

UMTS LTE protocol tests for all pha

The R&S®CMW500 wideband radio communication tester has been expanded with additional options to make it a UMTS LTE protocol tester. It simulates an LTE radio access network for the development of wireless devices. And it covers every stage from development to conformance tests.

R&S®CMW500 wideband radio communication tester: very first tester to meet latest standards

Manufacturers of mobile radio infrastructures and mobile phones are currently working very hard on the next big step in the development of the universal mobile telecommunications system (UMTS): long term evolution (LTE). This standard can help transform UMTS into the cellular wideband communications system of the future. Featuring data rates of up to 150 Mbit/s, LTE helps ensure that UMTS remains competitive

while giving users a simpler means of mobile wideband Internet access. The first commercial LTE networks can be provided by 2010. Manufacturers, therefore, will need suitable test solutions at an early stage of development to verify their implementations and to successfully launch their products. Protocol testers are indispensable for performing complete end-to-end testing of LTE-compatible wireless devices. This opens up a new field of application for advanced instruments such as the R&S®CMW500 wideband radio communication tester (FIG 1). With new options installed, it becomes a powerful UMTS LTE protocol tester.



ses of development

FIG 1 Powerful new options make the R&S®CMW500 wideband radio communication tester a UMTS LTE protocol tester that can simulate an LTE radio access network for the development of wireless devices.



UMTS LTE at a glance

The network and protocol architecture of UMTS had to be thoroughly revised in order to meet LTE requirements. LTE uses a lean, exclusively packet-based network architecture to attain high data rates and to reduce latency. FIG 2 provides an overview of the LTE network elements and interfaces between them. The LTE base station, which is also referred to as eNodeB (eNB), assumes an important role. It manages the radio resources, performs the scheduling of subscribers and initiates connections on the air interface. This eliminates the UMTS radio network controller (RNC), which significantly reduces the number of network-internal interfaces. The eNB basically assumes the functions previously handled by the RNC.

Many of the mechanisms commonly used in UMTS have been further simplified for LTE: As for data transmission, LTE makes exclusive use of the shared channel principle. This principle, which allows multiple users to dynamically access the air interface, is ideal for packet-oriented services. In

contrast to conventional circuit-switched operation, an LTE network does not assign air interface resources to a user for the entire duration of a connection. It only assigns a resource when a data packet is to be transmitted. When no data is being transmitted, this resource can be assigned to other subscribers.

The performance of the shared channel can be further increased by combining the shared channel principle with procedures for link adaptation. Plus, the base station can make frequency-dependent scheduling decisions such as whether a user would have better connection quality in a specific range of bandwidths. The scheduling mechanism is therefore very complex but significantly determines the performance of an LTE system. The stringent timing requirements are of particular importance because the base station has to make a new scheduling decision every millisecond.

The integration of LTE into existing mobile radio networks of the 3G WCDMA and 2G/2.5G GSM/GPRS/EDGE standards is an important aspect, particularly from the point of

