3GPP TSG CN Plenary Meeting #14 **Tdoc NP-010604**
Kyoto, Japan. 12th - 14th December 2001.

Source: **TSG CN WG3**

Title: **CRs on Rel-5 Work Item TEI_5**

Agenda item: **9.13**

Document for: **APPROVAL**

<u>Introduction</u>:

This document contains **10** CRs on **Rel-5** Work Item **"TEI_5"**, that have been agreed by TSG CN WG3, and are presented to TSG CN Plenary meeting #14 for approval.

NP Tdoc	WG Tdoc	Subject	Spec	CR	R.	Cat	Phase	C_Ver	WI
NP-010604	N3-010593	Terminology clarifications as requested by TSG GERAN	23.910	032	2	D	Rel-5	4.3.0	TEI_5
NP-010604	N3-010596	Terminology clarifications as requested by TSG GERAN	24.022	006	3	D	Rel-5	4.0.0	TEI_5
NP-010604	N3-010590	Terminology clarifications as requested by TSG GERAN	27.001	070	3	D	Rel-5	4.5.0	TEI_5
NP-010604	N3-010591	Terminology clarifications as requested by TSG GERAN	27.002	008	3	D	Rel-5	4.0.0	TEI_5
NP-010604	N3-010592	Terminology clarifications as requested by TSG GERAN	27.003	009	3	D	Rel-5	4.1.0	TEI_5
NP-010604	N3-010597	Terminology clarifications as requested by TSG GERAN	29.007	044	3	D	Rel-5	4.2.0	TEI_5
NP-010604	N3-010598	Terminology clarifications as requested by TSG GERAN	29.061	035	2	D	Rel-5	4.2.0	TEI_5
NP-010604	N3-010581	Terminology clarifications as requested by TSG GERAN	44.021	001	1	D	Rel-5	4.0.0	TEI_5
NP-010604	N3-010582	Terminology clarifications as requested by TSG GERAN	48.020	001	1	D	Rel-5	4.0.0	TEI_5
NP-010604	N3-010594	Terminology clarifications as requested by TSG GERAN	27.060	016	2	D	Rel-5	4.0.0	TEI_5

3GPP TSG-CN WG3 Meeting #20 **_Tdoc N3-010581_**
Cancun, Mexico. 26th - 30th November 2001.

CR-Form-v4

CHANGE REQUEST

⌘	**44.021**	**CR**	**001**	⌘	ev	**-**	⌘ Current version:	**4.0.0** ⌘

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

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

Title: ⌘	New terminology requested by GERAN		
Source: ⌘	CN3		
Work item code: ⌘	TEI_5	***Date:*** ⌘	30.11.2001
Category: ⌘	**D**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	To avoid possible confusion due to new terminology adopted in 3GPP in order to differentiate between networks, Radio Access Technologies (RAT) and modes of operation.
Summary of change: ⌘	Terminology corrections
Consequences if not approved: ⌘	Inconsistency with GERAN specifications.

Clauses affected: ⌘	1 - 6	
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

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3GPP TS 44.021 V4.0.0 (2000-12)

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 (Release 4)

GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

Keywords

GSM, A/Gb mode, GERAN, BSS, adaption

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Contents

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 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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x the first digit:

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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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 43.010 [3].

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

NOTE 1: This ETS should be considered together with 3GPP TS ~~0~~48.020 [9] (Rate Adaptation on the BSS-MSC Interface) to give a complete description of PLMN rate adaptation.

NOTE 2: The Gb interface does not play any role in the scope of the present document although the term “A/Gb mode” is used.

2 References, Definitions and Abbre~~i~~viations

2.1 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP specifications". ~~3GPP TS 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".~~

[2] 3GPP TS ~~0~~22.034: "~~Digital cellular telecommunications system (Phase 2+);~~ High Speed Circuit Switched Data (HSCSD) -Stage 1".

[3] 3GPP TS 43.010: "~~Digital cellular telecommunication system (Phase 2+);~~ GSM-Public Land Mobile Network (PLMN) connection types".

[4] 3GPP TS ~~0~~23.034: "~~Digital cellular telecommunications system (Phase 2+);~~ High Speed Circuit Switched Data (HSCSD) - Stage 2 Service Description".

[5] 3GPP TS ~~0~~45.003: "~~Digital cellular telecommunications system (Phase 2+);~~ Channel coding".

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

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

[8] Void.

[9] 3GPP TS ~~0~~48.020: "~~Digital cellular telecommunication system (Phase 2+);~~ Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

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

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

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 43.010 defines the PLMN connection types necessary to support the GSM PLMN data and telematic services.

Within the MS there are several different data rate adaptation functions - and a Split/Combine-function in case of a multislot data configuration - which are combined as shown in 3GPP TS 43.010 as part of the connection type.

The rate adaptation functions are RA0, RA1, RA2, RA1', RA1" and RA1/RA1'. The RA0, RA1 and RA2 are equivalent to those functions described in 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 ITU-T recommendation V.110 does not have a name.

The RA1/RA1' is a relay function, used as indicated in 3GPP TS 43.010.

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

3.1 Overview of data rates and configurations

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

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

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

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

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

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

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

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

Table 1: AIUR/Multislot intermediate rates

Air interface user rate	DTE/DCE statuses	RA0	RA1'/RA1 RA1'/RAA'		RA1'	
			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~~A/Gb mode-specific rate adaptation function RA1" rather than RA1is applied.

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

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

NOTE 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 the 300 bit/s user data signalling rate shall be adapted to a synchronous 600 bit/s stream. The resultant synchronous stream is fed to RA1 or RA1'. The RA0 used in ~~GSM~~ PLMN is not identical to that described in ITU-T Recommendation V.110 which converts 14,4 and 28,8 kbit/s user rates to 19,2 and 38,4 kbit/s, respectively.

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

4.2 Break signal

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

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

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

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

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

4.3 Overspeed/Underspeed

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

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

4.4 Parity Bits

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

4.5 Flow Control

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

5 The RA1 Function

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

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

Synchronous user rate	Intermediate rate
≤ 2,4 kbit/s	8 kbit/s
4,8 kbit/s	8 kbit/s
9,6 kbit/s	16 kbit/s
14,4 kbit/s	32 kbit/s
19,2 kbit/s	32 kbit/s
28,8 kbit/s	64 kbit/s
38,4 kbit/s	64 kbit/s

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

Adaptation of 600 bit/s to 8Kbit/s is performed by 8 times consecutive duplication of each user data bit. (Figure 9)

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

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

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

Adaptation of 9600 bit/s to 16 Kbit/s is performed by transmitting the bit stream with no duplication (the emitting period is halved with respect to the 4800 bit/s case). (Figure 3)

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

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

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

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

The ITU-T V.110 80 bit frames shown in Figures 3 and 12 are used. The D bits are used to convey the user data and the S and X bits are used to convey channel control information according to 3GPP TS 27.001.

