3G technological leaders have come up with initial UMTS implementations in the megabit range. These implementations, which are being presented at mobile radio fairs, are based on the High Speed Downlink Packet Access (HSDPA) standard. This development is accompanied by major technological progress at laboratories of leading mobile radio chip and terminal manufacturers, where the functionality and quality of initial HSDPA equipment are carefully optimized. With its R&S®CMU 200, Rohde & Schwarz provides the required test capability for HSDPA terminals at an early stage.

Universal Radio Communication Tester R&S®CMU 200

HSDPA signaling and extended measurements for 3GPP Release 5

New test functions

In tests of HSDPA terminals, the mobile radio tester controls the terminals exclusively by means of signaling messages transmitted via the air interface. The first step in an HSDPA test, therefore, is to set up a link between the tester and the terminal, same as in a real network. If the link is set up successfully, a suitable radio bearer is established also by way of signaling. The radio bearer determines the configuration of the desired HSDPA link both in the DUT and the tester. The selection of configuration parameters depends on the type of test the user wishes to carry out. The R&S®CMU 200 supports the following test and measurement functions for HSDPA terminals:

- Testing of basic signaling functionality
- Testing of HSDPA-specific physical baseband and RF parameters
- Expanded / new UMTS RF measurements for determining DUT transmit and receive quality

HSDPA – the major innovation in 3GPP Release 5

When UMTS was originally defined, nobody anticipated HSDPA. Therefore, many new signaling parameters and procedures had to be added to enable the migration from 3GPP Release 99 to Release 5. When a link is established, the base station and the mobile station signal Release 5 compatibility to each other and agree on whether and how HSDPA is to be activated. The R&S®CMU 200 tests this basic signaling functionality at the press of a button and

FIG 1 Generator settings.

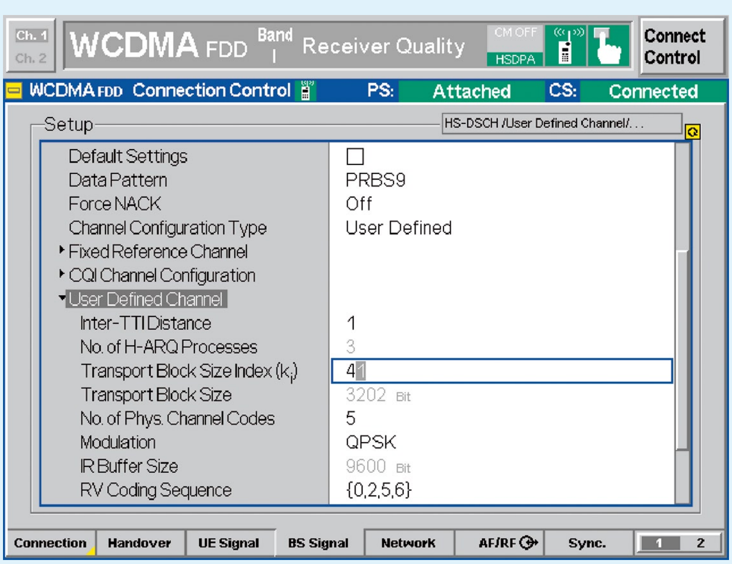
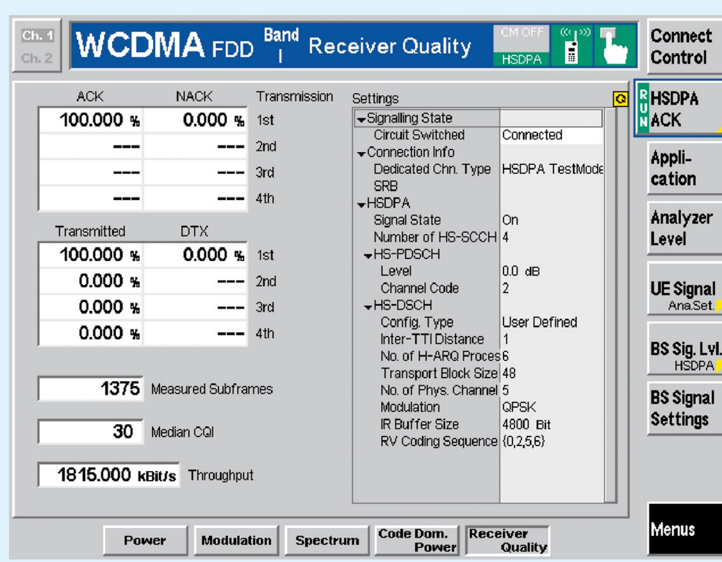


FIG 2 HSDPA ACK / NACK menu.



handles the procedures required for the following:

- Link setup and cleardown with and without HSDPA
- HSDPA activation / deactivation including the test mode
- More in-depth analyses, e. g. for querying measurement reports generated in the DUT

For more complex signaling scenarios, including detailed result analysis, the Protocol Tester R&S®CRTU-W is available.