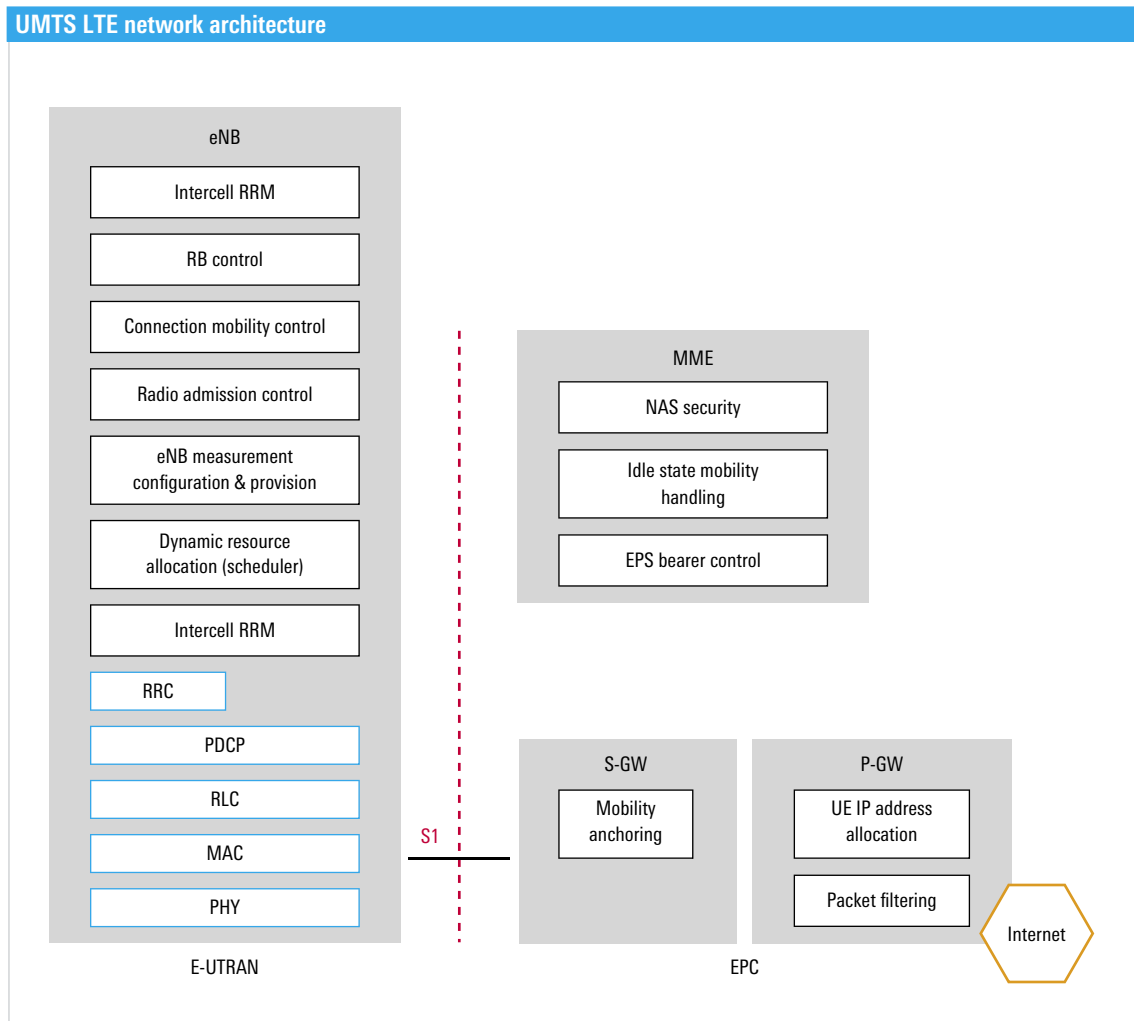
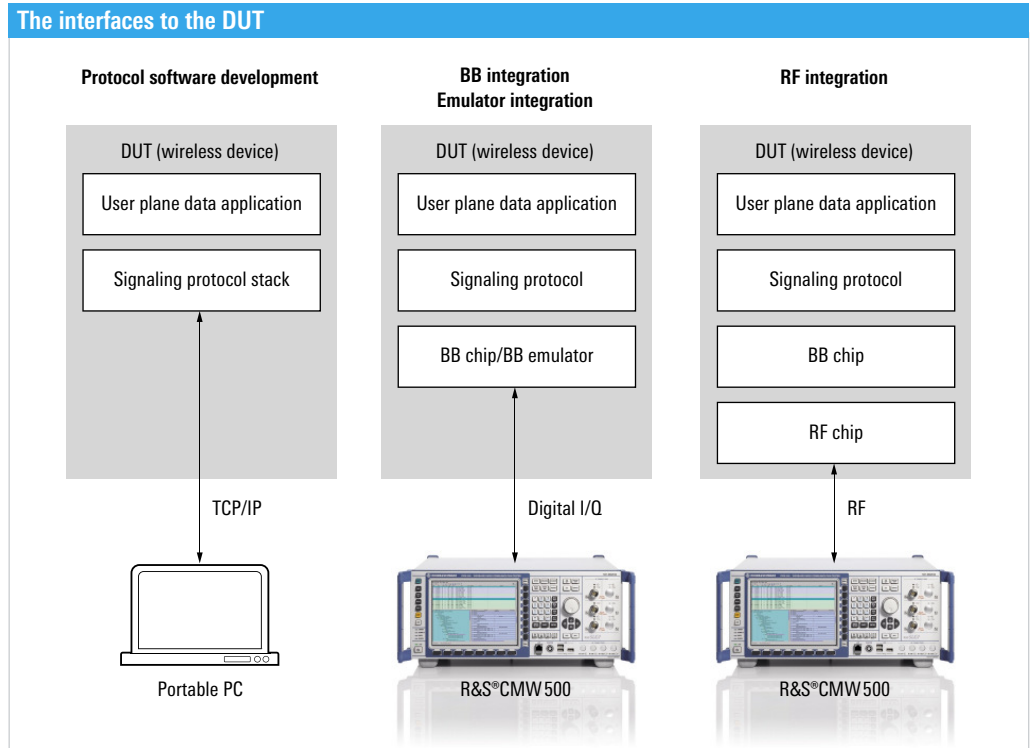


FIG 2 The lean, exclusively packet-based network architecture of LTE helps ensure high data rates and reduces latency.

