3GPP TSG CN Plenary
Meeting #10, Bangkok, Thailand
6th – 8th December 2000

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Source: **TSG CN WG 3**

Title: **CRs to R99 Work Item T.E.I**

Agenda item: **7.6**

Document for: **APPROVAL**

Introduction:

This document contains **5** CRs on **R99 Work Item "T.E.I",** that have been agreed by TSG CN WG3, and are forwarded to TSG CN Plenary meeting #10 for approval.

Spec	CR	Rev	Doc-2nd-	Phas	Subject	Cat	Version-
03.10	A013		N3-000535	R99	TCH/F32.0 reference models	F	8.2.0
04.21	A020		N3-000537	R99	Removal of the 1200/75 bit/s data rate and general clean-up	F	8.2.0
08.20	A009		N3-000539	R99	Removal of 1200/75 bit/s data rate and clean-up	F	8.2.0
27.001	041		N3-000591	R99	Correction for 32 kbit/s UDI/RDI	F	3.6.0
27.001	042		N3-000592	Rel-4	Correction for 32 kbit/s UDI/RDI	A	4.1.0

3GPP TSG-CN3 Meeting #13
Stuttgart, Germany 16th – 20th October 2000

Document ***N3-000535***
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or for SMG, use the format P-99-xxx

CHANGE REQUEST

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03.10 CR A013 Current Version: 8.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-CN #10	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑	for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [ ] Core Network [X]
(at least one should be marked with an X)

Source: TSG CN WG3 **Date:** 20/10/00

Subject: TCH/F32.0 reference models

Work item: Technical enhancements and improvements (TEI)

Category:				**Release:**	
	F	Correction	X	Phase 2	
	A	Corresponds to a correction in an earlier release		Release 96	
(only one category	B	Addition of feature		Release 97	
Shall be marked	C	Functional modification of feature		Release 98	
With an X)	D	Editorial modification		Release 99	X
				Release 00	

Reason for change: Addition of missing reference models.

Clauses affected: 6

Other specs Affected:			
Other 3G core specifications		→ List of CRs:	
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

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6.6 Limited set of GSM PLMN connection types **(for EDGE channels)**

Figure 8 provides the information transfer protocol models for the identified set of GSM PLMN connection types for support of TCH/F28.8 or TCH/F43.2 and figure 9 the models for the support of TCH/F32.0. The description of models given in subclause 6.4 applies also to figures 8 and 9.

When a TCH/F28.8 channel is used in multislot configurations, multiple EDGE multiplexing functions are applied on both sides of the air-interface; i.e. one multiplexing function — on each side of the air interface — is associated with each air-interface channel.

When TCH/F32.0 channels are used in double slot configurations, no rate adaptation is applied as the PLMN offers a '64 kbit/s pipe' between TE and an external network. When TCH/F32.0 channels are used in single slot configurations, the ITU-T I.460 rate adaptation is applied. (For details refer to GSM 04.21).

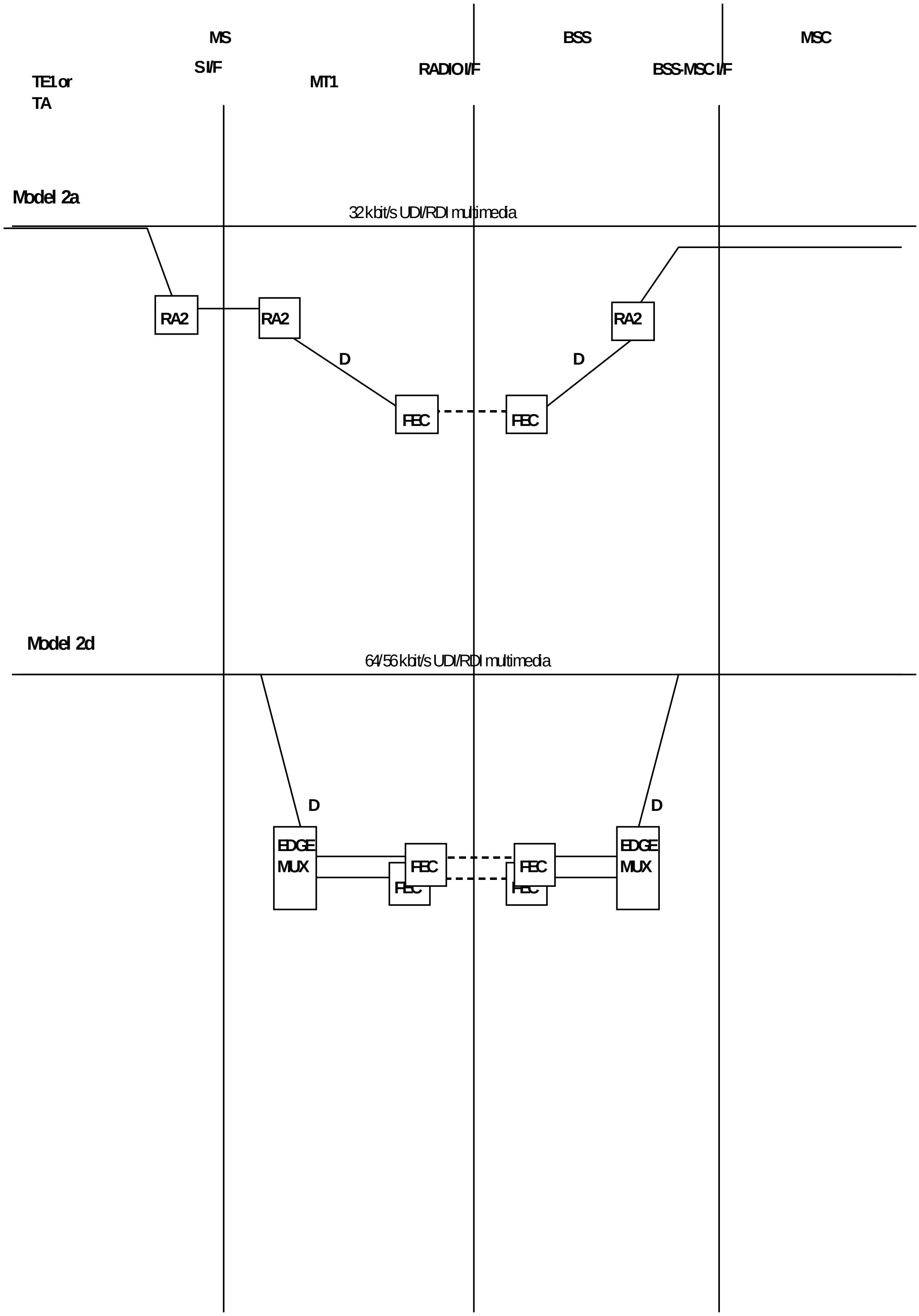

Figure 9: Information transfer protocol models for GSM PLMN connections using TCH/F32.0 EDGE channels

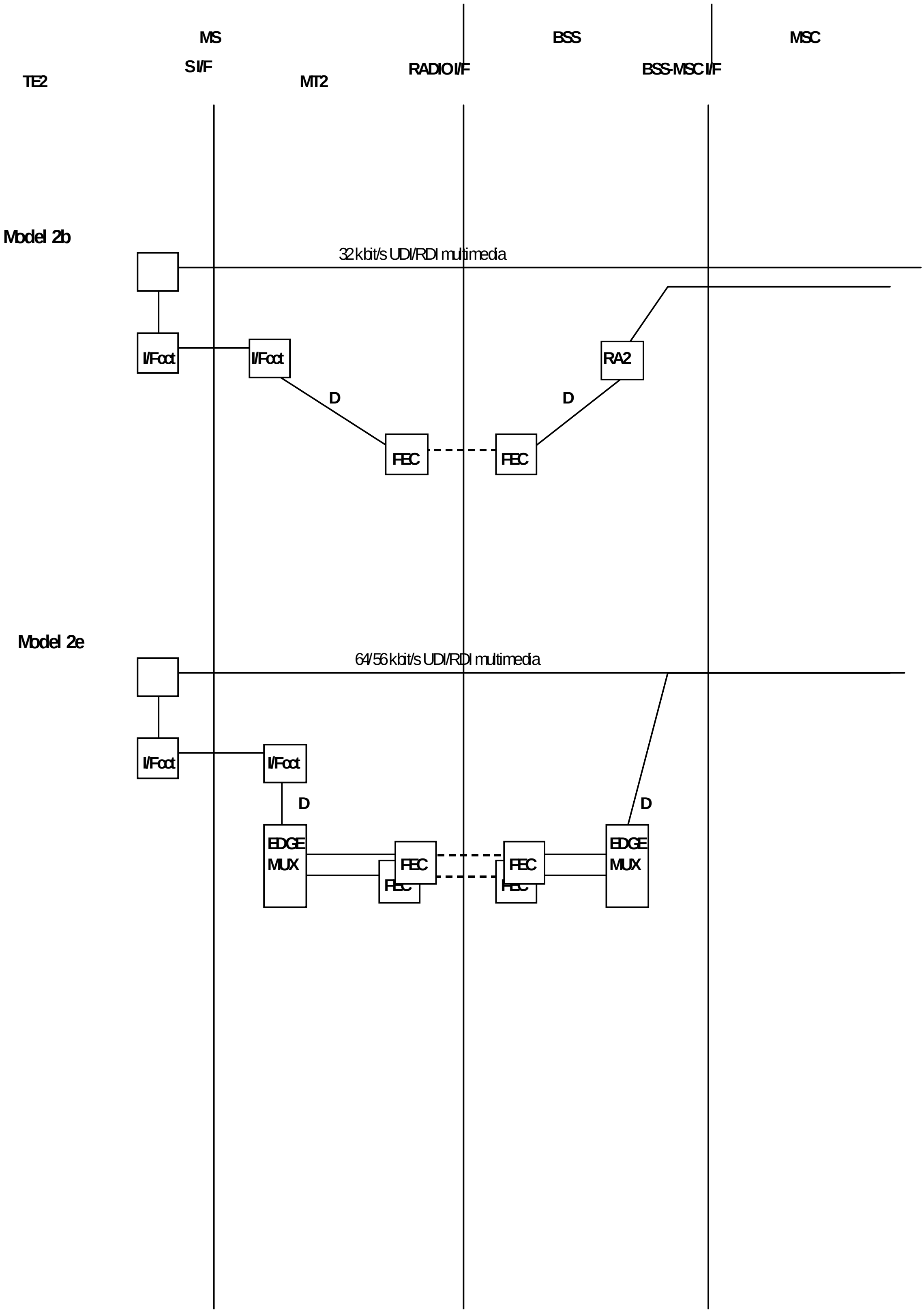

Figure 9 (continued) : Information transfer protocol models for GSM PLMN connections using TCH/F32.0 EDGE channels

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Stuttgart, Germany 16th – 20th October 2000

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04.21	**CR**	**A020**	Current Version:	8.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

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Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio		Core Network	X

Source: TSG CN WG3 **Date:** 20/10/00

Subject: Removal of the 1200/75 bit/s data rate and general clean-up

Work item: Technical enhancements and improvements (TEI)

Category:				**Release:**		
	F	Correction	X		Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
Shall be marked	C	Functional modification of feature			Release 98	
With an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: Removal of the 1200/75 bit/s data rate, correction of headers and specification clean-up.

