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EUROPEAN
TELECOMMUNICATION
STANDARD

ETS 300 737

February 1998

Second Edition

Source: SMG

Reference: RE/SMG-020860QR1

ICS: 33.020

Key words: Digital cellular telecommunications system, Global System for Mobile communications (GSM)

![GSM logo]

**GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS**

Digital cellular telecommunications system (Phase 2+);
Inband control of remote transcoders and rate adaptors for
Enhanced Full Rate (EFR) and full rate traffic channels
(GSM 08.60 version 5.1.1)

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Contents

Foreword

This European Telecommunication Standard (ETS) has been produced by the Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI).

This ETS specifies the inband control of remote transcoders and rate adaptors for full rate speech, Enhanced Full rate speech and full rate data within the Digital cellular telecommunications system (Phase 2+).

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

Transposition dates	
Date of adoption of this ETS:	23 January 1998
Date of latest announcement of this ETS (doa):	31 May 1998
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	30 November 1998
Date of withdrawal of any conflicting National Standard (dow):	30 November 1998

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1   Scope

When 64 kbit/s traffic channels are used on the Abis interface, the speech shall be coded according to CCITT Recommendation G.711 and the data rate adaptation shall be as specified in GSM 04.21 and GSM 08.20.

In the case where 16 kbit/s traffic channels are used for full rate speech or enhanced full rate speech or full rate data service, then this specification shall apply for frame structure and for control of remote transcoders and additional rate adaptors.

The use and general aspects of the Abis interface are given in GSM 08.51.

> NOTE: This specification should be considered together with the GSM 06 series of specifications, GSM 04.21 (Rate Adaptation on the MS-BSS Interface) and GSM 08.20 (Rate Adaptation on the BS/MSC Interface).

1.1   Normative references

This ETS 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 ETS 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 04.06 (ETS 300 938): "Digital cellular telecommunications system; Mobile Station - Base Station System (MS - BSS) interface; Data Link (DL) layer specification".

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

[4]   GSM 06.01 (ETS 300 960): "Digital cellular telecommunications system; Full rate speech; Processing functions".

[5]   GSM 06.10 (ETS 300 961): "Digital cellular telecommunications system; Full rate speech; Transcoding".

[6]   GSM 06.11 (ETS 300 962): "Digital cellular telecommunications system; Full rate speech; Substitution and muting of lost frames for full rate speech channels".

[7]   GSM 06.12 (ETS 300 963): "Digital cellular telecommunications system; Full rate speech; Comfort noise aspect for full rate speech traffic channels".

[8]   GSM 06.31 (ETS 300 964): "Digital cellular telecommunications system; Full rate speech; Discontinuous Transmission (DTX) for full rate speech traffic channels".

[9]   GSM 06.32 (ETS 300 965): "Digital cellular telecommunications system; Voice Activity Detector (VAD)".

[10]   GSM 08.20: "Digital cellular telecommunications system; Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[11]   GSM 08.51: "Digital cellular telecommunications system; Base Station Controller - Base Transceiver Station (BSC - BTS) interface; General aspects".

[12]   GSM 08.54: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 1 structure of physical circuits".

[13]   GSM 08.58: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface; Layer 3 specification".

[14]   GSM 12.21 (ETS 300 623): "Digital cellular telecommunications system (Phase 2); Network Management (NM) procedures and message on the A-bis interface".

[15]   CCITT Recommendation G.711: "Pulse code modulation (PCM) of voice frequencies".

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

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

[18]   GSM 06.51 (ETS 300 723): "Digital cellular telecommunications system; Enhanced Full rate speech processing functions".

[19]   GSM 06.60 (ETS 300 726): "Digital cellular telecommunications system; Enhanced Full rate speech transcoding".

[20]   GSM 06.61 (ETS 300 727): "Digital cellular telecommunications system; Substitution and muting of lost frames for Enhanced Full rate speech channels".

[21]   GSM 06.62 (ETS 300 728): "Digital cellular telecommunications system; Comfort noise aspect for Enhanced Full rate speech traffic channels".

[22]   GSM 06.81 (ETS 300 729): "Digital cellular telecommunications system; Discontinuous Transmission (DTX) for Enhanced Full rate speech traffic channel".

[23]   GSM 06.82 (ETS 300 730): "Digital cellular telecommunications system; Voice Activity Detection (VAD)".

1.2   Abbreviations

Abbreviations used in this specification are listed in GSM 01.04.

2   General Approach

When the transcoders/rate adaptors are positioned remote to the BTS, the information between the Channel Codec Unit (CCU) and the remote Transcoder/Rate Adaptor Unit (TRAU) is transferred in frames with a fixed length of 320 bits (20 mS). In this specification, these frames are denoted "TRAU frames". Within these frames, both the speech/data and the TRAU associated control signals are transferred.

The Abis interface should be the same if the transcoder is positioned 1) at the MSC site of the BSS or if it is positioned 2) at the BSC site of the BSS. In case 1), the BSC should be considered as transparent for 16 kbit/s channels.

In case of 4,8 and 9,6 kbit/s channel coding when data is adapted to the 320 bit frames, a conversion function is required in addition to the conversion/rate adaption specified in GSM 08.20. This function constitutes the RAA. In case of 14,5 kbit/s channel coding, no RAA rate adaption is required because V.110 framing is not used.

The TRAU is considered a part of the BSC, and the signalling between the BSC and the TRAU (e.g. detection of call release, handover and transfer of O&M information) may be performed by using BSC internal signals. The signalling between the CCU and the TRAU, using TRAU frames as specified in this specification, is mandatory when the Abis interface is applied.

NOTE: If standard 64 kbit/s switching is used in the BSC, multiplexing according to CCITT Recommendation I.460 should apply at both sides of the switch.

In figure 2.1, a possible configuration of the TRAU and the CCU is shown.

The functions inside the TRAU are:

- "Remote Transcoder and Rate Adaptor Control Function" (RTRACF);
- "Remote Speech Handler Function" (RSHF);
- The RAA function in case of 4.8 and 9.6 kbit/s channel coding;
- The RAA' function in case of 14.5 kbit/s channel coding;
- The RA2 function;
- The transcoder function.

The functions inside the CCU are:

- "Transcoder and Rate Adaptor Control Function" (TRACF);
- "Speech Handler Function" (SHF);
- The RAA function in case of 4.8 and 9.6 kbit/s channel coding;
- The RA1/RA1' function in case of 4.8 and 9.6 kbit/s channel coding;
- The RA1'/RAA' function in case of 14.5 kbit/s channel coding;
- The channel codec function.

This specification will not describe the procedures inside the TRAU and the CCU. The layout in figure 2.1 is only intended as a reference model.

