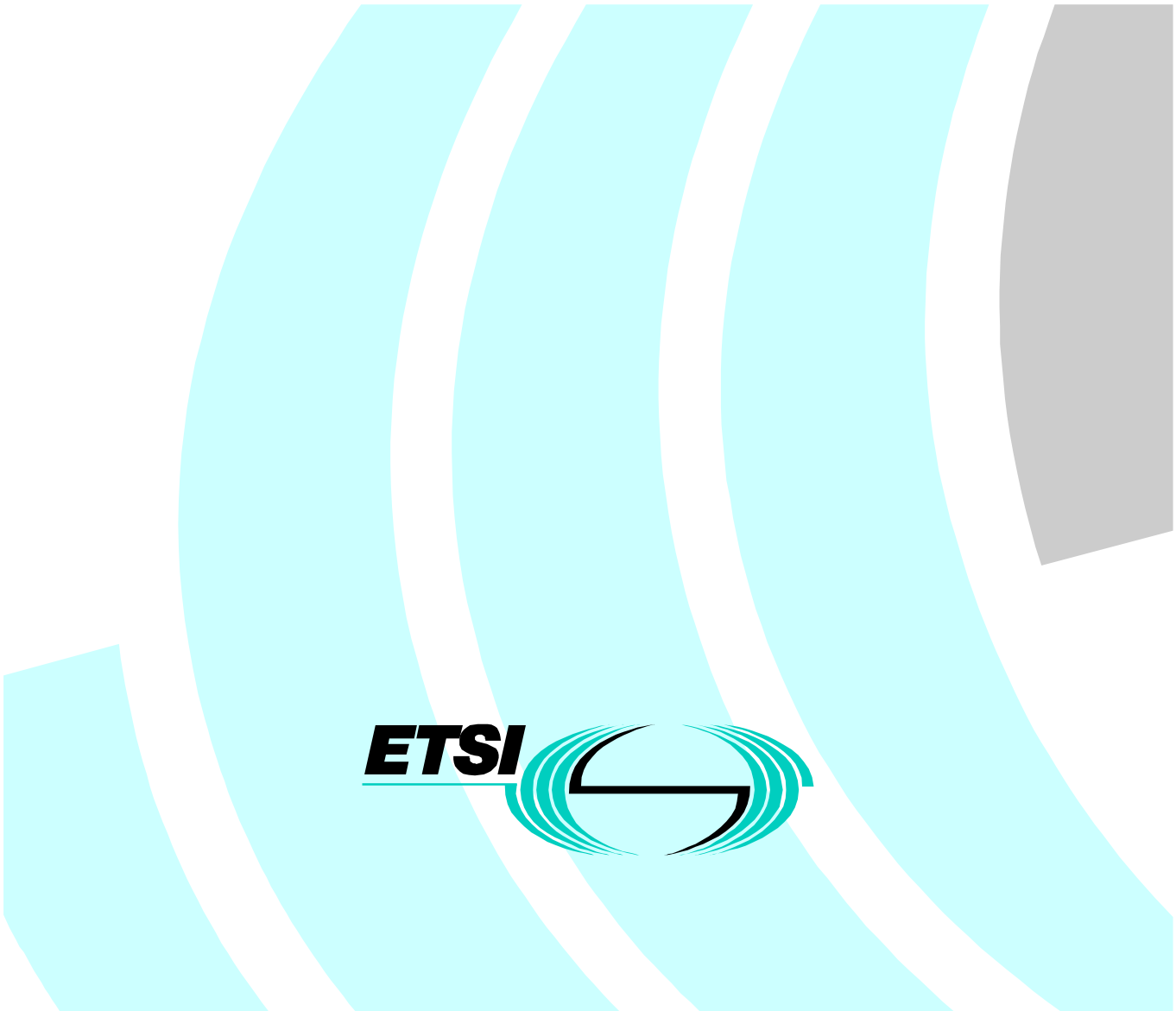
ETSI TS 101 377-4-10 V1.1.1 (2001-03)

Technical Specification

**GEO-Mobile Radio Interface Specifications;
Part 4: Radio interface protocol specifications;
Sub-part 10: Rate Adaptation on the Mobile
Earth Station (MES)- Gateway System Interface;
GMR-2 04.021**



Reference
DTS/SES-002-04021

Keywords
GMR, MSS, MES, satellite, GSO, S-PCN, GSM, adaption, gateway, interface, mobile, radio, rate

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TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US

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TS 101 377 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Transmitter Power Control for Radio Telephone System	GB	GB 2 233 517	GB

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Hughes Network Systems		US	Pending	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	2.4-to-3 KBPS Rate Adaptation Apparatus for Use in Narrowband Data and Facsimile Communication Systems	US	US 6,108,348	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Cellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic ThroughputCellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic Throughput	US	US 5,717,686	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Enhanced Access Burst for Random Access Channels in TDMA Mobile Satellite System	US	US 5,875,182	
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Mutual Offset High-argin Forward Control Signals	US	US 6,072,985	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Spot Beam Pairing for Reduced Updates	US	US 6,118,998	US