Clauses affected: 2 - 13

Other specs Affected:				
	Other 3G core specifications		→ List of CRs:	08.20
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

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3GPP TS 04.21 V8.2.0 DRAFT (2000-09)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Core Network; Digital cellular telecommunications system (Phase 2+); Rate adaption on the Mobile Station - Base Station System (MS - BSS) Interface DRAFT (Release 1999)

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Contents

Foreword 6
1 Scope 7
2 References, Definitions and Abbriviations 7
2.1 References 7
2.2 Definitions 8
2.2 Abbreviations 8
3 General approach 8
3.1 Overview of data rates and configurations 8
4 The RA0 Function 11
4.1 Asynchronous-to-Synchronous Conversion (RA0) 11
4.2 Break signal 11
4.3 Overspeed/Underspeed 11
4.4 Parity Bits 11
4.5 Flow Control 12
5 The RA1 Function 12
5.1 Adaptation of synchronous data rates up to 38,4 kbit/s 12
5.1.1 Network Independent Clocking 13
5.1.1.1 Multiframe Structure 13
5.1.1.2 Encoding and compensation 13
6 The RA1" function 14
6.1 Rate adaptation of 48 kbit/s user rates with DTE/DCE status to 64 kbit/s 14
6.2 Rate adaptation of 56 kbit/s user rate to 64 kbit/s 14
7 The RA2 Function 15
8 The RA1/RA1' Function 15
8.1 Single slot rates 15
8.1.1 Radio interface rate of 14,5 kbit/s 16
8.1.1.1 Multiframe structure over the radio-interface 16
8.1.1.2 Radio-interface data block for TCH/F14.4 channel coding 17
8.1.2 Radio Interface rate of 12 kbit/s 18
8.1.3 Radio Interface rate of 6 kbit/s 19
8.1.4 Radio Interface rate of 3,6 kbit/s (transparent services only) 20
8.1.5 Synchronisation 20
8.1.6 Idle frames 20
8.2 Multislot rates 20
8.2.1 TCH/F14.4 multislot operation 20
8.2.2 AIURs up to 38,4 kbit/s using TCH/F9.6 and TCH/F4.8 channel codings 21
8.2.3 AIURs up to 38,4 kbit/s using TCH/F14.4 channel coding 21
8.2.4 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 5 x 12 kbit/s 21
8.2.5 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 4 x 14,5 kbit/s 22
8.2.6 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s 22
8.2.7 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 4 x 14,5 kbit/s 22
8.2.8 AIUR of 64 kbit/s; Radio interface rate of 6 x 12 kbit/s 23
8.2.9 AIUR of 64 kbit/s; Radio interface rate of 5 x 14,5 kbit/s 23
9 The EDGE multiplexing function 23
9.1 Data block distribution into the substreams by the Multiplexing function; TCH/F28.8 channel coding 24
9.1.1 AIUR of 57.6 kbit/s; Radio interface rate of 2 × 29.0 kbit/s 24
9.2 Data block distribution to the radio interface by the Multiplexing function; TCH/F32.0 channel coding 24
9.2.1 AIUR of 56 kbit/s; Radio interface rate of 2 × 32.0 kbit/s 24
9.2.2 AIUR of 64 kbit/s; Radio interface rate of 2 × 32.0 kbit/s 24
9.3 Data block distribution into the substreams by the Multiplexing function; TCH/F43.2 channel coding 25

10 The RA1' Function....25
10.1 Synchronous user rates up to 9,6 kbit/s....25
10.2 Synchronous user rates from 9,6 kbit/s onward; TCH/F9.6/4.8 channel codings....25
10.3 Synchronous user rates from 9,6 kbit/s onward; TCH/F14.4 channel coding....26
11 The Split/Combine and Padding-functions....26
11.1 Data frame distribution into the substreams/channels by the Split/Combine function....26
11.1.1 Data frame distribution into the substreams/channels by the Split/Combine function (TCH/F9.6 and TCH/F4.8 channel codings)....26
11.1.2 Data block distribution into the substreams by the Split/Combine function (TCH/F14.4 channel coding)....27
11.2 Substream numbering in transparent operation....27
11.2.1 Substream numbering for TCH/F14.4 and TCH/F28.8 channel codings....28
11.3 Substream Synchronisation....28
11.4 Network independent clocking....28
11.4.1 Network Independent Clocking for TCH/F14.4 and TCH/F28.8 channel codings (both single- and multilinks)....28
11.4.1.1 Negative compensation....28
11.4.1.2 Positive compensation....29
11.5 Padding TCH/F frames when the AIUR is not a multiple of 9,6 or 4,8 kbit/s....29
11.5.1 Padding for TCH/F14.4 channel coding....29
11.6 Handling of the E1-E3 bits in multislot operation....29
12 Support of Non-Transparent Bearer Services....30
12.1 Support of non-transparent operation for TCH/F9.6 and TCH/F4.8 channel codings....30
12.2 Support of non-transparent operation for TCH/F14.4 channel coding....31
12.3 Support of non-transparent operation for TCH/F28.8 channel coding....31
12.4 Support of non-transparent operation for TCH/F43.2 channel coding....31
13 Figures on Frame structures....32
Annex A (Informative): Stacks of rate adaptation....37
A.1 Stacks of rate adaptation for 9,6/4,8 kbit/s single slot operation....37
A.2 Stacks of rate adaptation for 14,4 kbit/s single slot operation....39
A.3 Stacks of rate adaptation for 9,6/4,8 kbit/s multi slot operation....41
A.4 Stacks of rate adaptation for 14,4 kbit/s multi slot operation....43
A.5 Stacks of rate adaptation for EDGE channels TCH28.8 and TCH/F43.2 (NT only)....45
Annex B (Informative): An example of mapping Network Independent Clocking information for TCH/F14.4 when the S-interface is deployed....47
Annex C (Informative): Change history....48

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it ~~will be~~is re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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1 Scope

The present document defines the rate adaptation functions to be used in GSM PLMN Mobile Stations (MS)s for adapting terminal interface data rates to the Mobile Station - Base Station System (MS-BSS) interface data rates in accordance with 3GPP TS 03.10 [3].

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

NOTE: This ETS should be considered together with 3GPP TS 08.20 [9] (Rate Adaptation on the BSS-MSC Interface) to give a complete description of PLMN rate adaptation.

2 References, Definitions and Abbriviations

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.

[1] 3GPP TS 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".

[2] 3GPP TS 02.34: "Digital cellular telecommunications system (Phase 2+); High Speed Circuit Switched Data (HSCSD) -Stage 1".

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

[4] 3GPP TS 03.34: "Digital cellular telecommunications system (Phase 2+); High Speed Circuit Switched Data (HSCSD) - Stage 2 Service Description".

[5] 3GPP TS 05.03: "Digital cellular telecommunications system (Phase 2+); Channel coding".

[6] 3GPP TS ~~0~~27.001: "~~Digital cellular telecommunication system (Phase 2+)~~3rd Generation Partnership Project; Technical Specification Group Core Network; General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[7] 3GPP TS ~~0~~27.002: "~~Digital cellular telecommunications system (Phase 2+)~~3rd Generation Partnership Project; Technical Specification Group Core Network; Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[8] 3GPP TS ~~0~~27.003: "~~Digital cellular telecommunications system (Phase 2+)~~3rd Generation Partnership Project; Technical Specification Group Core Network; Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[9] 3GPP TS 08.20: "Digital cellular telecommunication system (Phase 2+); Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

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

[11] ~~CCITT~~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)".

2.2 Definitions

For the purposes of the present document, the following terms and definitions apply.

Overall data stream: The data stream in those parts of the network where the data flow is not split into multiple channels.

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

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

Multislot intermediate rate: Intermediate rate per substream in those parts of the network where the overall data stream is split into substreams.

Intermediate rate: Intermediate rate in the overall data stream.

Substream rate: The user rate including padding, if applicable, on one individual substream

EDGE channel: A general term referring to channels based on 8PSK modulation; i.e. TCH/F28.8, TCH/F32.0, and TCH/F43.2.

2.2 Abbreviations

Abbreviations used in the present document are listed in 3GPP TS 01.04.

3 General approach

3GPP TS 03.10 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 03.10 as part of the connection type.

The rate adaptation functions are RA0, RA1, RA2, RA1', RA1" and RA1/RA1'. The RA0, RA1 and RA2 are equivalent to those functions described in ~~CCITT~~ITU-T recommendation V.110 [11].

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

The RA1" 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 ~~CCITT~~ITU-T recommendation V.110 does not have a name.

The RA1/RA1' is a relay function, used as indicated in 3GPP TS 03.10.

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'**	
			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	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	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	3×14,5 kbit/s	P (note 6)
43.2 kbit/s Note 10	X		3 x 16 kbit/s Note7	Note 8	1×43.2 kbit/s	
48 kbit/s	X		Note 2	Note 2	5×12 kbit/s	
			4 x 16 kbit/s Note7	Note 8	4×14,5 kbit/s	P (note 6)
56 kbit/s			Note 2	Note 2	5×12 kbit/s (note 3)	
			4x16 kbit/s Note7	Note 8	4×14,5 kbit/s	P (note 6)
			Note 9	Note 9	2×32.0 kbit/s	
64 kbit/s			Note 2	Note 2	6×12 kbit/s (note 3)	P (note 1)
					5×14,5 kbit/s	(note 6)
			Note 9	Note 9	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 of the present document.

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

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

NOTE 4: For this rate GSM-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 7: At the network side, RA1'/RA1 not applied; instead a TCH/F14,4-specific adaptation RA1'/RAA' used (3GPP TS 08.20)

NOTE 8: A 320-bit frame format described in 3GPP TS 08.60.

