3GPP TSG CN Plenary Meeting #17 **NP-020405**
4th - 6th September 2002. Biarritz, France.

Source: **TSG CN WG 3**

Title: **CRs to Rel-4 (with mirror CRs) Work Item "CS Data Bearers"**

Agenda item: **7.12**

Document for: **APPROVAL**

Introduction:

This document contains **8** CRs on **Rel-4 (including mirror CRs)** Work Item **" CS Data Bearers"**, that have been agreed by **TSG CN WG3**, and are forwarded to TSG CN Plenary meeting #17 for approval.

Doc-2nd-	Spec	CR	Rev	Subject	Cat	Phase	Version-	Workitem
N3-020662	43.010	008	-	Correction of Rate Adaptation Functions and removal of S Reference Point in MS	F	Rel-4	4.0.0	CS Data
N3-020638	43.010	006	1	Correction of Rate Adaptation Functions and removal of S Reference Point in MS	A	Rel-5	5.0.0	CS Data
N3-020683	44.021	006	-	Correction of protocol stacks in annex A	F	Rel-4	4.0.0	CS Data
N3-020567	44.021	003	-	Correction of protocol stacks in annex A	A	Rel-5	5.0.0	CS Data
N3-020681	44.021	005	-	Correction of Rate Adaptation Functions and removal of S Reference Point in MS	F	Rel-4	4.0.0	CS Data
N3-020680	44.021	002	3	Correction of Rate Adaptation Functions and removal of S Reference Point in MS	A	Rel-5	5.0.0	CS Data
N3-020682	48.020	004	-	Correction of Rate Adaptation Functions and removal of S Reference Point in MS	F	Rel-4	4.0.0	CS Data
N3-020566	48.020	002	-	Correction of Rate Adaptation Functions and removal of S Reference Point in MS	A	Rel-5	5.0.0	CS Data

3GPP TSG CN WG3 Meeting #24
Helsinki, Finland. 29th July – 2nd August 2002

Tdoc ⌘ N3-020566

CR-Form-v7

CHANGE REQUEST

⌘	**48.020**	**CR 002**	⌘ **rev**	**-**	⌘ Current version:	**5.0.0** ⌘

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Proposed change affects: UICC apps⌘ [ ] ME [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	Correction of Rate Adaptation Functions and removal of S Reference Point in MS		
Source: ⌘	TSG_CN WG3		
Work item code: ⌘	TEI [CS Data]	***Date:*** ⌘	20/06/2002
Category: ⌘	**A**	***Release:*** ⌘	Rel-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change: ⌘

- Alignment with TS 43.010 and TS 44.021 concerning the rate adaptation function RA1'/RA1" for the user rates 48, 56 and 64 kbit/s.
- Introduction of the rate adaptation function RA1'/RAA" for the user rate of 64 kbit/s using TCH/F14.4 channel coding.
- Move of RA1, RA2 and RA1" rate adaptation functions from TS 44.021 to TS 48.020 because these functions are needed at A interface and they are no longer specified in 44.021 due to the removal of the S refernce point in the MS

Summary of change: ⌘ See attached pages, clauses 3, 5, 6, 8, 9, 10, 13, 16, 17

Consequences if not approved: ⌘ Inconsisteny between TS 44.021, 43.010 and 48.020 and errorneous specification of the rate adaptation function mentioned above.

Clauses affected: ⌘

Other specs affected: ⌘	Y	N		
	X		Other core specifications ⌘	TS 44.021, TS 43.010
		X	Test specifications	
		X	O&M Specifications	

Other comments: ⌘

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3 General approach

3GPP TS 43.010 (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 3GPP TS 43.010 as part of a connection type.

These functions are RA0, RA1, RA1/RA1' , RA1'' , RA1'/RA1", RA1'/RAA", RAA", RA1'/RAA', RAA' and RA2. The RA2 function is equivalent to that described in ITU-T Recommendation V.110. In addition, splitting/combining, padding and inband numbering functions as defined in 3GPP TS 44.021 and multiplexing as defined herein are used in cases where more than one channel is allowed.

The RA1/RA1', RA1'/RA1", RA1'/RAA" and RA1'/RAA' are relay functions used as indicated in 3GPP TS 43.010.

The BSS uses the information contained in the ASSIGNMENT REQUEST message on the A-interface (see 3GPP TS 48.008) 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 3GPP TS 44.021.

5 The RA1 Function

~~For connections where only one channel is allowed used on the radio interface, the specification in 3GPP TS 44.021 for adaptation of synchronous data rates up to and including 9,6 kbit/s to intermediate rates 8 or 16 kbit/s shall apply.~~

~~For connection where more than one channel are used on the radio interface, rate adaptation shall apply on the corresponding substreams as specified in 3GPP TS 44.021 for AIUR of 4,8 kbit/s or 9,6 kbit/s.~~ This function shall be used to adapt between the synchronous user rates, or the output of the RA0 function or Split/Combine function and the intermediate rate of 8, 16, 32 or 64 kbit/s.

For multislot operations RA1 applies per substream. RA1 applies only if TCH/F4.8 or TCH/F9.6 is used for user rates up to 38,4 kbit/s.

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
14,4 kbit/s	32 kbit/s
19,2 kbit/s	32 kbit/s
28,8 kbit/s	64 kbit/s
38,4 kbit/s	64 kbit/s

An ITU-T V.110 80 bits frame is constructed using the user data bits received (from the RA0 in the asynchronous case).

Adaptation of 600 bit/s to 8Kbit/s is performed by 8 times consecutive duplication of each user data bit. (Figure 11)

Adaptation of 1200 bit/s to 8 Kbit/s is performed by 4 times consecutive duplication of each user data bit. (Figure 10)

Adaptation of 2400 bit/s to 8kbit/s is performed by 2 times consecutive duplication of each user data bit. (Figure 9)

Adaptation of 4800 bit/s to 8 Kbit/s is performed by transmitting the bit stream with no duplication. (Figure 7)

Adaptation of 9600 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 4800 bit/s case). (Figure 7)

Adaptation of 14400 bit/s to 32 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 3600 bit/s case).(Adaptation of 3600 bit/s to 8 kbit/s is performed by transmitting the bit stream with no duplication.) (Figure 8)

Adaptation of 19200 bit/s to 32 Kbit/s is performed as for 4800 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 4800 bit/s case). (Figure 7)

Adaptation of 28800 bit/s to 64 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by eight with respect to the 3600 bit/s case). (Figure 8)

Adaptation of 38400 bit/s to 64 Kbit/s is performed as for 4800 bit/s 8 kbit/s (the emitting period is divided by eight with respect to the 4800 bit/s case). (Figure 7)

The ITU-T V.110 80 bit frames shown in Figures 7 and 8 are used. The meaning of the bits is specified in 44.021.

6 The RA1’’ Function

~~The RA1’’ function is specified in 3GPP TS 44.021. The RA1’’ function is only applicable in BSS for AIUR higher than 38,4 kbit/s.~~

The RA1" function shall be used for converting between synchronous user rates of 48 and 56 kbit/s and the 'intermediate' rate of 64 kbit/s.

Note, RA1" is a 3GPP-specific term which is used for the one-step adaptation of 48 and 56 kbit/s rates into 64 kbit/s as specified in ITU-T V.110. For the purposes of 3GPP specifications the term 'intermediate rate' is used for the resulting 64 kbit/s rate although this is not done in ITU-T V.110.

6.1 Rate adaptation of 48 kbit/s user rates with DTE/DCE status to 64 kbit/s

An ITU-T V.110 32 bits frame is constructed using the user data bits received.

The ITU-T V.110 32 bit frame shown in Figure 12 is used. The D bits are used for conveying the user data and the S and X bits are used for conveying channel control information according 3GPP TS 27.001.The order of transmission of the 32 bit frame is from left to right and top to bottom.

6.2 Rate adaptation of 56 kbit/s user rate to 64 kbit/s

An ITU-T V.110 64 bits frame is constructed using the user data bits received.

The ITU-T V.110 64 bit frame shown in figure 13 is used. The D bits are used for conveying the user data.

The order of transmission of the 64 bit frame is from left to right and top to bottom.

7 Split/Combine and Padding Functions

The Split/Combine-function in the IWF shall be used in cases when up to and including 4substreams are used.

The Split/Combine-function in the BSS shall be used only when more than four substreams are used.

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

Described in 3GPP TS 44.021.

7.2 Substream numbering

Described in 3GPP TS 44.021.

7.3 Initial Substream Synchronisation for Transparent Services

Described in 3GPP TS 44.021.

7.4 Frame Synchronisation and Action on loss of Synchronisation

When in the IWF, the Split/Combine function is responsible for controlling the initial frame synchronisation procedure and re-synchronisation procedure as described in 3GPP TS 29.007.

7.5 Network Independent Clocking

NIC is specified in 3GPP TS 44.021.

7.6 Padding

Padding is specified in 3GPP TS 44.021.

8 The EDGE Multiplexing Function

In EDGE configurations where the number of radio interface channels and number of channels or substreams used between BTS and MSC do not match, a multiplexing function described below shall be used at BTS to perform data multiplexing/demultiplexing between the radio interface and network channel configurations. A similar functionshall be used also at MS as described in 44.021.

The EDGE multiplexing function is located between the radio interface and RA1'/RAA' function.

8.1 Transparent services

TCH/F28.8;

Uplink direction
Refer to the description of corresponding downlink procedures in 3GPP TS 44.021. Two TCH/F14.4 substreams are forwarded towards the MSC as in a 2×TCH/F14.4 multislot connection.

Downlink direction
The multiplexing function combines the data received through the two TCH/F14.4 substreams into the 29.0 kbit/s radio interface channel. Refer to the description of corresponding uplink procedures in 3GPP TS 44.021.

TCH/F32.0

Uplink direction
The multiplexing function maps the data received from the radio interface into one 64 kbit/s channel so that data carried by timeslot a (0≤a≤6) precedes data carried by timeslot a+n (1≤a+n≤7) — the timeslots belonging to one TDMA-frame.

Downlink direction
The multiplexing function distributes the data received from the 64 kbit/s channel into two 32.0 kbit/s radio interface channels so that 640-bit data blocks are allocated to timeslots a (0≤a≤6) and a+n (1≤a+n≤7). In the datastream, data carried by timeslot a precedes data carried by timeslot a+n of the same TDMA-frame.

8.2 Non-Transparent services

TCH/F28.8;

Uplink direction
The multiplexing function demultiplexes the data received through the 29.0 kbit/s radio interface channel into two TCH/F14.4 substreams. Two 290-bit blocks carrying the two halves of one RLP frame belong to the same substream. Refer to the corresponding downlink procedures in 3GPP TS 44.021.

Downlink direction
The multiplexing function multiplexes the 290-bit blocks received through two TCH/F14.4 substreams into the 29.0 kbit/s radio interface channel. Refer to the corresponding uplink procedures in 3GPP TS 44.021.

TCH/F43.2;

Uplink direction
The multiplexing function demultiplexes the data received through the 43.5 kbit/s radio interface channel into three TCH/F14.4 substreams. Two 290-bit blocks carrying the two halves of one RLP frame belong to the same substream. Refer to the corresponding downlink procedures in 3GPP TS 44.021.

Downlink direction
The multiplexing function multiplexes the 290-bit blocks received through three TCH/F14.4 substreams into the 43.5 kbit/s radio interface channel. Refer to the corresponding uplink procedures in 3GPP TS 44.021.

9 The Functions RA1/RA1' ~~Function~~and RA1’/RA1”

For AIURs less than or equal to 38,4 kbit/s, the RA1/RA1’ function in the BSS shall be 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 than or equal to 38,4 kbit/s RA1/RA1’ is as specified in 3GPP TS 44.021 for the single slot case.

For AIURs of 48 kbit/s, 56 kbit/s and 64 kbit/s, RA1’/RA1’’ shall be applied as specified in 3GPP TS 44.021.

The table ~~below~~ 1 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 shall be rate adapted as in the single slot case.

~~For AIURs of 48 kbit/s, 56 kbit/s and 64 kbit/s, RA1/RA1’’ shall be as specified in 3GPP TS 44.021 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

10 THE The Functions RA1'/RAA' FUNCTIONand RA1’/RAA”

The RA1'/RAA' shall be applied only when TCH/F14.4, TCH/F28.8, or TCH/F43.2 channel coding is used. The RA1/RAA' converts 290-bit blocks from the channel coder or EDGE multiplexing function into E-TRAU frames and vice versa. The format of E-TRAU frame is specified in 3GPP TS 48.060.

The RA1'/RAA' function in the BSS shall be applied on each of the n substreams and there are no significant differences between the single slot case and the multislot case.

For the AIURs of 64 kbit/s, RA1’/RAA’’ shall be applied as specified in 3GPP TS 44.021. This function converts 290-bit blocks from the channel coder directly into the synchronous 64 kbit/s data stream, an E-TRAU frame is not created in this case.

The table below 2 gives a relation between the AIUR, channel coding and number of substreams. As an example from table 2 : The wanted AIUR is 28,8 kbit/s, the number of substreams needed to support this rate is 2. Each individual substream shall be rate adapted as in the single slot case.

Table 2 Relationship between AIUR, channel coding and number of channels.

AIUR	Transparent	Non-transparent
14,4 kbit/s	1	1
28,8 kbit/s	2	2
38,4 kbit/s	3	N/A
43,2 kbit/s	N/A	3
48 kbit/s	4	N/A
56 kbit/s	4	N/A
57,6 kbit/s	N/A	4
64 kbit/s	5	N/A

10.1 Radio Interface rate of 14,5 kbit/s

See 3GPP TS 48.060.

10.2 Synchronisation

See 3GPP TS 48.060.

10.3 Idle frames

See 3GPP TS 48.060.

11 THE RAA' FUNCTION

The RAA' function shall be applied only when TCH/F14.4, TCH/F28.8, or TCH/F43.2 channels are used.

The RAA' converts E-TRAU frame into A-TRAU frame and vice versa.

The format of the E-TRAU frame is specified in 3GPP TS 48.060.

11.1 Coding of A-TRAU frame

The format of the A-TRAU frame is given in Figure 5.

An A-TRAU frame carries eight 36 bit-data frames.

C Bits

Table 3

C1	C2	C3	C4	Date Rate
0	1	1	1	14,4 kbit/s
0	1	1	0	14.4 kbit/s idle (IWF to BSS only)

Table 4

C5	BSS to IWF Frame Type note 1	IWF to BSS UFE (Uplink Frame Error)
1	idle	framing error
0	data	no framing error

NOTE 1: Bit C5 corresponds to bit C6 of the E-TRAU frame as defined in 3GPP TS 48.060.

M Bits

Transparent data

M1 and M2 are as defined in 3GPP TS 44.021.

Non transparent data

See subclause 15.2 of the present document.

Z bits

Bits Zi are used for Framing Pattern Substitution.

See subclause 11.2.

11.2 Framing Pattern Substitution in A-TRAU frame

The Framing Pattern Substitution is used in each of the eight 36 bit data fields of the A-TRAU frame (see Figure 5) to avoid transmitting a sequence of eight zeroes (called Z sequence in the following).

The purposes of FPS is to avoid erroneous synchronisation to the A-TRAU due to sixteen zeroes occurring accidentally in the data bits and to avoid erroneous synchronisation to V.110. The synchronisation pattern of two consecutive V.110 frames cannot be found within a stream of A TRAU frames.

11.2.1 FPS encoding

A Zero Sequence Position (ZSP) field is used to account for the occurrence of eight zeroes in the 36 bit data field.

NOTE: A sequence of eight zeroes is considered as a block (e.g. a stream of eleven consecutive zeroes produces only one ZSP and not four ZSPs).

The ZSP field is defined as follows:

Table 5

1	2	3	4	5	6	7	8
1	C	A0	A1	A2	A3	A4	1

The meaning of the different bits of the ZSP field is :

C : Continuation bit. '0' means that there is another ZSP in the data field. '1' means that there is no other ZSP.

A0-A4 :address of the next Z sequence (eight zeroes) to be inserted. The address ‘00001’ corresponds to the bit D1, the value ‘11101’ to the bit D29, (A0 is the msb, A4 is the lsb).

NOTE: a Z sequence substitution cannot occur at bit D30..D36 (as it is 8 bit long)

1 : locking bit prevent the false occurrence of a Z sequence.

The Framing Pattern Substitution is applied in each of the eight 36 bit data field (see Figure 5).

Bit Zi indicates whether FPS is used in the ith 36 bit data field (i=1 to 8). The coding of the Zi bit is the following:

Table 6

Zi (i=1..8)	meaning
1	no substitution
0	at least one substitution

If Zi bit indicates no substitution, the output data bits of FPS are equal to the input data bits.

If Zi indicates at least one substitution, the bits D1-D8 contain the first ZSP.

The following description indicates the general operating procedures for FPS. It is not meant to indicate a required implementation of the encoding procedure.

Figure 1

Step 1:

The input 36 bit sub frame is considered as a bit stream in which the bits are numbered from 1 to 36.

This bit stream contains 0, 1 or several Z sequences, ($Zseq_1$ to $Zseq_3$ on the figure)

The Z sequence is a sequence of 8 consecutive zeroes : '0000 0000'

Step 2:

Starting from this bit stream, two lists are built up :

2-a : the 'a' list which contains the address of the first bit of each Z sequences.

2-d : the 'd' list which contains all the data blocks which do not have the Z sequence.

Step 3:

The 'a' list is transformed so as to build the ZSP list. Each ZSP element is used to indicate:

at which address is the next Z sequence of the message

if yet another ZSP element is found at this address (link element)

Step 4:

The output 37 bit sub frame is built from:

the Zi field which indicates whether the original message has been transformed or not with this technique. In the example given in Figure 1, Zi shall be set to '0' to indicate that at least one FPS has occurred.

the ZSP and D elements interleaved.

As the ZSP elements have exactly the same length as the Z sequence, the sub frame length is only increased by one (the Zi bit), whatever the number of frame pattern substitutions may be.

For special cases, refer to annex A.

11.3 A-TRAU Synchronisation Pattern

The frame synchronisation 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 coded binary "1". The following 17 bit alignment pattern is used to achieve frame synchronisation:

```
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
```

12 THE RAA" FUNCTION

On the IWF side of the A interface, the RAA" function shall convert between the A-TRAU format and a synchronous stream. FPS shall be performed by this function as well, see subclause 11.2. In transparent operation, the RAA" function shall handle the M1 and M2 bits as specified for the RA1' function in 3GPP TS 44.021.

In non-transparent operation, the RAA" function shall map between the A-TRAU format and 290 bit blocks consisting of M1, M2 and 288 bits making up half of an RLP frame, see subclause 15.2 of the present document.

13 The RA2 Function

~~Described in 3GPP TS 44.021.~~ The RA2 function shall be applied only for single slot operations. For multislot operations the A-interface Multiplexing Function applies (see clause 14).

This procedure is based on the RA2 function as specified in ITU-T V.110. It shall be used to rate adapt to/from the intermediate rates of 8, 16 or 32 kbit/s from/to the 64 kbit/s rate used at the A-interface.

Intermediate rate	Rate at the A-interface
8 kbit/s	64 kbit/s
16 kbit/s	64 kbit/s
32 kbit/s	64 kbit/s
64 kbit/s	64 kbit/s

For the intermediate and user data rate of 64 kbit/s, the RA2 transmits the bit stream over the A-interface as it is.

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

The procedure requires that:

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

ii) The 16 kbit/s bitstream occupies bit positions (1,2);

iii) The 32 kbit/s bitstream occupies bit positions (1,2,3,4) ;

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

v) All unused bits in the 64 kbit/s stream are set to binary "1".

14 The A-interface Multiplexing Function

The multiplexing function shall be applied only for AIUR up to and including 57.6 kbit/s for multislot operations.

The multiplexing function is based on the ITU-T 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 may be released in uplink direction. Always, the released subcircuit(s) in downlink direction shall be the same as the released subcircuit(s) in uplink direction. 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.

15 Support of non-transparent bearer services

15.1 TCH/F9.6 and TCH/F4.8 kbit/s channel codings

In the case of non-transparent services the RA1/RA1' function shall perform 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 ITU-T V.110 80 bit frames shown in Figure 3 (derived from the standard ITU-T V.110 frame shown in Figure 2) are used to indicate each consecutive sequence of ITU-T V.110 80 bit frames corresponding to the four modified ITU-T V.110 60 bit frames (Figure 4) 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 3GPP TS 45.003). 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 Table7.

Table 7

	E2	E3
First Modified ITU-T 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 ITU-T V.110 80 bit frames, it is necessary following a transmission break and at start up, to determine which modified ITU-T 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 ITU-T V.110 80 bit frame to determine the modified ITU-T V.110 80 bit frame boundaries, the FSI is required to determine which quarter of an RLP frame each modified ITU-T V.110 80 bit frame contains.

Table 8: 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	9,6 kbit/s	9,6 kbit/s	TCH/F9.6	16 kbit/s
9,6 kbit/s	9,6 kbit/s	2x4,8 kbit/s	2XTCH/F4.8	8 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 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.				

15.1.1 Alignment

An alignment window spanning four modified ITU-T V.110 80 bit frames shall be 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.

15.1.2 Support of Discontinuous Transmission (DTX)

The E1 bit in the modified ITU-T V.110 80 bit frame shown in Figure 3 shall be used in the direction MSC-BSS to indicate that DTX may be invoked (see 3GPP TS 24.022). 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.

15.1.3 Order of Transmission

The first bit of each quarter of an RLP frame to be transmitted shall correspond to bit D1 of a modified V.110 frame (figures 3 and 4). The remaining 59 bits of each quarter of an RLP frame shall correspond to the D and D' bits , D2 - D'12, in order left to right and top to bottom as shown in figures 3 and 4.

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

15.2 TCH/F14.4, TCH/F28.8, and TCH/F43.2 channel codings

In case of non-transparent service, a 576 bit RLP frame shall be mapped over two consecutive A-TRAU frames.

Because of that mapping, it is required, following a transmission break and at start up, to determine which A-TRAU 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.

The two consecutive M1 bits are referred to as the Frame Start Identifier. The FSI value is 01. This value is assigned to the M1 bits as shown in Table 9.

Table 9

	M1 bit
First A-TRAU frame	0
Second A-TRAU frame	1

A-TRAU frames can slip in time during re-routing, and whilst A-TRAU frame synchronisation exists, the FSI is required to determine which half of an RLP frame each A-TRAU frame contains.

Table 10: Relationship between AIUR, substream rate, number of substreams and intermediate rate

	AIUR	Number of substreams x AIUR per substream	Channel Coding	Multislot intermediate Rate
	14,4 kbit/s	14,4 kbit/s	TCH/F14.4	16 kbit/s
	28,8 kbit/s	2X14,4 kbit/s	2XTCH/F14.4 1XTCH/F28,8	16 kbit/s
	43,2 kbit/s	3X14,4 kbit/s	3XTCH/F14.4 1XTCH/F43,2	16 kbit/s
	57,6 kbit/s	4X14,4 kbit/s	4XTCH/F14.4	16 kbit/s
	57,6 kbit/s	4X14,4 kbit/s	4XTCH/F14.4 2XTCH/F28,8	16 kbit/s

NOTE: The table gives the relation between AIUR, Substream Rate, Channel Coding and Intermediate Rate. As an example: the AIUR is 28,8 kbit/s and the selected channel coding is 14,5 kbit/s. The data stream is split into two substreams of 14,5 kbit/s yielding an AIUR of 28,8 kbit/s

The same number of substreams is used in each direction, even if the AIURs in each direction differ. Superfluous substreams are filled with idle frames. These are inserted at the BTS or IWF and are discarded at the IWFor BTS respectively. At the IWF, the down link AIUR is determined by the out of band signalling (Assignment Complete, Handover Performed), whereas the up link AIUR is determined inband by examining the possible substream positions on the A interface.

15.2.1 Alignment

An alignment window spanning two 290 bit blocks in case of TCH/F14.4 channel shall be used to search for the pattern of 2 bits '01' described in subclause 15.2, in order to identify alignment with an RLP frame.

In the event of failure to detect the 2 bits pattern the alignment window is shifted one 290 bit block, discarding the contents of the most historical frame and then checking the new 2 bits pattern.

15.2.2 Support of Discontinuous Transmission (DTX)

The M2 bit in the A-TRAU frame shown in Figure 5 shall be used in the direction MSC to BSS to indicate that DTX may be invoked (see 3GPP TS 24.022). The M2 bit in all of the two consecutive A-TRAU 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 M2 bit shall be set to 0.

In the direction BSS to MSC the M2 bit shall always be set to 0.

16 Support of transparent bearer services

16.1 TCH/F9.6 and TCH/F4.8 channel codings

16.1.1 User rate adaptation on the A interface, AIUR less than or equal to 38,4 kbit/s

The ITU-T V.110 80 bit frame shall be 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 the present document. The relation between the AIUR and the number of channels is specified in table11.

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

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

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

No use of 4 kbit/s stream is foreseen.

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

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

16.1.2 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 ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS 44.021 shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, is as specified in 3GPP TS 44.021.

Table 11 gives the relation between the User Rate, Substream Rate Channel Coding and the Intermediate Rate.

16.1.3 Relation between AIUR and the number of channels

Table11: 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: For AIURs ≤ 38,4 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate.			

16.1.4 Handling of status bits X, SA, SB

In the single slot case, status bit SA shall be coded repeatedly as S1, S3, S6, S8, and SB is coded repeatedly as S4 and S9 in Figure 2. In the multislot case, status bit SA is coded repeatedly as S6, S8 and SB is coded as S9 in figures 2, 5 and 6.

The handling of the status bits shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS 29.007 (MSC), 3GPP TS 44.021 (BSS), 3GPP TS 27.001 (MS).

16.1.5 Handling of bits E1 to E7

Bits E1 to E3 shall be used according to 44.021.

Bits E4 to E7 may be used for network independent clocking as indicated in 3GPP TS 44.021.

16.2 TCH/F14.4, TCH/F28.8, and TCH/F32.0 channel codings

16.2.1 User rate adaptation on the A interface, AIUR less than or equal to 56 kbit/s

The A-TRAU frame shall be used for transparent user data rates other than 32 kbit/s on the A interface. The A-TRAU 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 7 of this TS. The relation between the AIUR and the number of channels is specified in table 12.

In a given A-TRAU frame on the A interface:

- for 14 400 bit/s there is no repetition of bits D within the 16 kbit/s stream in a given A-TRAU frame on the A interface.

The ITU-T I.460 rate adaptation is used for the transparent 32 kbit/s user rate on the A interface, i.e. four bits of each octet in the 64 kbit/s time slot are used for transporting the 32 kbit/s user data.

16.2.2 User Rate Adaptation on the A-interface, AIUR greater than 56 kbit/s

For AIUR of 64 kbit/s one stream consisting of ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS 44.021 shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, shall be as specified in 3GPP TS 44.021.

Table 12 gives the relation between the User Rate, Substream Rate Channel Coding and the Intermediate Rate.

16.2.3 Relation between AIUR and the number of channels

Table 12: Relationship between the AIUR, AIUR per substream, channel coding, intermediate rate and number of substreams

AIUR	Number of substreams x AIUR per substream	Channel Coding	Multislot intermediate Rate (note 1)
14,4 kbit/s	14,4 kbit/s	TCH/F14.4	16 kbit/s
28,8 kbit/s	2X14,4 kbit/s	TCH/F14.4 TCH/F28.8	16 kbit/s
32 kbit/s	1x32 kbit/s	TCH/F32.0	32 kbit/s
38,4 kbit/s	3X14,4 kbit/s w/padding	TCH/F14.4	16 kbit/s
48 kbit/s	4X14,4 kbit/s w/padding	TCH/F14.4	16 kbit/s
56 kbit/s	4X14,4 kbit/s w/padding 1x64.0 kbit/s (Note 2)	TCH/F14.4 TCH/F32.0	16 kbit/s 64 kbit/s
64kbit/s	5X14,4 kbit/s w/padding 1x64.0 kbit/s (Note 2)	TCH/F14.4 TCH/F32.0	64 kbit/s
NOTE 1: For AIURs ≤ 56 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate. NOTE 2: One substream over two air interface timeslots. No multislot intermediate rate.			

16.2.4 Handling of status bits X and SB

The X and SB bits shall be carried over the A interface in a multiframe structure as described in subclause ~~8.1.1.1~~10.3 of 3GPP TS 44.021. SA bit is not carried over the A interface.

The handling of the status bits shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS 29.007 (MSC), 3GPP TS 44.021 (BSS), 3GPP TS 27.001 (MS).

17 Frame Formats

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 2: The ITU-T 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 3: The modified ITU-T 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 4: Modified ITU-T V.110 60 bit frame for Non-Transparent Data

octet number	bit number 0	1	2	3	4	5	6	7	
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**	**M1**	**M2**	
3	**Z1**	D1	D2	D3	D4	D5	D6	D7	
4	D8	D9	D10	D11	D12	D13	D14	D15	36 bit data field 1
5	D16	D17	D18	D19	D20	D21	D22	D23	
6	D24	D25	D26	D27	D28	D29	D30	D31	
7	D32	D33	D34	D35	D36	**Z2**	D1	D2	
8	D3	D4	D5	D6	D7	D8	D9	D10	
9	D11	D12	D13	D14	D15	D16	D17	D18	36 bit data field 2
10	D19	D20	D21	D22	D23	D24	D25	D26	
11	D27	D28	D29	D30	D31	D32	D33	D34	
12	D35	D36	**Z3**	D1	D2	D3	D4	D5	
13	D6	D7	D8	D9	D10	D11	D12	D13	
14	D14	D15	D16	D17	D18	D19	D20	D21	36 bit data field 3
15	D22	D23	D24	D25	D26	D27	D28	D29	
16	D30	D31	D32	D33	D34	D35	D36	**Z4**	
17	D1	D2	D3	D4	D5	D6	D7	D8	
18	D9	D10	D11	D12	D13	D14	D15	D16	36 bit data field 4
19	D17	D18	D19	D20	D21	D22	D23	D24	
20	D25	D26	D27	D28	D29	D30	D31	D32	
21	D33	D34	D35	D36	**Z5**	D1	D2	D3	
22	D4	D5	D6	D7	D8	D9	D10	D11	
23	D12	D13	D14	D15	D16	D17	D18	D19	36 bit data field 5
24	D20	D21	D22	D23	D24	D25	D26	D27	
25	D28	D29	D30	D31	D32	D33	D34	D35	
26	D36	**Z6**	D1	D2	D3	D4	D5	D6	
27	D7	D8	D9	D10	D11	D12	D13	D14	
28	D15	D16	D17	D18	D19	D20	D21	D22	36 bit data field 6
29	D23	D24	D25	D26	D27	D28	D29	D30	
30	D31	D32	D33	D34	D35	D36	**Z7**	D1	
31	D2	D3	D4	D5	D6	D7	D8	D9	
32	D10	D11	D12	D13	D14	D15	D16	D17	
33	D18	D19	D20	D21	D22	D23	D24	D25	36 bit data field 7
34	D26	D27	D28	D29	D30	D31	D32	D33	
35	D34	D35	D36	**Z8**	D1	D2	D3	D4	
36	D5	D6	D7	D8	D9	D10	D11	D12	
37	D13	D14	D15	D16	D17	D18	D19	D20	36 bit data field 8
38	D21	D22	D23	D24	D25	D26	D27	D28	
39	D29	D30	D31	D32	D33	D34	D35	D36	

Figure 5: A-TRAU 320 bit frame

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 6: The modified ITU-T V.110 80 bit frame padded for 4,8 kbit/s transparent data at intermediate rate 16 kbit/s

Octet No.	Bit number							
	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 7: The ITU-T V.110 80 bit RA1 frame structure

0	0	0	0	0	0	0	0
1	D1	D2	D3	D4	D5	D6	S1
1	D7	D8	D9	D10	F	F	X
1	D11	D12	F	F	D13	D14	S3
1	F	F	D15	D16	D17	D18	S4
1	1	0	1	E4	E5	E6	E7
1	D19	D20	D21	D22	D23	D24	S6
1	D25	D26	D27	D28	F	F	X
1	D29	D30	F	F	D31	D32	S8
1	F	F	D33	D34	D35	D36	S9

F =Fill bits, which are set to 1.

Figure 8: The ITU-T V.110 80 bit frame for 3.6 kbit/s transparent data (8 kbit/s intermediate rate)

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	1	1	0	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

Figure 9: ITU-T V.110 80 bit frame for 2,4 kbit/s transparent data (8 kbit/s intermediate rate)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D2	D2	S1
1	D2	D2	D3	D3	D3	D3	X
1	D4	D4	D4	D4	D5	D5	S3
1	D5	D5	D6	D6	D6	D6	S4
1	0	1	0	E4	E5	E6	E7
1	D7	D7	D7	D7	D8	D8	S6
1	D8	D8	D9	D9	D9	D9	X
1	D10	D10	D10	D10	D11	D11	S8
1	D11	D11	D12	D12	D12	D12	S9

Figure 10: ITU-T V.110 80 bit frame for 1,2 kbit/s transparent data (8 kbit/s intermediate rate)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D1	D1	S1
1	D1	D1	D2	D2	D2	D2	X
1	D2	D2	D2	D2	D3	D3	S3
1	D3	D3	D3	D3	D3	D3	S4
1	1	0	0	E4	E5	E6	E7 (note)
1	D4	D4	D4	D4	D4	D4	S6
1	D4	D4	D5	D5	D5	D5	X
1	D5	D5	D5	D5	D6	D6	S8
1	D6	D6	D6	D6	D6	D6	S9

NOTE: In order to maintain compatibility with Recommendation X.30 (I.461), for the 600 bit/s user rate bit E7 is coded to enable the 4×80 bit multiframe synchronisation. To this end, E7 in the fourth 80 bit frame is set to binary '0'. See Table 6 of ITU-T Recommendation V.110(09/92).

Figure 11: ITU-T V.110 80 bit frame for 600 bit/s transparent data (8 kbit/s intermediate rate)

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

Figure 12: The ITU-T V.110 32 bit 48 kbit/s frame structure (64 kbit/s intermediate rate)

D1	D2	D3	D4	D5	D6	D7	1
D8	D9	D10	D11	D12	D13	D14	1
D15	D16	D17	D18	D19	D20	D21	1
D22	D23	D24	D25	D26	D27	D28	1
D29	D30	D31	D32	D33	D34	D35	1
D36	D37	D38	D39	D40	D41	D42	1
D43	D44	D45	D46	D47	D48	D49	1
D50	D51	D52	D53	D54	D55	D56	1

Figure 13: The ITU-T V.110 64 bit 56 kbit/s frame structure (64 kbit/s intermediate rate, option without status bits)

3GPP TSG CN WG3 Meeting #24
Helsinki, Finland. 29th July – 2nd August 2002

Tdoc ⌘ N3-020567

CR-Form-v7

CHANGE REQUEST

⌘ 44.021	CR 003	⌘ rev -	⌘ Current version: 5.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects:	UICC apps⌘		ME	X	Radio Access Network	X	Core Network

Title:	⌘	Correction of protocol stacks in annex A		
Source:	⌘	TSG_CN WG3		
Work item code:	⌘	TEI [CS Data]	***Date:*** ⌘	05/07/2002
Category:	⌘	**A**	***Release:*** ⌘	Rel-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	This CR updates the protocol stacks in annex A in order to reflect the following decision in 3GPP: • removal of S reference point as internal interface in the MS • removal of Fax NT in GERAN A/Gb mode • removal of BS 30 NT • correction of RA relay functions
Summary of change:	⌘	See attached pages
Consequences if not approved:	⌘	Inconsistency with other specs (e.g. 43.010) and errorneous specification of the protocol stacks.

Clauses affected:	⌘					
		Y	N			
Other specs affected:	⌘		X	Other core specifications	⌘	
			X	Test specifications		
			X	O&M Specifications		
Other comments:	⌘					

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

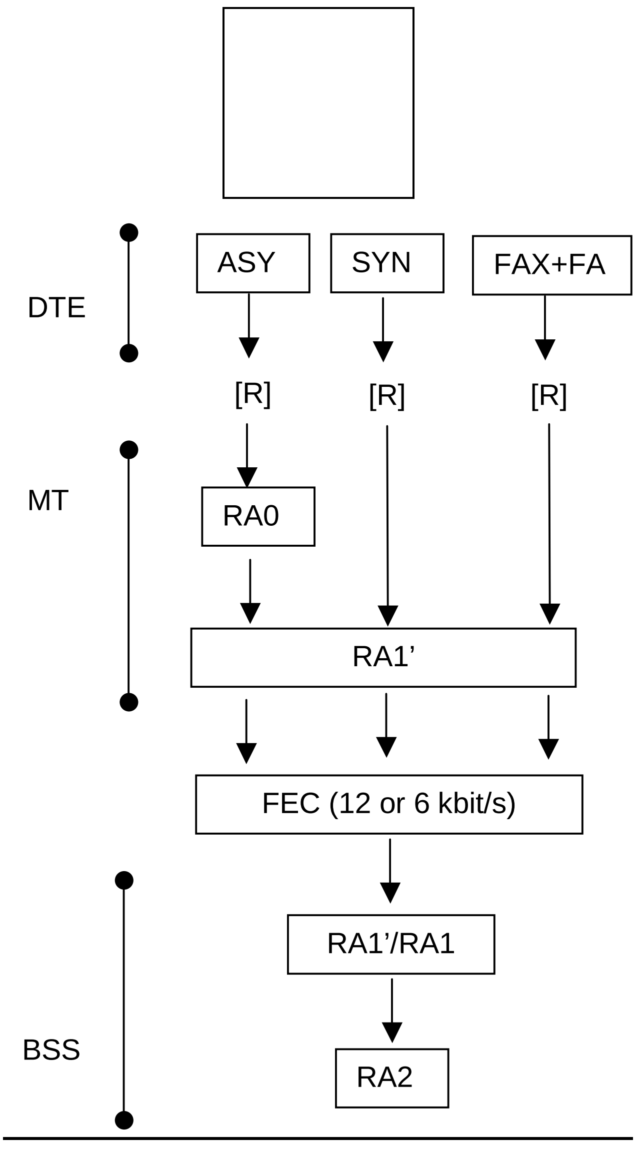
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

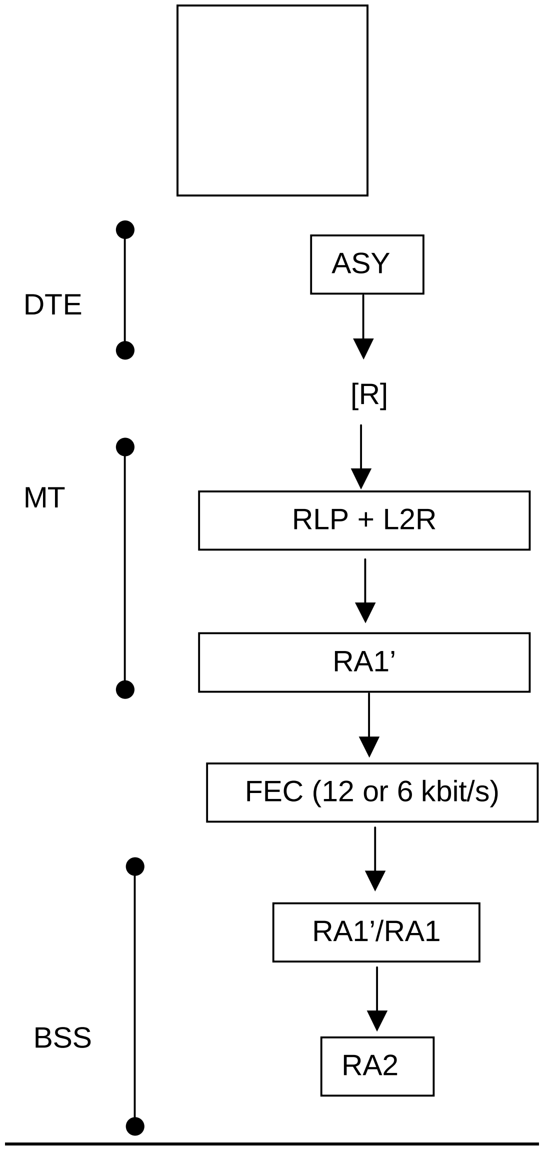
Annex A (Informative): Stacks of rate adaptation

A.1 Stacks of rate adaptation for 9,6/4,8 kbit/s single slot operation

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

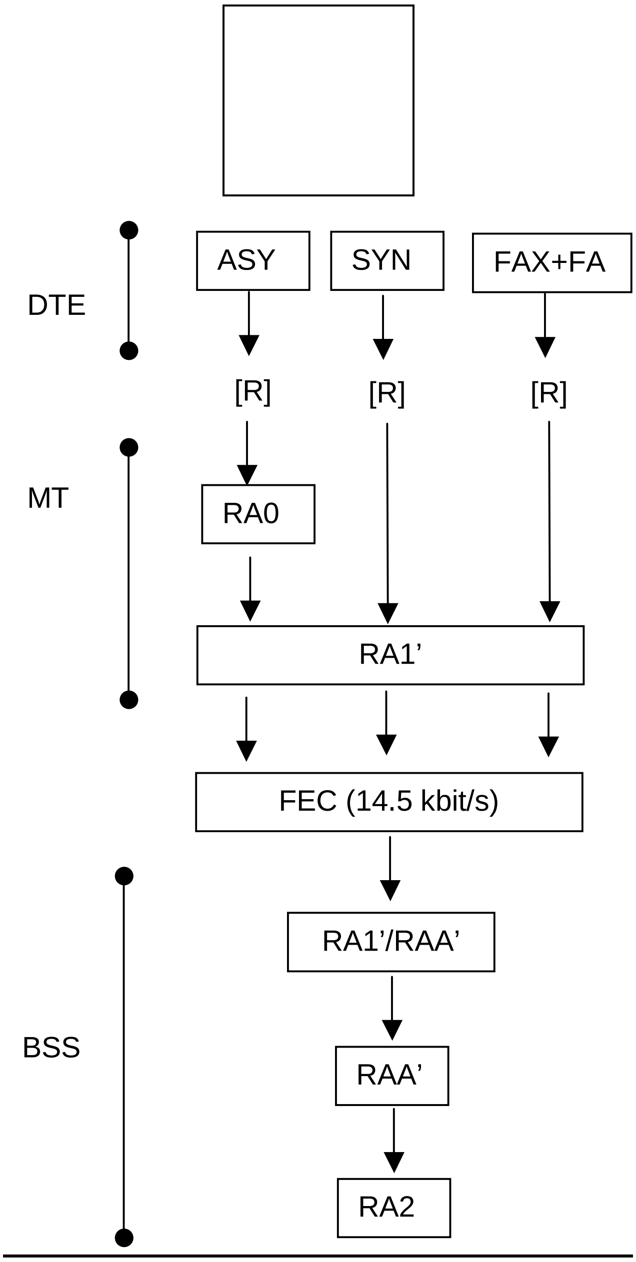


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

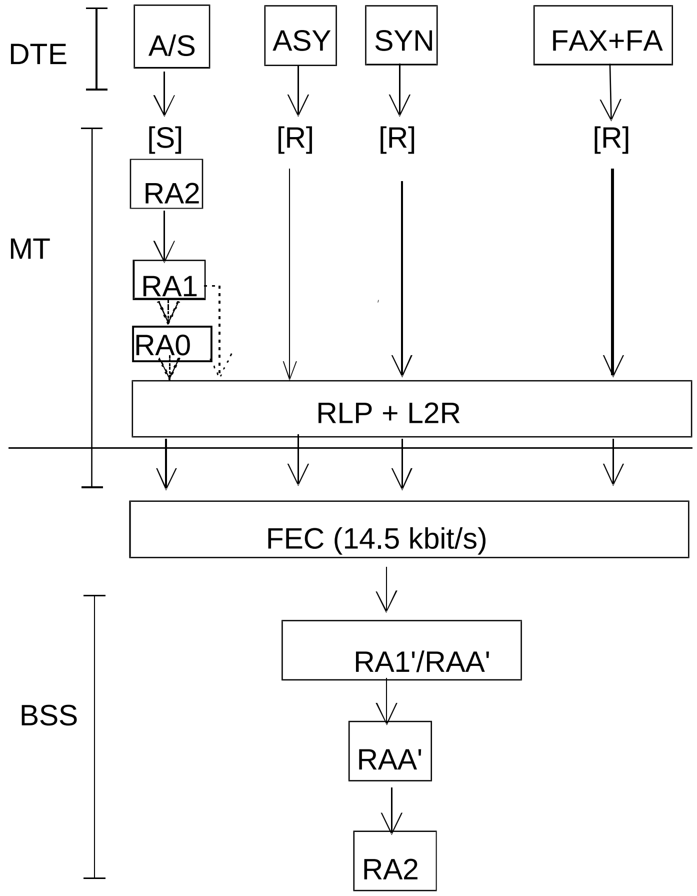


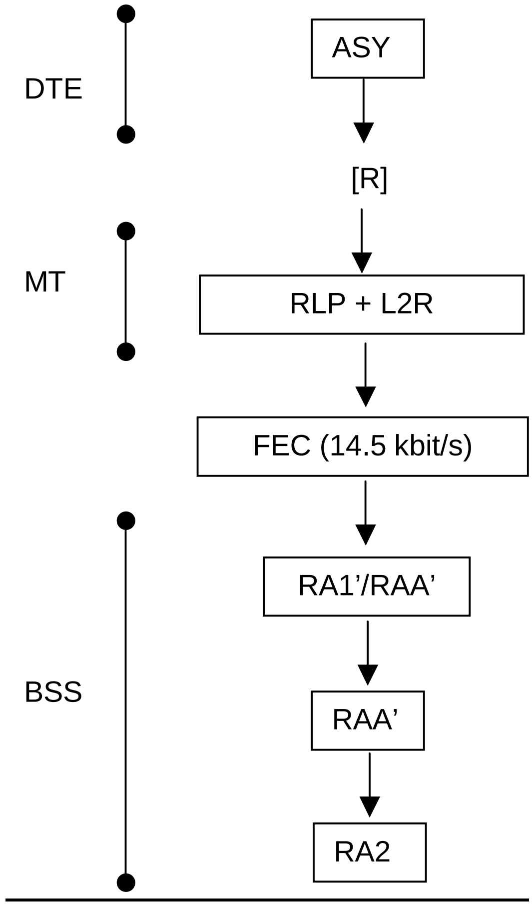
A.2 Stacks of rate adaptation for 14,4 kbit/s single slot operation

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



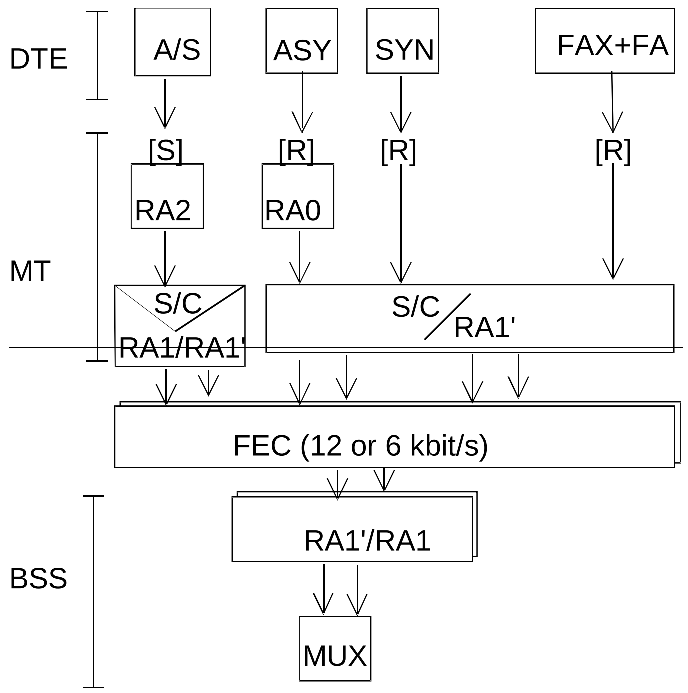
For the non-transparent services, the following stacks of rate adaptation and functions are possible:

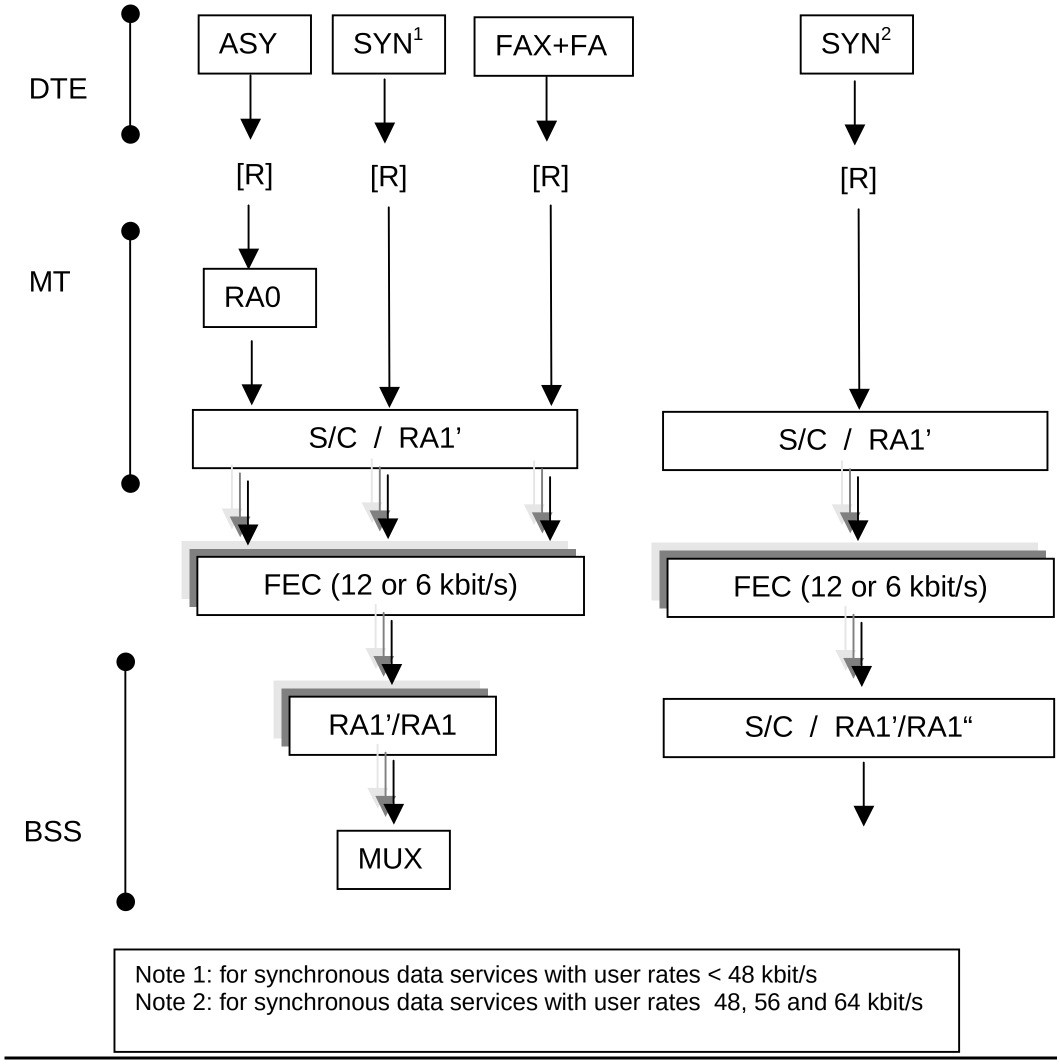



DTE
MT
BSS
ASY
[R]
RLP + L2R
FEC (14.5 kbit/s)
RA1'/RAA'
RAA'
RA2

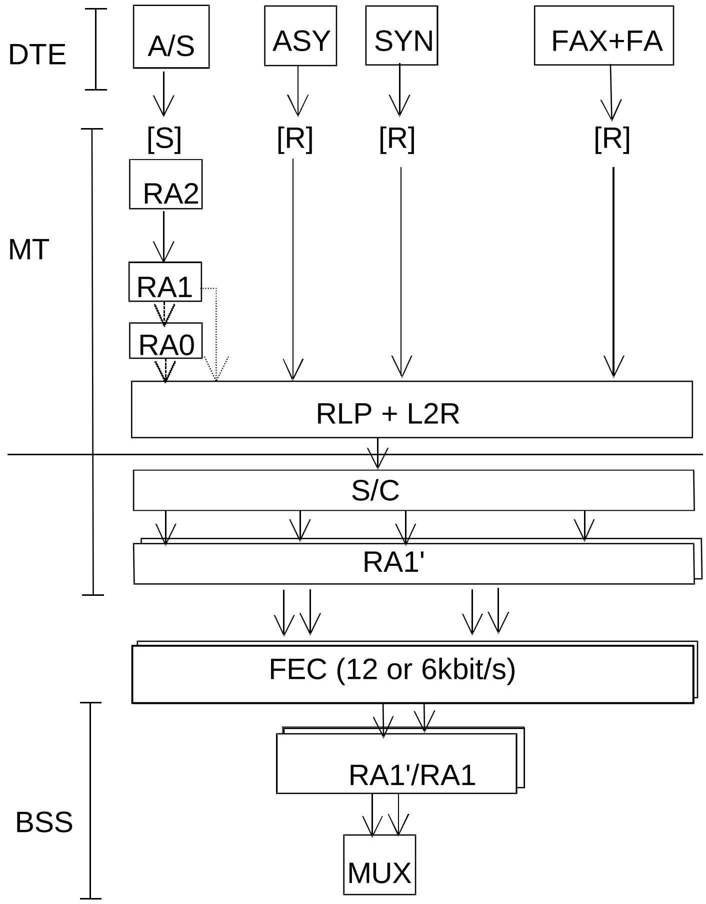
A.3 Stacks of rate adaptation for 9,6/4,8 kbit/s multi slot operation

