FIG 1 The R&S®TS8991 OTA test system is the first system worldwide to comply with the current standard for performance tests on WLAN user equipment.
At the end of October 2006, the Wi-Fi Alliance and CTIA certified the R&S® TS8991 test system (FIG 1) for performing over-the-air (OTA) measurements on mobile phones with a Wi-Fi interface. Rohde & Schwarz is thus the first company worldwide to offer a test system that complies with the current standard for performance tests on WLAN user equipment.

**Always keeping pace with new standards**

The implementation of new mobile radio standards and test methods to meet market requirements is a great challenge. Rohde & Schwarz — in close cooperation with mobile phone manufacturers, network operators, and test houses — has always successfully mastered this challenge. The most recent example are over-the-air (OTA) measurements performed on WLAN user equipment, for which a special standard was defined by the Cellular Telecommunications Industry Association (CTIA) and the Wi-Fi Alliance [1]. OTA performance is an important parameter for assessing the behavior of mobile phones in the radio network. It allows you to three-dimensionally record both the transmitted power and the reception sensitivity and derive the total radiated power (TRP) and the total isotropic sensitivity (TIS) [2]. There is a great demand for these measurements, since WLAN functions are increasingly being integrated into mobile phones and good quality of service (QoS) can only be ensured by OTA measurements.

Rohde & Schwarz, together with the test house Telecommunication Metrology Center (TMC) in China, implemented this new standard into the R&S® TS8991 OTA test system in a very short time. The R&S® TS8991 is based on the R&S® TS9970 test system, which has already become an established market solution for OTA measurements in networks supporting common mobile radio standards as well as for Bluetooth®. When the standard was implemented, the optimization of the measurement speed and, in particular, the reliability and reproducibility of measurement results were paramount. The success of these activities is reflected by the certification of TMC. It is now the first test house worldwide that can perform these measurements with the R&S® TS8991 OTA test system. A turnkey system solution or an upgrade of existing OTA test systems to test WLAN functionality is now available for all customers.

**Protocol tester with multimode capability**

FIG 2 outlines the basic system structure. While the R&S® CMU200 universal mobile radio communication tester performs call setup and call control during measurements in line with mobile radio standards, the R&S® PTW 70 WLAN protocol tester [3] is implemented to perform these tasks for WLAN tests. The high versatility of the system considerably simplifies the measurements: It sets up the call, sets the link parameters, generates the data packages, and measures the packet error ratio (PER). Plus, you do not have to bother about the functional separation stipulated in the standard between a call setup via a WLAN reference device, a subsequent switchover to a signal generator for packet generation, and the use of a step attenuator to determine the level (substitution method). Even in the unlikely event of a dropped call, the R&S® TS8991 will quickly and automatically set up the call again and continue the measurement. The dynamic range of the test system, which has already been optimized for the mobile radio standards, as well as the diversity of the communications antennas will also help to ensure stable WLAN communications.
Objective achieved: High system performance

During the implementation of WLAN tests, every effort was made to optimize the measurement speed by taking both the measurement accuracy and reproducibility into account. Especially when determining the reception sensitivity, the signal level has to be ascertained iteratively for a given PER. With GSM, adaptive step widths and the early pass/fail decision have already reduced the measurement time to a large extent [4]. Comparable methods, such as the adaptation of the number of measured data packets as a function of the PER reduce WLAN test time to a considerable extent. Thus, a test period comparable to the GSM measurement times is obtained. A WLAN OTA measurement as specified by the standard is performed only on the center channel (GSM: 3 channels); in principle you can select any channel. The R&S®TS8991 supports measurements in the ISM frequency band from 2.4 GHz to 2.4835 GHz (IEEE802.11b, g) and in the U-NII band from 5.15 GHz to 5.825 GHz (IEEE802.11a). Moreover, the wide range of analyzer functions offered by the R&S®PTW70 WLAN tester allows you to make a more detailed statement about the DUT: If sensitivity problems occur, for example, you can find out whether the RF performance is insufficient or whether protocol problems cause a deviation.

The high measurement accuracy of the test system is also reflected by the fact that the measured total radiated power (TRP) and the total isotropic sensitivity (TIS) perfectly match; see FIGs 3 and 4. Since the DUT transmits and receives with the same antenna, you would expect identical antenna radiation patterns for transmission and reflection. Yet the integrated active DUT electronics additionally affects the reception sensitivity, producing measurement errors. It is therefore important to perform individual transmission and reception measurements and also to measure the receiver at its sensitivity limit.

New software

The new R&S®AMS32 software, which replaces the R&S®RPS16 software used in the R&S®TS9970 predecessor system, further increases the measurement speed. In addition to standard-compliant measurements, it also makes it possible to perform fast measurements during development. A measurement mode with a continuously rotating positioner is available for this purpose. The measurement time is largely reduced using a complete 3D sphere.

The R&S®AMS32 software also offers further automation: The measurements can be performed in one go on several mobile radio channels and also across several mobile radio bands. The mobile radio channels to be tested are sequentially activated via handover procedures that are remote-controlled via the R&S®CMU200.

A wide range of device drivers support nearly the complete Rohde & Schwarz product portfolio of spectrum analyzers and power meters as well as mobile phone positioners and turntables of all important suppliers worldwide. You can therefore combine the R&S®TS8991 OTA test system in various ways with any absorber halls and positioners.

The R&S®AMS32 software offers the tried and tested, advanced, and intuitive Windows® user interface known from the R&S®EMC32 EMC test software [5]. A powerful 3D evaluation tool is integrated into the software [6] and allows a three-dimensional representation of measured values and a calculation of the required parameters as well as further data analysis. This tool provides versatile reports in different output formats (RTF, PDF, HTML).

Summary

Rohde & Schwarz’s longstanding expertise in the field of OTA test systems and communications testers as well as a close cooperation with the users — in this particular case with the test house TMC — ensured the fast implementation of these tests into the R&S®TS8991 OTA test system. These tests are now available to all users and enable them, like TMC, to obtain certification.

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REFERENCES

[2] Test Plan for Mobile Station Over the Air Performance, Rev. 2.2, Nov. 2006, CTIA Certification Program
FIG 2  Basic structure of the R&S®TS8991 OTA test system.

FIG 3  Result of a WLAN TRP measurement.

FIG 4  Example of a WLAN TIS measurement.