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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



Product Brochure
Version 05.00

ROHDE&SCHWARZ
Make ideas real



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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 test and measurement 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 – a reliable partner for wireless test solutions

Rohde&Schwarz has long been a pioneer in the development of test and measurement solutions for the wireless communications market. As the market leader in test and measurement 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, healthcare, smart home and other IoT segments.

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 in combination with with the R&S®CMX500 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 for devices in the FR1 frequency bands. The R&S®CMP200 is optimized for production of 5G FR2 products (mmWave).

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

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
- WLAN, Bluetooth®

3 LTE-Advanced
- 8 DL CC up to 4x4/8x2 MIMO fading, 2 UL CA
- FDD/TDD joint operation, 1024QAM DL
- LTE-U/LTE-LAA, LTE-D, LTE-D2D, eMTC, C-V2X

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
- Supported technologies
  - Cellular
  - Bluetooth®
  - WLAN
  - IEEE 802.15.4 (ZigBee)

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. The R&S®CMW500 includes a fully integrated end-to-end (E2E) data solution that permits comprehensive IP throughput and quality measurements. 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®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®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.



R&S®CMX500

The 5G NR signaling tester

The R&R®CMX500 radio communication tester is the test platform for signaling tests in all 5G frequency bands: sub6 GHz (FR1) and mmWave (FR2). In non-standalone (NSA) mode, the R&S®CMW500 supports legacy technologies in mixed operation with LTE.



R&S®CMP200

The mmWave (FR2) production tester

The R&S®CMP200 radio communication tester consists of a vector signal analyzer and a generator for RF frequencies from 4 GHz to 20 GHz. Together with the R&S®CMPHEAD30 remote radio head up/downconverter for the higher frequency ranges (mmWave), it forms a compact non-signaling test platform for production testing of 5G FR2 products.



R&S®CMW100

The sub6 GHz (FR1) 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 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 test and measurement tasks.

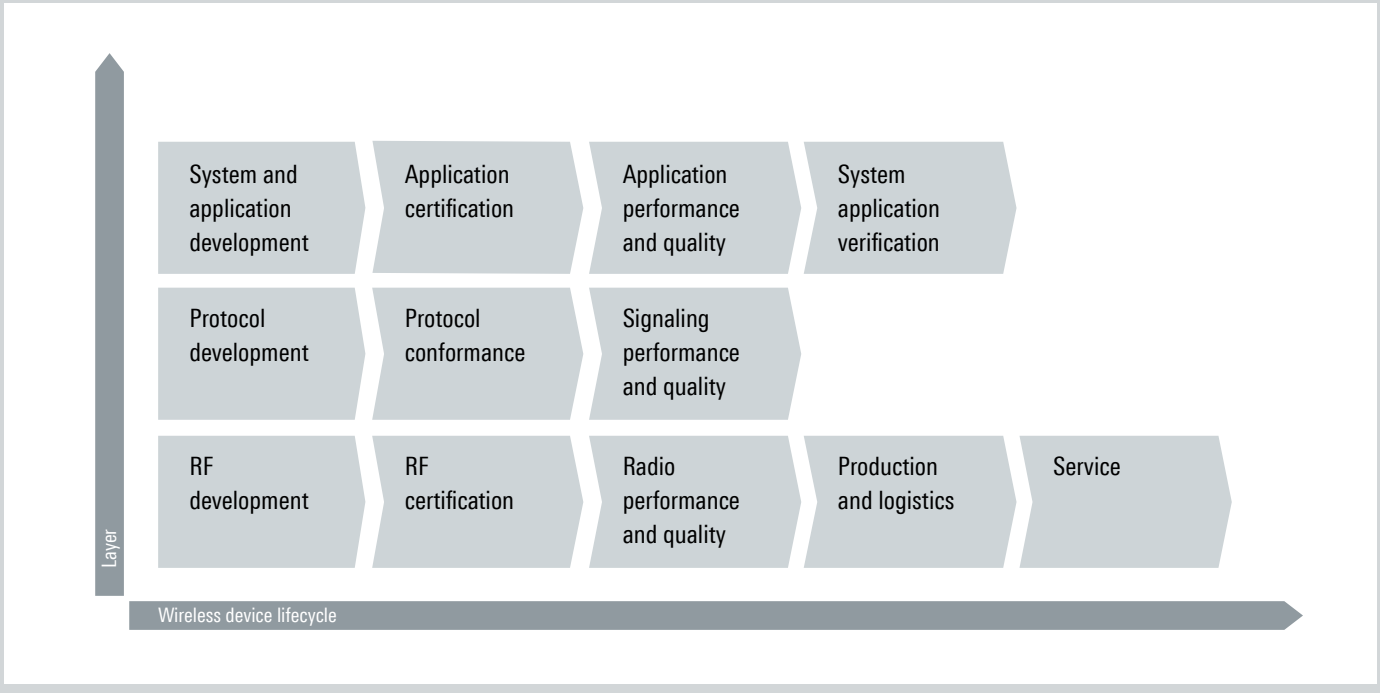
Tests for all layers of the OSI model

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, LTE and 5G NR, 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

5G NR test and measurement

Solutions for non-standalone (NSA) and standalone (SA) mode

E2E communications testing

User 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 RF conformance measurements with R&S®CMWrun



Battery life testing

Test of DUT current drain

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

Inter-RAT and roaming solutions

Simple device tests (from RF to protocol) during transitions from one technology to another and simulation of 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 wireless 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. In combination with the R&S®CMX500, even 5G NR signaling tests in non-standalone mode with LTE and other legacy technologies can be supported.

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

	RF generator	RF analyzer	Network emulation	Protocol testing	E2E application testing	Fading support
Cellular technologies						
5G NR	•	•	•	•	•	•
LTE-A	•	•	•	•	•	•
WCDMA/HSPA+	•	•	•	•	•	•
GSM/GPRS/EGPRS	•	•	•	•	•	•
eMTC	•	•	•	•	•	
NB-IoT	•	•	•	•	•	•
C-V2X	•	•	•	•	• [1]	
CDMA2000® 1xRTT, CDMA2000® 1xEV-DO	•	•	•	• (inter-RAT LTE)	•	•
Non-cellular technologies						
WLAN IEEE 802.11 a/b/g/n/ac/ax	•	•	•	• (offloading use cases)	•	•
Bluetooth® (BR/EDR/LE)	•	•	•			
IEEE 802.15.4 (ZigBee)	•	•				
Broadcast technologies						
GNSS (GPS, GLONASS, Beidou)	•					
DVB-T	•					
T-DMB	•					
CMMB	•					

[1] Requires additional external software from partner.

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.

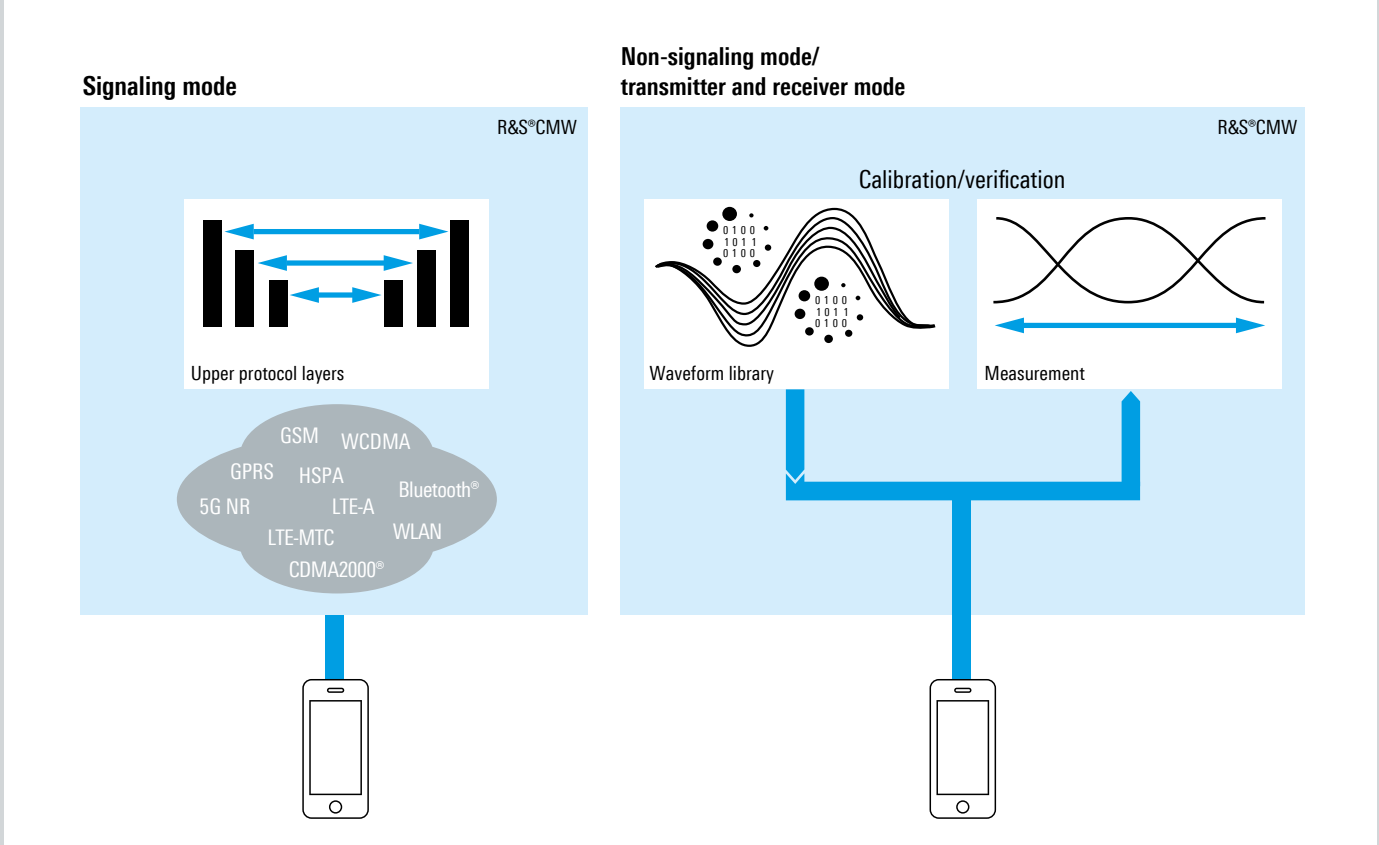
The R&S®CMW can be used to test handover within a technology or between technologies. Separate LTE and WLAN signaling allows detailed analysis of LTE WLAN traffic offload. A simple setup suffices for all phases – from protocol development to functional testing.

