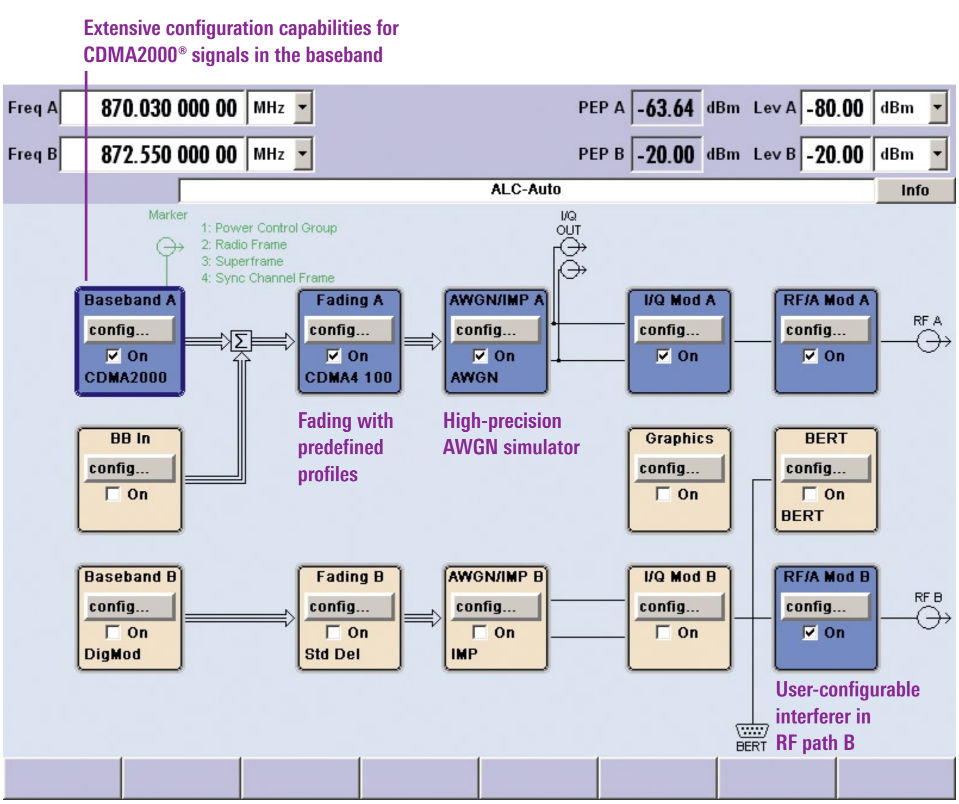
CDMA2000® and 1xEV-DV signals for demanding test scenarios

The expansion of the CDMA2000® standard for ever higher data rates in both transmission directions is placing new demands on the development of base stations and user equipment. The Vector Signal Generator R&S®SMU 200A now offers CDMA2000® signals, including the 1xEV-DV expansion for tasks such as amplifier and receiver tests.

CDMA2000® with 1xEV-DV expansion

The CDMA2000® standard (3GPP2 C.S0002-C) developed by the 3GPP2 standardization body has contained the 1xEV-DV expansion (1x evolution data & voice) since release C. In the 1x mode, which is downward-compatible to IS 95, the 1xEV-DV expansion offers data rates of up to 3.09 Mbit/s in the forward link (base station to user equipment). The new CDMA2000® option R&S®SMU-K46 generates the packet channels of radio configuration 10 (RC10) in addition to the regular channels that are generally used for voice communications. This makes the R&S®SMU an indispensable tool when testing new receiver components.



Just one generator for all base station tests

To meet the criteria of the 3GPP2 C.S0010-B specification for the minimum requirements of CDMA2000® base stations, you have to test their receivers with a series of wanted and unwanted signals.