BSC   BTS

TRAU (TRANSCODER/RA UNIT)   CCU (CHANNEL CODEC UNIT)

Trans-   Remote   Speech
coder   Speech   Handler
Function   Handler   Function
(Note)   Function   Speech

Speech

                                 Abis
                     Remote   Trans-   Channel
        64 kbit/s   Transcoder   coder and   Codec
                     and RA   RA Control   Function
                     Contr. Fn.   Function

                                 16 Kbit/s   Radio
                                 320 bit/   frames
                                 20 mS

Data   L3 Control
                                                      signals

RA2   RAA   RAA   RA1   RA1´
                                                        Data

————— Speech/data
. . . . Control
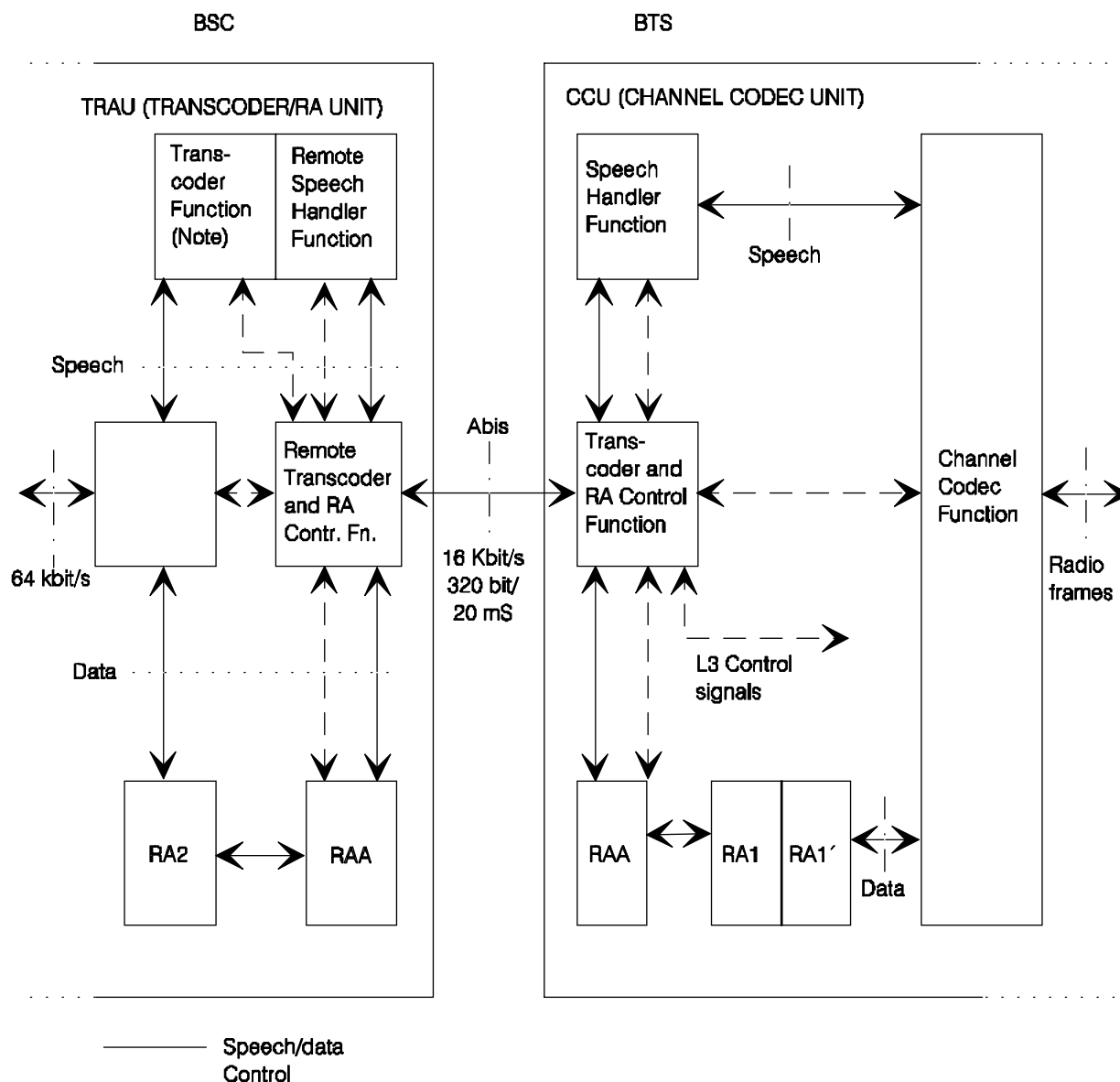
NOTE: This recommendation assumes the DTX handler function to be a part of the Transcoder Function.

Figure 2.1: Functional entities for handling of remote control of remote transcoders and rate adaptors

NOTE: This figure applies only for 4,8 and 9,6 kbit/s channel coding

3 Frame Structure

3.1 Speech Frames

Octet no.	Bit number							
	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	1	C1	C2	C3	C4	C5	C6	C7
3	C8	C9	C10	C11	C12	C13	C14	C15
4	1	D1	D2	D3	D4	D5	D6	D7
5	D8	D9	D10	D11	D12	D13	D14	D15
6	1	D16	D17	D18	D19	D20	D21	D22
7	D23	D24	D25	D26	D27	D28	D29	D30
8	1	D31	D32	D33	D34	D35	D36	D37
9	D38	D39	D40	D41	D42	D43	D44	D45
10	1	D46	D47	D48	D49	D50	D51	D52
11	D53	D54	D55	D56	D57	D58	D59	D60
12	1	D61	D62	D63	D64	D65	D66	D67
13	D68	D69	D70	D71	D72	D73	D74	D75
14	1	D76	D77	D78	D79	D80	D81	D82
15	D83	D84	D85	D86	D87	D88	D89	D90
16	1	D91	D92	D93	D94	D95	D96	D97
17	D98	D99	D100	D101	D102	D103	D104	D105
18	1	D106	D107	D108	D109	D110	D111	D112
19	D113	D114	D115	D116	D117	D118	D119	D120
20	1	D121	D122	D123	D124	D125	D126	D127
21	D128	D129	D130	D131	D132	D133	D134	D135
22	1	D136	D137	D138	D139	D140	D141	D142
23	D143	D144	D145	D146	D147	D148	D149	D150
24	1	D151	D152	D153	D154	D155	D156	D157
25	D158	D159	D160	D161	D162	D163	D164	D165
26	1	D166	D167	D168	D169	D170	D171	D172
27	D173	D174	D175	D176	D177	D178	D179	D180
28	1	D181	D182	D183	D184	D185	D186	D187
29	D188	D189	D190	D191	D192	D193	D194	D195
30	1	D196	D197	D198	D199	D200	D201	D202
31	D203	D204	D205	D206	D207	D208	D209	D210
32	1	D211	D212	D213	D214	D215	D216	D217
33	D218	D219	D220	D221	D222	D223	D224	D225
34	1	D226	D227	D228	D229	D230	D231	D232
35	D233	D234	D235	D236	D237	D238	D239	D240
36	1	D241	D242	D243	D244	D245	D246	D247
37	D248	D249	D250	D251	D252	D253	D254	D255
38	1	D256	D257	D258	D259	D260	C16	C17
39	C18	C19	C20	C21	T1	T2	T3	T4