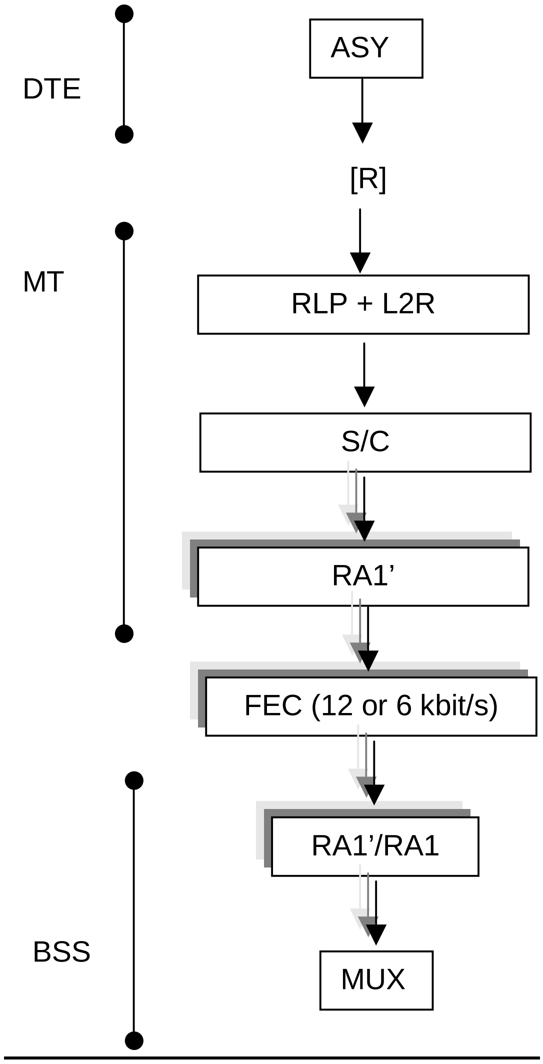
For transparent data services, the following stacks of rate adaptation are possible:




DTE
MT
BSS
ASY
SYN1
FAX+FA
SYN2
[R]
[R]
[R]
[R]
RA0
S/C / RA1'
S/C / RA1'
FEC (12 or 6 kbit/s)
FEC (12 or 6 kbit/s)
RA1'/RA1
S/C / RA1'/RA1"
MUX
Note 1: for synchronous data services with user rates < 48 kbit/s
Note 2: for synchronous data services with user rates 48, 56 and 64 kbit/s

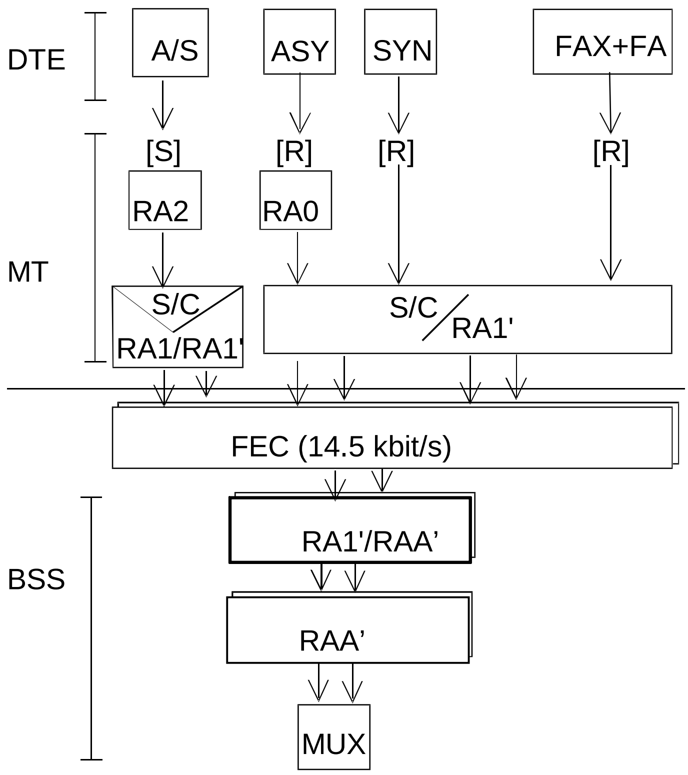
For the non-transparent services, the following stacks of rate adaptation and functions are possible:

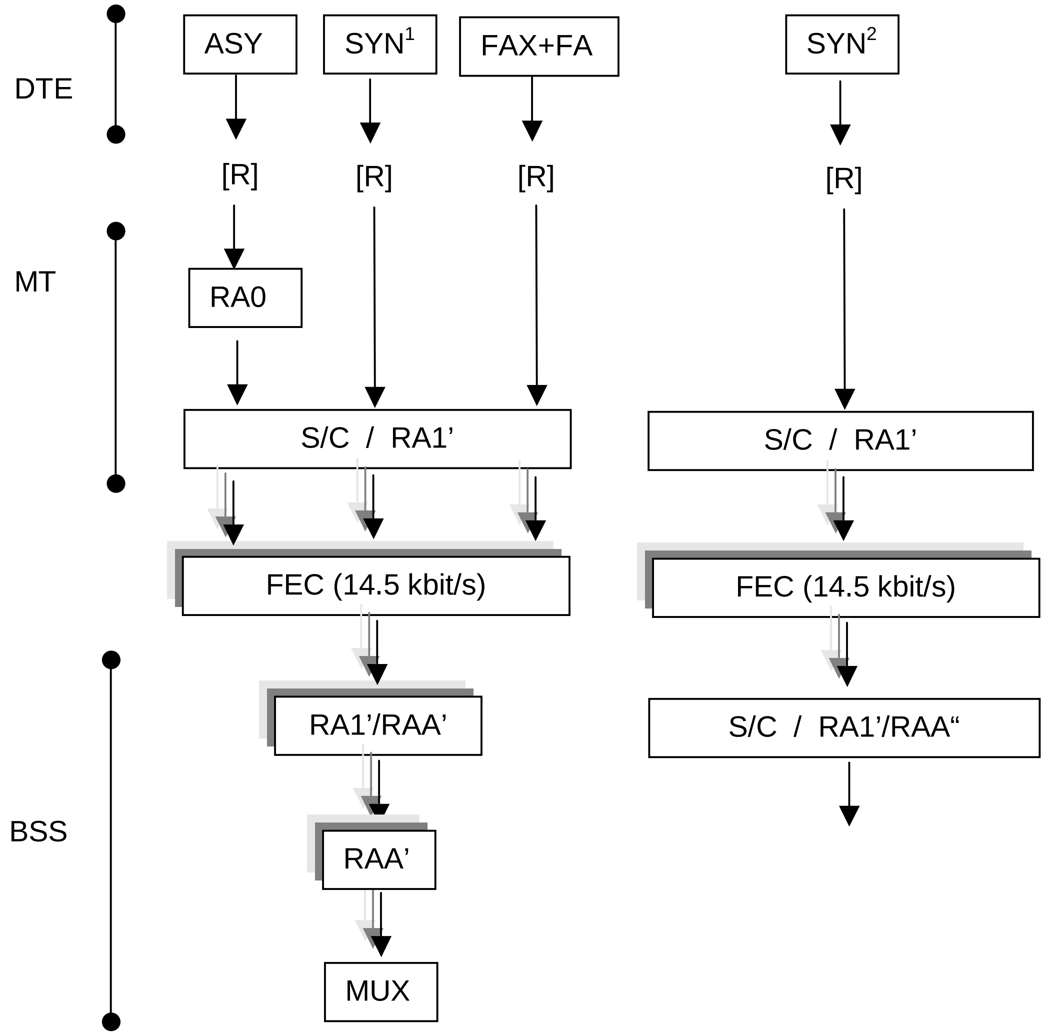



DTE
ASY
[R]
MT
RLP + L2R
S/C
RA1'
FEC (12 or 6 kbit/s)
BSS
RA1'/RA1
MUX

A.4 Stacks of rate adaptation for 14,4 kbit/s multi slot operation

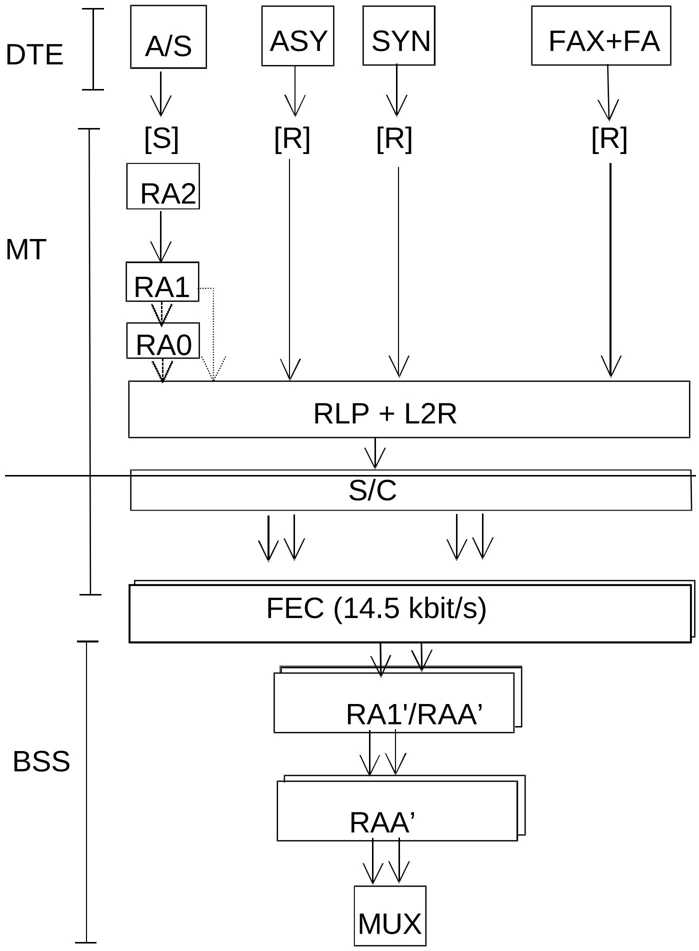
For transparent data services, the following stacks of rate adaptation are possible:

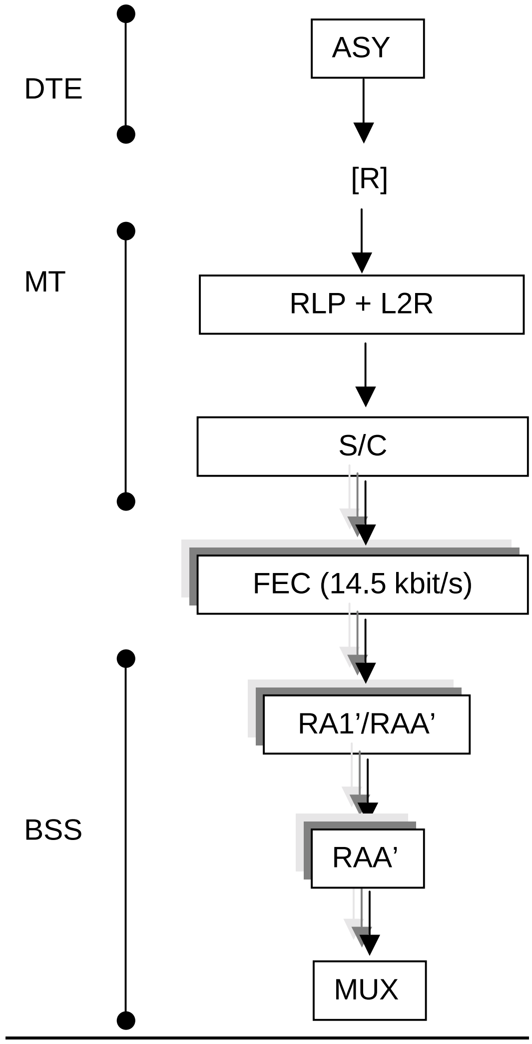




Note 1: for synchronous data services with user rates < 64 kbit/s
Note 2: for synchronous data services with user rate 64 kbit/s

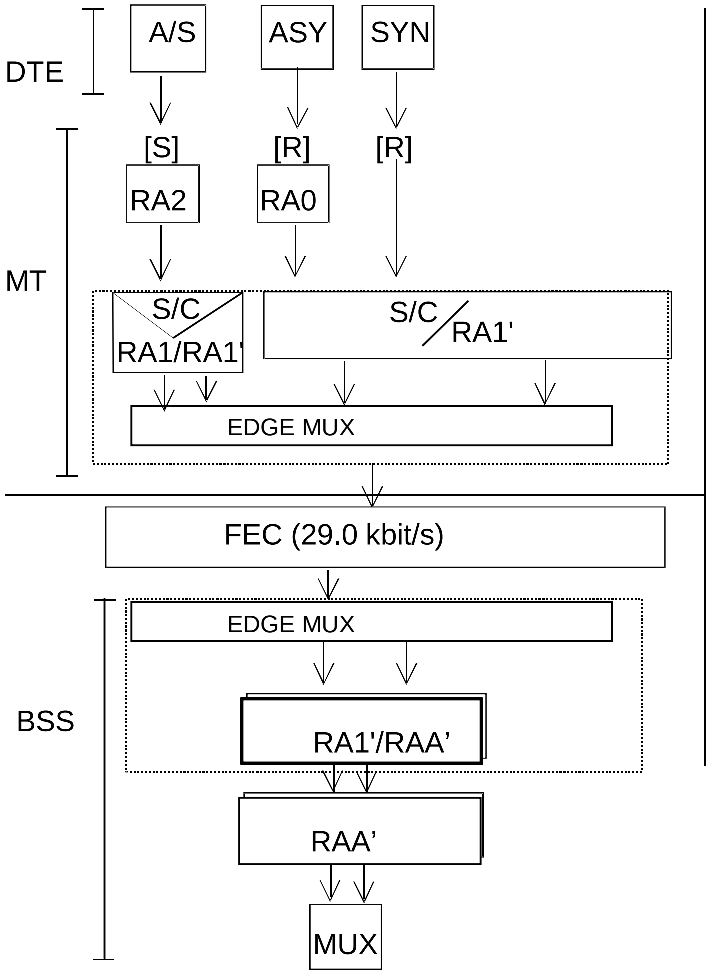
For the non-transparent services, the following stacks of rate adaptation and functions are possible:

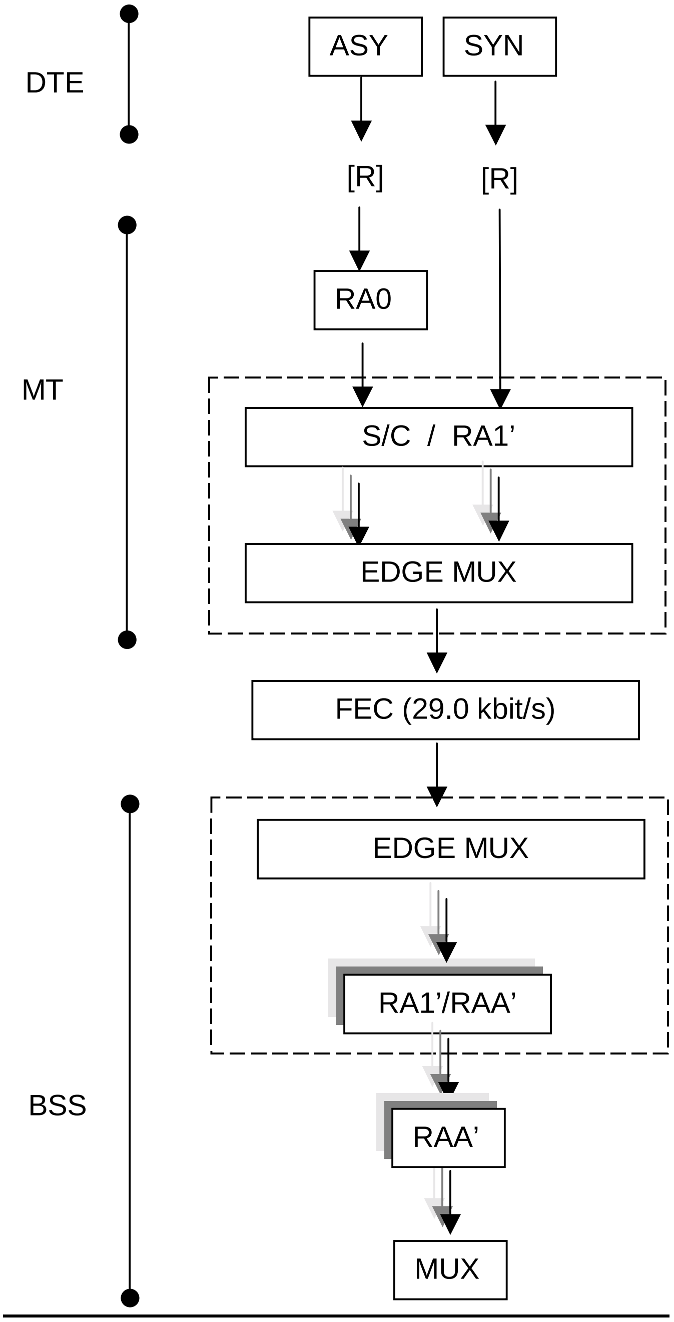



DTE
ASY
[R]
MT
RLP + L2R
S/C
FEC (14.5 kbit/s)
RA1'/RAA'
BSS
RAA'
MUX

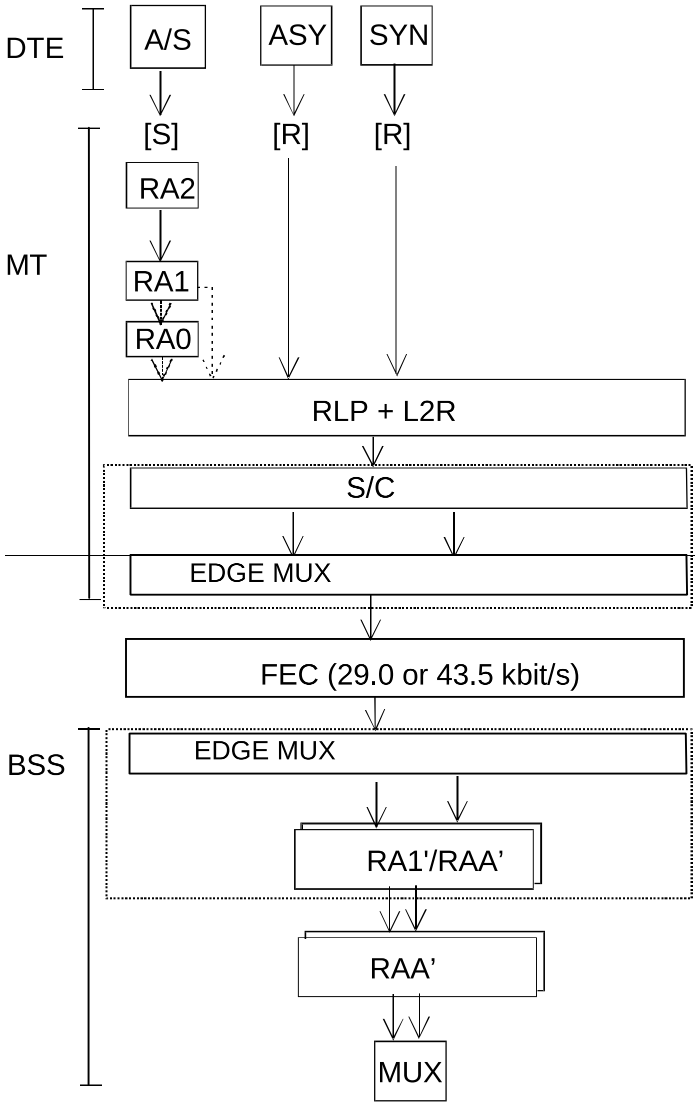
A.5 Stacks of rate adaptation for EDGE channels TCH28.8 and TCH/F43.2 (NT only)

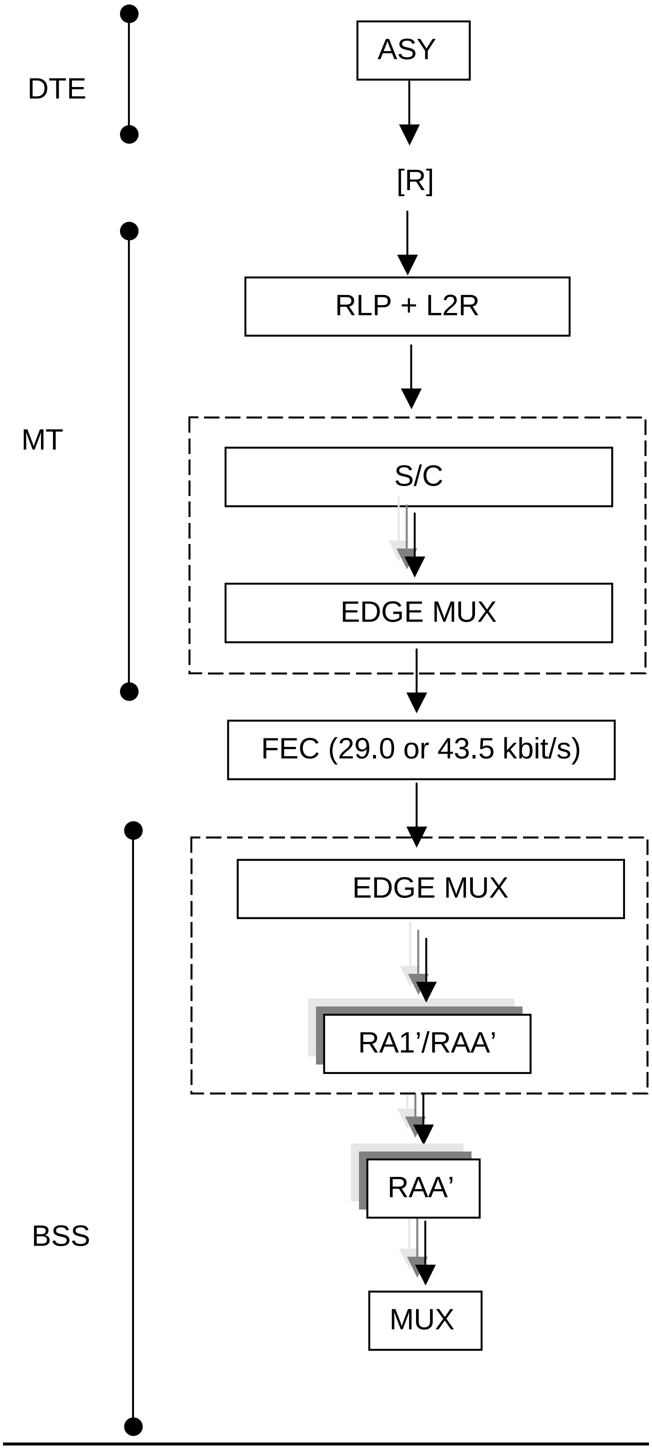
For transparent data services, the following stacks of rate adaptation are possible:




ASY
SYN
DTE
[R]
[R]
RA0
MT
S/C / RA1'
EDGE MUX
FEC (29.0 kbit/s)
EDGE MUX
RA1'/RAA'
BSS
RAA'
MUX

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




DTE
ASY
[R]
MT
RLP + L2R
S/C
EDGE MUX
FEC (29.0 or 43.5 kbit/s)
EDGE MUX
RA1'/RAA'
RAA'
BSS
MUX

3GPP TSG CN WG3 Meeting #24 **Tdoc ⌘ N3-020638**
Helsinki, Finland. 29th July – 2nd August 2002

CR-Form-v7

CHANGE REQUEST

⌘ 43.010 CR 006	⌘ rev 1 ⌘	Current version: 5.0.0 ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	Correction of Rate Adaptation Functions and removal of S Reference Point in MS
Source: ⌘	TSG_CN WG3
Work item code: ⌘	TEI [CS Data] — ***Date:*** ⌘ 17/07/2002
Category: ⌘	**A** — ***Release:*** ⌘ Rel-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
2 (GSM Phase 2)
R96 (Release 1996)
R97 (Release 1997)
R98 (Release 1998)
R99 (Release 1999)
Rel-4 (Release 4)
Rel-5 (Release 5)
Rel-6 (Release 6)

Reason for change: ⌘

- TS 43.010 uses in figure 6 (model 2e) the rate adaptation function RA1'/RA1 for the user rates 48, 56 and 64 kbit/s, but TS 48.020 requires here another rate adaptation function RA1'/RA1" because the data format provided at the A Interface is different in these cases compared with the data format expected by the RA1'/RA1 function.
- TS 43.010 uses in figure 7 (model 2e) the rate adaptation function RA1'/RA1 for the user rate of 64 kbit/s using TCH/F14.4 channel coding, but TS 44.021 requires that this rate adaptation function shall not be used for TCH/F14.4. The reason again is that the data format provided at the A Interface is different in these cases compared with the data format expected by the RA1'/RA1 function. This CR proposes to introduce a new rate adaptation function RA1'/RAA".
- The RA1/RA1' function only resides in the BSS. It does not reside in the MS anymore since the S – Referende Point was removed as internal interface in the MS.
- Figure 8 (model 3b) says that the L2RCOP contains data optionally, but is has to say that the L2RCOP contains optionally the Data Compression function)
- Model 2b and 2e are applicable for all transparent synchronous data and not only for multimedia.
- Update of references

Summary of change: ⌘ See attached pages

Consequences if not approved: ⌘ Inconsisteny between TS 44.021, 43.010 and 48.020 and errorneous specification of the rate adaptation function mentioned above.

Clauses affected: ⌘ 1, 2, 5.2, 6.1.4, 6.3.9, 6.3.10, Clause 6.4 figure 6, clause 6.5 figure 7, clause 6.6

		figures 8 and 9				
		Y	N			
Other specs affected:	⌘	X		Other core specifications	⌘	TS 44.021, TS 48.020
			X	Test specifications		
			X	O&M Specifications		
Other comments:	⌘					

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

1 Scope

This specification is only applicable for a PLMN operating in A/Gb mode.

A PLMN may be described by a limited set of access interfaces (refer to 3GPP TS 24.002 and 22.001) and a limited set of PLMN connection types to support the telecommunication services described in the 3GPP ~~02~~22-series of specifications. This ~~Global System for Mobile communications~~ Technical Specification (TS) identifies and defines these connection types in so far as they relate to the particular network capabilities for a PLMN.

The basic lower layer capabilities of a PLMN are represented by a set of PLMN connection types. The definition of a set of PLMN connection types provides the necessary input to identify network capabilities of a PLMN. In addition to describing network capabilities of a PLMN, the identification of connection types facilitates the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

This specification should be considered in conjunction with other 3GPP specifications with particular reference to 3GPP TS 22.001, 22.002, 22.003, ~~03.01,~~ 23.002, 24.002 and 44.004.

This specification provides a bridge between the service specification in the 3GPP TS ~~02 and~~ 22-series of specifications and the more detailed specifications such as the 3GPP TS ~~03~~43, ~~04~~44, 23, 24, 27 and 29 series. As such, it establishes a framework for the specification and understanding of the more detailed specifications. It is therefore not a specification against which detailed conformance testing can be performed. However, it shall be considered mandatory for the understanding of the more detailed specifications and used to resolve issues of conflict in these specifications.

From R99 onwards the following services are no longer required by a PLMN:

- the dual Bearer Services “alternate speech/data” and “speech followed by data”
- the dedicated services for PAD and Packet access
- the single asynchronous and synchronous Bearer Services (BS 21..26, BS 31..34)

From Release 4 onwards the following services are no longer required by a PLMN:

- the synchronous Bearer Service non-transparent (BS 30 NT).
- the Basic Packet access
- the Teleservice Facsimile non-transparent (TS 61/62 NT).

If a PLMN network still provides these services it has to fulfil the specification of former releases.

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, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] Void

[2] Void

[3] 3GPP TS 22.001: " Principles of telecommunications services supported by a ~~GSM~~ Public Land Mobile Network (PLMN)".

[4] 3GPP TS 22.002: "Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)".

[5] 3GPP TS 22.003: "Circuit Teleservices supported by a GSM Public Land Mobile Network (PLMN)".

[6] 3GPP TS 03.01: " Network functions".Void

[7] 3GPP TS 23.002: "Network architecture".

[8] 3GPP TS 23.009: "Handover procedures".

[9] 3GPP TS 23.034: "High Speed Circuit Switched Data (HSCSD) - Stage 2 Service Description".

[10] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS) Point-to-Point (PP)".

[11] 3GPP TS 23.041: "Technical realization of Short Message Service Cell Broadcast (SMSCB)".

[12] 3GPP TS 43.045: " Technical realization of facsimile group 3 transparent".

[13] 3GPP TS 44.001: " Mobile Station - Base Station System (MS - BSS) interface General aspects and principles".

[14] 3GPP TS 24.002: " GSM-UMTS Public Land Mobile Network (PLMN) access reference configuration".

[15] 3GPP TS 44.004: " Mobile Station - Base Station System (MS - BSS) interface Channel structures and access capabilitiesLayer 1 – General Requirements".

[16] 3GPP TS 44.005: " Data Link (DL) layer; General aspects".

[17] 3GPP TS 04.0644.006: " Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[18] 3GPP TS 24.007: " Mobile radio interface signalling layer 3; General aspects".

[19] 3GPP TS 24.008: " Mobile radio interface layer 3 specification".

[23] 3GPP TS 24.022: " Radio Link Protocol (RLP) for circuit switched bearer and teleservices".

[20] 3GPP TS 24.011: "Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[21] 3GPP TS 24.012: " Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface".

[22] 3GPP TS 44.021: " Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[24] 3GPP TS 45.001: " Physical layer on the radio path (General description)".

[25] 3GPP TS 45.003: " Channel coding".

[26] 3GPP TS 45.008: " Radio subsystem link control".

[27] 3GPP TS 46.031: " Full rate speech; Discontinuous Transmission (DTX) for full rate speech traffic channels".

[28] 3GPP TS 27.001: " General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[29] 3GPP TS 27.002: " Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[30] 3GPP TS 27.003: " Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[31] 3GPP TS 48.004: " Base Station System - Mobile-services Switching Centre (BSS - MSC) interface Layer 1 specification".

[32] 3GPP TS 48.006: " Signalling transport mechanism specification for the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[33] 3GPP TS 48.008: " Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".

[34] 3GPP TS 48.020: " Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[35] Void.

[36] 3GPP TS 29.007: "General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[37] ITU-T Recommendation I.460: "Multiplexing, rate adaption and support of existing interfaces".

[38] ITU-T Recommendation V.110: "Support of Data Terminal Equipments (DTEs) with V-Series interfaces by an integrated services digital network".

[39] ITU-T Recommendation V.21: "300 bits per second duplex modem standardised for use in the general switched telephone network".

[40] ITU-T Recommendation V.22: "1 200 bits per second duplex modem standardised for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[41] ITU-T Recommendation V.22bis: "2 400 bits per second duplex modem using the frequency division technique standardised for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[42] ITU-T Recommendation V.24: "List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE)".

[43] ITU-T Recommendation V.26ter: "2 400 bits per second duplex modem using the echo cancellation technique standardised for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[44] ITU-T Recommendation V.32: "A family of 2-wire, duplex modems operating at data signalling rates of up to 9 600 bit/s for use on the general switched telephone network and on leased telephone-type circuits".

[45] ITU-T Recommendation V.42bis: "Data Compression for Data Circuit terminating Equipment (DCE) using Error Correction Procedures".

[46] ITU-T Recommendation V.120: "Support by an ISDN of data terminal equipment with V-Series type interfaces with provision for statistical multiplexing".

[47] ITU-T Recommendation X.21: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for synchronous operation on public data networks".

[48] ITU-T Recommendation X.21bis: "Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-series modems".

[49] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[50] ITU-T Recommendation X.28: "DTE/DCE interface for a start-stop mode data terminal equipment accessing the Packet Assembly/Disassembly facility (PAD) in a public data network situated in the same country".

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

[52] ITU-T Recommendation X.31: "Support of packet mode terminal equipment by an ISDN".

[53] ITU-T Recommendation X.32: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and accessing a packet switched public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network".

[54] ITU-T Recommendation V.34 (1994): "A modem operating at data signalling rates of up to 28 800 bits for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits".

[55] ITU-T Recommendation I.440 (1989): "ISDN user-network interface data link layer - General aspects".

[56] ITU-T Recommendation I.450 (1989): "ISDN user-network interface layer 3 General aspects".

[57] ISO/IEC 6429 (1992): "Information technology - Control functions for coded character sets".

[58] 3GPP TS 23.060: " General Packet Radio Service (GPRS) Service Description; Stage 2".

[59] ITU-T Recommendation V.90 - A digital modem and analogue modem pair for use on the public switched telephone network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream.

[60] 3GPP TS 21.905: " Vocabulary for 3GPP Specifications "

Next section modified

5.2 Purpose of PLMN connection types

The definition of a set of PLMN connection types provides the necessary input to identify the network capabilities of a PLMN. Other key requirements of a PLMN are contained in other GSM specifications, in particular 3GPP TS ~~03.01,~~ 44.001 and 24.002. In addition to describing network capabilities of a PLMN, the identification of connection types facilitates the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

NOTE 1: The user specifies only the telecommunication service required while the GSM PLMN allocates the resources to set up a connection of the specific type as necessary to support the requested service. It is further noted that, for certain service offerings, additional network functions, e.g. additional lower layer functions and/or higher layer functions, may be required (see figure 2).

```
Service offering                        Network capability
┌──────────────────┐               ┌────────────────────────┐
│ Telecommunication│<──────────────│ Limited set of    PLMN │
│ Service          │               │ connection types       │
└──────────────────┘               ├────────────────────────┤
                                   │ Additional network     │
                                   │ functions where required
                                   │ to support the service,│
                                   │ e.g., additional lower │
                                   │ layer functions, higher│
                                   │ layer functions.       │
                                   └────────────────────────┘
```

Figure 2: The role of network capabilities in supporting service offerings

Next section modified

6.1.1 Rate adaptation

The RA0 rate adaptation is only used with asynchronous interfaces. Incoming asynchronous data is padded by the addition of stop elements to fit the same or nearest higher synchronous rate defined by 2 to the power n (where n≤ 6) times 600 bit/s, 14.4 kbit/s or 28.8 kbit/s. Thus 300 bit/s user data signalling rate shall be adapted to a synchronous 600 bit/s stream. This function is described in 3GPP TS 44.021. The RA0 used in the PLMN is not identical to that described in ITU-T Recommendation V.110 which converts the 14,4 and 28,8 kbit/s user rates to 19,2 and 38,4 kbit/s, respectively.

The intermediate rate adaptation function (RA1) is a rate adaptation function which turns either the output of the RA0 function or a synchronous user data stream into a data stream at 8, 16, or 32 kbit/s by bit repetition and frame addition. This function is described in 3GPP TS ~~44.021~~48.020.

The adaptation of intermediate rates to 64 kbit/s (RA2) performs the final conversion from the intermediate rates generated by the RA1 function to 64 kbit/s.

The radio interface intermediate rate adaptation function (RA1') is in the case of transparent data transmission a variant of the RA1 function and it adapts synchronous user data stream or the output of the RA0 function to one of the following data rates: 3.6, 6.0 or 12.0 or 14.5 kbit/s over the radio path. In case of a TCH/F28.8 channel two 14.5 kbit/s substreams produced by the RA1' function are multiplexed into a 29.0 kbit/s air interface channel by an EDGE multiplexing function. For the non-transparent case, the RA1' function provides direct access to the 12.0 or 6.0 kbit/s data rates. This is achieved by allowing the V.110 frame status bits to be used as additional data bits. This function is described in 3GPP TS 44.021 and 3GPP TS 48.020. RA1' is not applied in TCH/F14.4 or EDGE non-transparent operation.

For TCH/F14.4 channel coding ~~three~~ four PLMN-specific adaptation functions are used: namely, RA1'/RAA', RAA', RA1'/RAA" and RAA'' (3GPP TS 48.020). On the network side of the air interface, the 14.5 kbit/s substreams multiplexed into a 29.0 or 43.5 kbit/s air interface channel are transferred just as in a multislot connection of TCH/F14.4 substreams. RA1'/RAA' adapts between the 14.5 kbit/s air-interface rate and the 16 kbit/s rate used across the Abis-interface. RAA' adapts between the 16 kbit/s Abis Interface-rate and 16.0 kbit/s A-interface substream. (Up to four such A-interface substreams may be multiplexed into the 64kbit/s A-interface stream). RAA'' converts between the A-interface data substream(s) and the overall synchronous stream. In non-transparent operation the RAA'' converts between the A-interface stream and the 290-bit blocks containing bits M1, M2, and 288 data bits as described in 3GPP TS 44.021. The RA1'/RAA" function shall be used for channel codings TCH/F14.4 if the AIUR is equal to 64 kbit/s. It adapts between the 64 kbit/s data stream and the 14.5 kbit/s air-interface rate.

In multislot data configurations the intermediate rates 16, 32, and 64 kbit/s are supported on those sections of the network where the overall data stream is not split into multiple channels (3GPP TS 44.021 and 48.020). RA1-adaptation is not applied to rates higher than 38.4 kbit/s. Instead, a PLMN-specific rate adaptation function RA1'' to user rates 48 and 56 kbit/s is applied; this function adapts between these rates and the 64 kbit/s "intermediate" rate. The RA2 function passes rate 64 kbit/s on as such.

In multislot data connections, the rate adaptation functions are performed per TCH/F between the Split/Combine-functions. On the A-interface up to four TCH/Fs are multiplexed into one 64 kbit/s channel according to the procedures defined in 3GPP TS 48.020. However, multiplexing is not applied to those user rates which make use of more than four TCH/Fs; for such rates the Split/Combine-function is located at the BSS.

The splitting and recombining of the data flow into/from TCH/Fs takes place at the RA1-function or RAA" function (transparent service) at the MSC/IWF and at the MS's ~~RA1/RA1' or~~ RA1'-function, or between the RLP and RA1' (RA1' not applied to TCH/F14.4) (non-transparent service) at the MS and between RA1 or RAA"and RLP at MSC/IWF (figures 6 and 7). The TCH/Fs are treated as independent channels between the Split/Combine-functions.

For user rates requiring more than four TCH/Fs (transparent only) the Split/Combine-function is located at the ~~RA1/RA1' or~~ RA1'-function at the MS and at the RA1'/RA1" or RA1'/RAA"-function at the BSS (figures 6 and 7). The rate adaptation functions for the various user data rates are summarized in tables 1 to 3. It should be noted that in the case of synchronous data transmission, the RA0 is not present.

For 56 and 64 kbit/s connections using a 2×TCH/F32.0 channel configuration across the radio interface, no rate adaptation is applied as the PLMN offers a '64 kbit/s pipe' between TE and an external network.

For 32 kbit/s connections using a 1×TCH/F32.0 channel configuration across the radio interface, the ITU-T I.460 rate adaptation is applied as described in 3GPP TS 44.021.

Table 1: Rate adaptation functions for the support of TE2 in the transparent case

R I/F async	RA0 <------>	sync	RA1'	Radio I/F
≤ 2.4	<------>	≤ 2.4	<-->	3.6
4.8	<------>	4.8	<-->	6.0
9.6	<------>	9.6	<-->	12.0 or 2 × 6.0
14.4	<------>	14.4	<-->	14.5 or 2 × 12.0 or 3 × 6.0
19.2	<------>	19.2	<-->	2 × 12.0 or 4 × 6.0
28.8	<------>	28.8	<-->	1 x 29.0 or 2 x 14.5 or 3 × 12.0
		32	<-->	1 × 32
38.4	<------>	38.4	<-->	3 x 14.5 or 4 × 12.0
		48.0	<-->	4 x 14.5 or 5 × 12.0
		56.0	<-->	2 x 32.0 or 4 x 14.5 or 5 × 12.0 note 1
		64.0	<-->	2 x 32.0 or 5 x 14.5 or 6 × 12.0 note 1

NOTE 1: AIUR of 11.2 kbit/s per 12.0 kbit/s air interface channel (3GPP TS 44.021).

Table 2: voidRate adaptation functions for the support of TE1/TA in the transparent case

async	RA0	sync	RA1		RA2	S I/F	RA2		RA1/RA1'	Radio I/F
≤ 2.4	<------>	≤ 2.4	<------>	8	<------>	64	<------>	8	<------>	3.6
4.8	<------>	4.8	<------>	8	<------>	64	<------>	8	<------>	6.0
9.6	<------>	9.6	<------>	16	<------>	64	<------>	16	<------>	12.0 or 2 × 6.0
14.4	<------>	14.4	<------>	32	<------>	64	<------>	32	<------>	14.5 or 2 × 12.0 or 3 × 6.0
19.2	<------>	19.2	<------>	32	<------>	64	<------>	32	<------>	2 × 12.0 or 4 × 6.0
28.8	<------>	28.8	<------>	64	<------>	64	<------>	64	<------>	1 x 29.0 or 2 x 14.5 or 3 × 12.0
				32	<------>	64	<------>	32	<------>	1 × 32
38.4	<------>	38.4	<------>	64	<------>	64	<------>	64	<------>	3 x 14.5 or 4 × 12.0
			RA1''		RA2	S I/F	RA2		RA1/RA1'	Radio I/F
		48.0	<------>	64	<------>	64	<------>	64	<------>	4 x 14.5 or 5 × 12.0 note 1
		56.0	<------>	64	<------>	64	<------>	64	<------>	2 x 32.0 or 4 x 14.5 or 5 × 12.0 notes 1, 2
				64	<------>	64	<------>	64	<------>	2 x 32.0 or 5 x 14.5 or 6 × 12.0 notes 1, 2

NOTE 1: RA2 not applicable.

NOTE 2: AIUR of 11.2 kbit/s per 12.0 kbit/s air interface channel (3GPP TS 44.021).

Table 3: RA1' function in the non-transparent case

	RA1'	
6.0	<------>	6.0
12.0	<------>	12.0

NOTE: RA1’ not applicable to TCH/F14.4, TCH/F28.8, or TCH/F43.2

Next section modified

6.1.4 Resources allocated by the PLMN network

Part of the PLMN connection concerns the resources allocated by the PLMN network on the basis of the attribute values of the connection elements.

For the speech calls, the PLMN codec is allocated.

For data calls, resources are provided at the IWF/MSC such as:

- V.110 based rate adaptation for such channel codings as TCH/F 4~~,~~.8 and TCH/F9~~,~~.6 and PLMN specific rate adaption for channel codings TCH/F14.4, TCH/F28.8, TCH/F43.2 (3GPP TS 44.021, 48.020);
- filtering of status bits (TS 27.001);
- RLP for non-transparent services (TS 24.022);
- Data compression (TS 24.022, 27.002).

These are sufficient for data services such as:

- asynchronous circuit (bearer service series 20), used with unrestricted digital information transfer capability;
- synchronous circuit (bearer service series 30), used with unrestricted digital information transfer capability when interworking with circuit switched digital networks.

In addition to the above listed resources, further resources are allocated in the other cases:

- modems for asynchronous circuit (bearer service series 20) or synchronous circuit (bearer service series 30) used with 3.1 kHz information transfer capability;
- fax adaptor for the fax group 3 (teleservice series 60);

Next section modified

6.3.9 Connection control protocol

Attribute values for connection elements:

Radio interface connection element:

Layer 1: 3GPP TS 44.004 and 3GPP TS ~~05~~45-series.

Layer 2: 3GPP TS 44.005 and ~~04.06~~44.006.

Layer 3: 3GPP TS 24.007 and 24.008, 24.011.

A interface connection element:

Layer 1: 3GPP TS 48.004.

Layer 2: 3GPP TS 48.006.

Layer 3: TS 24.007, 24.008 and 48.008.

Attribute values for the overall connection type:

Not applicable.

6.3.10 Information transfer coding/protocol

Attribute values for connection elements:

Radio interface connection elements:

Layer 1: 3GPP TS 44.021, 3GPP TS ~~05~~45-series and ~~06~~46-series.

Layer 2: 3GPP TS ~~04.06~~44.006, 24.022 and 3GPP TS 27.002 or 3GPP TS 24.022 and 3GPP TS 27.003 or transparent.

Layer 3: Transparent, 3GPP TS 24.011.

A interface connection element:

Layer 1: 3GPP TS 48.004 and 3GPP TS 48.020.

Layer 2: 3GPP TS 24.022 and 3GPP TS 27.002 or 3GPP TS 24.022 and 3GPP TS 27.003 or transparent.

Layer 3: Transparent.

Attribute values for the overall connection type:

Not applicable.

6.3.11 Further attributes and attribute values

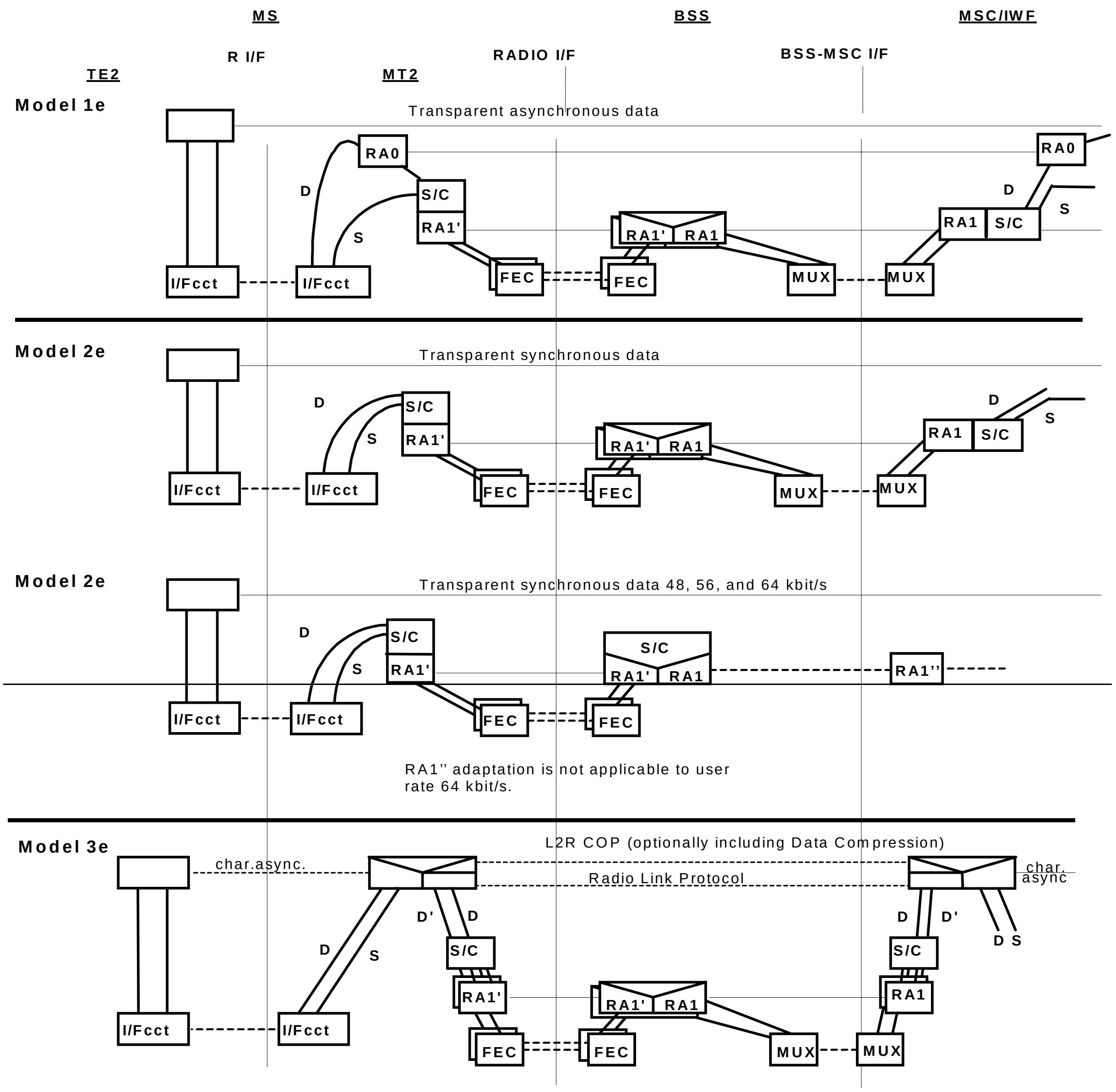
This subclause has outlined the relationships between those attributes values presently existing, the possibility for new values being added remains.

Table 4 summarizes the attributes values for PLMN connection elements.