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 test and measurement 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



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 (E2E traffic), the number of bytes (IP) consumed per app and the impact on the battery life.

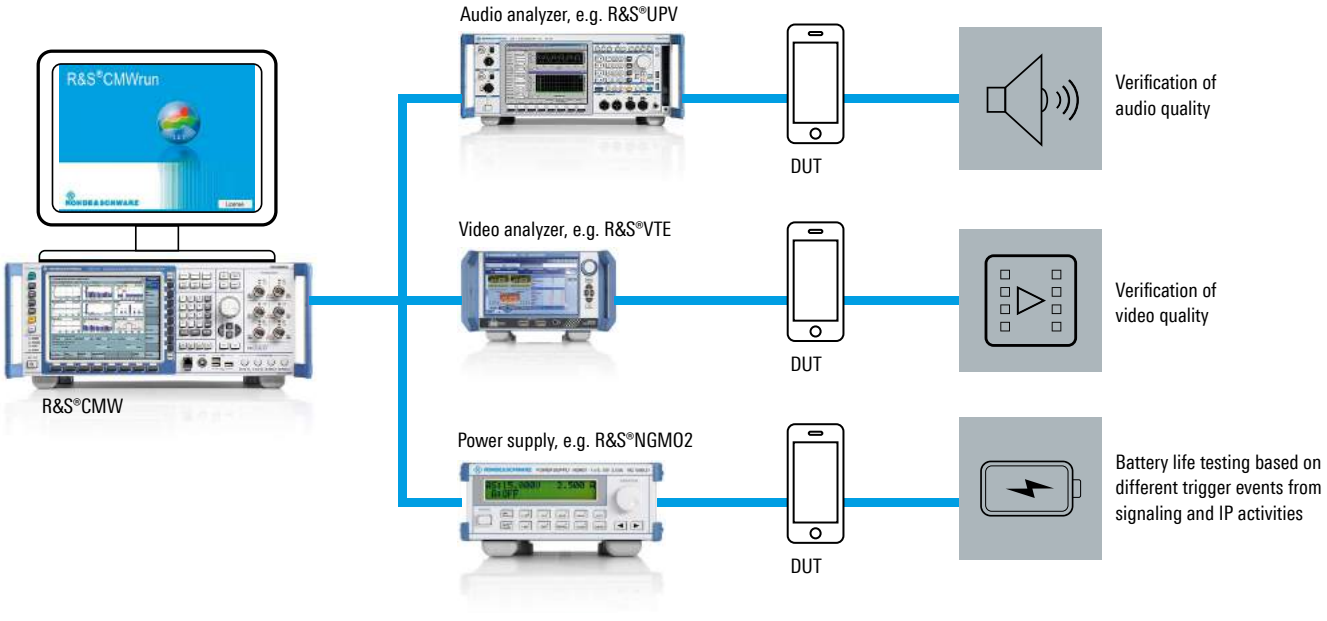
VoLTE/VoWLAN audio and performance testing

To ensure a consistently high QoS, network operators roll out VoLTE services for voice and video telephony in their networks and voice over WLAN (VoWLAN) to provide seamless multimedia service coverage within buildings. The audio quality of VoLTE, VoWLAN and legacy standards (GSM, WCDMA, CDMA2000®) depends on several network and DUT factors. A key technology for integrating voice services in a LTE or WLAN network is the IP multimedia subsystem (IMS). IMS offers a framework that supports IP based multimedia services. The R&S®CMW500 wideband radio communication tester comes with everything needed to test voice and video call mechanisms on mobile devices – from the access technologies to all necessary servers, e.g. an internal IMS server. It tests the handover between LTE and WLAN as well as legacy standards for single radio voice call continuity (SRVCC). With its integrated audio board, the R&S®CMW supports all important codes, including the new audio codec enhanced voice service (EVS) that is a key milestone on the road to high-quality audio connections (see blue box on next page).

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, WCDMA/HSPA, GSM and WLAN. Complex measurements are needed for services such as LTE Broadcast (eMBMS).

User experience testing scenarios



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. Such 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®CMW500/R&S®CMWrun user experience testing for all technologies

	Features/conditions	Metrics
Throughput testing		
	Upload/download iPerf/FTP/UDP Browsing/streaming IP impairments and fading	Throughput monitoring over time IP events over time (IP analysis) Throughput versus modulation coding schemes BLER versus modulation coding schemes
Audio performance		
	E2E voice quality VoLTE/circuit-switched Handovers, incl. SRVCC IP impairments and fading Real vocoding	Loopback Voice quality/performance (MOS: POLQA/PESQ) Audio delay (ms) Acoustical measurements
Video analysis		
	Streaming (HTTP streaming server/DASH) Video call, incl. ViLTE (IR94) IP impairments and fading	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		
	By voice, video, data By defined profile With signaling and IP event markers	Power consumption (mW) Current drain (mA) Estimated battery life (h)
Coexistence testing		
	WLAN RX desensitization LTE RX desensitization	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.

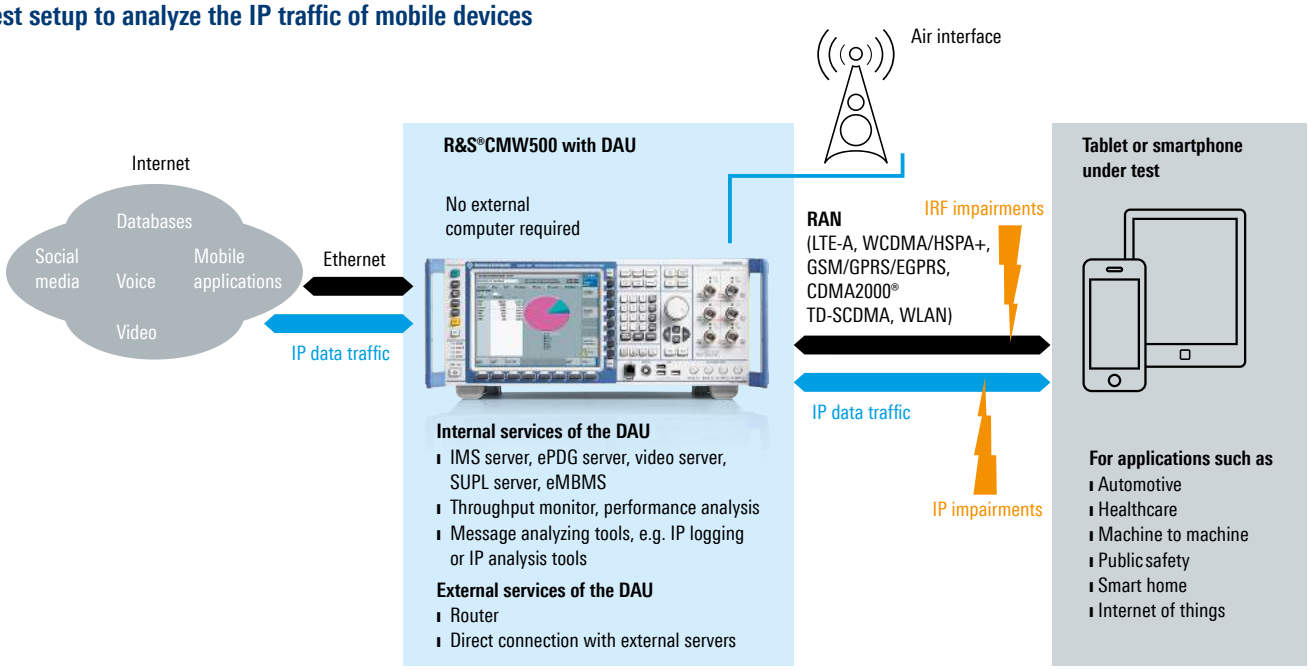
IP application testing under fully controlled network conditions

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.