The E bits are used to convey the following information:

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

ii) Network Independent Clocking - E4, E5, E6

iii) Multiframe Synchronisation - E7

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

5.1.1 Network Independent Clocking

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

5.1.1.1 Multiframe Structure

The transmitting end of the ~~GSM~~A/Gb mode PLMN connection shall establish a multiframe structure utilizing bit E7 consisting of four frames by setting E7 in every fourth frame to binary 0. This structure is identical to the use of E7 in V.110 (and X.30) except that such a multiframe structure exists for all user data rates. This frame synchronization is achieved and maintained during the entire call so that corrections for the network independent clocking by the receiving end of the ~~GSM~~A/Gb mode PLMN connection can be easily recognized and applied based on the code words (in c1, c2, c3, c4 and c5) positioned in bits E4, E5 and E6 of two consecutive V.110 frames as illustrated in figure 1. Thus, the multiframe structure allows for one 5-bit code words to be transmitted every two V.110 frames for the purposes of network independent clocking. The two code-words may be different from each other within the multiframe shown in figure 1.

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

Figure 1: NIC Multiframe Structure

Once Multiframe synchronization is achieved, each code word is independently evaluated to determine the compensation needed, if any. The compensation is applied as explained in section 3.1.2 in V.110 frames MF 1a and MF 1b.

5.1.1.2 Encoding and compensation

The V.110 transmitter uses the following 5-bit code words, as shown in figure 2, to indicate the four possible states of compensation required for network independent clocking.

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

Figure 2: NIC Code Words

When negative compensation is indicated, one less user data bit than normal is transported in the affected frame (MF1a or MF1b). A negative compensation shall cause the receiver to delete the user data bit occupied by bit position D25, since the transmitter sets this to binary 1 and does not utilize this position for user data. At those user data rates where the user data bit is repeated, all copies of D25 shall be discarded. In case of 80-bit frames with 36 data bits, bit D19 is discarded instead.

When a positive compensation is indicated, one additional user data bit is transferred by means of the code word. At the receiver, a positive compensation causes a user data bit of binary value 0 or 1, as indicated by the code word, to be inserted between the user data bits carried in bit positions D24 and D25 (in MF1a or MF1b) of the V.110 frame illustrated in figure 3. In case of 80-bit frames with 36 data bits, the insertion is done to between bits D18 and D19.

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

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

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

NOTE: NIC is not applicable in the following cases:

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

6 The RA1'' function

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

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

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

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

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

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

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

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

7 The RA2 Function

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

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

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

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

The procedure requires that:

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

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

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

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

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

8 The RA1/RA1' Function

The RA1/RA1' function described below 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 ITU-T V.110 frames of sizes 60,60 and 36 bits for the 12, 6 and 3.6 kbit/s data rates respectively. The resultant modified ITU-T V.110 frames for the various user data rates are shown in figures 5 - 9.

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

8.1.1 Radio interface rate of 14,5 kbit/s

In this case one modified ITU-T V.110 frame is received/sent from/to the network every 2.5 ms (see 3GPP TS 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 ITU-T V.110 36-bit frame received/sent from/to the network at 14,4 kbit/s:

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

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

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

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

8.1.1.1 Multiframe structure over the radio-interface

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

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

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

where # # # = Substream number (multilink operation)

SB = the SB status bit

X = the X-status bit

NNNNN = Network independent clocking code

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

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

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

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

	N-bit 24 in M2-sequence	N-bit 25 in M2-sequence	N-bit 26 in M2-sequence	N-bit 27 in M2-sequence	N-bit 28 in M2-sequence
No compensation	1	1	1	1	1
Negative compensation	1	0	0	1	0
Positive compensation of a zero	0	1	0	0	1
Positive compensation of a one	0	0	1	0	0

The Network to MS direction:

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

For NIC-procedure, refer to subclause 11.5.1.

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

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

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

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

8.1.2 Radio Interface rate of 12 kbit/s

In this case one modified ITU-T V.110 60 bit frame is received/sent from/to the network every 5ms (see 3GPP TS 05.03). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1,E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

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

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

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

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

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

For a modified ITU-T V.110 60 bit frames received from the network, 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 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 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 adds/subtracts the 17 bit synchronization pattern and the E1, E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

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

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

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

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

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

For a modified ITU-T V.110 60 bit frames received from the network, 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 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.

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

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

In this case one modified ITU-T V.110 36 bit frame is received/sent from/to the network every 10ms (see 3GPP TS 05.03 [3]). The RA1/RA1' function adds/subtracts the 17 bit synchronization pattern and the E1,E2 and E3 bits to/from each ITU-T V.110 80 bit frame as follows:

The modified ITU-T V.110 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 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 ITU-T V.110 36 bit frames transmitted to the network, E1, E2, E3 are discarded. For modified 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 27.001.

8.1.6 Idle frames

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

8.2 Multislot rates

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

8.2.1 TCH/F14.4 multislot operation

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

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

8.2.2 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 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 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 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 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 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 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 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 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 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 ($0 \leq a \leq 6$) and a+n ($1 \leq a+n \leq 7$) 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 ($0 \leq a \leq 6$) precedes the data carried by timeslot a+n ($1 \leq a+n \leq 7$) of the same TDMA-frame.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

10 The RA1' Function

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

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

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

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

10.2 Synchronous user rates from 9,6 kbit/s onward; TCH/F9.6/4.8 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 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 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 split/combine and padding functions shall be used with multislot connections as described below. The Split/Combine function splits/recombines the overall data stream to/from the substreams. The Padding function inserts filling into one of the substreams in cases where the total capacity of the substreams is larger than necessary to achieve the required AIUR.

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

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

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

   In the overall data stream

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

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

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

b) In the non-transparent case the Split/Combine-function distributes the RLP-frames — or the four V.110-frames making up an RLP-frame (Reference: 3GPP TS 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.