3.2 O&M Frames

Octet no.	Bit number							
	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	1	C1	C2	C3	C4	C5	C6	C7
3	C8	C9	C10	C11	C12	C13	C14	C15
4	1	D1	D2	D3	D4	D5	D6	D7
5	D8	D9	D10	D11	D12	D13	D14	D15
6	1	D16	D17	D18	D19	D20	D21	D22
7	D23	D24	D25	D26	D27	D28	D29	D30
8	1	D31	D32	D33	D34	D35	D36	D37
9	D38	D39	D40	D41	D42	D43	D44	D45
10	1	D46	D47	D48	D49	D50	D51	D52
11	D53	D54	D55	D56	D57	D58	D59	D60
12	1	D61	D62	D63	D64	D65	D66	D67
13	D68	D69	D70	D71	D72	D73	D74	D75
14	1	D76	D77	D78	D79	D80	D81	D82
15	D83	D84	D85	D86	D87	D88	D89	D90
16	1	D91	D92	D93	D94	D95	D96	D97
17	D98	D99	D100	D101	D102	D103	D104	D105
18	1	D106	D107	D108	D109	D110	D111	D112
19	D113	D114	D115	D116	D117	D118	D119	D120
20	1	D121	D122	D123	D124	D125	D126	D127
21	D128	D129	D130	D131	D132	D133	D134	D135
22	1	D136	D137	D138	D139	D140	D141	D142
23	D143	D144	D145	D146	D147	D148	D149	D150
24	1	D151	D152	D153	D154	D155	D156	D157
25	D158	D159	D160	D161	D162	D163	D164	D165
26	1	D166	D167	D168	D169	D170	D171	D172
27	D173	D174	D175	D176	D177	D178	D179	D180
28	1	D181	D182	D183	D184	D185	D186	D187
29	D188	D189	D190	D191	D192	D193	D194	D195
30	1	D196	D197	D198	D199	D200	D201	D202
31	D203	D204	D205	D206	D207	D208	D209	D210
32	1	D211	D212	D213	D214	D215	D216	D217
33	D218	D219	D220	D221	D222	D223	D224	D225
34	1	D226	D227	D228	D229	D230	D231	D232
35	D233	D234	D235	D236	D237	D238	D239	D240
36	1	D241	D242	D243	D244	D245	D246	D247
37	D248	D249	D250	D251	D252	D253	D254	D255
38	1	D256	D257	D258	D259	D260	D261	D262
39	D263	D264	S1	S2	S3	S4	S5	S6

3.3 Data Frames

3.3.1 Data Frame (for Synchronisation)

Octet no.	Bit number							
	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	1	C1	C2	C3	C4	C5	C6	C7
3	C8	C9	C10	C11	C12	C13	C14	C15
4	1							.
5	1							.
6	1							.
7	1			Data frame position 1				
8	1			63 bits.				
9	1			(72 bits including bit position 1)				
10	1							
11	1							
12	1							
13	1							
14	1							
15	1							
161	1			Data frame position 2				
17	1							
18	1							
19	1							
20	1							
21	1							
22	1							
23	1							
24	1							
25	1			Data frame position 3				
26	1							
27	1							
28	1							
29	1							
30	1							
31	1							
32	1							
33	1			Data frame position 4				
34	1							
35	1							
36	1							
37	1							
38	1							
39	1							

3.3.2 Extended data frame (E-TRAU : data transport)

					Bit number			
Octet no.	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	1	C1	C2	C3	C4	C5	C6	C7
3	C8	C9	C10	C11	C12	C13	M1	M2
4	D1	D2	...					
5								
6								
7			Data block of 288 data bits and M1, M2.					
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39							... D287	D288

3.4 Idle Speech Frames

Octet no.	Bit number 1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	1	C1	C2	C3	C4	C5	C6	C7
3	C8	C9	C10	C11	C12	C13	C14	C15
4	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1	1
19	1	1	1	1	1	1	1	1
20	1	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1	1
23	1	1	1	1	1	1	1	1
24	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1	1
26	1	1	1	1	1	1	1	1
27	1	1	1	1	1	1	1	1
28	1	1	1	1	1	1	1	1
29	1	1	1	1	1	1	1	1
30	1	1	1	1	1	1	1	1
31	1	1	1	1	1	1	1	1
32	1	1	1	1	1	1	1	1
33	1	1	1	1	1	1	1	1
34	1	1	1	1	1	1	1	1
35	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1
37	1	1	1	1	1	1	1	1
38	1	1	1	1	1	1	C16	C17
39	C18	C19	C20	C21	T1	T2	T3	T4

3.5 Coding

In the following sections, the coding of the frames is described. Any spare or not used control bits should be coded binary "1".

For all frame types the octet 0, 1 and the first bit of octets 2, 4, 6, 8, ... 38 are used as frame sync.

3.5.1 Coding of Speech Frames

Control bits (C-bits):

Description	Uplink	Downlink
Frame type FR (Bits C1 - C5). EFR	C1C2C3C4 C5 Speech: 0 0 0 1 0. Speech: 1 1 0 1 0	C1C2C3C4 C5 Speech: 1 1 1 0 0 Speech: 1 1 0 1 0
Time Alignment (Bits C6 - C11)	Binary number indicating the required timing adjustment to be made in steps of 250/500 µs.	Binary number indicating the timing adjustment made.

	The following values apply for the coding
	C6C7 . . . C11
	0 0 0 0 0 0 No change in frame timing
	0 0 0 0 0 1 Delay frame 1 x 500 µs
	0 0 0 0 1 0 Delay frame 2 x 500 µs
	     . . . .
	     . . . .
	1 0 0 1 1 1 Delay frame 39 x 500 µs
	1 0 1 0 0 0 Not used
	     . . . .
	1 1 1 1 0 1 Not used
	1 1 1 1 1 0 Delay frame 1 x 250 µs
	1 1 1 1 1 1 Advance frame 250 µs	

Frame indicators. The definition and coding of these indicators are given in GSM 06.31. Bits C12 - C16 Downlink Uplink Frame Error (UFE) C12 (see subclause 4.8.3)	C12: BFI 0 : BFI = 0 1 : BFI = 1 C13 C14: SID 0 0 :SID = 0 0 1 :SID = 1 1 0 :SID = 2 C15: TAF 0 : TAF = 0 1 : TAF = 1 C16: Spare	C12 - C15: Spare IF FR. Speech ELSE C12: UFE 0 :UFE=0 bad uplink frame 1 : UFE=1 good up-link frame C13 - C15: spare C16: SP 0 : SP = 0 1 : SP = 1
DTX indicator	C17: DTXd 0 : DTX not applied 1 : DTX applied	C17: Spare
Bits C18 - C21	Spare	Spare

Data Bits (D-bits):

Bits D1 .. D260:   Speech block transferred in the same order as output from the transcoder (see GSM 06.10).

For Enhanced Full Rate Speech:

The speech block is subdivided in five subsets. The order within a given subset is the same as output from the transcoder (see ETS 300 726, GSM 06.60). Three parity bits are added at the end of each sub-set.

These parity bits are added to the bits of the subset, according to a degenerate (shortened) cyclic code using the generator polynomial:

$$g(D) = D^3 + D + 1$$

The encoding of the cyclic code is performed in a systematic form which means that, in GF(2), the polynomial:

$$d(m)D^n + d(m+1)D^{n-1} + ...+ d(m + n-3)D^3 + p(0)D^2 + p(1)D + p(2)$$

where p(0), p(1), p(2) are the parity bits, when divided by g(D), yields a remainder equal to:

$$1 + D + D^2$$

For every CRC, the transmission order is p(0) first followed by p(1) and p(2) successively.

Bit D1   :   spare (binary "1").

Bits D2...D39   :   Indexes of the LSF submatrices.

Bits D40...D42   :   CRC over bits D1 to D22, D25 to D27 and D29.

Bits D43...D95   :   Indexes of the parameters of first sub-frame.

Bits D96...D98   :   CRC over bits D43 to D52, D91 and D92.

Bits D99...D148   :   Indexes of the parameters of second sub-frame.

Bits D149...D151   :   CRC over bits D99 to D103, D105, D144 and D145.

Bits D152...D204   :   Indexes of the parameters of third sub-frame.

Bits D205...D207   :   CRC over bits D152 to D161, D200 and D201.

Bits D208...D257   :   Indexes of the parameters of fourth sub-frame.

Bits D258...D260   :   CRC over bits D208 to D212, D214, D253 and D254.

Time Alignment Bits:

Bits T1 .. T4:   Bits positioned at the end of the downlink frames. If the timing of the frame is to be advanced 250 μS, these 4 bits are not transferred in order to reduce the frame length accordingly. When transferred the bits are set to binary "1".

