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GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

Digital cellular telecommunications system (Phase 2+); Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface (GSM 08.20)

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Foreword

This Global System for Mobile communications Technical Specification (GTS) has been produced by the Special Mobile Group (SMG) Technical Committee (TC) of the European Telecommunications Standards Institute (ETSI).

This GTS defines rate adaptation functions to be used within the digital cellular telecommunications system.

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

Version 5.x.y

where:

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

- x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The specification from which this GTS has been derived was originally based on CEPT documentation, hence the presentation of this GTS may not be entirely in accordance with the ETSI/PNE Rules.

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1 Scope

This Global System for Mobile communications Technical Specification (GTS) defines rate adaptation functions to be used in GSM PLMN Base Station Systems (BSS) transcoders and IWF for adapting radio interface data rates to the 64 kbit/s used at the A-interface in accordance with GSM 03.10.

The number of Base Station System - Mobile-services Switching Centre (BSS - MSC) traffic channels supporting data rate adaptation may be limited. In this case some channels may not support data rate adaptation. Those that do, must conform to this specification.

NOTE: This specification should be considered together with GSM 04.21 to give a complete description of PLMN rate adaptation.

2 Normative references

This GTS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this GTS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

[1] GSM 01.04 (ETR 350): "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 02.34: "Digital cellular telecommunications system (Phase 2+); High Speed Circuit Switched Data (HSCSD) - Stage 1"

[3] GSM 03.10: "Digital cellular telecommunications system (Phase 2+); GSM Public Land Mobile Network (PLMN) connection types".

[4] GSM 03.34: "Digital cellular telecommunications system (Phase2+); High Speed Circuit Switched Data (HSCSD) - Stage 2".

[5] GSM 04.21 (ETS 300 945): "Digital cellular telecommunications system; Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[6] GSM 04.22 (ETS 300 946): "Digital cellular telecommunications system (Phase 2+); Radio Link Protocol (RLP) for data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[7] GSM 05.03 (ETS 300 909): "Digital cellular telecommunications system (Phase 2+); Channel coding".

[8] GSM 07.01 (ETS 300 913): "Digital cellular telecommunications system (Phase 2+); General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[9] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile Services Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[10] GSM 09.07 (ETS 300 976): "Digital cellular telecommunications system (Phase 2+); General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[11] CCITT Recommendation V.110: "Support of data terminal equipment's (DTEs) with V-Series interfaces by an integrated services digital network".

[12] CCITT Recommendation I.460:-Multiplexing, rate adaption and support of existing interfaces.

2.1 Abbreviations and definitions

Abbreviations:

In addition to those below, abbreviations used in this specification are listed in GSM 01.04.

FSI Frame Start Identifier

Definitions:

Substream: Stream of data with explicit or implicit numbering between splitter and combine functions.

Channel: A physical full rate channel on the radio interface (TCH/F) independent of the contents.

A interface circuit: The 8 bits that constitute one 64 kbps circuit on the A interface.

A interface subcircuit: One specific bit position or one specific pair of bit positions within the A interface circuit.

3 General approach

GSM 03.10 (clause 6) defines the PLMN connection types necessary to support the GSM PLMN data and telematic services.

Within the BSS, transcoder and IWF, there are several data rate adaptation functions which are combined as shown in GSM 03.10 as part of a connection type.

These functions are RA0, RA1,RA1/RA1' , RA1" and RA2. The RA2 function is equivalent to that described in CCITT Recommendation V.110. In addition, splitting/combining, padding and inband numbering functions as defined in GSM 04.21 and multiplexing as defined herein are used in cases where more than one channel is allowed.

The RA1/RA1' is a relay function used as indicated in GSM 03.10.

The BSS uses the information contained in the ASSIGNMENT REQUEST message on the A-interface (see rec. GSM 08.08) to set the "E bits" and to map the "D bits" as shown below, as well as to choose the correct channel coding.

4 The RA0 Function

The RA0 function is specified in GSM 04.21.

5 The RA1 Function

For connections where only one channel is allowed used on the radio interface, the specification in GSM 04.21 for adaptation of synchronous data rates up to and including 9.6 kbit/s to intermediate rates 8 or 16 kbit/s applies.

For connection where more than one channel are used on the radio interface, rate adaptation is applied on the corresponding substreams as specified in GSM 04.21 for AIUR of 4.8 or 9.6 kbit/s.

