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Digital cellular telecommunications system (Phase 2+) (GSM); Multiplexing and multiple access on the radio path (GSM 05.02 version 8.5.1 Release 1999)

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Special Mobile Group (SMG).

The present document defines the physical channels of the radio sub-system required to support the logical channels of the digital mobile cellular and personal communication systems operating in the 900 MHz and 1 800 MHz band (GSM 900 and DCS 1 800).

The contents of the present document are subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of the present document it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 8.x.y

where:

8 indicates release 1999 of GSM Phase 2+.

x the second digit is incremented for changes of substance, i.e. technical enhancements, corrections, updates, etc.

y the third digit is incremented when editorial only changes have been incorporated in the specification.

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Date of adoption of this EN:	17 November 2000
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1 Scope

The present document defines the physical channels of the radio sub-system required to support the logical channels. It includes a description of the logical channels and the definition of frequency hopping, TDMA frames, timeslots and bursts.

1.1 References

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1999 document, references to GSM documents are for Release 1999 versions (version 8.x.y).

[1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 03.03: "Digital cellular telecommunications system (Phase 2+); Numbering, addressing and identification".

[3] GSM 04.03: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Channel structures and access capabilities".

[4] GSM 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[5] GSM 04.08: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[6] GSM 05.03: "Digital cellular telecommunications system (Phase 2+); Channel coding".

[7] GSM 05.04: "Digital cellular telecommunications system; Modulation".

[8] GSM 05.05: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception".

[9] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[10] GSM 05.10: "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization".

[11] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS Radio Interface; Stage 2".

[12] GSM 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS interface; Radio Link Control (RLC) and Medium Access Control (MAC) Layer Specification".

[13] GSM 03.52: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS), Phase 1; Lower layers of the CTS Radio Interface; Stage 2".

[14] GSM 04.56: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS), Phase 1; CTS radio interface layer 3 specification".

[15] GSM 05.56: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS), Phase 1; CTS-FP radio subsystem".

1.2 Abbreviations

Abbreviations used in the present document are listed in GSM 01.04 [1].

2 General

The radio subsystem is required to support a certain number of logical channels that can be separated into two categories as defined in GSM 04.03:

i) the traffic channels (TCH's);

ii) the control channels.

More information is given about these logical channels in clause 3 which also defines a number of special channels used by the radio sub-system.

Clause 4 of the present document describes the physical resource available to the radio sub-system, clause 5 defines physical channels based on that resource and clause 6 specifies how the logical channels shall be mapped onto physical channels. Figure 1 depicts this process.

3 Logical channels

3.1 General

This clause describes the logical channels that are supported by the radio subsystem.

3.2 Traffic channels

3.2.1 General

Traffic channels (TCH's) are intended to carry either encoded speech or user data in circuit switched mode. Two general forms of traffic channel are defined:

i) Full rate traffic channel (TCH/F). This channel carries information at a gross rate of 22,8 kbit/s.

ii) Half rate traffic channel (TCH/H). This channel carries information at a gross rate of 11,4 kbit/s.

iii) Enhanced circuit switched full rate traffic channel (E-TCH/F). This channel carries information at a gross rate of 69,6 kbit/s including the stealing symbols.

Packet data traffic channels (PDTCH's) are intended to carry user data in packet switched mode. For the purpose of the present document, any reference to traffic channel does not apply to PDTCH unless explicitly stated.

All traffic channels are bi-directional unless otherwise stated. Unidirectional downlink full rate channels, TCH/FD, are defined as the downlink part of the corresponding TCH/F.

Multiple full rate channels can be allocated to the same MS. This is referred to as multislot configurations, which is defined in clause 6.4.2.1.

Multiple packet data traffic channels can be allocated to the same MS. This is referred to as multislot packet configurations, as defined in clause 6.4.2.2.

A combination of a half rate traffic channel and a half rate packet data traffic channel on the same basic physical channel can be allocated to the same MS as defined in clause 6.4.2.3.

A combination of a traffic channel and one or more full rate packet data traffic channels can be allocated to the same MS.

The specific traffic channels available in the categories of speech and user data are defined in the clauses following.