Table 4: Values for attributes for PLMN connection elements

Attributes	Values for attributes	
	Radio interface connection element	A interface connection element
1 Information Transfer Mode	Circuit	Circuit
2 Information Transfer Rate Layer 1	 3.6 or 6.0 or 12.0 or 13.0 or 14.5 or 29.0 or 32.0 or 43.5 or n × 6.0 (1 ≤ n ≤ 4) or n × 12.0 (1 ≤ n ≤ 6) or n x 14.5 (1 ≤ n ≤ 5) or 2 x 29.0 or 2 x 32.0 kbit/s	 64.0 kbit/s
3 Information Transfer Susceptance	Speech processing equipment, Echo suppression equipment, Null	Speech processing equipment, Echo suppression equipment, Null
4 Establishment of Connection	Demand	Demand
5 Symmetry	Bidirectional symmetric Bidirectional asymmetric	Bidirectional symmetric Bidirectional asymmetric
6 Connection Configuration Topology	Point-to-point	Point-to-point
7 Structure	Unstructured SDU integrity	Unstructured SDU integrity
8 Channel Rate Information Channel Signalling Channel	 TCH/F(s) or TCH/H Dm	 64.0 kbit/s Common channel signalling system
9 Connection Control Protocol Layer 1 Layer 2 Layer 3	 3GPP TS 44.004 and ~~05~~ 45 series 3GPP TS 44.005 and ~~04.06~~44.006 3GPP TS 24.007, 24.008, 24.011	 3GPP TS 48.004 3GPP TS 48.006 3GPP TS 24.007, 24.008, 48.008
10 Information Transfer Coding/Protocol Layer 1 Layer 2 Layer 3	 3GPP TS 44.021 05 and 06 series 3GPP TS 24.022 and 27.002 or 24.022 and 27.003 ~~04.06~~44.006 or transparent Transparent, 24.011	 3GPP TS 48.004 and 48.020 3GPP TS 24.022 and 27.002 or 24.022 and 27.003 or transparent Transparent

Next section modified


MS
BSS
MSC/IWF
R I/F
RADIO I/F
BSS-MSC I/F
TE2
MT2
Model 1e
Transparent asynchronous data
RA0
D
S/C
S
RA1'
RA1' RA1
FEC
FEC
MUX
MUX
RA1 S/C
RA0
D
S
I/Fcct
I/Fcct
Model 2e
Transparent synchronous data
D
S/C
S
RA1'
RA1' RA1
FEC
FEC
MUX
MUX
RA1 S/C
D
S
I/Fcct
I/Fcct
Model 2e
Transparent synchronous data 48, 56, and 64 kbit/s
D
S/C
S
RA1'
S/C
RA1' RA1
RA1''
FEC
FEC
I/Fcct
I/Fcct
RA1'' adaptation is not applicable to user rate 64 kbit/s.
Model 3e
L2R COP (optionally including Data Compression)
char.async.
Radio Link Protocol
char. async
D' D
D D'
D S
D
S
S/C
S/C
RA1'
RA1' RA1
RA1
FEC
FEC
MUX
MUX
I/Fcct
I/Fcct

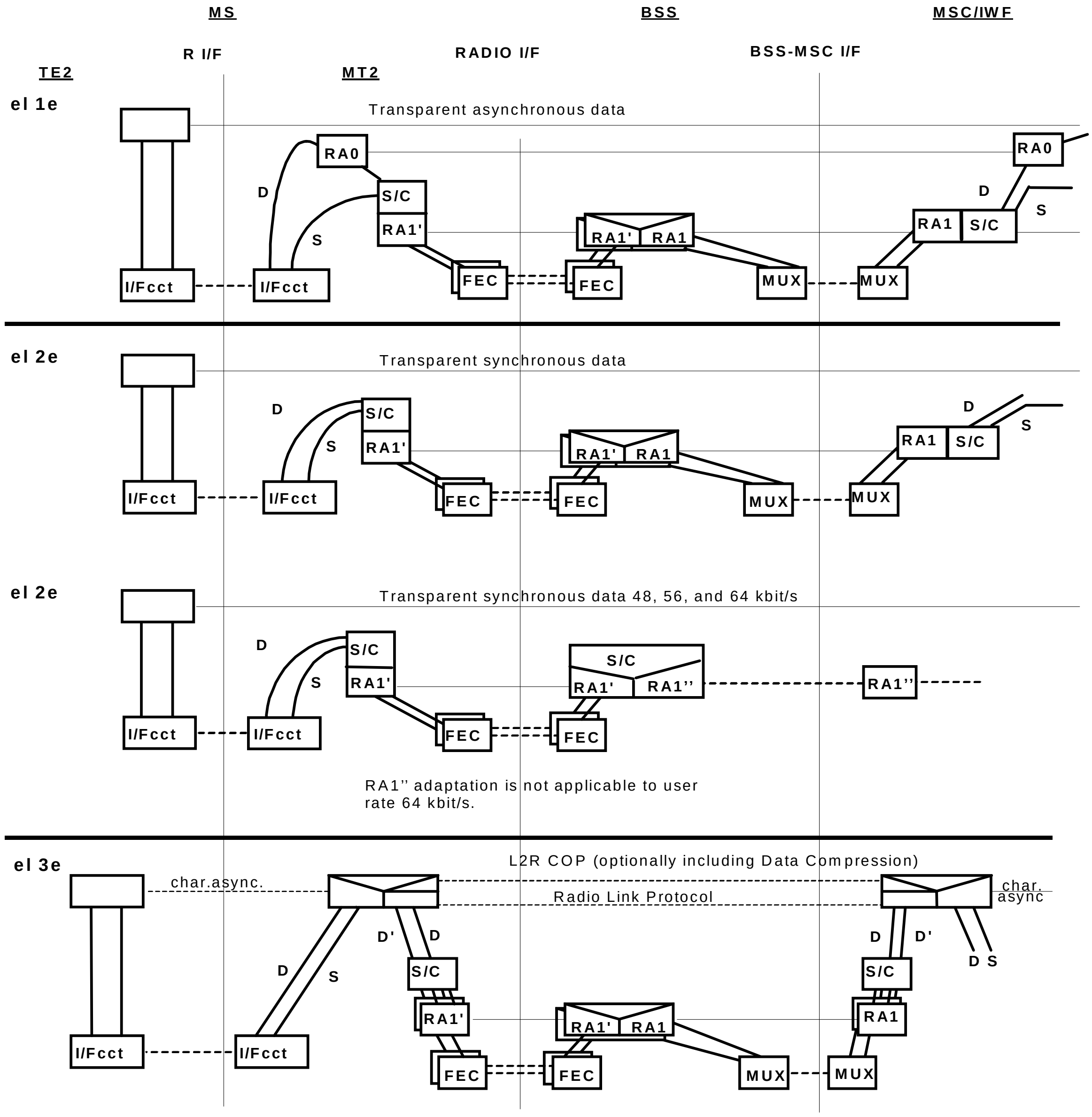
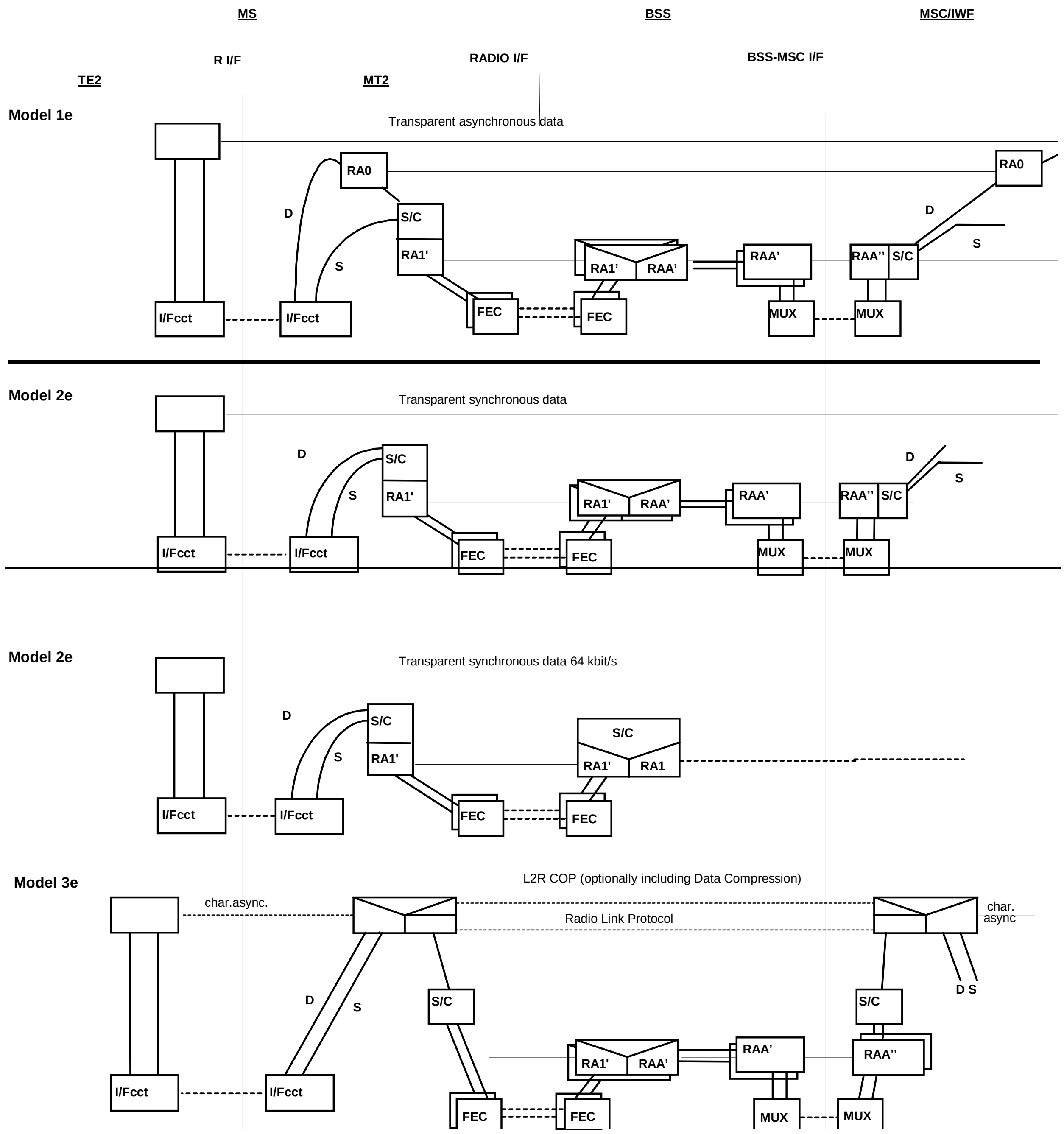


Figure 6 (continued): Information transfer protocol models for PLMN connections

Next section modified



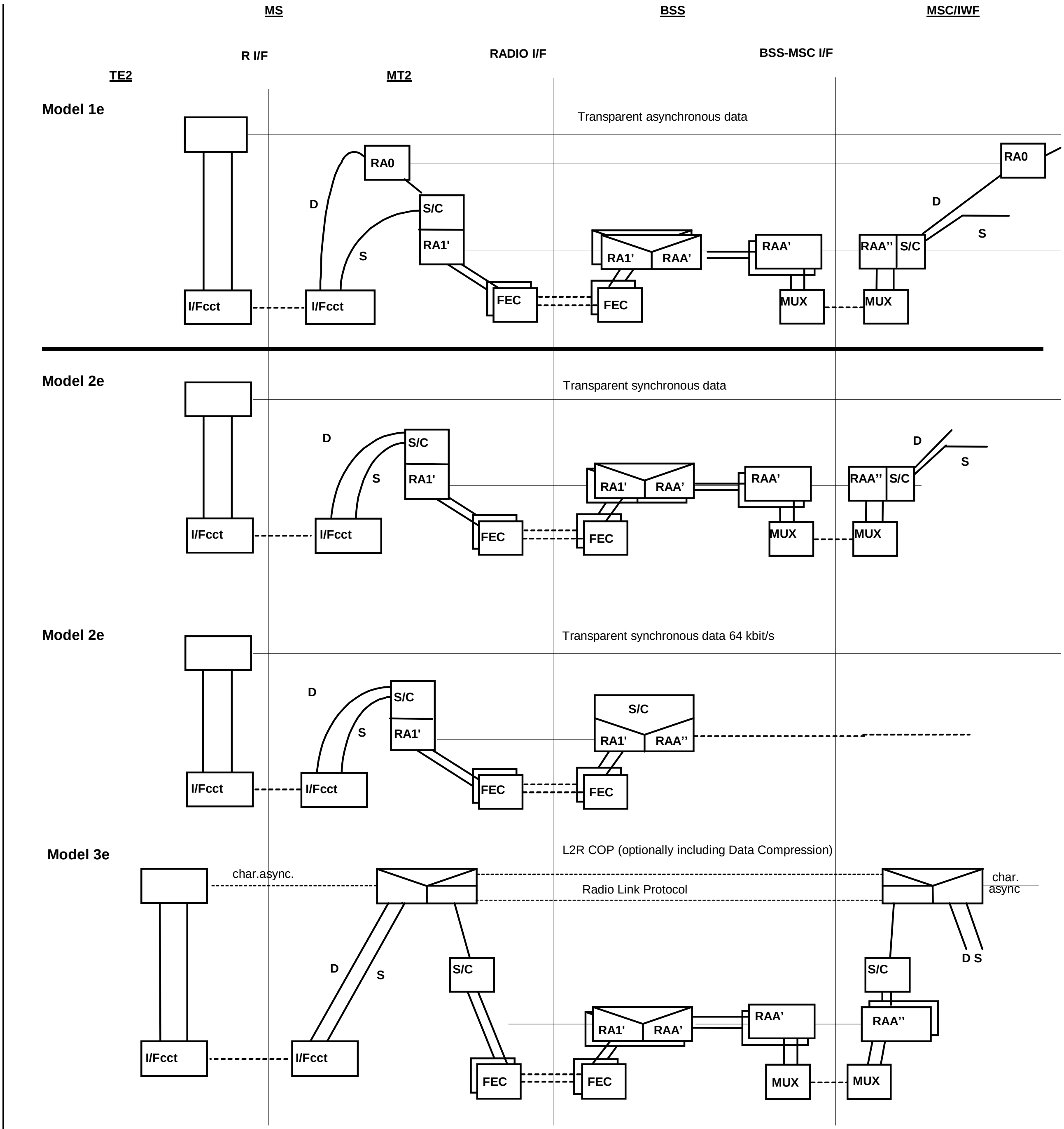
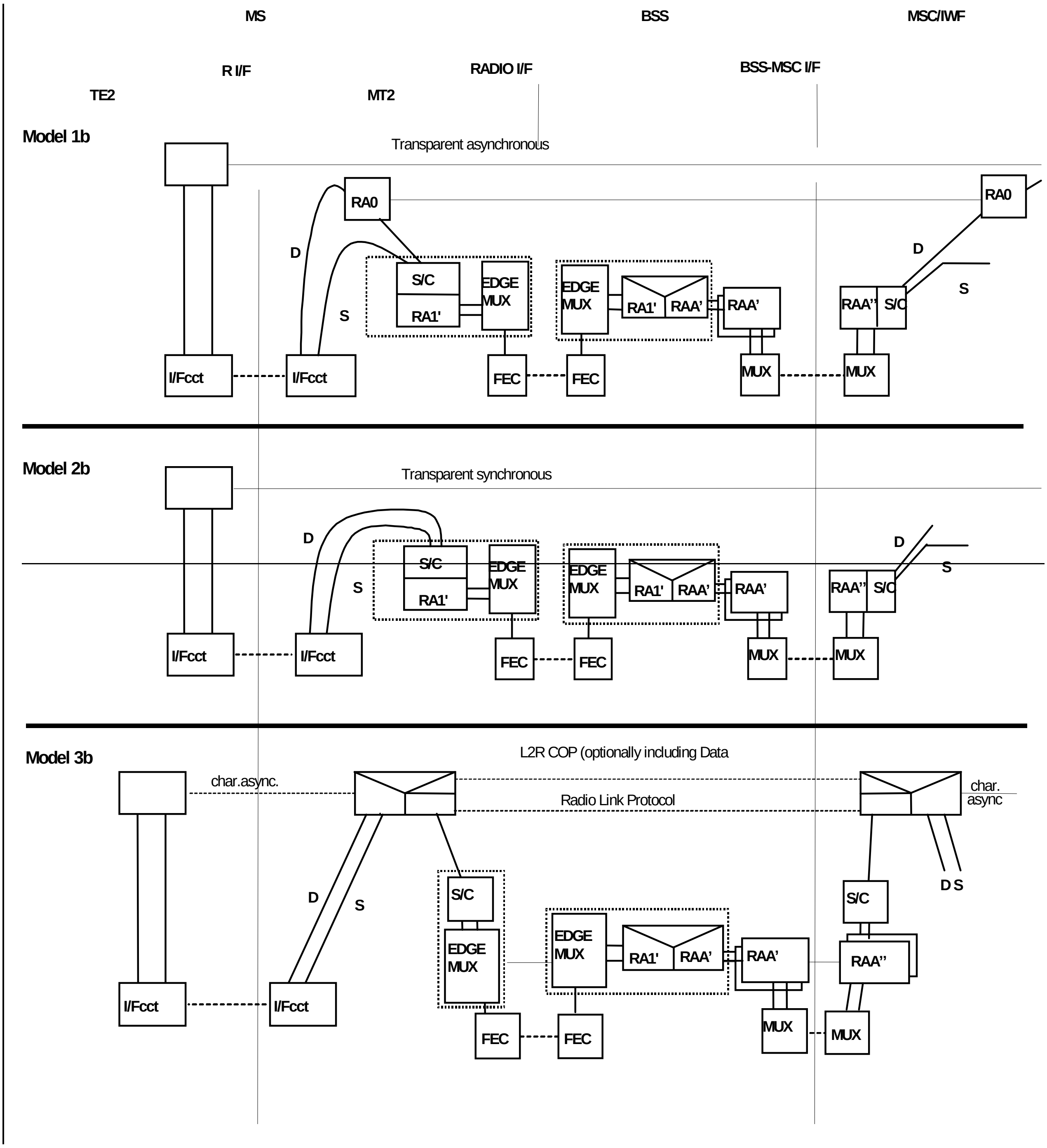


Figure 7 (continued) : Information transfer protocol models for PLMN connections using 14.4 channels

Next section modified



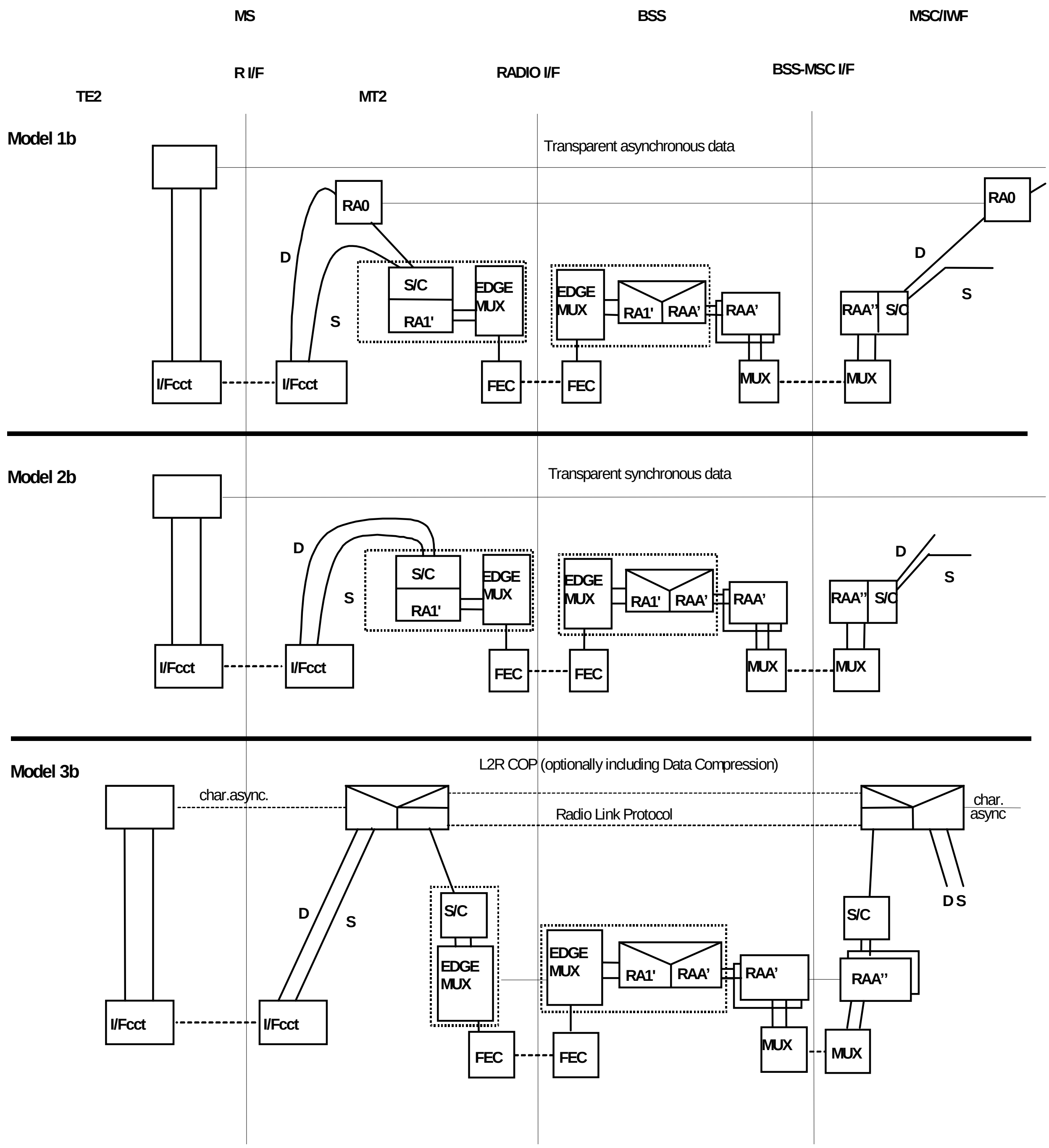
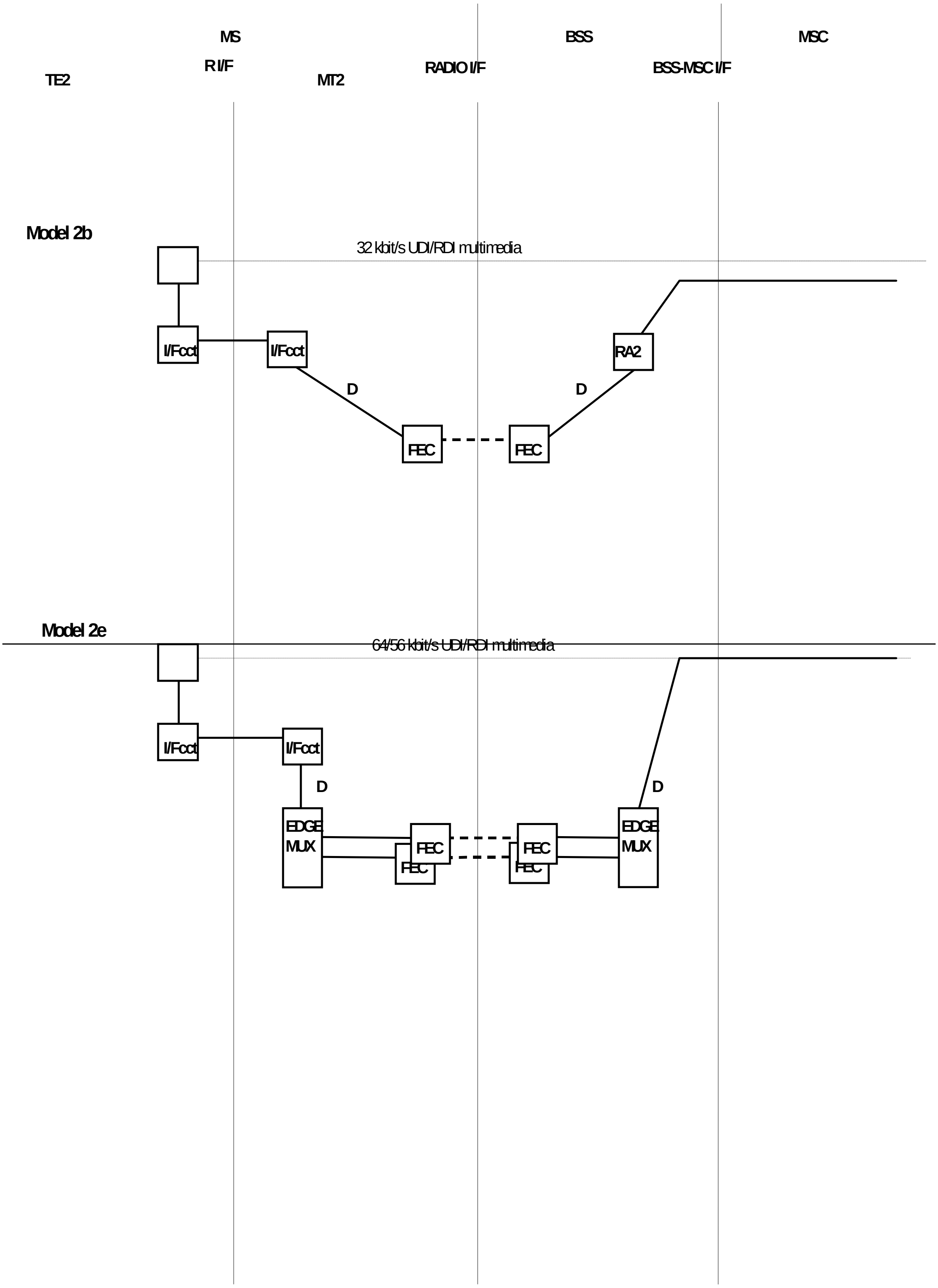


Figure 8: Information transfer protocol models for PLMN connections using EDGE channels

Next section modified



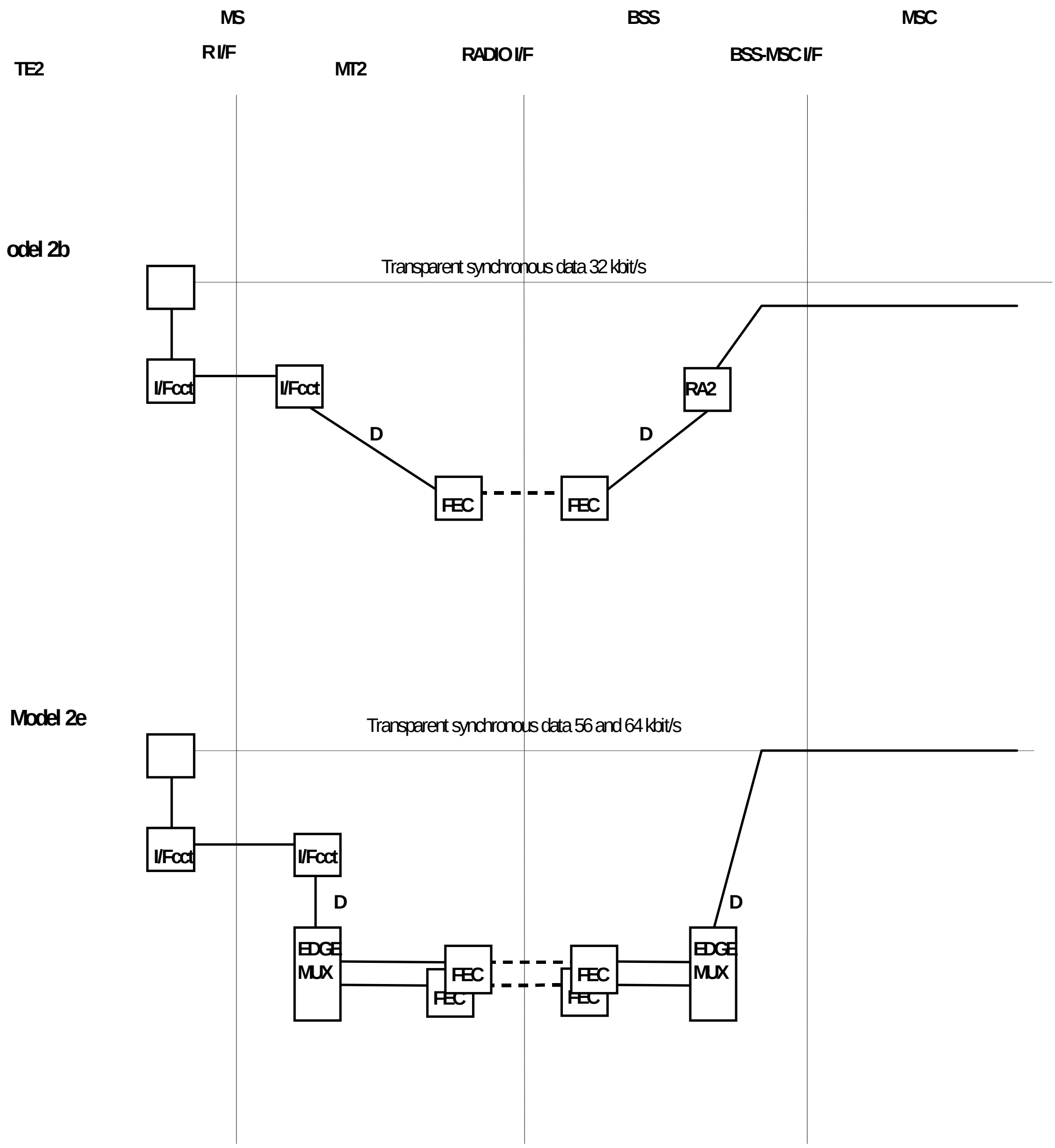


Figure 9: Information transfer protocol models for PLMN connections using TCH/F32.0 EDGE channels

CR-Form-v7

CHANGE REQUEST

⌘	**43.010**	**CR**	**008**	⌘ **rev**		⌘	Current version:	**4.1.0**	⌘

For ***HELP*** *on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [ ] Radio Access Network [X] Core Network [X]

Title:	⌘	Correction of Rate Adaptation Functions and removal of S Reference Point in MS
Source:	⌘	TSG_CN WG3
Work item code:	⌘	TEI [CS Data]
Date:	⌘	29/07/2002
Category:	⌘	**F**
Release:	⌘	Rel-4

Use one of the following categories:
- ***F*** *(correction)*
- ***A*** *(corresponds to a correction in an earlier release)*
- ***B*** *(addition of feature),*
- ***C*** *(functional modification of feature)*
- ***D*** *(editorial modification)*

Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:
- *2 (GSM Phase 2)*
- *R96 (Release 1996)*
- *R97 (Release 1997)*
- *R98 (Release 1998)*
- *R99 (Release 1999)*
- *Rel-4 (Release 4)*
- *Rel-5 (Release 5)*
- *Rel-6 (Release 6)*

Reason for change: ⌘

- TS 43.010 uses in figure 6 (model 2e) the rate adaptation function RA1'/RA1 for the user rates 48, 56 and 64 kbit/s, but TS 48.020 requires here another rate adaptation function RA1'/RA1" because the data format provided at the A Interface is different in these cases compared with the data format expected by the RA1'/RA1 function.
- TS 43.010 uses in figure 7 (model 2e) the rate adaptation function RA1'/RA1 for the user rate of 64 kbit/s using TCH/F14.4 channel coding, but TS 44.021 requires that this rate adaptation function shall not be used for TCH/F14.4. The reason again is that the data format provided at the A Interface is different in these cases compared with the data format expected by the RA1'/RA1 function. This CR proposes to introduce a new rate adaptation function RA1'/RAA".
- The RA1/RA1' function only resides in the BSS. It does not reside in the MS anymore since the S – Referende Point was removed as internal interface in the MS.
- Figure 8 (model 3b) says that the L2RCOP contains data optionally, but is has to say that the L2RCOP contains optionally the Data Compression function)
- Model 2b and 2e are applicable for all transparent synchronous data and not only for multimedia.
- Update of references

Summary of change: ⌘ See attached pages

Consequences if not approved: ⌘ Inconsisteny between TS 44.021, 43.010 and 48.020 and errorneous specification of the rate adaptation function mentioned above.

Clauses affected: ⌘ 1, 2, 5.2, 6.1.4, 6.3.9, 6.3.10, Clause 6.4 figure 6, clause 6.5 figure 7, clause 6.6

		figures 8 and 9				
		Y	N			
Other specs affected:	⌘	X		Other core specifications	⌘	TS 44.021, TS 48.020
			X	Test specifications		
			X	O&M Specifications		
Other comments:	⌘					

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

1 Scope

This specification is only applicable for a PLMN operating in A/Gb mode.

A PLMN may be described by a limited set of access interfaces (refer to 3GPP TS 24.002 and 22.001) and a limited set of PLMN connection types to support the telecommunication services described in the 3GPP ~~02~~22-series of specifications. This ~~Global System for Mobile communications~~ Technical Specification (TS) identifies and defines these connection types in so far as they relate to the particular network capabilities for a PLMN.

The basic lower layer capabilities of a PLMN are represented by a set of PLMN connection types. The definition of a set of PLMN connection types provides the necessary input to identify network capabilities of a PLMN. In addition to describing network capabilities of a PLMN, the identification of connection types facilitates the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

This specification should be considered in conjunction with other 3GPP specifications with particular reference to 3GPP TS 22.001, 22.002, 22.003, ~~03.01,~~ 23.002, 24.002 and 44.004.

This specification provides a bridge between the service specification in the 3GPP TS ~~02 and~~ 22-series of specifications and the more detailed specifications such as the 3GPP TS ~~03~~43, ~~04~~44, 23, 24, 27 and 29 series. As such, it establishes a framework for the specification and understanding of the more detailed specifications. It is therefore not a specification against which detailed conformance testing can be performed. However, it shall be considered mandatory for the understanding of the more detailed specifications and used to resolve issues of conflict in these specifications.

From R99 onwards the following services are no longer required by a PLMN:

- the dual Bearer Services “alternate speech/data” and “speech followed by data”
- the dedicated services for PAD and Packet access
- the single asynchronous and synchronous Bearer Services (BS 21..26, BS 31..34)

From Release 4 onwards the following services are no longer required by a PLMN:

- the synchronous Bearer Service non-transparent (BS 30 NT).
- the Basic Packet access
- the Teleservice Facsimile non-transparent (TS 61/62 NT).

If a PLMN network still provides these services it has to fulfil the specification of former releases.

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, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] Void

[2] Void

[3] 3GPP TS 22.001: " Principles of telecommunications services supported by a ~~GSM~~ Public Land Mobile Network (PLMN)".

[4] 3GPP TS 22.002: "Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)".

[5] 3GPP TS 22.003: "Circuit Teleservices supported by a ~~GSM~~ Public Land Mobile Network (PLMN)".

[6] ~~3GPP TS 03.01: " Network functions".~~Void

[7] 3GPP TS 23.002: "Network architecture".

[8] 3GPP TS 23.009: "Handover procedures".

[9] 3GPP TS 23.034: "High Speed Circuit Switched Data (HSCSD) - Stage 2 Service Description".

[10] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS) Point-to-Point (PP)".

[11] 3GPP TS 23.041: "Technical realization of Short Message Service Cell Broadcast (SMSCB)".

[12] 3GPP TS 43.045: " Technical realization of facsimile group 3 transparent".

[13] 3GPP TS 44.001: " Mobile Station - Base Station System (MS - BSS) interface General aspects and principles".

[14] 3GPP TS 24.002: " GSM-UMTS Public Land Mobile Network (PLMN) access reference configuration".

[15] 3GPP TS 44.004: " ~~Mobile Station - Base Station System (MS - BSS) interface Channel structures and access capabilities~~Layer 1 – General Requirements".

[16] 3GPP TS 44.005: " Data Link (DL) layer; General aspects".

[17] 3GPP TS ~~04.06~~44.006: " Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[18] 3GPP TS 24.007: " Mobile radio interface signalling layer 3; General aspects".

[19] 3GPP TS 24.008: " Mobile radio interface layer 3 specification".

[23] 3GPP TS 24.022: " Radio Link Protocol (RLP) for circuit switched bearer and teleservices".

[20] 3GPP TS 24.011: "Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[21] 3GPP TS 24.012: " Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface".

[22] 3GPP TS 44.021: " Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[24] 3GPP TS 45.001: " Physical layer on the radio path (General description)".

[25] 3GPP TS 45.003: " Channel coding".

[26] 3GPP TS 45.008: " Radio subsystem link control".

[27] 3GPP TS 46.031: " ~~Full rate speech;~~ Discontinuous Transmission (DTX) for full rate speech traffic channels".

[28] 3GPP TS 27.001: " General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[29] 3GPP TS 27.002: " Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[30] 3GPP TS 27.003: " Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[31] 3GPP TS 48.004: " Base Station System - Mobile-services Switching Centre (BSS - MSC) interface Layer 1 specification".

[32] 3GPP TS 48.006: " Signalling transport mechanism specification for the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[33] 3GPP TS 48.008: " Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".

[34] 3GPP TS 48.020: " Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[35] Void.

[36] 3GPP TS 29.007: "General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[37] ITU-T Recommendation I.460: "Multiplexing, rate adaption and support of existing interfaces".

[38] ITU-T Recommendation V.110: "Support of Data Terminal Equipments (DTEs) with V-Series interfaces by an integrated services digital network".

[39] ITU-T Recommendation V.21: "300 bits per second duplex modem standardised for use in the general switched telephone network".

[40] ITU-T Recommendation V.22: "1 200 bits per second duplex modem standardised for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[41] ITU-T Recommendation V.22bis: "2 400 bits per second duplex modem using the frequency division technique standardised for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[42] ITU-T Recommendation V.24: "List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE)".

[43] ITU-T Recommendation V.26ter: "2 400 bits per second duplex modem using the echo cancellation technique standardised for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[44] ITU-T Recommendation V.32: "A family of 2-wire, duplex modems operating at data signalling rates of up to 9 600 bit/s for use on the general switched telephone network and on leased telephone-type circuits".

[45] ITU-T Recommendation V.42bis: "Data Compression for Data Circuit terminating Equipment (DCE) using Error Correction Procedures".

[46] ITU-T Recommendation V.120: "Support by an ISDN of data terminal equipment with V-Series type interfaces with provision for statistical multiplexing".

[47] ITU-T Recommendation X.21: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for synchronous operation on public data networks".

[48] ITU-T Recommendation X.21bis: "Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-series modems".

[49] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[50] ITU-T Recommendation X.28: "DTE/DCE interface for a start-stop mode data terminal equipment accessing the Packet Assembly/Disassembly facility (PAD) in a public data network situated in the same country".

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

[52] ITU-T Recommendation X.31: "Support of packet mode terminal equipment by an ISDN".

[53] ITU-T Recommendation X.32: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and accessing a packet switched public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network".

[54] ITU-T Recommendation V.34 (1994): "A modem operating at data signalling rates of up to 28 800 bits for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits".

[55] ITU-T Recommendation I.440 (1989): "ISDN user-network interface data link layer - General aspects".

[56] ITU-T Recommendation I.450 (1989): "ISDN user-network interface layer 3 General aspects".

[57] ISO/IEC 6429 (1992): "Information technology - Control functions for coded character sets".

[58] 3GPP TS 23.060: " General Packet Radio Service (GPRS) Service Description; Stage 2".

[59] ITU-T Recommendation V.90 - A digital modem and analogue modem pair for use on the public switched telephone network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream.

[60] 3GPP TS 21.905: " Vocabulary for 3GPP Specifications "

Next section modified

5.2 Purpose of PLMN connection types

The definition of a set of PLMN connection types provides the necessary input to identify the network capabilities of a PLMN. Other key requirements of a PLMN are contained in other GSM specifications, in particular 3GPP TS ~~03.01,~~ 44.001 and 24.002. In addition to describing network capabilities of a PLMN, the identification of connection types facilitates the specification of network-to-network interfaces. It may also assist in the allocation of network performance parameters.

NOTE 1: The user specifies only the telecommunication service required while the GSM PLMN allocates the resources to set up a connection of the specific type as necessary to support the requested service. It is further noted that, for certain service offerings, additional network functions, e.g. additional lower layer functions and/or higher layer functions, may be required (see figure 2).

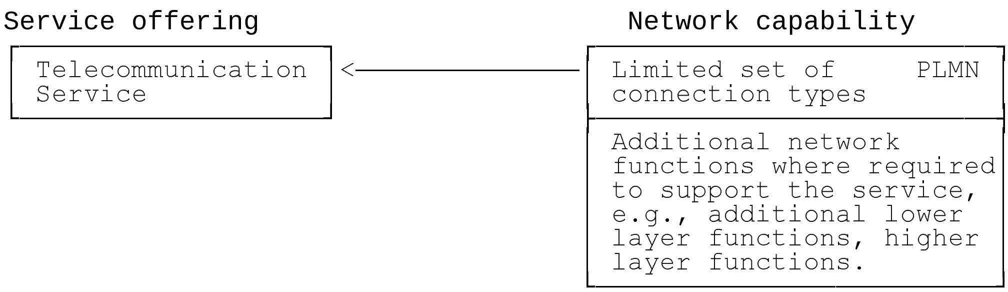


Figure 2: The role of network capabilities in supporting service offerings

Next section modified

6.1.1 Rate adaptation

The RA0 rate adaptation is only used with asynchronous interfaces. Incoming asynchronous data is padded by the addition of stop elements to fit the same or nearest higher synchronous rate defined by 2 to the power n (where $n \leq 6$) times 600 bit/s, 14.4 kbit/s or 28.8 kbit/s. Thus 300 bit/s user data signalling rate shall be adapted to a synchronous 600 bit/s stream. This function is described in 3GPP TS 44.021. The RA0 used in the PLMN is not identical to that described in ITU-T Recommendation V.110 which converts the 14,4 and 28,8 kbit/s user rates to 19,2 and 38,4 kbit/s, respectively.

The intermediate rate adaptation function (RA1) is a rate adaptation function which turns either the output of the RA0 function or a synchronous user data stream into a data stream at 8, 16, or 32 kbit/s by bit repetition and frame addition. This function is described in 3GPP TS ~~44.021~~48.020.

The adaptation of intermediate rates to 64 kbit/s (RA2) performs the final conversion from the intermediate rates generated by the RA1 function to 64 kbit/s.

The radio interface intermediate rate adaptation function (RA1') is in the case of transparent data transmission a variant of the RA1 function and it adapts synchronous user data stream or the output of the RA0 function to one of the following data rates: 3.6, 6.0 or 12.0 or 14.5 kbit/s over the radio path. In case of a TCH/F28.8 channel two 14.5 kbit/s substreams produced by the RA1' function are multiplexed into a 29.0 kbit/s air interface channel by an EDGE multiplexing function. For the non-transparent case, the RA1' function provides direct access to the 12.0 or 6.0 kbit/s data rates. This is achieved by allowing the V.110 frame status bits to be used as additional data bits. This function is described in 3GPP TS 44.021 and 3GPP TS 48.020. RA1' is not applied in TCH/F14.4 or EDGE non-transparent operation.

For TCH/F14.4 channel coding ~~three~~ four PLMN-specific adaptation functions are used: namely, RA1'/RAA', RAA', RA1'/RAA" and RAA'' (3GPP TS 48.020). On the network side of the air interface, the 14.5 kbit/s substreams multiplexed into a 29.0 or 43.5 kbit/s air interface channel are transferred just as in a multislot connection of TCH/F14.4 substreams. RA1'/RAA' adapts between the 14.5 kbit/s air-interface rate and the 16 kbit/s rate used across the Abis-interface. RAA' adapts between the 16 kbit/s Abis Interface-rate and 16.0 kbit/s A-interface substream. (Up to four such A-interface substreams may be multiplexed into the 64kbit/s A-interface stream). RAA'' converts between the A-interface data substream(s) and the overall synchronous stream. In non-transparent operation the RAA'' converts between the A-interface stream and the 290-bit blocks containing bits M1, M2, and 288 data bits as described in 3GPP TS 44.021. The RA1'/RAA" function shall be used for channel codings TCH/F14.4 if the AIUR is equal to 64 kbit/s. It adapts between the 64 kbit/s data stream and the 14.5 kbit/s air-interface rate.

In multislot data configurations the intermediate rates 16, 32, and 64 kbit/s are supported on those sections of the network where the overall data stream is not split into multiple channels (3GPP TS 44.021 and 48.020). RA1-adaptation is not applied to rates higher than 38.4 kbit/s. Instead, a PLMN-specific rate adaptation function RA1'' to user rates 48 and 56 kbit/s is applied; this function adapts between these rates and the 64 kbit/s "intermediate" rate. The RA2 function passes rate 64 kbit/s on as such.

In multislot data connections, the rate adaptation functions are performed per TCH/F between the Split/Combine-functions. On the A-interface up to four TCH/Fs are multiplexed into one 64 kbit/s channel according to the procedures defined in 3GPP TS 48.020. However, multiplexing is not applied to those user rates which make use of more than four TCH/Fs; for such rates the Split/Combine-function is located at the BSS.

The splitting and recombining of the data flow into/from TCH/Fs takes place at the RA1-function or RAA" function (transparent service) at the MSC/IWF and at the MS's ~~RA1/RA1' or~~ RA1'-function, or between the RLP and RA1' (RA1' not applied to TCH/F14.4) (non-transparent service) at the MS and between RA1 or RAA"and RLP at MSC/IWF (figures 6 and 7). The TCH/Fs are treated as independent channels between the Split/Combine-functions.

For user rates requiring more than four TCH/Fs (transparent only) the Split/Combine-function is located at the ~~RA1/RA1' or~~ RA1'-function at the MS and at the RA1'/RA1" or RA1'/RAA"-function at the BSS (figures 6 and 7). The rate adaptation functions for the various user data rates are summarized in tables 1 to 3. It should be noted that in the case of synchronous data transmission, the RA0 is not present.

For 56 and 64 kbit/s connections using a 2×TCH/F32.0 channel configuration across the radio interface, no rate adaptation is applied as the PLMN offers a '64 kbit/s pipe' between TE and an external network.

For 32 kbit/s connections using a 1×TCH/F32.0 channel configuration across the radio interface, the ITU-T I.460 rate adaptation is applied as described in 3GPP TS 44.021.

Table 1: Rate adaptation functions for the support of TE2 in the transparent case

R I/F async	RA0	sync	RA1'	Radio I/F
	<------>			
≤ 2.4	<------>	≤ 2.4	<-->	3.6
4.8	<------>	4.8	<-->	6.0
9.6	<------>	9.6	<-->	12.0 or 2 × 6.0
14.4	<------>	14.4	<-->	14.5 or 2 × 12.0 or 3 × 6.0
19.2	<------>	19.2	<-->	2 × 12.0 or 4 × 6.0
28.8	<------>	28.8	<-->	1 x 29.0 or 2 x 14.5 or 3 × 12.0
		32	<-->	1 × 32
38.4	<------>	38.4	<-->	3 x 14.5 or 4 × 12.0
		48.0	<-->	4 x 14.5 or 5 × 12.0
		56.0	<-->	2 x 32.0 or 4 x 14.5 or 5 × 12.0 note 1
		64.0	<-->	2 x 32.0 or 5 x 14.5 or 6 × 12.0 note 1

NOTE 1: AIUR of 11.2 kbit/s per 12.0 kbit/s air interface channel (3GPP TS 44.021).

Table 2: void~~Rate adaptation functions for the support of TE1/TA in the transparent case~~

async	RA0	sync	RA1		RA2	S I/F	RA2		RA1/RA1'	Radio I/F
≤ 2.4	<------>	≤ 2.4	<------>	8	<------>	64	<------>	8	<------>	3.6
4.8	<------>	4.8	<------>	8	<------>	64	<------>	8	<------>	6.0
9.6	<------>	9.6	<------>	16	<------>	64	<------>	16	<------>	12.0 or 2 × 6.0
14.4	<------>	14.4	<------>	32	<------>	64	<------>	32	<------>	14.5 or 2 × 12.0 or 3 × 6.0
19.2	<------>	19.2	<------>	32	<------>	64	<------>	32	<------>	2 × 12.0 or 4 × 6.0
28.8	<------>	28.8	<------>	64	<------>	64	<------>	64	<------>	1 x 29.0 or 2 x 14.5 or 3 × 12.0
				32	<------>	64	<------>	32	<------>	1 × 32
38.4	<------>	38.4	<------>	64	<------>	64	<------>	64	<------>	3 x 14.5 or 4 × 12.0
			RA1''		RA2	S I/F	RA2		RA1/RA1'	Radio I/F
		48.0	<------>	64	<------>	64	<------>	64	<------>	4 x 14.5 or 5 × 12.0 note 1
		56.0	<------>	64	<------>	64	<------>	64	<------>	2 x 32.0 or 4 x 14.5 or 5 × 12.0 notes 1, 2
				64	<------>	64	<------>	64	<------>	2 x 32.0 or 5 x 14.5 or 6 × 12.0 notes 1, 2

~~NOTE 1: RA2 not applicable.~~

~~NOTE 2: AIUR of 11.2 kbit/s per 12.0 kbit/s air interface channel (3GPP TS 44.021).~~

Table 3: RA1' function in the non-transparent case

	RA1'	
6.0	<------>	6.0
12.0	<------>	12.0

NOTE: RA1' not applicable to TCH/F14.4, TCH/F28.8, or TCH/F43.2

Next section modified

6.1.4 Resources allocated by the PLMN network

Part of the PLMN connection concerns the resources allocated by the PLMN network on the basis of the attribute values of the connection elements.

For the speech calls, the PLMN codec is allocated.

For data calls, resources are provided at the IWF/MSC such as:

- V.110 based rate adaptation for such channel codings as TCH/F 4,.8 and TCH/F9,.6 and PLMN specific rate adaption for channel codings TCH/F14.4, TCH/F28.8, TCH/F43.2 (3GPP TS 44.021, 48.020);
- filtering of status bits (TS 27.001);
- RLP for non-transparent services (TS 24.022);
- Data compression (TS 24.022, 27.002).

These are sufficient for data services such as:

- asynchronous circuit (bearer service series 20), used with unrestricted digital information transfer capability;
- synchronous circuit (bearer service series 30), used with unrestricted digital information transfer capability when interworking with circuit switched digital networks.

In addition to the above listed resources, further resources are allocated in the other cases:

- modems for asynchronous circuit (bearer service series 20) or synchronous circuit (bearer service series 30) used with 3.1 kHz information transfer capability;
- fax adaptor for the fax group 3 (teleservice series 60);

Next section modified

6.3.9 Connection control protocol

Attribute values for connection elements:

Radio interface connection element:

Layer 1: 3GPP TS 44.004 and 3GPP TS ~~05~~45-series.

Layer 2: 3GPP TS 44.005 and ~~04.06~~44.006.

Layer 3: 3GPP TS 24.007 and 24.008, 24.011.

A interface connection element:

Layer 1: 3GPP TS 48.004.

Layer 2: 3GPP TS 48.006.

Layer 3: TS 24.007, 24.008 and 48.008.

Attribute values for the overall connection type:

Not applicable.

6.3.10 Information transfer coding/protocol

Attribute values for connection elements:

Radio interface connection elements:

Layer 1: 3GPP TS 44.021, 3GPP TS ~~05~~45-series and ~~06~~46-series.

Layer 2: 3GPP TS ~~04.06~~44.006, 24.022 and 3GPP TS 27.002 or 3GPP TS 24.022 and 3GPP TS 27.003 or transparent.

Layer 3: Transparent, 3GPP TS 24.011.

A interface connection element:

Layer 1: 3GPP TS 48.004 and 3GPP TS 48.020.

Layer 2: 3GPP TS 24.022 and 3GPP TS 27.002 or 3GPP TS 24.022 and 3GPP TS 27.003 or transparent.

Layer 3: Transparent.

Attribute values for the overall connection type:

Not applicable.

6.3.11 Further attributes and attribute values

This subclause has outlined the relationships between those attributes values presently existing, the possibility for new values being added remains.

Table 4 summarizes the attributes values for PLMN connection elements.

