Transmitter and receiver measurements for cdma2000 1xEV-DO

To complement the cdma2000 1X standard [*], Rohde & Schwarz is now offering a fast test solution for its Radio Communication Tester R&S®CMU 200 for the new cdma2000 1xEV-DO data service standard.

All measurements for development and production

The new option for the R&S®CMU 200 is an all-in-one solution with a flexible 1xEV-DO generator for receiver measurements and numerous transmitter measurements; its functionality covers all tests required in the development and production of access terminals for 1xEV-DO. Short measurement times and optimized test sequences ensure higher throughput in production.

cdma2000 1xEV-DO has been officially approved by the ITU as the IMT-2000 standard for third-generation mobile radio (3G). The standard has been optimized for pure data transmission and provides a maximum data rate of 2.4 Mbit/s in the forward link (from base station to mobile phone) in a channel of 1.25 MHz width; 153.6 kbit/s are available in the reverse link. This technology is ideally suited both for mobile high-speed and fixed wireless Internet services. In addition to the 47 cdma2000 1X networks, eight commercial 1xEV-DO networks are already operating in Korea, the USA and Brazil; another six are scheduled to officially start operation by the end of this year. The existing networks are usually on a smaller scale, mainly covering big cities. It remains to be seen whether entire areas will be covered at a later stage. Of course, convenient integration (in overlay) in existing cdma2000 networks makes it easier for cdma2000 network operators to provide customers in hot spots relatively quickly with the new data service.

1xEV-DO is often incorrectly considered a subset or superset of cdma2000. However, it is true that cdma2000 1xEV-DO exhibits the same RF characteristics as cdma2000 such as bandwidth, chip rate and time basis (which is also derived from the GPS signal), although the actual protocol stack is completely different. 1xEV-DO is a TDMA system using CDMA concepts for coding and addressing. Transmission in the forward link occurs in only one physical channel at a time, in the reverse link in up to four channels simultaneously; differentiation is via different Walsh codes in accordance with the CDMA principle (FIG 1). Handoff to a cdma2000 system has already been provided for in the current version of the 1xEV-DO standard, and will be included in the cdma2000 standard for future versions.

cdma2000 1xEV-DO measurements

The minimum requirements placed on 1xEV-DO access terminals are defined in the TIA / EIA IS-866 and 3GPP2 C.S0033 standards. Over the past few years, it has become evident that the manufacturers of mobile phones have increasingly tried to introduce a test strategy with reduced signalling on module level both in the calibration phase and final testing in their production lines instead of a complete signalling solution. Compared to testing with complete signalling, this offers significant advantages in speed. Moreover, this approach is considerably more flexible; plus, manufac-

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Getting the names straight

1xEV-DO is known under various other names: HDR (high data rate), HRPD (high rate packed data), cdma2000-1x evolution – data oriented / optimized / only, TIA/EIA IS-856-1 (as named by the US-American standardization committee) and, last but not least, 3GPP2 C.S0024 V2.1 (3GPP2 standard).

The 1xEV-DO-specific name for base stations is access network (AN); the name for the mobile phone part is access terminal (AT).

Rohde & Schwarz has taken into account these requirements and, by providing the 1xEV-DO option for the R&S®CMU 200, supports the factory test mode that is implemented in most 1xEV-DO chipsets and their driver software. The factory test mode is a simple method for developers and manufacturers to reduce the test time for 1xEV-DO access terminals.

The basic test setup differs only minimally from that of a conventional signalling solution (FIG 2). The main difference is that the DUT is operated in the factory test mode during the test sequence.

Forward link simulation with the R&S®CMU 200

An outstanding feature is the wide variety of possible configurations of the access network signal of the 1xEV-DO option for the R&S®CMU 200. The radio tester can generate data for four different 1xEV-DO access terminals, thus permitting transmitter quality measurements on maximally four DUTs simul-

taneously. The MAC index (this is the address of the mobile station), data rate, data content and transmission interval can be defined for each access terminal. Different power control bit scenarios can also be defined (all up, all down, hold, range test as well as a configurable pattern mode). A limited "live" control channel is transmitted with a sync message which in turn is transmitted in realtime (FIG 3). Last but not least, comprehensive output trigger signals (e.g. even second clock, control channel, slot, AT reverse frame, AT forward slot) are available to the user.