3.5.2 Coding of O&M Frames

Control bits (C-bits):

Description	Uplink	Downlink
Frame type Bits C1 - C5	C1C2C3C4 C5 0 0 1 0 1 : O&M	C1C2C3C4 C5 1 1 0 1 1 : O&M
Bits C6 - C15	Spare	Spare

Data Bits (D-bits):

Bits D1 .. D264: Bits used for transfer of O&M information. The coding and use of these bits are left to the manufacturer of the BSC/TRAU.

Spare Bits:

Bits S1 .. S6: Spare

3.5.3 Coding of Data Frames

Control bits (C-bits):

Description	Uplink	Downlink
Frame type. Bits C1 - C5	C1C2C3C4 C5 0 1 0 0 0 : Data except 14.5 1 0 1 0 0 : Data14.5[1]	C1C2C3C4 C5 1 0 1 1 0 : Data except 14.5 1 0 1 0 0 : Data 14.5[1]
Intermediate RA bit rate. Bit C6 for data services except 14.5 Spare for Data 14.5	0: 8 kbit/s 1: 16 kbit/s Spare	0: 8 kbit/s 1: 16 kbit/s Spare
Bits C7 - C15	Spare	Spare

NOTE 1: The Data frame is in case of data 14.5 kbit/s used only for synchronization purposes. The data bits are in this case set according to subclause 4.5.1.

3.5.4 Coding of Extended Data Frames

Control bits (C-bits):

Description	Uplink	Downlink
Frame type. Bits C1 - C5	C1C2C3C4 C5 1 1 1 1 1 : Extended Data frame 14.5 kbit/s	C1C2C3C4 C5 1 1 1 1 1 : Extended data Frame 14.5
Bit C6 Idle/Data/UFE	Idle/data Frame indication	UFE
Bits C7 - C13	Spare	Spare
Multi Frame Structure defined in GSM 04.21 Bits M1, M2	M1, M2	M1, M2

3.5.5 Coding of Idle Speech Frames

Control bits (C-bits):

Description	Uplink	Downlink
Frame type. Bits C1 - C5	C1C2C3C4 C5 1 0 0 0 0 : Idle Speech	C1C2C3C4 C5 0 1 1 1 0 : Idle Speech
Bits C6 - C21	Coding as for Speech frames.	Coding as for Speech frames.

Time Alignment Bits:

Bits T1 .. T4: Coding as for Speech frames.

3.6. Order of Bit Transmission

The order of bit transmission is:

The first octet is transferred first with the bit no. 1 first, bit no. 2 next etc.

4 Procedures

4.1 Remote Control of Transcoders and Rate Adaptors

When the transcoder is positioned remote to the BTS, the Channel Codec Unit (CCU) in the BTS has to control some of the functions in the remote Transcoder/Rate Adaptor Unit (TRAU) in the BSC.

This remote control is performed by inband signalling carried by the control bits (C-bits) in each TRAU frame.

The following functions in the TRAU are remotely controlled by the CCU:

- Shift between speech and data.
- Control of the rate adaption functions for data calls.
- Downlink frame timing for speech frames.
- Transfer of DTX information.

In addition, the inband signalling also provides means for transfer of O&M signals between the TRAU and the BSC/BTS.

4.2 Resource Allocation

At reception of the ASSIGNMENT REQUEST message, e.g. at call setup, when a circuit switched connection is required, the BSC provides an appropriate TRAU to the circuit to be used between the BSC and the BTS and sends the CHANNEL ACTIVATION message to the BTS.

When receiving the CHANnel ACTIVation message, the BTS allocates the appropriate radio resources and a Channel Codec Unit (CCU) to be used.

In case of Speech or Data (except 14.5 kbit/s):

> The CCU now starts sending uplink frames with the appropriate "Frame Type" and, for data calls, the intermediate rate adaption bit rate set.

> When receiving the first frame, the TRAU sets the mode of operation accordingly and starts sending downlink frames with the "Frame Type" and, for data calls, the intermediate rate adaption bit rate set as an acknowledgement indication.

In case of Data 14.5 kbit/s:

> The CCU starts sending uplink Data TRAU Frames with the appropriate "Frame Type" set to establish initial synchronization.

> When receiving the first frame, the TRAU sets the mode of operation accordingly and as an acknowledgement starts sending downlink Data TRAU Frames with the same "Frame Type".

> The CCU starts sending uplink Extended Data TRAU Frames with the appropriate "Frame Type" set upon reception of that acknowledge indication.

> When receiving the first frame, when the "Frame Type" is set to Extended Data TRAU frame, the TRAU sets the mode of operation accordingly and as an acknowledgement starts sending downlink Extended Data TRAU frames with the same "Frame Type".

4.3 Resource Release

At release of circuit switched resources, e.g. at call release, the connection between the CCU and the TRAU will be released by the BSC. The BSC has to indicate that the connection has been released. How this is performed is a BSC internal matter. However, three methods have been identified.

i) The BSC indicates the call release to the TRAU by inserting the PCM idle bit pattern described in GSM 08.54 on the circuits towards the TRAU. The TRAU shall be able to detect this idle bit pattern. When received at the TRAU, the TRAU will loose frame synchronization and will start timer Tsync (see section 4.8.2). If, when Tsync expires, the idle bit pattern has been detected, the TRAU shall terminate the operation (go idle) until a valid frame is again received.

ii) This alternative does not apply to Enhanced Full Rate Speech, Data 14.5 kbit/s case.

> After a call release, the TRAU downlink channel is switched to the TRAU uplink channel (16 kbit/s side).

> The TRAU shall be able to detect the looped downlink frame. When it is detected, the TRAU shall terminate the normal operation (go idle) until a valid uplink TRAU frame is again received.

iii) It is handled by BSC internal signals (e.g. if the BSC and TRAU are collocated).

4.4 In Call Modification

If the subscriber orders "In Call Modification", the CCU sets the "Frame Type" and, for data calls, the inter mediate rate adaption bit rate in the uplink frames to the new mode of operation. When receiving this information, the TRAU changes the mode of operation accordingly and sets the new "Frame Type" and, for

data calls, the intermediate rate adaption bit rate in the downlink frames. The same procedure applies for mode change between Data 14,5 kbit/s.

In case of mode change to data 14,5 kbit/s from Speech or Data (other than 14.5 kbit/s) the same procedure as for "Resource Allocation" is performed.

4.5 Transfer of Idle Frames

Between the TRAU and the CCU a TRAU frame shall be transferred every 20 mS.

4.5.1 In Full rate data case:

If no data is received from the MS (uplink direction) or no data is received from the MSC side of the interface (downlink direction), idle data frames shall be transferred instead of data frames. Idle data frames are data frames with all data bit positions set to binary "1". In addition, for 14,5 kbit/s channel coding; the C6 bit shall be set to '1' in the uplink extended data frame.

4.5.2 In Full rate speech case:

If no speech is received from the MS (uplink direction), the CCU shall send TRAU speech frames with BFI flag set to 1 (bad frame) or idle speech frames.If no speech is received from the MSC side of the interface (downlink direction), idle speech frames shall be transferred instead of speech frames.

4.5.3 In Enhanced Full rate speech case:

If no speech is received from the MS (uplink direction), the CCU shall send TRAU speech frames with BFI flag set to 1 (bad frame). If no speech is received from the MSC side of the interface (downlink direction), idle speech frames shall be transferred instead of speech frames.