Test setup to analyze the IP traffic of mobile devices



EMERGENCY SERVICES TESTING AND TRAFFIC ANALYSIS

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 lives.

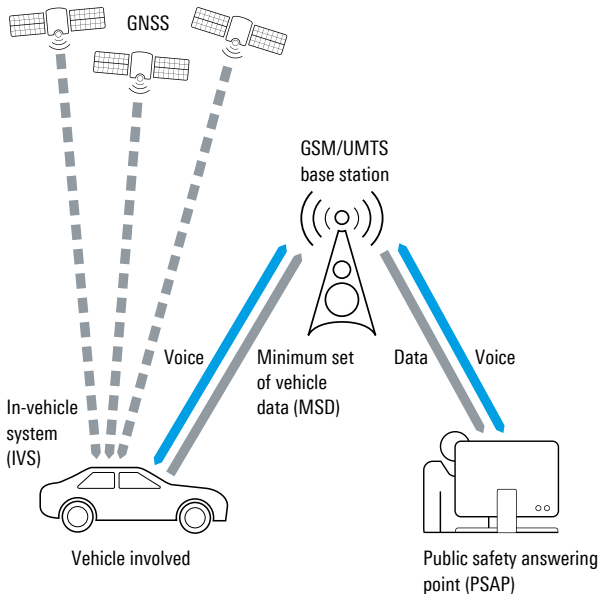
Testing emergency call in a laboratory environment

The R&S®CMW500 can be used to simulate a real network environment in the lab to test wireless emergency calls. 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 are mandatory in all new vehicle models. Rohde&Schwarz supports manufacturers by offering a standard-compliant test solution for the wireless and GNSS-capable components of ERA-GLONASS and eCall in-vehicle systems.

eCall/ERA-GLONASS data transfer principle principle



This test solution from Rohde&Schwarz is a future-ready investment, not just for legacy eCall but also for LTE and IMS based next generation eCall (NG eCall) system testing. The available extension for next generation eCall allows you to prepare today for future LTE and IMS based eCall systems for vehicles. This easy-to-use test solution is based on the R&S®CMW500 and the R&S®CMWrun sequencer software tool and can be extended by adding an R&S®SMBV100 to support GNSS testing of eCall modules as well.

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. 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. 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 Release 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, adjacent channel leakage (ACL) and power control. These measurements can be automated using the R&S®CMWrun sequencer software tool.

RELIABLE C-V2X TESTING IN A LAB ENVIRONMENT

Testing self-driving vehicles in road traffic is complex and expensive. In the development phase, reliable test solutions are needed for carrying out tests in the lab. The R&S®CMW platform helps prove that the C-V2X devices work as required.

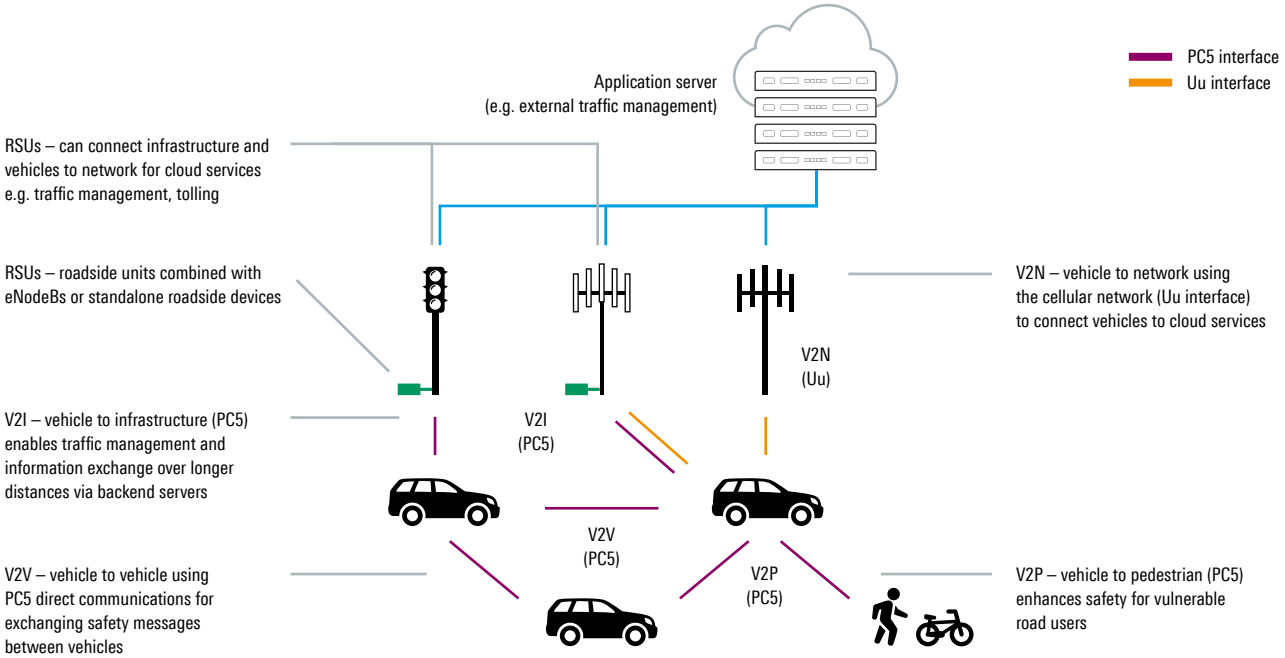
Driver assistance systems

For several years, automobile manufacturers and government agencies have sought ways to increase road safety, manage traffic efficiently and, in the future, make it more comfortable by realizing self-driving vehicles. Vehicle-to-everything (V2X) is a new generation of information and communications technologies that connect vehicles to everything. It is designed to offer low-latency vehicle-to-vehicle (V2V), vehicle-to-roadside infrastructure (V2I) and vehicle-to-pedestrian (V2P) communications to implement a new dimension in future driver assistance systems.

Communications standard for self-driving vehicle communications

Cellular V2X (C-V2X) as a candidate communications standard was initially defined as LTE V2X in 3GPP Release 14 and uses LTE technology as physical interface for communications. The standard describes two modes. In the device-to-device mode (V2V, V2I, V2P), also known as sidelink communications or direct communications over PC5, C-V2X does not necessarily require a network infrastructure. It can operate without a SIM, without network assistance and uses GNSS as its primary source of time synchronization. The second mode describes device-to-network (V2N) communications, also known as the Uu

V2X communications



interface using traditional cellular links, e.g. 4G LTE or soon 5G NR to enable cloud services to be part of the E2E solution e.g. to receive information about road conditions and traffic in the area.

With the first commercial deployment of C-V2X communications technology based on 3GPP Release 14, testing the system performance only by field testing in a real-world environment can easily become time-consuming, costly and very challenging. Test solutions for the development phase are needed to verify compliance with the standards and to ensure that especially direct PC5 communications allow highly reliable exchange of time sensitive and safety relevant information.

C-V2X testing with the R&S®CMW platform

For mobile devices, for instance, the radio interface must be checked to see whether regulatory requirements are met, and it must be verified whether the device uses the protocols provided in accordance with the standards. With the R&S®CMW platform, Rohde&Schwarz meets these needs and enables the automotive industry to bring C-V2X enabled cars to the market.

Production testing

The R&S®CMW100 and R&S®CMW500 offer dedicated measurement and waveform options for C-V2X for production testing using multiple test scenarios to verify transmission and reception of C-V2X direct communications (PC5) based on 3GPP Release 14.

The Global Certification Forum (GCF) specifies protocol conformance tests for C-V2X device certification based on the 3GPP Release 14 specification for direct communications specifications.

Protocol conformance testing

Rohde&Schwarz is the first test and measurement equipment manufacturer to meet the GCF test platform approval criteria (TPAC) for C-V2V protocol conformance testing. The certified solution brings together established Rohde&Schwarz hardware platforms and additional software. The R&S®CMW500 protocol tester offers a ready to use test package for 3GPP protocol conformance tests from LTE-V2V GCF work item 281 and LTE-V2X GCF work item 282. Additionally, a dedicated software package provides features to verify data transmission and reception over the PC5 interface in ideal, faded and congested channel conditions. Together, these packages enable the R&S®CMW500 to support C-V2X device testing through all protocol layers.

Application testing

The platform also supports comprehensive C-V2X E2E application test capabilities with the R&S®CMW500 providing an interface to an industry-leading test tool from a third-party automotive test tool vendor. With this approach, the solution offers simulation of C-V2X scenarios in a lab environment and allows reliable and repeatable E2E application tests for C-V2X covering all layers, including region-specific ITS protocol stacks for the EU, USA and China.

The test station can emulate a large number of vehicles to simulate real-world scenarios such as road intersections and congestion on a highway, allowing the user to verify their feature using C-V2X communications or to stress test the DUT with reproducible conditions in a lab environment.

The designed solution supports all common automotive bus systems such as CAN, LIN, MOST, FlexRay™ and automotive Ethernet so users can analyze or stimulate the ECU within an entire system from their desk and configure and run traffic scenarios to verify their C-V2X application.







Production testing	Conformance testing	Application testing
R&S®CMW100 (model K06)	R&S®CMW500 protocol tester + R&S®SMBV100A	R&S®CMW500 protocol tester + R&S®SMBV100B + CANoe.car2x

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 internal interferer signal.