Table 4: Values for attributes for PLMN connection elements

Attributes	Values for attributes	
	Radio interface connection element	A interface connection element
1 Information Transfer Mode	Circuit	Circuit
2 Information Transfer Rate Layer 1	 3.6 or 6.0 or 12.0 or 13.0 or 14.5 or 29.0 or 32.0 or 43.5 or n × 6.0 (1 ≤ n ≤ 4) or n × 12.0 (1 ≤ n ≤ 6) or n x 14.5 (1 ≤ n ≤ 5) or 2 x 29.0 or 2 x 32.0 kbit/s	 64.0 kbit/s
3 Information Transfer Susceptance	Speech processing equipment, Echo suppression equipment, Null	Speech processing equipment, Echo suppression equipment, Null
4 Establishment of Connection	Demand	Demand
5 Symmetry	Bidirectional symmetric Bidirectional asymmetric	Bidirectional symmetric Bidirectional asymmetric
6 Connection Configuration Topology	Point-to-point	Point-to-point
7 Structure	Unstructured SDU integrity	Unstructured SDU integrity
8 Channel Rate Information Channel Signalling Channel	 TCH/F(s) or TCH/H Dm	 64.0 kbit/s Common channel signalling system
9 Connection Control Protocol Layer 1 Layer 2 Layer 3	 3GPP TS 44.004 and ~~05~~ 45 series 3GPP TS 44.005 and ~~04.06~~44.006 3GPP TS 24.007, 24.008, 24.011	 3GPP TS 48.004 3GPP TS 48.006 3GPP TS 24.007, 24.008, 48.008
10 Information Transfer Coding/Protocol Layer 1 Layer 2 Layer 3	 3GPP TS 44.021 05 and 06 series 3GPP TS 24.022 and 27.002 or 24.022 and 27.003 ~~04.06~~44.006 or transparent Transparent, 24.011	 3GPP TS 48.004 and 48.020 3GPP TS 24.022 and 27.002 or 24.022 and 27.003 or transparent Transparent

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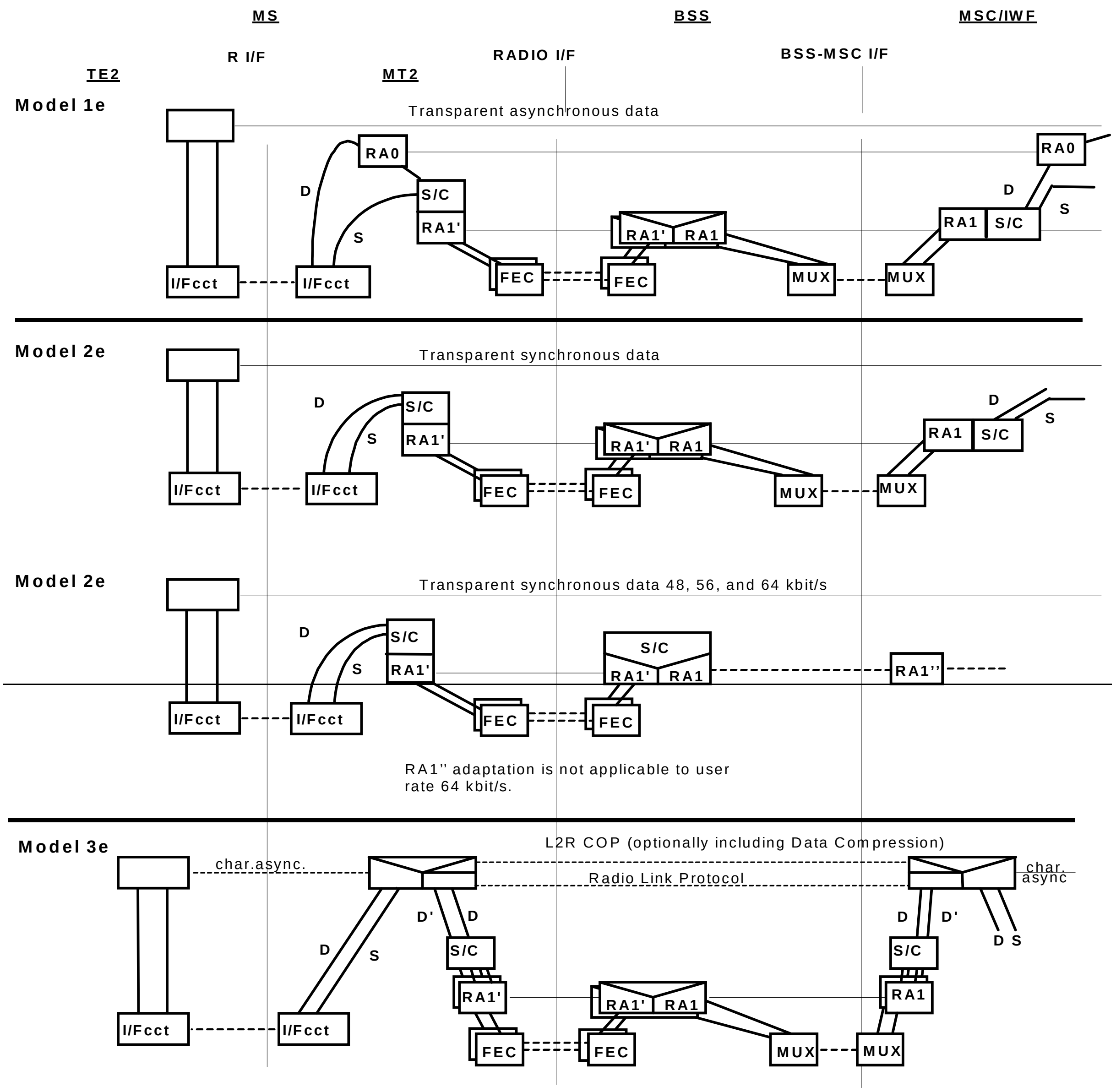

MS
BSS
MSC/IWF
R I/F
RADIO I/F
BSS-MSC I/F
TE2
MT2
Model 1e
Transparent asynchronous data
RA0
D
S/C
S
RA1'
RA1' RA1
FEC
MUX
RA1
S/C
I/Fcct
Model 2e
Transparent synchronous data
Model 2e
Transparent synchronous data 48, 56, and 64 kbit/s
RA1''
RA1'' adaptation is not applicable to user rate 64 kbit/s.
Model 3e
L2R COP (optionally including Data Compression)
char.async.
Radio Link Protocol
char. async
D'
D S

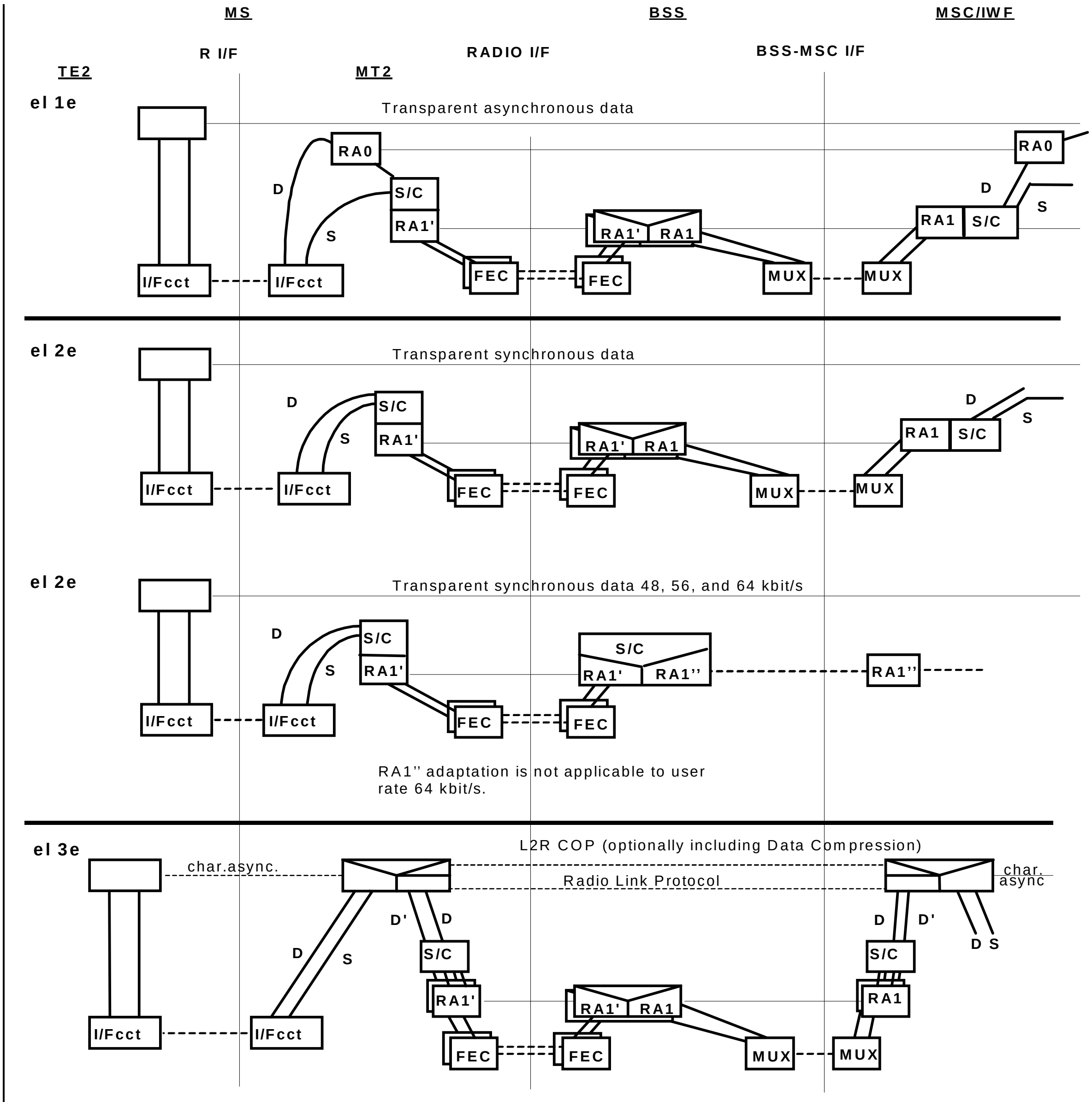

Figure 6 (continued): Information transfer protocol models for PLMN connections

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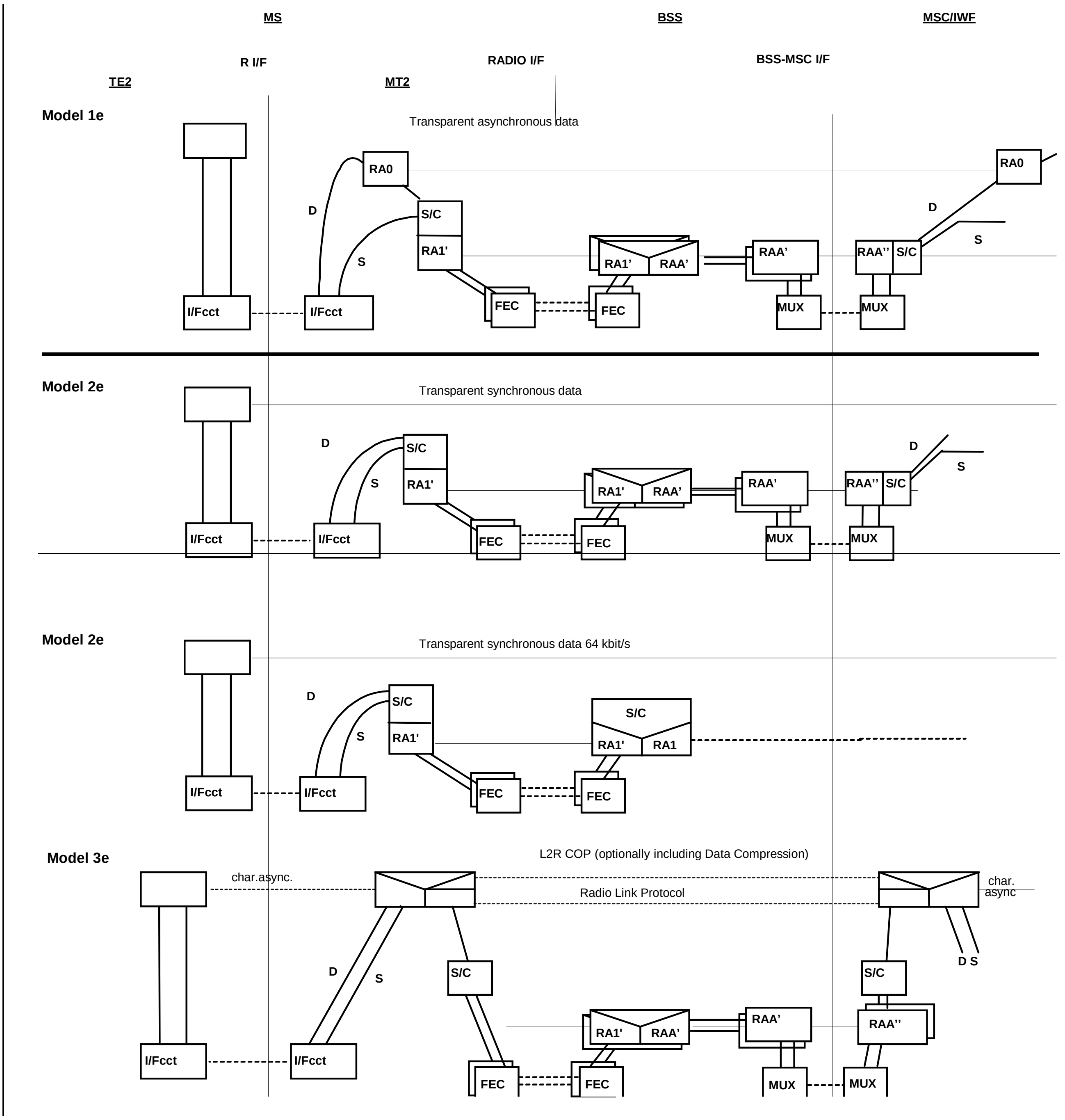

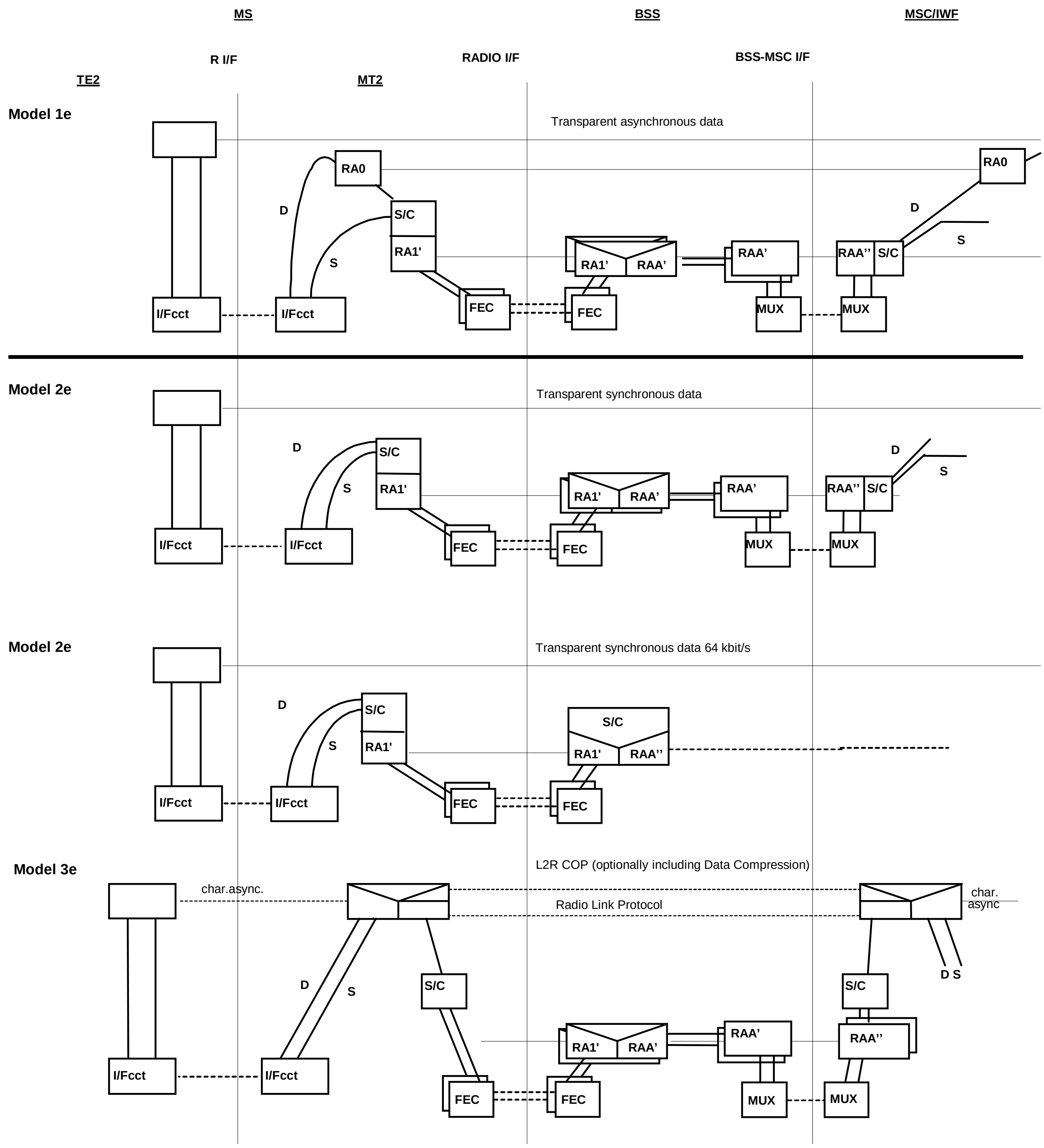

Figure 7 (continued) : Information transfer protocol models for PLMN connections using 14.4 channels

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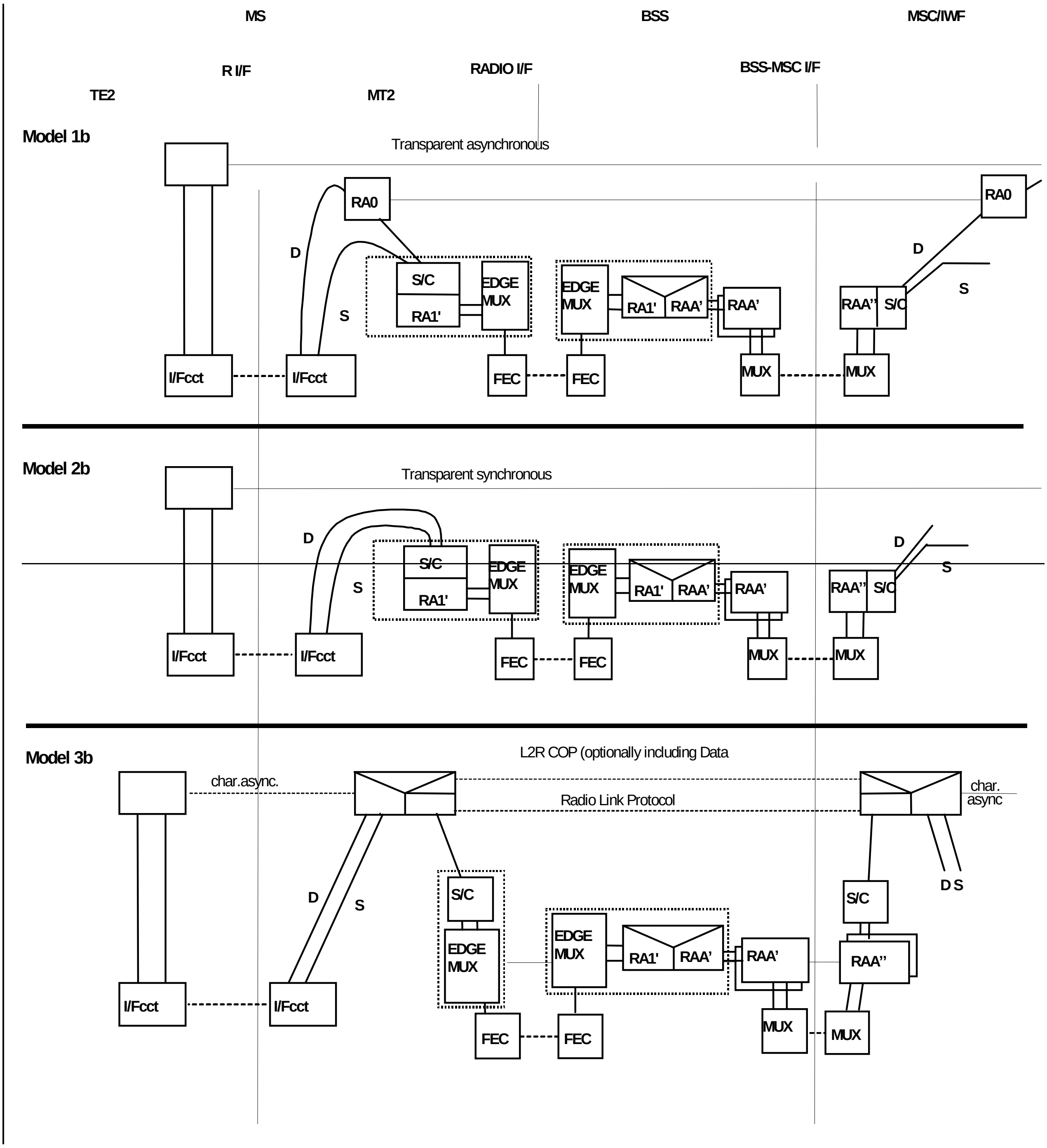

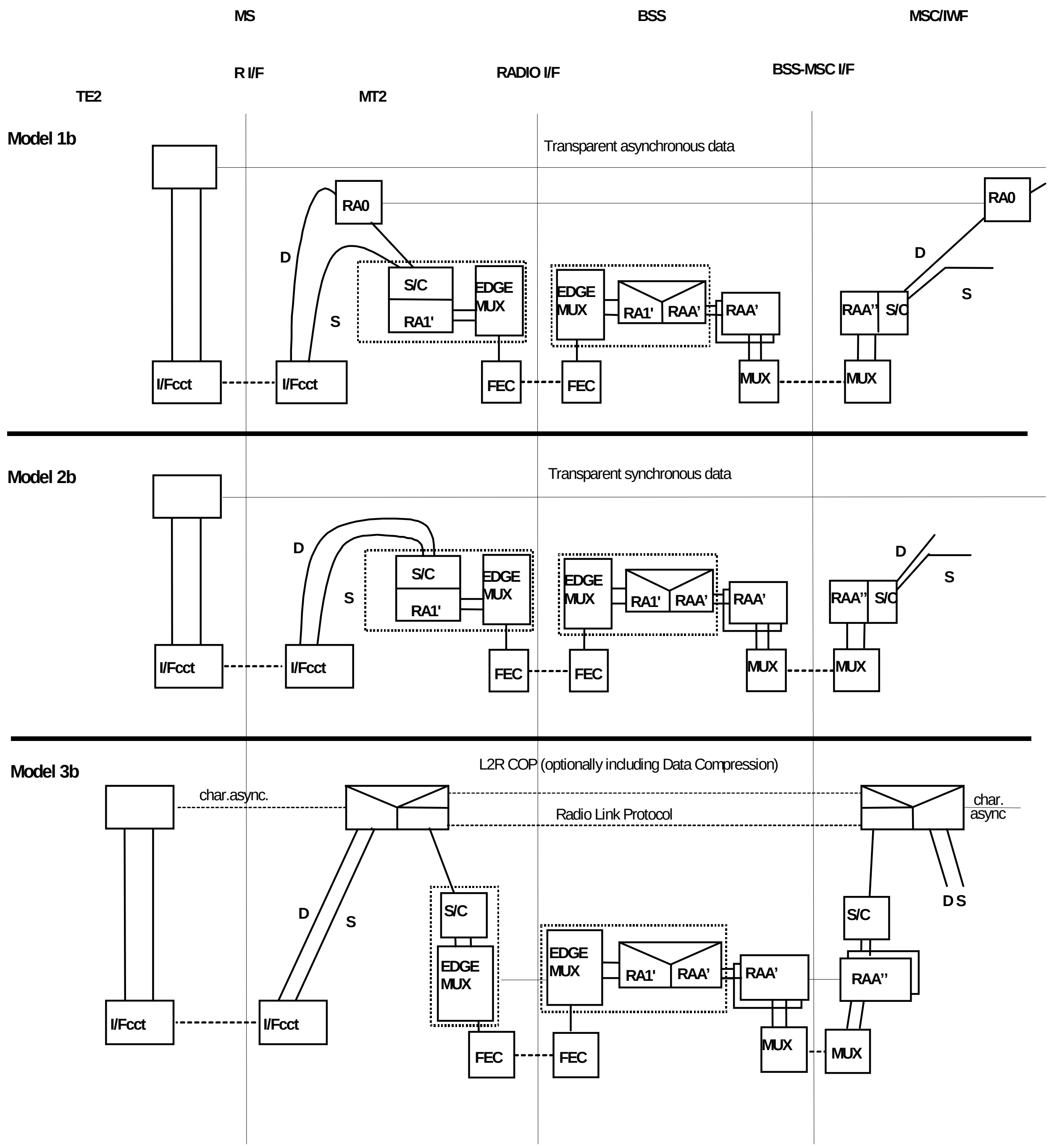

Figure 8: Information transfer protocol models for PLMN connections using EDGE channels

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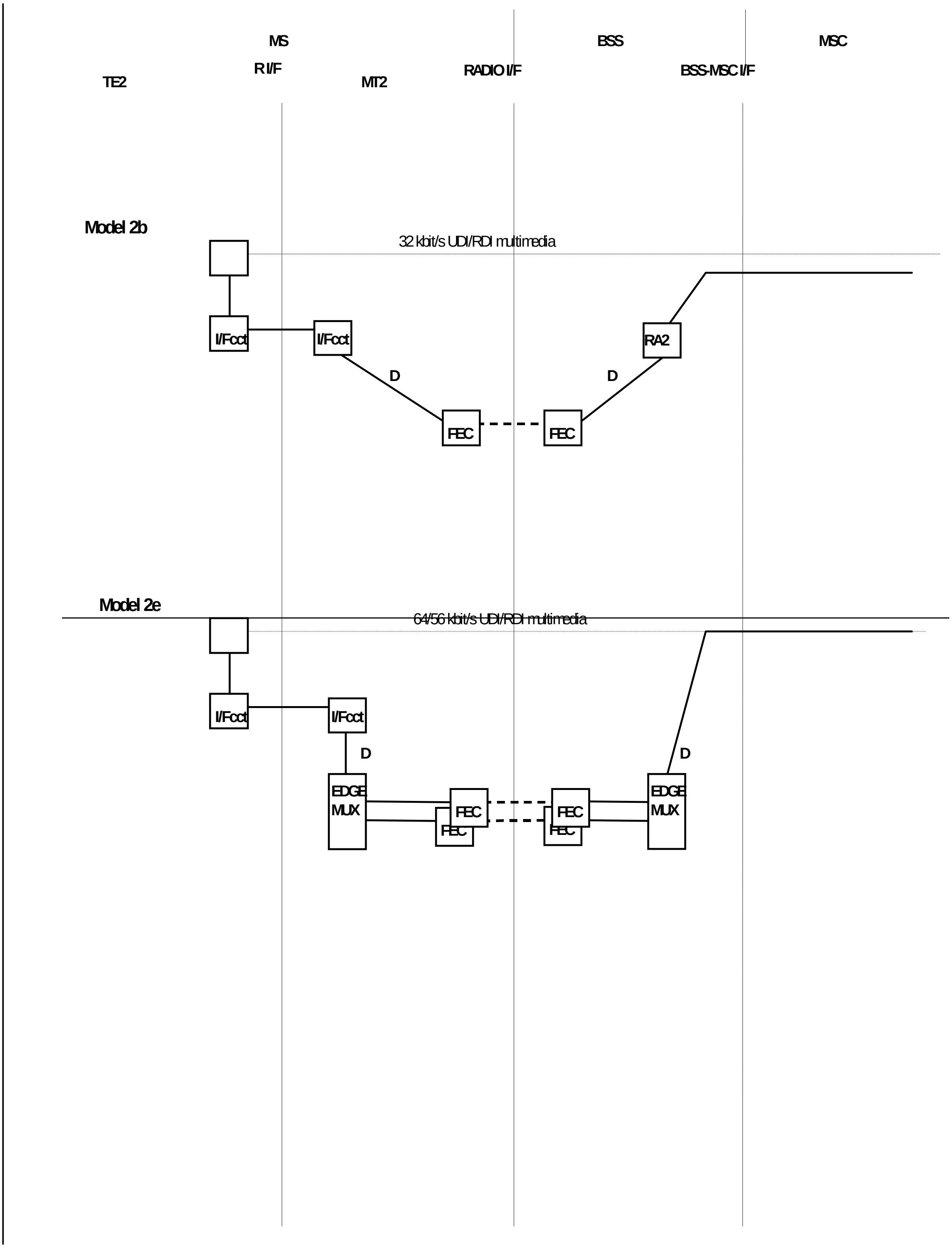

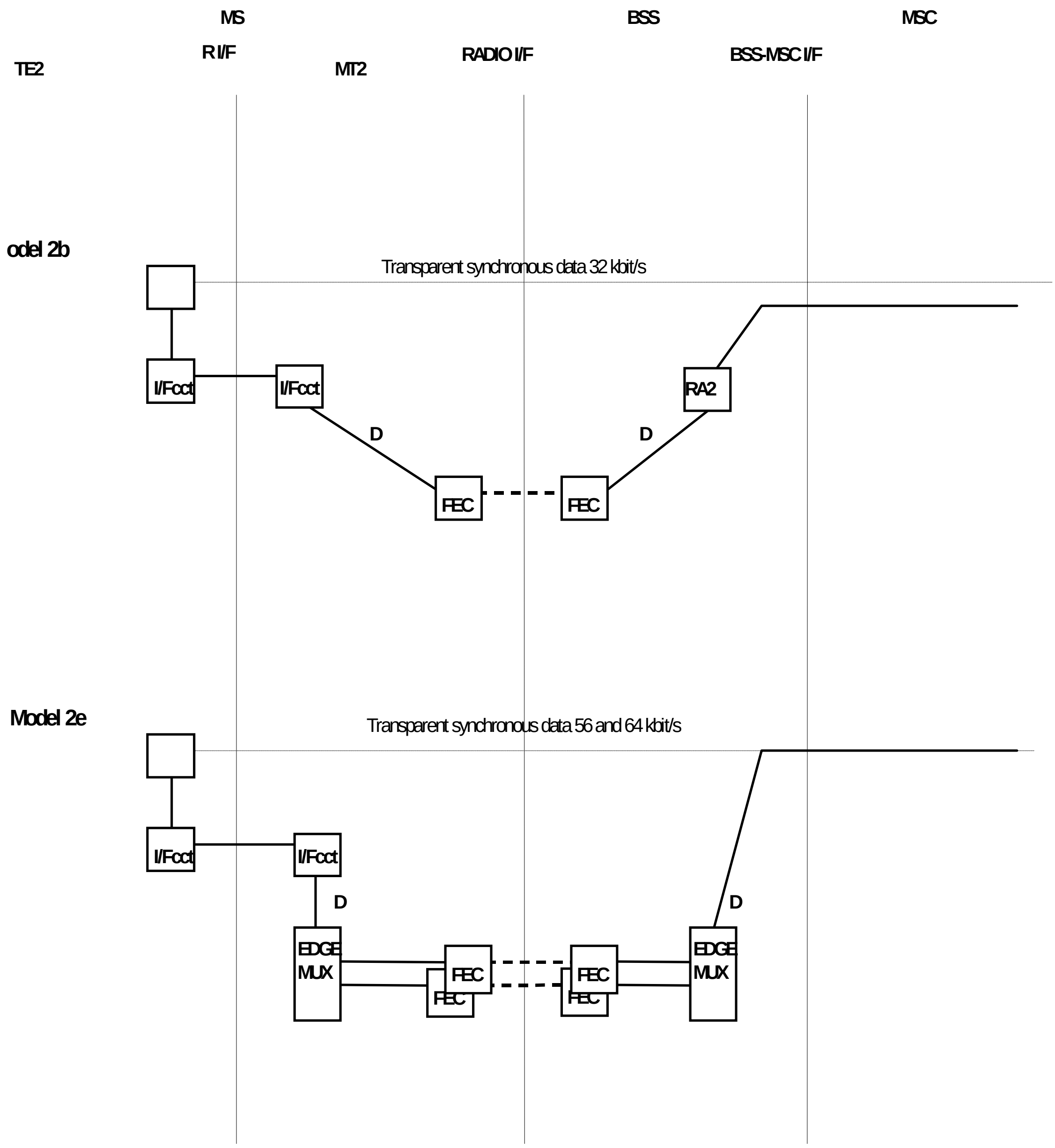

Figure 9: Information transfer protocol models for PLMN connections using TCH/F32.0 EDGE channels

3GPP TSG CN WG3 Meeting #24
Helsinki, Finland. 29th July – 2nd August 2002

Tdoc ⌘ N3-020680

CR-Form-v7

CHANGE REQUEST

⌘	**44.021**	**CR**	**002**	⌘ **rev**	**3**	⌘	Current version:	**5.0.0** ⌘

For ***HELP*** *on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title:	⌘	Correction of Rate Adaptation RA1/RA1' for higher User Rates and removal of S Reference Point in MS		
Source:	⌘	TSG_CN WG3		
Work item code:	⌘	TEI [CS Data]	***Date:*** ⌘	30/07/2002
Category:	⌘	**A**	***Release:*** ⌘	Rel-5
		Use *one* *of the following categories:* ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use* *one* *of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change:	⌘	• Alignment with TS 43.010 and TS 48.020 concerning the rate adaptation function RA1'/RA1" for the user rates 48, 56 and 64 kbit/s. • Introduction of the rate adaptation function RA1'/RAA" for the user rate of 64 kbit/s using TCH/F14.4 channel coding. • The S Reference Point has been removed as MS internal interface from Rel-4 onwards. This is already implemented in some specifications like e.g. TS 27.001, 43.010, but not yet in TS 44.021. The removal of this S Reference Point means that the RA1/RA1' function does not reside anymore in the MS, only in the BSS. Some rate adaptations have to be modified. Further, the RA1, RA2 and RA1" functions are no more needed at the MS/BSS interface and should be moved to TS 48.020.
Summary of change:	⌘	See attached pages, clauses 2, 3, 4, 5, 6, 7, 8, 10, 11
Consequences if not approved:	⌘	Inconsisteny between TS 44.021, 43.010 and 48.020 and errorneous specification of the rate adaptation function mentioned above.

Clauses affected:	⌘					
		Y	**N**			
Other specs affected:	⌘	X		Other core specifications	⌘	TS 48.020, TS 43.010
			X	Test specifications		
			X	O&M Specifications		
Other comments:	⌘					

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References, Definitions and Abbreviations

2.1 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, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP specifications".

[2] 3GPP TS 22.034: "High Speed Circuit Switched Data (HSCSD) -Stage 1".

[3] 3GPP TS 43.010: "GSMPublic Land Mobile Network (PLMN) connection types".

[4] 3GPP TS 23.034: "High Speed Circuit Switched Data (HSCSD) - Stage 2 Service Description".

[5] 3GPP TS 45.003: "Channel coding".

[6] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[7] 3GPP TS 27.002: "Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[8] ~~Void~~3GPP TS 48.060: "Inband control of remote transcoders and rate adaptors for Enha~~m~~nced Full Rate (EFR) and full rate traffic channels".

[9] 3GPP TS 48.020: "Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

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

[11] ITU-T Recommendation X.30: "Support of X.21,X.21 bis and X.20 bis based terminal equipments (DTEs) by integrated services digital network (ISDN)".

3 General approach

3GPP TS 43.010 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 - and a Split/Combine-function in case of a multislot data configuration - which are combined as shown in 3GPP TS 43.010 as part of the connection type.

The rate adaptation functions are RA0, ~~RA1, RA2,~~ RA1', ~~RA1"~~RA1'/RA1", RA1'/RAA", RA1'/RAA' and RA1/RA1'. The RA0~~, RA1 and RA2~~ ~~are~~ is ~~equivalent~~ similar to ~~those~~ the RA0 function~~s~~ described in ITU-T recommendation V.110 [11] with the exception of the conversion of the rates 14.4 and 28,8 kbit/s.

The RA1' function is similar to RA1 described in ITU-T recommendation V.110 [11] but has a reduced bit rate output compatible with the coding scheme proposed for data services on the radio interface.

~~The RA1" function is used for converting between synchronous user rates of 48 and 56 kbit/s and the rate 64 kbit/s. The equivalent function in ITU-T recommendation V.110 does not have a name.~~

The RA1/RA1', RA1'/RA1", RA1'/RAA" and RA1'/RAA' are is a relay functions, used as indicated in 3GPP TS 43.010.

In multislot data-configurations the overall data stream is split into parallel substreams between the Split/Combine-functions.

3.1 Overview of data rates and configurations

In Table 1, an overview of the supported transparent air-interface user rates is given. For each rate, also intermediate rates per channel between BTS and MSC, overall radio interface rates, and channel configurations are given. For single slot connections the intermediate rates are per channel carrying the overall data stream, whereas for multislot connections, the intermediate rates are per substream.

~~In Table 2, intermediate rates within the MS, overall radio interface rates, and channel configurations are given for the air-interface user rates. The intermediate rates are per overall data stream.~~

For single slot rates up to 4,8 kbit/s, the used intermediate rate is 8 kbit/s, and for the 9,6 kbit/s single slot rate 16 kbit/s.

For TCH/F9.6 and TCH/F4.8 channel codings, the multislot intermediate rates are 16 and 8 kbit/s per TCH/F, respectively.

For TCH/F14.4 channel coding, the multislot intermediate rate is 16 kbit/s per TCH/F.

Connections utilising TCH/F28.8 or TCH/F43.2 across the radio interface, use multislot combinations of TCH/F14.4 between BTS and MSC. Thus the corresponding multislot intermediate rate is 16 kbit/s.

No multislot intermediate rates are applicable to 56 and 64 kbit/s connections using TCH/F32.0 radio interface channels. The intermediate rate for the 32 kbit/s user rate using the TCH/F32.0 channel is 32 kbit/s.

~~Between the TE and the Split/Combine-function at the MS, where the overall data stream is not split, intermediate rates of 8, 16, 32 and 64 kbit/s are applicable.~~

Table 1: AIUR/Multislot intermediate rates

Air interface user rate	**DTE/DCE statuses**	**RA0**	**RA1'/RA1 RA1'/RAA' RA1'/RA1" RA1'/RAA" (Note 4)**		**RA1'**	
			Multislot intermediate rate	**Frame type**	**Radio interface rate**	**Padding**
≤ 600 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
1200 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
2,4 kbit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
4,8 kbit/s	X	X	8 kbit/s	80 bit frames	6 kbit/s	
9,6 kbit/s	X	X	16 kbit/s or 2×8 kbit/s	80 bit frames	12 kbit/s or 2×6 kbit/s	
14,4 kbit/s	X	X	2×16 kbit/s or 3×8 kbit/s	80 bit frames	2×12 kbit/s or 3×6 kbit/s	P (note 1)
			16 kbit/s ~~Note 7~~	Note ~~8~~5	14,5 kbit/s	
19,2 kbit/s	X	X	2×16 kbit/s or 4×8 kbit/s	80 bit frames	2×12 kbit/s or 4×6 kbit/s	
28,8 kbit/s	X	X	3×16 kbit/s	80 bit frames	3×12 kbit/s	
			2 x 16 kbit/s ~~Note 7~~	Note ~~8~~5	2×14,5 kbit/s	
					1×29 kbit/s	
32 kbit/s			1 x 32 kbit/s		1 x 32 kbit/s	
38,4 kbit/s	X	X	4×16 kbit/s	80 bit frames	4×12 kbit/s	
			3 x 16 kbit/s ~~Note7~~	Note ~~8~~5	3×14,5 kbit/s	P (note ~~6~~1)
43.2 kbit/s Note ~~10~~6	X		3 x 16 kbit/s ~~Note7~~	Note ~~8~~5	1×43.~~2~~5 kbit/s	
48 kbit/s	X		Note 2	Note 2	5×12 kbit/s	
			4 x 16 kbit/s ~~Note7~~	Note ~~8~~5	4×14,5 kbit/s	P (note ~~6~~1)
56 kbit/s			Note 2	Note 2	5×12 kbit/s (note 3)	
			4x16 kbit/s ~~Note7~~	Note ~~8~~5	4×14,5 kbit/s	P (note ~~6~~1)
			Note ~~9~~2	Note ~~9~~2	2×32.0 kbit/s	
64 kbit/s			Note 2	Note 2	6×12 kbit/s (note 3) 5×14,5 kbit/s	P (note 1) (note ~~6~~1)
			Note ~~9~~2	Note ~~9~~2	2×32.0 kbit/s	

P=Padding used

Table 2: AIUR / Intermediate rates

Air interface user rate	DTE/DCE statuses	RA0	RA1		RA1'	
			Intermediate rate	Frame type	Radio interface rate	Padding
≤ 600 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
1200 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
2,4 kbit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
4,8 kbit/s	X	X	8 kbit/s	80 bit frames	6 kbit/s	
9,6 kbit/s	X	X	16 kbit/s	80 bit frames	12 kbit/s or 2×6 kbit/s	
14,4 kbit/s	X	X	32 kbit/s	80 bit frames	2×12 kbit/s	P (note 1)
					3×6 kbit/s 1x14,5 kbit/s	
19,2 kbit/s	X	X	32 kbit/s	80 bit frames	2×12 kbit/s or 4×6 kbit/s	
28,8 kbit/s	X	X	64 kbit/s	80 bit frames	3×12 kbit/s 2×14,5 kbit/s 1×29 kbit/s	
32 kbit/s			32 kbit/s		1 x 32 kbit/s	
38,4 kbit/s	X	X	64 kbit/s	80 bit frames	4×12 kbit/s	
					3×14,5 kbit/s	P (note 6)
43.2 kbit/s Note 10	X		Note 11	Note 11	1×43.2 kbit/s	
48 kbit/s	X		64 kbit/s Note 4	Note 4	5×12 kbit/s	
					4×14,5 kbit/s	P (note 6)
56 kbit/s			64 kbit/s Note 4	Note 4	5×12 kbit/s (note 3)	
					4×14,5 kbit/s	P (note 6)
					2×32.0 kbit/s	
64 kbit/s			64 kbit/s Note 5	Note 5	6×12 kbit/s (note 3)	P (note 1)
					5×14,5 kbit/s	(note 6)
					2×32.0 kbit/s	

P =Padding used

NOTE 1: For information on the padding procedure, please refer to clause ~~10~~ 11 of the present document.

NOTE 2: No multislot intermediate rate; substreams combined at the BSS with a resulting data rate of 64 kbit/s between BSS and MSC.

NOTE 3: AIUR 11,2 kbit/s per channel

NOTE 4: For this rate A/Gb mode-specific rate adaptation function RA1'' rather than RA1is applied.

NOTE 5: For this rate RA1- and RA2- adaptations are not applied.

NOTE 6: Padding used as specified for TCH/F14.4 channel codings

NOTE 74: Different relay rate adaptation functions exist at At the network side:
, - RA1'/RA1 applies if the radio interface rate is n x 3,6, 86 or 12 kbit/s and the AIUR is less than 48 kbit/s,
- RA1'/RAA' applies if the radio interface rate is n x 14,5, 29 or 43,2 kbit/s and the AIUR is less than 64 kbit/s,
- RA1'/RA1" applies if the radio interface rate is n x 12 kbit/s and the AIUR is equal to 48, 56 or 64 kbit/s,
- RA1'/RAA" applies if the radio interface rate is n x 14,5 kbit/s and the AIUR is equal to 64 kbit/s,
- a relay rate adaptation function does not apply if the radio interface rate is n x 32 kbit/s

not applied; instead a TCH/F14,4-specific adaptation RA1'/RAA' used (3GPP TS 48.020)

NOTE 85: A 320-bit frame format described in 3GPP TS 08.6048.060.

NOTE 9: No multislot intermediate rate. Data rate between BSS and MSC 64 kbit/s.

NOTE 106: Used only in non-transparent configurations.

NOTE 11: In NT cases there is no direct relationship between AIUR and Intermediate rate.

4 The RA0 Function

4.1 Asynchronous-to-Synchronous Conversion (RA0)

The RA0 Function is only used with asynchronous interfaces. Incoming asynchronous data is padded by the addition of stop elements to fit the same or nearest higher synchronous rate defined by 2 to the power n (where n≤ 6) times 600 bit/s, 14,4 kbit/s or 28,8 kbit/s. Thus the 300 bit/s user data signalling rate shall be adapted to a synchronous 600 bit/s stream. The resultant synchronous stream is fed to RA1 or RA1' or Split/Combine Function. The RA0 used in PLMN is not identical to that described in ITU-T Recommendation V.110 which converts 14,4 and 28,8 kbit/s user rates to 19,2 and 38,4 kbit/s, respectively.

Asynchronous user rate	Synchronous user rate
≤ 0.6 kbit/s	0.6 kbit/s
1,2 kbit/s	1,2 kbit/s
2,4 kbit/s	2,4 kbit/s
4,8 kbit/s	4,8 kbit/s
9,6 kbit/s	9,6 kbit/s
14,4 kbit/s	14,4 kbit/s
19,2 kbit/s	19,2 kbit/s
28,8 kbit/s	28,8 kbit/s
38,4 kbit/s	38,4 kbit/s

4.2 Break signal

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

If the converter detects 2M to 2M+3 bits, all of start polarity, where M is the number of bits per character in the selected format including start and stops 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 shall transmit on circuit 103 at least 2M bits stop polarity after the start polarity break signal before sending further data character. The converter shall then regain character synchronism from the following stop to start transition.

4.3 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 %, 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 realization of overspeed handling, as described above, at the interface to the associated terminal is implementation dependent. Possible implementations are e.g. the reduction of the length of the stop elements according to V.110 [9] or increased data rates between the TA and terminal.

4.4 Parity Bits

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

4.5 Flow Control

Where applicable, this function is as specified in the relevant terminal adaptation function Specification (see 3GPP TS 07 series).

5 ~~The RA1 Function~~Void

~~This function shall be used to adapt between the synchronous user rates, or the output of the RA0 function and the intermediate rate of 8, 16, 32 or 64 kbit/s.~~

~~5.1 Adaptation of synchronous data rates up to 38,4 kbit/s~~

~~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~~
~~14,4 kbit/s~~	~~32 kbit/s~~
~~19,2 kbit/s~~	~~32 kbit/s~~
~~28,8 kbit/s~~	~~64 kbit/s~~
~~38,4 kbit/s~~	~~64 kbit/s~~

~~An ITU-T V.110 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 600 bit/s to 8Kbit/s is performed by 8 times consecutive duplication of each user data bit. (Figure 9)~~

~~Adaptation of 1200 bit/s to 8 Kbit/s is performed by 4 times consecutive duplication of each user data bit. (Figure 8)~~

~~Adaptation of 2400 bit/s to 8kbit/s is performed by 2 times consecutive duplication of each user data bit. (Figure 7)~~

~~Adaptation of 4800 bit/s to 8 Kbit/s is performed by transmitting the bit stream with no duplication. (Figure 3)~~

~~Adaptation of 9600 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 4800 bit/s case). (Figure 3)~~

~~Adaptation of 14400 bit/s to 32 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 3600 bit/s case).(Adaptation of 3600 bit/s to 8 kbit/s is performed by transmitting the bit stream with no duplication.) (Figure 12)~~

Adaptation of 19200 bit/s to 32 Kbit/s is performed as for 4800 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 4800 bit/s case). (Figure 3)

Adaptation of 28800 bit/s to 64 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by eight with respect to the 3600 bit/s case). (Figure 12)

Adaptation of 38400 bit/s to 64 Kbit/s is performed as for 4800 bit/s 8 kbit/s (the emitting period is divided by eight with respect to the 4800 bit/s case). (Figure 3)

The ITU-T V.110 80 bit frames shown in Figures 3 and 12 are 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 3GPP TS 27.001.

The E bits are used to convey the following information:

i) User Data Rate - E1, E2, E3 (for single slot operation see Figure 4, and for multislot operation Figure 4 and subclause 10.7)

ii) Network Independent Clocking - E4, E5, E6

iii) Multiframe Synchronisation - E7

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

5.1.1 Network Independent Clocking

Synchronous data signals received by the MT from the DTE at the MS 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 V.110 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 MS employs its own network independent clock. In any case, the frequency tolerance of the clocks involved is 100 ppm.

5.1.1.1 Multiframe Structure

The transmitting end of the A/Gb mode 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 V.110 (and X.30) except that such a multiframe structure exists for all user data rates. This frame synchronization is achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the A/Gb mode 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 frames as illustrated in figure 1. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe shown in figure 1.

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 1: 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 section 3.1.2 in V.110 frames MF 1a and MF 1b.

5.1.1.2 Encoding and compensation

The V.110 transmitter uses the following 5-bit code words, as shown in figure 2, 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 2: NIC Code Words

When negative compensation is indicated, one less user data bit than normal is transported in the affected frame (MF1a or MF1b). 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. In case of 80-bit frames with 36 data bits, bit D19 is discarded instead.

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 causes 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 MF1a or MF1b) of the V.110 frame illustrated in figure 3. In case of 80-bit frames with 36 data bits, the insertion is done to between bits D18 and D19.

When no compensation is necessary, or when NIC is applied, the values of E4, E5, E6, E7, on the 4 multi frame scheme is:

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

When NIC is not applicable, the MS and the IWF shall disregard the received value of bits E4, E5, E6 and E7 in the data transmission phase.

NOTE: NIC is not applicable in the following cases:

- transparent asynchronous bearer services;
- the facsimile teleservices in the transparent mode;
- every transparent bearer services when interworking with an UDI Information Transfer Capability.

6 The RA1'' functionVoid

The RA1'' function shall be used for converting between synchronous user rates of 48 and 56 kbit/s and the 'intermediate' rate of 64 kbit/s. (RA1'' is a A/Gb mode-specific term which is used for the one-step adaptation of 48 and 56 kbit/s rates into 64 kbit/s as specified in ITU-T V.110. For the purposes of A/Gb mode specifications the term 'intermediate rate' is used for the resulting 64 kbit/s rate although this is not done in V.110 recommendation.)

6.1 Rate adaptation of 48 kbit/s user rates with DTE/DCE status to 64 kbit/s

A ITU-T V.110 32 bits frame is constructed using the user data bits received, the values of the S bits are deduced from the R interface.

The ITU-T V.110 32 bit frame shown in Figure 13 is used. The D bits are used for conveying the user data and the S and X bits are used for conveying channel control information according 3GPP TS 27.001.The order of transmission of the 32 bit frame is from left to right and top to bottom.

6.2 Rate adaptation of 56 kbit/s user rate to 64 kbit/s

A ITU-T V.110 64 bits frame is constructed using the user data bits received.

The ITU-T V.110 64 bit frame shown in figure 14 is used. The D bits are used for conveying the user data.

The order of transmission of the 64 bit frame is from left to right and top to bottom.

7 The RA2 FunctionVoid

This procedure is based on the RA2 function as specified in ITU-T V.110. It shall be used to rate adapt to/from the intermediate rates of 8, 16 or 32 kbit/s from/to the 64 kbit/s rate used at the S interface.

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

For the intermediate- and user data rate of 64 kbit/s, the RA2 transmits the bit stream over the S-interface as it is.

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

The procedure requires that:

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

ii) The 16 kbit/s bitstream occupies bit positions (1,2);

iii) The 32 kbit/s bitstream occupies bit positions (1,2,3,4) ;

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

v) All unused bits in the 64 kbit/s stream are set to binary "1".

8 The RA1/RA1' Relay Functions RA1/RA1', RA1'/RA1", RA1'/RAA' and RA1'/RAA"

The relay functions realise conversions on the infrastructure side in both transparent and non-transparent cases as specified in 3GPP TS 43.010.

The RA1/RA1' function described below shall be used for channel codings TCH/F4.8 and TCH/F9.6 if the AIUR is less than 48 kbit/s. It in transparent cases to converts between the intermediate rate and the input rate to the channel coder or the multiplexing function.

The RA1'/RA1" function shall be used for channel codings TCH/F4.8 and TCH/F9.6 if the AIUR is equal to 48, 56 or 64 kbit/s. It converts between the 64 kbit/s data stream and the input rate to the channel coder.

The RA1'/RAA' function shall be used for channel codings TCH/F14.4, TCH/F28.8 and TCH/F43.2 if the AIUR is less than 64 kbit/s. It converts between the E-TRAU frame specified in 3GPP TS 48.060 and the input rate to the channel coder or the EDGE multiplexing function.

The RA1'/RAA" function shall be used for channel codings TCH/F14.4 if the AIUR is equal to 64 kbit/s. It converts between the 64 kbit/s data stream and the input rate to the channel coder.

A relay adaptation function is not needed for the channel coding TCH/F32.

This conversion also appears on the infrastructure side in both transparent and non-transparent cases as specified in 3GPP TS 48.020 except for channel codings TCH/F14.4, TCH/F28.8, TCH/F32.0, and TCH/F43.2.

8.1 Single slot rates

There are seven data rates (known as Radio Interface data rates) used for data transfer to the channel coder. These are 43.,5 kbit/s (NT only), 32.0 kbit/s (T only), 29 kbit/s (In cases where EDGE channel codings TCH/F43.2 or TCH/F28.8 are used, the RA1/RA1' function adapts the data stream to 14.5 kbit/s substreams as if multiple 14.5 kbit/s radio interface channels were used.), 14,5 kbit/s, 12 kbit/s, 6 kbit/s and 3.6 kbit/s. In cases where EDGE channel codings TCH/F43.2 or TCH/F28.8 are used, the RA1'/RAA' function adapts the data stream to 14,5 kbit/s substreams as if multiple 14,5 kbit/s radio interface channels were used.

The 32 kbit/s user rate is identical to the 32 kbit/s intermediate rate. In this case the 32 kbit/s intermediate rate is directly mapped to the 32 kbit/s radio interface data rate.

The 8, 16 and 64 kbit/s intermediate rates and the 32 kbit/s intermediate rate with other than 32 kbit/s user rates are adapted to the radio interface data rates as follows:

Intermediate rate	Radio interface data rate
8 kbit/s	3,6 kbit/s
8 kbit/s	6 kbit/s
16 kbit/s	12 kbit/s
32 kbit/s	14,5 kbit/s

AIUR	Intermediate rate	Radio interface rate
≤ 600 bit/s	8 kbit/s	3,6 kbit/s
1,2 kbit/s	8 kbit/s	3,6 kbit/s
2,4 kbit/s	8 kbit/s	3,6 kbit/s
4,8 kbit/s	8 kbit/s	6 kbit/s
9,6 kbit/s	16 kbit/s	12 kbit/s
14,54 kbit/s	32 kbit/s	14,5 kbit/s
28,8 kbit/s	64 kbit/s	29 kbit/s (Note 2)
43,2 kbit/s	(Note 1)	43,5 kbit/s(Note 2)
Note 1: AIUR only used in non-transparent configurations. There is no direct relationship between AIUR and Intermediate rate. Note 2: The RA1'/RAA' function adapts the data stream to 14,5 kbit/s substreams as if multiple 14,5 kbit/s radio interface channels were used.		

For the adaptation the following three processes are used:

Firstly the 17 synchronization bits are removed.