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

NOTE 10: 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 theboth 75 bit/s and 300 bit/s user data signalling rates shall be adapted to a synchronous 600 bit/s stream. The resultant synchronous stream is fed to RA1 or RA1'. The RA0 used in GSM 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 mustshall 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

This function ~~is~~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 ~~CCITT~~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 ~~CCITT~~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 ~~07.01~~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 GSM PLMN connection shall establish a multiframe structure utilizing bit E7 consisting of four frames by setting E7 in every fourth frame to binary 0. This structure is identical to the use of E7 in V.110 (and X.30) except that such a multiframe structure ~~will~~ exists for all user data rates. This frame synchronization ~~will be~~is achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the GSM PLMN connection can be easily recognized and applied based on the code words (in c1, c2, c3, c4 and c5) positioned in bits E4, E5 and E6 of two consecutive V.110 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 ~~will~~ 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 will 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" function

The RA1" function isshall 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 GSM-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 GSM 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

An CCITTITU-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 CCITTITU-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 07.0127.001.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 CCITTITU-T V.110 64 bits frame is constructed using the user data bits received.

The CCITTITU-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 Function

This procedure is based on the RA2 function as specified in ~~CCITT~~ITU-T V.110. It ~~is~~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' Function

The RA1/RA1' function described below ~~is~~shall be used in transparent cases to convert between the intermediate rate and the input rate to the channel coder or the multiplexing function. This conversion also appears on the infrastructure side in both transparent and non-transparent cases as specified in 3GPP TS 08.20 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.

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

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 08.20.

Thirdly, in the 3.6 kbit/s case, half the data bits are discarded. These processes result in modified ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~ITU-T V.110 frame is received/sent from/to the network every 2.5 ms (see 3GPP TS 05.03). 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.

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 05.03). 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 ~~CCITT~~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 ~~07.01~~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

<u>The Network to MS direction:</u>

The status-information is filtered as described in 3GPP TS ~~07.01~~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 ~~CCITT~~ITU-T V.110 60 bit frame is received/sent from/to the network every 5ms (see 3GPP TS 05.03). The RA1/RA1' function ~~will~~ adds/subtracts the 17 bit synchronization pattern and the E1,E2 and E3 bits to/from each ~~CCITT~~ITU-T V.110 80 bit frame as follows:

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

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

is converted into the following a ~~CCITT~~ITU-T V.110 80 bits frame at 16 Kbit/s:

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

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

For a modified ~~CCITT~~ITU-T V.110 60 bit frames received from the 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 08.20 in the non transparent case.

For modified ~~CCITT~~ITU-T V.110 60 bit frames transmitted over the network, 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 ~~CCITT~~ITU-T V.110 60 bit frame is received/sent from/to the network every 10 ms (see 3GPP TS 05.03). The RA1/RA1' function ~~will~~ adds/subtracts the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ~~CCITT~~ITU-T V.110 80 bit frame as follows:

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

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

is converted into the following ~~a~~ ~~CCITT~~ITU-T V.110 80 bits frame at 8 Kbit/s:

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

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

For a modified ~~CCITT~~ITU-T V.110 60 bit frames received from the 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 08.20 in the non transparent case.

For modified ~~CCITT~~ITU-T V.110 60 bit frames transmitted over the 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.

~~It should be noted that t~~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 ~~CCITT~~ITU-T V.110 36 bit frame is received/sent from/to the network every 10ms (see 3GPP TS 05.03 [3]). The RA1/RA1' function ~~will~~ adds/subtracts the 17 bit synchronization pattern and the E1,E2 and E3 bits to/from each ~~CCITT~~ITU-T V.110 80 bit frame as follows:

The modified ~~CCITT~~ITU-T V.110 36 bits frame received/sent from/to the radio interface at 3.6 Kbit/s,

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 CCITT~~ITU-T V.110 80 bits frame at 8 Kbit/s:

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

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

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 ~~07.01~~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 ~~CCITT~~the 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 AIURs up to 38,4 kbit/s using TCH/F9.6 and TCH/F4.8 channel codings

Intermediate rate/AIUR	Radio interface rate
16 kbit/s / 9,6 kbit/s	2×6 kbit/s
32 kbit/s / 14,4; 19,2 kbit/s	2×12 or 3×6 or 4×6 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 AIURs up to 38,4 kbit/s using TCH/F14.4 channel coding

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

For AIURs 14,4 and 28,8 kbit/s the 36 data bits in the 80-bit V.110 intermediate rate frames are extracted and sent through the substreams in data blocks containing eight 36-bit frames as described in subclause 8.1. 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 and 8.2.1.

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 AIUR of 48 kbit/s; Intermediate rate of 64 kbit/s; Radio interface rate of 5 x 12 kbit/s

One modified ~~CCITT~~ITU-T V.110 60 bit frame (Figure 5) is received/sent from/to a TCH/F every 5 ms (see 3GPP TS 05.03) resulting in an radio-interface rate of 12 kbit/s per channel.

One 60-bit radio-interface frame is converted into two ~~CCITT~~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 AIUR of 56 kbit/s; Intermediate rate of 64 kbit/s

Radio interface rate of 5 × 12 kbit/s

One modified ~~CCITT~~ITU-T V.110 60 bit frame (Figure 10) is received/sent from/to the network every 5 ms (see 3GPP TS 05.03) resulting in a radio-interface rate of 12 kbit/s per channel.

A modified ~~CCITT~~ITU-T V.110 60 bits radio-interface frame:

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 ~~CCITT~~ITU-T V.110 64 bits frame at 64 kbit/s:

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 AIUR of 64 kbit/s; Radio interface rate of 6 x 12 kbit/s

One modified ~~CCITT~~ITU-T V.110 60 bit frame (Figure 10) is received/sent from/to the network every 5 ms (see 3GPP TS 05.03) resulting in an radio-interface rate of 12 kbit/s per channel.

A modified ~~CCITT~~ITU-T V.110 60 bits radio-interface frame:

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.

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, 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 ~~is included~~ at MS and BTS (3GPP TS 08.20). 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 bit 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~~is~~ RA1' function ~~is~~described below shall 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

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 ~~CCITT~~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/F9.6/4.8 channel codings

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

Modified ~~CCITT~~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 5 and 7. For description of the padding procedure, please refer to clause 11 of the present document.

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				

The format used for transferring a synchronous data stream over the radio-interface is a multiframe consisting of 31 data blocks. 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, status information, and NIC-codes as described in subclauses 8.1.1.1 and 8.2.1. The status information carried by the M2-sequence(s) is interpreted as specified in 3GPP TS ~~07.01~~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. For the exact NIC-procedures refer to subclause 11.5.1.

11 The Split/Combine and Padding-functions

The~~se~~ split/combine and padding functions ~~are associated~~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 08.20, Clause 10) — 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).

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) 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.

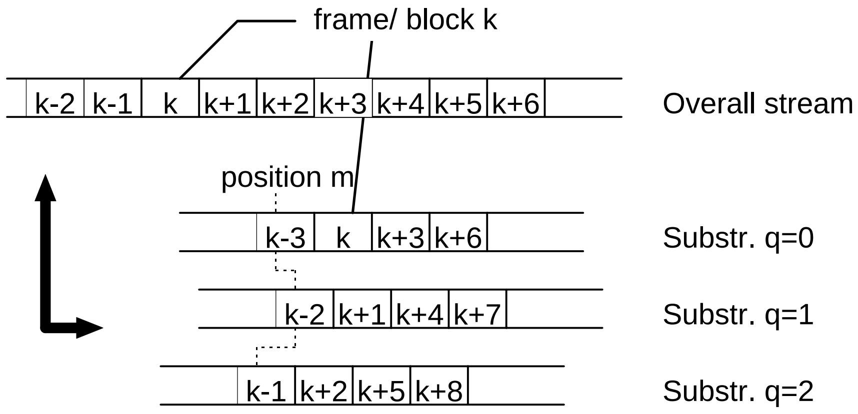


Figure 2a: Distribution of data frames or data blocks into the substreams in transparent operation

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).

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 ~~must~~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 subclause 10.2.

11.2.~~1~~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).

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 ~~07.01~~27.001.

11.4 Network independent clocking

The data frames carrying an NIC-multiframe (subclause 5.1.1) 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) 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.

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/s

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'.

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)

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)

11.5.1 Padding for TCH/F14.4 channel coding

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

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~~s~~ 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 ~~CCITT~~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 ~~CCITT~~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 05.03). 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 ~~07.01~~27.001, ~~07.02~~27.002, and ~~07.03~~27.003~~2~~).

The first bit of each RLP frame to be transmitted ~~will~~ corresponds to the first bit (D1) of the first 60 bit frame in a four frame sequence and the last bit ~~will~~ 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 ~~07.01~~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 ~~will be~~are transmitted. This frame ~~will be~~is discarded by the distant RLP function, due to FCS failure, but ~~will~~ 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 ~~will~~ 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 ~~are~~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 08.20

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame ~~will be~~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~~ will~~ 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 ~~are~~shall be used as described below. The 576-bit RLP-frames ~~are~~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 08.20

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame ~~will be~~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 ~~are~~shall be used as described below. The 576-bit RLP-frames ~~are~~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 08.20

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame ~~will be~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~ITU-T V.110 60 bit frame for a padded 11,2 kbit/s transparent data frame carrying 8.0 kbit/s with padding

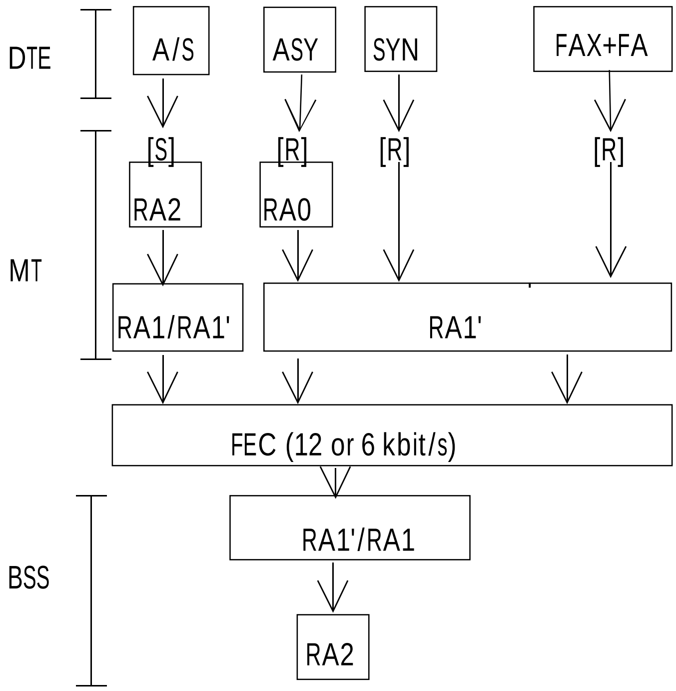
D1	D2	D3	D4	D5	D6
D7	D8	D9	D10	D11	D12
D13	D14	D15	D16	D17	D18
D19	D20	D21	D22	D23	D24
D25	D26	D27	D28	D29	D30
D31	D32	D33	D34	D35	D36