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The contents of the present document are subject to continuing work within TC-SES and may change following formal TC-SES approval. Should TC-SES 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 1.m.n

where:

- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 4, sub-part 10 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Part 4: "Radio interface protocol specifications";

Sub-part 1: "GMR-2 Mobile Earth Station-Network Interface; General Aspects and Principles; GMR-2 04.001";

Sub-part 2: "GMR-2 Mobile Earth Station-Network Interface; Channel Structures and Access capabilities; GMR-2 04.003";

Sub-part 3: "Layer 1 General requirements; GMR-2 04.004";

Sub-part 4: "Data Link Layer General Aspects; GMR-2 04.005";

Sub-part 5: "GMR-2 Mobile Earth Station - Network Interface; Data Link (DL) layer Specifications; GMR-2 04.006";

Sub-part 6: "Mobile Radio Interface Signalling Layer 3; General Aspects; GMR-2 04.007";

Sub-part 7: "Mobile radio interface Layer 3 Specifications; GMR-2 04.008";

Sub-part 8: "Point-to-Point Short Message Services; GMR-2 04.011";

Sub-part 9: "Performance requirements on the mobile radio interface; GMR-2 04.013";

Sub-part 10: "Rate Adaptation on the Mobile Earth Station (MES) - Gateway System Interface; GMR-2 04.021";

Sub-part 11: "Call Waiting (CW) and Call Holding (HOLD) Supplementary Services; GMR-2 04.083";

Sub-part 12: "Multiparty Supplementary Services (MPTY); GMR-2 04.084";

Sub-part 13: "Technical Realisation of the Early Flag Technique; GMR-2 04.201";

Sub-part 14: "Call Barring Supplementary Services; GMR-2 02.088";

Part 5: "Radio interface physical layer specifications";

Part 6: "Speech coding specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for mobile satellite services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM standard are necessary. Some GSM specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM specifications do not apply, while some GMR specifications have no corresponding GSM specification.

Since GMR is derived from GSM, the organization of the GMR specifications closely follows that of GSM. The GMR numbers have been designed to correspond to the GSM numbering system. All GMR specifications are allocated a unique GMR number as follows:

GMR-n xx.zyy

where :

xx.0yy (z=0) is used for GMR specifications that have a corresponding GSM specification. In this case, the numbers xx and yy correspond to the GSM numbering scheme.

xx.2yy (z=2) is used for GMR specifications that do not correspond to a GSM specification. In this case, only the number xx corresponds to the GSM numbering scheme and the number yy is allocated by GMR.

n denotes the first (n=1) or second (n=2) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM specification (if any). This precedence rule applies to any references in the corresponding GSM specifications.

NOTE: Any references to GSM specifications within the GMR specifications are not subject to this precedence rule. For example, a GMR specification may contain specific references to the corresponding GSM specification.

- If a GMR specification does not exist the corresponding GSM specification may or may not apply. The applicability of the GSM specifications are defined in GMR-n 01.201.

1 Scope

The present document defines the rate adaptation functions to be used in GMR-2 Mobile Earth Stations for adapting terminal interface data rates to the MS-BSS interface data rates in accordance with GSM 03.10 [2].

The provision of these functions will depend on the services a particular station is designed to support.

NOTE: The present document should be considered together with GSM 08.20 [7] (Rate adaption on the BSS-MSC interface) to give a complete description of GMR-2 rate adaptation.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- 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, subsequent revisions do apply.

[1] GMR-2 01.004 (ETSI TS 101 377-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and Acronyms; GMR-2 01.004".

[2] GSM 03.10 (ETSI ETS 300 528): "European digital cellular telecommunications system (Phase 2); GSM Public Land Mobile Network (PLMN) connection types (GSM 03.10 version 4.3.1)".

[3] GMR-2 05.003 (ETSI TS 101 377-5-3): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 3: Channel Coding; GMR-2 05.003".

[4] GSM 07.01 (ETSI ETS 300 582 Edition 3): "European digital cellular telecommunication system (Phase 2); General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS) (GSM 07.01 version 4.9.0)".

[5] GSM 07.02 (ETSI ETS 300 583): "European digital cellular telecommunications system (Phase 2); Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities (GSM 07.02 version 4.5.1)".

[6] GSM 07.03 (ETSI ETS 300 584): "European digital cellular telecommunications system (Phase 2); Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities (GSM 07.03)".

[7] GSM 08.20 (ETSI ETS 300 591 Edition 2): "European digital cellular telecommunications system (Phase 2); Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface (GSM 08.20 version 4.2.3)".

[8] ITU-T Recommendation V.110: "Support by an ISDN of data terminal equipments with V-series type interfaces".

