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Physical Layer on the Radio Path: General Description

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1. Reason for changes

No changes since the previously distributed version.

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**European digital cellular
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Physical Layer on the Radio Path:
General Description**

ETSI

European Telecommunications Standards Institute

ETSI Secretariat: B.P.152 . F - 06561 Valbonne Cedex . France

TP. + 33 92 94 42 00 TF. + 33 93 65 47 16 Tx. 47 00 40 F

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PREFATORY NOTE

ETSI has constituted stable and consistent documents which give specifications for the implementation of the European Cellular Telecommunications System. Historically, these documents have been identified as "GSM recommendations".

Some of these recommendations may subsequently become Interim European Telecommunications Standards (I-ETTs) or European Telecommunications Standards (ETTs), whilst some continue with the status of ETSI-GSM Technical Specifications. These ETSI-GSM Technical Specifications are for editorial reasons still referred to as GSM recommendations in some current GSM documents.

The numbering and version control system is the same for ETSI-GSM Technical Specifications as for "GSM recommendations".

FACCH blocks). These blocks are interleaved over a number of interleaved blocks which is channel dependent. All these operations are specified in Rec.05.03.

Type of channel	bits/block data+parity+tail ¹	convol. code rate	coded bits per block	interleav. depth
TCH/FS		456	8	
class I ²	182 + 3 + 4	1/2	(378)	
class II	78 + 0 + 0	-	(78)	
TCH/HS tbd	tbd	tbd	tbd	
TCH/F9.6	4*60 + 0 + 4	244/456	456	19
TCH/F4.8	60 + 0 + 16	1/3	228	19
TCH/H4.8	4*60 + 0 + 4	244/456	456	19
TCH/F2.4	72 + 0 + 4	1/6	456	8
TCH/H2.4	72 + 0 + 4	1/3	228	19
FACCHs	184 + 40 + 4	1/2	456	8
SDCCHs SACCHs	184 + 40 + 4	1/2	456	4
BCCH AGCH PCH
RACH	8 + 6 + 4	1/2	36	1
SCH	25 + 10 + 4	1/2	78	1

Notes:

- 1) The tail bits mentioned here are the tail bits of the convolutional code.
- 2) The 3 parity bits for TCH/FS detect an error on 50 bits of class I.

8. MODULATION:

The modulation scheme is gaussian MSK (GMSK) with BT = 0.3. As already mentioned the modulation rate is 1625/6 kbit/s (\approx 270.83 kbit/s). This scheme is specified in detail in Rec. 05.04 (Modulation and demodulation).

9. TRANSMISSION AND RECEPTION:

The modulated stream is then transmitted on a radio frequency carrier. The overall frequency band available is the band ~~890-915~~1710-1785 MHz (mobile transmit) and ~~935-960~~1805-1880 MHz (base transmit). The RF channel spacing is 200 kHz, allowing for ~~124~~374 radio frequency channels in the entire band, thus leaving a guard band of 200 kHz at each end of the subbands.

The specific RF channels, together with the requirements on the transmitter and the receiver will be found in Rec. 05.05 (Transmission and reception). In the radio subsystem, provision has been made for the possible use of extended bands in the future. Together with the GSM bands, three different frequency bands are allowed on a national basis.

In order to allow for low power consumption for different ~~classes~~categories of mobiles (~~eg. vehicle mounted, hand held, ...~~), ~~52~~ different power classes have been defined. The maximum power class is ~~20~~1W peak output power (ca ~~2.50~~0.125 W mean output power) and the minimum is ~~0.80~~0.25 W peak output power. Those classes are specified in Rec.05.05.

The requirements on the overall transmission quality together with the measurement conditions are also in Rec.05.05.