Secondly the E1, E2 and E3 bits are removed. For transparent services, the values of the E1, E2, E3 bits are determined at the MT and in case of TCH/F9.6 and TCH/F4.8, at the BTS 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 BSS). For non transparent services, the coding of the E1, E2 and E3 bits is described in 3GPP TS 48.020.

Thirdly, in the 3.6 kbit/s case, half the data bits are discarded. These processes result in modified ITU-T V.110 frames of sizes 60,60 and 36 bits for the 12, 6 and 3.6 kbit/s data rates respectively. The resultant modified ITU-T V.110 frames for the various user data rates are shown in figures 5 - 9.

Further procedures for TCH/F14.4, TCH/F 28.8, and TCH/F43.2 channel coder input rates in subclauses 8.1.1, 9.1 and 9.3, respectively.

8.1.1 Radio interface rate of 14,5 kbit/s

~~In this case one modified ITU-T V.110 frame is received/sent from/to the network every 2.5 ms (see 3GPP TS 45.003). The RA1/RA1' function adds/subtracts the 17-bit synchronisation pattern, the F-, E-, X-, and S-bits to/from the 80-bit V.110-frames.~~

The RA1'/RAA' function converts between the E-TRAU frame and the 290 bit blocks from the channel coder. The E-TRAU frames are defined in TS 48.060. The 290 bit blocks carry 288 data bits and the control bits M1 and M2 as specified in section 10.3.1 and 10.3.2. ~~Bits M1 and M2 are transmitted along with the modified 36-bit V.110 frames every 20 ms over the radio interface (See 3GPP TS 45.003). Bit M2 is used by the RA1/RA1' function for deriving/mapping the E-, S-, and X-bits. Bit M1 is used for multislot synchronisation. The usage of these bits is further elaborated in subclause 8.1.1.1.~~

~~The modified ITU-T V.110 36-bit frame received/sent from/to the network at 14,4 kbit/s:~~

~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~
~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~
~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~
~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~
~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~

~~is converted/derived into/from the following 80-bit V.110-frame at 32 kbit/s. The E-, S-, and X-bits are mapped/extracted to/from the M2-bit sequence.~~

~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~1~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~S1~~
~~1~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~F~~	~~F~~	~~X~~
~~1~~	~~D11~~	~~D12~~	~~F~~	~~F~~	~~D13~~	~~D14~~	~~S3~~
~~1~~	~~F~~	~~F~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~	~~S4~~
~~1~~	~~E1~~	~~E2~~	~~E3~~	~~E4~~	~~E5~~	~~E6~~	~~E7~~
~~1~~	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~S6~~
~~1~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~F~~	~~F~~	~~X~~
~~1~~	~~D29~~	~~D30~~	~~F~~	~~F~~	~~D31~~	~~D32~~	~~S8~~
~~1~~	~~F~~	~~F~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~	~~S9~~

~~For the 36-bit frames the received D-bits are set as they were transmitted. For transparent services E, S, and X-bits are reproduced based on the M2-bit sequence as described in subclause 8.1.1.1. Bits E1, E2, and E3 are set according to the user data rate as shown in Figure 4 for transparent services.~~

~~8.1.1.1 Multiframe structure over the radio-interface~~

~~Bit M1 carries a 31-bit PN multiframe code 0000 1001 0110 0111 1100 0110 1110 101. One multiframe bit is transmitted every 20 ms per substream, which means that one whole multiframe consists of 248 36-bit frames.~~

~~Bit M2 carries V.24 circuit status information, network independent clocking (NIC) information and substream numbering as indicated in the following figure:~~

~~bit number~~	~~0 1 2 3~~	~~4 5 6 7~~	~~8 - 11~~	~~12- 15~~	~~16 - 19~~	~~20 - 23~~	~~24 - 27~~	~~28 - 30~~
~~M1:~~	~~0 0 0 0~~	~~1 0 0 1~~	~~0 1 1 0~~	~~0 1 1 1~~	~~1 1 0 0~~	~~0 1 1 0~~	~~1 1 1 0~~	~~1 0 1~~
~~M2:~~	~~# # # SB~~	~~SB X # #~~	~~# X SB SB~~	~~# # # SB~~	~~SB X # #~~	~~# X SB SB~~	~~NNNN~~	~~N SB SB~~

~~where # # # = Substream number (multilink operation)~~

~~SB = the SB status bit~~

~~X = the X status bit~~

~~NNNNN = Network independent clocking code~~

~~In the MS to Network direction the information carried by the M2-bit sequence is mapped in the following manner:~~

~~An M1/M2-bit pair is transmitted along each block of data containing eight modified V.110 36-bit frames. The three-bit #-sequence carries a number identifying each substream (multislot operation); the substreams are numbered 0,1,2 etc.~~

The status- and NIC-information is mapped between the M2-sequence(s) and the V.110-frames. Bits SB and X are mapped to V.24 circuits as specified in 3GPP TS 27.001.

The SB-bit carries the V.110 SB-status information, and the X-bit the X-status information.

Five consecutive N-bits carrying an NIC-code in the M2-sequence indicate 'negative compensation' or 'positive compensation' if such a compensation is required. Otherwise' no compensation' is indicated by the N-bits.

	N-bit 24 in M2-sequence	N-bit 25 in M2-sequence	N-bit 26 in M2-sequence	N-bit 27 in M2-sequence	N-bit 28 in M2-sequence
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 a one	0	0	1	0	0

The Network to MS direction:

The status-information is filtered as described in 3GPP TS 27.001. To change the SB- or X-status mode, it is required that at least two consecutive SB- or X-bits, respectively, carry the same value.

For NIC-procedure, refer to subclause 11.5.1.

8.1.1.2 Radio-interface data block for TCH/F14.4 channel coding

A radio-interface data block for a TCH/F14.4 channel consists of 8 36-bit data frames and bits M1 and M2 as shown in the following table:

																	M1	M2
1	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
2	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
3	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
4	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
5	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
6	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
7	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
8	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36

The number on the left indicates the order of the data frames in the 290-bit block; the 36-bit frame in position one was received before that in position two etc. One such block is transmitted over the radio interface every 20 ms.

8.1.2 Radio Interface rate of 12 kbit/s

In this case one modified ITU-T V.110 60 bit frame is received/sent from/to the ~~network~~ radio interface every 5ms (see 3GPP TS 45.003). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1,E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

The modified ITU-T V.110 60 bits frame received/sent from/to the radio interface at 12 Kbit/s (Figure 5),

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 V.110 80 bits frame at 16 Kbit/s (Figure 3):

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 V.110 60 bit frames received from the ~~network~~radio interface, 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 4 for the transparent services, or the RLP multiframe and DTX indication as per 3GPP TS 48.020 in the non transparent case.

For modified ITU-T V.110 60 bit frames transmitted over the ~~network~~radio interface, 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.

8.1.3 Radio Interface rate of 6 kbit/s

In this case one modified ITU-T V.110 60 bit frame is received/sent from/to the radio interface ~~network~~ every 10 ms (see 3GPP TS 45.003). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

The modified ITU-T V.110 60 bits frame received/sent from/to the radio interface at 6 Kbit/s (Figure 6),

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 V.110 80 bits frame at 8 Kbit/s (Figure 3):

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 V.110 60 bit frames received from the radio interface~~network~~, 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 4 for the transparent services, or the RLP multiframe and DTX indication as per 3GPP TS 48.020 in the non transparent case.

For modified ITU-T V.110 60 bit frames transmitted over the radio interface~~network~~, 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.

This process is identical to that used for the 12 kbit/s case except that the frame repetition rates are halved.

8.1.4 Radio Interface rate of 3,6 kbit/s (transparent services only)

In this case one modified ITU-T V.110 36 bit frame is received/sent from/to the radio interface ~~network~~ every 10ms (see 3GPP TS 45.003 [5]). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

For the AIUR of 2,4 kbit/s ~~T~~the modified ITU-T V.110 36 bits frame received/sent from/to the radio interface at 3.6 ~~K~~kbit/s (Figure 7a),

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

is converted into the following a ITU-T V.110 80 bits frame at 8 Kbit/s (Figure 7b):

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

Figure 8 and 9 show the bit mappings for the AIUR of 1200 and 600 bit/s.

For modified ITU-T V.110 36 bit frames transmitted to the radio interface~~network~~, E1, E2, E3 are discarded. For modified ITU-T V.110 36 bit frames received from the radio interface~~network~~, E1, E2, E3 are set as shown in figure ~~2~~4.

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.

~~8.1.5 Synchronisation~~

~~Two interfaces are involved in the TAF regarding the need for data frame synchronisation, i.e. the TAF/air-interface and TAF/TE interface. For detailed definition of the synchronisation procedures refer to 3GPP TS 27.001.~~

~~8.1.6 Idle frames~~

~~Whenever no data is received from the radio interface (e.g. frame stealing applies, layer 2 fill frames are received, etc.) idle frames shall be sent to the DTE. These are V.110 frames with frame alignment pattern according to ITU-T recommendation. V.110 [11] and all data, status and E-bits set to binary "1".~~

8.2 Multislot rates

In multislot operation the transmission is performed using parallel substreams between the Split/Combine-functions.

~~8.2.1 TCH/F14.4 multislot operation~~

~~The information carried by the M2-sequences is read per substream; i.e. the substream number and a complete NIC-code are transferred through one substream.~~

~~A NIC-code is carried on as many substreams as is necessary to cover all NIC-compensations that have taken place. On channels where no NIC-compensation is carried, the N-bits are set to 'no compensation'. For the exact NIC-procedures, refer to subclause 11.5.1.~~

8.2.~~2~~1 AIURs up to 38,4 kbit/s using TCH/F9.6 and TCH/F4.8 channel codings

AIUR	Intermediate rate~~/AIUR~~	Radio interface rate
9,6 kbit/s	16 kbit/s~~ / 9,6 kbit/s~~	2×6 kbit/s
14,4 kbit/s	32 kbit/s	2×12 or 3×6 kbit/s
19,2 kbit/s	32 kbit/s~~ / 14,4; 19,2 kbit/s~~	2×12 ~~or 3×6~~ or 4×6 kbit/s
28,8 kbit/s	64 kbit/s	3×12 kbit/s
38,4 kbit/s	64 kbit/s ~~/ 28,8; 38,4 kbit/s~~	~~3×12 or~~ 4×12 kbit/s

In these cases, the data stream is mapped from 80-bit intermediate rate frames into modified frames of 60 bits for radio-interface transmission as specified in subclause 8.1 for 12 kbit/s and 6 kbit/s except for the following cases:

For AIURs 14,4 and 28,8 kbit/s using channel codings TCH/F4.8 and TCH/F9.6, respectively, four consecutive V.110 80-bit frames (Figure 12) are mapped onto three consecutive modified 60-bit V.110 (Figure 5 or 6) frames at the MS. The 4×36 data bits in the 80-bit frames are mapped onto the 3×48 data bits in the 60-bit frames. However, bits E4-E7 in the 80-bit frames are mapped onto the E4-E7 bits in the 60-bit frames when their value indicate either positive or negative compensation (NIC; See subclause 5.1.1). The E4-E7 bits that indicate 'No compensation' in the 80-bit frames need not be mapped onto the 60-bit frames. The S- and X-bits in every fourth 80 -bit frame are not mapped onto the 60-bit frames. When radio interface rate of 2 × 12 kbit/s is used for carrying AIUR 14,4 kbit/s, padding is used in the 60-bit frames of the higher substream number (Subclause 11.6).

For substream numbering information, please refer to subclause 10 of the present document.

8.2.~~3~~2 AIURs up to ~~38,4~~64 kbit/s using TCH/F14.4 channel coding

AIUR	Intermediate rate~~/AIUR~~	Radio interface rate
28,8 kbit/s	64 kbit/s	2×14,5
38,4 kbit/s	64 kbit/s~~ / 28,8; 38,4 kbit/s~~	~~2×14,5 or~~ 3×14,5
48 kbit/s	64 kbit/s	3×14,5
56 kbit/s	64 kbit/s	4×14,5
64 kbit/s	64 kbit/s	5×14,5

For AIURs ~~14,4 and 28,8~~< 64 kbit/s the RA1'/RAA' function extracts the eight 36 data bit~~s~~ blocks in the E-TRAU ~~80-bit V.110 intermediate rate~~ frames ~~are extracted~~ and ~~sent~~ sends ~~it~~them through the substreams in data blocks containing eight 36-bit frames as described in subclause ~~8.1~~10.3. For AIUR 64 kbit/s the RA1'/RAA" function sends the data bits in the 64 kbit/s data stream through the substreams in data blocks containing eight 36-bit frames as described in subclause 10.3. An M1/M2-bit pair is sent over the radio-interface along with each data block every 20 ms. These bits carry the multiframe, substream number, V.24 status, and NIC information as described in subclauses ~~8.1.1.1~~ 10.3.1 and ~~8.2.1~~10.3.2.

~~For AIUR 38.4 kbit/s the 80-bit V.110 intermediate rate frames carry 48 user data bits. The 290-bit blocks in the substreams of the lower substream numbers carry 288 user data bits while the 290-bit blocks in the substream of the highest substream number carries 192 user data bits; this means that five of the eight 36-bit frames making up the block carry 36 user data bits whereas the sixth frame carries 12 user data bits (5×36+12). Frames seven, eight, and the rest of the sixth frame are padded with '1's.~~

~~The M2-bit sequences are used as described in subclauses 8.1.1.1 and 8.2.1~~

~~For NIC-procedures refer to subclauses 8.2.1 and 11.5.1. No NIC-values are transported in association with AIUR 38,4; the N-bits are set to 'no compensation'.~~

8.2.~~4~~3 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 5 x 12 kbit/s

One modified ITU-T V.110 60 bit frame (Figure 5) is received/sent from/to a TCH/F every 5 ms (see 3GPP TS 45.003) resulting in an radio-interface rate of 12 kbit/s per channel.

One 60-bit radio-interface frame is converted into two ITU-T V.110 32-bit frames at 64 kbit/s (Figure 13):

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

~~8.2.5 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 4 x 14,5 kbit/s~~

~~For AIUR 48 kbit/s the 24 data bits in the 32-bit V.110-frames are extracted and sent through the substreams in 36-bit frames as described in subclause 8.1. An M1/M2-bit pair is sent over the air-interface along each data block every 20 ms. This pair of bits carries the multiframe, substream, and V.24 status information as described in subclauses 8.1.1.1 and 8.2.1.~~

~~The 290-bit blocks in the highest numbered substream carry 96 user data bits (2×36+24).~~

~~The M2-bit sequences are used, for the applicable parts, as described in subclauses 8.1.1.1 and 8.2.1.~~

~~No NIC-values are transported in association with AIUR 48.0; the N-bits are set to 'no compensation'.~~

8.2.~~6~~4 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s, Radio interface rate of 5 × 12 kbit/s

~~**Radio interface rate of 5 × 12 kbit/s**~~

One modified ITU-T V.110 60 bit frame (Figure 10) is received/sent from/to the network every 5 ms (see 3GPP TS 45.003) resulting in a radio-interface rate of 12 kbit/s per channel.

A modified ITU-T V.110 60 bits radio-interface frame (Figure 10):

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	D41	D42	D43	D44	D45
D46	D47	D48	D49	D50	D51	D52
D53	D54	D55	D56			

NOTE: For information on the T-bits, please refer to subclause 11.2 of the present document.

is converted into an ITU-T V.110 64 bits frame at 64 kbit/s (Figure 14):

D1	D2	D3	D4	D5	D6	D7	1
D8	D9	D10	D11	D12	D13	D14	1
D15	D16	D17	D18	D19	D20	D21	1
D22	D23	D24	D25	D26	D27	D28	1
D29	D30	D31	D32	D33	D34	D35	1
D36	D37	D38	D39	D40	D41	D42	1
D43	D44	D45	D46	D47	D48	D49	1
D50	D51	D52	D53	D54	D55	D56	1

~~8.2.7 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 4 x 14,5 kbit/s~~

~~For AIUR 56 kbit/s the 56 data bits in the 64-bit V.110 frames are extracted and sent through the substreams in 36-bit frames as described in subclause 8.1. An M1/M2-bit pair is sent over the air-interface along each data block every 20 ms. This pair of bits carries the multiframe and substream numbering information as described in subclause 8.1.1.1.~~

~~The 290-bit blocks in the highest numbered substream carry 256 user data bits (7×36+4).~~

~~The M2-bit sequences are used, for the applicable parts, as described in subclauses 8.1.1.1 and 8.2.1.~~

~~No V.24 status or NIC-values are transported in association with AIUR 56.0; the N-bits are set to 'no compensation'.~~

8.2.~~8~~5 AIUR of 64 kbit/s; Radio interface rate of 6 x 12 kbit/s

One modified ITU-T V.110 60 bit frame (Figure 10) is received/sent from/to the network every 5 ms (see 3GPP TS 45.003) resulting in a~~n~~ radio-interface rate of 12 kbit/s per channel.

A modified ITU-T V.110 60 bits radio-interface frame (Figure 10):

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	D41	D42	D43	D44	D45
D46	D47	D48	D49	D50	D51	D52
D53	D54	D55	D56			

NOTE: For information on the T-bits, please refer to subclause 11.2 of the present document.

is converted as follows: The data bits are extracted from the 60-bit frames received from the network; six frames, one of which carries padding as explained in subclause 11.~~6~~5, carry 320 bits of user data per 5 ms resulting in a 64 kbit/s user rate which is sent forward as such.

~~8.2.9 AIUR of 64 kbit/s; Radio interface rate of 5 x 14,5 kbit/s~~

~~For AIUR 64 kbit/s the 64 data bits in the 64-bit V.110 frames are extracted and sent through the substreams in 36-bit frames as described in subclause 8.1. An M1/M2-bit pair is sent over the air-interface along each data block every 20 ms. This pair of bits carries the multiframe and substream numbering information as described in subclause 8.1.1.1.~~

~~The 290-bit blocks in the highest numbered substream carry 128 user data bits (3×36+20).~~

~~The M2-bit sequences are used, for the applicable parts, as described in subclauses 8.1.1.1 and 8.2.1.~~

~~No V.24 status or NIC-values are transported in association with AIUR 64.0; the N-bits are set to 'no compensation'.~~

9 The EDGE multiplexing function

In EDGE configurations the number of channels across the radio interface and that of substreams do not necessarily match. In such cases a multiplexing function described below shall be used at MS and BTS (3GPP TS 48.020). These functions distribute data between the substreams and radio channels.

At the MS the multiplexing function multiplexes 14.5 kbit/s substreams — produced either by the combination of Split/Combine and RA1/RA1' or RA1' functions in the transparent case, or by the combination of Split/Combine and RLP functions in the non-transparent case — into the TCH/F28.8 or TCH/F43.2 EDGE radio interface channels.

In the case of transparent 56 kbit/s or 64 kbit/s operation, the multiplexing function maps the data stream into two EDGE TCH/F32.0 radio interface channels.

9.1 Data block distribution into the substreams by the Multiplexing function; TCH/F28.8 channel coding

The multiplexing function maps/extracts two 14.5 kbit/s substreams into/from a 29.0 kbit/s radio interface channel.

A radio interface data block for a TCH/F28.8 channel contains the bit sequence: M1, M2, 288 user data bits, M1, M2, and 288 user data bits, in other words, the block is a combination of two TCH/F14.4 radio interface data blocks. The two TCH/F14.4 blocks belong to two separate substreams. One 580-bit block is transmitted/received every 20 ms.

a) Transparent services

In uplink, the multiplexing function maps one 290-bit block from each substream into every 580-bit TCH/F28.8 radio interface data block. Blocks from one stream always occupy the same half of the 580-bit radio interface data blocks.

In downlink, the multiplexing function demultiplexes the two substreams by extracting the two 290-bit blocks from the received 580-bit radio interface blocks; the 290-bit blocks belonging to one substream are carried in the same half of the 580-bit radio interface blocks.

b) Non-transparent services

The multiplexing function works in the same way as in the transparent case, i.e. the multiplexing is based on the use of 290-bit blocks, which — in this case — contain halves of 576-bit RLP frames.

9.1.1 AIUR of 57.6 kbit/s; Radio interface rate of 2 × 29.0 kbit/s

Non-transparent 57.6 kbit/s radio interface user rate can be achieved by using a combination of two TCH/F28.8 channels across the radio interface. Two parallel multiplexing functions are applied; the operation of both of these is as described in section 9.1 above.

9.2 Data block distribution to the radio interface by the Multiplexing function; TCH/F32.0 channel coding

The multiplexing function divides the datastream into blocks of ten 64-bit V.110 frames (Figure 14) in case of the 56 kbit/s user rate or into blocks of 640 data bits in case of the 64 kbit/s user rate. These blocks are distributed cyclically into timeslots a (0≤a≤6) and a+n (1≤a+n≤7) in each TDMA-frame; in the data stream, data mapped into timeslot a precedes that mapped into slot a+n. The receiving Multiplexing function recombines overall data stream from radio-interface channels so that the data carried by timeslot a (0≤a≤6) precedes the data carried by timeslot a+n (1≤a+n≤7) of the same TDMA-frame.

9.2.1 AIUR of 56 kbit/s; Radio interface rate of 2 × 32.0 kbit/s

Two blocks of 10 64-bit V.110 frames (Figure 14) are sent/received every 20 ms over the radio interface.

No V.24 status or NIC-information is transferred in association with AIUR 56 kbit/s.

No substream numbering is needed as just one substream is used across a two–timeslot radio interface channel.

9.2.2 AIUR of 64 kbit/s; Radio interface rate of 2 × 32.0 kbit/s

Two blocks of 640 data bits are sent/received through the radio interface every 20 ms.

No V.24 status or NIC-information is transferred in association with AIUR 64 kbit/s.

No substream numbering is needed as just one substream is used across a two–timeslot radio interface channel.

9.3 Data block distribution into the substreams by the Multiplexing function; TCH/F43.2 channel coding

The multiplexing function maps/extracts three 14.5 kbit/s substreams into/from a 43.5 kbit/s radio interface channel.

A radio interface data block for a TCH/F43.2 channel is a combination of three TCH/F14.4 radio interface data blocks. The three TCH/F14.4 blocks belong to separate substreams. One 870-bit block is transmitted/received every 20 ms.

The TCH/F43.2 channel is used only in non-transparent operation. Therefore, the 290-bit blocks handled by the multiplexing function carry halves of 576-bit RLP frames.

In uplink, the multiplexing function maps one 290-bit block from each substream into every 870-bit TCH/F43.2 radio interface data block. Blocks from one stream always occupy the same third of the 870-bit radio interface data blocks.

In downlink, the multiplexing function demultiplexes the three substreams by extracting the 290-bit blocks from the received 870-bit radio interface blocks; the 290-bit blocks belonging to one substream are carried in the same third of the 870-bit radio interface blocks.

10 The RA1' Function

The RA1' function described below shall be used to adapt between the synchronous user data rates, or the output of the RA0 function and the radio interface data rates of 3.6, 6, 12, or 14,5 kbit/s. In cases where EDGE channel coding TCH/F28.8 is used, the RA1' function adapts the data stream to 14.5 kbit/s substreams as if multiple 14.5 kbit/s radio interface channels were used.

10.1 ~~Synchronous user rates up to 9,6 kbit/s~~Void

~~**Synchronous user rate**~~	~~**Rate at the radio interface**~~
~~≤ 2,4 kbit/s~~	~~3.6 kbit/s~~
~~4,8 kbit/s~~	~~6 kbit/s~~
~~9,6 kbit/s~~	~~12 kbit/s or 2x6 kbit/s~~

~~The modified ITU-T V.110 36 or 60 bit frame structures for each user rate are shown in figures 5 - 9. The meaning of the bits is described in clause 5.~~

10.2 Synchronous user rates from 9,6 kbit/s onward; TCH/F9.6 and TCH/F4.8 channel codings

Synchronous user rate	Total rate at the radio interface	DTE/DCE statuses	Air-interface bit frame structure60 Bit frame structure	Single slot rate at the radio interface
≤ 2,4 kbit/s	3.6 kbit/s	X	36 bit (Figs. 7-9)	3.6 kbit/s
4,8 kbit/s	6 kbit/s	X	60 bit (Fig. 6)	6 kbit/s
9,6 kbit/s	12 kbit/s	X	60 bit (Fig. 5)	12 kbit/s or 6 kbit/s
14,4 kbit/s	24 kbit/s or 18 kbit/s	X	60 bit9,6 kbit/s or 4,8 kbit/s (Figs. 5 and 15) Note	12 kbit/s or 6 kbit/s (note)
19,2 kbit/s	24 kbit/s	X	60 bit 9,6 kbit/s or 4,8 kbit/s (Fig. 5)	12 kbit/s or 6 kbit/s
28,8 kbit/s	36 kbit/s	X	60 bit 9,6 kbit/s (Fig. 5)	12 kbit/s
38,4 kbit/s	48 kbit/s	X	60 bit 9,6 kbit/s (Fig. 5)	12 kbit/s
48 kbit/s	60 kbit/s	X	60 bit 9,6 kbit/s (Fig. 5)	12 kbit/s
56 kbit/s	60 kbit/s		60 bit 11,2 kbit/s (Fig.10)	12 kbit/s
64 kbit/s	72 kbit/s		60 bit 11,2 kbit/s (Figs. 10 and 16) Note	12 kbit/s (note)
NOTE: Padding is used in frames making up the data substream of the highest substream number.				

Modified ITU-T V.110 60 bit frames structures are those shown in figures 5, (6,) and 10. The structure to apply is that for the partial user rate. The meaning of the bits is described in clauses 10.15 and 7. For description of the padding procedure, please refer to clause 11 of the present document.The modified ITU-T V.110 36 or 60 bit frame structures for each user rate are shown in figures 5 – 10, 15 and 16. The structure to apply is that for the partial user rate. 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 3GPP TS 27.001.

The E bits are used to convey the following information:

i) User Data Rate - E1, E2, E3 (for single slot operation see Figure 4, and for multislot operation Figure 4 and subclause 11.6)

ii) Network Independent Clocking - E4, E5, E6 (see subclause 10.2.1)

iii) Multiframe Synchronisation - E7 (see subclause 10.2.1).

For description of the padding procedure, please refer to clause 11 of the present document.

10.2.1 Network Independent Clocking

Synchronous data signals received by the MT from the DTE at the MS 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 V.110 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 MS employs its own network independent clock. In any case, the frequency tolerance of the clocks involved is 100 ppm.

10.2.1.1 Multiframe Structure

The transmitting end of the A/Gb mode 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 V.110 (and X.30) except that such a multiframe structure exists for all user data rates. This frame synchronization is achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the A/Gb mode 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 frames as illustrated in figure 1. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe shown in figure 1.

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 1: 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 section 3.1.2 in V.110 frames MF 1a and MF 1b.

10.2.1.2 Encoding and compensation

The V.110 transmitter uses the following 5-bit code words, as shown in figure 2, 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 2: NIC Code Words

When negative compensation is indicated, one less user data bit than normal is transported in the affected frame (MF1a or MF1b). 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. In case of frames with 36 data bits, bit D19 is discarded instead.

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 causes 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 MF1a or MF1b). In case of frames with 36 data bits, the insertion is done to between bits D18 and D19.

When no compensation is necessary, or when NIC is applied, the values of E4, E5, E6, E7, on the 4 multi frame scheme is:

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

When NIC is not applicable, the MS and the IWF shall disregard the received value of bits E4, E5, E6 and E7 in the data transmission phase.

NOTE: NIC is not applicable in the following cases:

- transparent asynchronous bearer services;
- the facsimile teleservices in the transparent mode;
- every transparent bearer services when interworking with an UDI Information Transfer Capability.

10.2.2 Synchronisation

Two interfaces are involved in the TAF regarding the need for data frame synchronisation, i.e. the TAF/air-interface and TAF/TE interface. For detailed definition of the synchronisation procedures refer to 3GPP TS 27.001.

10.2.3 Idle frames

Whenever no data is received from the radio interface (e.g. frame stealing applies, layer 2 fill frames are received, etc.) idle frames shall be sent to the DTE. These are V.110 frames with frame alignment pattern according to ITU-T recommendation. V.110 [11] and all data, status and E-bits set to binary "1".

10.3 ~~Synchronous user rates from 9,6 kbit/s onward;~~ TCH/F14.4 channel coding

Synchronous user rate	Total rate at the radio interface	DTE/DCE statuses	Air-interface bit frame structure	Single slot rate at the radio interface
14,4 kbit/s	14,5 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s
28,8 kbit/s	29.0 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s
38,4 kbit/s	43.5 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s (note)
48 kbit/s	58.0 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s (note)
56 kbit/s	58.0 kbit/s		36 bits, 290-bit block	14,5 kbit/s (note)
64 kbit/s	72.5 kbit/s		36 bits, 290-bit block	14,5 kbit/s (note)
NOTE: Padding used as specified for TCH/F14.4 channel coding in clause 11.				

The format used for transferring a synchronous data stream over the radio-interface is a multiframe consisting of 31 data blocks. The RA1' function transfers the synchronous data stream into data blocks containing eight 36-bit frames as described in subclause 10.3.2. Each data block contains bits M1 and M2 followed by 288 user data bits sent/received over the radio-interface every 20 ms. The M1-bit carries a 31-bit PN-sequence used for aligning the multiframe(s), whereas the M2-bit carries substream numbering, V.24 status information, and NIC-codes as described in subclauses ~~8.1.1.1 and 8.2.1~~10.3.1. The status information carried by the M2-sequence(s) is interpreted as specified in 3GPP TS 27.001. When three consecutive M2-bits carry a substream number, this is interpreted as specified in clause 11. Five consecutive M2-bits carrying NIC-information are interpreted according to subclause ~~8.1.1.1~~10.3.1. ~~For the exact NIC-procedures refer to subclause 11.5.1.~~

In multislot operation the transmission is performed using parallel substreams between the Split/Combine-functions.

10.3.1 Multiframe structure over the radio-interface

Bit M1 carries a 31-bit PN multiframe code 0000 1001 0110 0111 1100 0110 1110 101. One multiframe bit is transmitted every 20 ms per substream, which means that one whole multiframe consists of 248 36-bit frames.

Bit M2 carries V.24 circuit status information, network independent clocking (NIC) information and substream numbering as indicated in the following figure:

bit number	0 1 2 3	4 5 6 7	8 - 11	12- 15	16 - 19	20 - 23	24 - 27	28 - 30
M1:	0 0 0 0	1 0 0 1	0 1 1 0	0 1 1 1	1 1 0 0	0 1 1 0	1 1 1 0	1 0 1
M2:	# # # SB	SB X # #	# X SB SB	# # # SB	SB X # #	# X SB SB	NNNN	N SB SB

where # # # = Substream number (multilink operation)

SB = the SB status bit

X = the X-status bit

NNNNN = Network independent clocking code

The information carried by the M2-sequences is read per substream; i.e. the substream number and a complete NIC-code are transferred through one substream.

A NIC-code is carried on as many substreams as is necessary to cover all NIC-compensations that have taken place. On channels where no NIC-compensation is carried, the N-bits are set to 'no compensation'. For the exact NIC-procedures, refer to subclause 10.3.3.

In the MS to Network direction the information carried by the M2-bit sequence is mapped in the following manner:

An M1/M2-bit pair is transmitted along each block of data containing eight modified V.110 36-bit frames. The three-bit #-sequence carries a number identifying each substream (multislot operation); the substreams are numbered 0,1,2 etc. The status- and NIC-information is mapped between the M2-sequence(s) and the V.110-frames. Bits SB and X are mapped to V.24 circuits as specified in 3GPP TS 27.001.

The SB-bit carries the V.110 SB-status information, and the X-bit the X-status information.

Five consecutive N-bits carrying an NIC-code in the M2-sequence indicate 'negative compensation' or 'positive compensation' if such a compensation is required. Otherwise' no compensation' is indicated by the N-bits.

	N-bit 24 in M2-sequence	N-bit 25 in M2-sequence	N-bit 26 in M2-sequence	N-bit 27 in M2-sequence	N-bit 28 in M2-sequence
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 a one	0	0	1	0	0

The Network to MS direction:

The status-information is filtered as described in 3GPP TS 27.001. To change the SB- or X-status mode, it is required that at least two consecutive SB- or X-bits, respectively, carry the same value.

For NIC-procedure, refer to subclause 10.3.3.

10.3.2 Radio-interface data block for TCH/F14.4 channel coding

A radio-interface data block for a TCH/F14.4 channel consists of eight 36-bit data frames and bits M1 and M2 as shown in the following figure:

																	M1	M2
1	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
2	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
3	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
4	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
5	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
6	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
7	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
8	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36

The number on the left indicates the order of the data frames in the 290-bit block; the 36-bit frame in position one was received before that in position two etc. One such block is transmitted over the radio interface every 20 ms.

10.3.3 Network independent clocking

The data frames carrying an NIC-multiframe (subclause 10.2.1) indicating a positive or negative compensation are distributed into the substreams according to subclause 11.1.

In the following, 'a data bit position' means a non-padded bit position in the 290-bit radio interface blocks.

The NIC-codes are read per substream, i.e. the sequence of five N-bits in a substream carries one complete NIC-code.

In a 29 kbit/s radio interface channel the two halves of the 580-bit radio interface block correspond to substreams.

If NIC-compensation(s) take(s) place in the overall user data flow :

10.3.3.1. Negative compensation

a) From overall data stream to substreams

When only one substream is used and the data is mapped to the radio interface blocks, the 'extra null bit', which is set to '1', (subclause 10.2.1) is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure. The five N-bits encode 'negative compensation' as described in clause 10.2.1.

If more than one substream is used, and more than one negative compensation should be performed the 'extra null bit' is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure in as many substreams as necessary to perform all compensations. In those substreams where no compensation is needed the N-bits are set to 'no compensation'.

b) From substreams to overall data stream

When a radio interface block carrying the fifth bit of an NIC-code indicating negative compensation is received, the receiver discards the first data bit of the block.

10.3.3.2 Positive compensation

a) From overall data stream to substreams

An NIC-code indicating positive compensation means that the data bit from the overall data stream preceeding the bit mapped into the first position of the data block conveying the second N-bit is carried encoded by the five N-bits.

If more than one substream is used, and if more than one compensation has taken place in the overall data stream, more than one substream carries a NIC-code indicating 'positive compensation'. In those substreams where no NIC-compensation is needed the N-bits indicate 'no compensation'.

b) From substreams to overall data stream

When an NIC-code indicating positive compensation is received, an extra '0' or '1' — depending on whether a compensation of a '0' or '1' is indicated — is mapped to before the first data bit position of the block with which the second bit of the NIC-code is associated.

11 The Split/Combine and Padding-functions

The split/combine and padding functions shall be used with multislot connections as described below. The Split/Combine function splits/recombines the overall data stream to/from the substreams. The Padding function inserts filling into one of the substreams in cases where the total capacity of the substreams is larger than necessary to achieve the required AIUR.

11.1 Data frame distribution into the substreams/channels by the Split/Combine function

11.1.1 Data frame distribution into the substreams/channels by the Split/Combine function (TCH/F9.6 and TCH/F4.8 channel codings)

a) In the transparent case the Split/Combine-function distributes the V.110-frames into the substreams and recombines the overall data stream from the substreams according to the following rules:

In the overall data stream

1) the frame in position p in substream q precedes the frame in position p in substream q+1,0≤ q < n-1

2) the frame in position p in substream n-1 precedes the frame in position p+1 in substream 0;

where in the rules above n is the number of substreams.

b) In the non-transparent case the Split/Combine-function distributes the RLP-frames — or the four V.110-frames making up an RLP-frame (Reference: 3GPP TS 48.020, ~~Clause 10~~Subclause 15.1) — into channels so that one whole RLP-frame is carried through one channel. Furthermore the RLP-frames are distributed into the available channels so that the resulting delay in the overall data stream is kept as small as possible. The receiving Split/Combine-function recombines the overall data stream according to the inherent RLP-frame numbering, i.e. the N(S)-numbers in the RLP-frame header (3GPP TS ~~04.22~~24.022).

11.1.2 Data block distribution into the substreams by the Split/Combine function (TCH/F14.4 channel coding)

a) Transparent services

The Split/Combine-function distributes the user data carried in the 290-bit blocks (Refer to subclause ~~8.1.1.2~~10.3.2) into the substreams and recombines the overall data stream from the substreams according to the following rules:

In the overall data stream:

1) the data block in position m of multiframe in substream q precedes the data block in position m of multiframe in substream q+1, 0≤ q < n-1, 0≤m≤30.

2) the data block in position m of multiframe in substream n-1 precedes the data block in position m+1 of multiframe in substream 0;

where in the rules above n is the number of substreams.

Figure 2a: Distribution of data frames or data blocks into the substreams in transparent operation

b) Non-transparent services

In the non-transparent operation the Split/Combine-function distributes the RLP-frames into substreams so that one whole RLP-frame is carried through one substream. This means that the two 290-bit air-interface blocks carrying one RLP-frame are transmitted through the same substream. Furthermore the RLP-frames are distributed into the available substreams so that the resulting delay in the overall data stream is kept as small as possible. The receiving Split/Combine-function recombines the overall data stream according to the inherent RLP-frame numbering, i.e. the N(S)-numbers in the RLP-frame header (3GPP TS ~~04.22~~24.022).

11.2 Substream numbering in transparent operation

11.2.1 Substream numbering for TCH/F4.8 and TCH/F9.6 channel codings

In transparent multislot data configurations of more than one TCH/F the parallel data substreams between the Split/Combine-functions carry inband substream numbering. The status bits S1, S3, and the X-bit between data bits D12 and D13 (Figures 5 and 6) are used for transferring this substream numbering information (S1 is the MSB and S3 the LSB). The substreams are numbered 0, 1, 2, 3 etc. regardless of the physical channels through which the substreams are transmitted. The highest substream number is one less than the number of physical channels in use at a given time; i.e. the numbering cycle changes when physical channels are either added to or removed from a connection.

The S4-bit is used for frame synchronisation between the parallel substreams. This bit follows a 31-bit PN-sequence of 0000 1001 0110 0111 1100 0110 1110 101. This thirty one bit sequence is used for substream resynchronisation in cases where delay has occurred on one or more substream(s); the position of a frame in a substream can be determined modulo 31 by the values of the S4-bit in a sequence of 5 consecutive frames including the frame in question. Provided that the relative delay between substreams is less than 75 ms (i.e. less than a 15-frame displacement), this and the frame distribution rules given in subclause 11.1 are sufficient to determine the correct order of the frames.

Bits S6, S8, S9, and the other X-bit are used for conveying channel control information according to the relevant terminal adapter function specification.

These rules apply to all multislot data AIURs up to and including 48 kbit/s. When the received 48 kbit/s AIUR is converted into 64 kbit/s rate, the bits extracted from the 60-bit radio interface frames (Figure 5) are mapped into the 32-bit frame format of Figure 13. Here the values for the status bits S1, X, S3, and S4 in the 32-bit frame shall be derived from status bits S6, X, S8, and S9 in the radio-interface frame because status bits S1, X, S3, and S4 in the upper right hand corner of the 60-bit frame have been used for data substream numbering as described above.

In the 11,2 kbit/s frames used for AIURs 56 and 64 kbit/s (Figure 10) the T1, T2, T3 (T1 the MSB and T3 the LSB) are used for carrying the substream numbering as status bits S1, X, and S3 do according to the definition given in the first paragraph of subclause 10.1. Bit T4 is used for carrying the substream synchronisation sequence just as status bit S4 does in the description given in the second paragraph of this subclause~~ 10.2~~.

11.2.2 Substream numbering for TCH/F14.4 and TCH/F28.8 channel codings

Bit M1 carries the multiframe sequence 0000 1001 0110 0111 1100 0110 1110 101. The number of the substream in which a multiframe is sent is carried four times in a 31-bit period of the M2-sequence. In the three-bit number code the bit in the lowest bit position is the MSB (See table in subclause ~~8.1.1.1~~10.3.1).

11.3 Substream Synchronisation

Two interfaces are involved in the TAF regarding the need for the data frame synchronisation, i.e the TAF/multichannel interface and the TAF/TE interface.

The Split/Combine function is responsible for controlling the synchronisation and resynchronisation procedures as described in 3GPP TS 27.001.

~~11.4 Network independent clocking~~Void

~~The data frames carrying an NIC-multiframe (subclause 5.1.1~~10.4~~) indicating a positive or negative compensation are distributed into the substreams according to subclause 11.1.~~

~~11.4.1 Network Independent Clocking for TCH/F14.4 and TCH/F28.8 channel codings (both single- and multilinks)~~

~~In the following, 'a data bit position' means a non-padded bit position in the 290-bit radio interface blocks.~~

~~The NIC-codes are read per substream, i.e. the sequence of five N-bits in a substream carries one complete NIC-code.~~

~~In a 29 kbit/s radio interface channel the two halves of the 580-bit radio interface block correspond to substreams.~~

~~If NIC-compensation(s) take(s) place in the overall user data flow :~~

~~11.4.1.1 Negative compensation~~

~~a) From overall data stream to substreams~~

~~- When only one substream is used and the data is mapped to the radio interface blocks, the 'extra null bit', which is set to '1', (subclause 5.1.1~~10.4~~) is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure. The five N-bits encode 'negative compensation' as described in clause 5~~10.4~~.~~

~~- If more than one substream is used, and more than one negative compensation should be performed the 'extra null bit' is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure in as many substreams as necessary to perform all compensations. In those substreams where no compensation is needed the N-bits are set to 'no compensation'.~~

~~b) From substreams to overall data stream~~

~~- When a radio interface block carrying the fifth bit of an NIC-code indicating negative compensation is received, the receiver discards the first data bit of the block.~~

~~11.4.1.2 Positive compensation~~

~~a) From overall data stream to substreams~~

~~- An NIC-code indicating positive compensation means that the data bit from the overall data stream preceeding the bit mapped into the first position of the data block conveying the second N-bit is carried encoded by the five N-bits.~~

- If more than one substream is used, and if more than one compensation has taken place in the overall data stream, more than one substream carries a NIC-code indicating 'positive compensation'. In those substreams where no NIC-compensation is needed the N-bits indicate 'no compensation'.

b) From substreams to overall data stream

- When an NIC-code indicating positive compensation is received, an extra '0' or '1' — depending on whether a compensation of a '0' or '1' is indicated — is mapped to before the first data bit position of the block with which the second bit of the NIC-code is associated.

11.5 Padding TCH/F frames when the AIUR is not a multiple of 9,6 or 4,8 kbit/sFunctions

11.5.1 Padding for TCH/F9.6 and TCH/F4.8

When the required AIUR is not a multiple of the rates supported by TCH/F4.8 or TCH/F9.6, padding is used for producing the required AIUR.

To achieve the required AIUR the data bits are distributed across the substreams 1 to n as follows:

- Substream(s) 1 (to n-1) carry multiples of the rate supported by the channel coding used.
- Substream n carries the remaining amount of data bits required to achieve the required AIUR. The remainder of data stream n carries padding bits set to binary value '1'.

11.5.1.1 Padding for AIUR 14,4 kbit/s:

The frame of the lower substream number carries full 9,6 kbit/s. The frame of the higher substream number carries 4,8 kbit/s of user data in bit positions D1-D24 while bit positions D25-D48 are inserted with binary "1"s. (Figure 15)

11.5.1.2 Padding for AIUR 64 kbit/s:

The frames numbered 1-5 carry full 11,2 kbit/s. Frame number 6 carries 8.0 kbit/s of user data in bit positions D1-D40 while bit positions D41-D56 are inserted with binary "1"s. (Figure 16)

11.5.12 Padding for TCH/F14.4 channel coding

Padding for TCH/F14.4 channel coding is presented in the corresponding parts of clause 8.

11.5.2.1 Padding for AIURs up to 38,4 kbit/s

Padding is not necessary for AIURs 14,4 and 28,8 kbit/s.

For AIUR 38.4 kbit/s the 290-bit blocks in the substreams of the lower substream numbers carry 288 user data bits while the 290-bit blocks in the substream of the highest substream number carries 192 user data bits; this means that five of the eight 36-bit frames making up the block carry 36 user data bits whereas the sixth frame carries 12 user data bits ($5\times36+12$). Frames seven, eight, and the rest of the sixth frame are padded with '1's.

11.5.2.2 Padding for AIURs of 48 kbit/s

The 290-bit blocks in the highest numbered substream carry 96 user data bits ($2\times36+24$).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 10.3.1.1.

11.5.2.3 Padding for AIURs of 56 kbit/s

The 290-bit blocks in the highest numbered substream carry 256 user data bits ($7\times36+4$).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 10.3.1.1.

11.5.2.4 Padding for AIURs of 64 kbit/s

The 290-bit blocks in the highest numbered substream carry 128 user data bits (3×36+20).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 10.3.1.1.

11.6 Handling of the E1-E3 bits in multislot operation

Between the Split / Combine functions the substreams carry the code associated with the substream rate as defined in Figure 4. When the substreams are combined the code is set to correspond to the overall AIUR according to Figure 4.

12 Support of Non-Transparent Bearer Services

In the case of non-transparent services, the RA1' function shall provide access to the 12 and 6 kbit/s radio interface data rates as described below. (Alignment of RLP frames with the four TDMA slots makes it physically impossible to provide 3,6 kbit/s.) The RA1' function is not applied in case of TCH/F14.4, TCH/F28.8 and TCH/F43.2 channel codings.

Air interface user rate	Radio interface rate
4,8 kbit/s	6 kbit/s
9,6 kbit/s	12 kbit/s or 2×6 kbit/s
14,4 kbit/s	14,5 kbit/s or 2×12 kbit/s or 3×6 kbit/s
19,2 kbit/s	2×12 kbit/s or 4×6 kbit/s
28,8 kbit/s	29 kbit/s or 2×14,5 kbit/s or 3×12 kbit/s
38,4 kbit/s	3×14,5 kbit/s or 4×12 kbit/s
43.2 kbit/s	43.5 kbit/s or 3×14,5 kbit/s
57.6 kbit/s	2×29 kbit/s or 4×14,5 kbit/s

12.1 Support of non-transparent operation for TCH/F9.6 and TCH/F4.8 channel codings

This access results in the use of a modified ITU-T V.110 60 bit frame for non-transparent services (figure 11). In this case, the RA1' function also provides for alignment of four modified ITU-T V.110 60 bit frames sent on the same radio slot corresponding with each complete 240 bit frame to be encoded by the radio subsystem as a single unit (see 3GPP TS 45.003). 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 11).

NOTE: The status bits SA, SB, and the X bit are embedded in the L2R-PDU frames (see 3GPP TS 27.001, and 27.002).

The first bit of each RLP frame to be transmitted corresponds to the first bit (D1) of the first 60 bit frame in a four frame sequence and the last bit corresponds 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 11).

The radio subsystem provides for the synchronous transmission and reception of 240 bit RLP frames through a connection consisting of up to four TCH/Fs. An RLP-frame is received/sent from/to a particular radio channel every 20 ms (12 kbit/s radio interface rate) or every 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 3GPP TS 27.001) 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 are transmitted. This is be discarded by the distant RLP function, due to FCS failure, but allows physical link synchronization to be maintained between the MS and the MSC.

In the case of an asymmetric connection the BTS shall send V110 idle frames towards the MSC on the channels which are unused in the direction from the MS towards the MSC. This ensures that the IWF does not interprete V110 frames which are not originated from the MS as complete RLP frames.

12.2 Support of non-transparent operation for TCH/F14.4 channel coding

In 14,4 kbit/s channel 576-bit RLP-frames shall be used as described below.

The RA1' function is not applied in this case. Instead the RLP-, or in multislot operation the Split/Combine- function, handles the 290-bit data blocks received/sent from/to the network. The M1- bit is used for indicating the RLP-frame halves: in the first half M1= 0 and in the second half M1=1. Bit M2 is used for DTX-indication between the BSS and MSC as described in 3GPP TS 48.020

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

In the case of an asymmetric connection the BTS shall send idle frames towards the IWF on the channels which are unused in the direction from the MS towards the MSC, as specified in 3GPP TS 08.60. This ensures that the IWF does not interpret sequences of frames which are not originated from the MS as complete RLP frames.

12.3 Support of non-transparent operation for TCH/F28.8 channel coding

In a 28.8 kbit/s channel, 576-bit RLP-frames shall be used as described below. The 576-bit RLP-frames shall be mapped into the 580-bit radio interface blocks as described in section 9.1.

The RA1' function is not applied in this case. Instead, RLP handles the 580-bit data blocks received/sent from/to the Split/Combine function. The M1- bits are used for indicating RLP-frame halves. The M2-bits are used for DTX-indication between the BSS and MSC as described in 3GPP TS 48.020.

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

12.4 Support of non-transparent operation for TCH/F43.2 channel coding

In a 43.2 kbit/s channel 576-bit RLP-frames shall be used as described below. The 576-bit RLP-frames shall be mapped into 870-bit radio interface blocks as described in section 9.3.

The RA1' function is not applied in this case. Instead, RLP handles the 580-bit data blocks received/sent from/to the Split/Combine function. The M1- bits are used for indicating RLP-frame halves. The M2-bits are used for DTX-indication between the BSS and MSC as described in 3GPP TS 48.020.

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

13 Figures on Frame structures

Octet No.	Bit number							
	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 3: The ITU-T V.110 80 bit RA1 frame structure

Intermediate Data Rate							
8 kbit/s	16 kbit/s	32 kb/s	64 kb/s	E1	E2	E3	
600				1	0	0	Note
1200				0	1	0	
2400				1	1	0	
4800	9600	19200	38400	0	1	1	
		14400	28800	1	0	1	

NOTE: The 300 bit/s user data rate is carried on the 600 bit/s synchronous stream by adding stop elements, see subclause 4.1.

Figure 4: Coding of data rates

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 5: Modified ITU-T 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 6: Modified ITU-T V.110 60 bit frame for 4,8. kbit/s transparent data

a)

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

b)

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	1	1	0	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

Figure 7: a) Modified ITU-T V.110 36 bit frame for 2,4 kbit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

a)

D1	D1	D2	S1	D2	D3	D3	X
D4	D4	D5	S3	D5	D6	D6	S4
E4	E5	E6	E7	D7	D7	D8	S6
D8	D9	D9	X	D10	D10	D11	S8
D11	D12	D12	S9				

b)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D2	D2	S1
1	D2	D2	D3	D3	D3	D3	X
1	D4	D4	D4	D4	D5	D5	S3
1	D5	D5	D6	D6	D6	D6	S4
1	0	1	0	E4	E5	E6	E7
1	D7	D7	D7	D7	D8	D8	S6
1	D8	D8	D9	D9	D9	D9	X
1	D10	D10	D10	D10	D11	D11	S8
1	D11	D11	D12	D12	D12	D12	S9

Figure 8: a) Modified ITU-T V.110 36 bit frame for 1,2 kbit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

a)

D1	D1	D1	S1	D1	D2	D2	X
D2	D2	D3	S3	D3	D3	D3	S4
E4	E5	E6	E7	D4	D4	D4	S6
D4	D5	D5	X	D5	D5	D6	S8
D6	D6	D6	S9				

NOTE: The 300 bit/s user data rate is carried on the 600 bit/s synchronous stream by adding stop elements, see subclause 4.1.

b)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D1	D1	S1
1	D1	D1	D2	D2	D2	D2	X
1	D2	D2	D2	D2	D3	D3	S3
1	D3	D3	D3	D3	D3	D3	S4
1	1	0	0	E4	E5	E6	E7 (note)
1	D4	D4	D4	D4	D4	D4	S6
1	D4	D4	D5	D5	D5	D5	X
1	D5	D5	D5	D5	D6	D6	S8
1	D6	D6	D6	D6	D6	D6	S9

NOTE: In order to maintain compatibility with Recommendation X.30 (I.461), for the 600 bit/s user rate bit E7 is coded to enable the 4×80 bit multiframe synchronisation. To this end, E7 in the fourth 80 bit frame is set to binary '0'. See Table 6 of ITU-T Recommendation V.110(09/92).

Figure 9: a) Modified ITU-T V.110 36 bit frame for 600 bit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	D41	D42	D43	D44	D45
D46	D47	D48	D49	D50	D51	D52
D53	D54	D55	D56			

Figure 10: Modified ITU-T V.110 60 bit frame for 11,2 kbit/s partial rate

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 11: Modified ITU-T V.110 60 bit frame for non-transparent data

0	0	0	0	0	0	0	0
1	D1	D2	D3	D4	D5	D6	S1
1	D7	D8	D9	D10	F	F	X
1	D11	D12	F	F	D13	D14	S3
1	F	F	D15	D16	D17	D18	S4
1	1	0	1	E4	E5	E6	E7
1	D19	D20	D21	D22	D23	D24	S6
1	D25	D26	D27	D28	F	F	X
1	D29	D30	F	F	D31	D32	S8
1	F	F	D33	D34	D35	D36	S9

F =Fill bits, which are set to 1.