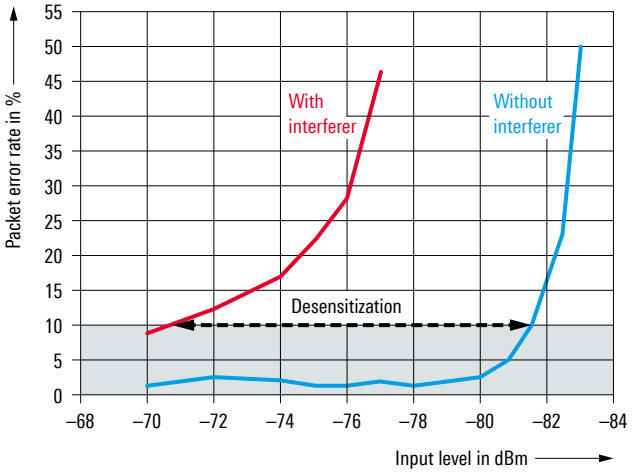
For standard sensitivity tests, measuring the receiver error rate has been adopted as the evaluation criterion. The packet error rate (PER) is measured for WLAN, for example.

Coexistence measurements with the R&S®CMW500

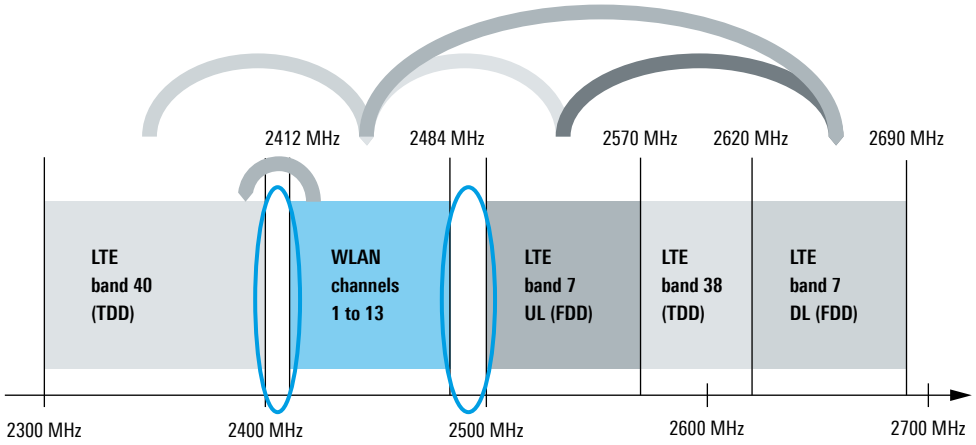
The R&S®CMW500 is ideal for coexistence measurements. It provides signaling for both cellular and non-cellular technologies. It can operate two different wireless systems in parallel and can define the relative RX sensitivity measurements. In combination with a shielded chamber (e.g. R&S®TS7124 RF shielded 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.

In-device coexistence testing, RX sensitivity



Possible interference between WLAN and LTE



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:

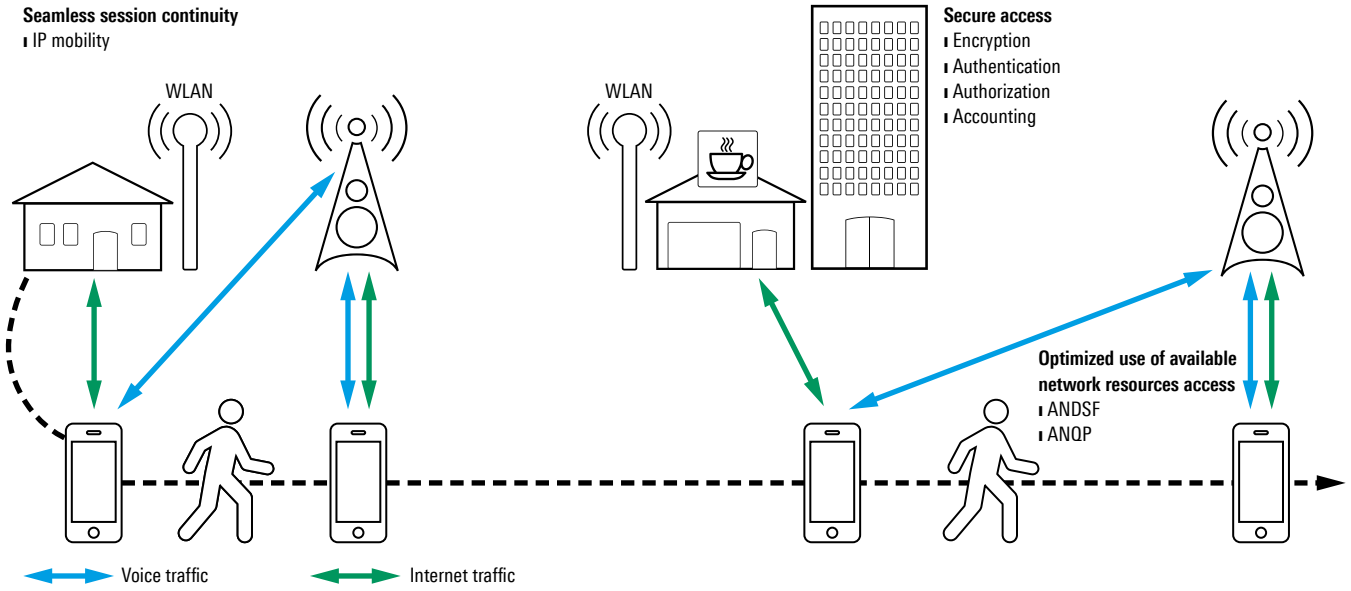
- Emulated LTE base station, including the LTE core network
- Emulated WLAN access point
- Gateway/firewall (ePDG) during the offload from WLAN to the LTE core network
- IMS server for implementing real-world applications such as video and voice telephony
- Message analyzer for recording all protocol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

Traffic offload principle



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 research and development 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 up to 8CC 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 Cat21, Rohde&Schwarz offers R&S®CMWflexx, an extremely flexible high-end solution. The intuitive user interface supports users, e.g. when testing 8 DL CA up to 4x4 MIMO, including internal fading. In combination with the R&S®CMX500, even 5G NR signaling tests in non-standalone mode with LTE and other legacy technologies can be supported.



The R&S®CMX500 radio communication tester (bottom) is the new test platform for signaling tests in all 5G frequency bands. It works together with the tried and tested R&S®CMW500 tester (top) to support mixed operation with LTE (5G NSA).

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.

Supported 3GPP/3GPP2 RF TRX functional tests

Technology	TX, RX and performance measurements
5G NR (EN-DC)	3GPP TS 38.521-3, chapters 6, 7
LTE/LTE-A (FDD, TDD)	3GPP TS 36.521-1, chapters 6, 7, 8, 9
NB-IoT/eMTC	3GPP TS 36.521-1
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

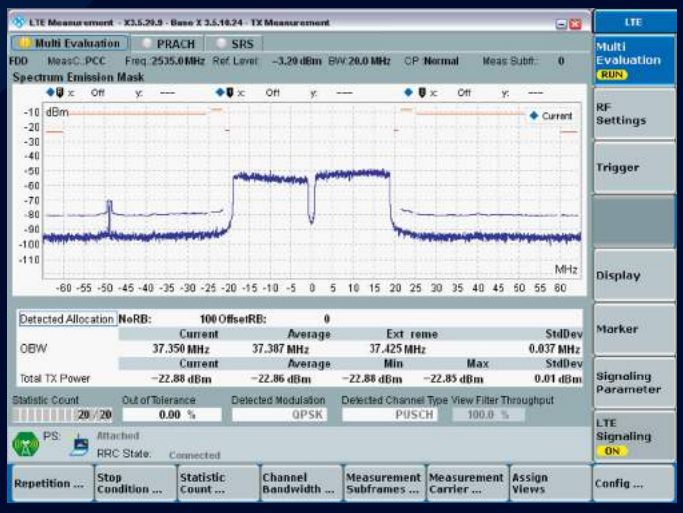
The R&S®CMW is the only platform to deliver all defined Bluetooth® SIG RF signaling tests in combination with other cellular technologies such as LTE-A, WCDMA, GSM, CDMA2000® and non-cellular technologies such as WLAN and GNSS. The R&S®CMWrun automation tool offers solutions for Bluetooth® BR, EDR and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

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

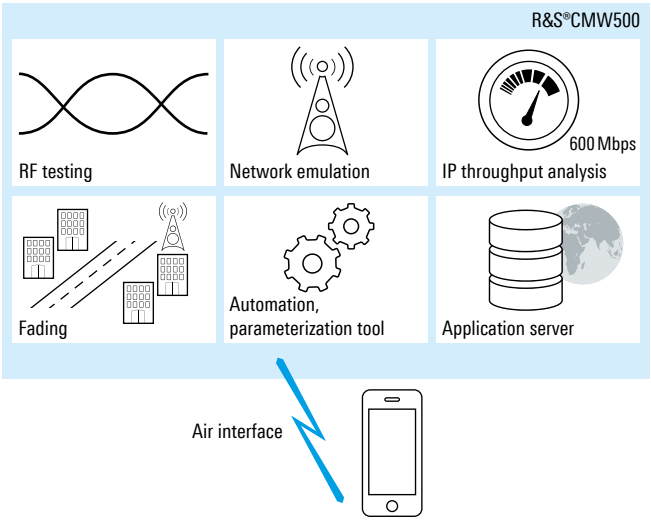
To simulate fading scenarios, 3GPP has defined various fading profiles (pedestrian, vehicular, typical urban, high-speed train, etc.). Using the R&S®CMW platform's integrated fading simulator, the user can dynamically and individually apply 3GPP profiles for the various technologies. This one-box solution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

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



Functional blocks of the R&S®CMW callbox



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 as well as cellular IoT, eMTC and NB-IoT. 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 research and development, the R&S®CMW500 provides 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 users 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 Release 8 to Release 15, 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 8CC in downlink and 6CC in uplink are supported, including antenna configuration for single input single output (SISO), multiple input multiple output (MIMO) and TX diversity. This allows maximum throughput performance tests for wireless devices up to 2 Gbps, 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, eMTC, NB-IoT

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.