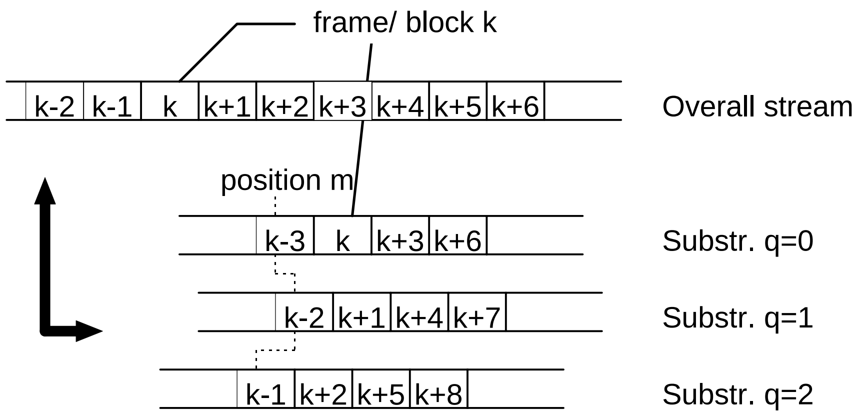


Figure 2a: Distribution of data frames or data blocks into the substreams in transparent operation

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 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.

11.2.2 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 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 access to the 12 and 6 kbit/s radio interface data rates as described below. (Alignment of RLP frames with the four TDMA slots makes it physically impossible to provide 3,6 kbit/s.) The RA1' function is not applied in case of TCH/F14.4, TCH/F28.8 and TCH/F43.2 channel codings.

Air interface user rate	Radio interface rate
4,8 kbit/s	6 kbit/s
9,6 kbit/s	12 kbit/s or 2×6 kbit/s
14,4 kbit/s	14,5 kbit/s or 2×12 kbit/s or 3×6 kbit/s
19,2 kbit/s	2×12 kbit/s or 4×6 kbit/s
28,8 kbit/s	29 kbit/s or 2×14,5 kbit/s or 3×12 kbit/s
38,4 kbit/s	3×14,5 kbit/s or 4×12 kbit/s
43.2 kbit/s	43.5 kbit/s or 3×14,5 kbit/s
57.6 kbit/s	2×29 kbit/s or 4×14,5 kbit/s

12.1 Support of non-transparent operation for TCH/F9.6 and TCH/F4.8 channel codings

This access results in the use of a modified ITU-T V.110 60 bit frame for non-transparent services (figure 11). In this case, the RA1' function also provides for alignment of four modified ITU-T V.110 60 bit frames sent on the same radio slot corresponding with each complete 240 bit frame to be encoded by the radio subsystem as a single unit (see 3GPP TS 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 27.001, and 27.002).

The first bit of each RLP frame to be transmitted corresponds to the first bit (D1) of the first 60 bit frame in a four frame sequence and the last bit corresponds to the last bit (D'12) of the last 60 bit frame in a four frame sequence. Each 60 bit frame is filled from left to right starting at D1 (see figure 11).

The radio subsystem provides for the synchronous transmission and reception of 240 bit RLP frames through a connection consisting of up to four TCH/Fs. An RLP-frame is received/sent from/to a particular radio channel every 20 ms (12 kbit/s radio interface rate) or every 40 ms (6 kbit/s radio interface rate) irrespective of the user rate.

The request to use 6 kbit/s radio interface rate on a Full Rate Channel is indicated in the BC-IE by setting the NIRR bit to 6 kbit/s (Negotiation procedure see 3GPP TS 27.001) and selecting a Full Rate Channel and Non-Transparent service. If the entity receiving the BC-IE is unable to support this request then the 12 kbit/s radio interface rate shall be provided automatically.

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

In the case of an asymmetric connection the BTS shall send V110 idle frames towards the MSC on the channels which are unused in the direction from the MS towards the MSC. This ensures that the IWF does not interprete V110 frames which are not originated from the MS as complete RLP frames.

12.2 Support of non-transparent operation for TCH/F14.4 channel coding

In 14,4 kbit/s channel 576-bit RLP-frames shall be used as described below.

The RA1' function is not applied in this case. Instead the RLP-, or in multislot operation the Split/Combine- function, handles the 290-bit data blocks received/sent from/to the network. The M1- bit is used for indicating the RLP-frame halves: in the first half M1= 0 and in the second half M1=1. Bit M2 is used for DTX-indication between the BSS and MSC as described in 3GPP TS 08.20

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

In the case of an asymmetric connection the BTS shall send idle frames towards the IWF on the channels which are unused in the direction from the MS towards the MSC, as specified in 3GPP TS 08.60. This ensures that the IWF does not interpret sequences of frames which are not originated from the MS as complete RLP frames.

12.3 Support of non-transparent operation for TCH/F28.8 channel coding

In a 28.8 kbit/s channel, 576-bit RLP-frames shall be used as described below. The 576-bit RLP-frames shall be mapped into the 580-bit radio interface blocks as described in section 9.1.

The RA1' function is not applied in this case. Instead, RLP handles the 580-bit data blocks received/sent from/to the Split/Combine function. The M1- bits are used for indicating RLP-frame halves. The M2-bits are used for DTX-indication between the BSS and MSC as described in 3GPP TS 08.20

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

12.4 Support of non-transparent operation for TCH/F43.2 channel coding

In a 43.2 kbit/s channel 576-bit RLP-frames shall be used as described below. The 576-bit RLP-frames shall be mapped into 870-bit radio interface blocks as described in section 9.3.

The RA1' function is not applied in this case. Instead, RLP handles the 580-bit data blocks received/sent from/to the Split/Combine function. The M1- bits are used for indicating RLP-frame halves. The M2-bits are used for DTX-indication between the BSS and MSC as described in 3GPP TS 08.20

In cases where no RLP-frame is ready to be transmitted, a sequence of 576 '1's is transmitted. This frame is discarded by the distant RLP-function due to FCS failure.

13 Figures on Frame structures

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

Figure 3: The ITU-T V.110 80 bit RA1 frame structure

Intermediate Data Rate							
8 kbit/s	16 kbit/s	32 kb/s	64 kb/s	E1	E2	E3	
600				1	0	0	Note
1200				0	1	0	
2400				1	1	0	
4800	9600	19200	38400	0	1	1	
		14400	28800	1	0	1	

NOTE: The 300 bit/s user data rate is carried on the 600 bit/s synchronous stream by adding stop elements, see subclause 4.1.