DUT and tester put through their paces

For 3GPP Release 5, the R&S®CMU 200 generates new physical channels in the downlink – currently up to four HS-SCCH and up to five HS-DPDCH channels (suitable for 3.6 Mbit class) – in addition to the existing 3GPP Release 99 channels. You can set the desired levels and physical codes on the mobile radio tester in the same convenient way as known from other physical channels and select further settings such as QPSK or 16QAM modulation for the data channels. The high speed shared control channels (HS-SCCH) transmit control information via subframes every 2 ms. This information is used to address mobile terminals, schedule different hybrid automatic repeat request (HARQ) processes if required, and inform the mobile terminals of the coding and modulation of the HS-DPDCH data that follow the coding and modulation information.

The R&S®CMU 200 offers a selection of basic configurations in the HSDPA generator menu (FIG 1) from which users can choose depending on the intended test purpose and their expertise:

- Fixed reference channel, based on test specification included in 3GPP TS 34.121
- Channel quality indication (CQI) test, based on test specification included in 3GPP TS 34.121
- User-defined configuration and editing of parameters

To appropriately deal with the high complexity of the HSDPA baseband, merely generating predefined signals is not enough. Rather is it necessary to analyze the information transmitted via the HS-DPCCH uplink control channel (CQI report, acknowledge bits) and trigger follow-up activities in the next downlink transmission at a high level of priority – for example a repeat transmission with modified coding. Only through this process of rapid interaction between the transmitter and the receiver can the actual data throughput in the baseband be measured. One of the highlights offered by the R&S®CMU 200 for this measurement is the Follow CQI function. This function causes the downlink configuration of the tester to dynamically follow the CQI proposal of the DUT, which periodically estimates channel quality and reports it to the base station or the tester in its uplink HS-DPCCH.

HSDPA-specific evaluations

In the ACK / NACK menu (FIG 2), the tester displays the data throughput, the CQI median value and the percentages of the ACK, NACK and DTX values (ACK: ▶

FIG 3 **Code domain power with HS-DPCCH visualization.**

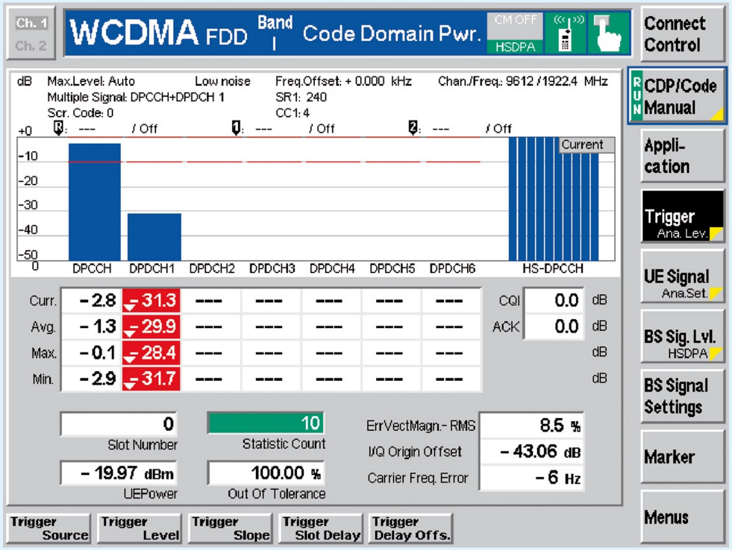
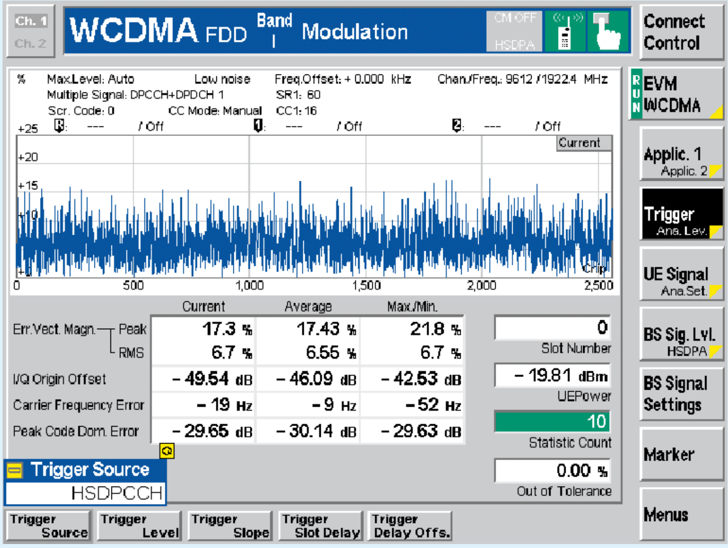


FIG 4 **RF measurement with activated HSDPA trigger.**



DUT has acknowledged; NACK: DUT has not acknowledged and may request a repeat transmission; DTX: discontinuous transmissions – DUT was expected to respond but did not).