FIG 3 The R&S®CMW500 used as network simulator: The wireless device or the chipset to be tested is connected via an RF connection or, in future, via a digital baseband I/Q interface.



view of network operators. They need a smooth and trouble-free means of handover between LTE networks and networks based on other standards so that the handover is not noticed by mobile radio subscribers. Suitable handover mechanisms are currently being specified by 3GPP.

In contrast to the present UMTS, LTE does without the compressed mode as this procedure is quite difficult to implement. In LTE, the base station now has to provide individual subscribers with the scheduling pauses that are required to perform measurements in other technologies.

Protocol tests using the R&S®CMW500

Manufacturers of LTE chipsets and wireless devices use protocol test solutions during the early phases of development to thoroughly check their implementations. The focus is on tests that help ensure that the basic functioning of the protocols on the air interface complies with the 3GPP LTE specifications. In later development phases, engineers should also address performance aspects, e.g. the data throughput of LTE wireless devices that is measured under various propagation conditions.

Depending on the integration of the protocol layers, various approaches for performing protocol tests can be used. If a layer 1 implementation is not yet provided or if integration has not yet been performed, the LTE virtual test software (for

PC) from Rohde&Schwarz can be used to test exclusively the protocol software. The LTE virtual test software (for PC) emulates the behavior of the radio protocol layers at the network end, whereby an abstract layer 1 is used. The software sets up an IP connection to the protocol stack to be tested. It then runs through special signaling test scenarios that verify the behavior of the protocol stack at the wireless device end. All essential functions of the layer 2 and layer 3 protocols can be verified in the virtual test environment. The R&S®CMW500 wideband radio communication tester is used after layer 1 has been implemented. With the appropriate options installed, it can be used as a powerful LTE protocol tester.

The wireless device or the chipset to be tested is connected to the R&S®CMW500 – which acts as a network simulator (FIG 3) – via an RF connection or, in future, via a digital baseband I/Q interface. The DUT again runs through special signaling scenarios that are used to check the implementation behavior and to find potential deviations from the standard specification. The test scenarios created by the LTE virtual test software remain unchanged and can be reused in the protocol tester. Plus, unlike the LTE virtual test software, the R&S®CMW500 covers test cases that additionally include layer 1 functionality. Of particular interest are the test cases that are able to test downlink/uplink interactions. The connection to the user plane – for example, to a video streaming server – is important for throughput measurements. Actual user data can therefore be processed in the protocol test scenario.

LTE must be able to interoperate with other mobile radio standards. This is an important aspect in protocol testing, as network operators cannot roll out LTE everywhere right from the start. The R&S®CMW500 is also rated for inter-RAT handover tests. A great challenge for implementing wireless devices is the successful support of various standards. Protocol test solutions that are specifically tailored to meet these requirements are thus extremely beneficial to manufacturers.

Test scenarios for development

One of R&D's main requirements is to have protocol test solutions for LTE at hand starting at an early phase of development. Another is maximum flexibility so that numerous test scenarios can be covered and complex sequences can be recorded. This is no problem at all for the C++-based programming interface: The R&S®CMW500 distinguishes between the low-level application programming interface (LLAPI) and the medium-level application programming interface (MLAPI), depending on whether the interface accesses to layer 2 or layer 3.

The LLAPI offers users direct access to protocol layers 1 and 2 and thus extra flexibility in programming the R&S®CMW500. Plus, the LLAPI is available at an early stage as it does not require layer 3 functionality, which is currently being specified in the 3GPP standardization bodies.