[9] ITU-T Recommendation X.30: "Support of X.21, X.21 bis and X.20 bis based Data Terminal Equipments (DTEs) by an Integrated Services Digital Network (ISDN)".

3 Abbreviations

For the purposes of the present document, the abbreviations are listed in GMR-2 01.004 [1].

4 General Approach

GSM 03.10 [2] defines the PLMN connection types necessary to support the GSM PLMN data and telematic services.

Within the MS there are several different data rate adaptation functions which are combined as shown in GSM 03.10 [2] as part of the connection type.

These functions are RA0, RA1, RA2, RA1' and RA1/RA1'. The RA0, RA1 and RA2 are equivalent to those functions described in ITU-T Recommendation V.110 [8].

The RA1' function is similar to RA1 but has a reduced bit rate output compatible with the coding scheme proposed for data services on the radio interface.

The RA1/RA1' is a relay function, used as indicated in GSM 03.10 [2].

5 RA0 Function

5.1 Asynchronous-to-Synchronous Conversion

The RA0 Function is only used with asynchronous interfaces. Incoming asynchronous data is padded by the addition of stop elements to fit the nearest channel defined by 2^n (2 to the power n times 2 400 bit/s). The resultant synchronous stream is fed to RA1 or RA1'.

Table 5.1.1: RA0 Asynchronous to Synchronous User Rate Conversions

Asynchronous user rate	Synchronous user rate
2,4 kbit/s	2,4 kbit/s
4,8 kbit/s	4,8 kbit/s
9,6 kbit/s	9,6 kbit/s

5.2 Break Signal

The RA0 shall detect and transmit the break signal in the following fashion:

If the converter detects M to 2M + 3 bits, all of start polarity, where M is the number of bits per character in the selected format including start and stop bits, the converter shall transmit 2M + 3 bits of start polarity.

If the converter detects more than 2M + 3 bits all of start polarity, the converter shall transmit all these bits as start polarity.

The 2M + 3 or more bits of start polarity received from the transmitting sides shall be output to the receiving terminal.

The terminal must transmit on circuit 103 at least 2M bits stop polarity after the start polarity break signal before sending further data character. The converter shall than regain character synchronism from the following stop to start transition.

5.3 Overspeed / Underspeed

A RA0 shall insert additional stop elements when its associated terminal is transmitting with a lower than nominal character rate. If the terminal is transmitting characters with an overspeed of up to 1% (or 2,5% in the case of nominal speeds lower than 600 bit/s), the asynchronous-to synchronous converter may delete stop elements as often as is necessary to a maximum of one for every eight characters at 1% overspeed. The converter on the receiving side shall detect the deleted stop elements and reinsert them in the received data stream (circuit 104).

The nominal length of the start and data elements shall be the same for all characters. The length of the stop elements may be reduced by as much as 12,5% for nominal speeds exceeding 2 400 bit/s to allow for overspeed in the transmitting terminal.

5.4 Parity Bits

Possible parity bits included in the user data are considered as data bits by the RA0 function (and RA1 function).

5.5 Flow Control

Where applicable, this function is as specified in the relevant terminal adaptation function specification (GSM 07-series).

6 RA1 Function

This function is used to adapt between the synchronous user rates, or the output of the RA0 function and the intermediate rate of 8 or 16 kbit/s as shown in table 6.1.

Table 6.1: RA1 Synchronous User Rate to Intermediate Rate Adaption

Synchronous user rate	Intermediate rate
2,4 kbit/s	8 kbit/s
4,8 kbit/s	8 kbit/s
9,6 kbit/s	16 kbit/s

A ITU-T Recommendation V.110 [8] 80 bits frame is constructed using the user data bits received (from the RA0 in the asynchronous case), the values of the S bits are deduced from the R interface.

Adaptation of 2 400 bit/s to 8 kbit/s is performed by 2 times consecutive duplication of each user data bit.

Adaptation of 4 800 bit/s to 8 kbit/s is performed by transmitting the bit stream with no duplication.

Adaptation of 9 600 bit/s to 16 kbit/s is performed by transmitting the bit stream with no duplication (the emitting period is halved with respect to the 4 800 bit/s case).

The ITU-T Recommendation V.110 [8] 80 bit frame structure shown in figure 6.1.1 is used. The D bits are used to convey the user data and the S and X bits are used to convey channel control information according to the relevant terminal adapter function specification.

The E bits are used to convey the following information:

a) User Data Rate - E1, E2, E3 (see figure 6.1.2);

b) Network Independent Clocking - E4, E5, E6;

c) Multiframe Synchronization - E7.

The order of transmission of the 80 bit frame is from left to right and top to bottom.

6.1 Network Independent Clocking

Synchronous data signals received by the MT from the DTE at the MES or by IWF from the modem on the PSTN may not be synchronized to the PLMN. The following method shall be used to enable transfer of those data signals and the corresponding bit timing information via the ITU-T Recommendation V.110 [8] frames. Such a situation would exist where the signals received from the modem at the IWF require its own clock, or where the signals received from the DTE at the MES employs its own network independent clock. In any case, the frequency tolerance of the clocks involved is 100 ppm.

