# Test signals for the EDGE Evolution enhancements to the GSM standard

GSM is still the world's most important mobile radio standard. Now, in response to the increasing requirements for greater transmission capacities, the GSM standard specifies higher data rates. The new R&S®SMU-K41 option, which is available for the entire R&S®SMx generator family, provides the manufacturers of mobile and base stations with the signals they need to develop and produce devices with EDGE Evolution capability.

## EDGE Evolution – doubling the data rate

After the introduction of EDGE the GSM standardization body is taking another step toward higher data rates with its recently released EDGE Evolution specification. The following is at the core of the technological enhancements:

- Additional, higher-order, crest-factor-optimized modulation modes, such as rotating QPSK (FIG 1), rotating 16QAM, and rotating 32QAM
- Besides the standard GSM symbol rate of 270.833 ksymbol/s, there is an option for an increased symbol rate of 325 ksymbol/s – combined with a spectral adaptation to the existing GSM channel spacing using the newly defined spectrally narrow/spectrally wide pulse shape filters
- Downlink dual carrier (DLDC): The base station simultaneously transmits data to a mobile receiver on two frequency channels, thus doubling data throughput in the downlink
- Mobile station receiver diversity (MSRD): By employing multiple built-in antennas (antenna diversity), mobile receivers improve the receive signal quality

FIG 2 uses the example of a packet data traffic channel (PDTCH) to provide an overview of the data rates that can be achieved with EDGE Evolution compared to those reached using GSM with GMSK and 8PSK modulation. Compared to EDGE, EDGE Evolution doubles the data rate again; compared to the original GMSK modulation, this even represents a six-fold increase.

## The R&S®SMU-K41 software option gets generators ready for EDGE Evolution

The R&S®SMU-K41 software option enhances the R&S®SMU-K40 GSM/EDGE software option that is already established on the market. Primarily, it can, of course, be used for all conventional receiver tests. Furthermore, due to the use of higher-order modulation modes, the transmitter amplifiers must satisfy higher linearity requirements.

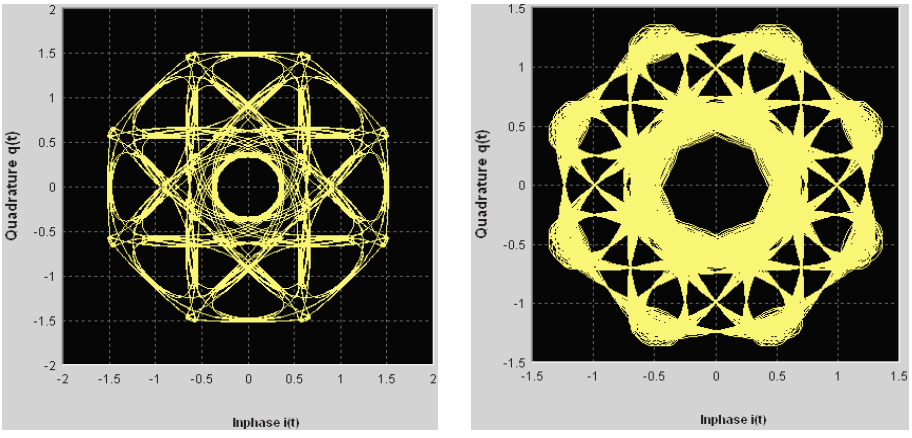


FIG 1 Rotating QPSK EDGE modulation at 325 ksymbol/s generated by means of R&S®WinIQSIM2: with a spectrally narrow pulse shape filter on the left and a spectrally wide pulse shape filter on the right.

The parameters that are typical of EDGE Evolution are set via the software's graphical user interface. For the optional higher symbol rate of 325 ksymbol/s, for instance, it is possible to select the newly defined burst types "higher symbol rate for QPSK/16QAM/32QAM" as well as the desired filter type (FIG 3). For the common symbol rate of 270.833 ksymbol/s, the burst types "normal burst for 16QAM/32QAM" have been added. These new types, can, of course, be combined in a frame with the previous burst types such as SCH or FCH.

The R&S®SMU-K41 software option is available for the following generators: R&S®SMU200A, R&S®SMATE200A, R&S®SMJ100A, and R&S®AMU200A. A comparable solution for the R&S®AFQ100A arbitrary waveform generator or for the ARB generators from the R&S®SMx family is available in the form of the R&S®WinIQSIM2 waveform creation tool with the R&S®SMU-K241/R&S®AFQ-K241 software option.