For receiver power measurements, the R&S®SMU generates access, control and traffic channels of the various radio configurations in the 1x mode. The AWGN module (option R&S®SMU-K62) adds channel noise that is as precise as necessary for the measurement. Moreover, the optional Fading Simulator R&S®SMU-B14 (page 16) allows you to perform tests under fading conditions. Since the channel coding is fully implemented in the generator, no additional testers are necessary for the bit error ratio (BER): By evaluating the CRC fields, the base station is able to perform the frame error ratio (FER) measurement specified in the standard directly on the received signal.

The R&S®SMU also has no problem in detecting adjacent-channel rejection of the receiver. If the R&S®SMU 200A is equipped with two paths, one generator is sufficient for generating wanted and unwanted signals with a power difference of 87 dB as defined in the standard. FIG 1 shows how easily you can configure the R&S®SMU.

FIG 1
The block diagram on the screen of the R&S®SMU, with which you can easily configure the generator, is especially useful in complicated measurements.

Downlink signals without restrictions

In the forward link, the R&S®SMU supports a total of four user-selectable base stations for each carrier frequency. Each simulated base station provides all control channels of the standard and up to eight independently configurable traffic channels. You can set the channel coding for each fundamental, supplemental and dedicated control subchannel of a traffic channel in any manner within the parameters set by the standard. This makes it possible to set up complex test scenarios that far exceed the tests in 3GPP2 C.S00011-B.

Unlimited and complex 1xEV-DV scenarios

For the packet channels of radio configuration 10 (1xEV-DV), the R&S®SMU offers even more flexibility. 1xEV-DV uses free code domain and available output power of the base station to provide data services with a high data rate to user equipment. The concept of incremental redundancy, paired with powerful turbo codes, ensures optimum utilization of channel capacity.

The focus here is on two applications:

- To test power amplifiers at the base station's RF output, realistic signals as generated by the R&S®SMU are necessary. The fluctuating output power of burst packet channels places high demands on the power amplifiers of the base station.
- The R&S®SMU supports receiver tests with fully channel-coded F-PDCHs and F-PDCCHs. In addition to the packet channels, it is also possible to activate all regular control and useful channels.

The R&S®SMU and R&S®FSQ – an ideal combination

FIG 2 shows an example of F-PDCH settings. In the example, four subpackets of a data packet are active; the graphic shows their time characteristic. Each subpacket has a different configuration. Various modulation modes, different occupancy of the code domain and various subpacket lengths are used. In addition to the F-PDCH, a pilot is active.

By analyzing this signal with the Signal Analyzer R&S®FSQ, you can identify the pilot and the nine occupied codes of the first subpacket (FIG 3, top). The Walsh codes found match those listed in FIG 2; PDCH is displayed as the channel type in both figures. The lower half of FIG 3 shows various measurement results, e.g. the detected modulation mode 8PSK.

The second subpacket with 16QAM modulation occupies another code domain. The upper half of FIG 4 shows the occupancy of the code domain in the reverse bit sequence. The lower half of FIG 4 shows the constellation diagram of the second subpacket.

For the third subpacket, yet another code domain is occupied (FIG 5, top). The lower part of FIG 5 shows the time characteristic of the power for all subpackets and mirrors the graphic in FIG 2.

The example shown here provides just a glimpse of the diverse capabilities offered by the Vector Signal Generator R&S®SMU. Since this generator features flexible means of combining all channel types while simultaneously providing fully implemented channel coding, it meets every need. Thus, you can perform even the most demanding amplifier and receiver tests.