Figure 4: Coding of data rates

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

Figure 5: Modified ITU-T V.110 60 bit frame for 9,6 kbit/s transparent data

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

Figure 6: Modified ITU-T V.110 60 bit frame for 4,8. kbit/s transparent data

a)

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

b)

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

Figure 7: a) Modified ITU-T V.110 36 bit frame for 2,4 kbit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

a)

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

b)

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

Figure 8: a) Modified ITU-T V.110 36 bit frame for 1,2 kbit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

a)

D1	D1	D1	S1	D1	D2	D2	X
D2	D2	D3	S3	D3	D3	D3	S4
E4	E5	E6	E7	D4	D4	D4	S6
D4	D5	D5	X	D5	D5	D6	S8
D6	D6	D6	S9				

NOTE: The 300 bit/s user data rate is carried on the 600 bit/s synchronous stream by adding stop elements, see subclause 4.1.

b)

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

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

Figure 9: a) Modified ITU-T V.110 36 bit frame for 600 bit/s transparent data and b) the corresponding intermediate rate frame at 8 kbit/s

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

Figure 10: Modified ITU-T V.110 60 bit frame for 11,2 kbit/s partial rate

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

Figure 11: Modified ITU-T V.110 60 bit frame for non-transparent data

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

F =Fill bits, which are set to 1.

Figure 12: The ITU-T V.110 80 bit frame for 3.6 kbit/s transparent data (8 kbit/s intermediate rate)

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

Figure 13: The ITU-T V.110 32 bit 48 kbit/s frame structure (64 kbit/s intermediate rate)

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

Figure 14: The ITU-T V.110 64 bit 56 kbit/s frame structure (64 kbit/s intermediate rate, option without status bits)

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

Figure 15: Modified ITU-T V.110 60 bit frame for a padded 9,6 kbit/s transparent data frame carrying 4,8 kbit/s with padding

D1	D2	D3	D4	D5	D6	T1
D7	D8	D9	D10	D11	D12	T2
D13	D14	D15	D16	D17	D18	T3
D19	D20	D21	D22	D23	D24	T4
D25	D26	D27	D28	D29	D30	D31
D32	D33	D34	D35	D36	D37	D38
D39	D40	1	1	1	1	1
1	1	1	1	1	1	1
1	1	1	1			

Figure 16: Modified ITU-T V.110 60 bit frame for a padded 11,2 kbit/s transparent data frame carrying 8.0 kbit/s with padding

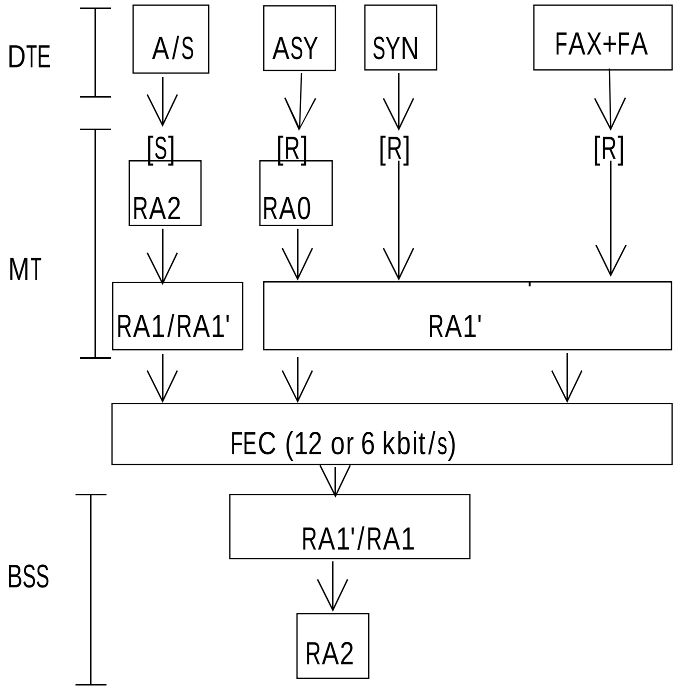
D1	D2	D3	D4	D5	D6
D7	D8	D9	D10	D11	D12
D13	D14	D15	D16	D17	D18
D19	D20	D21	D22	D23	D24
D25	D26	D27	D28	D29	D30
D31	D32	D33	D34	D35	D36

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

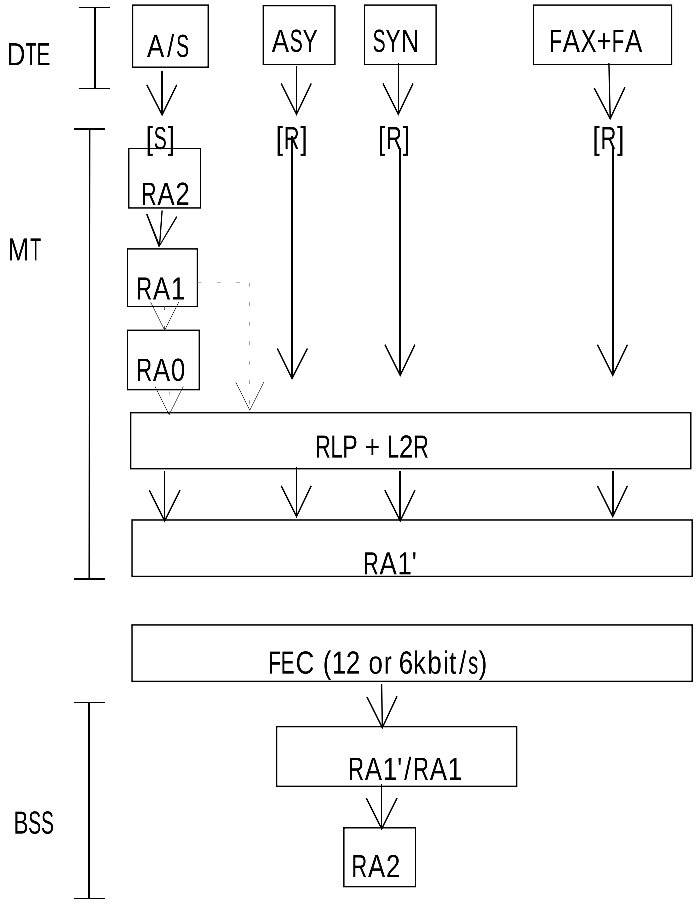
Annex A (Informative): Stacks of rate adaptation