3.2.2 Speech traffic channels

The following traffic channels are defined to carry encoded speech:

i) full rate traffic channel for speech (TCH/FS);

ii) half rate traffic channel for speech (TCH/HS);

iii) enhanced full rate traffic channel for speech (TCH/EFS);

iv) adaptive full rate traffic channel for speech (TCH/AFS);

v) adaptive half rate traffic channel for speech (TCH/AHS).

3.2.3 Circuit switched data traffic channels

The following traffic channels are defined to carry user data:

i) full rate traffic channel for 9,6 kbit/s user data (TCH/F9.6);

ii) full rate traffic channel for 4,8 kbit/s user data (TCH/F4.8);

iii) half rate traffic channel for 4,8 kbit/s user data (TCH/H4.8);

iv) half rate traffic channel for ≤ 2,4 kbit/s user data (TCH/H2.4);

v) full rate traffic channel for ≤ 2,4 kbit/s user data (TCH/F2.4);

vi) full rate traffic channel for 14,4 kbit/s user data (TCH/F14.4);

vii) enhanced circuit switched full rate traffic channel for 28,8 kbit/s user data (E-TCH/F28.8);

viii) enhanced circuit switched full rate traffic channel for 32,0 kbit/s user data (E-TCH/F32.0);

ix) enhanced circuit switched full rate traffic channel for 43.2 kbit/s user data (E-TCH/F43.2).

3.2.4 Packet data traffic channels (PDTCH)

A PDTCH/F corresponds to the resource allocated to a single MS on one physical channel for user data transmission. Due to the dynamic multiplexing onto the same physical channel of different logical channels (see clause 6.3.2), a PDTCH/F using GMSK modulation carries information at an instantaneous bit rate ranging from 0 to 22,8 kbit/s. A PDTCH/F using 8PSK modulation carries information (including stealing symbols) at an instantaneous bit rate ranging from 0 to 69,6 kbit/s.

A PDTCH/H corresponds to the resource allocated to a single MS on half a physical channel for user data transmission. The maximum instantaneous bit rate for a PDTCH/H is half that for a PDTCH/F.

All packet data traffic channels are uni-directional, either uplink (PDTCH/U), for a mobile originated packet transfer or downlink (PDTCH/D) for a mobile terminated packet transfer.

3.3 Control channels

3.3.1 General

Control channels are intended to carry signalling or synchronization data. Four categories of control channel are defined: broadcast, common, dedicated and CTS control channels. Specific channels within these categories are defined in the clauses following.

3.3.2 Broadcast channels

3.3.2.1 Frequency correction channels (FCCH and CFCCH)

The frequency correction channel carries information for frequency correction of the mobile station. It is required only for the operation of the radio sub-system. Different mapping is used for FCCH and COMPACT CFCCH (see clause 7).

3.3.2.2 Synchronization channels

The synchronization channel carries information for frame synchronization of the mobile station and identification of a base transceiver station. It is required only for the operation of the radio sub-system. Different channels are used for SCH and COMPACT CSCH.

3.3.2.2.1 Synchronization channel (SCH)

Specifically the synchronization channel (SCH) shall contain two encoded parameters:

a) Base transceiver station identity code (BSIC): 6 bits (before channel coding) consists of 3 bits of PLMN colour code with range 0 to 7 and 3 bits of BS colour code with range 0 to 7 as defined in GSM 03.03.

b) Reduced TDMA frame number (RFN): 19 bits (before channel coding) =

T1 (11 bits) range 0 to 2047 = FN div (26 x 51)

T2 (5 bits) range 0 to 25 = FN mod 26

T3 ' (3 bits) range 0 to 4 = (T3 - 1) div 10

where

T3 (6 bits) range 0 to 50 = FN mod 51

and

FN = TDMA frame number as defined in clause 4.3.3.

GSM 04.06 and GSM 04.08 specify the precise bit ordering, GSM 05.03 the channel coding of the above parameters and GSM 05.10 defines how the TDMA frame number can be calculated from T1, T2, and T3'.