6 The RA1" Function

The RA1" function is specified in GSM 04.21. The RA1" function is only applicable in BSS for AIUR higher than 38.4 kbit/s.

7 Split/Combine and Padding Functions

The Split/Combine-function in the IWF is used only in cases when more than one channel is allowed used for AIURs up to and including 38.4 kbit/s.

The Split/Combine-function in the BSS is used only when more than four channels are allowed for air interface user rates of 48, 56 and 64 kbit/s.

7.1 Data Frame distribution into the channels by the Split/Combine function

Described in GSM 04.21.

7.2 Substream numbering

Described in GSM 04.21.

7.3 Initial Substream Synchronization for Transparent Services

Described in GSM 04.21.

7.4 Synchronization

7.4.1 Initial Substream Synchronization

The Split/Combine function is responsible for controlling the initial V.110 frame synchronization procedure as described in GSM 09.07. 'Initial V.110 frame synchronization'.

7.4.2 Action on loss of V.110 frame synchronization for non-transparent services

If the IWF detects a loss of V.110 frame synchronization on one or more channels on the MSC/IWF-BSS interface, the IWF initiates a re-synchronization on the channels in question as specified in GSM 09.07 'Action on loss of frame synchronization for non-transparent services'.

7.4.3 Action on loss of V.110 frame synchronization for transparent services

If the IWF detects a loss of V.110 frame synchronization on one or more channels on the MSC/IWF-BSS interface, the IWF initiates a re-synchronization on the channels in question as specified in GSM 09.07 'Action on loss of frame synchronization for transparent services'.

7.5 Network Independent Clocking

NIC is specified in GSM 04.21.

7.6 Padding

Padding is specified in GSM 04.21.

8 The RA1/RA1' Function

For AIURs less or equal to 38.4 kbit/s, the RA1/RA1' function in the BSS is applied on each of the n substreams and there are no significant differences between the single slot case and the multislot case. For AIURs less or equal to 38.4 kbit/s RA1/RA1' is as specified in GSM 04.21 for the single slot case. The table below gives a relation between the AIUR, channel coding and number of substreams. As an example from table 1: The wanted AIUR is 28.8 kbit/s, the number of substreams needed to support this rate is 3. Each individual substream is rate adapted as in the single slot case.

For AIURs of 48 kbit/s, 56 kbit/s and 64 kbit/s, RA1/RA1" is as specified in GSM 04.21 for these rates.

Table 1: Relationship between AIUR, channel coding and number of channels

	Multislot intermediaterate 8 kbps		Multislot intermediate rate of 16 kbps	
AIUR	Transparent	Non-transparent	Transparent	Non-transparent
≤2.4 kbit/s	1	N/A	N/A	N/A
4.8 kbit/s	1	1	N/A	N/A
9.6 kbit/s	2	2	1	1
14.4 kbit/s	3	3	2	N/A
19.2 kbit/s	4	4	2	2
28.8 kbit/s	N/A	N/A	3	3
38.4 kbit/s	N/A	N/A	4	4
48 kbit/s	N/A	N/A	5	N/A
56 kbit/s	N/A	N/A	5	N/A
64 kbit/s	N/A	N/A	6	N/A

8.1 Radio Interface rate of 12 kbit/s

Described in GSM 04.21.

8.2 Radio Interface rate of 6 kbit/s

Described in GSM 04.21.

8.3 Radio Interface rate of 3.6 kbit/s

Described in GSM 04.21.

8.4 Synchronization

Refer to GSM 04.21.

8.5 Idle frames

Refer to GSM 04.21.

9 The RA2 Function

Described in GSM 04.21. The RA2 function is applicable only for single slot operations.

10 The Multiplexing Function

The multiplexing function is only applicable for AIUR up to and including 38.4 kbit/s for multislot operations.

The multiplexing function is based on the CCITT I.460. The multiplexing function is used to combine n (n=2 to 4) substreams of multislot intermediate rate of 8 kbit/s or n substreams of multislot intermediate rate of 16 kbit/s on one 64 kbit/s stream by using subcircuits in each octet to each substream such that:

i) An 8 kbit/s substream is allowed to occupy subcircuits with positions 1,3,5 or 7 of each octet of the 64 kbit/s stream; a 16 kbit/s stream occupies bit positions (1,2) or (3,4) or (5,6) or (7,8).

ii) The order of the bits at each substream is identical before and after multiplexing.

iii) All unused bit positions shall be set to binary "1".

iv) For transparent multislot configurations the lowest allowed subcircuits are always used.

v) For non-transparent multislot configurations, the lowest allowed subcircuits shall be used at call set up and after change of channel configuration except at downgrading. At downgrading any of the used subcircuits can be released. At a possible subsequent upgrading, the lowest available bit positions shall be used for the added substreams.

