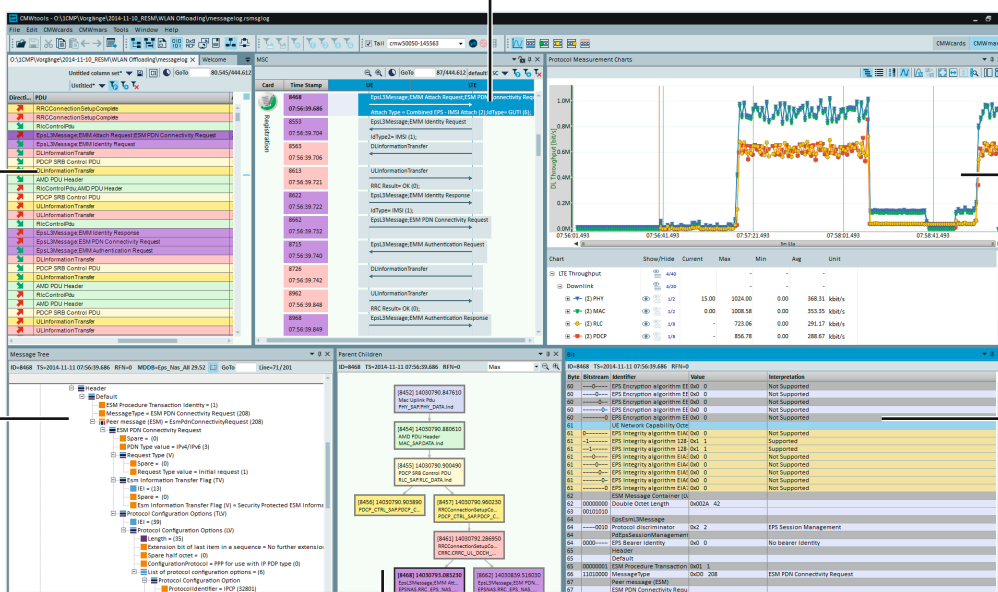
- Access to all protocol stack layers of all wireless technologies, including the IP data layer
- Easiest filtering thanks to optimized GUI usability
- Inline message and message content comparison
- Pass/fail view at a glance
- Smart UE capability view for DUT features at a glance
- Unique graphical timeline view for chronological analysis
- Easy navigation in logfiles with powerful full-text search features and bookmarks
- Realtime display of message flow (online tracing) during test case execution
- Effective graphical protocol measurement charts for throughput and BLER measurements on all layers
- Postprocessing (offline analysis) of recorded message logs
- Powerful scripting interface for automatic logfile analysis using predefined macros

R&S®CMWmars message logfile for a WLAN offload measurement

High-level message flow

Detailed message flow

Decoded information elements



Throughput measurements on all protocol layers

Bit analysis of information elements

Relationship of messages within protocol stack

Glossary

Term	Explanation
2G, 3G, 4G, 5G	second, third, fourth, fifth generation of mobile telecommunications technology
3GPP 3GPP TS 3GPP2	3rd Generation Partnership Project 3GPP technical specification 3rd Generation Partnership Project 2
ACL	adjacent channel leakage
ANDSF	access network discovery and selection function
API	application programming interface
ANQP	access network query protocol
ARB	arbitrary waveform generator
Beidou (BDS)	Chinese satellite navigation system
BLER	block error ratio
Bluetooth®	wireless technology standard for exchanging data over short distances
Bluetooth® SIG	...special interest group
Bluetooth® BR	...basic rate
Bluetooth® EDR	...enhanced data rate
Bluetooth® LE	...low energy
CA	carrier aggregation
CC 2CC/3CC/4CC	component carrier two/three/four component carrier aggregation
CDMA	code division multiple access
CDMA2000® CDMA2000® 1xRTT CDMA2000® 1xEV-DO	family of 3G mobile technology standards ...one times radio transmission technology ...one times evolution-data optimized
CMAS	commercial mobile alert system
CMMB	China mobile multimedia broadcasting
CTIA	The Wireless Association (formerly: Cellular Telephone Industries Association)
CW	continuous wave
D2D	device to device
DAU	data application unit
DASH	dynamic adaptive streaming over HTTP
DL	downlink
DLL	dynamic link library
DPI	deep packet inspection
DRX	discontinuous reception, the power saving mode in LTE
DUT	device under test
DVB-T	digital video broadcasting – terrestrial
E2E	end to end
eCall	European emergency call system
eCID	enhanced cell ID
ePDG	evolved packet data gateway
ETWS	earthquake and tsunami warning system
EVM	error vector magnitude
FDD	frequency division duplexing
FTP	file transfer protocol
GCF	Global Certification Forum
Glonass, ERA-Glonass	Russian system for satellite-based navigation, Russian automated emergency call system
GNSS, A-GNSS	global navigation satellite system, assisted GNSS