3.3.2.2.2 COMPACT synchronization channel (CSCH)

The COMPACT packet synchronization channel CSCH shall contain two encoded parameters:

a) Base transceiver station identity code (BSIC): 6 bits (before channel coding) consists of 3 bits of PLMN colour code with range 0 to 7 and 3 bits BS colour code with range 0 to 7 as defined in GSM 03.03.

b) Reduced TDMA frame number (RFN): 19 bits (before channel coding) =

R1 (10 bits) range 0 to 1023 = FN div (51 x 52)

R2 (6 bits) range 0 to 50 = (FN div 52) mod 51

TG (2 bits) range 0 to 3

Reserved (1 bit)

where

FN = TDMA frame number as defined in clause 4.3.3

and

TG = time group as defined in clause 4.3.4.

GSM 04.06 and GSM 04.08 specify the precise bit ordering, GSM 05.03 the channel coding of the above parameters and GSM 05.10 defines how the TDMA frame number can be calculated from R1 and R2.

3.3.2.3 Broadcast control channel (BCCH)

The broadcast control channel broadcasts general information on a base transceiver station per base transceiver station basis. Of the many parameters contained in the BCCH, the use of the following parameters, as defined in GSM 04.08 are referred to in clause 6.5:

a) CCCH_CONF which indicates the organization of the common control channels:

From this parameter, the number of common control channels (BS_CC_CHANS) and whether or not CCCH or SDCCH are combined (BS_CCCH_SDCCH_COMB = true or false) are derived as follows:

CCCH_CONF	BS_CC_CHANS	BS_CCCH_SDCCH_COMB
000	1	false
001	1	true
010	2	false
100	3	false
110	4	false

b) BS_AG_BLKS_RES which indicates the number of blocks on each common control channel reserved for access grant messages:

3 bits (before channel coding) range 0 to 7.

c) BS_PA_MFRMS which indicates the number of 51-multiframes between transmission of paging messages to mobiles of the same paging group:

3 bits (before channel coding) range 2 to 9.

d) support of GPRS

The BCCH shall indicate whether or not packet switched traffic is supported. If packet switched traffic is supported and if the PBCCH exists, then the BCCH shall broadcast the position of the packet data channel (PDCH), as defined in clause 6.3.2.1, carrying the PBCCH.

3.3.2.4 Packet Broadcast Control Channels

3.3.2.4.1 Packet Broadcast Control Channel (PBCCH)

The PBCCH broadcasts parameters used by the MS to access the network for packet transmission operation. In addition to those parameters the PBCCH reproduces the information transmitted on the BCCH to allow circuit switched operation, such that a MS in GPRS attached mode monitors the PBCCH only, if it exists. The existence of the PBCCH in the cell is indicated on the BCCH. In the absence of PBCCH, the BCCH shall be used to broadcast information for packet operation.

Of the many parameters contained in the PBCCH, the use of the following parameters, as defined in GSM 04.60 are referred to in clauses 6.5 and 6.3.2:

a) BS_PBCCH_BLKS (1,...,4) indicates the number of blocks allocated to the PBCCH in the multiframe. The position of the PBCCH blocks is based on the ordered list as defined in clause 6.3.2.1.

b) BS_PCC_CHANS indicates the number of physical channels carrying PCCCHs including the physical channel carrying the PBCCH

c) BS_PAG_BLKS_RES indicates the number of blocks on each PDCH carrying PCCCH per multiframe where neither packet paging nor PBCCH should appear. This number corresponds therefore to the number of blocks reserved for PAGCH, PNCH, PDTCH and PACCH. The position of these blocks is based on the ordered list as defined in clause 6.3.2.1.

d) BS_PRACH_BLKS indicates the number of blocks reserved in a fixed way to the PRACH channel on any PDCH carrying PCCCH. The position of the PRACH blocks is based on the ordered list as defined in clause 6.3.2.1.

3.3.2.4.2 COMPACT Packet Broadcast Control Channel (CPBCCH)

The CPBCCH is a stand-alone packet control channel for COMPACT. The CPBCCH broadcasts parameters used by the MS to access the network for packet transmission operation.

