Universal Radio Communication Tester R&S CMU 200

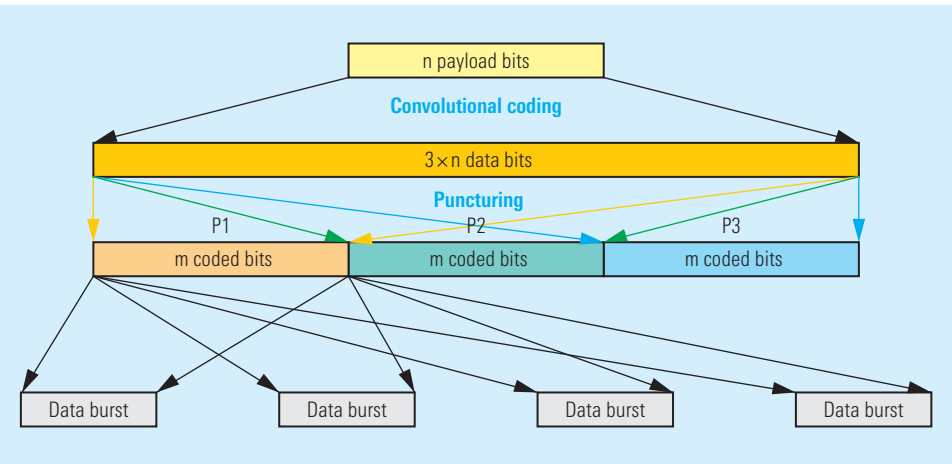
EGPRS signalling with incremental redundancy

With newer and newer innovations, standardization committees have been trying to increase data throughput in mobile radio systems and reduce infrastructure costs. Through the use of a different modulation mode, the data rate of EGPRS is up to three times higher than that of GPRS. An additional increase in data throughput is possible by using incremental redundancy.

EGPRS channel coding

To comprehend incremental redundancy, you have to understand EGPRS channel coding. There are nine different channel coders (MCS-1 to MCS-9) plus their variants, which can be defined by the puncturing scheme. FIG 1 shows the principle of complex EGPRS channel coding in a simplified way. A convolutional coder first spreads the payload data to three times the number of bits, which allows transmission errors to be corrected. Then individual bits are "punched out" according to a defined scheme (puncturing scheme P1, P2 and P3) and the bits are rearranged. Subsequently only the data packet containing puncturing scheme P1 is transmitted in four data bursts. The schemes are selected in such a way that the receiver can reproduce the complete original payload data from each single packet.

FIG 1 Simplified principle of EGPRS channel coding. The payload data is first tripled and then rearranged by punching out bits Thus only some of the bits have to be transmitted but protection against transmission errors is nevertheless maintained.



The principle of incremental redundancy

If an uncorrectable error occurs during the transmission of a data block, the entire block is requested and transmitted again – in the case of GPRS, until it has been received error-free. Information may be transmitted again and again, completely unnecessarily, e.g. if the first transmitted data block contained only a few defective bits.

With EGPRS, the transmitter can alternatively send the data block using puncturing scheme P2. The receiver then puts both received data blocks together and tries to correct the errors. Since it now has considerably more redundancy bits available, the probability that it can decode the block without errors is much higher. If this is still not possible, it will receive the data block with puncturing scheme P3 with the next transmission and can again use all the transmitted bits for decoding it. The receiver thus incrementally requests more and more redundancy bits to analyze the block (FIG 2).

The test method

To test EGPRS signals, it is important that incremental redundancy can be switched on and off as required. If layer 1 is to be tested, it must be off, for otherwise it feigns better receiver quality. If, however, the incremental redundancy performance is to be tested according to test specification 3GPP TS 51.010, the function must be on. In this test, the mobile phone must show a long-term data throughput of at least 20 kbit/s per timeslot.

Incremental redundancy with the R&S CMU 200

The Universal Radio Communication Tester R&S CMU 200 supports incremental redundancy in the EGPRS tests. Incremental redundancy can be switched on / off as necessary. When the function is off, the desired puncturing scheme can be set (FIG 3). If incremental redundancy is on, the selected puncturing scheme is transmitted first, enabling the tester to check a wide range of transmission combinations. The BLER measurement determines the block error rate and the data throughput separately for each timeslot (FIG 4). Using the BLER measurement of the R&S CMU 200, the incremental redundancy performance can be easily tested.