## Typical application-specific configurations for EDGE Evolution

Besides the above-mentioned improvements regarding modulation modes and symbol rates, EDGE Evolution employs other processes for boosting network capacity. As an all-purpose instrument, the R&S®SMU200A allows these new techniques to be tested without extensive equipment requirements:

- Downlink dual carrier (DLDC): The signal generator simulates a base station and supplies the required double signal on two carriers to a mobile station by adding two basebands with a frequency offset (FIG 4)
- Mobile station receiver diversity (MSRD): At its two RF outputs, the signal generator provides a statistically uncorrelated diversity signal that results in improved BER values for receivers with antenna diversity

The base stations continue to emit the SCH and/or FCH synchronization channels with the standard symbol rate of 270833.33 symbol/s. Therefore, for some applications, it is also necessary to simultaneously combine normal symbol rate bursts (270.833 ksymbol/s) with higher symbol rate bursts (325 ksymbol/s) in one frequency channel through the addition of two baseband signals. This can be done easily and immediately with an R&S®SMU with two channels (where $\Delta f = 0$ Hz) (FIG 4).

Users can also simulate DLDC signals or combine different data rates in a single frequency channel by means of the R&S®WinIQSIM2 waveform creation tool. To do this, they simply add several baseband signals in the multicarrier menu either with or without frequency offset or time offset.

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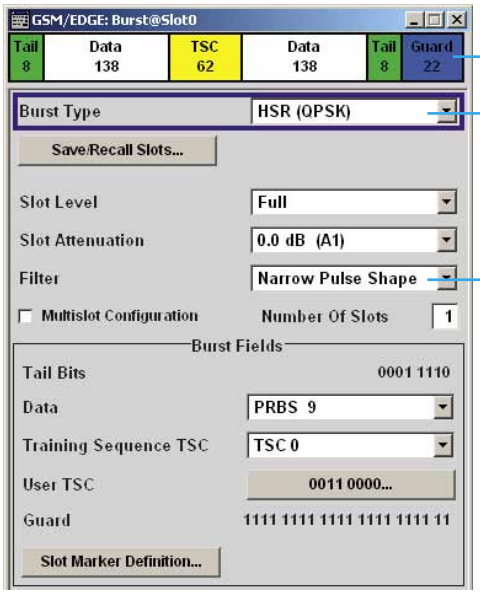
| Modulation | Standard symbol rate (270.833 ksymbol/s) | Higher symbol rate (325 ksymbol/s) |
|---|---|---|
| GMSK | 22.8 | – |
| QPSK | – | 55.2 |
| 8PSK | 69.6 | – |
| 16QAM | 92.8 | 110.4 |
| 32QAM | 116.0 | 138.0 |

FIG 2 Maximum instantaneous bit rate in kbit/s for a packet data traffic channel (PDTCH) per frequency carrier in line with 3GPP TS 45.002; (blue: the enhancements brought by EDGE Evolution).




Graphical display of burst structure

Selection of all burst types for EDGE Evolution

For higher symbol rate bursts, the user can select either the spectrally narrow or spectrally wide pulse shape filter

FIG 3 Entry field for a higher symbol rate burst.

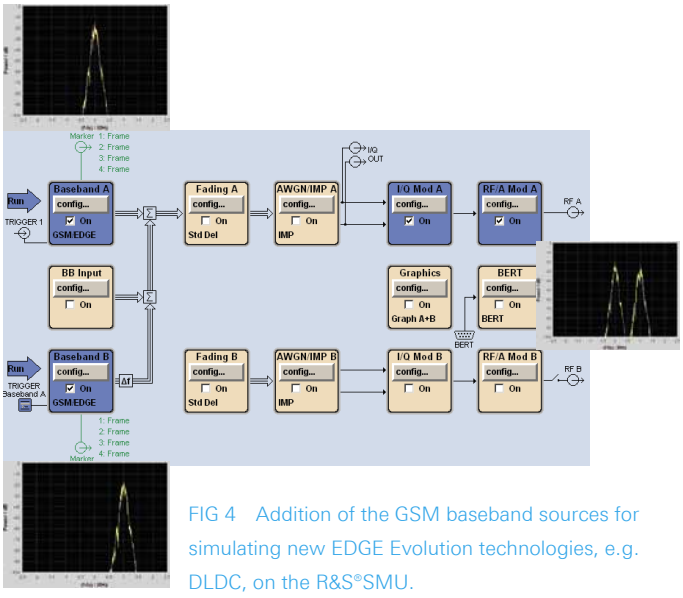



FIG 4 Addition of the GSM baseband sources for simulating new EDGE Evolution technologies, e.g. DLDC, on the R&S®SMU.