NOTE: The rules given here are almost identical to those of I.460, Section 'Fixed format multiplexing', except for the rule i) is stricter in that 8 kbit/s substreams cannot occupy any positions, iv) and v) are added.

11 Support of non-transparent bearer services

In the case of non-transparent services the RA1/RA1' function performs the same mapping as that described for transparent services, using 12 and 6 kbit/s radio interface data rates, with the following modification.

The E2 and E3 bits in the modified CCITT V.110 80 bit frames shown in figure 2 (derived from the standard CCITT V.110 frame shown in figure 1) are used to indicate each consecutive sequence of CCITT V.110 80 bit frames corresponding to the four modified CCITT V.110 60 bit frames (figure 3) received/transmitted in one radio interface frame. This allows 240 bit Radio Link Protocol frames to/from the MSC to be aligned with the 4x60 bit frames encoded by the radio subsystem channel coder as a single unit (see GSM 05.03). The 8 bits consisting of the E2 and E3 bits in one of the above sequences is referred to as the Frame Start Identifier. The FSI value is 00 01 10 11. This value is assigned to the E2 and E3 bits as shown in table 2.

Table 2

	E2	E3
First Modified CCITT V.110 80 bit frame	0	0
Second	0	1
Third	1	0
Fourth	1	1

As each RLP frame is transported between the BSS and MSC in four modified CCITT V.110 80 bit frames, it is necessary following a transmission break and at start up, to determine which modified CCITT V.110 80 bit frame of the stream is the first for a particular RLP frame. This is needed so that correct alignment with the radio subsystem can be achieved.

Modified V.110 80 bit frames can slip in time during re-routing, and whilst sync exists within the modified CCITT V.110 80 bit frame to determine the modified CCITT V.110 80 bit frame boundaries, the FSI is required to determine which quarter of an RLP frame each modified CCITT V.110 80 bit frame contains.

Table 3: Relationship between FNUR, AIUR, substream rate, number of substreams and intermediate rate

FNUR	AIUR	Number of Channels x Substream Rate	Channel Coding	Multislot Intermediate Rate
≤2.4 kbit/s	2.4 kbit/s	2-8 times duplication of each bit to reach 2.4 kbit/s	TCH/F4.8	8 kbit/s
4.8 kbit/s	4.8 kbit/s	4.8 kbit/s	TCH/F4.8	8 kbit/s
4.8 kbit/s	4.8 kbit/s	4.8 kbit/s	TCH/F9.6	16 kbit/s
9.6 kbit/s	9.6 kbit/s	2x4.8 kbit/s	2XTCH/4.8	16 kbit/s
9.6 kbit/s	9.6 kbit/s	9.6 kbit/s	TCH/F9.6	16 kbit/s
14.4 kbit/s	14.4 kbit/s	3X4.8 kbit/s	3XTCH/F4.8	8 kbit/s
14.4 kbit/s	19.2 kbit/s	2X9.6 kbit/s	2XTCH/F9.6	16 kbit/s
19.2 kbit/s	19.2 kbit/s	4X4.8 kbit/s	4XTCH/F4.8	8 kbit/s
19.2 kbit/s	19.2 kbit/s	2X9.6 kbit/s	2XTCH/F9.6	16 kbit/s
28.8 kbit/s	28.8 kbit/s	3X9.6 kbit/s	3XTCH/F9.6	16 kbit/s
38.4	38.4 kbit/s	4X9.6 kbit/s	4XTCH/F9.6	16 kbit/s

NOTE: The table above gives the relation between the FNUR, AIUR, Substream Rate, Channel Coding and Intermediate Rate. As an example: the wanted FNUR is 14.4 kbit/s and the selected channel coding is TCH/F9.6. The data stream is split into two substreams of 9.6 kbit/s yielding an AIUR of 19.2 kbit/s.

11.1 Alignment

An alignment window spanning four modified CCITT V.110 80 bit frames is used to search for the pattern of 8 bits described above in order to identify alignment with an RLP frame.