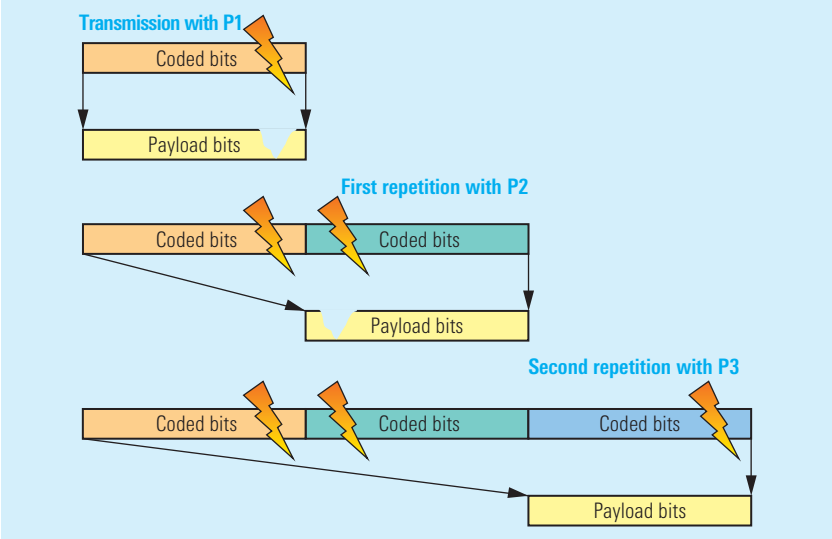


FIG 2 With incremental redundancy, the incorrectly transmitted block is not repeated but the data is transmitted with the next puncturing scheme. Both blocks are then used for error correction. This increases the probability of correcting transmission errors. In the example, all three transmissions are flawed. By combining the three received data blocks, data can, however, be decoded without error.

Summary

The versatile measurement and signalling capabilities of the Universal Radio Communication Tester R&S CMU 200 have made the instrument an indispensable tool, especially in EGPRS development. This is a result of the close cooperation between Rohde & Schwarz and the development labs of mobile phone manufacturers.

Rudolf Schindlmeier

FIG 3 In the R&S CMU 200, the puncturing scheme to be used can be set for each channel coder. Incremental redundancy can be switched on or off.

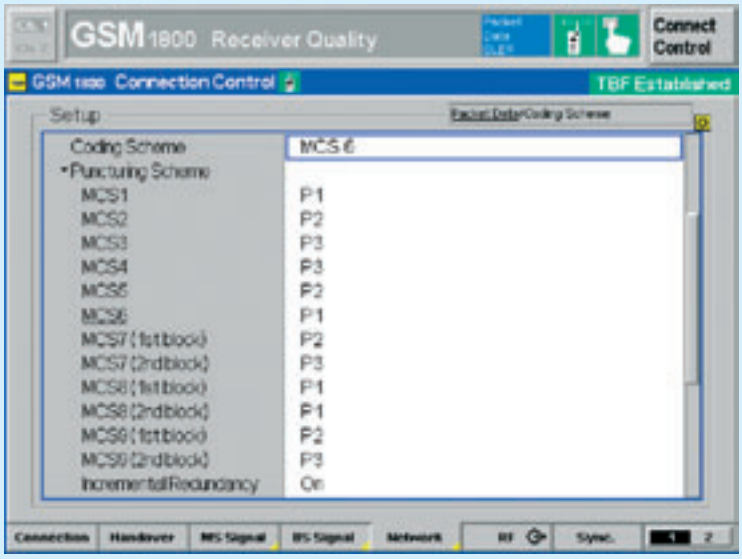


FIG 4 The BLER measurement of the R&S CMU 200 evaluates the block error rate and the data throughput separately for each timeslot. This makes the measurement ideal for testing the incremental redundancy performance.