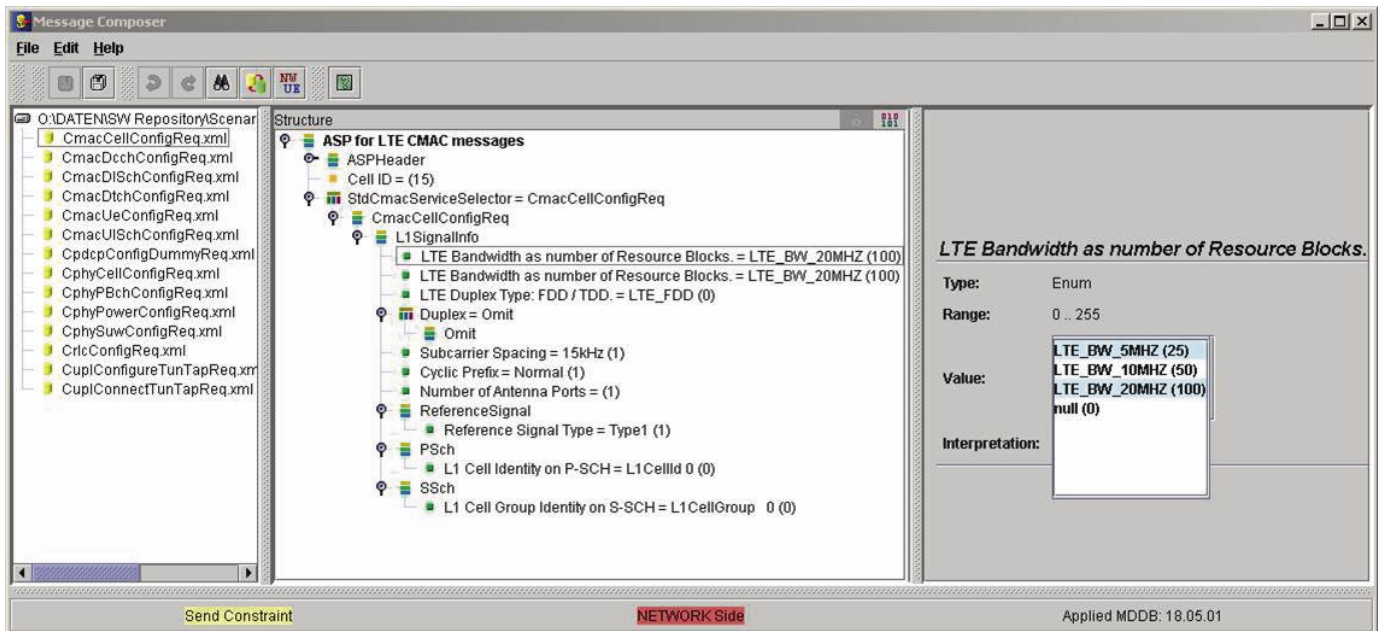
As soon as the layer 3 specification is available, the MLAPI will be a particularly efficient approach. The user does not have to bother about the tedious layer 1 and 2 configuration at the tester end – layer 3 messages will handle that task automatically. The only thing the user has to do is to specify the desired message sequence of the protocol test scenario and the contents of the layer 3 messages, for example, for setting up the connection. Convenient Rohde&Schwarz software tools are provided for editing the messages (FIG 4).

Since state machines are used, scenarios are set up modularly. In other words, the individual test sections can easily be reused in other tests. Once a test scenario has been traversed, the signaling messages between the R&S®CMW500 and the DUT are analyzed by means of log files. FIG 5 shows a suitable analysis tool.

Interoperability test scenarios

In 2009, the first LTE-compatible wireless devices will be tested in network trials. To optimally prepare these field tests, manufacturers of chipsets and wireless devices are provided with special interoperability test scenarios allowing an almost exact simulation of the real network conditions on the R&S®CMW500. As a result, implementation errors can be spotted right away, which saves valuable time and money. In the unlikely event that problems occur during these field tests, the scenarios can be simulated again in the laboratory by using the R&S®CMW500.

FIG 4 The R&S®CMW-KT012 message composer software is a convenient tool for editing layer 3 messages, for example.