Moreover, the HS-DPCCH log provides you with a readable sequence of successive HS-DPCCH transmissions. The CQI menu visualizes the block error distribution for different CQI ratios, based on the test requirements specified in TS 34.121.

RF measurements

In UMTS, only one (DPCCH) or two code channels (DPDCH and DPCCH) were previously active in the uplink to handle data rates up to 384 kbit/s. With HSDPA, a new uplink channel (HS-DPCCH) is added, which the R&S®CMU 200 displays both as code domain power and as a function of time (FIG 3). This channel includes the following characteristics:

- The HS-DPCCH channel is switched on and off as a function of the dynamic time scheduling in the downlink, i.e. it is switched on or off each time an HSDPA HARQ process is active and scheduled
- The beginning and the end of the channel are not synchronized with the timeslot pattern of the other uplink channels but may be shifted by n × 256 chips relative to this pattern

These characteristics place new demands on the RF functionality of DUTs, which in turn calls for an extension of 3GPP TS 34.121 RF test definitions. For example, an HS-DPCCH that is out of tolerance may produce undesired spectral components, which may affect results both in modulation and spectral (ACLR, SEM) measurements. The power setting of the mobile terminal in limit ranges and transitional regions, for example at maximum power, must correspond to a predefined nominal behavior. The R&S®CMU 200 can start measurements (modulation, spectrum, power, etc) using a time-variable HS-DPCCH trigger (FIG 4). By means of this trigger, the additional RF component introduced by the HS-DPCCH uplink signal can be included or omitted in measurements. Moreover, nominal beta factors can be set on the R&S®CMU 200 for determining the code power of each uplink code channel (DPCCH, DPDCH and HS-DCCH).

Supplementary RF measurements

In addition to HSDPA-specific extensions, a number of RF measurements were included in the 3GPP standard to fill some existing gaps:

Phase discontinuity measurement

Phase discontinuities caused, for example, by amplifier switching in the mobile terminal, may lead to a temporary loss of synchronization of the base station receiver in a network, which means that valuable radio resources are tied up in the network during this period. 3GPP Release 5 specifies limit values as well as a clearly defined test method. With its large memory depth, the R&S®CMU 200 can analyze up to 45 consecutive timeslots in a measurement sequence (FIG 5). The mobile terminal transmit power can be flexibly controlled during the measurement by means of predefined TPC bits.

Modulation measurement on the preamble

3GPP Release 5 now includes measurement of the modulation quality during link setup, thus filling another gap in the standard specifications.

Summary

By incorporating state-of-the-art HSDPA functionality and T&M capability in the R&S®CMU 200, Rohde & Schwarz has reinforced the ability of this leading mobile radio tester to meet future challenges. We can already look forward to further extensions of applications and measurements to accommodate data rates in the 10 Mbit range.

Pirmin Seebacher

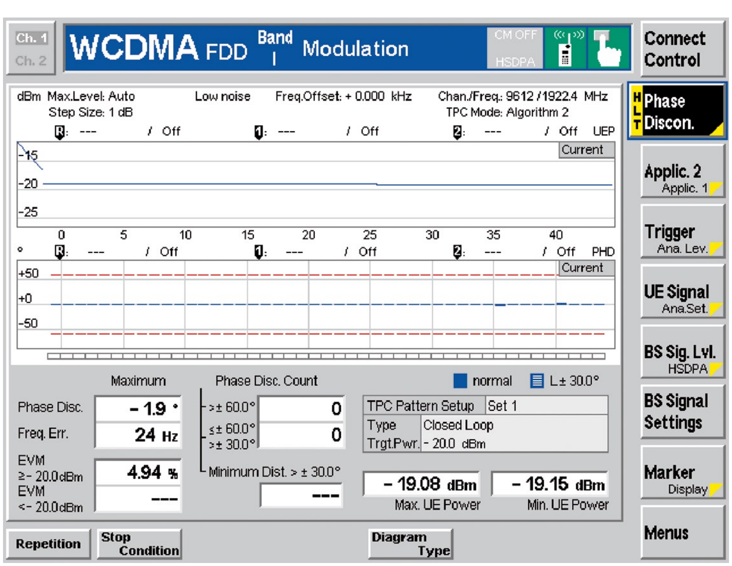


FIG 5
Phase discontinuity measurement.