Figure 12: The ITU-T V.110 80 bit frame for 3.6 kbit/s transparent data (8 kbit/s intermediate rate)

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

Figure 13: The ITU-T V.110 32 bit 48 kbit/s frame structure (64 kbit/s intermediate rate)

D1	D2	D3	D4	D5	D6	D7	1
D8	D9	D10	D11	D12	D13	D14	1
D15	D16	D17	D18	D19	D20	D21	1
D22	D23	D24	D25	D26	D27	D28	1
D29	D30	D31	D32	D33	D34	D35	1
D36	D37	D38	D39	D40	D41	D42	1
D43	D44	D45	D46	D47	D48	D49	1
D50	D51	D52	D53	D54	D55	D56	1

Figure 14: The ITU-T V.110 64 bit 56 kbit/s frame structure (64 kbit/s intermediate rate, option without status bits)

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	1	1	1
1	1	1	S6	1	1	1
1	1	1	X	1	1	1
1	1	1	S8	1	1	1
1	1	1	S9			

Figure 15: Modified ITU-T V.110 60 bit frame for a padded 9,6 kbit/s transparent data frame carrying 4,8 kbit/s with padding

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	1	1	1	1	1
1	1	1	1	1	1	1
1	1	1	1			

Figure 16: Modified ITU-T V.110 60 bit frame for a padded 11,2 kbit/s transparent data frame carrying 8.0 kbit/s with padding

D1	D2	D3	D4	D5	D6
D7	D8	D9	D10	D11	D12
D13	D14	D15	D16	D17	D18
D19	D20	D21	D22	D23	D24
D25	D26	D27	D28	D29	D30
D31	D32	D33	D34	D35	D36

Figure 17: Modified ITU-T V.110 36-bit frame received/sent from/to the network at 14,4 kbit/s

CR-Form-v7

CHANGE REQUEST

⌘	**44.021**	**CR**	**005**	⌘ **rev**	**-**	⌘	Current version:	**4.0.0**	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects:	UICC apps⌘		ME	X	Radio Access Network	X	Core Network	

Title:	⌘	Correction of Rate Adaptation RA1/RA1' for higher User Rates and removal of S Reference Point in MS		
Source:	⌘	TSG_CN WG3		
Work item code:	⌘	TEI [CS Data]	***Date:*** ⌘	30/07/2002
Category:	⌘	**F**	***Release:*** ⌘	Rel-4
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*	

Reason for change:	⌘	• Alignment with TS 43.010 and TS 48.020 concerning the rate adaptation function RA1'/RA1" for the user rates 48, 56 and 64 kbit/s. • Introduction of the rate adaptation function RA1'/RAA" for the user rate of 64 kbit/s using TCH/F14.4 channel coding. • The S Reference Point has been removed as MS internal interface from Rel-4 onwards. This is already implemented in some specifications like e.g. TS 27.001, 43.010, but not yet in TS 44.021. The removal of this S Reference Point means that the RA1/RA1' function does not reside anymore in the MS, only in the BSS. Some rate adaptations have to be modified. Further, the RA1, RA2 and RA1" functions are no more needed at the MS/BSS interface and should be moved to TS 48.020.
Summary of change:	⌘	See attached pages, clauses 2, 3, 4, 5, 6, 7, 8, 10, 11
Consequences if not approved:	⌘	Inconsisteny between TS 44.021, 43.010 and 48.020 and errorneous specification of the rate adaptation function mentioned above.

Clauses affected:	⌘					
		Y	**N**			
Other specs affected:	⌘	X		Other core specifications	⌘	TS 48.020, TS 43.010
			X	Test specifications		
			X	O&M Specifications		
Other comments:	⌘					

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

2 References, Definitions and Abbreviations

2.1 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, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP specifications".

[2] 3GPP TS 22.034: "High Speed Circuit Switched Data (HSCSD) -Stage 1".

[3] 3GPP TS 43.010: "GSMPublic Land Mobile Network (PLMN) connection types".

[4] 3GPP TS 23.034: "High Speed Circuit Switched Data (HSCSD) - Stage 2 Service Description".

[5] 3GPP TS 45.003: "Channel coding".

[6] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[7] 3GPP TS 27.002: "Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[8] ~~Void~~3GPP TS 48.060: "Inband control of remote transcoders and rate adaptors for Enha~~m~~nced Full Rate (EFR) and full rate traffic channels".

[9] 3GPP TS 48.020: "Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

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

[11] ITU-T Recommendation X.30: "Support of X.21,X.21 bis and X.20 bis based terminal equipments (DTEs) by integrated services digital network (ISDN)".

3 General approach

3GPP TS 43.010 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 - and a Split/Combine-function in case of a multislot data configuration - which are combined as shown in 3GPP TS 43.010 as part of the connection type.

The rate adaptation functions are RA0, ~~RA1, RA2,~~ RA1', ~~RA1"~~RA1'/RA1", RA1'/RAA", RA1'/RAA' and RA1/RA1'. The RA0~~, RA1 and RA2~~ ~~are~~ is ~~equivalent~~ similar to ~~those~~ the RA0 function~~s~~ described in ITU-T recommendation V.110 [11] with the exception of the conversion of the rates 14.4 and 28,8 kbit/s.

The RA1' function is similar to RA1 described in ITU-T recommendation V.110 [11] but has a reduced bit rate output compatible with the coding scheme proposed for data services on the radio interface.

~~The RA1" function is used for converting between synchronous user rates of 48 and 56 kbit/s and the rate 64 kbit/s. The equivalent function in ITU-T recommendation V.110 does not have a name.~~

The RA1/RA1', RA1'/RA1", RA1'/RAA" and RA1'/RAA' are is a relay functions, used as indicated in 3GPP TS 43.010.

In multislot data-configurations the overall data stream is split into parallel substreams between the Split/Combine-functions.

3.1 Overview of data rates and configurations

In Table 1, an overview of the supported transparent air-interface user rates is given. For each rate, also intermediate rates per channel between BTS and MSC, overall radio interface rates, and channel configurations are given. For single slot connections the intermediate rates are per channel carrying the overall data stream, whereas for multislot connections, the intermediate rates are per substream.

~~In Table 2, intermediate rates within the MS, overall radio interface rates, and channel configurations are given for the air-interface user rates. The intermediate rates are per overall data stream.~~

For single slot rates up to 4,8 kbit/s, the used intermediate rate is 8 kbit/s, and for the 9,6 kbit/s single slot rate 16 kbit/s.

For TCH/F9.6 and TCH/F4.8 channel codings, the multislot intermediate rates are 16 and 8 kbit/s per TCH/F, respectively.

For TCH/F14.4 channel coding, the multislot intermediate rate is 16 kbit/s per TCH/F.

Connections utilising TCH/F28.8 or TCH/F43.2 across the radio interface, use multislot combinations of TCH/F14.4 between BTS and MSC. Thus the corresponding multislot intermediate rate is 16 kbit/s.

No multislot intermediate rates are applicable to 56 and 64 kbit/s connections using TCH/F32.0 radio interface channels. The intermediate rate for the 32 kbit/s user rate using the TCH/F32.0 channel is 32 kbit/s.

~~Between the TE and the Split/Combine-function at the MS, where the overall data stream is not split, intermediate rates of 8, 16, 32 and 64 kbit/s are applicable.~~

Table 1: AIUR/Multislot intermediate rates

Air interface user rate	**DTE/DCE statuses**	**RA0**	**RA1'/RA1 RA1'/RAA' RA1'/RA1" RA1'/RAA" (Note 4)**		**RA1'**	
			Multislot intermediate rate	**Frame type**	**Radio interface rate**	**Padding**
≤ 600 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
1200 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
2,4 kbit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
4,8 kbit/s	X	X	8 kbit/s	80 bit frames	6 kbit/s	
9,6 kbit/s	X	X	16 kbit/s or 2×8 kbit/s	80 bit frames	12 kbit/s or 2×6 kbit/s	
14,4 kbit/s	X	X	2×16 kbit/s or 3×8 kbit/s	80 bit frames	2×12 kbit/s or 3×6 kbit/s	P (note 1)
			16 kbit/s ~~Note 7~~	Note ~~8~~5	14,5 kbit/s	
19,2 kbit/s	X	X	2×16 kbit/s or 4×8 kbit/s	80 bit frames	2×12 kbit/s or 4×6 kbit/s	
28,8 kbit/s	X	X	3×16 kbit/s	80 bit frames	3×12 kbit/s	
			2 x 16 kbit/s ~~Note 7~~	Note ~~8~~5	2×14,5 kbit/s	
					1×29 kbit/s	
32 kbit/s			1 x 32 kbit/s		1 x 32 kbit/s	
38,4 kbit/s	X	X	4×16 kbit/s	80 bit frames	4×12 kbit/s	
			3 x 16 kbit/s ~~Note7~~	Note ~~8~~5	3×14,5 kbit/s	P (note ~~6~~1)
43.2 kbit/s Note ~~10~~6	X		3 x 16 kbit/s ~~Note7~~	Note ~~8~~5	1×43.~~2~~ 5 kbit/s	
48 kbit/s	X		Note 2	Note 2	5×12 kbit/s	
			4 x 16 kbit/s ~~Note7~~	Note ~~8~~5	4×14,5 kbit/s	P (note ~~6~~1)
56 kbit/s			Note 2	Note 2	5×12 kbit/s (note 3)	
			4x16 kbit/s ~~Note7~~	Note ~~8~~5	4×14,5 kbit/s	P (note ~~6~~1)
			Note ~~9~~2	Note ~~9~~2	2×32.0 kbit/s	
64 kbit/s			Note 2	Note 2	6×12 kbit/s (note 3) 5×14,5 kbit/s	P (note 1) (note ~~6~~1)
			Note ~~9~~2	Note ~~9~~2	2×32.0 kbit/s	

P=Padding used

Table 2: AIUR / Intermediate rates

Air interface user rate	DTE/DCE statuses	RA0	RA1		RA1'	
			Intermediate rate	Frame type	Radio interface rate	Padding
≤ 600 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
1200 bit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
2,4 kbit/s	X	X	8 kbit/s	80 bit frames	3,6 kbit/s	
4,8 kbit/s	X	X	8 kbit/s	80 bit frames	6 kbit/s	
9,6 kbit/s	X	X	16 kbit/s	80 bit frames	12 kbit/s or 2×6 kbit/s	
14,4 kbit/s	X	X	32 kbit/s	80 bit frames	2×12 kbit/s	P (note 1)
					3×6 kbit/s 1x14,5 kbit/s	
19,2 kbit/s	X	X	32 kbit/s	80 bit frames	2×12 kbit/s or 4×6 kbit/s	
28,8 kbit/s	X	X	64 kbit/s	80 bit frames	3×12 kbit/s 2×14,5 kbit/s 1×29 kbit/s	
32 kbit/s			32 kbit/s		1 x 32 kbit/s	
38,4 kbit/s	X	X	64 kbit/s	80 bit frames	4×12 kbit/s	
					3×14,5 kbit/s	P (note 6)
43.2 kbit/s Note 10	X		Note 11	Note 11	1×43.2 kbit/s	
48 kbit/s	X		64 kbit/s Note 4	Note 4	5×12 kbit/s	
					4×14,5 kbit/s	P (note 6)
56 kbit/s			64 kbit/s Note 4	Note 4	5×12 kbit/s (note 3)	
					4×14,5 kbit/s	P (note 6)
					2×32.0 kbit/s	
64 kbit/s			64 kbit/s Note 5	Note 5	6×12 kbit/s (note 3)	P (note 1)
					5×14,5 kbit/s	(note 6)
					2×32.0 kbit/s	

P =Padding used

NOTE 1: For information on the padding procedure, please refer to clause ~~10~~ 11 of the present document.

NOTE 2: No multislot intermediate rate; substreams combined at the BSS with a resulting data rate of 64 kbit/s between BSS and MSC.

NOTE 3: AIUR 11,2 kbit/s per channel

~~NOTE 4: For this rate A/Gb mode-specific rate adaptation function RA1" rather than RA1is applied.~~

~~NOTE 5: For this rate RA1- and RA2- adaptations are not applied.~~

~~NOTE 6: Padding used as specified for TCH/F14.4 channel codings~~

NOTE 74: Different relay rate adaptation functions exist at At the network side:
, - RA1'/RA1 applies if the radio interface rate is n x 3,6, 86 or 12 kbit/s and the AIUR is less than 48 kbit/s,
- RA1'/RAA' applies if the radio interface rate is n x 14,5, 29 or 43,2 kbit/s and the AIUR is less than 64 kbit/s,
- RA1'/RA1" applies if the radio interface rate is n x 12 kbit/s and the AIUR is equal to 48, 56 or 64 kbit/s,
- RA1'/RAA" applies if the radio interface rate is n x 14,5 kbit/s and the AIUR is equal to 64 kbit/s,
- a relay rate adaptation function does not apply if the radio interface rate is n x 32 kbit/s

not applied; instead a TCH/F14,4 specific adaptation RA1'/RAA' used (3GPP TS 48.020)

NOTE 85: A 320-bit frame format described in 3GPP TS 08.6048.060.

NOTE 9: No multislot intermediate rate. Data rate between BSS and MSC 64 kbit/s.

NOTE 106: Used only in non-transparent configurations.

NOTE 11: In NT cases there is no direct relationship between AIUR and Intermediate rate.

4 The RA0 Function

4.1 Asynchronous-to-Synchronous Conversion (RA0)

The RA0 Function is only used with asynchronous interfaces. Incoming asynchronous data is padded by the addition of stop elements to fit the same or nearest higher synchronous rate defined by 2 to the power n (where n≤ 6) times 600 bit/s, 14,4 kbit/s or 28,8 kbit/s. Thus the 300 bit/s user data signalling rate shall be adapted to a synchronous 600 bit/s stream. The resultant synchronous stream is fed to RA1 or RA1' or Split/Combine Function. The RA0 used in PLMN is not identical to that described in ITU-T Recommendation V.110 which converts 14,4 and 28,8 kbit/s user rates to 19,2 and 38,4 kbit/s, respectively.

Asynchronous user rate	Synchronous user rate
≤ 0.6 kbit/s	0.6 kbit/s
1,2 kbit/s	1,2 kbit/s
2,4 kbit/s	2,4 kbit/s
4,8 kbit/s	4,8 kbit/s
9,6 kbit/s	9,6 kbit/s
14,4 kbit/s	14,4 kbit/s
19,2 kbit/s	19,2 kbit/s
28,8 kbit/s	28,8 kbit/s
38,4 kbit/s	38,4 kbit/s

4.2 Break signal

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

If the converter detects 2M to 2M+3 bits, all of start polarity, where M is the number of bits per character in the selected format including start and stops 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 shall transmit on circuit 103 at least 2M bits stop polarity after the start polarity break signal before sending further data character. The converter shall then regain character synchronism from the following stop to start transition.

4.3 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 %, 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 realization of overspeed handling, as described above, at the interface to the associated terminal is implementation dependent. Possible implementations are e.g. the reduction of the length of the stop elements according to V.110 [9] or increased data rates between the TA and terminal.

4.4 Parity Bits

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

4.5 Flow Control

Where applicable, this function is as specified in the relevant terminal adaptation function Specification (see 3GPP TS 07 series).

5 ~~The RA1 Function~~Void

~~This function shall be used to adapt between the synchronous user rates, or the output of the RA0 function and the intermediate rate of 8, 16, 32 or 64 kbit/s.~~

~~5.1 Adaptation of synchronous data rates up to 38,4 kbit/s~~

~~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~~
~~14,4 kbit/s~~	~~32 kbit/s~~
~~19,2 kbit/s~~	~~32 kbit/s~~
~~28,8 kbit/s~~	~~64 kbit/s~~
~~38,4 kbit/s~~	~~64 kbit/s~~

~~An ITU-T V.110 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 600 bit/s to 8Kbit/s is performed by 8 times consecutive duplication of each user data bit. (Figure 9)~~

~~Adaptation of 1200 bit/s to 8 Kbit/s is performed by 4 times consecutive duplication of each user data bit. (Figure 8)~~

~~Adaptation of 2400 bit/s to 8kbit/s is performed by 2 times consecutive duplication of each user data bit. (Figure 7)~~

~~Adaptation of 4800 bit/s to 8 Kbit/s is performed by transmitting the bit stream with no duplication. (Figure 3)~~

~~Adaptation of 9600 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 4800 bit/s case). (Figure 3)~~

~~Adaptation of 14400 bit/s to 32 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 3600 bit/s case).(Adaptation of 3600 bit/s to 8 kbit/s is performed by transmitting the bit stream with no duplication.) (Figure 12)~~

Adaptation of 19200 bit/s to 32 Kbit/s is performed as for 4800 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 4800 bit/s case). (Figure 3)

Adaptation of 28800 bit/s to 64 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by eight with respect to the 3600 bit/s case). (Figure 12)

Adaptation of 38400 bit/s to 64 Kbit/s is performed as for 4800 bit/s 8 kbit/s (the emitting period is divided by eight with respect to the 4800 bit/s case). (Figure 3)

The ITU-T V.110 80 bit frames shown in Figures 3 and 12 are 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 3GPP TS 27.001.

The E bits are used to convey the following information:

i) User Data Rate - E1, E2, E3 (for single slot operation see Figure 4, and for multislot operation Figure 4 and subclause 10.7)

ii) Network Independent Clocking - E4, E5, E6

iii) Multiframe Synchronisation - E7

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

5.1.1 Network Independent Clocking

Synchronous data signals received by the MT from the DTE at the MS 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 V.110 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 MS employs its own network independent clock. In any case, the frequency tolerance of the clocks involved is 100 ppm.

5.1.1.1 Multiframe Structure

The transmitting end of the A/Gb mode 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 V.110 (and X.30) except that such a multiframe structure exists for all user data rates. This frame synchronization is achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the A/Gb mode 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 frames as illustrated in figure 1. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe shown in figure 1.

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 1: 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 section 3.1.2 in V.110 frames MF 1a and MF 1b.

5.1.1.2 Encoding and compensation

The V.110 transmitter uses the following 5-bit code words, as shown in figure 2, 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 2: NIC Code Words

When negative compensation is indicated, one less user data bit than normal is transported in the affected frame (MF1a or MF1b). 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. In case of 80-bit frames with 36 data bits, bit D19 is discarded instead.

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 causes 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 MF1a or MF1b) of the V.110 frame illustrated in figure 3. In case of 80-bit frames with 36 data bits, the insertion is done to between bits D18 and D19.

When no compensation is necessary, or when NIC is applied, the values of E4, E5, E6, E7, on the 4 multi frame scheme is:

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

When NIC is not applicable, the MS and the IWF shall disregard the received value of bits E4, E5, E6 and E7 in the data transmission phase.

NOTE: NIC is not applicable in the following cases:

- transparent asynchronous bearer services;
- the facsimile teleservices in the transparent mode;
- every transparent bearer services when interworking with an UDI Information Transfer Capability.

6 The RA1'' functionVoid

The RA1'' function shall be used for converting between synchronous user rates of 48 and 56 kbit/s and the 'intermediate' rate of 64 kbit/s. (RA1'' is a A/Gb mode-specific term which is used for the one-step adaptation of 48 and 56 kbit/s rates into 64 kbit/s as specified in ITU-T V.110. For the purposes of A/Gb mode specifications the term 'intermediate rate' is used for the resulting 64 kbit/s rate although this is not done in V.110 recommendation.)

6.1 Rate adaptation of 48 kbit/s user rates with DTE/DCE status to 64 kbit/s

A ITU-T V.110 32 bits frame is constructed using the user data bits received, the values of the S bits are deduced from the R interface.

The ITU-T V.110 32 bit frame shown in Figure 13 is used. The D bits are used for conveying the user data and the S and X bits are used for conveying channel control information according 3GPP TS 27.001.The order of transmission of the 32 bit frame is from left to right and top to bottom.

6.2 Rate adaptation of 56 kbit/s user rate to 64 kbit/s

A ITU-T V.110 64 bits frame is constructed using the user data bits received.

The ITU-T V.110 64 bit frame shown in figure 14 is used. The D bits are used for conveying the user data.

The order of transmission of the 64 bit frame is from left to right and top to bottom.

7 The RA2 FunctionVoid

This procedure is based on the RA2 function as specified in ITU-T V.110. It shall be used to rate adapt to/from the intermediate rates of 8, 16 or 32 kbit/s from/to the 64 kbit/s rate used at the S interface.

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

For the intermediate- and user data rate of 64 kbit/s, the RA2 transmits the bit stream over the S-interface as it is.

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

The procedure requires that:

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

ii) The 16 kbit/s bitstream occupies bit positions (1,2);

iii) The 32 kbit/s bitstream occupies bit positions (1,2,3,4) ;

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

v) All unused bits in the 64 kbit/s stream are set to binary "1".

8 The RA1/RA1' Relay Functions RA1/RA1', RA1'/RA1", RA1'/RAA' and RA1'/RAA"

The relay functions realise conversions on the infrastructure side in both transparent and non-transparent cases as specified in 3GPP TS 43.010.

The RA1/RA1' function described below shall be used for channel codings TCH/F4.8 and TCH/F9.6 if the AIUR is less than 48 kbit/s. It in transparent cases to converts between the intermediate rate and the input rate to the channel coder or the multiplexing function.

The RA1'/RA1" function shall be used for channel codings TCH/F4.8 and TCH/F9.6 if the AIUR is equal to 48, 56 or 64 kbit/s. It converts between the 64 kbit/s data stream and the input rate to the channel coder.

The RA1'/RAA' function shall be used for channel codings TCH/F14.4, TCH/F28.8 and TCH/F43.2 if the AIUR is less than 64 kbit/s. It converts between the E-TRAU frame specified in 3GPP TS 48.060 and the input rate to the channel coder or the EDGE multiplexing function.

The RA1'/RAA" function shall be used for channel codings TCH/F14.4 if the AIUR is equal to 64 kbit/s. It converts between the 64 kbit/s data stream and the input rate to the channel coder.

A relay adaptation function is not needed for the channel coding TCH/F32.

This conversion also appears on the infrastructure side in both transparent and non-transparent cases as specified in 3GPP TS 48.020 except for channel codings TCH/F14.4, TCH/F28.8, TCH/F32.0, and TCH/F43.2.

8.1 Single slot rates

There are seven data rates (known as Radio Interface data rates) used for data transfer to the channel coder. These are 43.,5 kbit/s (NT only), 32.0 kbit/s (T only), 29 kbit/s (In cases where EDGE channel codings TCH/F43.2 or TCH/F28.8 are used, the RA1/RA1' function adapts the data stream to 14.5 kbit/s substreams as if multiple 14.5 kbit/s radio interface channels were used.), 14,5 kbit/s, 12 kbit/s, 6 kbit/s and 3.6 kbit/s. In cases where EDGE channel codings TCH/F43.2 or TCH/F28.8 are used, the RA1'/RAA' function adapts the data stream to 14,5 kbit/s substreams as if multiple 14,5 kbit/s radio interface channels were used.

The 32 kbit/s user rate is identical to the 32 kbit/s intermediate rate. In this case the 32 kbit/s intermediate rate is directly mapped to the 32 kbit/s radio interface data rate.

The 8, 16 and 64 kbit/s intermediate rates and the 32 kbit/s intermediate rate with other than 32 kbit/s user rates are adapted to the radio interface data rates as follows:

Intermediate rate	Radio interface data rate
8 kbit/s	3,6 kbit/s
8 kbit/s	6 kbit/s
16 kbit/s	12 kbit/s
32 kbit/s	14,5 kbit/s

AIUR	Intermediate rate	Radio interface rate
≤ 600 bit/s	8 kbit/s	3,6 kbit/s
1,2 kbit/s	8 kbit/s	3,6 kbit/s
2,4 kbit/s	8 kbit/s	3,6 kbit/s
4,8 kbit/s	8 kbit/s	6 kbit/s
9,6 kbit/s	16 kbit/s	12 kbit/s
14,54 kbit/s	32 kbit/s	14,5 kbit/s
28,8 kbit/s	64 kbit/s	29 kbit/s (Note 2)
43,2 kbit/s	(Note 1)	43,5 kbit/s(Note 2)
Note 1: AIUR only used in non-transparent configurations. There is no direct relationship between AIUR and Intermediate rate. Note 2: The RA1'/RAA' function adapts the data stream to 14,5 kbit/s substreams as if multiple 14,5 kbit/s radio interface channels were used.		

For the adaptation the following three processes are used:

Firstly the 17 synchronization bits are removed.

Secondly the E1, E2 and E3 bits are removed. For transparent services, the values of the E1, E2, E3 bits are determined at the MT and in case of TCH/F9.6 and TCH/F4.8, at the BTS 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 BSS). For non transparent services, the coding of the E1, E2 and E3 bits is described in 3GPP TS 48.020.

Thirdly, in the 3.6 kbit/s case, half the data bits are discarded. These processes result in modified ITU-T V.110 frames of sizes 60,60 and 36 bits for the 12, 6 and 3.6 kbit/s data rates respectively. The resultant modified ITU-T V.110 frames for the various user data rates are shown in figures 5 - 9.

Further procedures for TCH/F14.4, TCH/F 28.8, and TCH/F43.2 channel coder input rates in subclauses 8.1.1, 9.1 and 9.3, respectively.

8.1.1 Radio interface rate of 14,5 kbit/s

~~In this case one modified ITU-T V.110 frame is received/sent from/to the network every 2.5 ms (see 3GPP TS 45.003). The RA1/RA1' function adds/subtracts the 17-bit synchronisation pattern, the F-, E-, X-, and S-bits to/from the 80-bit V.110-frames.~~

The RA1'/RAA' function converts between the E-TRAU frame and the 290 bit blocks from the channel coder. The E-TRAU frames are defined in TS 48.060. The 290 bit blocks carry 288 data bits and the control bits M1 and M2 as specified in section 10.3.1 and 10.3.2. ~~Bits M1 and M2 are transmitted along with the modified 36-bit V.110 frames every 20 ms over the radio interface (See 3GPP TS 45.003). Bit M2 is used by the RA1/RA1' function for deriving/mapping the E-, S-, and X-bits. Bit M1 is used for multislot synchronisation. The usage of these bits is further elaborated in subclause 8.1.1.1.~~

~~The modified ITU-T V.110 36-bit frame received/sent from/to the network at 14,4 kbit/s:~~

D1	D2	D3	D4	D5	D6
D7	D8	D9	D10	D11	D12
D13	D14	D15	D16	D17	D18
D19	D20	D21	D22	D23	D24
D25	D26	D27	D28	D29	D30
D31	D32	D33	D34	D35	D36

~~is converted/derived into/from the following 80-bit V.110-frame at 32 kbit/s. The E-, S-, and X-bits are mapped/extracted to/from the M2-bit sequence.~~

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

~~For the 36-bit frames the received D-bits are set as they were transmitted. For transparent services E, S, and X-bits are reproduced based on the M2-bit sequence as described in subclause 8.1.1.1. Bits E1, E2, and E3 are set according to the user data rate as shown in Figure 4 for transparent services.~~

~~8.1.1.1 Multiframe structure over the radio-interface~~

~~Bit M1 carries a 31-bit PN multiframe code 0000 1001 0110 0111 1100 0110 1110 101. One multiframe bit is transmitted every 20 ms per substream, which means that one whole multiframe consists of 248 36-bit frames.~~

~~Bit M2 carries V.24 circuit status information, network independent clocking (NIC) information and substream numbering as indicated in the following figure:~~

bit number	0 1 2 3	4 5 6 7	8 - 11	12- 15	16 - 19	20 - 23	24 - 27	28 - 30
M1:	0 0 0 0	1 0 0 1	0 1 1 0	0 1 1 1	1 1 0 0	0 1 1 0	1 1 1 0	1 0 1
M2:	# # # SB	SB X # #	# X SB SB	# # # SB	SB X # #	# X SB SB	NNNN	N SB SB

~~where # # # = Substream number (multilink operation)~~

~~SB = the SB status bit~~

~~X = the X status bit~~

~~NNNNN = Network independent clocking code~~

~~In the MS to Network direction the information carried by the M2-bit sequence is mapped in the following manner:~~

~~An M1/M2-bit pair is transmitted along each block of data containing eight modified V.110 36-bit frames. The three-bit #-sequence carries a number identifying each substream (multislot operation); the substreams are numbered 0,1,2 etc.~~

~~The status- and NIC-information is mapped between the M2-sequence(s) and the V.110-frames. Bits SB and X are mapped to V.24 circuits as specified in 3GPP TS 27.001.~~

~~The SB-bit carries the V.110 SB-status information, and the X-bit the X-status information.~~

~~Five consecutive N-bits carrying an NIC-code in the M2-sequence indicate 'negative compensation' or 'positive compensation' if such a compensation is required. Otherwise' no compensation' is indicated by the N-bits.~~

	~~N-bit 24 in M2-sequence~~	~~N-bit 25 in M2-sequence~~	~~N-bit 26 in M2-sequence~~	~~N-bit 27 in M2-sequence~~	~~N-bit 28 in M2-sequence~~
~~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 a one~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~

~~The Network to MS direction:~~

~~The status-information is filtered as described in 3GPP TS 27.001. To change the SB- or X-status mode, it is required that at least two consecutive SB- or X-bits, respectively, carry the same value.~~

~~For NIC-procedure, refer to subclause 11.5.1.~~

~~8.1.1.2 Radio-interface data block for TCH/F14.4 channel coding~~

~~A radio-interface data block for a TCH/F14.4 channel consists of 8 36-bit data frames and bits M1 and M2 as shown in the following table:~~

																	~~M1~~	~~M2~~
~~1~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~2~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~3~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~4~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~5~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~6~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~7~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~
~~8~~	~~D1~~	~~D2~~	~~D3~~	~~D4~~	~~D5~~	~~D6~~	~~D7~~	~~D8~~	~~D9~~	~~D10~~	~~D11~~	~~D12~~	~~D13~~	~~D14~~	~~D15~~	~~D16~~	~~D17~~	~~D18~~
	~~D19~~	~~D20~~	~~D21~~	~~D22~~	~~D23~~	~~D24~~	~~D25~~	~~D26~~	~~D27~~	~~D28~~	~~D29~~	~~D30~~	~~D31~~	~~D32~~	~~D33~~	~~D34~~	~~D35~~	~~D36~~

~~The number on the left indicates the order of the data frames in the 290-bit block; the 36-bit frame in position one was received before that in position two etc. One such block is transmitted over the radio interface every 20 ms.~~

8.1.2 Radio Interface rate of 12 kbit/s

In this case one modified ITU-T V.110 60 bit frame is received/sent from/to the ~~network~~ radio interface every 5ms (see 3GPP TS 45.003). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1,E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

The modified ITU-T V.110 60 bits frame received/sent from/to the radio interface at 12 Kbit/s (Figure 5),

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 V.110 80 bits frame at 16 Kbit/s (Figure 3):

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 V.110 60 bit frames received from the ~~network~~radio interface, 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 4 for the transparent services, or the RLP multiframe and DTX indication as per 3GPP TS 48.020 in the non transparent case.

For modified ITU-T V.110 60 bit frames transmitted over the ~~network~~radio interface, 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.

8.1.3 Radio Interface rate of 6 kbit/s

In this case one modified ITU-T V.110 60 bit frame is received/sent from/to the radio interface ~~network~~ every 10 ms (see 3GPP TS 45.003). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

The modified ITU-T V.110 60 bits frame received/sent from/to the radio interface at 6 Kbit/s (Figure 6),

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 V.110 80 bits frame at 8 Kbit/s (Figure 3):

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 V.110 60 bit frames received from the radio interface~~network~~, 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 4 for the transparent services, or the RLP multiframe and DTX indication as per 3GPP TS 48.020 in the non transparent case.

For modified ITU-T V.110 60 bit frames transmitted over the radio interface~~network~~, 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.

This process is identical to that used for the 12 kbit/s case except that the frame repetition rates are halved.

8.1.4 Radio Interface rate of 3,6 kbit/s (transparent services only)

In this case one modified ITU-T V.110 36 bit frame is received/sent from/to the radio interface ~~network~~ every 10ms (see 3GPP TS 45.003 [5]). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

For the AIUR of 2,4 kbit/s ~~T~~the modified ITU-T V.110 36 bits frame received/sent from/to the radio interface at 3.6 ~~K~~kbit/s (Figure 7a),

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

is converted into the following a ITU-T V.110 80 bits frame at 8 Kbit/s (Figure 7b):

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

Figure 8 and 9 show the bit mappings for the AIUR of 1200 and 600 bit/s.

For modified ITU-T V.110 36 bit frames transmitted to the radio interface~~network~~, E1, E2, E3 are discarded. For modified ITU-T V.110 36 bit frames received from the radio interface~~network~~, E1, E2, E3 are set as shown in figure ~~2~~4.

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.

~~8.1.5 Synchronisation~~

~~Two interfaces are involved in the TAF regarding the need for data frame synchronisation, i.e. the TAF/air-interface and TAF/TE interface. For detailed definition of the synchronisation procedures refer to 3GPP TS 27.001.~~

~~8.1.6 Idle frames~~

~~Whenever no data is received from the radio interface (e.g. frame stealing applies, layer 2 fill frames are received, etc.) idle frames shall be sent to the DTE. These are V.110 frames with frame alignment pattern according to ITU-T recommendation. V.110 [11] and all data, status and E-bits set to binary "1".~~

8.2 Multislot rates

In multislot operation the transmission is performed using parallel substreams between the Split/Combine-functions.

~~8.2.1 TCH/F14.4 multislot operation~~

~~The information carried by the M2-sequences is read per substream; i.e. the substream number and a complete NIC-code are transferred through one substream.~~

~~A NIC-code is carried on as many substreams as is necessary to cover all NIC-compensations that have taken place. On channels where no NIC-compensation is carried, the N-bits are set to 'no compensation'. For the exact NIC-procedures, refer to subclause 11.5.1.~~

8.2.~~2~~1 AIURs up to 38,4 kbit/s using TCH/F9.6 and TCH/F4.8 channel codings

AIUR	Intermediate rate~~/AIUR~~	Radio interface rate
9,6 kbit/s	16 kbit/s~~ / 9,6 kbit/s~~	2×6 kbit/s
14,4 kbit/s	32 kbit/s	2×12 or 3×6 kbit/s
19,2 kbit/s	32 kbit/s~~ / 14,4; 19,2 kbit/s~~	2×12 ~~or 3×6~~ or 4×6 kbit/s
28,8 kbit/s	64 kbit/s	3×12 kbit/s
38,4 kbit/s	64 kbit/s ~~/ 28,8; 38,4 kbit/s~~	~~3×12 or~~ 4×12 kbit/s

In these cases, the data stream is mapped from 80-bit intermediate rate frames into modified frames of 60 bits for radio-interface transmission as specified in subclause 8.1 for 12 kbit/s and 6 kbit/s except for the following cases:

For AIURs 14,4 and 28,8 kbit/s using channel codings TCH/F4.8 and TCH/F9.6, respectively, four consecutive V.110 80-bit frames (Figure 12) are mapped onto three consecutive modified 60-bit V.110 (Figure 5 or 6) frames at the MS. The 4×36 data bits in the 80-bit frames are mapped onto the 3×48 data bits in the 60-bit frames. However, bits E4-E7 in the 80-bit frames are mapped onto the E4-E7 bits in the 60-bit frames when their value indicate either positive or negative compensation (NIC; See subclause 5.1.1). The E4-E7 bits that indicate 'No compensation' in the 80-bit frames need not be mapped onto the 60-bit frames. The S- and X-bits in every fourth 80 -bit frame are not mapped onto the 60-bit frames. When radio interface rate of 2 × 12 kbit/s is used for carrying AIUR 14,4 kbit/s, padding is used in the 60-bit frames of the higher substream number (Subclause 11.6).

For substream numbering information, please refer to subclause 10 of the present document.

8.2.~~3~~2 AIURs up to ~~38,4~~64 kbit/s using TCH/F14.4 channel coding

AIUR	Intermediate rate~~/AIUR~~	Radio interface rate
28,8 kbit/s	64 kbit/s	2×14,5
38,4 kbit/s	64 kbit/s~~ / 28,8; 38,4 kbit/s~~	~~2×14,5 or~~ 3×14,5
48 kbit/s	64 kbit/s	3×14,5
56 kbit/s	64 kbit/s	4×14,5
64 kbit/s	64 kbit/s	5×14,5

For AIURs ~~14,4 and 28,8~~< 64 kbit/s the RA1'/RAA' function extracts the eight 36 data bit~~s~~ blocks in the E-TRAU ~~80-bit V.110 intermediate rate~~ frames ~~are extracted~~ and ~~sent~~ sends ~~it~~them through the substreams in data blocks containing eight 36-bit frames as described in subclause ~~8.1~~10.3. For AIUR 64 kbit/s the RA1'/RAA" function sends the data bits in the 64 kbit/s data stream through the substreams in data blocks containing eight 36-bit frames as described in subclause 10.3. An M1/M2-bit pair is sent over the radio-interface along with each data block every 20 ms. These bits carry the multiframe, substream number, V.24 status, and NIC information as described in subclauses ~~8.1.1.1~~ 10.3.1 and ~~8.2.1~~10.3.2.

~~For AIUR 38.4 kbit/s the 80-bit V.110 intermediate rate frames carry 48 user data bits. The 290-bit blocks in the substreams of the lower substream numbers carry 288 user data bits while the 290-bit blocks in the substream of the highest substream number carries 192 user data bits; this means that five of the eight 36-bit frames making up the block carry 36 user data bits whereas the sixth frame carries 12 user data bits (5×36+12). Frames seven, eight, and the rest of the sixth frame are padded with '1's.~~

~~The M2-bit sequences are used as described in subclauses 8.1.1.1 and 8.2.1~~

~~For NIC-procedures refer to subclauses 8.2.1 and 11.5.1. No NIC-values are transported in association with AIUR 38,4; the N-bits are set to 'no compensation'.~~

8.2.43 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 5 x 12 kbit/s

One modified ITU-T V.110 60 bit frame (Figure 5) is received/sent from/to a TCH/F every 5 ms (see 3GPP TS 45.003) resulting in an radio-interface rate of 12 kbit/s per channel.

One 60-bit radio-interface frame is converted into two ITU-T V.110 32-bit frames at 64 kbit/s (Figure 13):

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

8.2.5 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 4 x 14,5 kbit/s

For AIUR 48 kbit/s the 24 data bits in the 32-bit V.110-frames are extracted and sent through the substreams in 36-bit frames as described in subclause 8.1. An M1/M2-bit pair is sent over the air-interface along each data block every 20 ms. This pair of bits carries the multiframe, substream, and V.24 status information as described in subclauses 8.1.1.1 and 8.2.1.

The 290-bit blocks in the highest numbered substream carry 96 user data bits (2×36+24).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 8.1.1.1 and 8.2.1.

No NIC-values are transported in association with AIUR 48.0; the N-bits are set to 'no compensation'.

8.2.64 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s, Radio interface rate of 5 × 12 kbit/s

Radio interface rate of 5 × 12 kbit/s

One modified ITU-T V.110 60 bit frame (Figure 10) is received/sent from/to the network every 5 ms (see 3GPP TS 45.003) resulting in a radio-interface rate of 12 kbit/s per channel.

A modified ITU-T V.110 60 bits radio-interface frame (Figure 10):

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	D41	D42	D43	D44	D45
D46	D47	D48	D49	D50	D51	D52
D53	D54	D55	D56			

NOTE: For information on the T-bits, please refer to subclause 11.2 of the present document.

is converted into an ITU-T V.110 64 bits frame at 64 kbit/s (Figure 14):

D1	D2	D3	D4	D5	D6	D7	1
D8	D9	D10	D11	D12	D13	D14	1
D15	D16	D17	D18	D19	D20	D21	1
D22	D23	D24	D25	D26	D27	D28	1
D29	D30	D31	D32	D33	D34	D35	1
D36	D37	D38	D39	D40	D41	D42	1
D43	D44	D45	D46	D47	D48	D49	1
D50	D51	D52	D53	D54	D55	D56	1

~~8.2.7 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 4 x 14,5 kbit/s~~

~~For AIUR 56 kbit/s the 56 data bits in the 64-bit V.110 frames are extracted and sent through the substreams in 36-bit frames as described in subclause 8.1. An M1/M2-bit pair is sent over the air-interface along each data block every 20 ms. This pair of bits carries the multiframe and substream numbering information as described in subclause 8.1.1.1.~~

~~The 290-bit blocks in the highest numbered substream carry 256 user data bits (7×36+4).~~

~~The M2-bit sequences are used, for the applicable parts, as described in subclauses 8.1.1.1 and 8.2.1.~~

~~No V.24 status or NIC-values are transported in association with AIUR 56.0; the N-bits are set to 'no compensation'.~~

8.2.~~8~~5 AIUR of 64 kbit/s; Radio interface rate of 6 x 12 kbit/s

One modified ITU-T V.110 60 bit frame (Figure 10) is received/sent from/to the network every 5 ms (see 3GPP TS 45.003) resulting in a~~n~~ radio-interface rate of 12 kbit/s per channel.

A modified ITU-T V.110 60 bits radio-interface frame (Figure 10):

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	D41	D42	D43	D44	D45
D46	D47	D48	D49	D50	D51	D52
D53	D54	D55	D56			

NOTE: For information on the T-bits, please refer to subclause 11.2 of the present document.

is converted as follows: The data bits are extracted from the 60-bit frames received from the network; six frames, one of which carries padding as explained in subclause 11.~~6~~5, carry 320 bits of user data per 5 ms resulting in a 64 kbit/s user rate which is sent forward as such.

~~8.2.9 AIUR of 64 kbit/s; Radio interface rate of 5 x 14,5 kbit/s~~

~~For AIUR 64 kbit/s the 64 data bits in the 64-bit V.110 frames are extracted and sent through the substreams in 36-bit frames as described in subclause 8.1. An M1/M2-bit pair is sent over the air-interface along each data block every 20 ms. This pair of bits carries the multiframe and substream numbering information as described in subclause 8.1.1.1.~~

~~The 290-bit blocks in the highest numbered substream carry 128 user data bits (3×36+20).~~

~~The M2-bit sequences are used, for the applicable parts, as described in subclauses 8.1.1.1 and 8.2.1.~~

~~No V.24 status or NIC-values are transported in association with AIUR 64.0; the N-bits are set to 'no compensation'.~~

9 The EDGE multiplexing function

In EDGE configurations the number of channels across the radio interface and that of substreams do not necessarily match. In such cases a multiplexing function described below shall be used at MS and BTS (3GPP TS 48.020). These functions distribute data between the substreams and radio channels.

At the MS the multiplexing function multiplexes 14.5 kbit/s substreams — produced either by the combination of Split/Combine and RA1/RA1' or RA1' functions in the transparent case, or by the combination of Split/Combine and RLP functions in the non-transparent case — into the TCH/F28.8 or TCH/F43.2 EDGE radio interface channels.

In the case of transparent 56 kbit/s or 64 kbit/s operation, the multiplexing function maps the data stream into two EDGE TCH/F32.0 radio interface channels.

9.1 Data block distribution into the substreams by the Multiplexing function; TCH/F28.8 channel coding

The multiplexing function maps/extracts two 14.5 kbit/s substreams into/from a 29.0 kbit/s radio interface channel.

A radio interface data block for a TCH/F28.8 channel contains the bit sequence: M1, M2, 288 user data bits, M1, M2, and 288 user data bits, in other words, the block is a combination of two TCH/F14.4 radio interface data blocks. The two TCH/F14.4 blocks belong to two separate substreams. One 580-bit block is transmitted/received every 20 ms.

a) Transparent services

In uplink, the multiplexing function maps one 290-bit block from each substream into every 580-bit TCH/F28.8 radio interface data block. Blocks from one stream always occupy the same half of the 580-bit radio interface data blocks.

In downlink, the multiplexing function demultiplexes the two substreams by extracting the two 290-bit blocks from the received 580-bit radio interface blocks; the 290-bit blocks belonging to one substream are carried in the same half of the 580-bit radio interface blocks.

b) Non-transparent services

The multiplexing function works in the same way as in the transparent case, i.e. the multiplexing is based on the use of 290-bit blocks, which — in this case — contain halves of 576-bit RLP frames.

9.1.1 AIUR of 57.6 kbit/s; Radio interface rate of 2 × 29.0 kbit/s

Non-transparent 57.6 kbit/s radio interface user rate can be achieved by using a combination of two TCH/F28.8 channels across the radio interface. Two parallel multiplexing functions are applied; the operation of both of these is as described in section 9.1 above.

9.2 Data block distribution to the radio interface by the Multiplexing function; TCH/F32.0 channel coding

The multiplexing function divides the datastream into blocks of ten 64-bit V.110 frames (Figure 14) in case of the 56 kbit/s user rate or into blocks of 640 data bits in case of the 64 kbit/s user rate. These blocks are distributed cyclically into timeslots a (0≤a≤6) and a+n (1≤a+n≤7) in each TDMA-frame; in the data stream, data mapped into timeslot a precedes that mapped into slot a+n. The receiving Multiplexing function recombines overall data stream from radio-interface channels so that the data carried by timeslot a (0≤a≤6) precedes the data carried by timeslot a+n (1≤a+n≤7) of the same TDMA-frame.

9.2.1 AIUR of 56 kbit/s; Radio interface rate of 2 × 32.0 kbit/s

Two blocks of 10 64-bit V.110 frames (Figure 14) are sent/received every 20 ms over the radio interface.

No V.24 status or NIC-information is transferred in association with AIUR 56 kbit/s.

No substream numbering is needed as just one substream is used across a two–timeslot radio interface channel.

9.2.2 AIUR of 64 kbit/s; Radio interface rate of 2 × 32.0 kbit/s

Two blocks of 640 data bits are sent/received through the radio interface every 20 ms.

No V.24 status or NIC-information is transferred in association with AIUR 64 kbit/s.

No substream numbering is needed as just one substream is used across a two–timeslot radio interface channel.

9.3 Data block distribution into the substreams by the Multiplexing function; TCH/F43.2 channel coding

The multiplexing function maps/extracts three 14.5 kbit/s substreams into/from a 43.5 kbit/s radio interface channel.

A radio interface data block for a TCH/F43.2 channel is a combination of three TCH/F14.4 radio interface data blocks. The three TCH/F14.4 blocks belong to separate substreams. One 870-bit block is transmitted/received every 20 ms.

The TCH/F43.2 channel is used only in non-transparent operation. Therefore, the 290-bit blocks handled by the multiplexing function carry halves of 576-bit RLP frames.

In uplink, the multiplexing function maps one 290-bit block from each substream into every 870-bit TCH/F43.2 radio interface data block. Blocks from one stream always occupy the same third of the 870-bit radio interface data blocks.

In downlink, the multiplexing function demultiplexes the three substreams by extracting the 290-bit blocks from the received 870-bit radio interface blocks; the 290-bit blocks belonging to one substream are carried in the same third of the 870-bit radio interface blocks.

10 The RA1' Function

The RA1' function described below shall be used to adapt between the synchronous user data rates, or the output of the RA0 function and the radio interface data rates of 3.6, 6, 12, or 14,5 kbit/s. In cases where EDGE channel coding TCH/F28.8 is used, the RA1' function adapts the data stream to 14.5 kbit/s substreams as if multiple 14.5 kbit/s radio interface channels were used.

10.1 ~~Synchronous user rates up to 9,6 kbit/s~~Void

~~**Synchronous user rate**~~	~~**Rate at the radio interface**~~
~~≤ 2,4 kbit/s~~	~~3.6 kbit/s~~
~~4,8 kbit/s~~	~~6 kbit/s~~
~~9,6 kbit/s~~	~~12 kbit/s or 2x6 kbit/s~~

~~The modified ITU-T V.110 36 or 60 bit frame structures for each user rate are shown in figures 5 - 9. The meaning of the bits is described in clause 5.~~

10.2 Synchronous user rates from 9,6 kbit/s onward; TCH/F9.6 and TCH/F4.8 channel codings

Synchronous user rate	Total rate at the radio interface	DTE/DCE statuses	Air-interface bit frame structure60 Bit frame structure	Single slot rate at the radio interface
≤ 2,4 kbit/s	3.6 kbit/s	X	36 bit (Figs. 7-9)	3.6 kbit/s
4,8 kbit/s	6 kbit/s	X	60 bit (Fig. 6)	6 kbit/s
9,6 kbit/s	12 kbit/s	X	60 bit (Fig. 5)	12 kbit/s or 6 kbit/s
14,4 kbit/s	24 kbit/s or 18 kbit/s	X	60 bit9,6 kbit/s or 4,8 kbit/s (Figs. 5 and 15) Note	12 kbit/s or 6 kbit/s (note)
19,2 kbit/s	24 kbit/s	X	60 bit 9,6 kbit/s or 4,8 kbit/s (Fig. 5)	12 kbit/s or 6 kbit/s
28,8 kbit/s	36 kbit/s	X	60 bit 9,6 kbit/s (Fig. 5)	12 kbit/s
38,4 kbit/s	48 kbit/s	X	60 bit 9,6 kbit/s (Fig. 5)	12 kbit/s
48 kbit/s	60 kbit/s	X	60 bit 9,6 kbit/s (Fig. 5)	12 kbit/s
56 kbit/s	60 kbit/s		60 bit 11,2 kbit/s (Fig.10)	12 kbit/s
64 kbit/s	72 kbit/s		60 bit 11,2 kbit/s (Figs. 10 and 16) Note	12 kbit/s (note)
NOTE: Padding is used in frames making up the data substream of the highest substream number.				

Modified ITU-T V.110 60 bit frames structures are those shown in figures 5, (6,) and 10. The structure to apply is that for the partial user rate. The meaning of the bits is described in clauses 10.15 and 7. For description of the padding procedure, please refer to clause 11 of the present document.The modified ITU-T V.110 36 or 60 bit frame structures for each user rate are shown in figures 5 – 10, 15 and 16. The structure to apply is that for the partial user rate. 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 3GPP TS 27.001.

The E bits are used to convey the following information:

i) User Data Rate - E1, E2, E3 (for single slot operation see Figure 4, and for multislot operation Figure 4 and subclause 11.6)

ii) Network Independent Clocking - E4, E5, E6 (see subclause 10.2.1)

iii) Multiframe Synchronisation - E7 (see subclause 10.2.1).

For description of the padding procedure, please refer to clause 11 of the present document.

10.2.1 Network Independent Clocking

Synchronous data signals received by the MT from the DTE at the MS 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 V.110 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 MS employs its own network independent clock. In any case, the frequency tolerance of the clocks involved is 100 ppm.

10.2.1.1 Multiframe Structure

The transmitting end of the A/Gb mode 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 V.110 (and X.30) except that such a multiframe structure exists for all user data rates. This frame synchronization is achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the A/Gb mode 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 frames as illustrated in figure 1. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe shown in figure 1.

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 1: 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 section 3.1.2 in V.110 frames MF 1a and MF 1b.

10.2.1.2 Encoding and compensation

The V.110 transmitter uses the following 5-bit code words, as shown in figure 2, 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 2: NIC Code Words

When negative compensation is indicated, one less user data bit than normal is transported in the affected frame (MF1a or MF1b). 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. In case of frames with 36 data bits, bit D19 is discarded instead.

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 causes 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 MF1a or MF1b). In case of frames with 36 data bits, the insertion is done to between bits D18 and D19.

When no compensation is necessary, or when NIC is applied, the values of E4, E5, E6, E7, on the 4 multi frame scheme is:

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

When NIC is not applicable, the MS and the IWF shall disregard the received value of bits E4, E5, E6 and E7 in the data transmission phase.

NOTE: NIC is not applicable in the following cases:

- transparent asynchronous bearer services;
- the facsimile teleservices in the transparent mode;
- every transparent bearer services when interworking with an UDI Information Transfer Capability.

10.2.2 Synchronisation

Two interfaces are involved in the TAF regarding the need for data frame synchronisation, i.e. the TAF/air-interface and TAF/TE interface. For detailed definition of the synchronisation procedures refer to 3GPP TS 27.001.