Of the many parameters contained in the CPBCCH, the use of the following parameters, as defined in GSM 04.60 are referred to in clauses 6.5 and 6.3.3:

a) BS_PBCCH_BLKS (1,…,4) indicates the number of blocks allocated to the CPBCCH in the multiframe. The position of the CPBCCH blocks is based on the ordered list as defined in clause 6.3.2.1.

b) BS_PCC_CHANS indicates the number of radio frequency channels per cell carrying CPCCCHs including the radio frequency channel carrying the CPBCCH.

c) BS_PAG_BLKS_RES indicates the number of blocks on each radio frequency channel carrying CPCCCH per multiframe where neither packet paging nor CPBCCH should appear. This number corresponds therefore to the number of blocks reserved for CPAGCH, CPNCH, PDTCH, and PACCH. The position of these blocks is based on the ordered list as defined in clause 6.3.2.1. BS_PAG_BLKS_RES cannot be greater than 8.

d) BS_PRACH_BLKS indicates the number of blocks reserved in a fixed way to the CPRACH channel on any radio frequency channel carrying CPCCCH. The position of the CPRACH blocks is based on the ordered list as defined in clause 6.3.2.1.

e) NIB_CCCH_0, NIB_CCCH_1, NIB_CCCH_2, and NIB_CCCH_3 indicate the number of downlink blocks per multiframe designated as idle to protect CPBCCH and CPCCCH blocks for non-serving time groups. The downlink position is based on the ordered list and rotation rule as defined in clause 6.3.2.1.

f) LARGE_CELL_OP indicates which type of cell size is used: nominal or large.

3.3.3 Common control type channels

3.3.3.1 Common control type channels, known when combined as a common control channel (CCCH)

i) Paging channel (PCH): Downlink only, used to page mobiles.

ii) Random access channel (RACH): Uplink only, used to request allocation of a SDCCH.

iii) Access grant channel (AGCH): Downlink only, used to allocate a SDCCH or directly a TCH.

iv) Notification channel (NCH): Downlink only, used to notify mobile stations of voice group and voice broadcast calls.

3.3.3.2 Packet Common control channels

3.3.3.2.1 Packet Common Control Channels (PCCCH)

i) Packet Paging channel (PPCH): Downlink only, used to page MS.

ii) Packet Random access channel (PRACH): Uplink only, used to request allocation of one or several PDTCHs (for uplink or downlink direction).

iii) Packet Access grant channel (PAGCH): Downlink only, used to allocate one or several PDTCH.

iv) Packet Notification channel (PNCH): Downlink only, used to notify MS of PTM-M call.

If a PCCCH is not allocated, the information for packet switched operation is transmitted on the CCCH. If a PCCCH is allocated, it may transmit information for circuit switched operation.

3.3.3.2.2 COMPACT Common Control Channels (CPCCCH)

i) Packet Paging channel (CPPCH): Downlink only, used to page MS.

ii) Packet Random access channel (CPRACH): Uplink only, used to request allocation of one or several PDTCHs (for uplink or downlink direction).

iii) Packet Access grant channel (CPAGCH): Downlink only, used to allocate one or several PDTCH.

iv) Packet Notification channel (CPNCH): Downlink only, used to notify MS of PTM-M call.

3.3.4 Dedicated control channels

3.3.4.1 Circuit switched dedicated control channels

i) Slow, TCH/F or E-TCH/F associated, control channel (SACCH/TF).

ii) Fast, TCH/F associated, control channel (FACCH/F).

iii) Slow, TCH/H associated, control channel (SACCH/TH).

iv) Fast, TCH/H associated, control channel (FACCH/H).

v) Stand alone dedicated control channel (SDCCH/8).

vi) Slow, SDCCH/8 associated, control channel (SACCH/C8)

vii) Stand alone dedicated control channel, combined with CCCH (SDCCH/4).

viii) Slow, SDCCH/4 associated, control channel (SACCH/C4).

ix) slow, TCH/F or E-TCH/F associated, control channel for multislot configurations (SACCH/M).

x) slow, TCH/F associated, control channel for CTS (SACCH/CTS).

xi) Fast, E-TCH/F associated, control channel (E-FACCH/F).

xii) Inband, E-TCH/F associated, control channel (E-IACCH/F).

All associated control channels have the same direction (bi-directional or unidirectional) as the channels they are associated to. The unidirectional SACCH/MD is defined as the downlink part of SACCH/M.

3.3.4.2 Packet dedicated control channels

i) The Packet Associated Control channel (PACCH): The PACCH is bi-directional. For description purposes PACCH/U is used for the uplink and PACCH/D for the downlink.