	Bit number							
Octet No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
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 6.1.1: The ITU-T Recommendation V. 80 bit RA1 Frame Structure

Intermediate Data Rate				
8 kbit/s	**16 kbit/s**	**E1**	**E2**	**E3**
2 400		1	1	0
4 800	9 600	0	1	1

Figure 6.1.2: Coding of Data Rates

6.1.1 Multiframe Structure

The transmitting end of the GSM PLMN connection shall establish a multiframe structure utilizing bit E7 consisting of four frames by setting E7 in every fourth frame to binary 0. This structure is identical to the use of E7 in ITU-T Recommendation V.110 [8] (and ITU-T Recommendation X.30 [9]) except that such a multiframe structure will exist for all user data rates. This frame synchronization will be achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the GSM PLMN connection can be easily recognized and applied based on the code words (in c1, c2, c3, c4 and c5) positioned in bits E4, E5 and E6 of two consecutive V.110 [8] frames as illustrated in figure 6.1.3. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 [8] frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe shown in figure 6.1.3.

Frame	**E4**	**E5**	**E6**	**E7**
MF 0a	c1	c2	1	0
MF 1a	c3	c4	c5	1
MF 0b	c1	c2	1	1
MF 1b	c3	c4	c5	1

Figure 6.1.3: NIC Multiframe Structure

Once Multiframe synchronization is achieved, each code word is independently evaluated to determine the compensation needed, if any. The compensation is applied as explained in clause 6.1.2 in V.110 [8] frames MF 1a and MF lb.

6.1.2 Encoding and Compensation

The ITU-T Recommendation V.110 [8] transmitter will use the following 5-bit code words, as shown in figure 6.1.4, to indicate the four possible states of compensation required for network independent clocking.

	c1	c2	c3	c4	c5
No compensation	1	1	1	1	1
Negative compensation	1	0	0	1	0
Positive compensation of a zero	0	1	0	0	1
Positive compensation of one	0	0	1	0	0

Figure 6.1.4: NIC Code Words

When negative compensation is indicated, one less user data bit than normal is transported in the affected frame (MF 1a or MF 1b). A negative compensation shall cause the receiver to delete the user data bit occupied by bit position D25, since the transmitter sets this to binary 1 and does not utilize this position for user data. At those user data rates where the user data bit is repeated, all copies of D25 shall be discarded.

When a positive compensation is indicated, one additional user data bit is transferred by means of the code word. At the receiver, a positive compensation will cause a user data bit of binary value 0 or 1, as indicated by the code word, to be inserted between the user data bits carried in bit positions D24 and D25 (in MF 1a or MF 1b) of the ITU-T Recommendation V.110 [8] frame illustrated in figure 6.1.5.

When no compensation is necessary, or when NIC is not applied, the values of E4, E5, E6. E7, on the 4 multi frame scheme is:

Table 6.1.5: E bit values

Frame	E4	E5	E6	E7
MF 0a	1	1	1	0
MF 1a	1	1	1	1
MF 0b	1	1	1	1
MF 1b	1	1	1	1

7 RA2 Function

This procedure is based on the RA2 function as specified in ITU-T Recommendation V.110 [8]. It is used to rate adapt to/from the intermediate rates of 8 or 16 kbit/s from/to the 64 kbit/s rate used at the S interface.

Table 7.1: RA2 Intermediate To S Rate Adaption

Intermediate rate	Rate at the S interface
8 kbit/s	64 kbit/s
16 kbit/s	64 kbit/s

It considers the 64 kbit/s stream to consist of octets, bits 1 through 8, with bit 1 being transmitted first.

The procedure requires that:

a) The 8 kbit/s stream occupies bit position 1;

b) The 16 kbit/s bit stream occupies bit positions (1,2);

c) The order of transmission of the bits of the subrate stream is identical before and after rate adaptation;

d) All unused bits in the 64 kbits stream are set to binary "1".

8 RA1/RA1' Function

The RA1/RA1' function is used to convert between the ITU-T Recommendation V.110 [8] 80 bit frames produced at the 8 and 16 kbit/s intermediate rates and the input rate to the channel coder function for transmission by the radio subsystem.