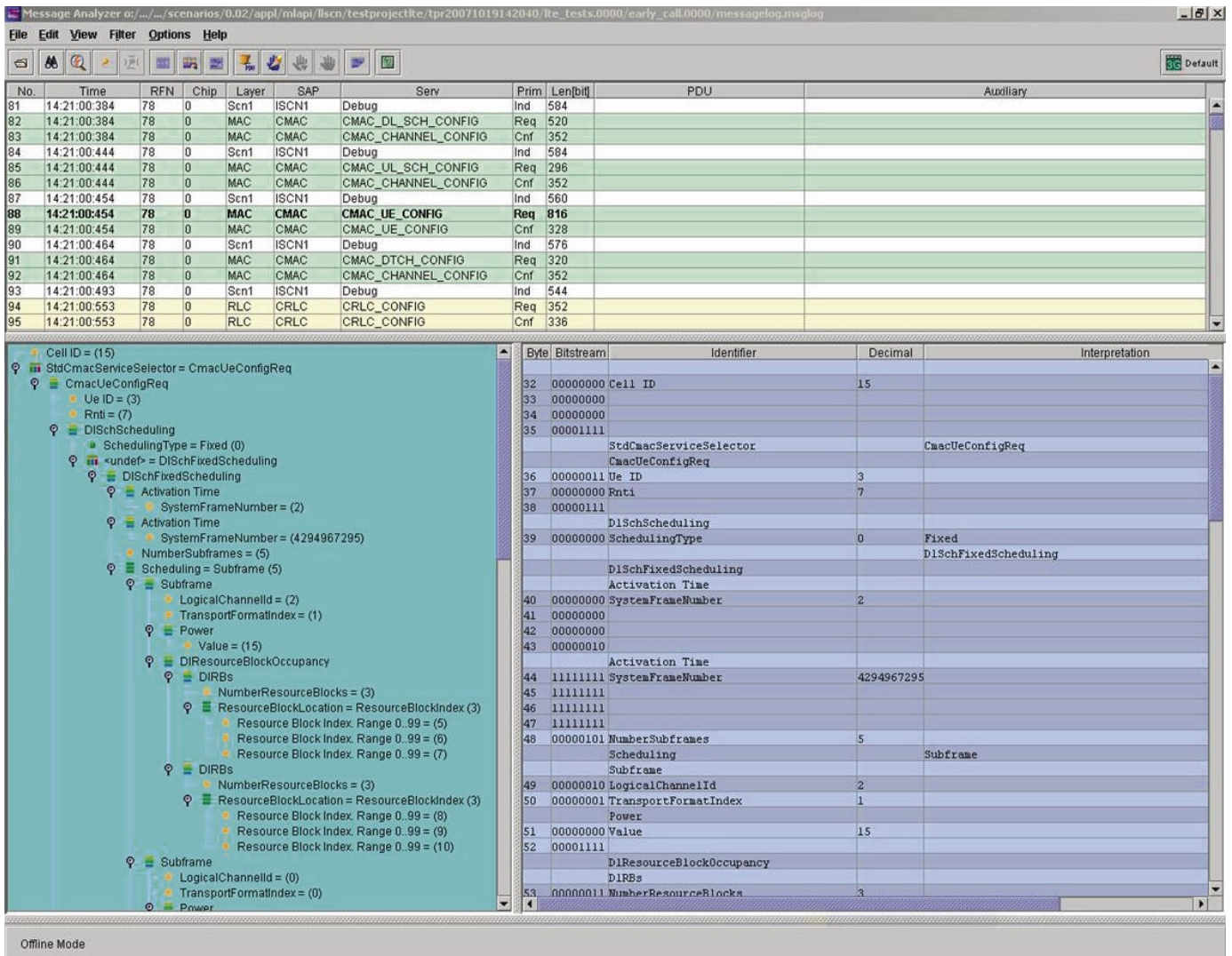


FIG 5 The R&S®CMW-KT011 message analyzer analyzes signaling sequences between the protocol tester and the DUT.

Conformance test cases in accordance with 3GPP specifications

3GPP is currently preparing LTE test specifications that form the basis for the certification of wireless devices in order to help ensure the worldwide interoperability of LTE terminals and networks. In addition to test cases for RF and radio resource management, numerous layer 2, layer 3 and non-access stratum signaling test cases will be available and will also be supported by the R&S®CMW500. 3GPP agreed upon writing these test cases in the testing and test control notation version 3 (TCN-3), a programming language for the specification and implementation of test cases. The required software tools for creating and preparing these test cases will be provided by the R&S®CMW500.

Summary

LTE involves numerous technical changes for UMTS. Developers of LTE-compatible chipsets and wireless devices must perform comprehensive protocol tests to detect errors at an early phase of implementation, thus saving time and money. The R&S®CMW500 wideband radio communication tester, which offers options for LTE protocol tests, is a powerful solution for every development phase. It also covers the certification of wireless devices and is exactly tailored to meet user requirements with regard to operability and flexibility.

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