Gernot Bauer

Abbreviations

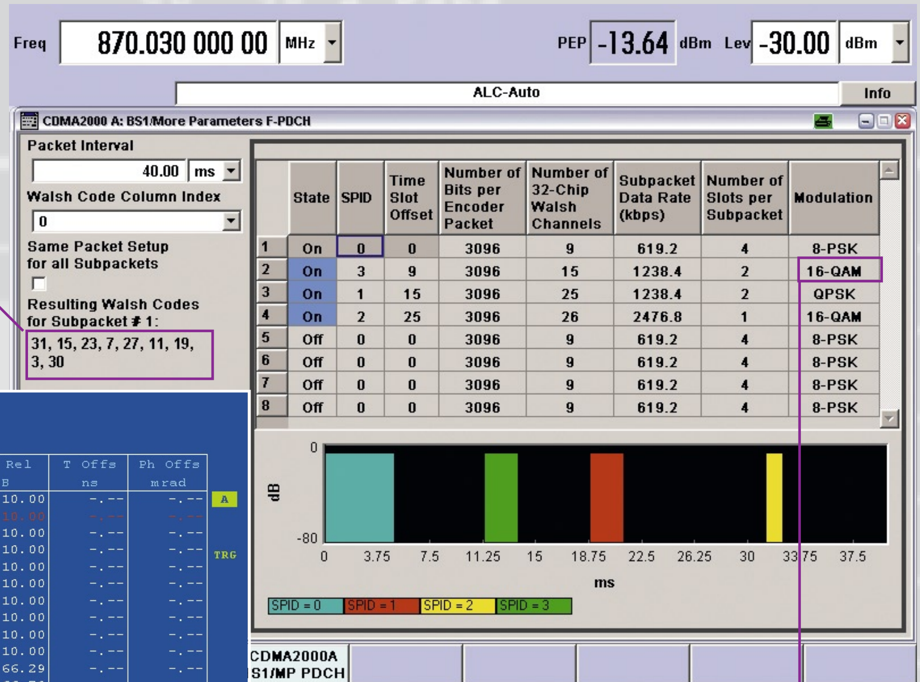
AWGN	Additive white Gaussian noise
CRC	Cyclic redundancy check
FER	Frame error ratio
F-PDCH	Forward packet data channel
F-PDCCH	Forward packet data control channel

R&S®SMU200A options for testing CDMA2000® applications

R&S®SMU-K46	Digital Standard CDMA2000® / 1xEV-DV
R&S®SMU-K62	Additive White Gaussian Noise (AWGN)
R&S®SMU-B14	Fading Simulator
R&S®SMU-B203	RF Path B – 100 kHz to 3 GHz

Further information on the R&S®SMU200A on page 18

FIG 2
Example of a 1xEV-DV signal configuration in the R&S®SMU.



Walsh codes with length 32 for the first subpacket

The set Walsh codes from FIG 2

16QAM, see FIG 4

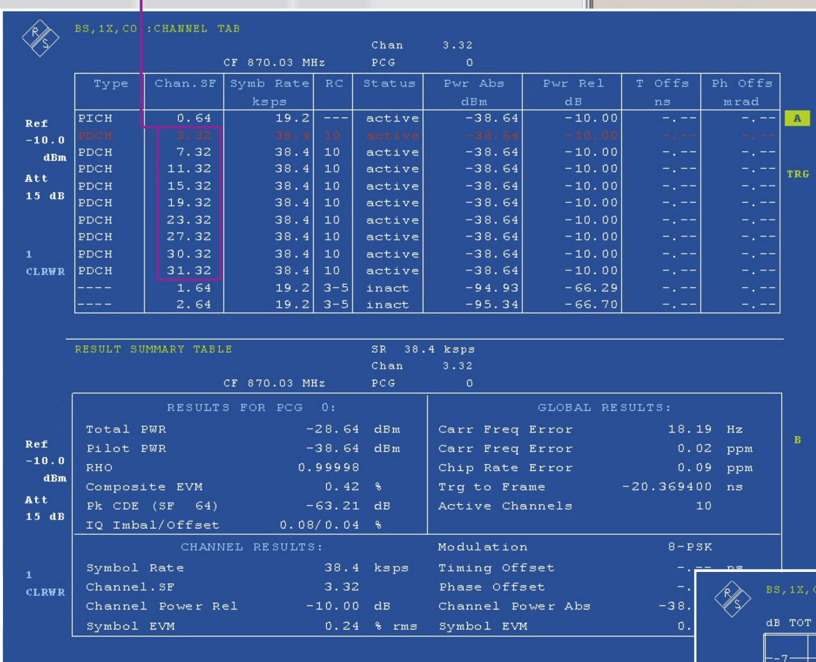


FIG 3
Measurement of the first subpacket: channel table and measurement results.