Figure 17: Modified ~~CCITT~~ITU-T V.110 36-bit frame received/sent from/to the network at 14,4 kbit/s

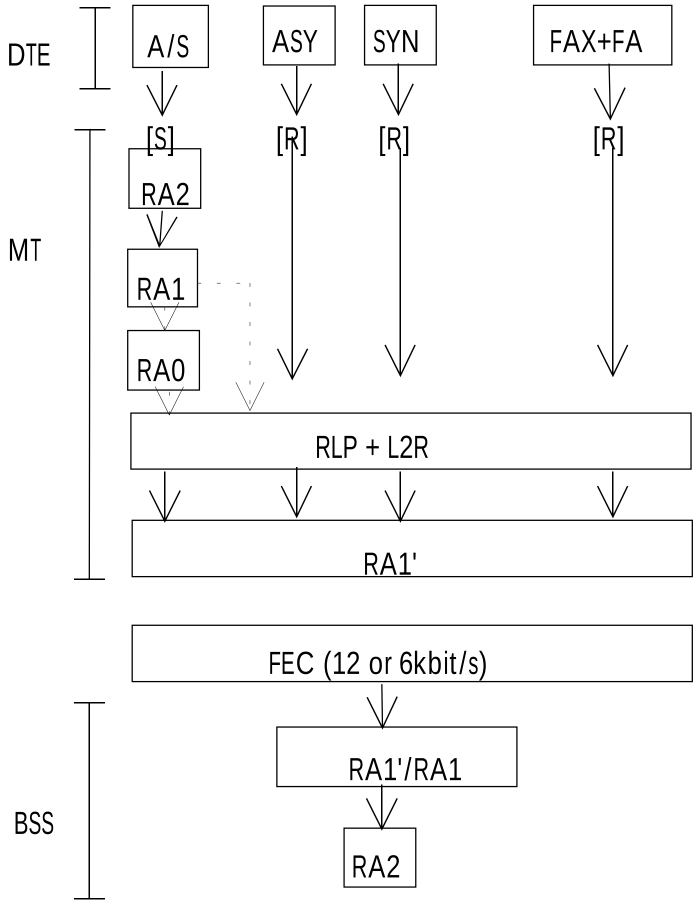
Annex A (Informative): Stacks of rate adaptation

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:

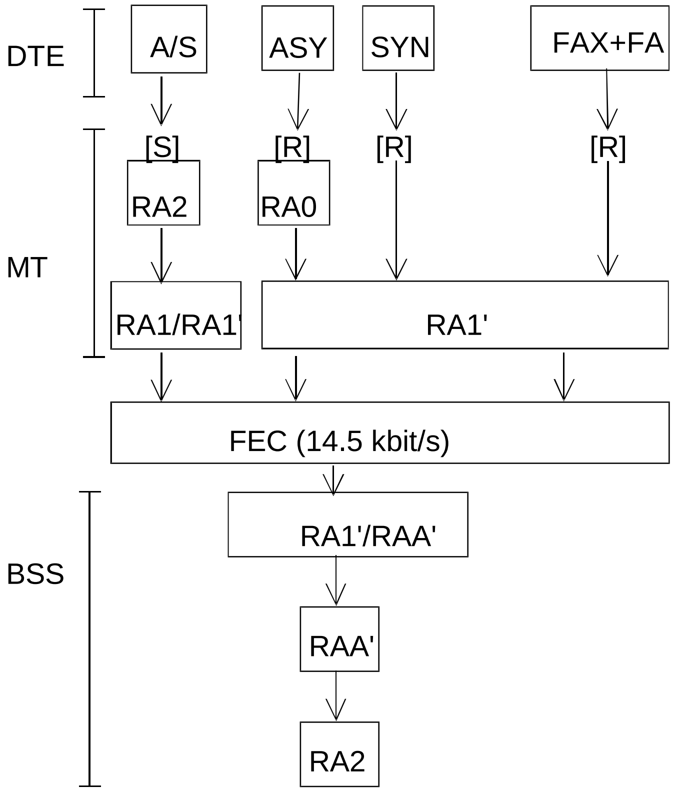


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

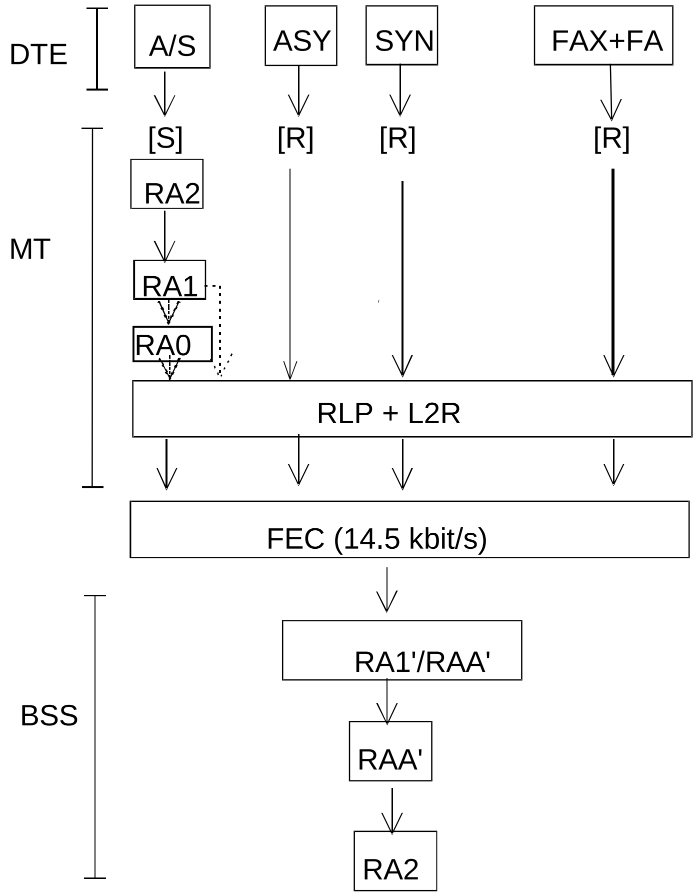


A.2 Stacks of rate adaptation for 14,4 kbit/s single slot operation

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

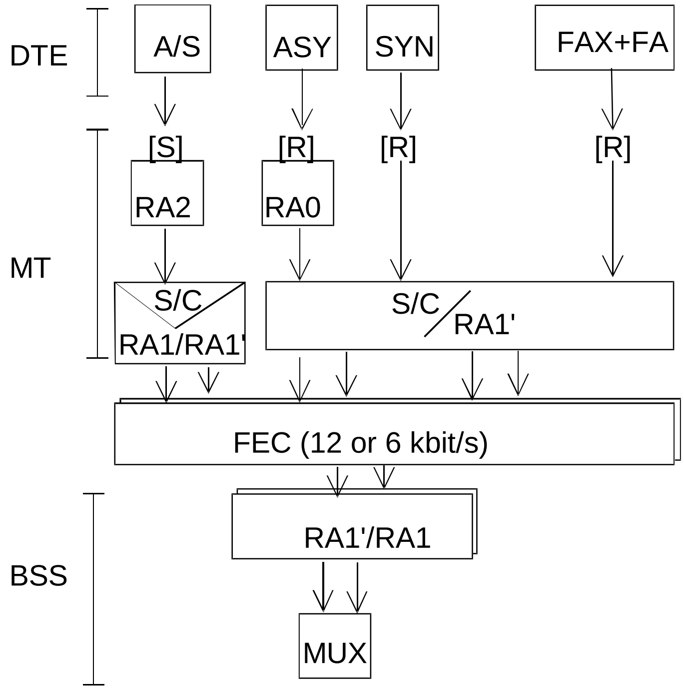


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

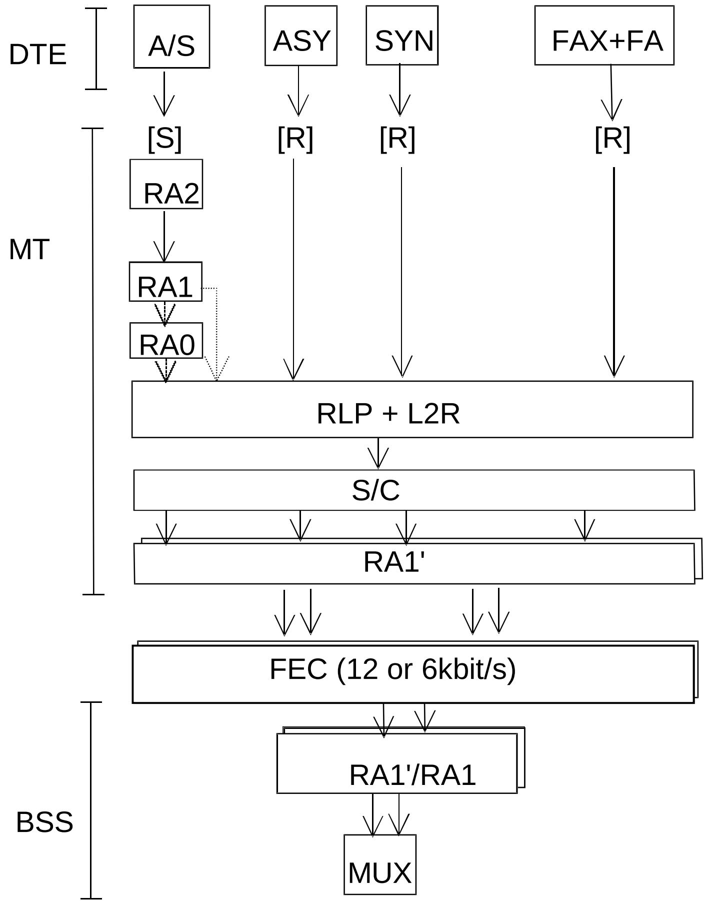


A.3 Stacks of rate adaptation for 9,6/4,8 kbit/s multi slot operation

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

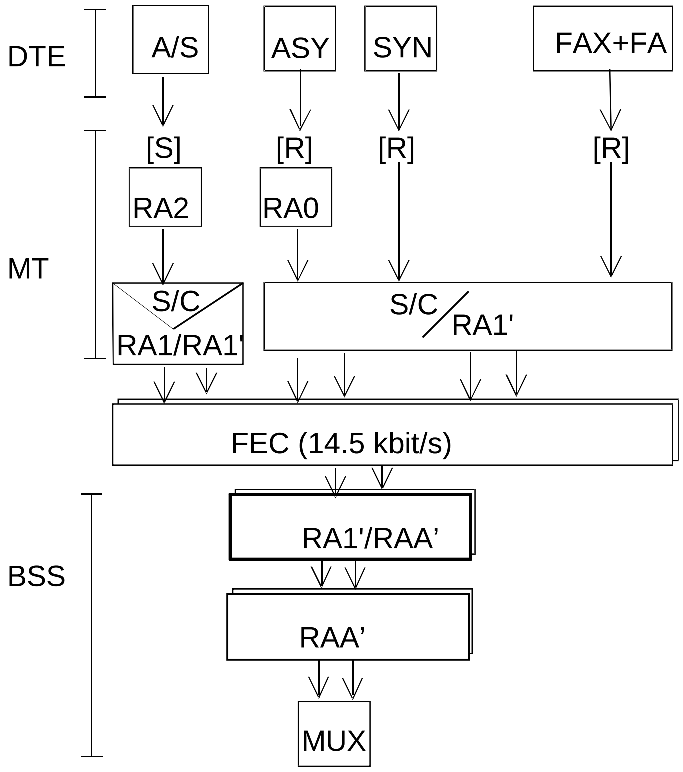


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

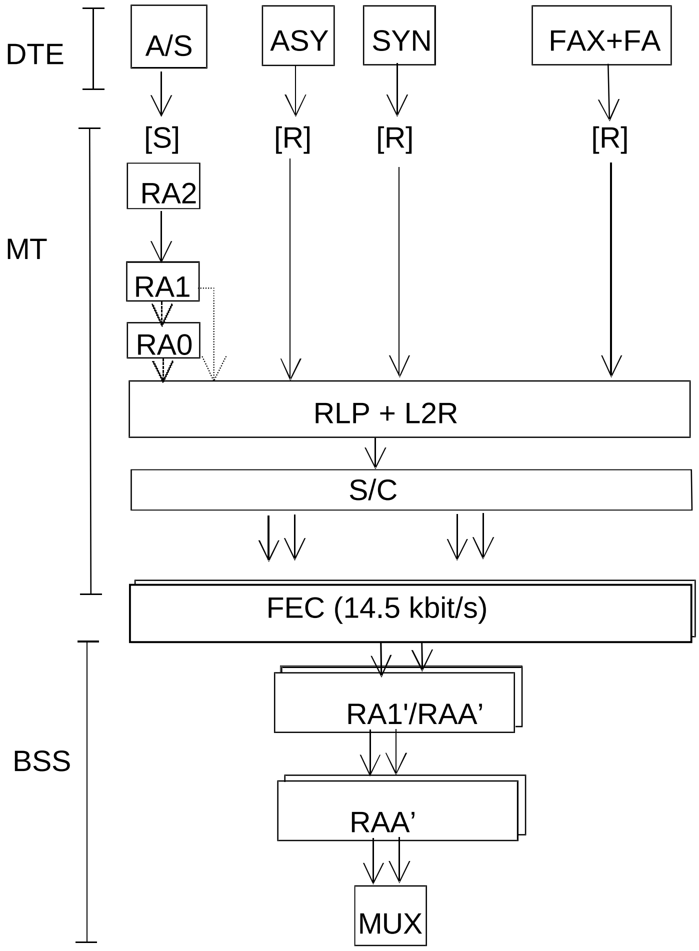


A.4 Stacks of rate adaptation for 14,4 kbit/s multi slot operation

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

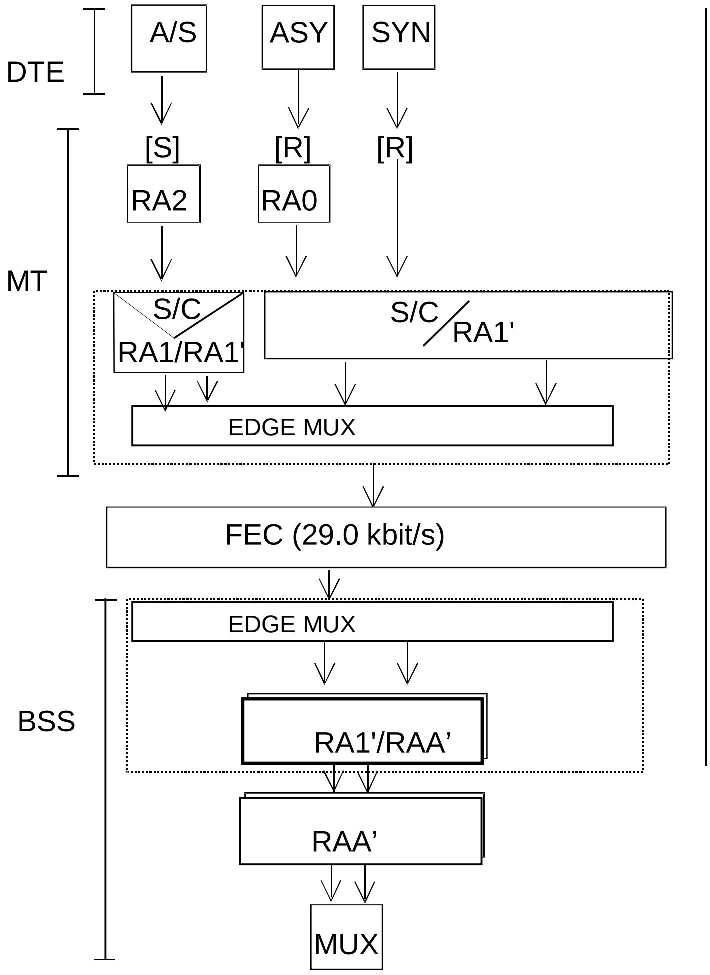


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

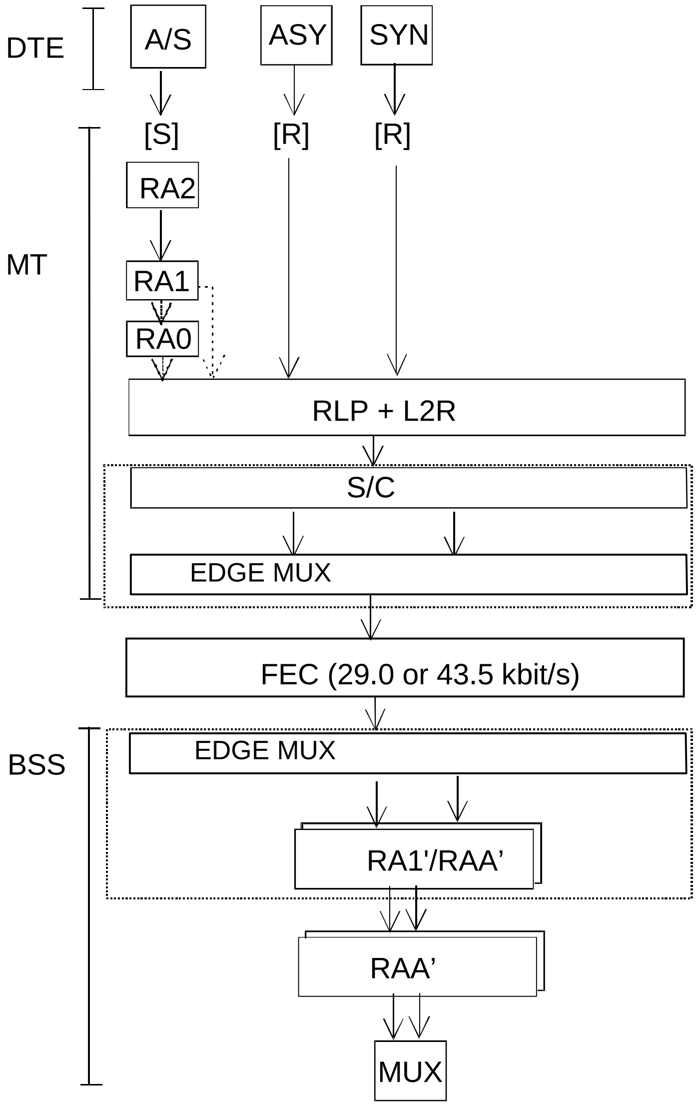


A.5 Stacks of rate adaptation for EDGE channels TCH28.8 and TCH/F43.2 (NT only)

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



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



Annex B (Informative): An example of mapping Network Independent Clocking information for TCH/F14.4 when the S-interface is deployed

In the following, when data bits are moved forwards or backwards between data frames and blocks, padded bit positions are skipped, and the data is moved between bit positions occupied by data bits, i.e. data bit positions.

Negative compensation:

a) From overall data stream to substreams

When the data is mapped from the V.110-frames to the radio interface blocks, the 'extra null bit' (subclause 5.1.1) is dropped and remapped to the first data bit position of radio interface block number 28, which is the block carrying the fifth N-bit in the 31-block multiframe structure.

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 data in the first data bit position of the block.

Positive compensation:

a) From overall data stream to substreams

When the data is mapped from the V.110-frames to the radio interface blocks, the extra bit — either 0 or 1 — is added to the data flow in the correct position (subclause 5.1.1). This means that the 36-bit frame (inside a radio-interface block) in which this has taken place has a bit overflow; this overflow is carried over to the next frames and to the next radio interface blocks; i.e. bit position 1 of the following frame/block would carry the user data bit that originally was the last non-padded bit in the previous frame/block. The overflow is halted in the block carrying the second bit of the NIC-code; the value of the N-bit carried by this block (by bit M2) is set to either 1 or 0 depending on the value of the bit that would be mapped to the first data bit position of the block if the overflow carry over would continue. If this bit is a 1, the N-bit is set to 0 (positive compensation of a 1); if the bit is a 0, the N-bit is set to 1 (positive compensation of a 0). The bit that has been thus coded is not mapped to the first data bit position but carried by the NIC-code. The following bits are moved up by one data bit position.

b) From substreams to overall data stream

When a radio interface block indicating positive compensation is received from the radio, the NIC is decoded and the data is mapped into the V.110-frames in the overall data stream. Decoding the NIC means that an 'extra bit' emerges. This bit takes its real place in the overall data stream (before the first data bit position of the block carrying the second bit of the NIC-code.) Thus a bit overflow results. This overflow is carried over the V.110-frames until an air-interface block associated with the M2-bit carrying the fifth bit of the NIC-code (subclause 5.1.1) has been fully received. After such block is received the next two suitable V.110-frames carry an NIC-code; the overflow of one bit which has been carried over a sequence of V.110-frames halts here as the second V.110-frame carries one extra bit; the value of the D-bit following the E4-E7 sequence in the V.110-frame is carried by the NIC-code and the following data bits are moved up by one step in the V.110-frame.