4.6 Procedures for Speech Frames

4.6.1 Time Alignment of Speech Frames

The time alignment needed for obtaining minimum buffer delay will differ from call to call. The reasons for this are:

- The BSC will have no information about the radio timing at the BTS, and will start sending frames at an arbitrary or default time. Each TRAU frame is 320 bits (20 mS) and will in the worst case be received at the BTS 319 bits out of phase.

- The different timeslots on one carrier is sent at different times (max 4.04 mS which equals 7 timeslots in a TDMA radio frame).

- Different channels may be transferred on different transmission systems using different routes in the network. The transmission delay may therefore differ.

The required time alignment between radio frames and TRAU frames is considered to be an internal BTS matter for uplink frames. However, the buffer delay for these frames should be kept to a minimum.

For downlink frames, the procedures in the following sections should apply. In order to describe the time alignment procedure in the TRAU, two time alignment states are described (Initial Time Alignment state and Static Time Alignment state).

In order to achieve optimum timing between the radio TDMA frames and the frames on the transmission side, the speech coding and decoding function in the transcoder should not be synchronized.

4.6.1.1 Initial Time Alignment State

The TRAU shall enter the Initial Time Alignment state at the switching-on of the system, when it goes idle (e.g. when receiving the PCM idle pattern after a call release as described in section 4.3), if loss of frame

synchronization is detected, in call modification from data to speech is performed or if BSS internal handover is detected.

In the initial state, the frames shall only be delayed (or no change)(see note). The transcoder is able to adjust the time for transmitting the speech frames in steps of 125 µS (one speech sample). The CCU calculates the required timing adjustment and returns a frame including the number of 250/500 µS steps by which the frames in the downlink direction have to be delayed (binary number in the "Time Alignment" field).

When receiving this information, the TRAU processes this data and sets the "Time Alignment" field in the next downlink frame as ordered and then delays the subsequent frame accordingly.

> NOTE: If the TRAU, in this state, receives an order to advance the next frame 250 µS, this order shall be interpreted as "Delay frame 39*500 µS".

When a frame is delayed due to timing adjustments, the TRAU shall fill in the gap between the frames with the appropriate number of binary "1".

After having adjusted the timing, the TRAU shall receive at least three new frames before a new adjustment is made. This in order to avoid oscillation in the regulation.

The TRAU shall change from the Initial Time Alignment state to the Static Time Alignment state when it has performed two subsequent timing adjustments which are less than 500 µS (including no change).

The procedure is illustrated in figure 4.1.

4.6.1.2 The Static Time Alignment State

In the Static Time Alignment state, the TRAU performs timing adjustments in single steps of 250 µS. The timing may either be delayed (time alignment code 111110, advanced (time alignment code 111111) or not changed (time alignment code 000000).

When receiving an order for adjusting the timing, the transcoder skips or repeats two speech samples in order to achieve the correct timing.

If the timing is to be advanced 250 µS, the TRAU sets the "Time Alignment" field in the next downlink frame as ordered and then the 4 last bits of the frame are not transferred (the T-bits).

If the timing is to be delayed, the TRAU sets the "Time Alignment" field in the next downlink frame as ordered and then delays the subsequent frame by adding four binary "1" between the frames.

After having adjusted the timing, the TRAU shall receive at least three new frames before a new adjustment is made.

If, in this state, the TRAU detects a change in the timing of the uplink frames bigger than n x 250 µS, where n = 4, it shall enter the Initial Time Alignment state and in that state it may perform an adjustment on the downlink equal to the change detected on the uplink.
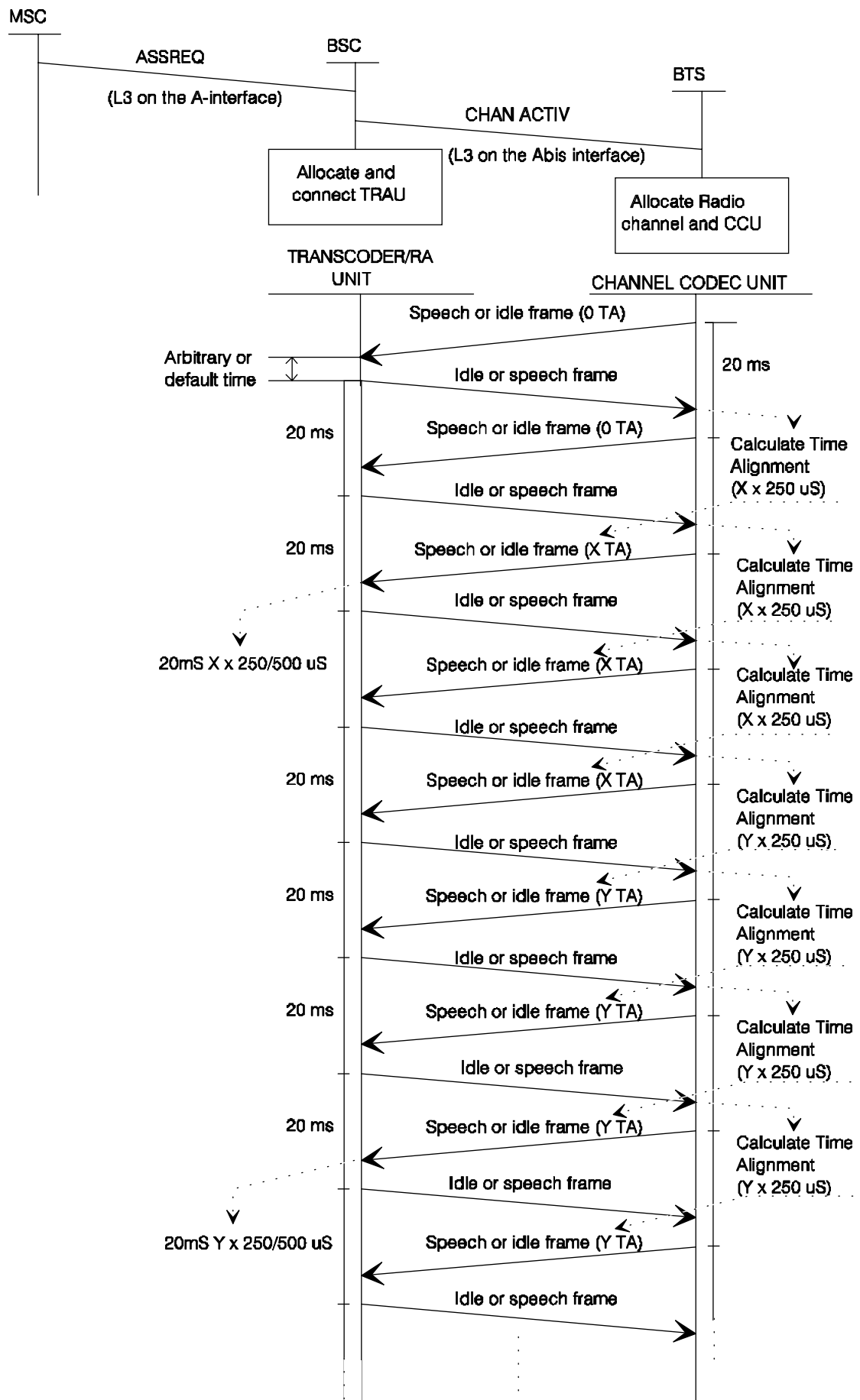
MSC

ASSREQ

(L3 on the A-interface)

BSC

CHAN ACTIV

BTS

(L3 on the Abis interface)

Allocate and
connect TRAU

Allocate Radio
channel and CCU

TRANSCODER/RA
UNIT

CHANNEL CODEC UNIT

Speech or idle frame (0 TA)