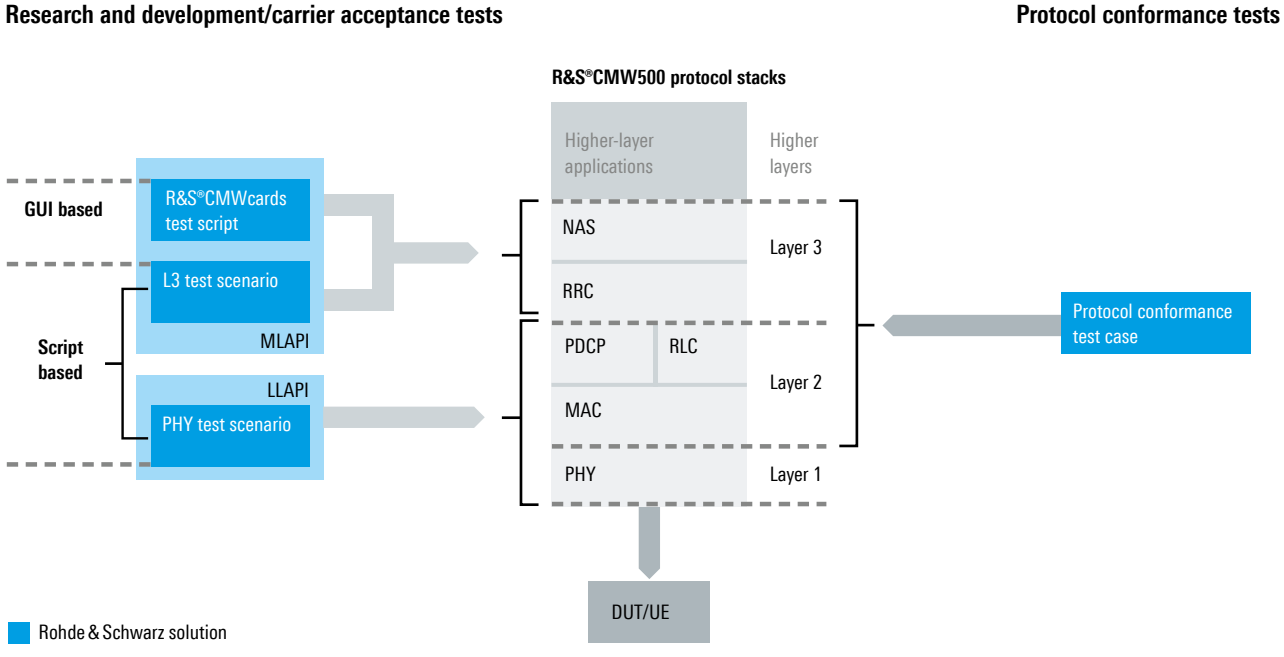
For protocol requirements, the R&S®CMW500 protocol tester offers a development environment for layer 1 to layer 3 signaling scenarios with automatic configuration of the layers below (MLAPI).

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.

Protocol stack test solutions for research and development and protocol conformance



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. All systems can be upgraded smoothly to 5G with R&S®CMX500.

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 and GSMA. Organizations like GCF and PTCRB provide the framework for a worldwide recognized wireless device certification scheme by referencing test cases from 3GPP, OMA and 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-3: fully automated in-band test solution
- R&S®TS8980PRE-3: in-band and out-of-band RF test cases
- R&S®TS8980FTA-3: fully automated validated RF conformance testing

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, precertification 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®CMW platform and the test system family



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



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 plus interferer
Specific network operator tests, in-band preconformance tests



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



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



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

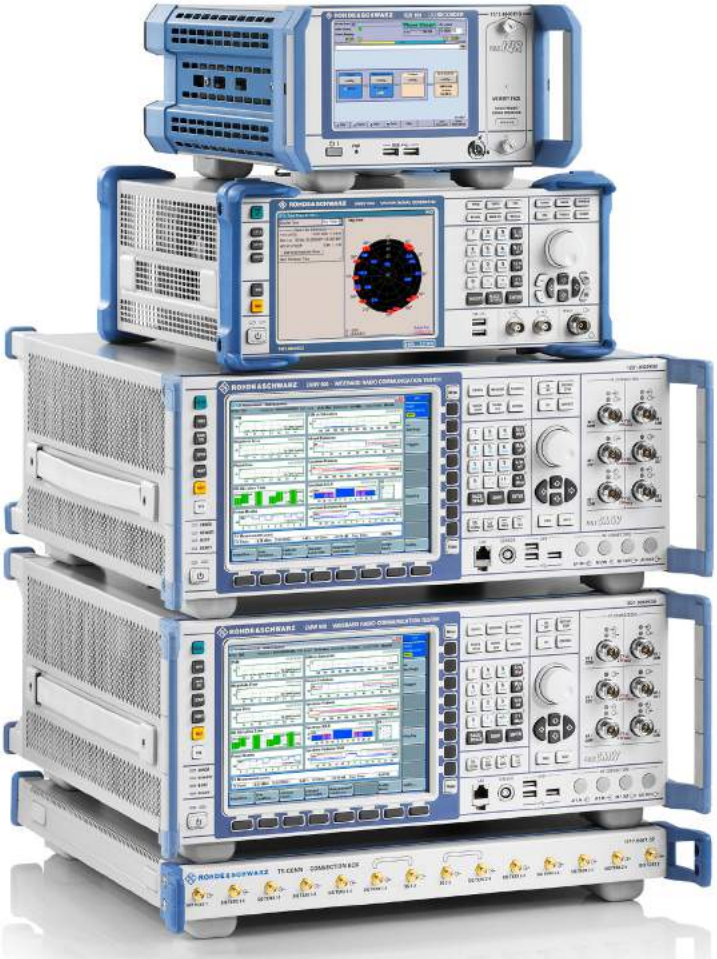
NETWORK OPERATOR ACCEPTANCE TESTING, INCLUDING OTA

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 E2E performance testing.

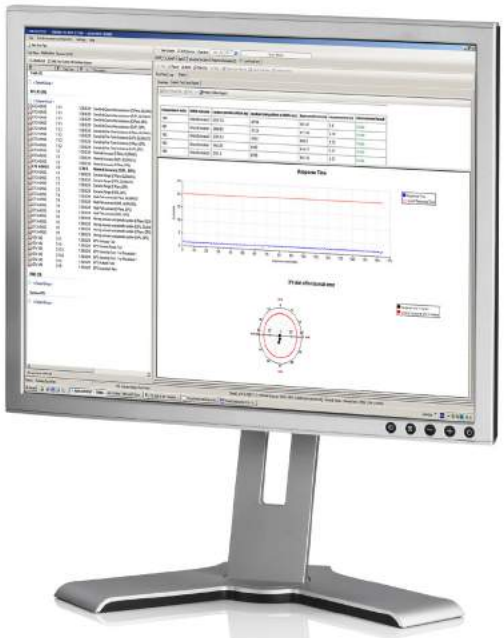
Operator-specific test solutions

Rohde&Schwarz NetOp test solutions are approved by operators and cover test requirements in line with latest network operator specifications. The Rohde&Schwarz NetOp solutions include all applications for operator acceptance testing such as R&S®NPT for protocol testing, R&S®ATE for IMS testing and R&S®PQA for performance testing. NetOp is 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 NetOp test solutions for network operator acceptance testing are a safe investment since constant updates make them ready for future test needs.



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



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

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.

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

The R&S®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®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®PQA for performance quality analysis tests

Verification of (E2E) performance is one of the key areas of network operators' supplementary testing. The R&S®PQA supports network operators' test plans for E2E 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.

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.