Annex C (Informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
-	s21	-	A004		HSCSD	5.0.0	5.1.0
-	s21	-	A005		Support of 14.4 kbit/s (Radio interface related)	5.0.0	5.1.0
-	s22	-	A006		Corrections and improvements for 14.4 kbit/s	5.1.1	5.2.0
-	s22	-	A007		Clarification to HSCSD	5.1.1	5.2.0
-	s23	-	A008		Editorial changes, rate adaptation procedure	5.2.0	5.3.0
-	s24	-	A009		Removal of 2*14.4=19.2 Transparent configuration	5.3.0	5.4.0
-	s24	-	A010		Update of the protocol stack models in Annex A	5.3.0	5.4.0
-	s25	-	A011		Clarification to the association between channel codings and intermediate rates	5.4.0	5.5.0
-	s27	-	A012		Synchronisation	5.5.0	7.0.0
-	s27	-	A013		Break handling	7.0.0	7.0.1
-	s29	-	A014		Introduction of EDGE channel codings into the specifications	7.0.1	8.0.0
-	s32	-	A018		Harmonisation of split / combine function	8.0.0	8.1.0
09-2000	TSG#09	NP-000551	A019	1	32 kbit/s UDI/RDI multimedia in GSM	8.1.0	8.2.0

3GPP TSG-CN3 Meeting #13
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***Document* N3-000539**

e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

08.20 CR A009 Current Version: 8.2.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG CN #10	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑	for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [ ] Core Network [X]
(at least one should be marked with an X)

Source: TSG CN WG3 **Date:** 20/10/00

Subject: Removal of 1200/75 bit/s data rate and clean-up

Work item: Technical enhancements and improvements (TEI)

Category:				**Release:**	
	F	Correction	X	Phase 2	
	A	Corresponds to a correction in an earlier release		Release 96	
(only one category	B	Addition of feature		Release 97	
Shall be marked	C	Functional modification of feature		Release 98	
With an X)	D	Editorial modification		Release 99	X
				Release 00	

Reason for change: Removal of the 1200/75 bit/s data rate, specification clean-up.

Clauses affected: 2, 3, 5, 7 - 17

Other specs Affected:			
Other 3G core specifications		→ List of CRs:	04.21
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

help.doc

<---------- double-click here for help and instructions on how to create a CR.

3GPP TS 08.20 V8.2.0 DRAFT (2000-09)

Technical Specification

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Contents

Foreword....11

1 Scope....13

2 References, Abbreviations and Definitions....14

2.1 References....14

2.2 Abbreviations....17

2.3 Definitions....17

3 General approach 18
4 The RA0 Function....19
5 The RA1 Function....20
6 The RA1'' Function....20
7 Split/Combine and Padding Functions....21
7.1 Data Frame distribution into the channels by the Split/Combine function....21
7.2 Substream numbering....22
7.3 Initial Substream Synchronisation for Transparent Services....22
7.4 Frame Synchronisation and Action on loss of Synchronisation....22
7.5 Network Independent Clocking....23
7.6 Padding....23

8 The EDGE Multiplexing Function 23
9 The RA1/RA1' Function 27
9.1 Radio Interface rate of 12 kbit/s 29
9.2 Radio Interface rate of 6 kbit/s 30
9.3 Radio Interface rate of 3.6 kbit/s 30
9.4 Synchronisation 30
9.5 Idle frames 31
10 THE RA1'/RAA' FUNCTION 31
10.1 Radio Interface rate of 14,5 kbit/s 32
10.2 Synchronisation 33
10.3 Idle frames 33
11 THE RAA' FUNCTION 33
11.1 Coding of A-TRAU frame 34
11.2 Framing Pattern Substitution in A-TRAU frame 38

11.2.1 FPS encoding 38
11.3 A-TRAU Synchronisation Pattern 46
12 THE RAA" FUNCTION 47
13 The RA2 Function 47
14 The A-interface Multiplexing Function 48
15 Support of non-transparent bearer services 50
15.1 TCH/F9.6 and TCH/F4.8 kbit/s channel codings 50
15.1.1 Alignment 53
15.1.2 Support of Discontinuous Transmission (DTX) 54
15.1.3 Order of Transmission 54
15.2 TCH/F14.4, TCH/F28.8, and TCH/F43.2 channel codings 55
15.2.1 Alignment 58
15.2.2 Support of Discontinuous Transmission (DTX) 59

16 Support of transparent bearer services 60
16.1 TCH/F9.6 and TCH/F4.8 channel codings 60
16.1.1 User rate adaptation on the A interface, AIUR less or equal to 38,4 kbit/s 60
16.1.2 User rate Adaptation on the A-interface, AIUR greater than 38,4 kbit/s 62
16.1.3 Relation between AIUR and the number of channels 63
16.1.4 Handling of status bits X, SA, SB 65
16.1.5 Handling of bits E1 to E7 66
16.2 TCH/F14.4, TCH/F28.8, and TCH/F32.0 channel codings 66
16.2.1 User rate adaptation on the A interface, AIUR less or equal to 56 kbit/s 66
16.2.2 User Rate Adaptation on the A-interface, AIUR greater than 56 kbit/s 67
16.2.3 Relation between AIUR and the number of channels 69
16.2.4 Handling of status bits X and SB 70

17 Frame Formats 71

Annex A (informative): Frame Pattern Substitution 80

A.1 Special cases 80

A.2 False Z sequence detection 84

Annex B (informative): Change History 88

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it ~~will be~~is re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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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.

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

NOTE: This specification should be considered together with 3GPP TS 04.21 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.

[1] 3GPP TS 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] 3GPP TS 02.34: “Digital cellular telecommunications system (Phase2+): High Speed Circuit Switched Data (HSCSD) - Stage1”

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

[4] 3GPP TS 03.34: “Digital cellular telecommunications system (Phase 2+): High Speed Circuit Switched Data (HSCSD) - Stage2”.

[5] 3GPP TS 04.21: "Digital cellular telecommunications system (Phase 2+); Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[6] 3GPP TS ~~0~~24.022: "~~Digital cellular telecommunications system (Phase 2+)~~3rd Generation Partnership Project; Technical Specification Group Core Network; Radio Link Protocol (RLP) for Circuit Switched Bearer and Teleservices~~data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface~~".

[7] 3GPP TS 05.03: "Digital cellular telecommunications system (Phase 2+); Channel coding".

[8] 3GPP TS ~~0~~27.001: "~~Digital cellular telecommunications system (Phase 2+)~~3rd Generation Partnership Project; Technical Specification Group Core Network; General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

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

[10] 3GPP TS ~~0~~29.007: "~~Digital cellular telecommunications system (Phase 2+)~~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] ~~CCITT~~ITU-T Recommendation V.110: "Support of data terminal equipment's (DTEs) with V-Series interfaces by an integrated services digital network".

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

2.2 Abbreviations

In addition to those below, abbreviations used in this specification are listed in 3GPP TS 01.04.

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 (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 as part of a connection type.

These functions are RA0, RA1, RA1/RA1' , RA1’’ , RAA", RA1'/RAA', RAA' and RA2. The RA2 function is equivalent to that described in ~~CCITT~~ITU-T Recommendation V.110. In addition, splitting/combining, padding and inband numbering functions as defined in 3GPP TS 04.21 and multiplexing as defined herein are used in cases where more than one channel is allowed.

The RA1/RA1' and RA1'/RAA' are relay functions used as indicated in 3GPP TS 03.10.

The BSS uses the information contained in the ASSIGNMENT REQUEST message on the A-interface (see 3GPP TS 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 04.21

5 The RA1 Function

For connections where only one channel is allowed used on the radio interface, the specification in 3GPP TS 04.21 for adaptation of synchronous data rates up to and including 9,6 kbit/s to intermediate rates 8 or 16 kbit/s shall applyies.

For connection where more than one channel are used on the radio interface, rate adaptation isshall be applied on the corresponding substreams as specified in 3GPP TS 04.21 for AIUR of 4,8 kbit/s or 9,6 kbit/s.

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.

7 Split/Combine and Padding Functions

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

The Split/Combine-function in the BSS ~~is~~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 04.21

7.2 Substream numbering

Described in 3GPP TS 04.21

7.3 Initial Substream Synchronisation for Transparent Services

Described in 3GPP TS 04.21

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 ~~09.07~~29.007.

7.5 Network Independent Clocking

NIC is specified in 3GPP TS 04.21

7.6 Padding

Padding is specified in 3GPP TS 04.21

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 ~~is required~~shall be used at BTS to perform data multiplexing/demultiplexing between the radio interface and network channel configurations. A similar function ~~is~~shall be used also ~~used~~ at MS as described in 04.21.

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. 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.

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 ($0 \leq a \leq 6$) precedes data carried by timeslot a+n ($1 \leq a+n \leq 7$) — 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 ($0 \leq a \leq 6$) and a+n ($1 \leq a+n \leq 7$). 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.

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.

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.

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.

9 The RA1/RA1' Function

For AIURs less than or equal to 38,4 kbit/s, the RA1/RA1' function in the BSS ~~is~~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 04.21 for the single slot case. The table below gives a relation between the AIUR, channel coding and number of substreams. As an example from table 1: The wanted AIUR is 28,8 kbit/s, the number of substreams needed to support this rate is 3. Each individual substream ~~is~~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'' ~~is~~shall be as specified in 3GPP TS 04.21 for these rates.

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

	Multislot intermediaterate 8 kbps		Multislot intermediate rate of 16 kbps	
AIUR	Transparent	Non-transparent	Transparent	Non-transparent
≤2,4 kbit/s	1	N/A	N/A	N/A
4,8 kbit/s	1	1	N/A	N/A
9,6 kbit/s	2	2	1	1
14,4 kbit/s	3	3	2	N/A
19,2 kbit/s	4	4	2	2
28,8 kbit/s	N/A	N/A	3	3
38,4 kbit/s	N/A	N/A	4	4
48 kbit/s	N/A	N/A	5	N/A
56 kbit/s	N/A	N/A	5	N/A
64 kbit/s	N/A	N/A	6	N/A

9.1 Radio Interface rate of 12 kbit/s

Described in 3GPP TS 04.21.

9.2 Radio Interface rate of 6 kbit/s

Described in 3GPP TS 04.21.

9.3 Radio Interface rate of 3.6 kbit/s

Described in 3GPP TS 04.21.

9.4 Synchronisation

Refer to 3GPP TS 04.21.