In the event of failure to detect the 8 bit pattern, the alignment window is shifted one complete modified V.110 80 bit frame, discarding the contents of the most historical frame and then checking the new 8 bit pattern.

11.2 Support of Discontinuous Transmission (DTX)

The E1 bit in the modified CCITT V.110 80 bit frame shown in figure 2 is used in the direction MSC-BSS to indicate that DTX may be invoked (see GSM 04.22). The E1 bit in all of the four consecutive frames relating to the RLP frame to which DTX may be applied shall be set to 1. If DTX is not to be applied, the E1 bit shall be set to 0.

In the direction BSS-MSC the E1 bit shall always be set to 0.

11.3 Order of Transmission

The first bit of each quarter of an RLP frame to be transmitted will correspond to bit D1 of a modified V.110 frame (figures 2 and 3). The remaining 59 bits of each quarter of an RLP frame will correspond to the D and D' bits , D2 - D'12, in order left to right and top to bottom as shown in figures 2 and 3.

The first quarter of an RLP frame to be transmitted will contain the E2 and E3 bit code 00 as shown in table 1. The second quarter will contain the code 01, etc.

12 Support of transparent bearer services

12.1 User rate adaptation on the A interface, AIUR less or equal to 38.4 kbit/s

The CCITT V.110 80 bit frame is used for transparent data on the A interface. These frames are transmitted on up to four substreams multiplexed into one stream sent over the A interface. The split/combine function is applied on the substreams as specified in clause 5 of this GSM. The relation between the AIUR and the number of channels is specified in table 3.

The 64 kbit/s consists of octets, bits 1 through 8, with bit 1 transmitted first.

For a 9 600 b/s air interface user rate the V.110 frame is carried with a 16 kb/s stream which occupies bit positions (1,2).

For air interface user rates of either 4 800 b/s, 2 400 b/s, 1 200 b/s, 300 b/s or 1 200/75 b/s the V.110 frame is carried with a 8 kb/s stream which occupies bit position (1). For user rates < 1 200 b/s asynchronous characters are padded with additional stop elements by the RA0 function (in the MSC/IWF) to fit into 600 b/s synchronous RA1 rate prior to rate adaptation to 64 kb/s.

No use of 4 kb/s stream is foreseen.

In a given V.110 frame on the A interface:

- for 9 600 b/s there is no repetition of bits D within the 16 kb/s stream ;
- for 4 800 b/s there is no repetition of bits D within the 8 kb/s stream ;
- for 2 400 b/s each bit D is repeated twice within the 8 kb/s stream (D1 D1 D2 D2 etc.) ;
- for 1 200 b/s each bit D is repeated four times within the 8 kb/s stream (D1 D1 D1 D1 D2 D2 D2 D2 etc.) ;
- for 600 b/s each bit D is repeated eight times within the 8kb/s stream (D1 D1 D1 D1 D1 D1 D1 D1 D2 D2 D2 D2 D2 D2 D2 D2 etc.);

- for 1 200/75 b/s each bit D is repeated four times within the 8 kb/s stream for 1 200 b/s. 75 bit/s will be padded by additional stop elements to fit 600 b/s by the RA0 function. For the resulting 600 b/s each bit D is repeated eight times within the 8 kb/s stream.

12.2 User rate Adaptation on the A-interface, AIUR greater than 38.4 kbit/s

For AIUR of 48 kbit/s, 56 kbit/s and 64 kbit/s one stream consisting of CCITT V.110 32 bit frames or 64 bit frames, as specified in GSM 04.21 is transmitted over the A-interface. Splitting/Combining which occurs in the BSS, is as specified in GSM 04.21.

Table 3 gives the relation between the User Rate, Substream Rate Channel Coding and the Intermediate Rate.