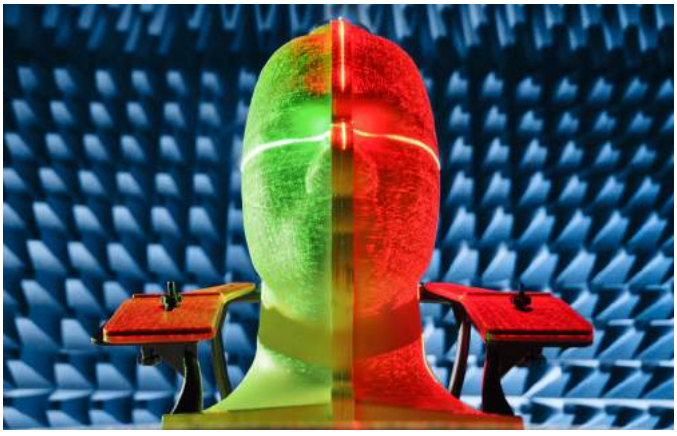
The basic setup for A-GNSS testing can easily be extended to include the powerful field-to-lab solution, which saves users cost and time by bringing real-world scenarios into the lab. The R&S®TS-LBS also supports network based positioning methods (OTDOA/eCID), including hybrid positioning methods (combination of satellite based and network based). It can also be extended for indoor positioning such as WLAN, Bluetooth® LE, Barometric, MBS, LPP Release 13 and LPPe features.

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), in the antenna test system R&S®ATS1000 or in larger wireless performance test chambers (WPTC).

A phantom head simulates the human influence during OTA measurements



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

A-GNSS minimum performance	LBS protocol conformance	Network based positioning OTDOA/eCID	Network operator acceptance	LBS hybrid	5G NR	Indoor positioning	LBS development features	A-GNSS OTA	RED EN 303413 GNSS multi-frequency

LBS test cycle

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 test and measurement 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®CMW100 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 trendsetting product for calibrating and verifying wireless devices. This follow-up to the R&S®CMW500 focuses on production needs.

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



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 on 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.

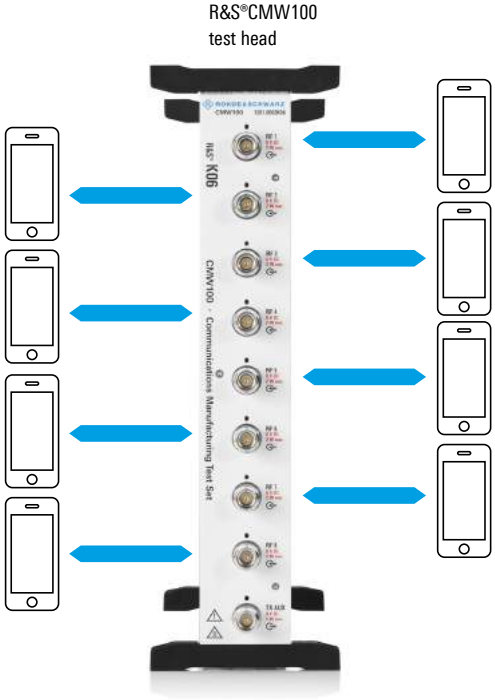
The R&S®CMW100 offers high measurement accuracy as a basis for high production throughput. This accuracy results from the proven, fully automatic level, frequency and temperature compensation concept.

Small cell production testing

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 and R&S®CMW100 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.

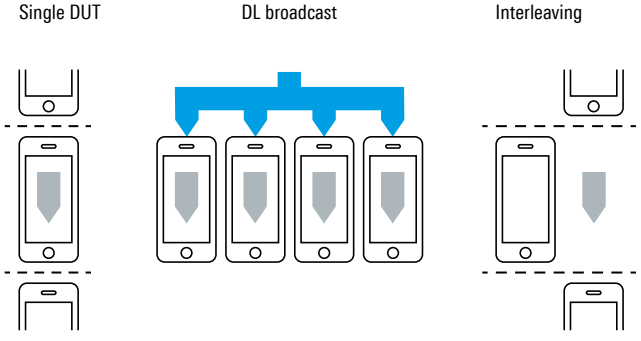
Parallel testing of eight DUTs with the R&S®CMW100



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%

Different test modes



ONE-STOP SHOPPING FOR PRODUCTION, INCLUDING SHIELDED BOXES

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.

Off-the-shelf solutions from one supplier

The R&S®CMW platform together with RF shielded chambers provides a compact turnkey solution for all production test cases: calibration, verification and functional tests. The wide product portfolio of RF shielded chambers allows flexible configuration to meet user requirements.

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

Shielded boxes from Rohde&Schwarz









Type	R&S®CMW-Z10 RF shielded box	R&S®TS7124 RF shielded box	R&S®DST200 RF diagnostic chamber	R&S®CMQ200 shielding cube
Application	research and development, service: radiated measurements	production: radiated power and sensitivity measurements	research and development: OTA measurements with automated 3D positioner	research and development: OTA measurements for 5G mmWave RF parametric testing
Shielding effectiveness	> 80 dB	> 80 dB	110 dB	> 45 dB
Dimensions (W × H × D)	264 mm × 321 mm × 527 mm (10.4 in × 12.6 in × 20.7 in)	400 mm × 450 mm × 480 mm (15.7 in × 17.7 in × 18.9 in), rack integrable	760 mm × 770 mm × 695 mm (30.0 in × 30.3 in × 27.4 in)	446 mm × 600 mm × 602 mm (17.6 in × 23.6 in × 23.7 in)
Handling	manual	automatic and manual	manual	automatic and 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 research and development to service, the R&S®CMW290 functional radio communication tester is a leaner solution that has been optimized for typical hardware verification tasks 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.

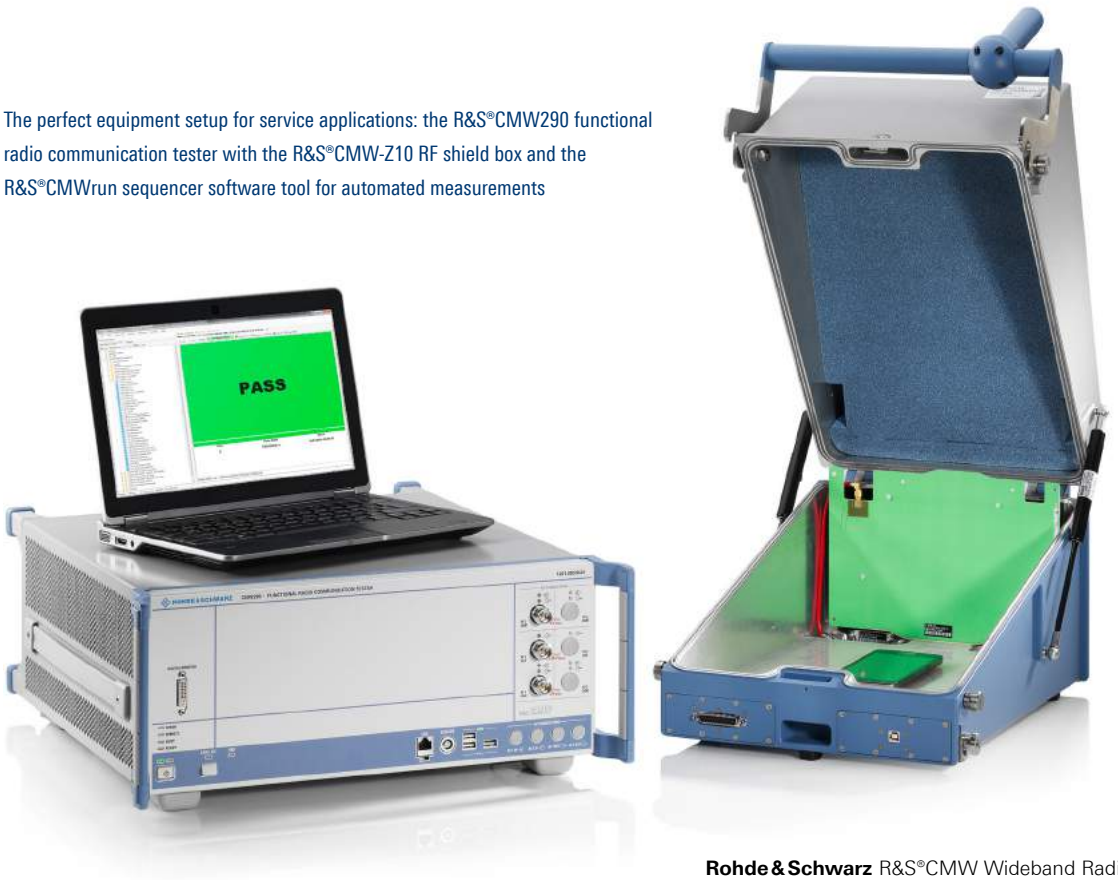
Comprehensive measurement of wireless devices

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 standards can be measured.

Functional testing for integrating IoT modules

The R&S®CMW290 is also the ideal solution for 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 operate correctly.

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

All-encompassing automation 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, preconformance 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 research and development, quality assurance, production and service. It can handle the requirements of both current and future wireless devices.