Arbitrary or
default time

Idle or speech frame

20 ms

20 ms
Speech or idle frame (0 TA)

Calculate Time
Alignment
(X x 250 uS)

Idle or speech frame

20 ms
Speech or idle frame (X TA)

Calculate Time
Alignment
(X x 250 uS)

Idle or speech frame

20mS X x 250/500 uS
Speech or idle frame (X TA)

Calculate Time
Alignment
(X x 250 uS)

Idle or speech frame

20 ms
Speech or idle frame (X TA)

Calculate Time
Alignment
(Y x 250 uS)

Idle or speech frame

20 ms
Speech or idle frame (Y TA)

Calculate Time
Alignment
(Y x 250 uS)

Idle or speech frame

20 ms
Speech or idle frame (Y TA)

Calculate Time
Alignment
(Y x 250 uS)

Idle or speech frame

20 ms
Speech or idle frame (Y TA)

Calculate Time
Alignment
(Y x 250 uS)

Idle or speech frame

20mS Y x 250/500 uS
Speech or idle frame (Y TA)

Idle or speech frame

Figure GSM 08.60/4.1:   Initial Time Alignment procedure

4.6.1.3   Initiation at Resource Allocation

When the BTS receives the CHANNEL ACTIVATION message from the BSC, it allocates the appropriate radio resources and a Channel Codec Unit (CCU). The CCU then initiates sending of speech frames (or idle speech frames if speech is not received from the MS) towards the transcoder with normal frame phase for the TDMA channel in question. The "Time Alignment" field in these frames is set to "no change".

The TRAU will now be in the Initial Time Alignment state. When receiving the first frame it shall start sending speech frames (or idle speech frames) towards the BTS with arbitrary or default phase related to the uplink frame phase.

When receiving these frames the CCU calculates the timing adjustment required in order to achieve minimum buffer delay and sets the "Time Alignment" field in the uplink frames accordingly.

The procedures described for the Initial and for the Static Time Alignment states are then followed during the call.

4.6.1.4   Time Alignment During Handover

4.6.1.4.1   BSS External Handover

For BSS external handover, the procedure described in section 4.6.1.3 should be used by the new BSC/BTS at resource allocation.

4.6.1.4.2   BSS Internal Handover

If a BSS internal handover has been performed, the timing of the downlink frames may have to be adjusted several steps of 250/500 µS. In order to speed up the alignment of the downlink frames, this must be detected by the TRAU, e.g. by detecting the change in the uplink frame timing as described in section 4.6.1.2. The TRAU should then enter the Initial Time Alignment state and in that state it may perform an adjustment on the downlink equal to the change detected on the uplink.

4.6.2   Procedures for Discontinuous Transmission (DTX)

The procedures for comfort noise are described in GSM 06.12, for Full rate speech and in GSM 06.62 (ETS 300 728) for Enhanced Full rate speech, the overall operation of DTX is described in GSM 06.31 and in GSM 06.81 (ETS 300 729) for respectively Full rate speech and Enhanced Full rate speech and the Voice Activity Detector is described in GSM 06.32 and   GSM 06.82 (ETS 300 730) for respectively Full rate speech and Enhanced full rate speech.

The DTX Handler function is considered as a part of the TRAU when remote transcoders are applied. The specification of the DTX Handler is given in GSM 06.31 for Full rate speech and in GSM 06.81 (ETS 300 729) for Enhanced Full Rate speech.

4.6.2.1   DTX procedures in the uplink direction

In all frames in the uplink direction, the BFI (Bad Frame Indicator), the SID (Silence Descriptor) indicator and the TAF (Time Alignment Flag) indicator is set as output from the RSS (see GSM 06.31 and GSM 06.81 (ETS 300 729)).

In the comfort noise states, the MS will transmit a new frame only every 480 mS (24 frames). These frames are transferred in the normal way between the CCU and the TRAU. Between these frames the CCU shall transfer uplink idle speech frames in case of Full Rate Speech and speech frames with BFI set to "1" in case of Enhanced Full rate Speech.

4.6.2.2   DTX procedures in the downlink direction

To inform the DTX handler in the remote transcoder whether downlink DTX may be applied or not, the DTXd bit (C17) in the uplink speech frame is used. The coding is as follows:

DTXd = 0 : downlink DTX is not applied;
DTXd = 1 : downlink DTX is applied.

Though this parameter is linked with the resource allocation in the BTS at call setup, its value may vary during the connection.

In the downlink frames the SP (Speech) indicator is set as output from the TX DTX handler (see GSM 06.31 and GSM 06.81 (ETS 300 729)).

If downlink DTX is not used, the SP indicator should be coded binary "1".

4.7 Procedures for Data Frames

4.7.1 9.6 and 4.8 kbit/s channel coding

When rate adaption to 64 Kbit/s is performed at the BTS (sub-64 kbit/s traffic channels are not used), the rate adaption between the format used on the radio interface and the 64 Kbit/s format is made by the RA1/RA1' and the RA2 function as described in GSM. 08.20. This is illustrated in figure 4.2.
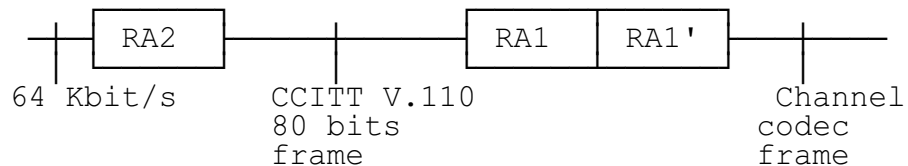
```
        ┌──────┐              ┌──────┬──────┐
────────┤ RA2  ├──────────────┤ RA1  │ RA1' ├──────────
   │    └──────┘    │         └──────┴──────┘    │
64 Kbit/s       CCITT V.110                 Channel
                80 bits                      codec
                frame                        frame
```

Figure GSM 08.60/4.2: Rate adaption when performed at the BTS.

When sub-64 kbit/s traffic channels are used, up to four data frames are transferred in each TRAU frame. In order to convert between the TRAU frame format and the CCITT 80 bits frame format an additional intermediate rate adaption function, RAA, is applied. This is illustrated in figure 4.3.
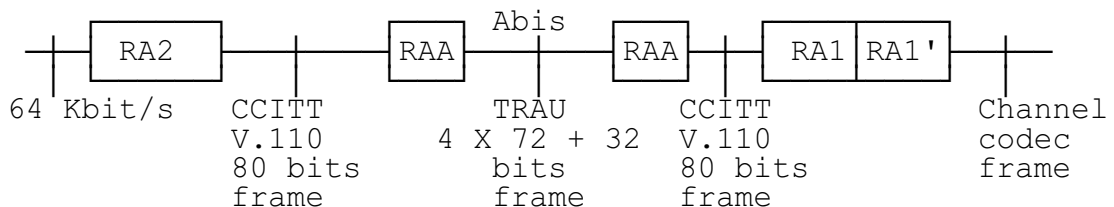
```
       ┌──────┐       ┌─────┐  Abis  ┌─────┐    ┌──────┬──────┐
───────┤ RA2  ├───────┤ RAA ├────────┤ RAA ├────┤ RA1  │ RA1' ├────
   │   └──────┘   │   └─────┘    │   └─────┘  │  └──────┴──────┘  │
64 Kbit/s     CCITT          TRAU       CCITT            Channel
              V.110        4 X 72 + 32   V.110            codec
              80 bits        bits       80 bits           frame
              frame          frame      frame
```

Figure GSM 08.60/4.3: Rate adaption when 16 kbit/s traffic channels are used

4.7.1.1 The RAA Function

The RAA function is used to convert between the CCITT V.110 80 bits frame format and the TRAU frame format. When going from the V.110 format to the TRAU frame format the first octet (all bits coded binary "0") in the CCITT V.110 80 bits frame is stripped off. Up to four such frames are then transferred in each TRAU frame as shown in section 3.3.