10. OTHER LAYER 1 FUNCTIONS:

The transmission involves other functions. These functions may necessitate the handling of specific protocols between BS and MS. Relevant topics for these cases are:

- 1) the power control mechanisms which adjust the output level of the mobile station (and optionally of the base station) in order to ensure that the required quality is achieved with the less possible radiated power. Sixteen power levels, with 2 dB steps, have been defined for that purpose. This is described in Rec.05.08 (radio subsystem link control) and Rec.05.05.
- 2) the synchronisation of the receiver with regard to frequency and time (time acquisition and time frame alignment). The synchronisation problems are described in Rec.05.10 (synchronisation aspects).
- 3) the hand-over and quality monitoring which are necessary to allow a mobile to continue a call during a change of physical channel. This can occur either because of degradation of the quality of the current serving channel, or because of the availability of another channel which can allow communication at a lower Tx power level, or to prevent a MS from grossly exceeding the planned cell boundaries.

The choice of the new channel is done by the network (base station control and MSC) based on measurements (on its own and on adjacent base stations) that are sent on a continuous basis by the mobile station via the SACCHs. The requirements are specified in Rec. 05.08 (radio subsystem link control).

- 4) the strategy of first selection or reselection of a base station by a mobile, together with the idle mode activity (listening to CCCH, sleep mode,..) are specified in Rec.05.08 (radio subsystem link control).

11. PERFORMANCE:

Under typical urban fading conditions (ie multipath delays no greater than 5 us), the quality threshold for full-rate speech is reached at a C/I value of approximately 9 dB and the maximum sensitivity is approximately -104 dBm for ~~mobile and base stations~~ and ~~-102-100~~ -100 dBm for hand-helds.

Recommendation 05.01-DCS PHYSICAL LAYER ON THE RADIO PATH GENERAL DESCRIPTION

1. SCOPE:

This recommendation is an introduction to the 05 series of the GSM recommendations. It is not of a mandatory nature, but consists in a general description of the organisation of the physical layer with reference to the recommendations where each part is specified in details. It introduces furthermore, the reference configuration that will be used throughout this series of recommendations.

GSM 05.01-DCS consists of GSM 05.01 with sections 1, 9 and 11 in this document replacing those in GSM 05.01.

2. SET OF CHANNELS:

The radio subsystem provides a certain number of logical channels that can be separated into two categories according to Rec.04.03:

1) the traffic channels (TCH): they are intended to carry two types of user information streams: encoded speech and data. Two types of traffic channels are defined: Bm or full-rate (TCH/F) and Lm or half-rate (TCH/H) traffic channels. For the purpose of this series of recommendations, the following traffic channels are distinguished:

- full rate speech TCH (TCH/FS)
- half rate speech TCH (TCH/HS)
- 9.6 kbit/s full rate data TCH (TCH/F9.6)
- 4.8 kbit/s full rate data TCH (TCH/F4.8)
- 4.8 kbit/s half rate data TCH (TCH/H4.8)
- ≤ 2.4 kbit/s full rate data TCH (TCH/F2.4)
- ≤ 2.4 kbit/s half rate data TCH (TCH/H2.4)
- cell broadcast channel (CBCH)

2) the signaling channels: these can be sub-divided into BCCH (broadcast control channel), CCCH (common control channel), SDCCH (stand-alone dedicated control channel) and ACCH (associated control channel). An associated control channel is always allocated in conjunction with, either a TCH, or a SDCCH. Two types of ACCH are defined: continuous stream (slow ACCH) and burst stealing mode (fast ACCH). For the purpose of this series of recommendations, the following signalling channels are distinguished:

- stand-alone dedicated control channel, four of them mapped on the same basic physical channel as the CCCH (SDCCH/4)
- stand-alone dedicated control channel, eight of them mapped on a separate basic physical channel (SDCCH/8)
- full rate fast associated control channel (FACCH/F)
- half rate fast associated control channel (FACCH/H)
- slow, TCH/F associated, control channel (SACCH/TF)
- slow, TCH/H associated, control channel (SACCH/TH)
- slow, SDCCH/4 associated, control channel (SACCH/C4)
- slow, SDCCH/8 associated, control channel (SACCH/C8)
- broadcast control channel (BCCH)
- random access channel (ie uplink CCCH) (RACH)

GSM Recommendation: 05.01-DCS

Title: PHYSICAL LAYER ON THE RADIO PATH: GENERAL DESCRIPTION

Date : January, 1991

Version 3.0.0 (based on GSM 05.01 version 3.3.2)

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