9.5 Idle frames

Refer to 3GPP TS 04.21

10 THE RA1'/RAA' FUNCTION

The RA1'/RAA' ~~is only applicable~~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 08.60.

The RA1'/RAA' function in the BSS ~~is~~shall be applied on each of the n substreams and there are no significant differences between the single slot case and the multislot case. The table below 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 ~~is~~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 08.60.

10.2 Synchronisation

See 3GPP TS 08.60.

10.3 Idle frames

See 3GPP TS 08.60.

11 THE RAA' FUNCTION

The RAA' function ~~is only applicable~~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 08.60.

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 08.60.

M Bits

Transparent data

M1 and M2 are as defined in 3GPP TS 04.21.

Non transparent data

See subclause 15.2 of this GSM TS.

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.

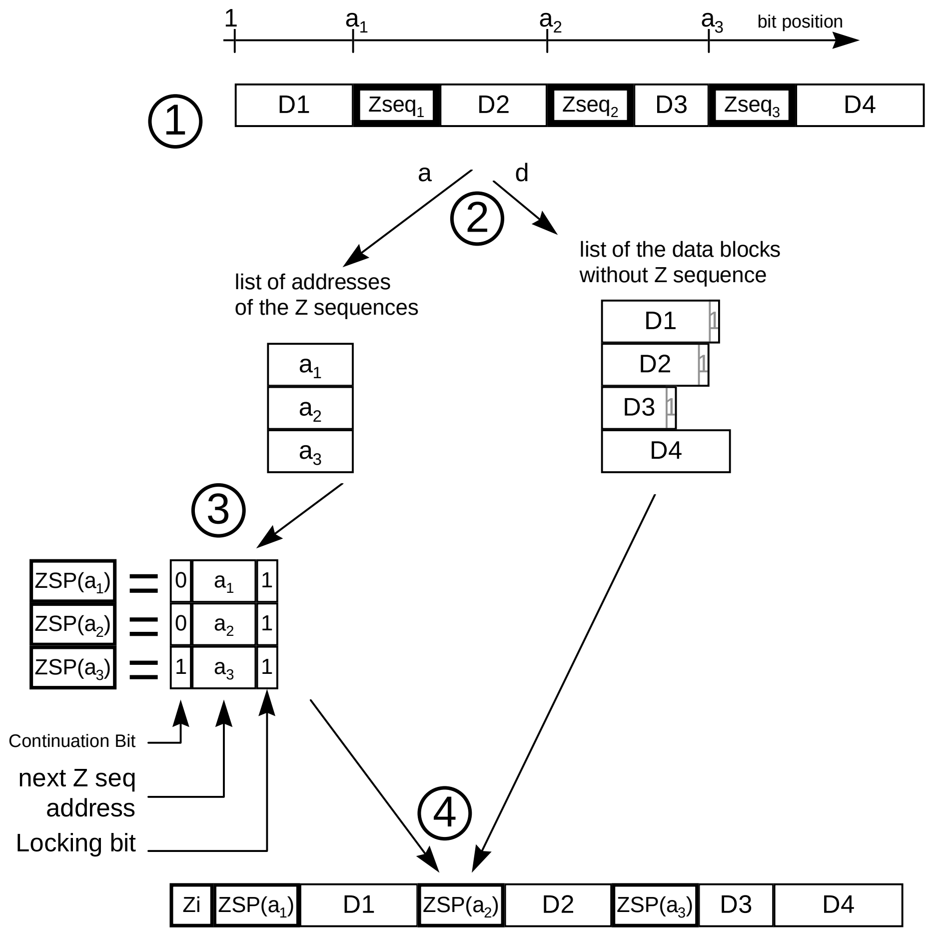
1
a1
a2
a3
bit position
1
D1
Zseq1
D2
Zseq2
D3
Zseq3
D4
a
d
2
list of addresses
of the Z sequences
list of the data blocks
without Z sequence
a1
a2
a3
D1
D2
D3
D4
3
ZSP(a1)
ZSP(a2)
ZSP(a3)
0
0
1
a1
a2
a3
1
1
1
Continuation Bit
next Z seq
address
Locking bit
4
Zi
ZSP(a1)
D1
ZSP(a2)
D2
ZSP(a3)
D3
D4

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 ~~will be~~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 ~~should~~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 converts between the A-TRAU format and a synchronous stream. FPS isshall performed by this function as well, see subclause 11.2. In transparent operation, the RAA" function shall handles the M1 and M2 bits as specified for the RA1' function in 3GPP TS 04.21.

In non-transparent operation, the RAA" function shall maps 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 this GSM TS.

13 The RA2 Function

Described in 3GPP TS 04.21. The RA2 function is applicableshall be applied only for single slot operations.

14 The A-interface Multiplexing Function

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

The multiplexing function is based on the ~~CCITT~~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 can be released. At a possible subsequent upgrading, the lowest available bit positions shall be used for the added substreams.

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

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~~s~~ the same mapping as that described for transparent services, using 12 and 6 kbit/s radio interface data rates, with the following modification.

The E2 and E3 bits in the modified ~~CCITT~~ITU-T V.110 80 bit frames shown in Figure 3 (derived from the standard ~~CCITT~~ITU-T V.110 frame shown in Figure 2) are used to indicate each consecutive sequence of ~~CCITT~~ITU-T V.110 80 bit frames corresponding to the four modified ~~CCITT~~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 05.03). The 8 bits consisting of the E2 and E3 bits in one of the above sequences is referred to as the Frame Start Identifier. The FSI value is 00 01 10 11. This value is assigned to the E2 and E3 bits as shown in Table7.

Table 7

	E2	E3
First Modified ~~CCITT~~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 ~~CCITT~~ITU-T V.110 80 bit frames, it is necessary following a transmission break and at start up, to determine which modified ~~CCITT~~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 ~~CCITT~~ITU-T V.110 80 bit frame to determine the modified ~~CCITT~~ITU-T V.110 80 bit frame boundaries, the FSI is required to determine which quarter of an RLP frame each modified ~~CCITT~~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 ~~CCITT~~ITU-T V.110 80 bit frames ~~is~~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 ~~CCITT~~ITU-T V.110 80 bit frame shown in Figure 3 ~~is~~shall be used in the direction MSC-BSS to indicate that DTX may be invoked (see 3GPP TS ~~04.22~~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 ~~will~~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 ~~will~~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 ~~will~~shall contain the E2 and E3 bit code 00 as shown in Table 1. The second quarter~~ will~~ 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 ~~is~~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.

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15.2.1 Alignment

An alignment window spanning two 290 bit blocks in case of TCH/F14.4 channel ~~is~~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 isshall be used in the direction MSC to BSS to indicate that DTX may be invoked (see 3GPP TS 04.2224.022). 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 CCITTITU-T V.110 80 bit frame isshall 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 this GSM TS. 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 ~~or 1 200/75 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).;

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

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 ~~CCITT~~ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS 04.21 ~~is~~shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, is as specified in 3GPP TS 04.21.

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 ~~is~~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 ~~will~~shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS ~~09.07~~29.007 (MSC), 3GPP TS 04.21 (BSS), 3GPP TS ~~07.01~~27.001 (MS).

16.1.5 Handling of bits E1 to E7

Bits E1 to E3 ~~are~~shall be used according to 04.21.

Bits E4 to E7 may be used for network independent clocking as indicated in 3GPP TS 04.21.

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 ~~is~~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 ~~CCITT~~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 ~~CCITT~~ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS 04.21 ~~is~~shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, ~~is~~shall be as specified in 3GPP TS 04.21.

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	TCH/F14.4	64 kbit/s

	1x64.0 kbit/s (Note 2)	TCH/F32.0	
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 ~~are~~shall be carried over the A interface in a multiframe structure as described in subclause 8.1.1.1 of 3GPP TS 04.21. SA bit is not carried over the A interface.

The handling of the status bits ~~will~~shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS ~~09.07~~29.007 (MSC), 3GPP TS 04.21 (BSS), 3GPP TS ~~07.01~~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 ~~CCITT~~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 ~~CCITT~~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 ~~CCITT~~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

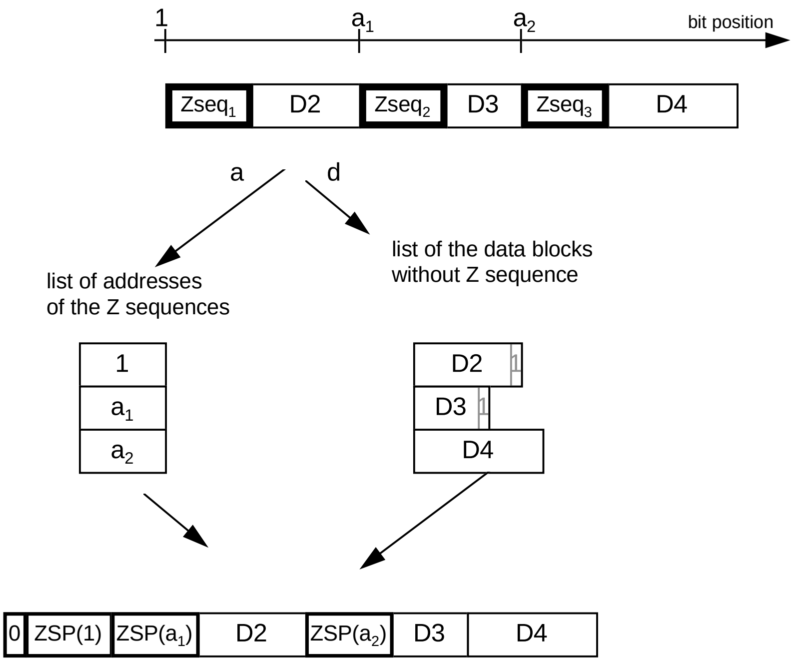
octet no.	bit number 0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	1	D1	D2	D3	D4	D5	D6	S1
2	1	D7	D8	D9	D10	D11	D12	X
3	1	D13	D14	D15	D16	D17	D18	S3
4	1	D19	D20	D21	D22	D23	D24	S4
5	1	E1	E2	E3	E4	E5	E6	E7
6	1	1	1	1	1	1	1	S6
7	1	1	1	1	1	1	1	X
8	1	1	1	1	1	1	1	S8
9	1	1	1	1	1	1	1	S9