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:

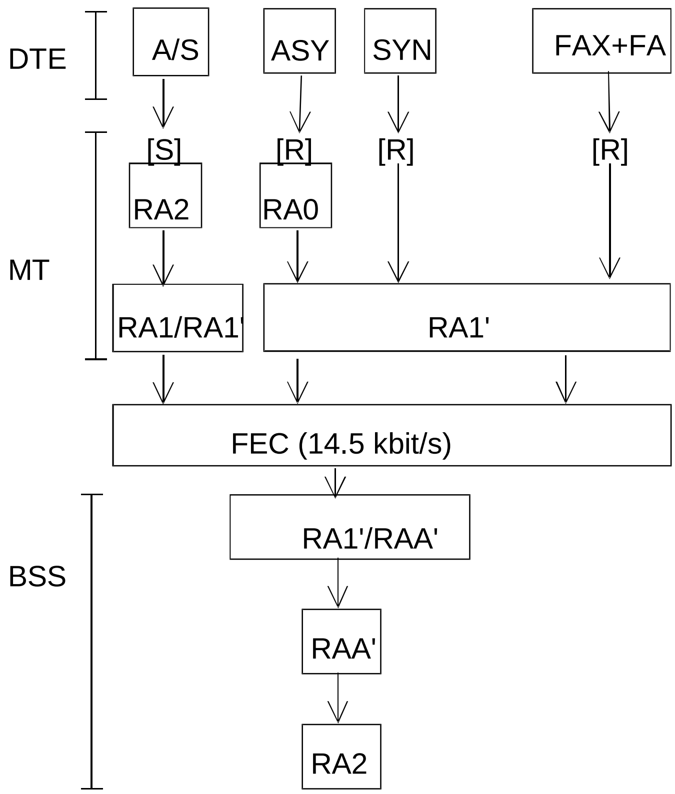


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

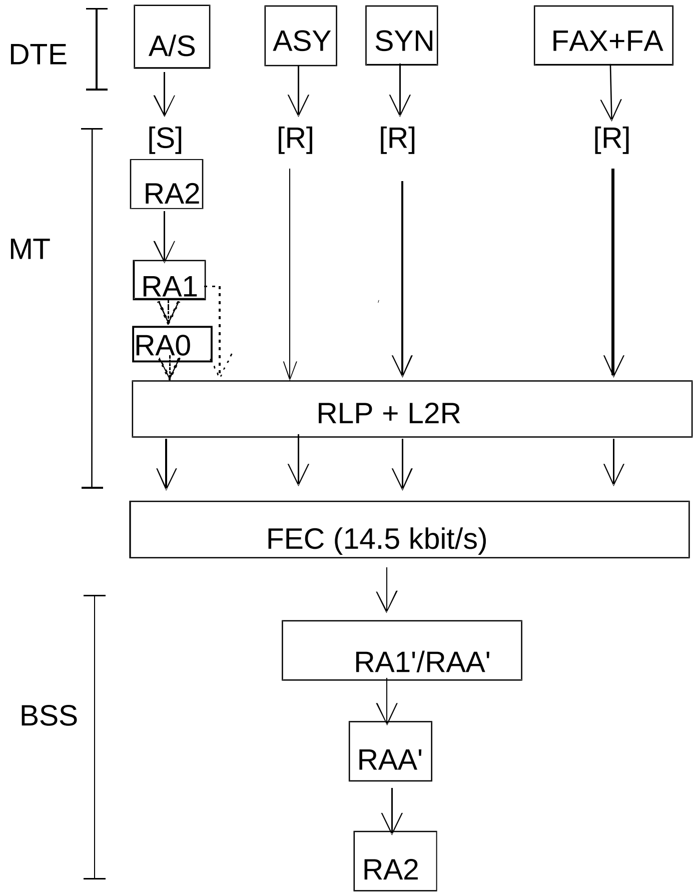


A.2 Stacks of rate adaptation for 14,4 kbit/s single slot operation

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

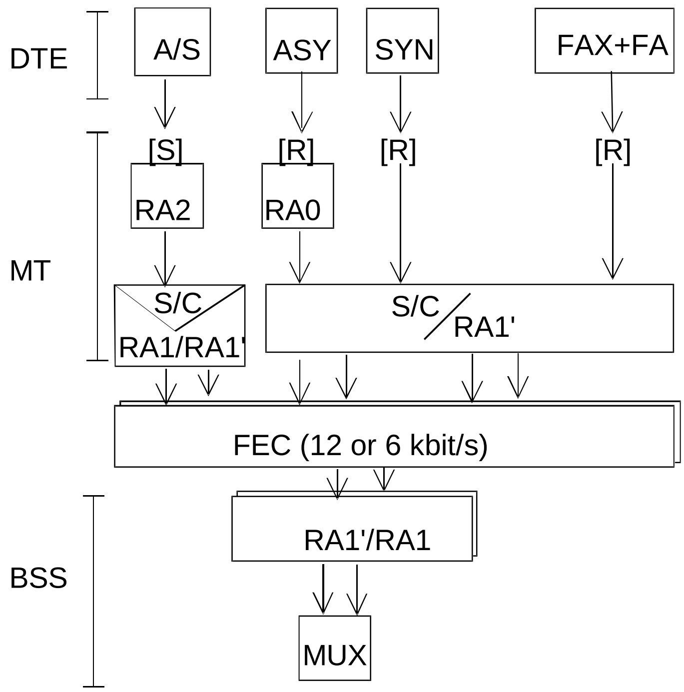


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

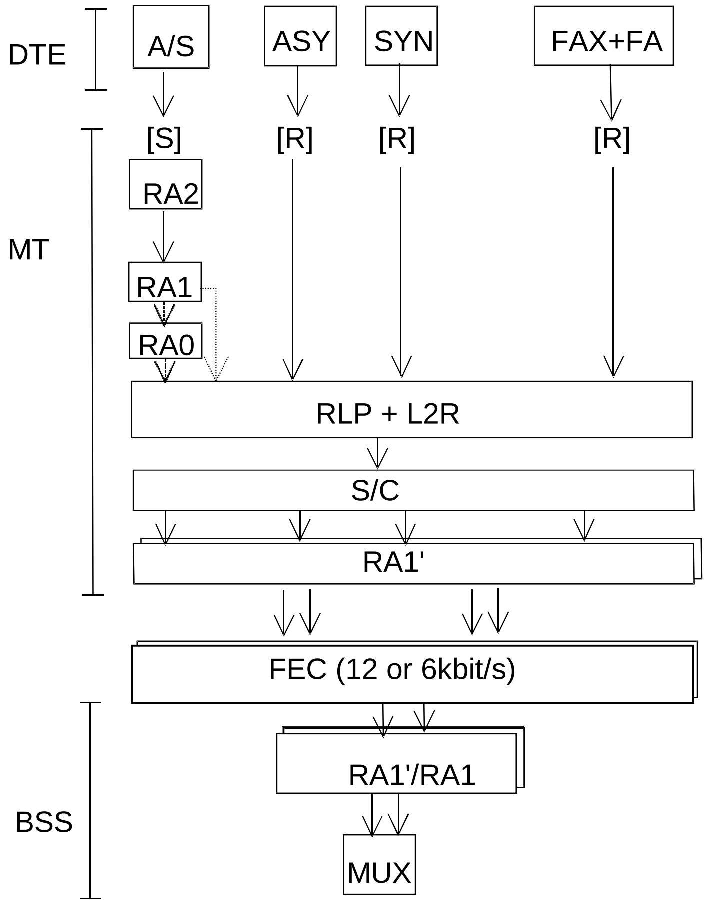


A.3 Stacks of rate adaptation for 9,6/4,8 kbit/s multi slot operation

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

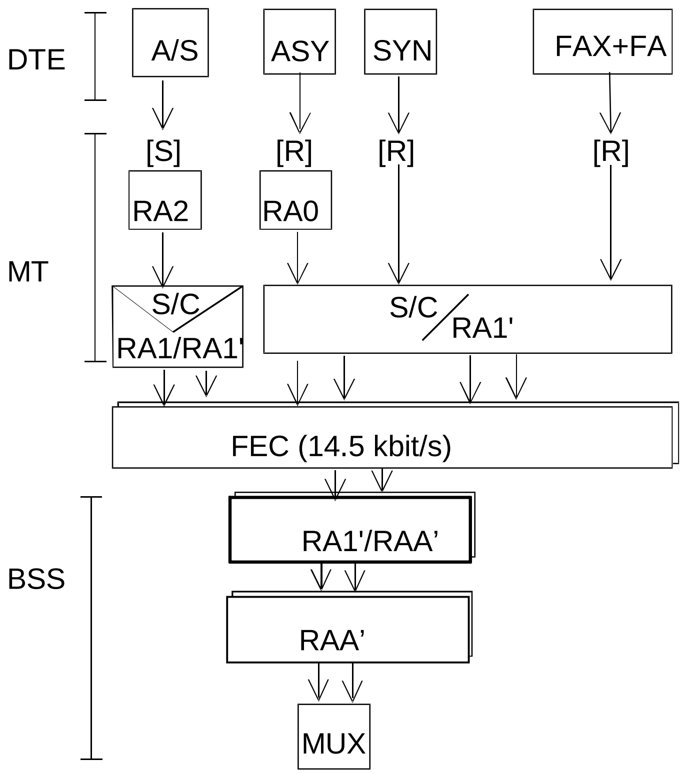


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

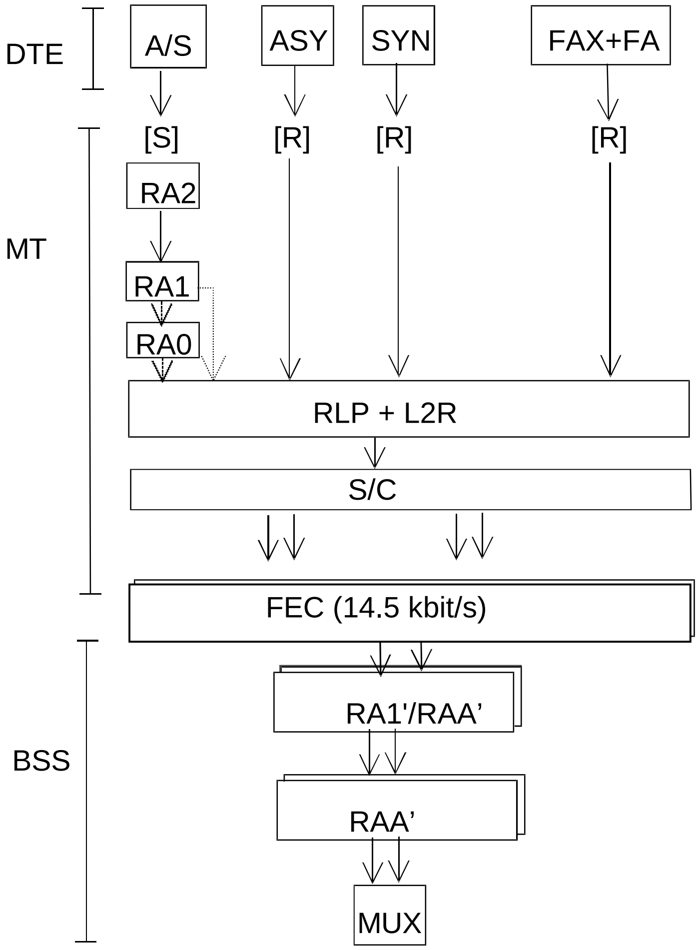


A.4 Stacks of rate adaptation for 14,4 kbit/s multi slot operation

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

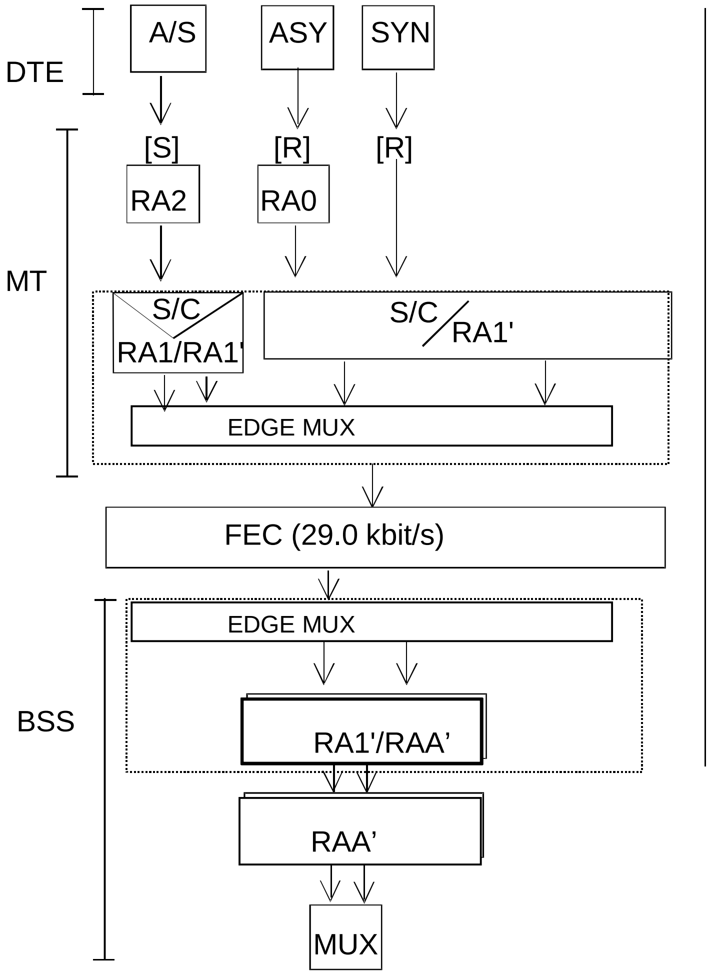


For the non-transparent services, the following stacks of rate adaptation and functions are possible:

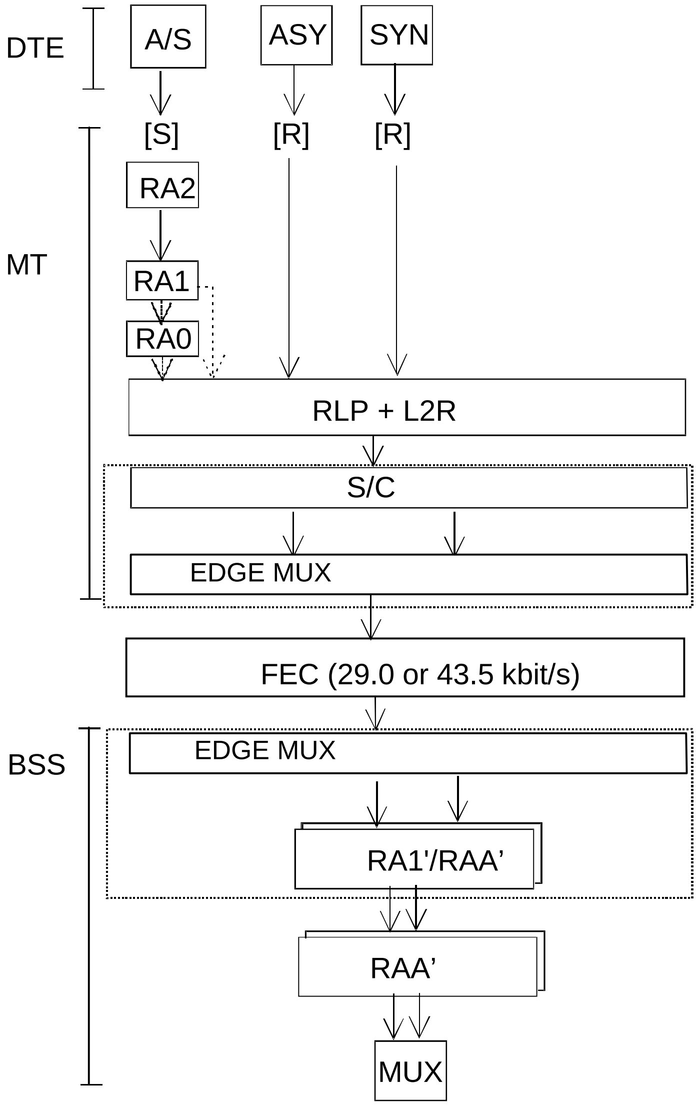


A.5 Stacks of rate adaptation for EDGE channels TCH28.8 and TCH/F43.2 (NT only)

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
12-2000	TSG#10	NP-000604	A020		Removal of the 1200/75 bit/s data rate and general clean-up	8.2.0	8.3.0