Table 8.1: RA1/RA1' Intermediate to Channel Coder Input Rate Adaption

Intermediate rate	Radio interface rate
8 kbit/s	3,0 kbit/s
8 kbit/s	6 kbit/s
16 kbit/s	12 kbit/s

There are three data rates (known as Radio Interface rates) used for data transfer to the channel coder. These are 12 kbit/s, 6 kbit/s and 3,0 kbit/s, and in order to adapt the 8 and 16 kbit/s intermediate rates to these data rates, three processes are used:

- The 17 synchronization bits are removed;
- The E1, E2 and E3 bits are removed. For 3,0 kbit/s, the E4, E5, E6 and one X bits are also removed since Network Independent Clocking (NIC) is supported to only 'No compensation' state.
  - For transparent services, the values of the E1, E2, E3, E4, E5, E6 bits are determined at the MT and the TCE based on the indication given by outband signalling (either in the User Rate field of the BC-IE of the SETUP message for the MT or in the Channel Type information in the ASSIGNMENT REQUEST message for the GATEWAY).
  - For non transparent services, the coding of the E1, E2 and E3 bits is described in GSM 08.20 [7].
- For the 3,0 kbit/s case, half the data bits are discarded and some of the line control bits (S) are sub-sampled to alternate frames.

These processes result in modified ITU-T Recommendation V.110 [8] frames of sizes 60, 60 and 30 bits for the 12, 6 and 3,0 kbit/s data rates respectively. The resultant modified ITU-T Recommendation V.110 [8] frames for the various user data rates are shown in figures 8.1 to 8.3.

D1	D2	D3	D4	D5	D6	S1
D7	D8	D9	D10	D11	D12	X
D13	D14	D15	D16	D17	D18	S3
D19	D20	D21	D22	D23	D24	S4
E4	E6	E6	E7	D25	D26	D27
D28	D29	D30	S6	D31	D32	D33
D34	D35	D36	X	D37	D38	D39
D40	D41	D42	S8	D43	D44	D45
D46	D47	D48	S9			

Figure 8.1: Modified ITU-T Recommendation V.110 60 bit Frame for 9,6 kbit/s Transparent Data

D1	D2	D3	D4	D5	D6	S1
D7	D8	D9	D10	D11	D12	X
D13	D14	D15	D16	D17	D18	S3
D19	D20	D21	D22	D23	D24	S4
E4	E5	E6	E7	D25	D26	D27
D28	D29	D30	S6	D31	D32	D33
D34	D35	D36	X	D37	D38	D39
D40	D41	D42	S8	D43	D44	D45
D46	D47	D48	S9			

Figure 8.2: Modified ITU-T Recommendation V.110 60 bit Frame for 4,8 kbit/s Transparent Data

D1	D2	D3	S1	D4	D5	D6	X
D7	D8	D9		D10	D11	D12	S3/S4
D13	D14	D15	E7	D16	D17	D18	S6
D19	D20	D21		D22	D23	D24	S8/S9

Figure 8.3: Modified ITU-T Recommendation V.110 30 bit Frame for 2,4 kbit/s Transparent Data

8.1 Radio Interface Rate of 12 kbit/s

In this case one modified ITU-T Recommendation V.110 [8] 60 bit frame is received/sent from/to the radio subsystem every 5 ms (see GMR-2 05.003 [3]). The RA1/RA1' function will add/subtract the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T Recommendation V.110 [8] 80 bit frame as follows:

The modified ITU-T Recommendation V.110 [8] 60 bits frame received/sent from/to the air interface at 12 kbit/s,

D1	D2	D3	D4	D5	D6	S1
D7	D8	D9	D10	D11	D12	X
D13	D14	D15	D16	D17	D18	S3
D19	D20	D21	D22	D23	D24	S4
E4	E5	E6	E7	D25	D26	D27
D28	D29	D30	S6	D31	D32	D33
D34	D35	D36	X	D37	D38	D39
D40	D41	D42	S8	D43	D44	D45
D46	D47	D48	S9			

is converted into the following, a ITU-T Recommendation V.110 [8] 80 bits frame at 16 Kbit/s:

0	0	0	0	0	0	0	0
1	D1	D2	D3	D4	D5	D6	S1
1	D7	D8	D9	D10	D11	D12	X
1	D13	D14	D15	D16	D17	D18	S3
1	D19	D20	D21	D22	D23	D24	S4
1	E1	E2	E3	E4	E5	E6	E7
1	D25	D26	D27	D28	D29	D30	S6
1	D31	D32	D33	D34	D35	D36	X
1	D37	D38	D39	D40	D41	D42	S8
1	D43	D44	D45	D46	D47	D48	S9

In the case of the non transparent services, bits S1, X, S3, S4, E4, E5, E6, E7, S6, X (second occurrence), S8, and S9 carry bits D'1, D'2, D'3, D'4, D'5, D'6, D'7, D'8, D'9, D'10, D'11, and D'12, respectively.

For a modified ITU-T Recommendation V.110 [8] 60 bit frames received from the radio subsystem, the received D, S and X bits or D and D' bits, are set to the same value as the transmitted bits. Bits E1, E2, E3 are set according to the user data rate as shown in figure 6.1.2 for the transparent services, or the RLP multiframe and DTX indication as per GSM 08.20 [7] in the non transparent case.

For modified ITU-T Recommendation V.110 [8] 60 bit frames transmitted over the radio subsystem, the received D, S. and X bits or D and D' are set to the same value as the transmitted bits. Bits E1, E2, E3 are discarded.