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

Annex A (informative): Frame Pattern Substitution

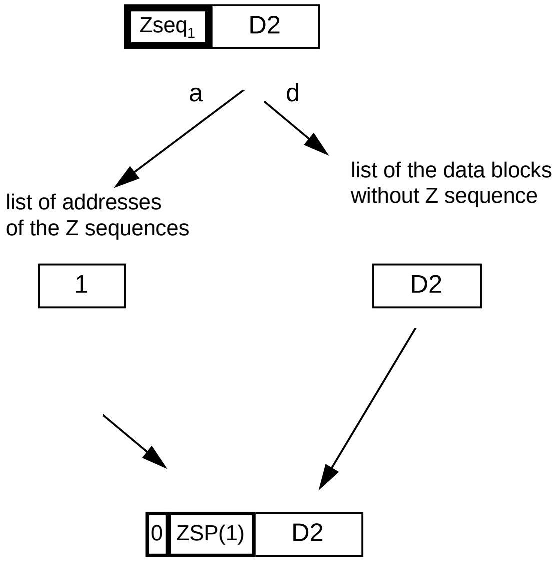
A.1 Special cases

If the sub frame starts with a Zseq, D1 is empty. With the above example, the resulting input and output sub frames are the following :



1
a_1
a_2
bit position
$Zseq_1$
D2
$Zseq_2$
D3
$Zseq_3$
D4
a
d
list of addresses
of the Z sequences
list of the data blocks
without Z sequence
1
a_1
a_2
D2
1
D3
1
D4
0
ZSP(1)
ZSP(a_1)
D2
ZSP(a_2)
D3
D4

In the same case as above but with only one ZSP, the resulting input and output sub frames are the following:


Zseq1
D2
a
d
list of addresses
of the Z sequences
list of the data blocks
without Z sequence
1
D2
0
ZSP(1)
D2

A.2 False Z sequence detection

The Framing Pattern Substitution algorithm presented in subclause 10.2 ensures sure that all the Z sequences found in the original sub frame are removed, but it ~~must~~shall be checked that the transformations performed do not introduce new unwanted Z sequences.

The goal of this subclause is to show that the transformed sub frame ~~will~~does not contain new Z sequences introduced by the algorithm itself.

The coding of the ZSP is the key point to avoid such an emulation. The different cases are considered below.

1 : Sequence ZSP

The worst case is when the address is equal to 1 :

1	C	A0	A1	A2	A3	A4	1
1	0	0	0	0	0	1	1

There is a maximum of 5 zeroes.

2 : Sequence Di / ZSP.

By definition, a data block always ends up with a one (except the last one of the message) and the ZSP always starts with a 1.

3 : Sequence ZSP / Di

ZSP always ends up with a 1 and Di has a maximum of 7 zeroes : it is not possible to find 16 zeroes in a row.

4 : Sequence Di / Dj

Di is not the last data block of the message.

As already mentioned, Di ends up with a one (except the last one) : this is the same case as 3.

5 : Sequence Zi / D or D / Zi

This case only occurs when there is no substitution. In this case, the Zi bit close to the D field is always a one: this does not change the number of zeroes in sequence.

6 : Sequence last Di / new framing pattern

The last D sequence can end up with up to 7 zeroes, followed by the 16 zeroes of the next frame.

There is anyhow no ambiguity, when considering that the framing pattern is made up of 16 zeroes *followed* by a one.

7 : Sequence last Di / Z bit of the next sub frame

The last D sequence can end up with up to 7 zeroes, followed in the worst case by Z=0 and then a ZSP. As a ZSP starts with a one, this makes a maximum of 8 zeroes in a row.

8 : Sequence ZSP / ZSP (not shown on the figure)

This case arrives when the original message has at least 16 zeroes in a row.

As the ZSP element always starts and ends up with a one, this always induces two consecutive ones.

Annex B (informative): Change History

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
	s27		A005		Synchronisation	5.3.0	7.0.0
	s29		A006		Introduction of EDGE channel codings into the specifications	7.0.0	8.0.0
	s30		A007		Asymmetric channel coding	8.0.0	8.1.0
09-2000	TSG#09	NP-000551	A008	1	32 kbit/s UDI/RDI multimedia in GSM	8.1.0	8.2.0

3GPP TSG-CN3 Meeting #14 ***N3-000591***
Sophia Antipolis, France, 14 – 16 November

CR-Form-v3

CHANGE REQUEST

⌘	**27.001**	**CR**	**041**	⌘ rev	**-**	⌘	Current version:	**3.6.0**	⌘

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

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title:	⌘	Correction for 32 kbit/s UDI/RDI		
Source:	⌘	TSG CN WG3		
Work item code:	⌘	T.E.I	***Date:*** ⌘	2000-11-16
Category:	⌘	**F**	***Release:*** ⌘	R99

Use one of the following categories:
- ***F*** *(essential 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)*

Reason for change:	⌘	FNUR = 32 kbit/s is missing in subclause B.1.12.1.
Summary of change:	⌘	FNUR = 32 kbit/s is added in a table in subclause B.1.12.1.
Consequences if not approved:	⌘	The specification remains incomplete and obscure.

Clauses affected:	⌘	B.1
Other specs affected:	⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] 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/3G_Specs/CRs.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://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 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.

B.1.12 Valid combinations of FNUR, WAIUR, ACC, mTCH

B.1.12.1 Transparent Services

The MS is allowed to signal any combination of FNUR, ACC and mTCH compliant to the following table. The network is allowed to assign any Channel Mode compliant to the following table.

FNUR	**mTCH (Note 7)**	**ACC (Note 1,6)**					**Channel Mode (Note 4,5)**				
		TCH/F4.8	TCH/F9.6	TCH/F14.4	TCH/F 28.8	TCH/F 32.0	TCH/F4.8	TCH/F9.6	TCH/F14.4	TCH/F 28.8	TCH/F 32.0
9.6 kbit/s	1	*	+	*	*	*	-	1	-	-	-
	2	+	*	*	*	*	2	1	-	-	-
14.4 kbit/s	1	*	*	+	*	*	-	-	1	-	-
	2	*	+	*	*	*	-	2 (N2)	1	-	-
	3	+	*	*	*	*	3	2 (N2)	1	-	-
19.2 kbit/s	2	*	+	*	*	*	-	2	-	-	-
	4	+	*	*	*	*	4	2	-	-	-
28.8 kbit/s	1	*	*	*	+	*	-	-	-	1	-
	2	*	*	+	*	*	-	-	2	1	-
	3	*	+	*	*	*	-	3	2	1	-
32.0 kbit/s	1	*	*	*	*	+	-	-	-	-	1
38.4 kbit/s	3	*	*	+	*	*	-	-	3 (N2)	-	-
	4	*	+	*	*	*	-	4	3 (N2)	-	-
48.0 kbit/s	4	*	*	+	*	*	-	-	4 (N2)	-	-
	5	*	+	*	*	*	-	5	4 (N2)	-	-
56.0 kbit/s	2	*	*	*	*	+	-	-	-	-	2(N8)
	4	*	*	+	*	*	-	-	4 (N2)	-	2(N8)
	5	*	+	*	*	*	-	5 (N3)	4 (N2)	-	2(N8)
64.0 kbit/s	2	*	*	*	*	+	-	-	-	-	2(N8)
	5	*	*	+	*	*	-	-	5 (N2)	-	2(N8)
	6	*	+	*	*	*	-	6 (N2,3)	5 (N2)	-	2(N8)

NB: N in the table stands for NOTE.

NOTE 1: A '+' indicates that a certain channel coding must be included in the ACC and a '*' indicates that it may or may not be included.

NOTE 2: Padding Required, ref GSM 04.21.

NOTE 3: Air interface user rate 11,2 kbit/s, ref. GSM 04.21.

NOTE 4: A '-' indicates that this channel coding cannot be assigned for this FNUR.

NOTE 5: A certain channel coding may only be assigned if indicated as acceptable in the ACC.

NOTE 6: In case the MS signals an ACC containing TCH/F4.8 only and the network does not support TCH/F4.8 channel coding, then the network may act as if TCH/F9.6 were included in the ACC.

NOTE 7: The MS is allowed to signal higher values for mTCH than indicated in the table for the signalled FNUR and ACC. Before initiating the assignment procedure, the MSC, if necessary, will lower the value of the mTCH to the highest value applicable for the signalled FNUR and ACC.

NOTE 8: Can only be used for bit transparent 56 (RDI) and 64 (UDI) kbit/s connections in 56 kbit/s and 64 kbit/s environments, respectively.

The final decision about the radio interface configuration is taken by the BSS during the Assignment procedure subject to the restrictions that the number of assigned TCH/F may not exceed the mTCH, that the channel coding is among the ACC and that the AIUR equals the FNUR.

The radio interface configuration may be changed by the BSS during the call as long as the channel coding used is among the ACC, the mTCH is not exceeded and the AIUR is kept constant (ref. 3GPP TS 22.034).

CR-Form-v3

CHANGE REQUEST

⌘	**27.001**	**CR**	**042**	⌘	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: ⌘ (U)SIM [ ] ME/UE [X] Radio Access Network [ ] Core Network [X]

Title: ⌘	Correction for 32 kbit/s UDI/RDI			
Source: ⌘	TSG CN WG3			
Work item code: ⌘	CORRECT		***Date:*** ⌘	2000-11-16
Category: ⌘	**A**		***Release:*** ⌘	REL-4
	Use one of the following categories: ***F*** *(essential 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)*	

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	2	+	*	*	*	*	2	1	-	-	-
14.4 kbit/s	1	*	*	+	*	*	-	-	1	-	-
	2	*	+	*	*	*	-	2 (N2)	1	-	-
	3	+	*	*	*	*	3	2 (N2)	1	-	-
19.2 kbit/s	2	*	+	*	*	*	-	2	-	-	-
	4	+	*	*	*	*	4	2	-	-	-
28.8 kbit/s	1	*	*	*	+	*	-	-	-	1	-
	2	*	*	+	*	*	-	-	2	1	-
	3	*	+	*	*	*	-	3	2	1	-
32.0 kbit/s	1	*	*	*	*	+	-	-	-	-	1
38.4 kbit/s	3	*	*	+	*	*	-	-	3 (N2)	-	-
	4	*	+	*	*	*	-	4	3 (N2)	-	-
48.0 kbit/s	4	*	*	+	*	*	-	-	4 (N2)	-	-
	5	*	+	*	*	*	-	5	4 (N2)	-	-
56.0 kbit/s	2	*	*	*	*	+	-	-	-	-	2(N8)
	4	*	*	+	*	*	-	-	4 (N2)	-	2(N8)
	5	*	+	*	*	*	-	5 (N3)	4 (N2)	-	2(N8)
64.0 kbit/s	2	*	*	*	*	+	-	-	-	-	2(N8)
	5	*	*	+	*	*	-	-	5 (N2)	-	2(N8)
	6	*	+	*	*	*	-	6 (N2,3)	5 (N2)	-	2(N8)

NB: N in the table stands for NOTE.

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