When going from the TRAU frame format to the V.110 format the data frames are separated and the synchronization octet (all bits coded binary "0") is again included.

The 80 bits V.110 frame is illustrated in figure 4.4, and the modified 72 bits frame is illustrated in figure 4.5.

Octet no.	Bit number							
	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	1	D1	X	X	X	X	X	X
2	1	X	X	X	X	X	X	X
3	1	X	X	X	X	X	X	X
4	1	X	X	X	X	X	X	X
5	1	X	X	X	X	X	X	X
6	1	X	X	X	X	X	X	X
7	1	X	X	X	X	X	X	X
8	1	X	X	X	X	X	X	X
9	1	X	X	X	X	X	X	X

Figure GSM 08.60/4.4: CCITT V.110 80 bits frame

Octet no.	Bit number							
	1	2	3	4	5	6	7	8
0	1	D1	X	X	X	X	X	X
1	1	X	X	X	X	X	X	X
2	1	X	X	X	X	X	X	X
3	1	X	X	X	X	X	X	X
4	1	X	X	X	X	X	X	X
5	1	X	X	X	X	X	X	X
6	1	X	X	X	X	X	X	X
7	1	X	X	X	X	X	X	X
8	1	X	X	X	X	X	X	X

**Figure GSM 08.60/4.5: Modified CCITT V.110 72 bits frame transferred
in a TRAU data frame position**

4.7.1.2   The RA1/RA1' Function

This function is described in GSM 04.21.

4.7.1.3   The RA2 Function

This function is described in GSM 04.21.

4.7.1.4   Procedures for 8 kbit/s intermediate rate adaption rate

For 8 kbit/s intermediate rate adaption rate up to two data frames are transferred in each TRAU frame.
The first data frame is transferred in TRAU data frame position 1 and the subsequent data frame is
transferred in TRAU data frame position 3 (see section 3.3).

In TRAU data frame position 2 and 4, all bits are coded binary "1".

If the data transfer terminates before the TRAU frame has been completed, the remaining data bit
positions in the TRAU frame should be coded binary "1".

4.7.1.5   Procedures for 16 kbit/s intermediate rate adaption rate

For 16 kbit/s intermediate rate adaption rate, up to four data frames are transferred in each TRAU frame.
The first data frame is transferred in TRAU data frame position 1, the next in data frame position 2 etc.

If the data transfer terminates before the TRAU frame has been completed, the remaining data bit
positions in the TRAU frame should be coded binary "1".

4.7.1.6 Support of Non-Transparent Bearer Applications

In GSM 08.20, the procedures for transfer of non-transparent bearer applications are specified. The 240 bit RLP frame is converted to four modified V.110 80 bit frames.

The same conversion is applied when transferred in a TRAU frame. The frames are coded as specified in sections 4.7.4 and 4.7.5.

4.7.2 14.5 kbit/s channel coding

When rate adaption to 64 Kbit/s is performed at the BTS (sub-64 kbit/s traffic channels are not used), the rate adaption between the format used on the radio interface and the 64 Kbit/s format is as described in GSM 08.20.

When sub-64 kbit/s traffic channels are used, up to eight 36 bits frames are transferred in each E-TRAU frame. In order to convert between the E-TRAU frame format and the 36 bits frame format used for the radio interface an additional intermediate rate adaption function, RA1'/RAA', is applied. This is illustrated in figure 4.3.1 (see also GSM 08.20).
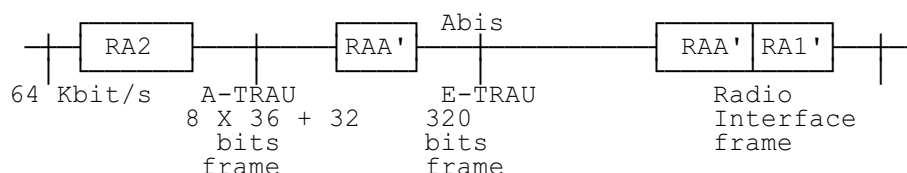
```
                                        Abis
    ┌──────────┐         ┌──────┐           ┌──────┬──────┐
────┤   RA2    ├─────────┤ RAA' ├───────────┤ RAA' │ RA1' ├────────
    └──────────┘         └──────┘           └──────┴──────┘
 64 Kbit/s      A-TRAU             E-TRAU            Radio
                8 X 36 + 32        320              Interface
                bits               bits             frame
                frame              frame
```

Figure GSM 08.60/4.3.1: Rate adaption when 16 kbit/s traffic channels are used

4.7.2.1 The RAA' Function

See GSM 08.20

4.7.2.2 The RA1'/RAA' Function

This function is described in GSM 08.20.

4.7.2.3 The RA2 Function

This function is described in GSM 04.21.

4.8 Frame Synchronization

4.8.1 Search for Frame Synchronization

The frame synchronization is obtained by means of the first two octets in each frame, with all bits coded binary "0", and the first bit in octet no. 2, 4, 6, 8, ... 38 coded binary "1". The following 35 bit alignment pattern is used to achieve frame synchronization:

```
00000000 00000000 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX
1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX
1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX
1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX
1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX 1XXXXXXX XXXXXXXX
```

4.8.2 Frame Synchronization After Performing Downlink Timing Adjustments

If the timing of the downlink speech frames is adjusted, the adjustment is indicated in bits C6 - C11 as described in sections 4.6.1.1 and 4.6.1.2. The frame synchronization unit shall change its frame synchronization window accordingly.

4.8.3 Frame Synchronization Monitoring and Recovery

The monitoring of the frame synchronization shall be a continuous process.

Loss of frame synchronization shall not be assumed unless at least three consecutive frames, each with at least one framing bit error, are detected.

In case of Full Rate speech:

If the TRAU looses its frame synchronization it starts a timer Tsync = 1 second. If Tsync expires before frame synchronization is again obtained the TRAU initiates sending of the urgent alarm pattern described in section 4.10.2.

The exception from this procedure is when "Resource Release" is detected while Tsync is running (see section 4.3). In this case, the procedure in section 4.3 shall be followed.

If loss of frame synchronization is detected by the CCU it starts a timer Tsync. If Tsync expires before frame synchronization is again obtained the call shall be released and an indication given to O&M.

Tsync is reset every time frame synchronization is again obtained.

In case of Enhanced full rate speech:

When it detects a framing bit error, the TRAU uses the control bit UFE (uplink Frame Error) in the next downlink TRAU frame to indicate it to the CCU. When the CCU receives a TRAU frame indicating an Uplink Frame Error and which has no errors on the sychronization pattern and the control bits, it starts a timer TsyncU.

If loss of frame sychronization is detected by the CCU it starts a timer TsyncD. If TsyncD or TsyncU expires before frame sychronization is again obtained, the call shall be released as specified in GSM 08.58 with the case field set to " Remote Transcoder Failure".

TsyncD is reset every time frame synchronisation is again obtained.

TsychU is reset every time three consecutive TRAU frames are received without Uplink Frame Error indication, without errors on the frame synchronisation pattern and on the control bits.

TsyncD and TsyncU are parameters set by O&M (default value = 1 second).