10.2.3 Idle frames

Whenever no data is received from the radio interface (e.g. frame stealing applies, layer 2 fill frames are received, etc.) idle frames shall be sent to the DTE. These are V.110 frames with frame alignment pattern according to ITU-T recommendation. V.110 [11] and all data, status and E-bits set to binary "1".

10.3 ~~Synchronous user rates from 9,6 kbit/s onward;~~ TCH/F14.4 channel coding

Synchronous user rate	Total rate at the radio interface	DTE/DCE statuses	Air-interface bit frame structure	Single slot rate at the radio interface
14,4 kbit/s	14,5 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s
28,8 kbit/s	29.0 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s
38,4 kbit/s	43.5 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s (note)
48 kbit/s	58.0 kbit/s	X	36 bits, 290-bit block	14,5 kbit/s (note)
56 kbit/s	58.0 kbit/s		36 bits, 290-bit block	14,5 kbit/s (note)
64 kbit/s	72.5 kbit/s		36 bits, 290-bit block	14,5 kbit/s (note)
NOTE: Padding used as specified for TCH/F14.4 channel coding in clause 11.				

The format used for transferring a synchronous data stream over the radio-interface is a multiframe consisting of 31 data blocks. The RA1' function transfers the synchronous data stream into data blocks containing eight 36-bit frames as described in subclause 10.3.2. Each data block contains bits M1 and M2 followed by 288 user data bits sent/received over the radio-interface every 20 ms. The M1-bit carries a 31-bit PN-sequence used for aligning the multiframe(s), whereas the M2-bit carries substream numbering, V.24 status information, and NIC-codes as described in subclauses ~~8.1.1.1 and 8.2.1~~10.3.1. The status information carried by the M2-sequence(s) is interpreted as specified in 3GPP TS 27.001. When three consecutive M2-bits carry a substream number, this is interpreted as specified in clause 11. Five consecutive M2-bits carrying NIC-information are interpreted according to subclause ~~8.1.1.1~~10.3.1. ~~For the exact NIC-procedures refer to subclause 11.5.1.~~

In multislot operation the transmission is performed using parallel substreams between the Split/Combine-functions.

10.3.1 Multiframe structure over the radio-interface

Bit M1 carries a 31-bit PN multiframe code 0000 1001 0110 0111 1100 0110 1110 101. One multiframe bit is transmitted every 20 ms per substream, which means that one whole multiframe consists of 248 36-bit frames.

Bit M2 carries V.24 circuit status information, network independent clocking (NIC) information and substream numbering as indicated in the following figure:

bit number	0 1 2 3	4 5 6 7	8 - 11	12- 15	16 - 19	20 - 23	24 - 27	28 - 30
M1:	0 0 0 0	1 0 0 1	0 1 1 0	0 1 1 1	1 1 0 0	0 1 1 0	1 1 1 0	1 0 1
M2:	# # # SB	SB X # #	# X SB SB	# # # SB	SB X # #	# X SB SB	NNNN	N SB SB

where # # # = Substream number (multilink operation)

SB = the SB status bit

X = the X-status bit

NNNNN = Network independent clocking code

The information carried by the M2-sequences is read per substream; i.e. the substream number and a complete NIC-code are transferred through one substream.

A NIC-code is carried on as many substreams as is necessary to cover all NIC-compensations that have taken place. On channels where no NIC-compensation is carried, the N-bits are set to 'no compensation'. For the exact NIC-procedures, refer to subclause 10.3.3.

In the MS to Network direction the information carried by the M2-bit sequence is mapped in the following manner:

An M1/M2-bit pair is transmitted along each block of data containing eight modified V.110 36-bit frames. The three-bit #-sequence carries a number identifying each substream (multislot operation); the substreams are numbered 0,1,2 etc. The status- and NIC-information is mapped between the M2-sequence(s) and the V.110-frames. Bits SB and X are mapped to V.24 circuits as specified in 3GPP TS 27.001.

The SB-bit carries the V.110 SB-status information, and the X-bit the X-status information.

Five consecutive N-bits carrying an NIC-code in the M2-sequence indicate 'negative compensation' or 'positive compensation' if such a compensation is required. Otherwise' no compensation' is indicated by the N-bits.

	N-bit 24 in M2-sequence	N-bit 25 in M2-sequence	N-bit 26 in M2-sequence	N-bit 27 in M2-sequence	N-bit 28 in M2-sequence
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 a one	0	0	1	0	0

The Network to MS direction:

The status-information is filtered as described in 3GPP TS 27.001. To change the SB- or X-status mode, it is required that at least two consecutive SB- or X-bits, respectively, carry the same value.

For NIC-procedure, refer to subclause 10.3.3.

10.3.2 Radio-interface data block for TCH/F14.4 channel coding

A radio-interface data block for a TCH/F14.4 channel consists of eight 36-bit data frames and bits M1 and M2 as shown in the following figure:

																	M1	M2
1	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
2	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
3	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
4	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
5	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
6	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
7	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36
8	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31	D32	D33	D34	D35	D36

The number on the left indicates the order of the data frames in the 290-bit block; the 36-bit frame in position one was received before that in position two etc. One such block is transmitted over the radio interface every 20 ms.

10.3.3 Network independent clocking

The data frames carrying an NIC-multiframe (subclause 10.2.1) indicating a positive or negative compensation are distributed into the substreams according to subclause 11.1.

In the following, 'a data bit position' means a non-padded bit position in the 290-bit radio interface blocks.

The NIC-codes are read per substream, i.e. the sequence of five N-bits in a substream carries one complete NIC-code.

In a 29 kbit/s radio interface channel the two halves of the 580-bit radio interface block correspond to substreams.

If NIC-compensation(s) take(s) place in the overall user data flow :

10.3.3.1. Negative compensation

a) From overall data stream to substreams

When only one substream is used and the data is mapped to the radio interface blocks, the 'extra null bit', which is set to '1', (subclause 10.2.1) is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure. The five N-bits encode 'negative compensation' as described in clause 10.2.1.

If more than one substream is used, and more than one negative compensation should be performed the 'extra null bit' is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure in as many substreams as necessary to perform all compensations. In those substreams where no compensation is needed the N-bits are set to 'no compensation'.

b) From substreams to overall data stream

When a radio interface block carrying the fifth bit of an NIC-code indicating negative compensation is received, the receiver discards the first data bit of the block.

10.3.3.2 Positive compensation

a) From overall data stream to substreams

An NIC-code indicating positive compensation means that the data bit from the overall data stream preceeding the bit mapped into the first position of the data block conveying the second N-bit is carried encoded by the five N-bits.

If more than one substream is used, and if more than one compensation has taken place in the overall data stream, more than one substream carries a NIC-code indicating 'positive compensation'. In those substreams where no NIC-compensation is needed the N-bits indicate 'no compensation'.

b) From substreams to overall data stream

When an NIC-code indicating positive compensation is received, an extra '0' or '1' — depending on whether a compensation of a '0' or '1' is indicated — is mapped to before the first data bit position of the block with which the second bit of the NIC-code is associated.

11 The Split/Combine and Padding-functions

The split/combine and padding functions shall be used with multislot connections as described below. The Split/Combine function splits/recombines the overall data stream to/from the substreams. The Padding function inserts filling into one of the substreams in cases where the total capacity of the substreams is larger than necessary to achieve the required AIUR.

11.1 Data frame distribution into the substreams/channels by the Split/Combine function

11.1.1 Data frame distribution into the substreams/channels by the Split/Combine function (TCH/F9.6 and TCH/F4.8 channel codings)

a) In the transparent case the Split/Combine-function distributes the V.110-frames into the substreams and recombines the overall data stream from the substreams according to the following rules:

In the overall data stream

1) the frame in position p in substream q precedes the frame in position p in substream q+1,0≤ q < n-1

2) the frame in position p in substream n-1 precedes the frame in position p+1 in substream 0;

where in the rules above n is the number of substreams.

b) In the non-transparent case the Split/Combine-function distributes the RLP-frames — or the four V.110-frames making up an RLP-frame (Reference: 3GPP TS 48.020, ~~Clause 10~~Subclause 15.1) — into channels so that one whole RLP-frame is carried through one channel. Furthermore the RLP-frames are distributed into the available channels so that the resulting delay in the overall data stream is kept as small as possible. The receiving Split/Combine-function recombines the overall data stream according to the inherent RLP-frame numbering, i.e. the N(S)-numbers in the RLP-frame header (3GPP TS ~~04.22~~24.022).

11.1.2 Data block distribution into the substreams by the Split/Combine function (TCH/F14.4 channel coding)

a) Transparent services

The Split/Combine-function distributes the user data carried in the 290-bit blocks (Refer to subclause ~~8.1.1.2~~10.3.2) into the substreams and recombines the overall data stream from the substreams according to the following rules:

In the overall data stream:

1) the data block in position m of multiframe in substream q precedes the data block in position m of multiframe in substream q+1, 0≤ q < n-1, 0≤m≤30.

2) the data block in position m of multiframe in substream n-1 precedes the data block in position m+1 of multiframe in substream 0;

where in the rules above n is the number of substreams.

Figure 2a: Distribution of data frames or data blocks into the substreams in transparent operation

b) Non-transparent services

In the non-transparent operation the Split/Combine-function distributes the RLP-frames into substreams so that one whole RLP-frame is carried through one substream. This means that the two 290-bit air-interface blocks carrying one RLP-frame are transmitted through the same substream. Furthermore the RLP-frames are distributed into the available substreams so that the resulting delay in the overall data stream is kept as small as possible. The receiving Split/Combine-function recombines the overall data stream according to the inherent RLP-frame numbering, i.e. the N(S)-numbers in the RLP-frame header (3GPP TS ~~04.22~~24.022).

11.2 Substream numbering in transparent operation

11.2.1 Substream numbering for TCH/F4.8 and TCH/F9.6 channel codings

In transparent multislot data configurations of more than one TCH/F the parallel data substreams between the Split/Combine-functions carry inband substream numbering. The status bits S1, S3, and the X-bit between data bits D12 and D13 (Figures 5 and 6) are used for transferring this substream numbering information (S1 is the MSB and S3 the LSB). The substreams are numbered 0, 1, 2, 3 etc. regardless of the physical channels through which the substreams are transmitted. The highest substream number is one less than the number of physical channels in use at a given time; i.e. the numbering cycle changes when physical channels are either added to or removed from a connection.

The S4-bit is used for frame synchronisation between the parallel substreams. This bit follows a 31-bit PN-sequence of 0000 1001 0110 0111 1100 0110 1110 101. This thirty one bit sequence is used for substream resynchronisation in cases where delay has occurred on one or more substream(s); the position of a frame in a substream can be determined modulo 31 by the values of the S4-bit in a sequence of 5 consecutive frames including the frame in question. Provided that the relative delay between substreams is less than 75 ms (i.e. less than a 15-frame displacement), this and the frame distribution rules given in subclause 11.1 are sufficient to determine the correct order of the frames.

Bits S6, S8, S9, and the other X-bit are used for conveying channel control information according to the relevant terminal adapter function specification.

These rules apply to all multislot data AIURs up to and including 48 kbit/s. When the received 48 kbit/s AIUR is converted into 64 kbit/s rate, the bits extracted from the 60-bit radio interface frames (Figure 5) are mapped into the 32-bit frame format of Figure 13. Here the values for the status bits S1, X, S3, and S4 in the 32-bit frame shall be derived from status bits S6, X, S8, and S9 in the radio-interface frame because status bits S1, X, S3, and S4 in the upper right hand corner of the 60-bit frame have been used for data substream numbering as described above.

In the 11,2 kbit/s frames used for AIURs 56 and 64 kbit/s (Figure 10) the T1, T2, T3 (T1 the MSB and T3 the LSB) are used for carrying the substream numbering as status bits S1, X, and S3 do according to the definition given in the first paragraph of subclause 10.1. Bit T4 is used for carrying the substream synchronisation sequence just as status bit S4 does in the description given in the second paragraph of this subclause~~ 10.2~~.

11.2.2 Substream numbering for TCH/F14.4 and TCH/F28.8 channel codings

Bit M1 carries the multiframe sequence 0000 1001 0110 0111 1100 0110 1110 101. The number of the substream in which a multiframe is sent is carried four times in a 31-bit period of the M2-sequence. In the three-bit number code the bit in the lowest bit position is the MSB (See table in subclause ~~8.1.1.1~~10.3.1).

11.3 Substream Synchronisation

Two interfaces are involved in the TAF regarding the need for the data frame synchronisation, i.e the TAF/multichannel interface and the TAF/TE interface.

The Split/Combine function is responsible for controlling the synchronisation and resynchronisation procedures as described in 3GPP TS 27.001.

~~11.4 Network independent clocking~~Void

~~The data frames carrying an NIC-multiframe (subclause 5.1.1~~10.4~~) indicating a positive or negative compensation are distributed into the substreams according to subclause 11.1.~~

~~11.4.1 Network Independent Clocking for TCH/F14.4 and TCH/F28.8 channel codings (both single- and multilinks)~~

~~In the following, 'a data bit position' means a non-padded bit position in the 290-bit radio interface blocks.~~

~~The NIC-codes are read per substream, i.e. the sequence of five N-bits in a substream carries one complete NIC-code.~~

~~In a 29 kbit/s radio interface channel the two halves of the 580-bit radio interface block correspond to substreams.~~

~~If NIC-compensation(s) take(s) place in the overall user data flow :~~

~~11.4.1.1 Negative compensation~~

~~a) From overall data stream to substreams~~

~~- When only one substream is used and the data is mapped to the radio interface blocks, the 'extra null bit', which is set to '1', (subclause 5.1.1~~10.4~~) is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure. The five N-bits encode 'negative compensation' as described in clause 5~~10.4~~.~~

~~- If more than one substream is used, and more than one negative compensation should be performed the 'extra null bit' is mapped to the first data bit position of the radio interface block which carries the fifth N-bit in the 31-block multiframe structure in as many substreams as necessary to perform all compensations. In those substreams where no compensation is needed the N-bits are set to 'no compensation'.~~

~~b) From substreams to overall data stream~~

~~- When a radio interface block carrying the fifth bit of an NIC-code indicating negative compensation is received, the receiver discards the first data bit of the block.~~

~~11.4.1.2 Positive compensation~~

~~a) From overall data stream to substreams~~

~~- An NIC-code indicating positive compensation means that the data bit from the overall data stream preceeding the bit mapped into the first position of the data block conveying the second N-bit is carried encoded by the five N-bits.~~

- If more than one substream is used, and if more than one compensation has taken place in the overall data stream, more than one substream carries a NIC-code indicating 'positive compensation'. In those substreams where no NIC-compensation is needed the N-bits indicate 'no compensation'.

b) From substreams to overall data stream

- When an NIC-code indicating positive compensation is received, an extra '0' or '1' — depending on whether a compensation of a '0' or '1' is indicated — is mapped to before the first data bit position of the block with which the second bit of the NIC-code is associated.

11.5 Padding TCH/F frames when the AIUR is not a multiple of 9,6 or 4,8 kbit/sFunctions

11.5.1 Padding for TCH/F9.6 and TCH/F4.8

When the required AIUR is not a multiple of the rates supported by TCH/F4.8 or TCH/F9.6, padding is used for producing the required AIUR.

To achieve the required AIUR the data bits are distributed across the substreams 1 to n as follows:

- Substream(s) 1 (to n-1) carry multiples of the rate supported by the channel coding used.
- Substream n carries the remaining amount of data bits required to achieve the required AIUR. The remainder of data stream n carries padding bits set to binary value '1'.

11.5.1.1 Padding for AIUR 14,4 kbit/s:

The frame of the lower substream number carries full 9,6 kbit/s. The frame of the higher substream number carries 4,8 kbit/s of user data in bit positions D1-D24 while bit positions D25-D48 are inserted with binary "1"s. (Figure 15)

11.5.1.2 Padding for AIUR 64 kbit/s:

The frames numbered 1-5 carry full 11,2 kbit/s. Frame number 6 carries 8.0 kbit/s of user data in bit positions D1-D40 while bit positions D41-D56 are inserted with binary "1"s. (Figure 16)

11.5.12 Padding for TCH/F14.4 channel coding

Padding for TCH/F14.4 channel coding is presented in the corresponding parts of clause 8.

11.5.2.1 Padding for AIURs up to 38,4 kbit/s

Padding is not necessary for AIURs 14,4 and 28,8 kbit/s.

For AIUR 38.4 kbit/s the 290-bit blocks in the substreams of the lower substream numbers carry 288 user data bits while the 290-bit blocks in the substream of the highest substream number carries 192 user data bits; this means that five of the eight 36-bit frames making up the block carry 36 user data bits whereas the sixth frame carries 12 user data bits (5×36+12). Frames seven, eight, and the rest of the sixth frame are padded with '1's.

11.5.2.2 Padding for AIURs of 48 kbit/s

The 290-bit blocks in the highest numbered substream carry 96 user data bits (2×36+24).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 10.3.1.1.

11.5.2.3 Padding for AIURs of 56 kbit/s

The 290-bit blocks in the highest numbered substream carry 256 user data bits (7×36+4).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 10.3.1.1.

11.5.2.4 Padding for AIURs of 64 kbit/s

The 290-bit blocks in the highest numbered substream carry 128 user data bits (3×36+20).

The M2-bit sequences are used, for the applicable parts, as described in subclauses 10.3.1.1.

11.6 Handling of the E1-E3 bits in multislot operation

Between the Split / Combine functions the substreams carry the code associated with the substream rate as defined in Figure 4. When the substreams are combined the code is set to correspond to the overall AIUR according to Figure 4.

12 Support of Non-Transparent Bearer Services

In the case of non-transparent services, the RA1' function shall provide access to the 12 and 6 kbit/s radio interface data rates as described below. (Alignment of RLP frames with the four TDMA slots makes it physically impossible to provide 3,6 kbit/s.) The RA1' function is not applied in case of TCH/F14.4, TCH/F28.8 and TCH/F43.2 channel codings.

Air interface user rate	Radio interface rate
4,8 kbit/s	6 kbit/s
9,6 kbit/s	12 kbit/s or 2×6 kbit/s
14,4 kbit/s	14,5 kbit/s or 2×12 kbit/s or 3×6 kbit/s
19,2 kbit/s	2×12 kbit/s or 4×6 kbit/s
28,8 kbit/s	29 kbit/s or 2×14,5 kbit/s or 3×12 kbit/s
38,4 kbit/s	3×14,5 kbit/s or 4×12 kbit/s
43.2 kbit/s	43.5 kbit/s or 3×14,5 kbit/s
57.6 kbit/s	2×29 kbit/s or 4×14,5 kbit/s

12.1 Support of non-transparent operation for TCH/F9.6 and TCH/F4.8 channel codings

This access results in the use of a modified ITU-T V.110 60 bit frame for non-transparent services (figure 11). In this case, the RA1' function also provides for alignment of four modified ITU-T V.110 60 bit frames sent on the same radio slot corresponding with each complete 240 bit frame to be encoded by the radio subsystem as a single unit (see 3GPP TS 45.003). 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 11).

NOTE: The status bits SA, SB, and the X bit are embedded in the L2R-PDU frames (see 3GPP TS 27.001, and 27.002).

The first bit of each RLP frame to be transmitted corresponds to the first bit (D1) of the first 60 bit frame in a four frame sequence and the last bit corresponds 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 11).

The radio subsystem provides for the synchronous transmission and reception of 240 bit RLP frames through a connection consisting of up to four TCH/Fs. An RLP-frame is received/sent from/to a particular radio channel every 20 ms (12 kbit/s radio interface rate) or every 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 3GPP TS 27.001) 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 are transmitted. This is be discarded by the distant RLP function, due to FCS failure, but allows physical link synchronization to be maintained between the MS and the MSC.

In the case of an asymmetric connection the BTS shall send V110 idle frames towards the MSC on the channels which are unused in the direction from the MS towards the MSC. This ensures that the IWF does not interprete V110 frames which are not originated from the MS as complete RLP frames.

12.2 Support of non-transparent operation for TCH/F14.4 channel coding

In 14,4 kbit/s channel 576-bit RLP-frames shall be used as described below.

The RA1' function is not applied in this case. Instead the RLP-, or in multislot operation the Split/Combine- function, handles the 290-bit data blocks received/sent from/to the network. The M1- bit is used for indicating the RLP-frame halves: in the first half M1= 0 and in the second half M1=1. Bit M2 is used for DTX-indication between the BSS and MSC as described in 3GPP TS 48.020

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

In the case of an asymmetric connection the BTS shall send idle frames towards the IWF on the channels which are unused in the direction from the MS towards the MSC, as specified in 3GPP TS 08.60. This ensures that the IWF does not interpret sequences of frames which are not originated from the MS as complete RLP frames.

12.3 Support of non-transparent operation for TCH/F28.8 channel coding

In a 28.8 kbit/s channel, 576-bit RLP-frames shall be used as described below. The 576-bit RLP-frames shall be mapped into the 580-bit radio interface blocks as described in section 9.1.

The RA1' function is not applied in this case. Instead, RLP handles the 580-bit data blocks received/sent from/to the Split/Combine function. The M1- bits are used for indicating RLP-frame halves. The M2-bits are used for DTX-indication between the BSS and MSC as described in 3GPP TS 48.020.

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

12.4 Support of non-transparent operation for TCH/F43.2 channel coding

In a 43.2 kbit/s channel 576-bit RLP-frames shall be used as described below. The 576-bit RLP-frames shall be mapped into 870-bit radio interface blocks as described in section 9.3.

The RA1' function is not applied in this case. Instead, RLP handles the 580-bit data blocks received/sent from/to the Split/Combine function. The M1- bits are used for indicating RLP-frame halves. The M2-bits are used for DTX-indication between the BSS and MSC as described in 3GPP TS 48.020.

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

13 Figures on Frame structures

Octet No.	Bit number							
	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 3: The ITU-T V.110 80 bit RA1 frame structure

Intermediate Data Rate							
8 kbit/s	16 kbit/s	32 kb/s	64 kb/s	E1	E2	E3	
600				1	0	0	Note
1200				0	1	0	
2400				1	1	0	
4800	9600	19200	38400	0	1	1	
		14400	28800	1	0	1	

NOTE: The 300 bit/s user data rate is carried on the 600 bit/s synchronous stream by adding stop elements, see subclause 4.1.

Figure 4: Coding of data rates

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 5: Modified ITU-T 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 6: Modified ITU-T V.110 60 bit frame for 4,8. kbit/s transparent data

a)

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

b)

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	1	1	0	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

Figure 7: a) Modified ITU-T V.110 36 bit frame for 2,4 kbit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

a)

D1	D1	D2	S1	D2	D3	D3	X
D4	D4	D5	S3	D5	D6	D6	S4
E4	E5	E6	E7	D7	D7	D8	S6
D8	D9	D9	X	D10	D10	D11	S8
D11	D12	D12	S9				

b)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D2	D2	S1
1	D2	D2	D3	D3	D3	D3	X
1	D4	D4	D4	D4	D5	D5	S3
1	D5	D5	D6	D6	D6	D6	S4
1	0	1	0	E4	E5	E6	E7
1	D7	D7	D7	D7	D8	D8	S6
1	D8	D8	D9	D9	D9	D9	X
1	D10	D10	D10	D10	D11	D11	S8
1	D11	D11	D12	D12	D12	D12	S9

Figure 8: a) Modified ITU-T V.110 36 bit frame for 1,2 kbit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

a)

D1	D1	D1	S1	D1	D2	D2	X
D2	D2	D3	S3	D3	D3	D3	S4
E4	E5	E6	E7	D4	D4	D4	S6
D4	D5	D5	X	D5	D5	D6	S8
D6	D6	D6	S9				

NOTE: The 300 bit/s user data rate is carried on the 600 bit/s synchronous stream by adding stop elements, see subclause 4.1.

b)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D1	D1	S1
1	D1	D1	D2	D2	D2	D2	X
1	D2	D2	D2	D2	D3	D3	S3
1	D3	D3	D3	D3	D3	D3	S4
1	1	0	0	E4	E5	E6	E7 (note)
1	D4	D4	D4	D4	D4	D4	S6
1	D4	D4	D5	D5	D5	D5	X
1	D5	D5	D5	D5	D6	D6	S8
1	D6	D6	D6	D6	D6	D6	S9

NOTE: In order to maintain compatibility with Recommendation X.30 (I.461), for the 600 bit/s user rate bit E7 is coded to enable the 4×80 bit multiframe synchronisation. To this end, E7 in the fourth 80 bit frame is set to binary '0'. See Table 6 of ITU-T Recommendation V.110(09/92).

Figure 9: a) Modified ITU-T V.110 36 bit frame for 600 bit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	D41	D42	D43	D44	D45
D46	D47	D48	D49	D50	D51	D52
D53	D54	D55	D56			

Figure 10: Modified ITU-T V.110 60 bit frame for 11,2 kbit/s partial rate

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 11: Modified ITU-T V.110 60 bit frame for non-transparent data

0	0	0	0	0	0	0	0
1	D1	D2	D3	D4	D5	D6	S1
1	D7	D8	D9	D10	F	F	X
1	D11	D12	F	F	D13	D14	S3
1	F	F	D15	D16	D17	D18	S4
1	1	0	1	E4	E5	E6	E7
1	D19	D20	D21	D22	D23	D24	S6
1	D25	D26	D27	D28	F	F	X
1	D29	D30	F	F	D31	D32	S8
1	F	F	D33	D34	D35	D36	S9

F =Fill bits, which are set to 1.

Figure 12: The ITU-T V.110 80 bit frame for 3.6 kbit/s transparent data (8 kbit/s intermediate rate)

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

Figure 13: The ITU-T V.110 32 bit 48 kbit/s frame structure (64 kbit/s intermediate rate)

D1	D2	D3	D4	D5	D6	D7	1
D8	D9	D10	D11	D12	D13	D14	1
D15	D16	D17	D18	D19	D20	D21	1
D22	D23	D24	D25	D26	D27	D28	1
D29	D30	D31	D32	D33	D34	D35	1
D36	D37	D38	D39	D40	D41	D42	1
D43	D44	D45	D46	D47	D48	D49	1
D50	D51	D52	D53	D54	D55	D56	1

Figure 14: The ITU-T V.110 64 bit 56 kbit/s frame structure (64 kbit/s intermediate rate, option without status bits)

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	1	1	1
1	1	1	S6	1	1	1
1	1	1	X	1	1	1
1	1	1	S8	1	1	1
1	1	1	S9			

Figure 15: Modified ITU-T V.110 60 bit frame for a padded 9,6 kbit/s transparent data frame carrying 4,8 kbit/s with padding

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	1	1	1	1	1
1	1	1	1	1	1	1
1	1	1	1			

Figure 16: Modified ITU-T V.110 60 bit frame for a padded 11,2 kbit/s transparent data frame carrying 8.0 kbit/s with padding

D1	D2	D3	D4	D5	D6
D7	D8	D9	D10	D11	D12
D13	D14	D15	D16	D17	D18
D19	D20	D21	D22	D23	D24
D25	D26	D27	D28	D29	D30
D31	D32	D33	D34	D35	D36

Figure 17: Modified ITU-T V.110 36-bit frame received/sent from/to the network at 14,4 kbit/s

3GPP TSG CN WG3 Meeting #24
Helsinki, Finland. 29th July – 2nd August 2002

Tdoc ⌘ N3-020682

CR-Form-v7

CHANGE REQUEST

⌘ **48.020**	**CR 004**	⌘ **rev** **-** ⌘	Current version: **4.0.0** ⌘

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Title: ⌘	Correction of Rate Adaptation Functions and removal of S Reference Point in MS		
Source: ⌘	TSG_CN WG3		
Work item code: ⌘	TEI [CS Data]	***Date:*** ⌘	31/07/2002
Category: ⌘	**F**	***Release:*** ⌘	Rel-4
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change: ⌘	• Alignment with TS 43.010 and TS 44.021 concerning the rate adaptation function RA1'/RA1" for the user rates 48, 56 and 64 kbit/s. • Introduction of the rate adaptation function RA1'/RAA" for the user rate of 64 kbit/s using TCH/F14.4 channel coding. • Move of RA1, RA2 and RA1" rate adaptation functions from TS 44.021 to TS 48.020 because these functions are needed at A interface and they are no longer specified in 44.021 due to the removal of the S refernce point in the MS
Summary of change: ⌘	See attached pages, clauses 3, 5, 6, 8, 9, 10, 13, 16, 17
Consequences if not approved: ⌘	Inconsisteny between TS 44.021, 43.010 and 48.020 and errorneous specification of the rate adaptation function mentioned above.

Clauses affected: ⌘				
	Y	**N**		
Other specs affected: ⌘	X		Other core specifications ⌘	TS 44.021, TS 43.010
		X	Test specifications	
		X	O&M Specifications	
Other comments: ⌘				

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1 Scope

The present document 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 3GPP TS ~~03.10~~43.010.

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, shall conform to this specification.

NOTE: This specification should be considered together with 3GPP TS ~~04.21~~44.021 to give a complete description of PLMN rate adaptation.

2 References, abbreviations and definitions

2.1 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, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: " Vocabulary for 3GPP specifications ".~~3GPP TS 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".~~

[2] 3GPP TS ~~02.34~~22.034: "~~Digital cellular telecommunications system (Phase2+):~~ High Speed Circuit Switched Data (HSCSD) - Stage1"

[3] 3GPP TS ~~03.10~~43.010: "~~Digital cellular telecommunications system (Phase 2+);~~ GSM Public Land Mobile Network (PLMN) connection types".

[4] 3GPP TS ~~03.34~~22.034: "~~Digital cellular telecommunications system (Phase 2+):~~ High Speed Circuit Switched Data (HSCSD) - Stage2".

[5] 3GPP TS ~~04.21~~44.021: "~~Digital cellular telecommunications system (Phase 2+);~~ Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[6] 3GPP TS 24.022: "~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ Radio Link Protocol (RLP) for Circuit Switched Bearer and Teleservices".

[7] 3GPP TS ~~05.03~~45.003: "~~Digital cellular telecommunications system (Phase 2+);~~ Channel coding".

[8] 3GPP TS 27.001: "~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[9] 3GPP TS ~~08.08~~48.008: "~~Digital cellular telecommunications system (Phase 2+);~~ Mobile Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[10] 3GPP TS 29.007: "~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ 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] ITU-T Recommendation V.110: "Support of data terminal equipment's (DTEs) with V-Series interfaces by an integrated services digital network".

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

2.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

FPS Frame Pattern Substitution
FSI Frame Start Identifier
ZSP Zero Sequence Position

2.3 Definitions

For the purposes of the present document, the following terms and definitions apply.

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.

EDGE channel: A general term referring to channels based on 8PSK modulation; i.e. TCH/F28.8, TCH/F32.0, and TCH/F43.2.

3 General approach

3GPP TS ~~03.10~~ 43.010 (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 3GPP TS ~~03.10~~43.010 as part of a connection type.

These functions are RA0, RA1, RA1/RA1' , RA1'' , RA1'/RA1", RA1'/RAA", RAA", RA1'/RAA', RAA' and RA2. The RA2 function is equivalent to that described in ITU-T Recommendation V.110. In addition, splitting/combining, padding and inband numbering functions as defined in 3GPP TS 44.021 ~~04.21~~ and multiplexing as defined herein are used in cases where more than one channel is allowed.

The RA1/RA1', RA1'/RA1", RA1'/RAA" and RA1'/RAA' are relay functions used as indicated in 3GPP TS 43.010~~03.10~~.

The BSS uses the information contained in the ASSIGNMENT REQUEST message on the A-interface (see 3GPP TS 48.008~~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 3GPP TS 44.021~~04.21~~.

5 The RA1 Function

~~For connections where only one channel is allowed used on the radio interface, the specification in 3GPP TS 44.021 for adaptation of synchronous data rates up to and including 9,6 kbit/s to intermediate rates 8 or 16 kbit/s shall apply.~~

For connection where more than one channel are used on the radio interface, rate adaptation shall apply on the corresponding substreams as specified in 3GPP TS 44.021 for AIUR of 4,8 kbit/s or 9,6 kbit/s. This function shall be used to adapt between the synchronous user rates, or the output of the RA0 function or Split/Combine function and the intermediate rate of 8, 16, 32 or 64 kbit/s.

For multislot operations RA1 applies per substream. RA1 applies only if TCH/F4.8 or TCH/F9.6 is used for user rates up to 38,4 kbit/s.

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
14,4 kbit/s	32 kbit/s
19,2 kbit/s	32 kbit/s
28,8 kbit/s	64 kbit/s
38,4 kbit/s	64 kbit/s

An ITU-T V.110 80 bits frame is constructed using the user data bits received (from the RA0 in the asynchronous case).

Adaptation of 600 bit/s to 8Kbit/s is performed by 8 times consecutive duplication of each user data bit. (Figure 11)

Adaptation of 1200 bit/s to 8 Kbit/s is performed by 4 times consecutive duplication of each user data bit. (Figure 10)

Adaptation of 2400 bit/s to 8kbit/s is performed by 2 times consecutive duplication of each user data bit. (Figure 9)

Adaptation of 4800 bit/s to 8 Kbit/s is performed by transmitting the bit stream with no duplication. (Figure 7)

Adaptation of 9600 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 4800 bit/s case). (Figure 7)

Adaptation of 14400 bit/s to 32 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 3600 bit/s case).(Adaptation of 3600 bit/s to 8 kbit/s is performed by transmitting the bit stream with no duplication.) (Figure 8)

Adaptation of 19200 bit/s to 32 Kbit/s is performed as for 4800 bit/s to 8 kbit/s (the emitting period is divided by four with respect to the 4800 bit/s case). (Figure 7)

Adaptation of 28800 bit/s to 64 Kbit/s is performed as for 3600 bit/s to 8 kbit/s (the emitting period is divided by eight with respect to the 3600 bit/s case). (Figure 8)

Adaptation of 38400 bit/s to 64 Kbit/s is performed as for 4800 bit/s 8 kbit/s (the emitting period is divided by eight with respect to the 4800 bit/s case). (Figure 7)

The ITU-T V.110 80 bit frames shown in Figures 7 and 8 are used. The meaning of the bits is specified in 44.021.

6 The RA1'' Function

The RA1'' function is specified in 3GPP TS 04.21. The RA1'' function is only applicable in BSS for AIUR higher than 38,4 kbit/s.

The RA1" function shall be used for converting between synchronous user rates of 48 and 56 kbit/s and the 'intermediate' rate of 64 kbit/s.

Note, RA1" is a 3GPP-specific term which is used for the one-step adaptation of 48 and 56 kbit/s rates into 64 kbit/s as specified in ITU-T V.110. For the purposes of 3GPP specifications the term 'intermediate rate' is used for the resulting 64 kbit/s rate although this is not done in ITU-T V.110.

6.1 Rate adaptation of 48 kbit/s user rates with DTE/DCE status to 64 kbit/s

An ITU-T V.110 32 bits frame is constructed using the user data bits received.

The ITU-T V.110 32 bit frame shown in Figure 12 is used. The D bits are used for conveying the user data and the S and X bits are used for conveying channel control information according 3GPP TS 27.001.The order of transmission of the 32 bit frame is from left to right and top to bottom.

6.2 Rate adaptation of 56 kbit/s user rate to 64 kbit/s

An ITU-T V.110 64 bits frame is constructed using the user data bits received.

The ITU-T V.110 64 bit frame shown in figure 13 is used. The D bits are used for conveying the user data.

The order of transmission of the 64 bit frame is from left to right and top to bottom.

7 Split/Combine and Padding Functions

The Split/Combine-function in the IWF shall be used in cases when up to and including 4 substreams are used.

The Split/Combine-function in the BSS shall be used only when more than four substreams are used.

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

Described in 3GPP TS 04.2144.021.

7.2 Substream numbering

Described in 3GPP TS 04.21 44.021. .

7.3 Initial Substream Synchronisation for Transparent Services

Described in 3GPP TS 04.2144.021.

7.4 Frame Synchronisation and Action on loss of Synchronisation

When in the IWF, the Split/Combine function is responsible for controlling the initial frame synchronisation procedure and re-synchronisation procedure as described in 3GPP TS 29.007.

7.5 Network Independent Clocking

NIC is specified in 3GPP TS 44.02104.21.

7.6 Padding

Padding is specified in 3GPP TS 44.02104.21.

8 The EDGE Multiplexing Function

In EDGE configurations where the number of radio interface channels and number of channels or substreams used between BTS and MSC do not match, a multiplexing function described below shall be used at BTS to perform data multiplexing/demultiplexing between the radio interface and network channel configurations. A similar functionshall be used also at MS as described in ~~04.21~~44.021.

The EDGE multiplexing function is located between the radio interface and RA1'/RAA' function.

8.1 Transparent services

TCH/F28.8;

Uplink direction
Refer to the description of corresponding downlink procedures in 3GPP TS ~~04.21~~44.021. Two TCH/F14.4 substreams are forwarded towards the MSC as in a 2×TCH/F14.4 multislot connection.

Downlink direction
The multiplexing function combines the data received through the two TCH/F14.4 substreams into the 29.0 kbit/s radio interface channel. Refer to the description of corresponding uplink procedures in 3GPP TS ~~04.21~~44.021.

TCH/F32.0

Uplink direction
The multiplexing function maps the data received from the radio interface into one 64 kbit/s channel so that data carried by timeslot a (0≤a≤6) precedes data carried by timeslot a+n (1≤a+n≤7) — the timeslots belonging to one TDMA-frame.

Downlink direction
The multiplexing function distributes the data received from the 64 kbit/s channel into two 32.0 kbit/s radio interface channels so that 640-bit data blocks are allocated to timeslots a (0≤a≤6) and a+n (1≤a+n≤7). In the datastream, data carried by timeslot a precedes data carried by timeslot a+n of the same TDMA-frame.

8.2 Non-Transparent services

TCH/F28.8;

Uplink direction
The multiplexing function demultiplexes the data received through the 29.0 kbit/s radio interface channel into two TCH/F14.4 substreams. Two 290-bit blocks carrying the two halves of one RLP frame belong to the same substream. Refer to the corresponding downlink procedures in 3GPP TS ~~04.21~~44.021.

Downlink direction
The multiplexing function multiplexes the 290-bit blocks received through two TCH/F14.4 substreams into the 29.0 kbit/s radio interface channel. Refer to the corresponding uplink procedures in 3GPP TS ~~04.21~~44.021.

TCH/F43.2;

Uplink direction
The multiplexing function demultiplexes the data received through the 43.5 kbit/s radio interface channel into three TCH/F14.4 substreams. Two 290-bit blocks carrying the two halves of one RLP frame belong to the same substream. Refer to the corresponding downlink procedures in 3GPP TS ~~04.21~~44.021.

Downlink direction
The multiplexing function multiplexes the 290-bit blocks received through three TCH/F14.4 substreams into the 43.5 kbit/s radio interface channel. Refer to the corresponding uplink procedures in 3GPP TS ~~04.21~~44.021.

9 The Functions RA1/RA1' Functionand RA1'/RA1"

For AIURs less than or equal to 38,4 kbit/s, the RA1/RA1' function in the BSS shall be 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 than or equal to 38,4 kbit/s RA1/RA1' is as specified in 3GPP TS 04.2144.021 for the single slot case.

For AIURs of 48 kbit/s, 56 kbit/s and 64 kbit/s, RA1'/RA1'' shall be applied as specified in 3GPP TS 44.021.

The table below 1 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 shall be rate adapted as in the single slot case.

~~For AIURs of 48 kbit/s, 56 kbit/s and 64 kbit/s, RA1/RA1'' shall be as specified in 3GPP TS 44.021 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

10 THE The Functions RA1'/RAA' FUNCTIONand RA1'/RAA"

The RA1'/RAA' shall be applied only when TCH/F14.4, TCH/F28.8, or TCH/F43.2 channel coding is used. The RA1/RAA' converts 290-bit blocks from the channel coder or EDGE multiplexing function into E-TRAU frames and vice versa. The format of E-TRAU frame is specified in 3GPP TS 48.060.

The RA1'/RAA' function in the BSS shall be applied on each of the n substreams and there are no significant differences between the single slot case and the multislot case.

For the AIURs of 64 kbit/s, RA1'/RAA'' shall be applied as specified in 3GPP TS 44.021. This function converts 290-bit blocks from the channel coder directly into the synchronous 64 kbit/s data stream, an E-TRAU frame is not created in this case.

The table below 2 gives a relation between the AIUR, channel coding and number of substreams. As an example from table 2 : The wanted AIUR is 28,8 kbit/s, the number of substreams needed to support this rate is 2. Each individual substream shall be rate adapted as in the single slot case.

Table 2 Relationship between AIUR, channel coding and number of channels.

AIUR	Transparent	Non-transparent
14,4 kbit/s	1	1
28,8 kbit/s	2	2
38,4 kbit/s	3	N/A
43,2 kbit/s	N/A	3
48 kbit/s	4	N/A
56 kbit/s	4	N/A
57,6 kbit/s	N/A	4
64 kbit/s	5	N/A

10.1 Radio Interface rate of 14,5 kbit/s

See 3GPP TS 48.060.

10.2 Synchronisation

See 3GPP TS 48.060.

10.3 Idle frames

See 3GPP TS 48.060.

11 THE RAA' FUNCTION

The RAA' function shall be applied only when TCH/F14.4, TCH/F28.8, or TCH/F43.2 channels are used.

The RAA' converts E-TRAU frame into A-TRAU frame and vice versa.

The format of the E-TRAU frame is specified in 3GPP TS 48.060.

11.1 Coding of A-TRAU frame

The format of the A-TRAU frame is given in Figure 5.

An A-TRAU frame carries eight 36 bit-data frames.

C Bits

Table 3

C1	C2	C3	C4	Date Rate
0	1	1	1	14,4 kbit/s
0	1	1	0	14.4 kbit/s idle (IWF to BSS only)

Table 4

C5	BSS to IWF Frame Type note 1	IWF to BSS UFE (Uplink Frame Error)
1	idle	framing error
0	data	no framing error

NOTE 1: Bit C5 corresponds to bit C6 of the E-TRAU frame as defined in 3GPP TS 48.060.

M Bits

Transparent data

M1 and M2 are as defined in 3GPP TS ~~04.21~~44.021.

Non transparent data

See subclause 15.2 of the present document.

Z bits

Bits Zi are used for Framing Pattern Substitution.

See subclause 11.2.

11.2 Framing Pattern Substitution in A-TRAU frame

The Framing Pattern Substitution is used in each of the eight 36 bit data fields of the A-TRAU frame (see Figure 5) to avoid transmitting a sequence of eight zeroes (called Z sequence in the following).

The purposes of FPS is to avoid erroneous synchronisation to the A-TRAU due to sixteen zeroes occurring accidentally in the data bits and to avoid erroneous synchronisation to V.110. The synchronisation pattern of two consecutive V.110 frames cannot be found within a stream of A TRAU frames.

11.2.1 FPS encoding

A Zero Sequence Position (ZSP) field is used to account for the occurrence of eight zeroes in the 36 bit data field.

NOTE: A sequence of eight zeroes is considered as a block (e.g. a stream of eleven consecutive zeroes produces only one ZSP and not four ZSPs).

The ZSP field is defined as follows:

Table 5

1	2	3	4	5	6	7	8
1	C	A0	A1	A2	A3	A4	1

The meaning of the different bits of the ZSP field is :

C : Continuation bit. '0' means that there is another ZSP in the data field. '1' means that there is no other ZSP.

A0-A4 :address of the next Z sequence (eight zeroes) to be inserted. The address ‘00001’ corresponds to the bit D1, the value ‘11101’ to the bit D29, (A0 is the msb, A4 is the lsb).

NOTE: a Z sequence substitution cannot occur at bit D30..D36 (as it is 8 bit long)

1 : locking bit prevent the false occurrence of a Z sequence.

The Framing Pattern Substitution is applied in each of the eight 36 bit data field (see Figure 5).

Bit Zi indicates whether FPS is used in the ith 36 bit data field (i=1 to 8). The coding of the Zi bit is the following:

Table 6

Zi (i=1..8)	meaning
1	no substitution
0	at least one substitution

If Zi bit indicates no substitution, the output data bits of FPS are equal to the input data bits.

If Zi indicates at least one substitution, the bits D1-D8 contain the first ZSP.

The following description indicates the general operating procedures for FPS. It is not meant to indicate a required implementation of the encoding procedure.

Figure 1

Step 1:

The input 36 bit sub frame is considered as a bit stream in which the bits are numbered from 1 to 36.

This bit stream contains 0, 1 or several Z sequences, ($Zseq_1$ to $Zseq_3$ on the figure)

The Z sequence is a sequence of 8 consecutive zeroes : '0000 0000'

Step 2:

Starting from this bit stream, two lists are built up :

2-a : the 'a' list which contains the address of the first bit of each Z sequences.

2-d : the 'd' list which contains all the data blocks which do not have the Z sequence.

Step 3:

The 'a' list is transformed so as to build the ZSP list. Each ZSP element is used to indicate:

at which address is the next Z sequence of the message

if yet another ZSP element is found at this address (link element)

Step 4:

The output 37 bit sub frame is built from:

the Zi field which indicates whether the original message has been transformed or not with this technique. In the example given in Figure 1, Zi shall be set to '0' to indicate that at least one FPS has occurred.

the ZSP and D elements interleaved.

As the ZSP elements have exactly the same length as the Z sequence, the sub frame length is only increased by one (the Zi bit), whatever the number of frame pattern substitutions may be.

For special cases, refer to annex A.

11.3 A-TRAU Synchronisation Pattern

The frame synchronisation 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 coded binary "1". The following 17 bit alignment pattern is used to achieve frame synchronisation:

```
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
```

12 THE RAA" FUNCTION

On the IWF side of the A interface, the RAA" function shall convert between the A-TRAU format and a synchronous stream. FPS shall be performed by this function as well, see subclause 11.2. In transparent operation, the RAA" function shall handle the M1 and M2 bits as specified for the RA1' function in 3GPP TS ~~04.21~~44.021.

In non-transparent operation, the RAA" function shall map between the A-TRAU format and 290 bit blocks consisting of M1, M2 and 288 bits making up half of an RLP frame, see subclause 15.2 of the present document.

13 The RA2 Function

~~Described in 3GPP TS 44.021.~~ The RA2 function shall be applied only for single slot operations. For multislot operations the A-interface Multiplexing Function applies (see clause 14).

This procedure is based on the RA2 function as specified in ITU-T V.110. It shall be used to rate adapt to/from the intermediate rates of 8, 16 or 32 kbit/s from/to the 64 kbit/s rate used at the A-interface.

Intermediate rate	**Rate at the A-interface**
8 kbit/s	64 kbit/s
16 kbit/s	64 kbit/s
32 kbit/s	64 kbit/s
64 kbit/s	64 kbit/s

For the intermediate and user data rate of 64 kbit/s, the RA2 transmits the bit stream over the A-interface as it is.

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

The procedure requires that:

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

ii) The 16 kbit/s bitstream occupies bit positions (1,2);

iii) The 32 kbit/s bitstream occupies bit positions (1,2,3,4) ;

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

v) All unused bits in the 64 kbit/s stream are set to binary "1".

14 The A-interface Multiplexing Function

The multiplexing function shall be applied only for AIUR up to and including 57.6 kbit/s for multislot operations.

The multiplexing function is based on the ITU-T 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 may be released in uplink direction. Always, the released subcircuit(s) in downlink direction shall be the same as the released subcircuit(s) in uplink direction. 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.

15 Support of non-transparent bearer services

15.1 TCH/F9.6 and TCH/F4.8 kbit/s channel codings

In the case of non-transparent services the RA1/RA1' function shall perform 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 ITU-T V.110 80 bit frames shown in Figure 3 (derived from the standard ITU-T V.110 frame shown in Figure 2) are used to indicate each consecutive sequence of ITU-T V.110 80 bit frames corresponding to the four modified ITU-T V.110 60 bit frames (Figure 4) 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 3GPP TS 45.003). 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 Table7.

Table 7

	E2	E3
First Modified ITU-T 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 ITU-T V.110 80 bit frames, it is necessary following a transmission break and at start up, to determine which modified ITU-T 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 ITU-T V.110 80 bit frame to determine the modified ITU-T V.110 80 bit frame boundaries, the FSI is required to determine which quarter of an RLP frame each modified ITU-T V.110 80 bit frame contains.

Table 8: 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	9,6 kbit/s	9,6 kbit/s	TCH/F9.6	16 kbit/s
9,6 kbit/s	9,6 kbit/s	2x4,8 kbit/s	2XTCH/F4.8	8 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 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.				

15.1.1 Alignment

An alignment window spanning four modified ITU-T V.110 80 bit frames shall be 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.

15.1.2 Support of Discontinuous Transmission (DTX)

The E1 bit in the modified ITU-T V.110 80 bit frame shown in Figure 3 shall be used in the direction MSC-BSS to indicate that DTX may be invoked (see 3GPP TS 24.022). 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.

15.1.3 Order of Transmission

The first bit of each quarter of an RLP frame to be transmitted shall correspond to bit D1 of a modified V.110 frame (figures 3 and 4). The remaining 59 bits of each quarter of an RLP frame shall correspond to the D and D' bits , D2 - D'12, in order left to right and top to bottom as shown in figures 3 and 4.

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

15.2 TCH/F14.4, TCH/F28.8, and TCH/F43.2 channel codings

In case of non-transparent service, a 576 bit RLP frame shall be mapped over two consecutive A-TRAU frames.

Because of that mapping, it is required, following a transmission break and at start up, to determine which A-TRAU 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.

The two consecutive M1 bits are referred to as the Frame Start Identifier. The FSI value is 01. This value is assigned to the M1 bits as shown in Table 9.

Table 9

	M1 bit
First A-TRAU frame	0
Second A-TRAU frame	1

A-TRAU frames can slip in time during re-routing, and whilst A-TRAU frame synchronisation exists, the FSI is required to determine which half of an RLP frame each A-TRAU frame contains.

Table 10: Relationship between AIUR, substream rate, number of substreams and intermediate rate

	AIUR	Number of substreams x AIUR per substream	Channel Coding	Multislot intermediate Rate
	14,4 kbit/s	14,4 kbit/s	TCH/F14.4	16 kbit/s
	28,8 kbit/s	2X14,4 kbit/s	2XTCH/F14.4 1XTCH/F28,8	16 kbit/s
	43,2 kbit/s	3X14,4 kbit/s	3XTCH/F14.4 1XTCH/F43,2	16 kbit/s
	57,6 kbit/s	4X14,4 kbit/s	4XTCH/F14.4	16 kbit/s
	57,6 kbit/s	4X14,4 kbit/s	4XTCH/F14.4 2XTCH/F28,8	16 kbit/s

NOTE: The table gives the relation between AIUR, Substream Rate, Channel Coding and Intermediate Rate. As an example: the AIUR is 28,8 kbit/s and the selected channel coding is 14,5 kbit/s. The data stream is split into two substreams of 14,5 kbit/s yielding an AIUR of 28,8 kbit/s

The same number of substreams is used in each direction, even if the AIURs in each direction differ. Superfluous substreams are filled with idle frames. These are inserted at the BTS or IWF and are discarded at the IWFor BTS respectively. At the IWF, the down link AIUR is determined by the out of band signalling (Assignment Complete, Handover Performed), whereas the up link AIUR is determined inband by examining the possible substream positions on the A interface.

15.2.1 Alignment

An alignment window spanning two 290 bit blocks in case of TCH/F14.4 channel shall be used to search for the pattern of 2 bits '01' described in subclause 15.2, in order to identify alignment with an RLP frame.

In the event of failure to detect the 2 bits pattern the alignment window is shifted one 290 bit block, discarding the contents of the most historical frame and then checking the new 2 bits pattern.

15.2.2 Support of Discontinuous Transmission (DTX)

The M2 bit in the A-TRAU frame shown in Figure 5 shall be used in the direction MSC to BSS to indicate that DTX may be invoked (see 3GPP TS 24.022). The M2 bit in all of the two consecutive A-TRAU 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 M2 bit shall be set to 0.

In the direction BSS to MSC the M2 bit shall always be set to 0.

16 Support of transparent bearer services

16.1 TCH/F9.6 and TCH/F4.8 channel codings

16.1.1 User rate adaptation on the A interface, AIUR less than or equal to 38,4 kbit/s

The ITU-T V.110 80 bit frame shall be 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 the present document. The relation between the AIUR and the number of channels is specified in table11.

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

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

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

No use of 4 kbit/s stream is foreseen.

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

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

16.1.2 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 ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS ~~04.21~~44.021 shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, is as specified in 3GPP TS ~~04.21~~44.021.

Table 11 gives the relation between the User Rate, Substream Rate Channel Coding and the Intermediate Rate.