Receiver measurements
The concept detailed above makes it possible to perform receiver measurements on up to four DUTs simultaneously by means of the control software of the access terminal, drastically cutting the measurement times of the very time-consuming packet error rate (PER) measurement.
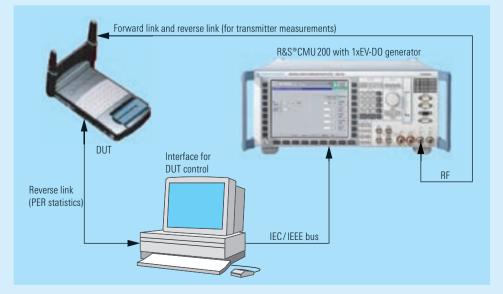
Transmitter measurements
The R&S®CMU 200 measures all important RF parameters of the transmit signal ▶

turer-specific test scenarios can also be implemented. An asymmetric connection between forward link and reverse link (usually high data rates from the base station to the mobile phone, i.e. in forward link, lower data rates in reverse direction) makes conventional loopback testing impossible anyway.

FIG 1 Overview of the various 1xEV-DO channels.

Forward link	
Pilot	
DRCLock	Data rate control lock channel
RPC	Reverse power control channel
RAB	Reverse activity bit channel
Data	
Reverse link	
Pilot	
RRI	Reverse rate indicator channel
DRC	Data rate control channel
ACK	Acknowledge
Data	

FIG 2 Typical test setup of the 1xEV-DO solution with the R&S®CMU 200.

Forward link and reverse link (for transmitter measurements)

R&S®CMU 200 with 1xEV-DO generator

DUT

Interface for DUT control

Reverse link (PER statistics)

IEC / IEEE bus

RF

▷ of 1xEV-DO access terminals, covering inband measurements such as vector error, waveform quality, code domain power (including code error power and channel power) and constellation diagrams. Moreover, the 1xEV-DO option also offers fast spectrum measurement capability. In accordance with the 1xEV-DO test specification, a power measurement is performed with a 30 kHz spectrum analyzer filter at up to four frequencies; the maximum offset is 2 MHz (FIG 4). By means of code channel filters, the precise DUT signal configuration to be used for the measurement can be defined, which is indispensable for a conclusive measurement with packet-oriented networks.

Summary

The cdma2000 1xEV-DO option once again proves the flexibility of the hardware and software concept of the Universal Radio Communication Testers R&S®CMU 200 for 3GPP 2 technologies. Equipped with this new option, the radio tester is ready for future CDMA generations such as cdma2000 1xEV-DV.

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**More information and data sheet at
www.rohde-schwarz.com
(search term: CMU 200)**

REFERENCES
[*]   Universal Radio Communication Tester R&S®CMU 200: cdma2000 – a new challenge for 3G mobile radio testers. News from Rohde & Schwarz (2002) No. 173, pp 4–8

1xEV-DO options

The 1xEV-DO option for the R&S®CMU 200 is based on the cdma2000 Signalling Unit R&S®CMU-B 83. The following options are required for retrofitting the radio tester to include 1xEV-DO functionality:

◆ **R&S®CMU-B 83 (model 12)**
   cdma2000 / IS-95 signalling unit
◆ **R&S®CMU-U 65**
   3G measurement DSP extension
◆ **R&S®CMU-B 88**
   1xEV-DO extension for R&S®CMU-B 83 (model 12)
◆ **R&S®CMU-K 88**
   1xEV-DO test software

Option R&S®CMU-U 83 allows radio testers already equipped with an IS-95 signalling unit (R&S®CMU-B 81) or a former version of the cdma2000 signalling unit (R&S®CMU-B 83 model 02) to be upgraded economically to the new cdma2000 signalling unit (R&S®CMU-B 83 model 12) which is necessary for the 1xEV-DO extension R&S®CMU-B 88.

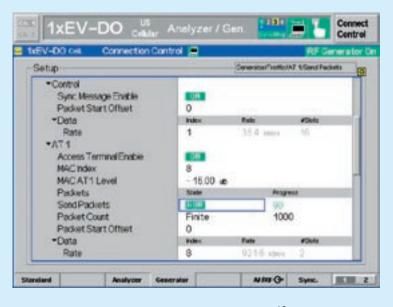**FIG 3   Comprehensive configuration capabilities for access network simulation.**

FIG 4   Fast 1xEV-DO spectrum measurement.