R&S®CMU 200 Universal Radio Communication Tester

Downlink DTX and BFI measurements

The R&S®CMU 200 now also supports discontinuous transmission (DTX) in the downlink, as well as the important "performance of bad frame indication" (BFI) test case.

Downlink DTX

Telephone calls as a rule do not utilize the full capacity of a duplex link. In most cases, the two subscribers speak alternately, i. e. only 50 % of the link capacity is utilized on average. Practical experience has shown that in some cases no more than 20 % of the link capacity is used for speech transmission.

To reduce this waste of resources, discontinuous transmission (DTX) has been introduced for GSM. This method causes the mobile phone to stop transmitting when there is a pause in the conversation, i. e. there is no voice input to the mobile phone. This also saves battery power in the mobile phone. During pauses, the mobile phone only sends the minimum information required to maintain the link. To this effect, the phone transmits data via a control channel (SACCH) and sends SID speech frames at regular intervals (FIG 1).

The receiver uses the information from the SID frames to generate comfort noise during speech pauses by simulating the noise that would be present during speech transmission. This is considerably more pleasant for the subscriber at the receiving end than the total silence that would occur with the loudspeaker switched off completely.

The R&S®CMU 200 previously supported DTX only in the uplink. As already mentioned, the information from the SID frames transmitted by the mobile phone during a speech pause (referred to as DTX period in the following) causes the speech codec in the R&S®CMU 200 to generate comfort noise. With firmware V4.20 installed and the R&S®CMU-B21v14 signaling unit

More information and data sheet at www.rohde-schwarz.com (search term: CMU200)

REFERENCES
[*] Universal Radio Communication Tester R&S®CMU 200: Measuring bit error rate on GSM mobiles. News from Rohde & Schwarz (2000) No. 169, pp 11–13

FIG 1 104 TDMA multiframes without DTX (top) and with DTX for full-rate speech channel.

TCH Speech 0	TCH Speech 1	TCH Speech 2	TCH Speech 3	TCH Speech 4	TCH Speech 5	TCH Speech 6	TCH Speech 7	TCH Speech 8	TCH Speech 9	TCH Speech 10	TCH Speech 11	SACCH 12	TCH Speech 13	TCH Speech 14	TCH Speech 15	TCH Speech 16	TCH Speech 17	TCH Speech 18	TCH Speech 19	TCH Speech 20	TCH Speech 21	TCH Speech 22	TCH Speech 23	TCH Speech 24	Idle 25
TCH Speech 26	TCH Speech 27	TCH Speech 28	TCH Speech 29	TCH Speech 30	TCH Speech 31	TCH Speech 32	TCH Speech 33	TCH Speech 34	TCH Speech 35	TCH Speech 36	TCH Speech 37	SACCH 38	TCH Speech 39	TCH Speech 40	TCH Speech 41	TCH Speech 42	TCH Speech 43	TCH Speech 44	TCH Speech 45	TCH Speech 46	TCH Speech 47	TCH Speech 48	TCH Speech 49	TCH Speech 50	Idle 51
TCH Speech 52	TCH Speech 53	TCH Speech 54	TCH Speech 55	TCH Speech 56	TCH Speech 57	TCH Speech 58	TCH Speech 59	TCH Speech 60	TCH Speech 61	TCH Speech 62	TCH Speech 63	SACCH 64	TCH Speech 65	TCH Speech 66	TCH Speech 67	TCH Speech 68	TCH Speech 69	TCH Speech 70	TCH Speech 71	TCH Speech 72	TCH Speech 73	TCH Speech 74	TCH Speech 75	TCH Speech 76	Idle 77
TCH Speech 78	TCH Speech 79	TCH Speech 80	TCH Speech 81	TCH Speech 82	TCH Speech 83	TCH Speech 84	TCH Speech 85	TCH Speech 86	TCH Speech 87	TCH Speech 88	TCH Speech 89	SACCH 90	TCH Speech 91	TCH Speech 92	TCH Speech 93	TCH Speech 94	TCH Speech 95	TCH Speech 96	TCH Speech 97	TCH Speech 98	TCH Speech 99	TCH Speech 100	TCH Speech 101	TCH Speech 102	Idle 103