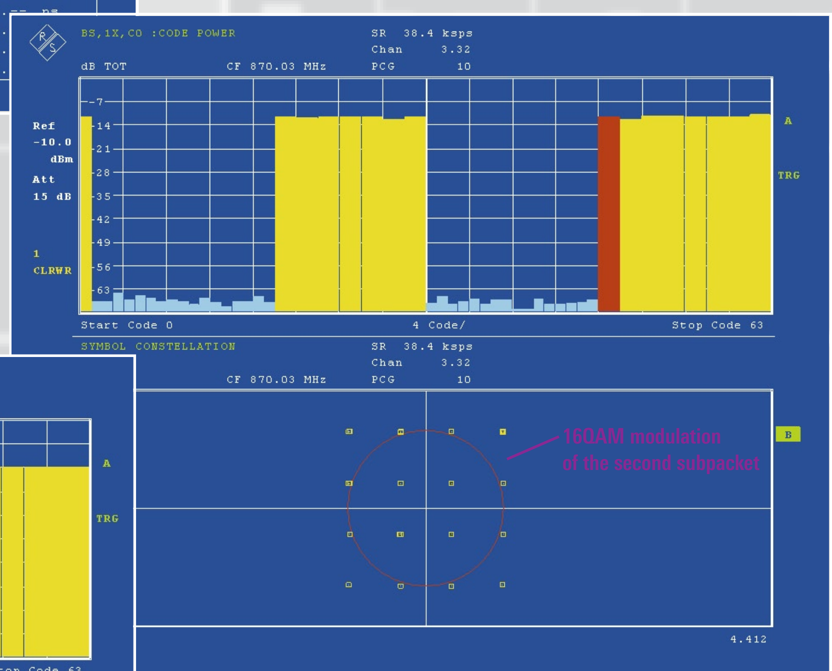
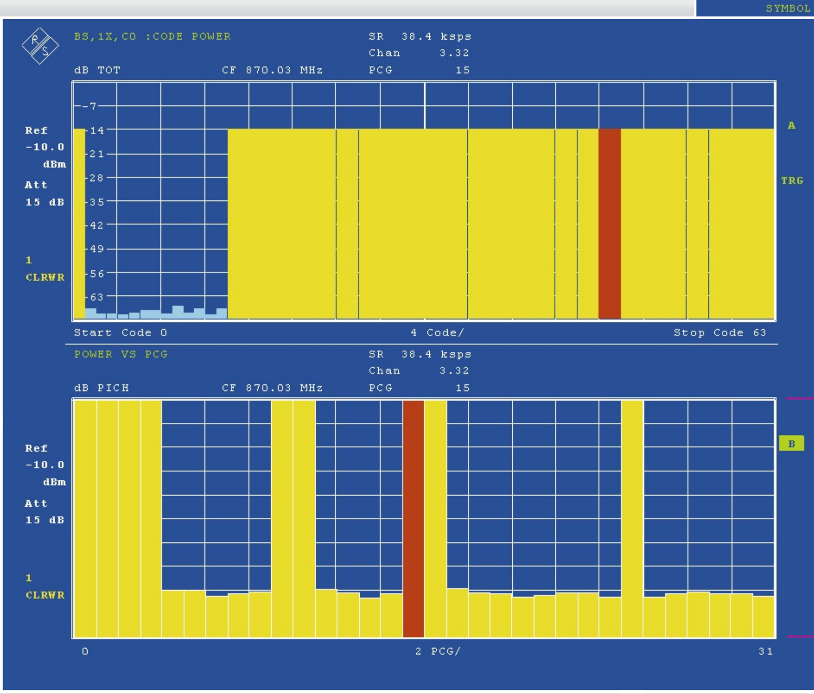


FIG 4
Code domain and constellation diagram of the second subpacket.



Signal time characteristic corresponding to graphic in FIG 2

FIG 5
Code domain of the third subpacket (top), time characteristic of the signal power (bottom).