8.2 Radio Interface Rate of 6 kbit/s

In this case, one modified ITU-T Recommendation V.110 [8] 60 bit frame is received/sent from/to the radio subsystem every 10 ms (see GMR-2 05.003 [3]). The RA1/RA1' function will add/subtract the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T Recommendation V.110[8] 80 bit frame as follows:

The modified ITU-T Recommendation V.110 [8] 60 bits frame received/sent from/to the air interface at 6 kbit/s,

D1	D2	D3	D4	D5	D6	S1
D7	D8	D9	D10	D11	D12	X
D13	D14	D15	D16	D17	D18	S3
D19	D20	D21	D22	D23	D24	S4
E4	E5	E6	E7	D25	D26	D27
D28	D29	D30	S6	D31	D32	D33
D34	D35	D36	X	D37	D38	D39
D40	D41	D42	S8	D43	D44	D45
D46	D47	D48	S9			

is converted into the following a ITU-T Recommendation V.110 [8] 80 bits frame at 8 kbit/s:

0	0	0	0	0	0	0	0
1	D1	D2	D3	D4	D5	D6	S1
1	D7	D8	D9	D10	D11	D12	X
1	D13	D14	D15	D16	D17	D18	S3
1	D19	D20	D21	D22	D23	D24	S4
1	E1	E2	E3	E4	E5	E6	E7
1	D25	D26	D27	D28	D29	D30	S6
1	D31	D32	D33	D34	D35	D36	X
1	D37	D38	D39	D40	D41	D42	S8
1	D43	D44	D45	D46	D47	D48	S9

In the case of the non transparent services, bits S1, X, S3, S4, E4, E5, E6, E7, S6, X (second occurrence), S8, and S9 carry bits D'1, D'2, D'3, D'4, D'5, D'6, D'7, D'8, D'9, D'10, D'11, and D'12, respectively.

For a modified ITU-T Recommendation V.110[8] 60 bit frames received from the radio subsystem, the received D, S and X bits or D and D' bits are set to the same value as the transmitted bits. Bits El, E2, E3 are set according to the user data rate as shown in figure 6.1.2 for the transparent services, or the RLP multiframe and DTX indication as per GSM 08.20 [7] in the non transparent case.

For modified ITU-T Recommendation V.110 [8] 60 bit frames transmitted over the radio subsystem, the received D, S, and X bits or D and D' bits are set to the same value as the transmitted bits. Bits E1, E2, E3 are discarded.

It should be noted that this process is identical to that used for the 12 kbit/s case except that the frame repetition rates are halved.

8.3 Radio Interface Rate of 3.0 kbit/s (Transparent Services Only)

In this case one modified ITU-T Recommendation V.110 [8] 30 bit frame is received/sent from/to the radio subsystem every 10 ms (see GMR-2 05.003 [3]). The RA1/RA1' function will add/subtract the 17 bit synchronization pattern and the E1, E2, E3, E4, E5, E6, X, S3 or S4, and S8 or S9 bits to/from each ITU-T Recommendation V.110 [8] 80 bit frame as follows:

The modified ITU-T Recommendation V.110 [8] 30 bits frame received/sent from/to the air interface at 3,0 kbit/s,

D1	D2	D3	S1	D4	D5	D6	X
D7	D8	D9		D10	D11	D12	S3/S4
D13	D14	D15	E7	D16	D17	D18	S6
D19	D20	D21		D22	D23	D24	S8/S9

is converted into the following a ITU-T Recommendation V.110 [8] 80 bits frame at 8 kbit/s:

0	0	0	0	0	0	0	0
1	D1	D1	D2	D2	D3	D3	S1
1	D4	D4	D5	D5	D6	D6	X
1	D7	D7	D8	D8	D9	D9	S3
1	D10	D10	D11	D11	D12	D12	S4
1	E1	E2	E3	E4	E5	E6	E7
1	D13	D13	D14	D14	D15	D15	S6
1	D16	D16	D17	D17	D18	D18	X
1	D19	D19	D20	D20	D21	D21	S8
1	D22	D22	D23	D23	D24	D24	S9

For modified ITU-T Recommendation V.110 [8] 30 bit frames transmitted by the radio subsystem, E1, E2, E3, E4, E5, E6 and one of the X bits are discarded. In addition, frames with the E7 set to 0 (N0) will transmit S3 and S8 (SA signaling) in the positions indicated as well as in frame N0+2. The frames N0+1 and N0+3 will transmit S4 and S9 (SB signaling). For modified ITU-T Recommendation V.110 [8] 30 bit frames received from the radio subsystem, E1, E2, E3 are set as shown in figure 6.1.2. The E4, E5, and E6 bits are set to 1, indicating no use of network independent clocking. The X bit is duplicated. The S3/S4 and S8/S9 bits are respectively replaced according to the value signalled in the previous frame.