In case of Data 14.5 kbit/s:

The following 17 bit alignment pattern of the Extended Data TRAU Frame is used for Frame Synchronization Monitoring:

```
00000000 00000000 1XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
```

When it detects a framing bit error, the TRAU uses the control bit UFE (uplink Frame Error) in the next downlink Extended Data TRAU Frame to indicate it to the CCU. When the CCU receives an Extended Data TRAU Frame indicating an Uplink Frame Error and which has no errors on the synchronization pattern and the control bits, it starts a timer TsyncU and TsyncR.

If loss of frame synchronization is detected by the CCU it starts a timer TsyncD and starts sending Data TRAU Frames in the uplink direction to trigger the TRAU to start sending Data TRAU Frames in the downlink direction to be used for downlink Synchronization Recovery.

If TsyncR expires before frame synchronization is again obtained, the CCU starts sending Data TRAU Frames in the uplink direction to be used for uplink Synchronization Recovery.

If TsyncD or TsyncU expires before frame synchronization is again obtained, the call shall be released as specified in GSM 08.58 with the case field set to " Remote Transcoder Failure".

TsyncD is reset every time frame synchronization is again obtained.

TsychU and TsyncR is reset every time three consecutive TRAU frames are received without Uplink Frame Error indication, without errors on the frame synchronization pattern and on the control bits.

TsyncD and TsyncU are parameters set by O&M (default value = 1 second)

TsyncR are a parameter set by O&M (default value = 60 milliseconds).

4.9 Correction/detection of bit errors on the terrestrial circuits

4.9.1 Error Detection on the Control Bits

For the control bits, (C-bits), no error coding is made. However, in order to reduce the possibility of misinterpretation of control information due to bit errors, the following procedure should be followed.

4.9.1.1 General Procedure

If any undefined combination of the C-bits is received (see section 3.5), the frame should be reacted upon as received with errors.

4.9.1.2 Speech Frames

In addition to the general procedure described in the previous section, the following procedure should be followed for the speech frames:

Bits C6 - C11: Time Alignment.

The full range of the time alignment adjustment should only be applied when the TRAU is in the Initial Time Alignment state (see sections 4.6.1.1 and 4.6.1.2).

If, in the Static Time Alignment state, a time alignment order is received indicating an adjustment of more than 250 µS, the next downlink frame should be delayed only one 250 µS step.

If an uplink frame is received with the "Time Alignment" field set to an unused value (101000 ... 111101), this value should be interpreted as "no change".

4.9.2 Handling of frames received with errors

If TRAU frame is received in the uplink or downlink with detectable errors in the control bits, then the control information shall be ignored. The speech or data bits shall be handled as if no error had been detected.

If frame synchronisation has been lost (see section 4.8.3) in the uplink direction the TRAU shall:

- for speech, mute the decoded speech as if it has received frames with errors (cf. GSM 06.11 and GSM 06.61 (ETS 300 727));

- for data, send idle frames as defined in GSM 08.20 to the MSC/interworking.

4.9.2.1 In case of Full Rate:

If frame synchronisation has been lost in the downlink direction then the same procedure shall be followed as when frame synchronisation is lost on the PCM link.

4.9.2.2 In case of Enhanced Full rate:

For speech calls, the CCU shall transmit a layer two fill frame on the air interface if frame synchronization has been lost in the downlink direction.

If a CRC error is detected in a downlink TRAU speech frame a solution can be to transmit a layer two fill frame on the air interface, another solution can be to replace the bad part of the TRAU speech frame only. The choice of the solution is left open.

If a CRC error is detected in a uplink TRAU speech frame, the TRAU speech frame shall be regarded as bad or partly bad and the TRAU shall apply the procedure defined in GSM 06.61 (ETS 300 727).

4.10 Procedures for Operation & Maintenance

The general procedures for Operation and Maintenance are described in GSM 12.21.

If the transcoders are positioned outside the BTS, some O&M functions will be required for the TRAU and the CCU. In particular this applies for transcoders positioned at the MSC site.

The transcoders outside the BTS are considered a part of the BSC, and the O&M functions for the TRAU should therefore be implemented in the BSC.

The CCU is a part of the BTS and the O&M functions for this unit should therefore be implemented in the BTS.

4.10.1 Transfer of O&M Information Between the TRAU and the BSC

The transfer of O&M information between the BSC and the TRAU is possible to do in two ways. Either it is handled directly between the BSC and the TRAU or a BTS is used as a message transfer point. The choice between the two methods is up to the manufacturer of the BSC:

i) The transfer of O&M information between the BSC and the TRAU is handled internally by the BSC. The O&M signalling between the TRAU and the BSC may either be handled by proprietary BSC solutions or the O&M TRAU frames defined in sections 3.2 and 3.5.2 could be used. In the latter case, the BSC has to act as a terminal for the O&M TRAU frames sent between the TRAU and the BSC.

ii) The O&M information between the TRAU and the BSC is transferred using O&M TRAU frames between the TRAU and the CCU in a BTS. The BTS then acts as a relay function between the O&M TRAU frames and the associated O&M messages sent between the BTS and the BSC.

4.10.2 Procedures in the TRAU

In case of urgent fault conditions in the TRAU, e.g. loss of frame synchronization, non-ability of the transcoder to process data etc., this should if possible, be signalled to the BTS/BSC as an urgent alarm pattern. The urgent alarm pattern is a continuous stream of binary "0".

If O&M TRAU frames information between the TRAU and the BSC is transferred using O&M frames between the CCU in a BTS and the TRAU, the TRAU sends O&M frames periodically until the identical O&M TRAU frame is received for acknowledgement. The period is at least 64*20ms (1,28 sec).

In case of minor fault conditions, when no immediate action is required, the TRAU may send O&M frames indicating the fault instead of the urgent alarm pattern.

4.10.3 Procedures in the BSC

The BSC should be able to detect a faulty TRAU, take it out of service and give an indication to O&M. A faulty TRAU could be detected e.g. by routine tests, alarms from the TRAU, release of call initiated by the BTS due to remote transcoder failure etc. How this is handled by the BSC is regarded as a BSC internal matter.

4.10.3.1 Use of O&M Frames

The use and coding of O&M TRAU frames is left to the implementor of the BSC/TRAU.

If O&M TRAU frames are used, they are always carrying 264 data bits.

Any corresponding O&M message between the BSC and the BTS shall always carry all 264 O&M data bits.

4.10.4 Procedures in the BTS

If a CCU in a BTS receives O&M TRAU frames from the TRAU, the BTS shall:

- send the identical frame to the TRAU for acknowledgement; and

- put the 264 data bits from the received frames into an appropriate O&M message and send it to the BSC.

If the CCU receives O&M frames during a call then "stolen frames" shall be indicated to the MS and layer 2 frames of format A (see GSM 04.06) shall be transmitted.

If the CCU receives O&M frames during a data call, then the same procedure shall be used as when V.110 frame is lost.

If receiving an O&M message from the BSC, carrying TRAU O&M information, the BTS puts the 264 data bits from the received message into an O&M TRAU frame and then the CCU allocated to the addressed connection sends the frame to the TRAU in one single O&M TRAU frame. Repetition is done according to GSM 12.21.

In case of a faulty CCU, the O&M procedures are BTS internal.

If the CCU receives the urgent alarm pattern, the BTS shall initiate release of the call as specified in GSM 08.58 with the cause field set to "Remote Transcoder Failure".

History

Document history			
March 1996	Public Enquiry	PE 104:	1996-03-25 to 1996-08-16
November 1996	Vote	V 115:	1996-11-25 to 1997-01-17
March 1997	First Edition		
September 1997	One-step Approval Procedure (Second Edition)	OAP 9803:	1997-09-19 to 1998-01-16
February 1998	Second Edition		