12-2000	TSG#10	NP-000605	A021		Handover for 56 kbit/s	8.2.0	8.3.0
12-2000	TSG#10	NP-000606	A022		Removal of BS30 NT	8.3.0	4.0.0

3GPP TSG-CN WG3 Meeting #20 ***Tdoc N3-010582***
Cancun, Mexico. 26th - 30th November 2001.

CR-Form-v4

CHANGE REQUEST

⌘	48.020 CR 001	⌘ ev - ⌘	Current version: 4.0.0 ⌘

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

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

Title: ⌘	New terminology requested by GERAN		
Source: ⌘	CN3		
Work item code: ⌘	TEI_5	***Date:*** ⌘	30.11.2001
Category: ⌘	**D**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	To avoid possible confusion due to new terminology adopted in 3GPP in order to differentiate between networks, Radio Access Technologies (RAT) and modes of operation.
Summary of change: ⌘	Terminology corrections
Consequences if not approved: ⌘	Inconsistency with GERAN specifications.

Clauses affected: ⌘	1 – 13, 16
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications
Other comments: ⌘	

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

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

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

3GPP TS 48.020 V4.0.0 (2001-03)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Core Network;
Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface
(Release 4)

GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

Keywords

GSM, A/Gb mode, GERAN, BSS, adaption

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Contents

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 is re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

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 ~~0~~43.010.

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

NOTE: This specification should be considered together with 3GPP TS ~~0~~44.021 to give a complete description of PLMN rate adaptation.

2 References, abbreviations and definitions

2.1 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: " Vocabulary for 3GPP specifications ". ~~3GPP TS 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".~~

[2] 3GPP TS ~~0~~22.034: "~~Digital cellular telecommunications system (Phase2+):~~ High Speed Circuit Switched Data (HSCSD) - Stage1"

[3] 3GPP TS ~~0~~43.010: "~~Digital cellular telecommunications system (Phase 2+);~~ GSM Public Land Mobile Network (PLMN) connection types".

[4] 3GPP TS ~~0~~23.034: "~~Digital cellular telecommunications system (Phase 2+):~~ High Speed Circuit Switched Data (HSCSD) - Stage2".