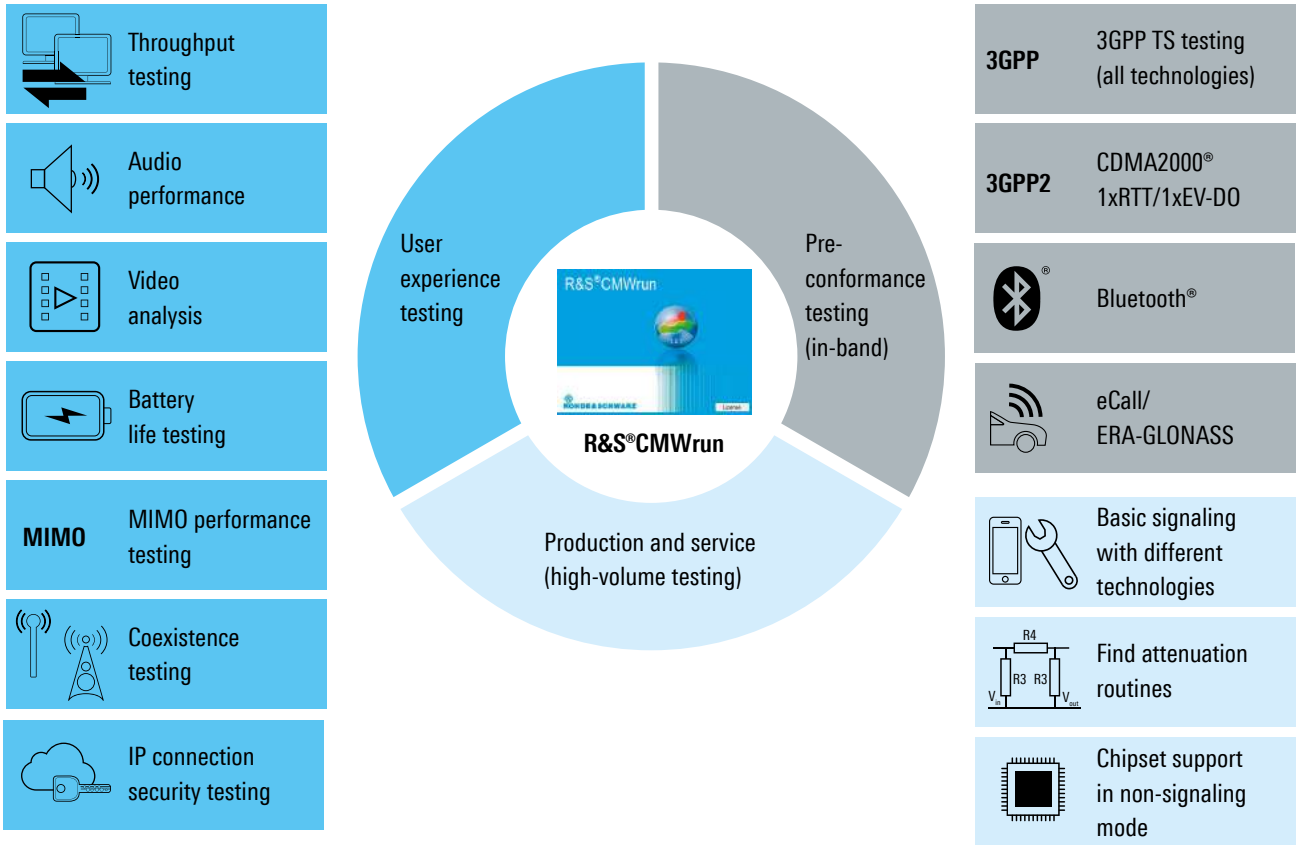
The software engine is based on the execution of test DLLs (plug-in assemblies). This architecture allows easy and straightforward configuration of test sequences without specific programming knowledge of how to remotely control the instrument. It also provides full flexibility when configuring parameters 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



R&S®CMWmars MULTIFUNCTIONAL LOGFILE ANALYZER

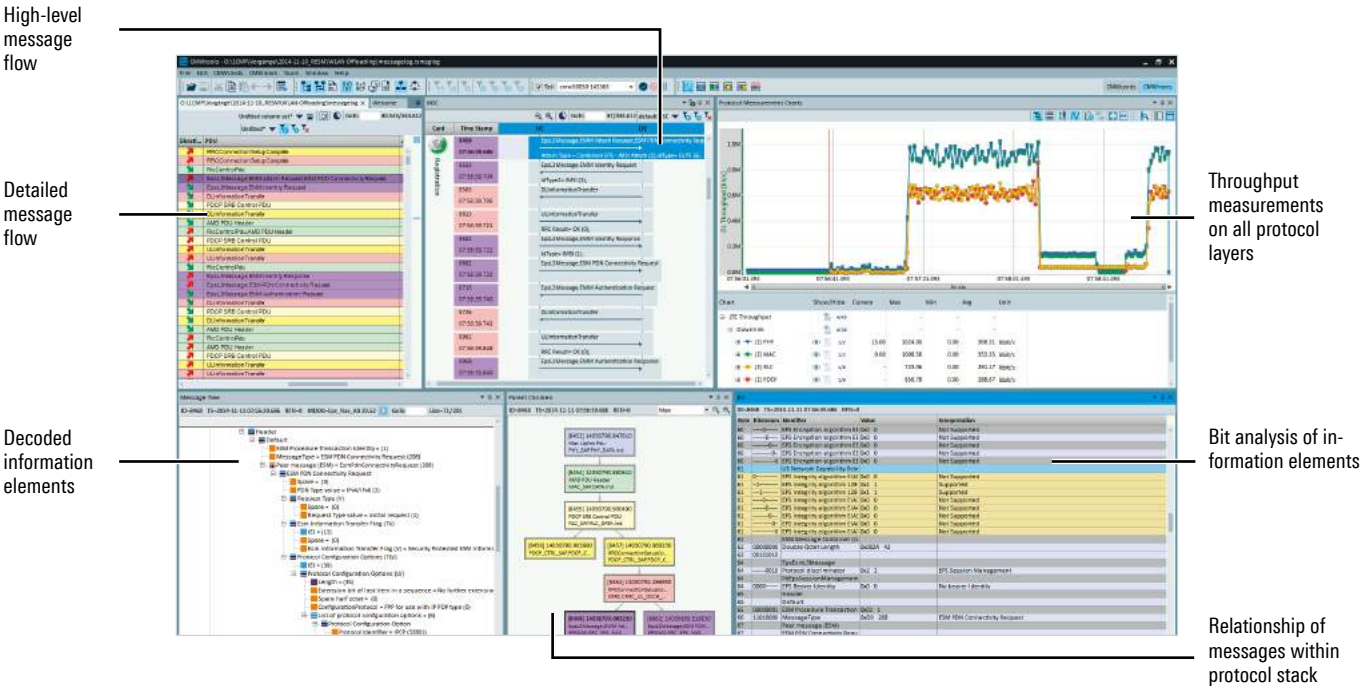
Powerful message analyzer for all R&S®CMW applications and use cases

R&S®CMWmars is the message analyzer for all R&S®CMW signaling applications. Users can efficiently analyze recorded message logfiles and trace information on the fly in real time 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, Bluetooth®, eMTC and NB-IoT, including the IP layer. It is well-established as the standard analysis tool for users 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
- Real-time 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



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)
- Key performance indicator (KPI) testing

Testing scope

- Layer 3 signaling tests for 3GPP LTE (Rel. 8 to Rel. 14), WCDMA, GSM and inter-RAT
- C-IoT tests for Cat. 1, eMTC (Cat. M1) and NB-IoT (Cat. NB1/NB2, Rel. 14)
- Up to 5CC with MIMO 4x4 and DL 256QAM
- LBS testing with A-GNSS and OTDOA
- LTE-U and LTE-LAA
- Cell selection, redirections and handovers
- IMS and VoLTE including call flow fallback (CSFB) and SRVCC
- LTE-WLAN offload
- Evolved multimedia broadcast multicast service (eMBMS)
- Failure scenarios
- CMAS (WEA) and ETWS public warning systems

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



R&S®Field-to-Lab BRINGS REAL NETWORK ENVIRONMENT INTO THE LAB

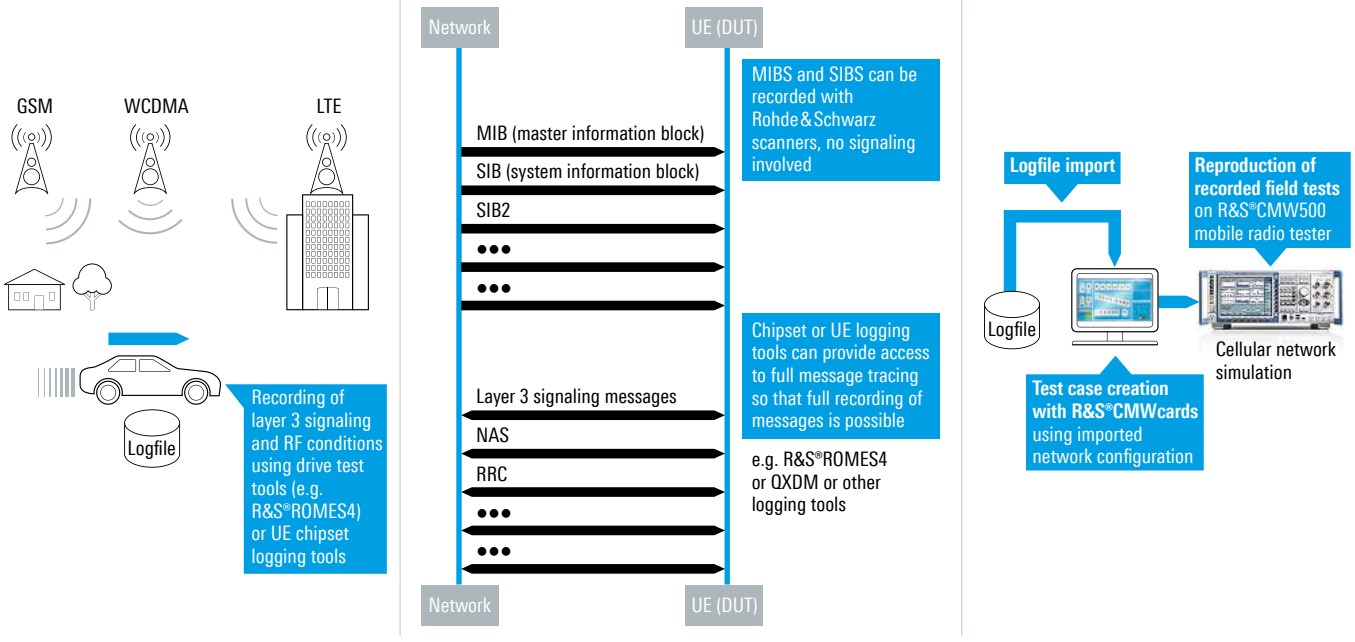
Simplify and accelerate the daunting task of recreating field configurations/issues in the lab