0	1	2	3	4	5	6	7	8	9	10	11	SACCH 12	13	14	15	16	17	18	19	20	21	22	23	24	Idle 25
26	27	28	29	30	31	32	33	34	35	36	37	SACCH 38	39	40	41	42	43	44	45	46	47	48	49	50	Idle 51
TCH SID 52	TCH SID 53	TCH SID 54	TCH SID 55	TCH SID 56	TCH SID 57	TCH SID 58	TCH SID 59	60	61	62	63	SACCH 64	65	66	67	68	69	70	71	72	73	74	75	76	Idle 77
78	79	80	81	82	83	84	85	86	87	88	89	SACCH 90	91	92	93	94	95	96	97	98	99	100	101	102	Idle 103

and R&S®CMU-B52v14 speech codec options fitted, the R&S®CMU 200 can now send SID frames also in the downlink.

In the echo/loop mode this works even if the optional speech codec is not installed. The R&S®CMU 200 previously transmitted neutral FACCH filler frames during speech pauses of the mobile phone to replace the missing speech frames. The R&S®CMU 200 was, however, not able to return received SID frames in half-rate and adaptive multirate (AMR) operation due to the channel structure. This problem has been overcome with the R&S®CMU 200 now supporting DTX in the downlink. The mobile radio tester now returns to the mobile phone exactly the information it has received, i.e. a speech frame, an SID frame, or a speech pause.

The downlink DTX is configured via three additional parameters (FIG 2). "Handset DTX Enable" switches DTX in the optional speech codec on or off. With DTX switched on, the codec will generate either speech or SID frames, depending on the audio input signal. Irrespective of whether the speech codec option is installed, the filler signal sent by the R&S®CMU 200 during a speech pause can be configured by means of the other two parameters. "BFI/DTX Filling Signal – Type" defines the signal to be sent during a speech pause; either a pseudo-random sequence or dummy bursts can be sent. "BFI/DTX Filling Signal – Level" defines the level of the filler signal relative to the useful signal. The signal thus defined is also used for the test case described below, which relies on the support of downlink DTX.

BFI test

Supporting downlink DTX, the R&S®CMU 200 can now also perform the bad frame indication (BFI) test. This test is an integral part of the 3GPP TS 51.010 GSM test specification (section 14.1.x). The R&S®CMU 200 performs it on all known speech channels (FIG 3). According to the test specification, a mobile phone may fail to detect maximally one speech frame per second during a DTX period. The R&S®CMU 200 simulates a base station in DTX operation, i.e. it generates a signal as shown in FIG 1. The test is performed using the mechanisms known from BER measurements. For the test, loop A in the mobile phone is closed. If the phone receives speech frames containing non-correctable class 1a bit errors – caused by the filler signal sent by the tester – while the loop is closed, it will return these frames as erased frames. In a normal BER measurement, these frames would increase the frame error rate (FER) [*]. The BFI test, however, basically functions like an inverse FER measurement. It is not the erased frames that are counted but the number of times the mobile phone erroneously returns a speech frame while it is expected to return erased frames only.

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FIG 2 Typical configuration of DTX/BFI parameters.

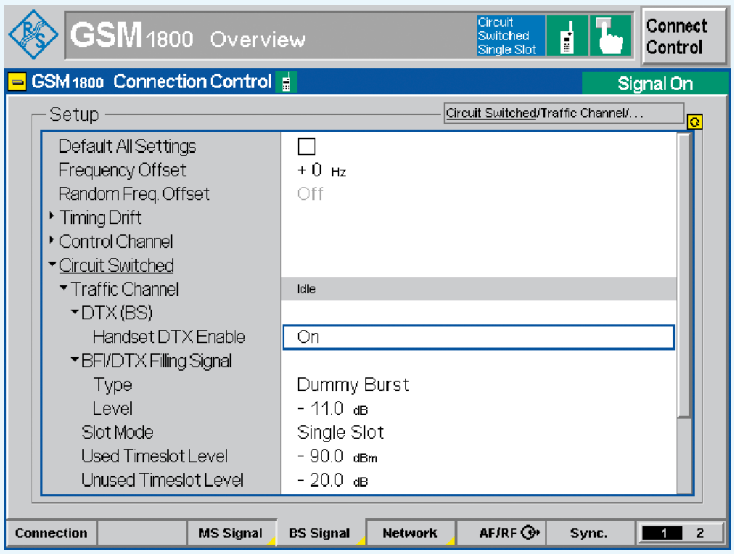

FIG 3 In-progress BFI measurement for full-rate version 1 speech channel.