NOTE: The action to be taken in the case where two bits which should have the same value (e.g., bits noted D1 are received with different values, is for further study.

8.4 Synchronization

Synchronization shall be in accordance with clause 2.1.3.1 of ITU-T Recommendation V.110 [8], "Search of frame synchronization."

On loss of synchronization, Section 2.1.3.2 of ITU-T Recommendation V.110 [8], "Frame synchronization monitoring and recovery-, shall apply. In this case, idle frames with all data, status and E-bits set to binary "1" shall be sent to the air interface.

As the synchronization process uses the V.110 [8] frame alignment pattern only, the action is the same for Transparent and Non-Transparent network support.

8.5 Idle Frames

Whenever no data is received from the air interface (e.g., frame stealing applies, layer 2 fill frames are received, etc.) idle frames shall be sent. These are V.110 [8] frames with frame alignment pattern according to ITU-T Recommendation V.110 [8] and all data. status and E-bits set to binary "1".

9 RA1' Function

This function is used to adapt between the synchronous user data rates, or the output of the RA0 function and the radio interface data rates of 3,0, 6 or 12 kbit/s.

Table 9.1: RA1' Synchronous User Rate to Radio Interface Data Rate Adaption

Synchronous user rate	Rate at the air interface
2,4 kbit/s	3,0 kbit/s
4,8 kbit/s	6 kbit/s
9,6 kbit/s	12 kbit/s

The modified ITU-T Recommendation V.110 [8] 30 or 60 bit frame structures for each of the user rates is shown in figures 8.1 to 8.3. The meaning of the bits is described in clause 6.

10 Support of Non-Transparent Bearer Services

In the case of non-transparent services, the RA1' function provides access to the 12 and 6 kbit/s (alignment of RLP frames with the four TDMA slots makes it physically impossible to provide 3.0 kbit/s) radio interface data rates.

Table 10.1: RA1' Maximum User Rate to Radio Interface Data Rate Adaption

Maximum user rate	Radio interface rate
4,8 kbit/s	6 kbit/s
9,6 kbit/s	12 kbit/s

This access results in the use of a modified ITU-T Recommendation V.110 [8] 60 bit frame for non-transparent services (figure 10.1). In this case, the RA1' function also provides for alignment of four modified ITU-T Recommendation V.110 [8] 60 bit frames corresponding with each complete 240 bit frame to be encoded by the radio subsystem as a single unit (see GMR-2 05.003 [3]). The difference between the non-transparent 60 bit frame and the 60 bit frame for the transparent service is that the bit positions used for status in a transparent frame are used to carry data (designated as D' bits in figure 10.1).

NOTE: The status bits SA, SB, and the X bit are embedded in the L2R-PDU frames (see GSM 07.01 [4], 07.02 [5], and 07.03 [6]).

The first bit of each RLP frame to be transmitted will correspond to the first bit (D1) of the first 60 bit frame in a four frame sequence and the last bit will correspond to the last bit (D'12) of the last 60 bit frame in a four frame sequence. Each 60 bit frame is filled from left to right starting at D1 (see figure 10.1).

The radio subsystem provides for the synchronous transmission and reception of 240 bit RLP frames every 20 ms (12 kbit/s radio interface rate) or 40 ms (6 kbit/s radio interface rate) irrespective of the user rate.

The request to use 6 kbit/s radio interface rate on a Full Rate Channel is indicated in the BC-IE by setting the NIRR bit to 6 kbit/s (Negotiation procedure, see GSM 07.01 [4]) and selecting a Full Rate Channel and Non-Transparent service. If the entity receiving the BC-IE is unable to support this request then the 12 kbit/s radio interface rate shall be provided automatically.

Occasions may arise when there is no RLP frame ready to be transmitted. In this case a frame of 240 zeroes will be transmitted. This frame will be discarded by the distant RLP function, due to FCS failure, but will allow physical link synchronization to be maintained between the MES and the MSC.

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	D6	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 10.1: Modified ITU-T Recommendation V.110 60 bit Frame for Non-Transparent Data

Annex A (informative): Stacks of Rate Adaptation

For transparent data services, the following stacks of rate adaption are possible:

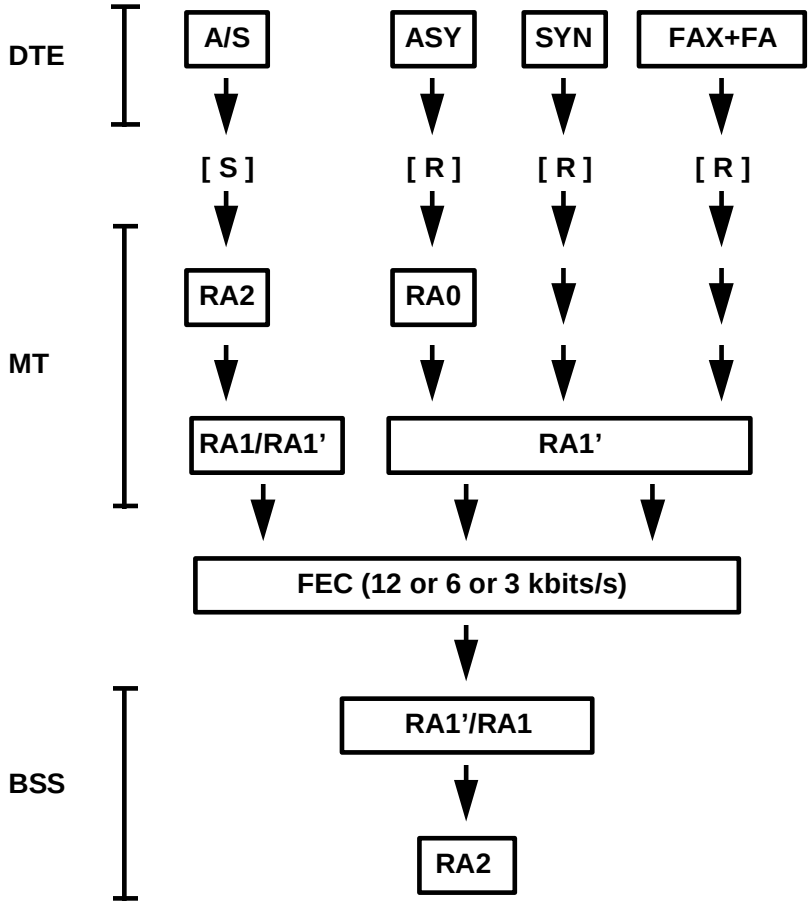

Figure A.1: Transparent Rate Adaption Stacks

For the non-transparent services, the following stacks of rate adaption and functions are possible:

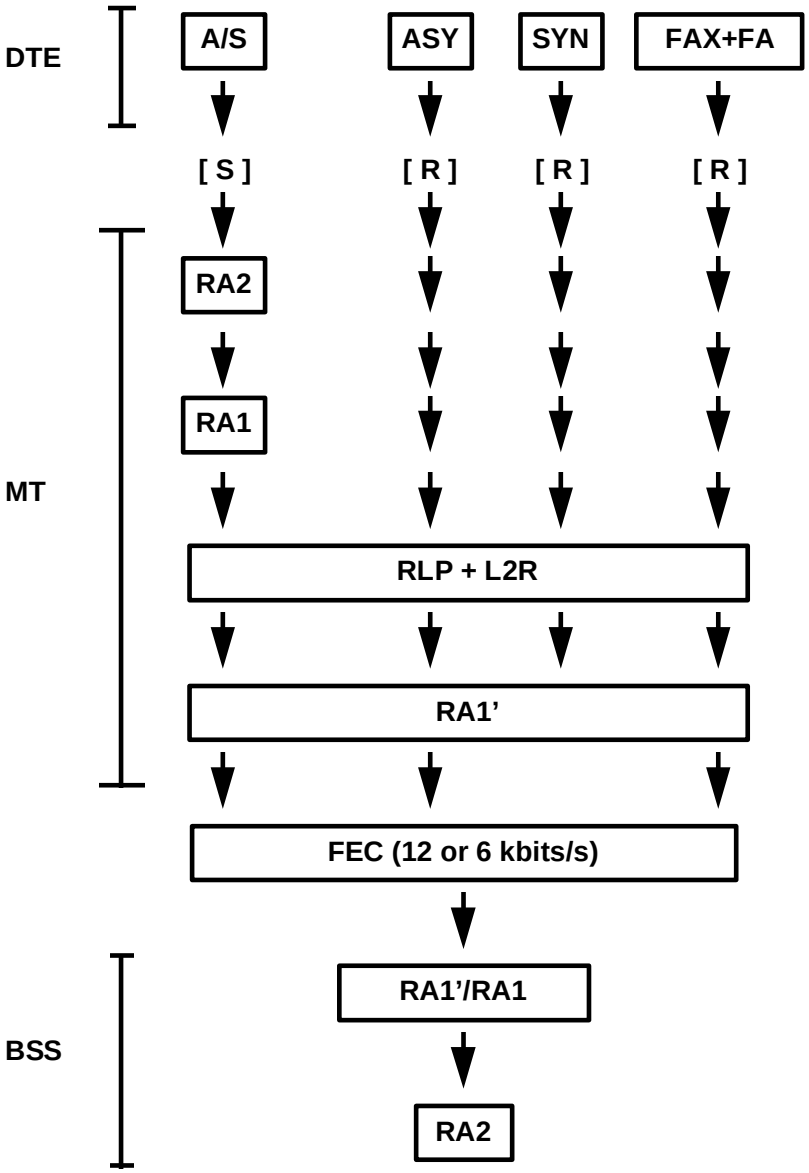

Figure A.2: Non-Transparent Rate Adaption and Function Stacks

History

Document history		
V1.1.1	March 2001	Publication