R&S®Field-to-Lab empowers its user to import the mobile network configuration recorded in field trials or drive tests into the lab environment. R&S®Field-to-Lab can automatically recreate field environments in the lab, thereby reducing the time and expense of drive tests and making it possible to reproduce issues almost infinitely. Be it network cell information, RX power levels and/or signaling message contents, R&S®Field-to-Lab can import any or all of this, providing the configurability and flexibility users desire. Issues seen during field tests are usually hard to reproduce due to the dynamic real-world conditions, making it hard to verify fixes.

Key facts

- Avoid frequent and multiple drive tests: quick and easy way to test devices with real network configuration
  - Designed with a simplistic wizard approach, R&S®Field-to-Lab is easy to learn and use
  - Multiple drive tests in the same location can be avoided by recreating cell, broadcast and dedicated signaling data in the lab for LTE and NB-IoT
  - Hard to manually reproduce RF data can now be made available on the Rohde&Schwarz simulator using R&S®Field-to-Lab
- Field logs in various file formats are no problem: R&S®Field-to-Lab is not bound to a single chipset or scanner log format
  - Supports logs generated by Rohde&Schwarz network scanners and scanners from other vendors
  - Supports most widely used chipset log formats
  - Offers open log format, enabling proprietary logs to be converted to open logs
- Manifold use cases
  - Reproduces field issues by creating a test script from field logs
  - Enhances existing test suites written in R&S®CMWcards or R&S®PQA by applying real field configuration from field logs
  - Highly flexible configuration options let the user precisely specify the information to be extracted from field logs

R&S®Field-to-Lab workflow



GLOSSARY

Term	Explanation
2G, 3G, 4G, 5G	second, third, fourth, fifth generation of mobile telecommunications technology
5G NR 5G NR (EN-DC)	5G New Radio 5G NR (E-UTRA New Radio dual connectivity)
3GPP 3GPP TS 3GPP2	3rd Generation Partnership Project 3GPP technical specification 3rd Generation Partnership Project 2
ANDSF	access network discovery and selection function
ANQP	access network query protocol
Beidou (BDS)	Chinese satellite navigation system
BLER	block error ratio
Bluetooth® Bluetooth® SIG Bluetooth® BR Bluetooth® EDR Bluetooth® LE	wireless technology standard for exchanging data over short distances ...special interest group ...basic rate ...enhanced data rate ...low energy
CA	carrier aggregation
CC 2CC/3CC/4CC/6CC/8CC	component carrier two/three/four/six/eight component carrier aggregation
CDMA	code division multiple access
CDMA2000® CDMA2000® 1xRTT CDMA2000® 1xEV-DO	family of 3G mobile technology standards ...single carrier radio transmission technology ...single carrier evolution-data optimized
CMAS	commercial mobile alert system
CMMB	China mobile multimedia broadcasting
CTIA	The Wireless Association (formerly: Cellular Telephone Industries Association)
D2D	device to device
DASH	dynamic adaptive streaming over HTTP
DL	downlink
DLL	dynamic link library
DUT	device under test
DVB-T	digital video broadcasting – terrestrial
E2E	end to end
eCall	European emergency call system
eCID	enhanced cell ID
eMTC	enhanced machine-type communications
ePDG	evolved packet data gateway
ETWS	earthquake and tsunami warning system
EVM	error vector magnitude
FDD	frequency division duplexing
FR	frequency range
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
GPRS EGPRS	general packet radio service enhanced GPRS

Term	Explanation
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
IMS	IP multimedia subsystem
IoT C-IoT NB-IoT	internet of things consumer IoT narrowband IoT
IP	internet protocol
iPerf	freeware for measuring the throughput of a network
I/Q	in-phase and quadrature
LLAPI	low-level application programming interface
LBS	location based services
LPP LPPe	LTE positioning protocol LPP extensions
LTE LTE-A LTE-B LTE-D LTE-D2D LTE-FDD LTE-LAA LTE-MTC LTE-TDD LTE-U PS-LTE ViLTE VoLTE	long-term evolution LTE-Advanced LTE Broadcast LTE direct LTE device to device communication LTE frequency division duplex LTE license assisted access LTE machine-type communication LTE time division duplex LTE-Unlicensed public safety LTE video over LTE voice over LTE
M2M	machine to machine
MAC	medium access control (L2 in the OSI model)
MBMS eMBMS	multimedia broadcast multicast services evolved MBMS
MBS	multimedia broadcast services
MHL	mobile high-definition link
MIMO	multiple input multiple output
MLAPI	medium-level application programming interface
MOS	mean opinion score
NAS	network attached storage
NetOp	network operator
NSA	non-standalone
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
PS	public safety
PDCP	packet data convergence protocol
PESQ	perceptual evaluation of speech quality

Term	Explanation
PHY	physical layer (L1 in the OSI model)
POLQA	perceptual objective listening quality assessment
PTCRB	PCS type certification review board
QoS	quality of service
RAN	random access network
RAT inter-RAT or IRAT multi-RAT	radio access technology inter-radio access technology multi-radio access technology
RED	radio equipment directive
RF	radio frequency
RLC	radio link control
RRC	radio resource control
RRM	radio resource management
RX	receiver
SA	standalone
SNR	signal-to-noise ratio
SRVCC	single radio voice call continuity
SSIM	structural similarity

Term	Explanation
SUPL server	secure user plane location server
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
V2X C-V2X	vehicle to everything cellular V2X
WCDMA	wideband CDMA
WEA	wireless emergency alert
WLAN	wireless local area network
ZigBee	IEEE 802.15.4 based specification for personal area networks
Z-wave	wireless communications specification for home automation (IoT)

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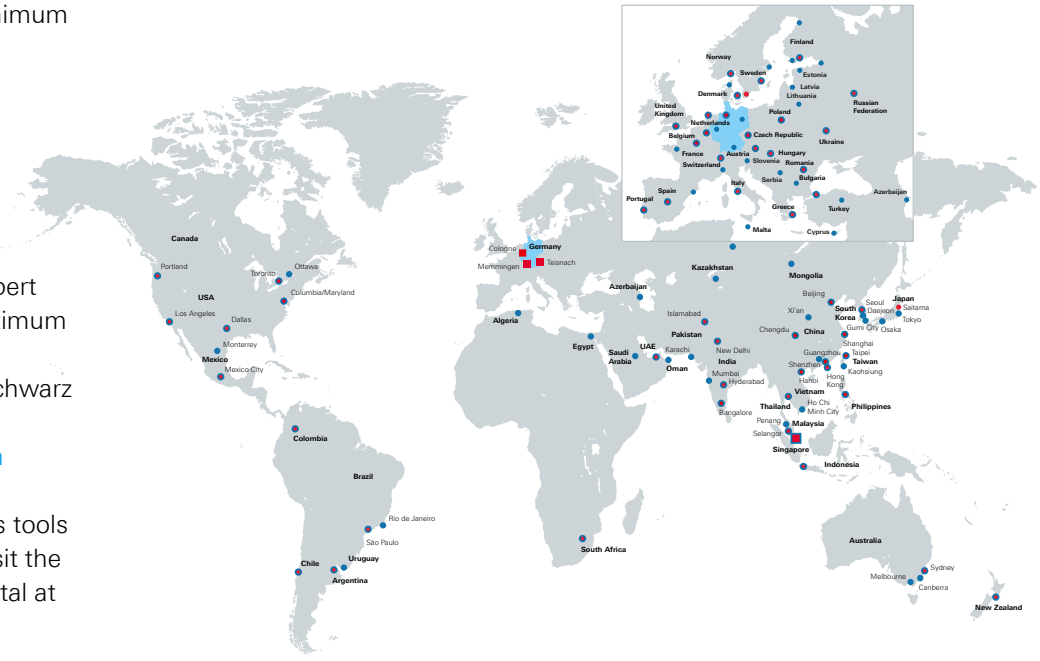
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R&S®CMW Wideband Radio Communication Tester

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