16.1.3 Relation between AIUR and the number of channels

Table11: 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: For AIURs ≤ 38,4 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate.			

16.1.4 Handling of status bits X, SA, SB

In the single slot case, status bit SA shall be coded repeatedly as S1, S3, S6, S8, and SB is coded repeatedly as S4 and S9 in Figure 2. In the multislot case, status bit SA is coded repeatedly as S6, S8 and SB is coded as S9 in figures 2, 5 and 6.

The handling of the status bits shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS 29.007 (MSC), 3GPP TS ~~04.21~~44.021 (BSS), 3GPP TS 27.001 (MS).

16.1.5 Handling of bits E1 to E7

Bits E1 to E3 shall be used according to ~~04.21~~44.021.

Bits E4 to E7 may be used for network independent clocking as indicated in 3GPP TS ~~04.21~~44.021.

16.2 TCH/F14.4, TCH/F28.8, and TCH/F32.0 channel codings

16.2.1 User rate adaptation on the A interface, AIUR less than or equal to 56 kbit/s

The A-TRAU frame shall be used for transparent user data rates other than 32 kbit/s on the A interface. The A-TRAU 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 7 of this TS. The relation between the AIUR and the number of channels is specified in table 12.

In a given A-TRAU frame on the A interface:

- for 14 400 bit/s there is no repetition of bits D within the 16 kbit/s stream in a given A-TRAU frame on the A interface.

The ITU-T I.460 rate adaptation is used for the transparent 32 kbit/s user rate on the A interface, i.e. four bits of each octet in the 64 kbit/s time slot are used for transporting the 32 kbit/s user data.

16.2.2 User Rate Adaptation on the A-interface, AIUR greater than 56 kbit/s

For AIUR of 64 kbit/s one stream consisting of ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS ~~04.21~~44.021 shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, shall be as specified in 3GPP TS ~~04.21~~44.021.

Table 12 gives the relation between the User Rate, Substream Rate Channel Coding and the Intermediate Rate.

16.2.3 Relation between AIUR and the number of channels

Table 12: Relationship between the AIUR, AIUR per substream, channel coding, intermediate rate and number of substreams

AIUR	Number of substreams x AIUR per substream	Channel Coding	Multislot intermediate Rate (note 1)
14,4 kbit/s	14,4 kbit/s	TCH/F14.4	16 kbit/s
28,8 kbit/s	2X14,4 kbit/s	TCH/F14.4 TCH/F28.8	16 kbit/s
32 kbit/s	1x32 kbit/s	TCH/F32.0	32 kbit/s
38,4 kbit/s	3X14,4 kbit/s w/padding	TCH/F14.4	16 kbit/s
48 kbit/s	4X14,4 kbit/s w/padding	TCH/F14.4	16 kbit/s
56 kbit/s	4X14,4 kbit/s w/padding 1x64.0 kbit/s (Note 2)	TCH/F14.4 TCH/F32.0	16 kbit/s 64 kbit/s
64kbit/s	5X14,4 kbit/s w/padding 1x64.0 kbit/s (Note 2)	TCH/F14.4 TCH/F32.0	64 kbit/s

NOTE 1: For AIURs ≤ 56 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate.
NOTE 2: One substream over two air interface timeslots. No multislot intermediate rate.

16.2.4 Handling of status bits X and SB

The X and SB bits shall be carried over the A interface in a multiframe structure as described in subclause ~~8.1.1.1~~10.3 of 3GPP TS ~~04.21~~44.021. SA bit is not carried over the A interface.

The handling of the status bits shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS 29.007 (MSC), 3GPP TS ~~04.21~~44.021 (BSS), 3GPP TS 27.001 (MS).

17 Frame Formats

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 2: The ITU-T V.110 80 bit frame for Transparent Data

octet | bit number

no.	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 3: The modified ITU-T 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 4: Modified ITU-T V.110 60 bit frame for Non-Transparent Data

octet number	bit number 0	1	2	3	4	5	6	7	
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**	**M1**	**M2**	
3	**Z1**	D1	D2	D3	D4	D5	D6	D7	
4	D8	D9	D10	D11	D12	D13	D14	D15	36 bit data field 1
5	D16	D17	D18	D19	D20	D21	D22	D23	
6	D24	D25	D26	D27	D28	D29	D30	D31	
7	D32	D33	D34	D35	D36	**Z2**	D1	D2	
8	D3	D4	D5	D6	D7	D8	D9	D10	
9	D11	D12	D13	D14	D15	D16	D17	D18	36 bit data field 2
10	D19	D20	D21	D22	D23	D24	D25	D26	
11	D27	D28	D29	D30	D31	D32	D33	D34	
12	D35	D36	**Z3**	D1	D2	D3	D4	D5	
13	D6	D7	D8	D9	D10	D11	D12	D13	
14	D14	D15	D16	D17	D18	D19	D20	D21	36 bit data field 3
15	D22	D23	D24	D25	D26	D27	D28	D29	
16	D30	D31	D32	D33	D34	D35	D36	**Z4**	
17	D1	D2	D3	D4	D5	D6	D7	D8	
18	D9	D10	D11	D12	D13	D14	D15	D16	36 bit data field 4
19	D17	D18	D19	D20	D21	D22	D23	D24	
20	D25	D26	D27	D28	D29	D30	D31	D32	
21	D33	D34	D35	D36	**Z5**	D1	D2	D3	
22	D4	D5	D6	D7	D8	D9	D10	D11	
23	D12	D13	D14	D15	D16	D17	D18	D19	36 bit data field 5
24	D20	D21	D22	D23	D24	D25	D26	D27	
25	D28	D29	D30	D31	D32	D33	D34	D35	
26	D36	**Z6**	D1	D2	D3	D4	D5	D6	
27	D7	D8	D9	D10	D11	D12	D13	D14	
28	D15	D16	D17	D18	D19	D20	D21	D22	36 bit data field 6
29	D23	D24	D25	D26	D27	D28	D29	D30	
30	D31	D32	D33	D34	D35	D36	**Z7**	D1	
31	D2	D3	D4	D5	D6	D7	D8	D9	
32	D10	D11	D12	D13	D14	D15	D16	D17	
33	D18	D19	D20	D21	D22	D23	D24	D25	36 bit data field 7
34	D26	D27	D28	D29	D30	D31	D32	D33	
35	D34	D35	D36	**Z8**	D1	D2	D3	D4	
36	D5	D6	D7	D8	D9	D10	D11	D12	
37	D13	D14	D15	D16	D17	D18	D19	D20	36 bit data field 8
38	D21	D22	D23	D24	D25	D26	D27	D28	
39	D29	D30	D31	D32	D33	D34	D35	D36	

Figure 5: A-TRAU 320 bit frame

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 6: The modified ITU-T V.110 80 bit frame padded for 4,8 kbit/s transparent data at intermediate rate 16 kbit/s

Octet No.	Bit number							
	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 7: The ITU-T V.110 80 bit RA1 frame structure

0	0	0	0	0	0	0	0
1	D1	D2	D3	D4	D5	D6	S1
1	D7	D8	D9	D10	F	F	X
1	D11	D12	F	F	D13	D14	S3
1	F	F	D15	D16	D17	D18	S4
1	1	0	1	E4	E5	E6	E7
1	D19	D20	D21	D22	D23	D24	S6
1	D25	D26	D27	D28	F	F	X
1	D29	D30	F	F	D31	D32	S8
1	F	F	D33	D34	D35	D36	S9

F =Fill bits, which are set to 1.

Figure 8: The ITU-T V.110 80 bit frame for 3.6 kbit/s transparent data (8 kbit/s intermediate rate)

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	1	1	0	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

Figure 9: ITU-T V.110 80 bit frame for 2,4 kbit/s transparent data (8 kbit/s intermediate rate)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D2	D2	S1
1	D2	D2	D3	D3	D3	D3	X
1	D4	D4	D4	D4	D5	D5	S3
1	D5	D5	D6	D6	D6	D6	S4
1	0	1	0	E4	E5	E6	E7
1	D7	D7	D7	D7	D8	D8	S6
1	D8	D8	D9	D9	D9	D9	X
1	D10	D10	D10	D10	D11	D11	S8
1	D11	D11	D12	D12	D12	D12	S9

Figure 10: ITU-T V.110 80 bit frame for 1,2 kbit/s transparent data (8 kbit/s intermediate rate)

0	0	0	0	0	0	0	0
1	D1	D1	D1	D1	D1	D1	S1
1	D1	D1	D2	D2	D2	D2	X
1	D2	D2	D2	D2	D3	D3	S3
1	D3	D3	D3	D3	D3	D3	S4
1	1	0	0	E4	E5	E6	E7 (note)
1	D4	D4	D4	D4	D4	D4	S6
1	D4	D4	D5	D5	D5	D5	X
1	D5	D5	D5	D5	D6	D6	S8
1	D6	D6	D6	D6	D6	D6	S9

NOTE: In order to maintain compatibility with Recommendation X.30 (I.461), for the 600 bit/s user rate bit E7 is coded to enable the 4×80 bit multiframe synchronisation. To this end, E7 in the fourth 80 bit frame is set to binary '0'. See Table 6 of ITU-T Recommendation V.110(09/92).

Figure 11: ITU-T V.110 80 bit frame for 600 bit/s transparent data (8 kbit/s intermediate rate)

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

Figure 12: The ITU-T V.110 32 bit 48 kbit/s frame structure (64 kbit/s intermediate rate)

D1	D2	D3	D4	D5	D6	D7	1
D8	D9	D10	D11	D12	D13	D14	1
D15	D16	D17	D18	D19	D20	D21	1
D22	D23	D24	D25	D26	D27	D28	1
D29	D30	D31	D32	D33	D34	D35	1
D36	D37	D38	D39	D40	D41	D42	1
D43	D44	D45	D46	D47	D48	D49	1
D50	D51	D52	D53	D54	D55	D56	1

Figure 13: The ITU-T V.110 64 bit 56 kbit/s frame structure (64 kbit/s intermediate rate, option without status bits)

3GPP TSG CN WG3 Meeting #24
Helsinki, Finland. 29th July – 2nd August 2002

Tdoc ⌘ N3-020683

CR-Form-v7

CHANGE REQUEST

⌘	**44.021**	**CR 006**	⌘ **rev**	**-**	⌘ Current version:	**4.0.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [X] Core Network [ ]

Title: ⌘	Correction of protocol stacks in annex A		
Source: ⌘	TSG_CN WG3		
Work item code: ⌘	TEI [CS Data]	***Date:*** ⌘	30/07/2002
Category: ⌘	**F**	***Release:*** ⌘	Rel-4
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *Rel-4 (Release 4)* *Rel-5 (Release 5)* *Rel-6 (Release 6)*

Reason for change: ⌘	This CR updates the protocol stacks in annex A in order to reflect the following decision in 3GPP: • removal of S reference poni as internal interface in the MS • removal of Fax NT in GERAN A/Gb mode • removal of BS 30 NT • correction of RA relay functions
Summary of change: ⌘	See attached pages
Consequences if not approved: ⌘	Inconsistency with other specs (e.g. 43.010) and errorneous specification of the protocol stacks.

Clauses affected: ⌘				
	Y	**N**		
Other specs affected: ⌘		X	Other core specifications ⌘	
		X	Test specifications	
		X	O&M Specifications	
Other comments: ⌘				

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

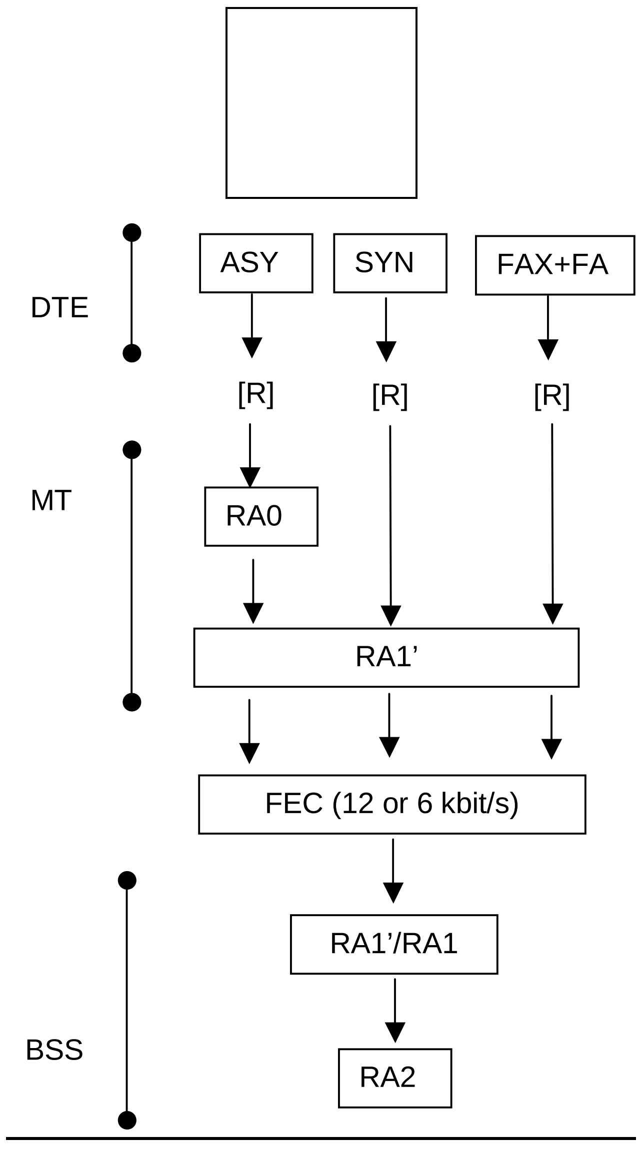
2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

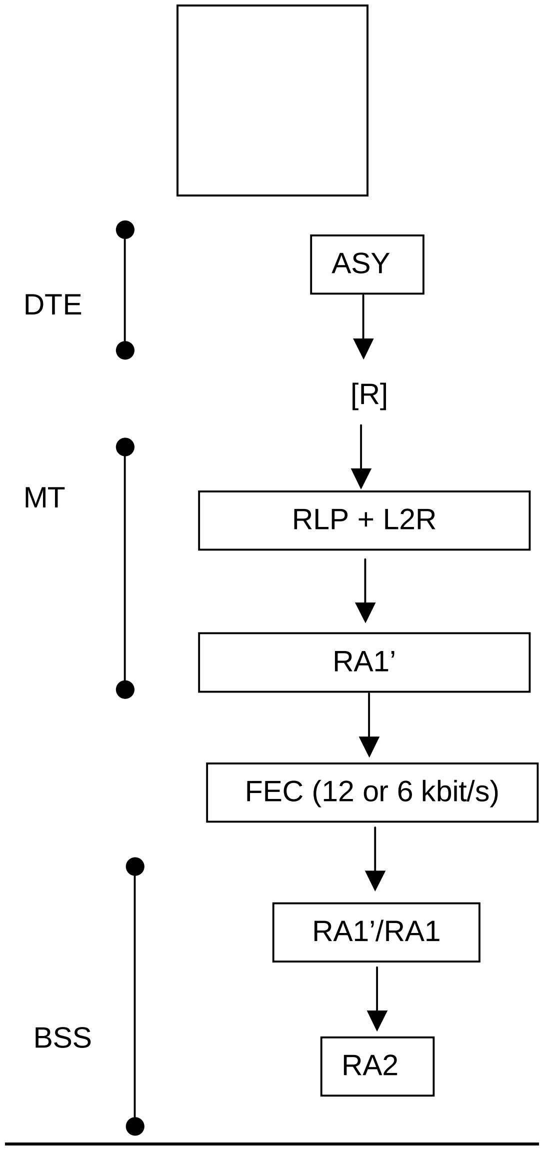
Annex A (Informative): Stacks of rate adaptation

A.1 Stacks of rate adaptation for 9,6/4,8 kbit/s single slot operation

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

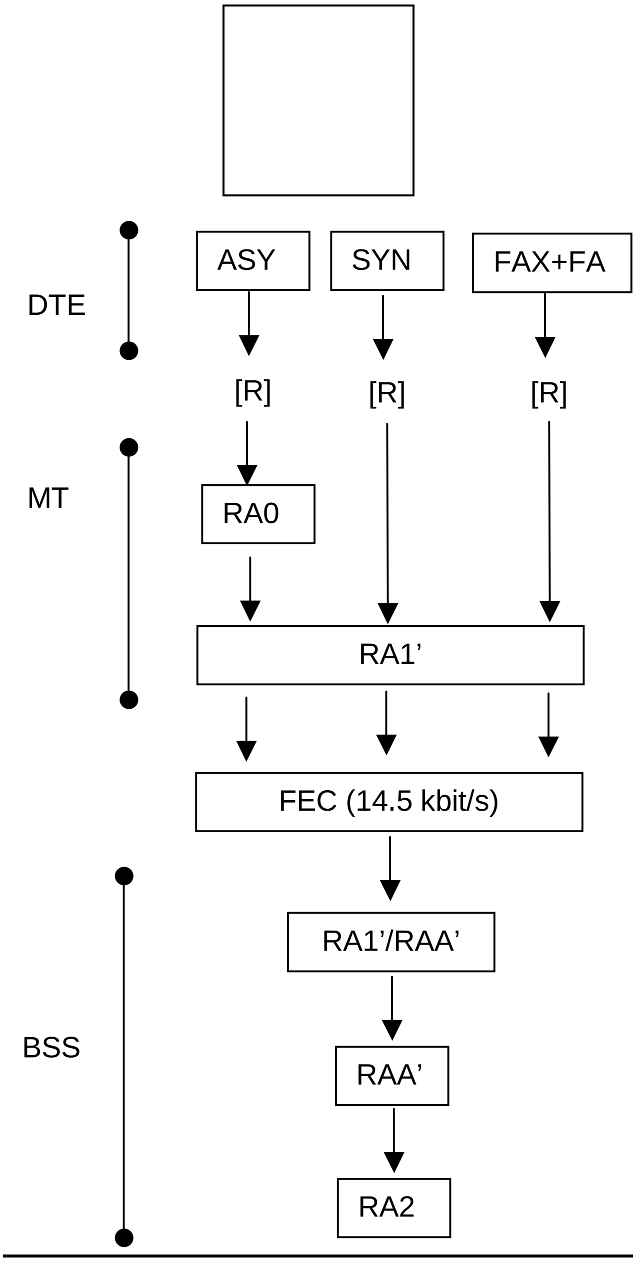


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

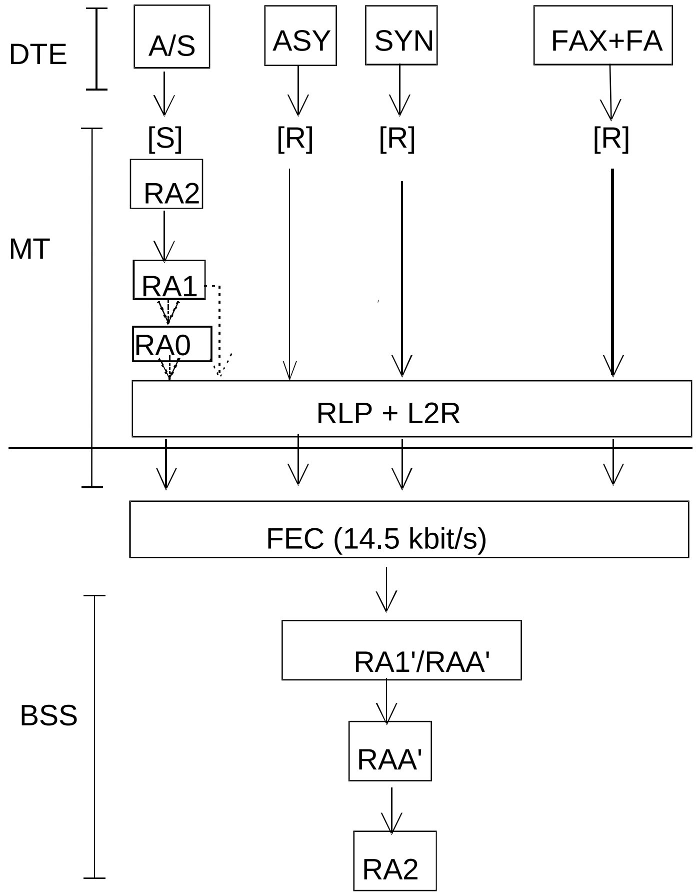


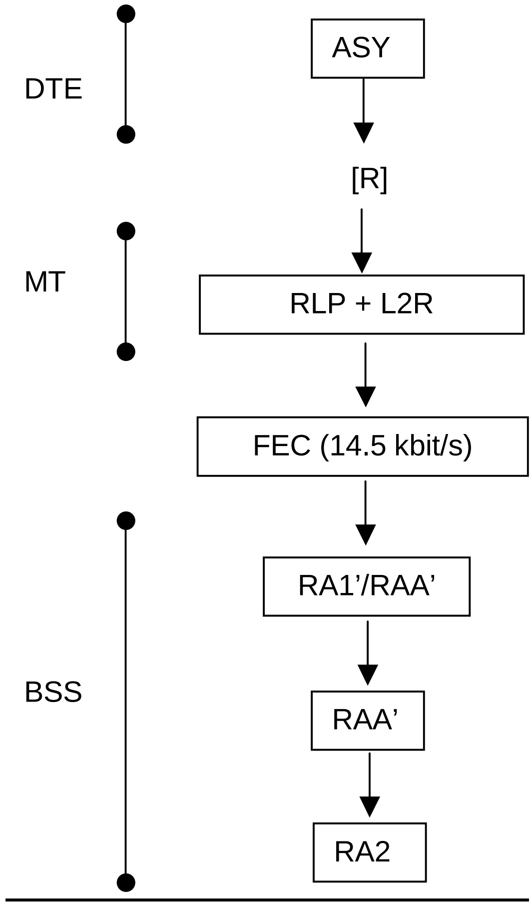
A.2 Stacks of rate adaptation for 14,4 kbit/s single slot operation

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



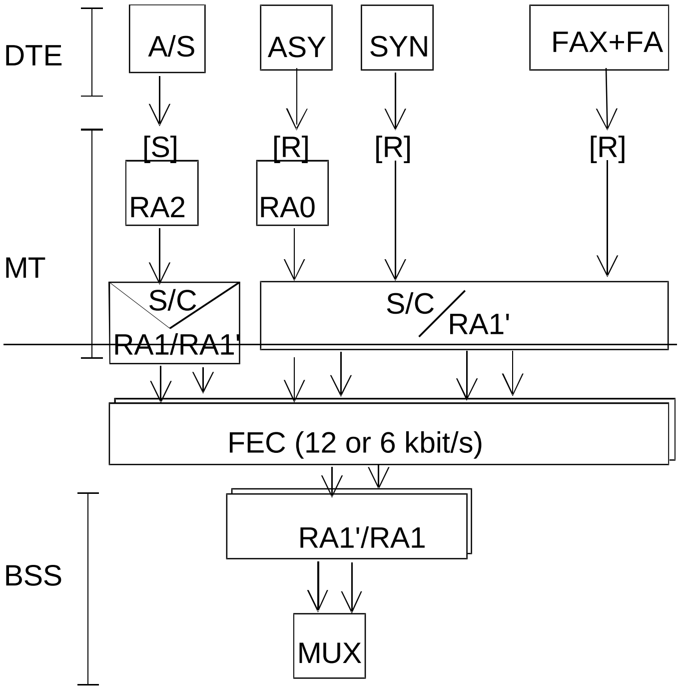
For the non-transparent services, the following stacks of rate adaptation and functions are possible:

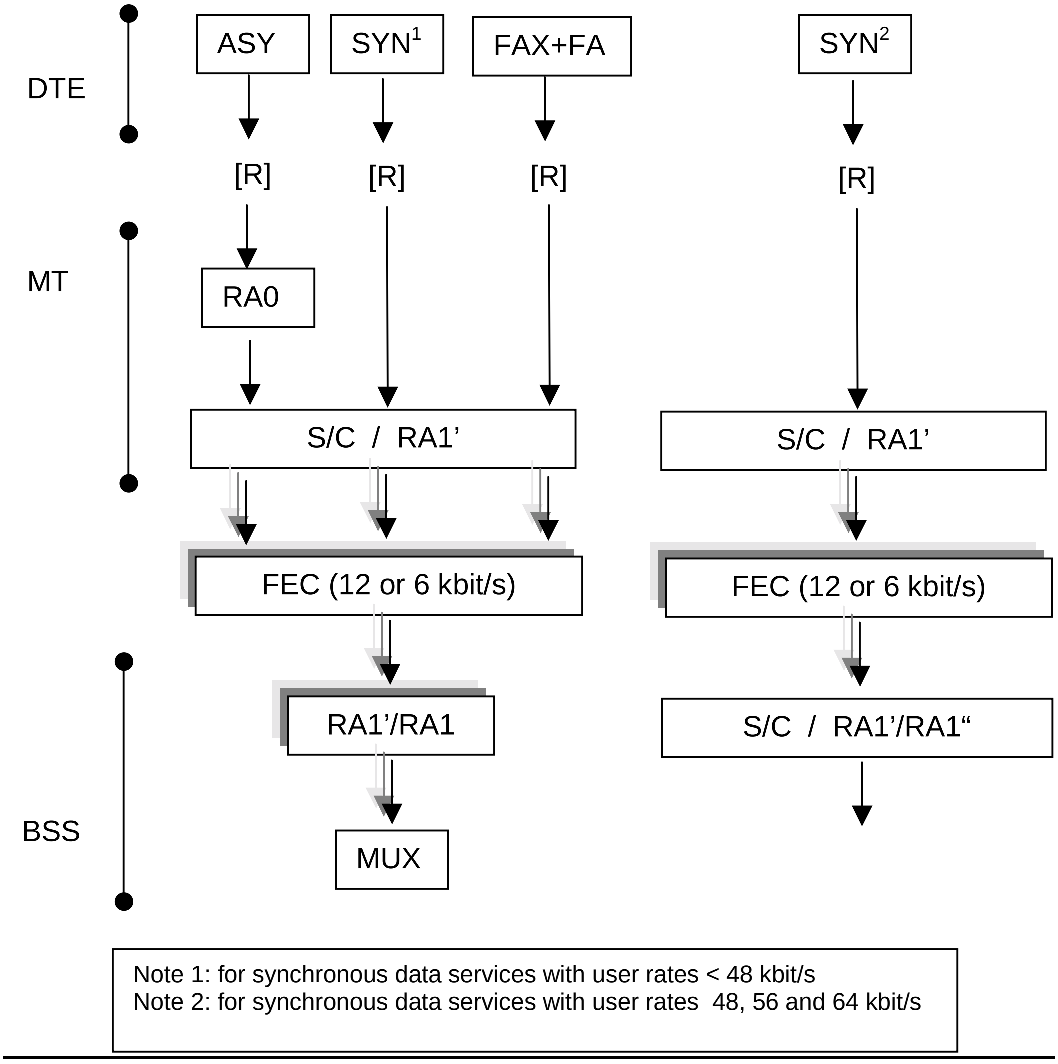



DTE
ASY
[R]
MT
RLP + L2R
FEC (14.5 kbit/s)
RA1'/RAA'
BSS
RAA'
RA2

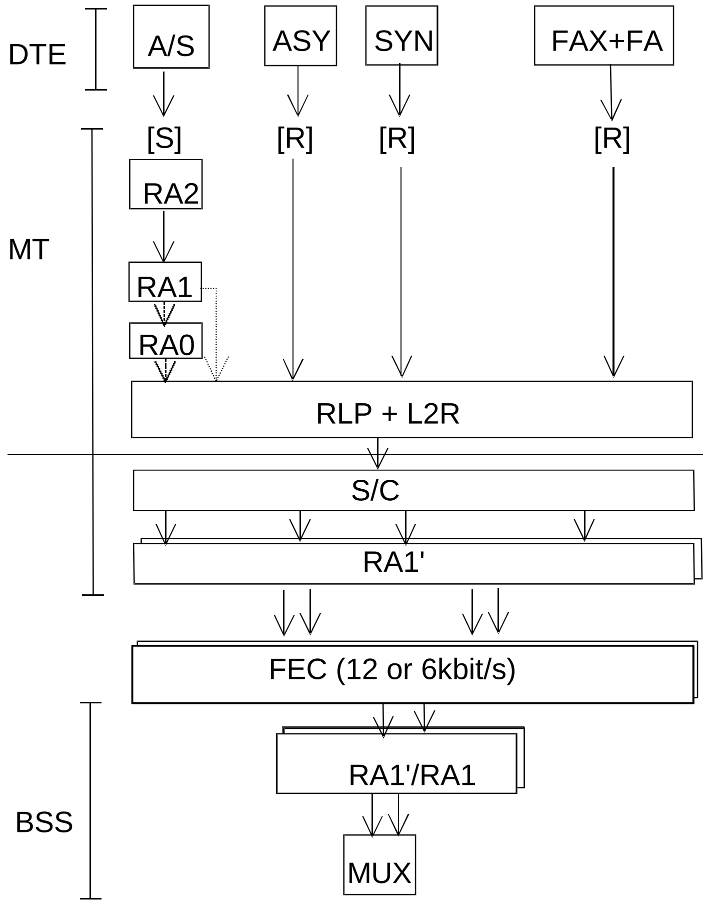
A.3 Stacks of rate adaptation for 9,6/4,8 kbit/s multi slot operation

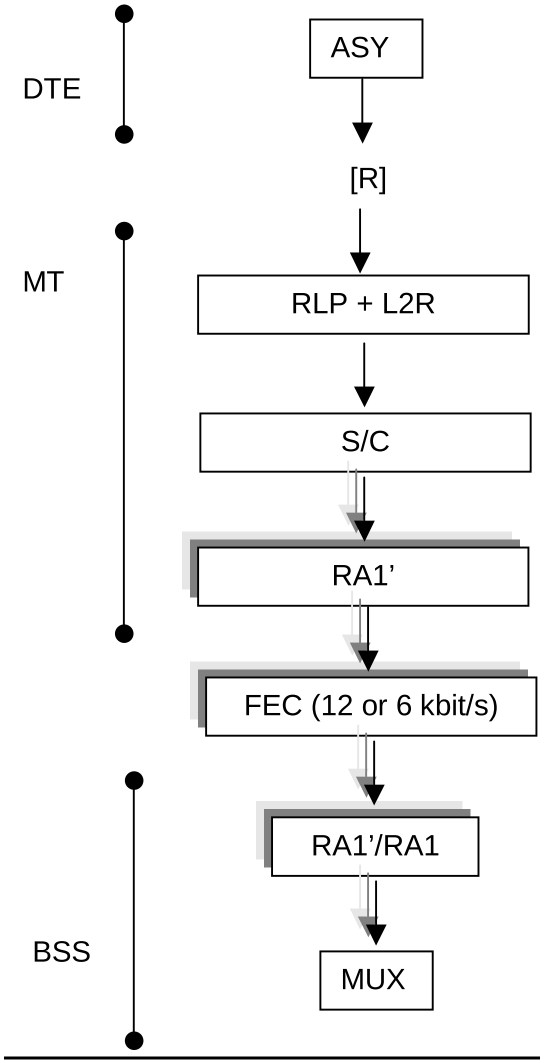
For transparent data services, the following stacks of rate adaptation are possible:




DTE
MT
BSS
ASY
SYN1
FAX+FA
SYN2
[R]
[R]
[R]
[R]
RA0
S/C / RA1'
S/C / RA1'
FEC (12 or 6 kbit/s)
FEC (12 or 6 kbit/s)
RA1'/RA1
S/C / RA1'/RA1"
MUX
Note 1: for synchronous data services with user rates < 48 kbit/s
Note 2: for synchronous data services with user rates 48, 56 and 64 kbit/s

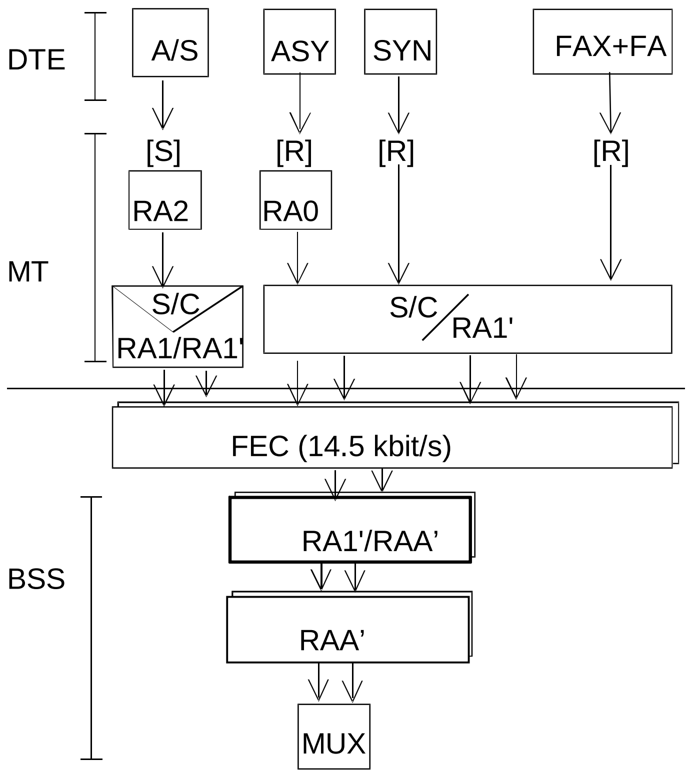
For the non-transparent services, the following stacks of rate adaptation and functions are possible:

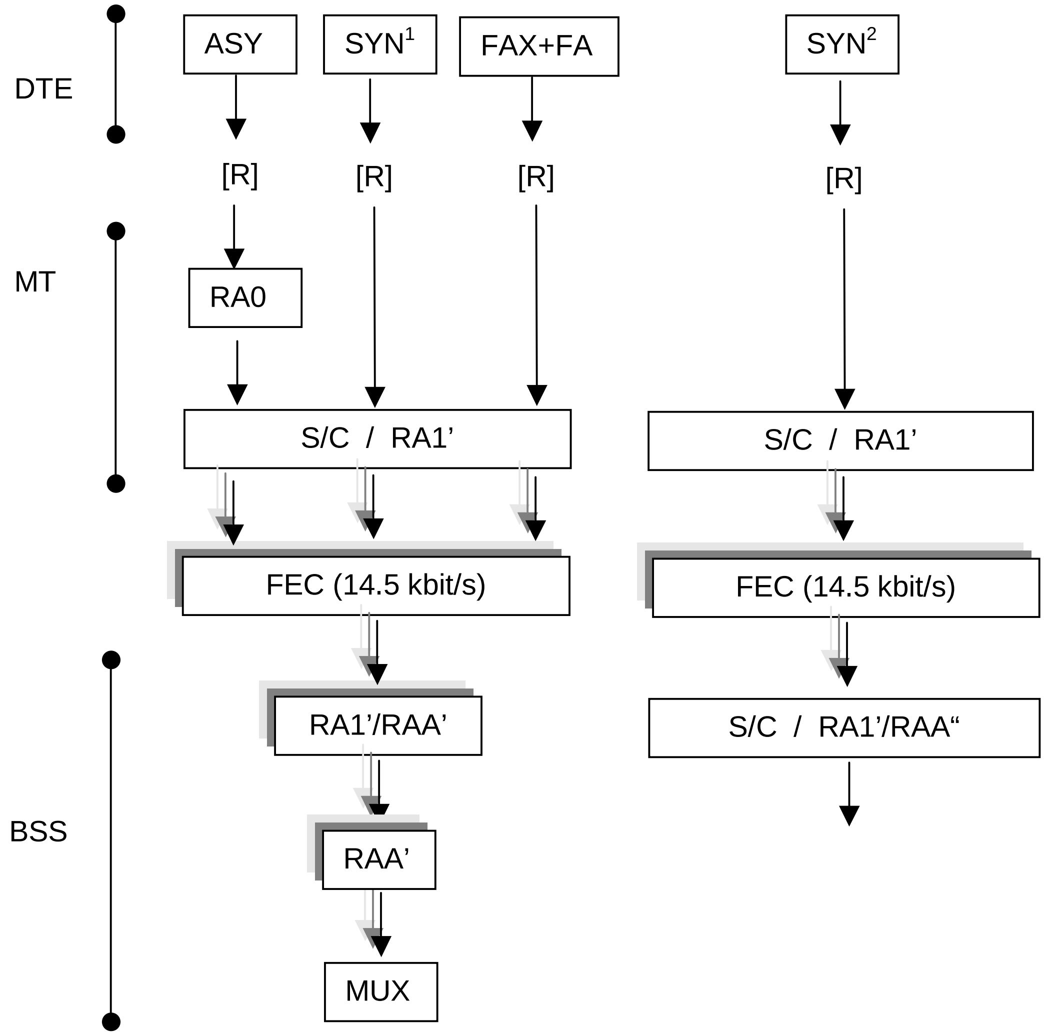



DTE
ASY
[R]
MT
RLP + L2R
S/C
RA1'
FEC (12 or 6 kbit/s)
BSS
RA1'/RA1
MUX

A.4 Stacks of rate adaptation for 14,4 kbit/s multi slot operation

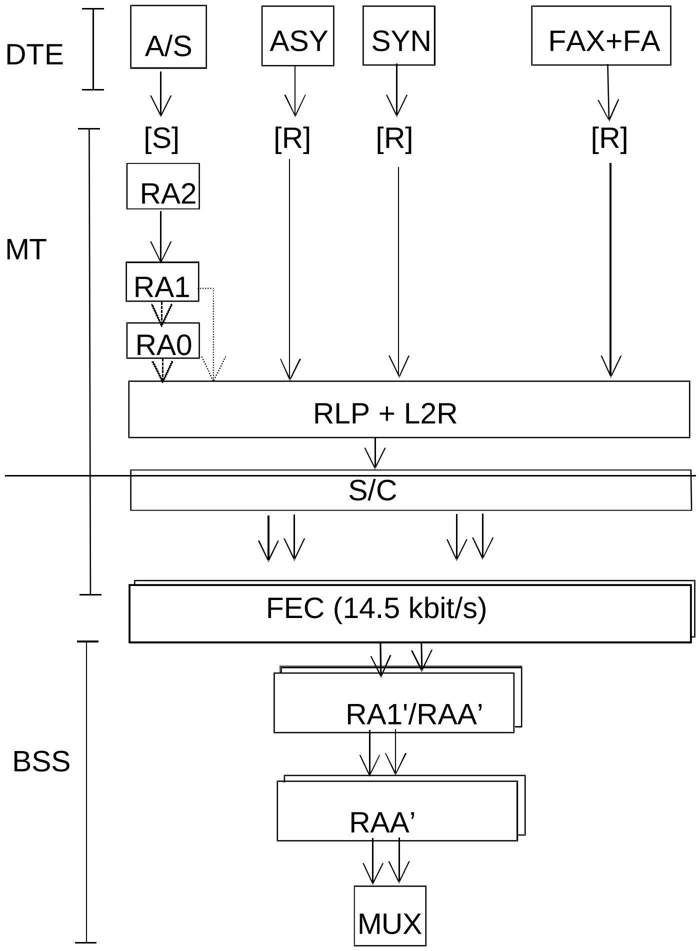
For transparent data services, the following stacks of rate adaptation are possible:

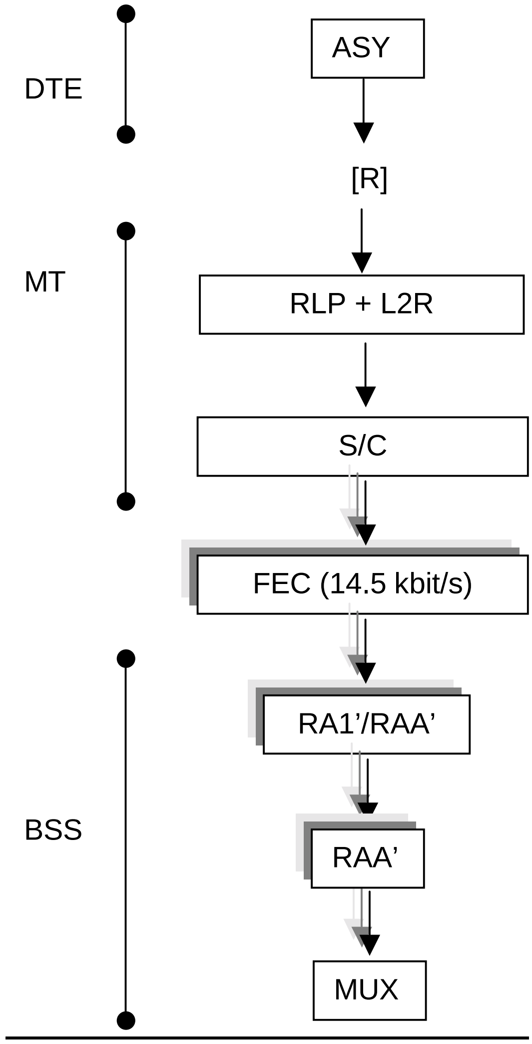




Note 1: for synchronous data services with user rates < 64 kbit/s
Note 2: for synchronous data services with user rate 64 kbit/s

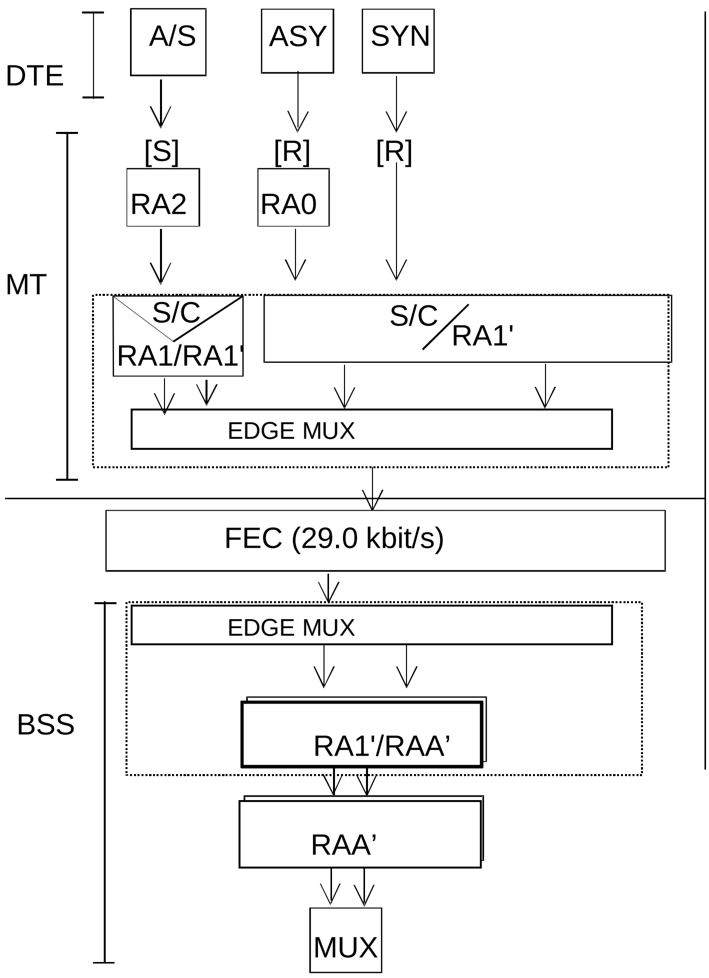
For the non-transparent services, the following stacks of rate adaptation and functions are possible:

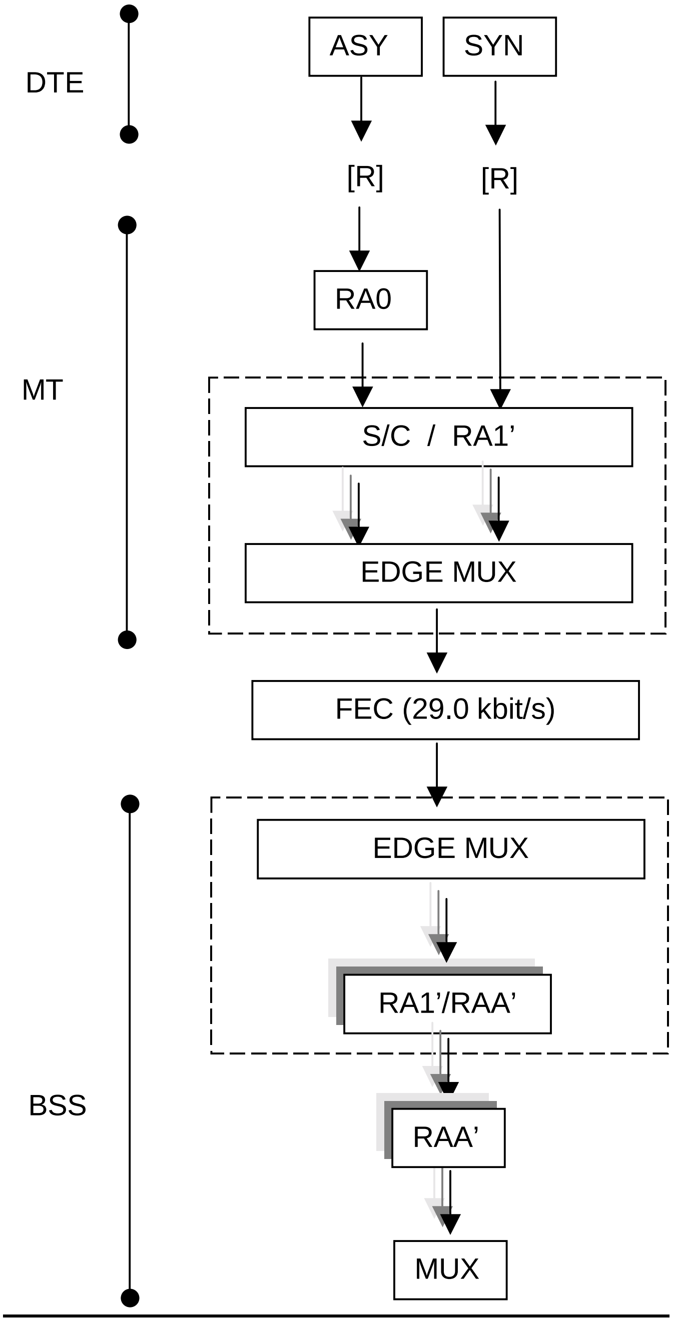



DTE
ASY
[R]
MT
RLP + L2R
S/C
FEC (14.5 kbit/s)
BSS
RA1'/RAA'
RAA'
MUX

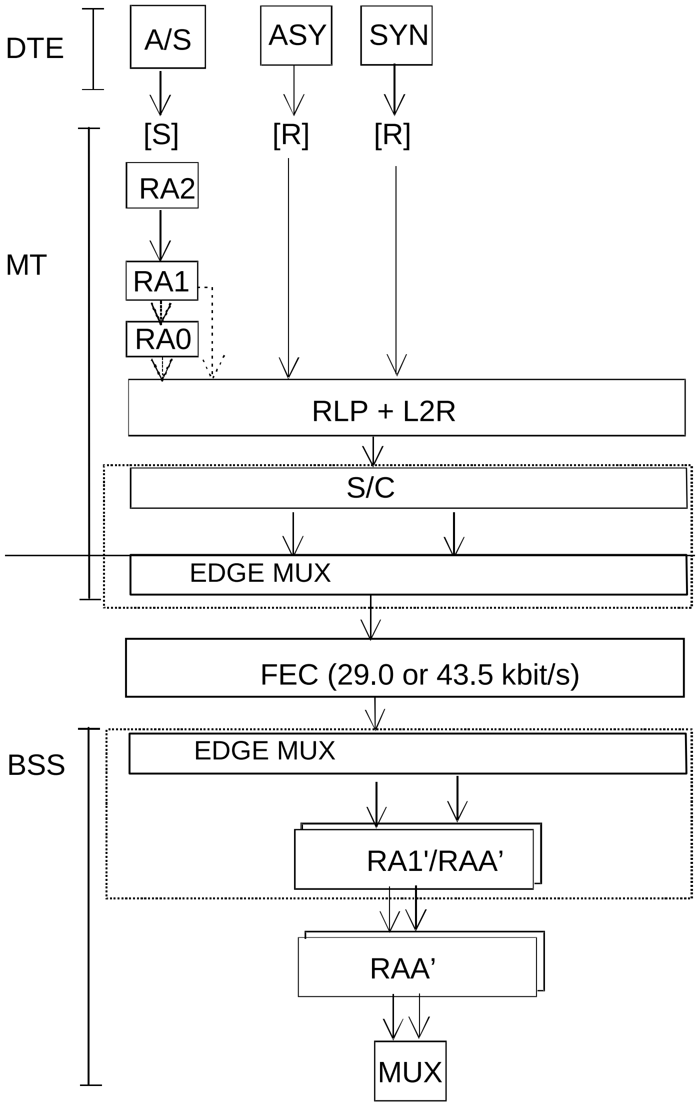
A.5 Stacks of rate adaptation for EDGE channels TCH28.8 and TCH/F43.2 (NT only)

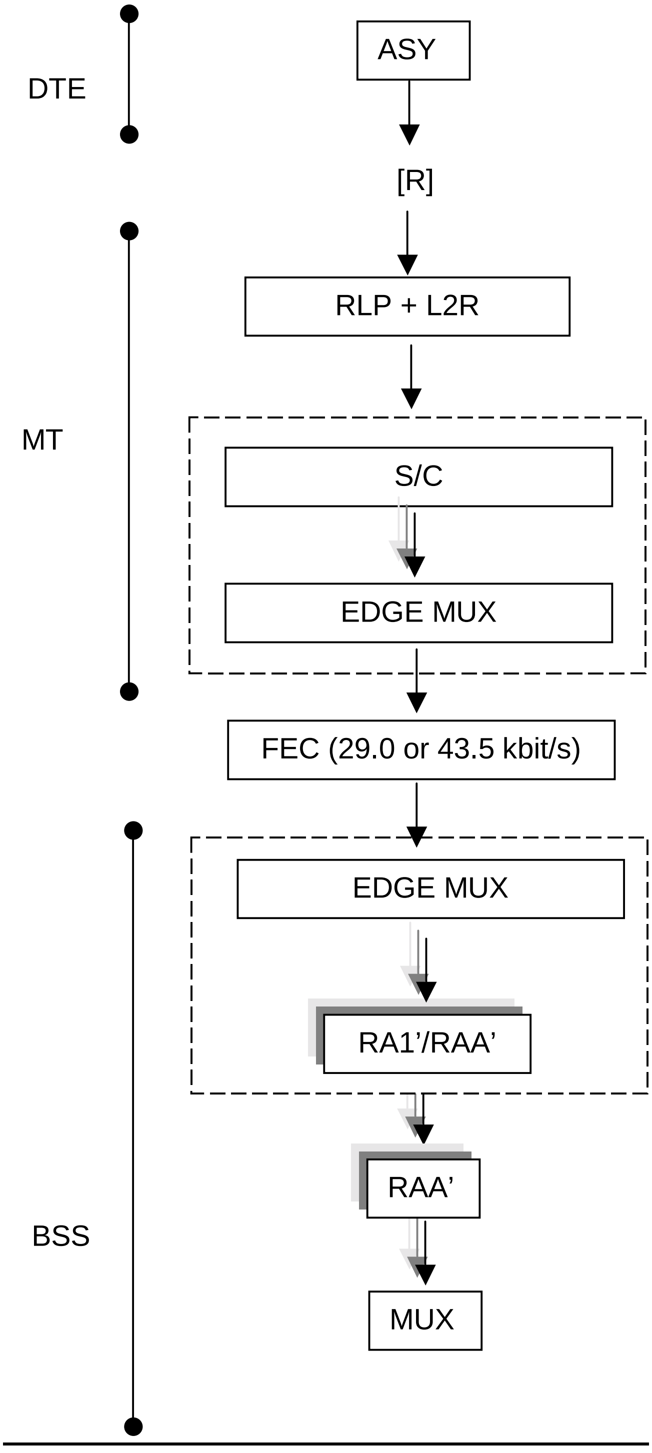
For transparent data services, the following stacks of rate adaptation are possible:




DTE
ASY
SYN
[R]
[R]
MT
RA0
S/C / RA1'
EDGE MUX
FEC (29.0 kbit/s)
BSS
EDGE MUX
RA1'/RAA'
RAA'
MUX

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




DTE
ASY
[R]
MT
RLP + L2R
S/C
EDGE MUX
FEC (29.0 or 43.5 kbit/s)
BSS
EDGE MUX
RA1'/RAA'
RAA'
MUX