12.3 Relation between AIUR and the number of channels

Table 4: Relationship between the AIUR, substream rate, channel coding, intermediate rate and number of channels

AIUR	Number of channels x Substream Rate	Channel Coding	(Multislot) intermediate Rate (Note1)
≤2.4 kbit/s	2-8 times duplication of each bit to reach 4.8 kbit/s	TCH/F4.8	8 kbit/s
4.8 kbit/s	4.8 kbit/s	TCH/F4.8	8 kbit/s
9.6 kbit/s	2X4.8 kbit/s	2XTCH/F4.8	8 kbit/s
9.6 kbit/s	9.6 kbit/s	TCH/F9.6	16 kbit/s
14.4 kbit/s	3X4.8 kbit/s	3XTCH/F4.8	8 kbit/s
14.4 kbit/s	2X9.6 kbit/s w/ padding	2XTCH/F9.6	16 kbit/s
19.2 kbit/s	4X4.8 kbit/s	4XTCH/F4.8	8 kbit/s
19.2 kbit/s	2X9.6 kbit/s	2XTCH/F9.6	16 kbit/s
28.8 kbit/s	3x9.6 kbit/s	3XTCH/F9.6	16 kbit/s
38.4 kbit/s	4X9.6 kbit/s	4XTCH/F9.6	16 kbit/s
48 kbit/s	5X9.6 kbit/s	5XTCH/F9.6	64 kbit/s
56 kbit/s	5X11.2 kbit/s	5XTCH/F9.6	64 kbit/s
64 kbit/s	66x11.2 kbit/s w/padd.	6XTCH/F9.6	64 kbit/s

NOTE 1: For AIURs ≤ 38.4 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate.

12.4 Handling of status bits X, SA, SB

In the single slot case, status bit SA is coded repeatedly as S1, S3, S6, S8, and SB is coded repeatedly as S4 and S9 in figure 1. In the multislot case, status bit SA is coded repeatedly as S6,S8 and SB is coded as S9 in figures 1,4 and 5.

The handling of the status bits will comply with the synchronization procedures for transparent services which are as described in GSM 09.07 (MSC), GSM 04.21 (BSS), GSM 07.01 (MS).

12.5 Handling of bits E1 to E7

Bits E1 to E3 are used according to 04.21.

Bits E4 to E7 may be used for network independent clocking as indicated in GSM 04.21.

Octet No.	Bit number							
	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	1	D1	D2	D3	D4	D5	D6	S1
2	1	D7	D8	D9	D10	D11	D12	X
3	1	D13	D14	D15	D16	D17	D18	S3
4	1	D19	D20	D21	D22	D23	D24	S4
5	1	E1	E2	E3	E4	E5	E6	E7
6	1	D25	D26	D27	D28	D29	D30	S6
7	1	D31	D32	D33	D34	D35	D36	X
8	1	D37	D38	D39	D40	D41	D42	S8
9	1	D43	D44	D45	D46	D47	D48	S9

Figure 1: The CCITT V.110 80 bit frame for Transparent Data

octet no.	bit number							
	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	1	D1	D2	D3	D4	D5	D6	D'1
2	1	D7	D8	D9	D10	D11	D12	D'2
3	1	D13	D14	D15	D16	D17	D18	D'3
4	1	D19	D20	D21	D22	D23	D24	D'4
5	1	E1	E2	E3	D'5	D'6	D'7	D'8
6	1	D25	D26	D27	D28	D29	D30	D'9
7	1	D31	D32	D33	D34	D35	D36	D'10
8	1	D37	D38	D39	D40	D41	D42	D'11
9	1	D43	D44	D45	D46	D47	D48	D'12

Figure 2: The modified CCITT V.110 80 bit frame for Non-Transparent Data

D1	D2	D3	D4	D5	D6	D'1
D7	D8	D9	D10	D11	D12	D'2
D13	D14	D15	D16	D17	D18	D'3
D19	D20	D21	D22	D23	D24	D'4
D'5	D'6	D'7	D'8	D25	D26	D27
D28	D29	D30	D'9	D31	D32	D33
D34	D35	D36	D'10	D37	D38	D39
D40	D41	D42	D'11	D43	D44	D45
D46	D47	D48	D'12			

Figure 3: Modified CCITT V.110 60 bit frame for Non-Transparent Data

octet no.	bit number							
	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	1	D1	D2	D3	D4	D5	D6	S1
2	1	D7	D8	D9	D10	D11	D12	X
3	1	D13	D14	D15	D16	D17	D18	S3
4	1	D19	D20	D21	D22	D23	D24	S4
5	1	E1	E2	E3	E4	E5	E6	E7
6	1	1	1	1	1	1	1	S6
7	1	1	1	1	1	1	1	X
8	1	1	1	1	1	1	1	S8
9	1	1	1	1	1	1	1	S9

Figure 4: The modified CCITT V.110 80 bit frame padded for 4.8 kbit/s transparent data at intermediate rate 16 kbit/s

History

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