Term	Explanation
GPRS EGPRS	general packet radio service enhanced GPRS
GPS	global positioning system
GSM	global system for mobile communications
GSMA	GSM Association
GUI	graphical user interface
HDMI™	high definition multimedia interface
HSPA HSPA+	high-speed packet access evolved HSPA
HTTP	hypertext transfer protocol
IEEE	Institute of Electrical and Electronics Engineers
IMEI	international mobile equipment identity
IMS	IP multimedia subsystem
In-device coexistence	requirement to simultaneously operate multiple collocated radio systems with their antennas in a single communications device
IOT	interoperability test
IoT	Internet of Things
IP	Internet protocol
iPerf	freeware for measuring the throughput of a network
IVS	in-vehicle system
I/Q	in-phase and quadrature
LLAPI	low-level application programming interface
LBS	location based services
LPP	LTE positioning protocol
LTE	long-term evolution
LTE-A	LTE-Advanced
LTE-B	LTE Broadcast
LTE-D	LTE direct
LTE-D2D	LTE device to device communication
LTE-FDD	LTE frequency division duplex
LTE-LAA	LTE license assisted access
LTE-MTC	LTE machine-type communication
LTE-TDD	LTE time division duplex
LTE-U	LTE-Unlicensed
PS-LTE	public safety LTE
ViLTE	video over LTE
VoLTE	voice over LTE
M2M	machine to machine
MAC	medium access control (L2 in the OSI model)
MBMS eMBMS	multimedia broadcast multicast services evolved MBMS
MHL	mobile high-definition link
MIMO	multiple input multiple output
MLAPI	medium-level application programming interface
MOS	mean opinion score
MS	mobile station
MSD	minimum set of data (vehicle data)
MTBF	mean time between failures
NAS	network attached storage
OMA	Open Mobile Alliance
OSI model L1, L2, L3, ... L7	open systems interconnection model different layers of the OSI model
OTA	over the air
OTDOA	observed time difference of arrival
OTT	over the top

Term	Explanation
PS	public safety
PSAP	public-safety answering point
PDCP	packet data convergence protocol
PESQ	perceptual evaluation of speech quality
PHY	physical layer (L1 in the OSI model)
POLQA	perceptual objective listening quality assessment
PSNR	peak signal-to-noise ratio
PTCRB	PCS type certification review board
QoE	quality of experience
QoS	quality of service
RAN	random access network
R&D	research and development
RAT inter-RAT or IRAT multi-RAT	radio access technology inter-radio access technology multi-radio access technology
RF	radio frequency
RLC	radio link control
RRC	radio resource control
RRM	radio resource management
RX	receiver
SISO	single input single output
SNR	signal-to-noise ratio

Term	Explanation
SRVCC	single radio voice call continuity
SSIM	structural similarity
SUPL server	secure user plane location server
T&M	test and measurement
TDD	time division duplexing
T-DMB	terrestrial digital multimedia broadcasting
TD-SCDMA	time division synchronous code division multiple access
TRX	transceiver
TTCN-2/TTCN-3	testing and test control notation
TX	transmitter
UDP	user datagram protocol
UE	user equipment
UL	uplink
WCDMA	wideband CDMA
WEA	wireless emergency alert
WLAN	wireless local area network
WLAN traffic offload	transparent rerouting from a cellular standard to WLAN
WPTC	wireless performance test chamber
ZigBee	IEEE 802.15.4-based specification for personal area networks
Z-wave	wireless communications specification for home automation (IoT)

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R&S®CMW Wideband Radio Communication Tester

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