[5] 3GPP TS ~~0~~44.021: "~~Digital cellular telecommunications system (Phase 2+);~~ Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[6] 3GPP TS 24.022: "~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ Radio Link Protocol (RLP) for Circuit Switched Bearer and Teleservices".

[7] 3GPP TS ~~0~~45.003: "~~Digital cellular telecommunications system (Phase 2+);~~ Channel coding".

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

[9] 3GPP TS ~~0~~48.008: "~~Digital cellular telecommunications system (Phase 2+);~~ Mobile Switching Centre - Base Station System (MSC - BSS) interface; Layer 3 specification".

[10] 3GPP TS 29.007: "~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[11] ITU-T Recommendation V.110: "Support of data terminal equipment’s (DTEs) with V-Series interfaces by an integrated services digital network".

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

[13] 3GPP TS 48.060: "In-band control of remote transcoders and rate adaptors for full rate traffic channels”

2.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

FPS Frame Pattern Substitution
FSI Frame Start Identifier
ZSP Zero Sequence Position

2.3 Definitions

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

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

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

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

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

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

3 General approach

3GPP TS ~~0~~43.010 (clause 6) defines the PLMN connection types necessary to support the GSM PLMN data and telematic services.

Within the BSS , transcoder and IWF, there are several data rate adaptation functions which are combined as shown in 3GPP TS 4~~0~~3.010 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 ITU-T Recommendation V.110. In addition, splitting/combining, padding and inband numbering functions as defined in 3GPP TS ~~0~~44.021 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 ~~0~~43.010.

The BSS uses the information contained in the ASSIGNMENT REQUEST message on the A-interface (see 3GPP TS ~~0~~48.008) to set the "E bits" and to map the "D bits" as shown below, as well as to choose the correct channel coding.

4 The RA0 Function

The RA0 function is specified in 3GPP TS ~~0~~44.021

5 The RA1 Function

For connections where only one channel is allowed used on the radio interface, the specification in 3GPP TS ~~0~~44.021 for adaptation of synchronous data rates up to and including 9,6 kbit/s to intermediate rates 8 or 16 kbit/s shall apply.

For connection where more than one channel are used on the radio interface, rate adaptation shall apply on the corresponding substreams as specified in 3GPP TS ~~0~~44.021 for AIUR of 4,8 kbit/s or 9,6 kbit/s.

6 The RA1'' Function

The RA1'' function is specified in 3GPP TS 4~~0~~4.021. 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 shall be used in cases when up to and including 4substreams are used.

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

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

Described in 3GPP TS ~~0~~44.021

7.2 Substream numbering

Described in 3GPP TS ~~0~~44.021

7.3 Initial Substream Synchronisation for Transparent Services

Described in 3GPP TS ~~0~~44.021

7.4 Frame Synchronisation and Action on loss of Synchronisation

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

7.5 Network Independent Clocking

NIC is specified in 3GPP TS ~~0~~44.021

7.6 Padding

Padding is specified in 3GPP TS ~~0~~44.021

8 The EDGE Multiplexing Function

In EDGE configurations where the number of radio interface channels and number of channels or substreams used between BTS and MSC do not match, a multiplexing function described below shall be used at BTS to perform data multiplexing/demultiplexing between the radio interface and network channel configurations. A similar functionshall be used also at MS as described in ~~0~~44.021.

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

8.1 Transparent services

TCH/F28.8;

Uplink direction
Refer to the description of corresponding downlink procedures in 3GPP TS ~~0~~44.021. Two TCH/F14.4 substreams are forwarded towards the MSC as in a 2×TCH/F14.4 multislot connection.

Downlink direction
The multiplexing function combines the data received through the two TCH/F14.4 substreams into the 29.0 kbit/s radio interface channel. Refer to the description of corresponding uplink procedures in 3GPP TS 4~~0~~4.021.

TCH/F32.0

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

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

8.2 Non-Transparent services

TCH/F28.8;

Uplink direction
The multiplexing function demultiplexes the data received through the 29.0 kbit/s radio interface channel into two TCH/F14.4 substreams. Two 290-bit blocks carrying the two halves of one RLP frame belong to the same substream. Refer to the corresponding downlink procedures in 3GPP TS ~~0~~44.021.

Downlink direction
The multiplexing function multiplexes the 290-bit blocks received through two TCH/F14.4 substreams into the 29.0 kbit/s radio interface channel. Refer to the corresponding uplink procedures in 3GPP TS ~~0~~44.021.

TCH/F43.2;

Uplink direction
The multiplexing function demultiplexes the data received through the 43.5 kbit/s radio interface channel into three TCH/F14.4 substreams. Two 290-bit blocks carrying the two halves of one RLP frame belong to the same substream. Refer to the corresponding downlink procedures in 3GPP TS ~~0~~44.021.

Downlink direction
The multiplexing function multiplexes the 290-bit blocks received through three TCH/F14.4 substreams into the 43.5 kbit/s radio interface channel. Refer to the corresponding uplink procedures in 3GPP TS ~~0~~44.021.

9 The RA1/RA1' Function

For AIURs less than or equal to 38,4 kbit/s, the RA1/RA1’ function in the BSS shall be applied on each of the n substreams and there are no significant differences between the single slot case and the multislot case. For AIURs less than or equal to 38,4 kbit/s RA1/RA1’ is as specified in 3GPP TS ~~0~~44.021 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 shall be rate adapted as in the single slot case.

For AIURs of 48 kbit/s, 56 kbit/s and 64 kbit/s, RA1/RA1’’ shall be as specified in 3GPP TS ~~0~~44.021 for these rates.

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

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

9.1 Radio Interface rate of 12 kbit/s

Described in 3GPP TS ~~0~~44.021.

9.2 Radio Interface rate of 6 kbit/s

Described in 3GPP TS ~~0~~44.021.

9.3 Radio Interface rate of 3.6 kbit/s

Described in 3GPP TS ~~0~~44.021.

9.4 Synchronisation

Refer to 3GPP TS ~~0~~44.021.

9.5 Idle frames

Refer to 3GPP TS ~~0~~44.021

10 THE RA1'/RAA' FUNCTION

The RA1'/RAA' shall be applied only when TCH/F14.4, TCH/F28.8, or TCH/F43.2 channel coding is used. The RA1/RAA' converts 290-bit blocks from the channel coder or EDGE multiplexing function into E-TRAU frames and vice versa. The format of E-TRAU frame is specified in 3GPP TS 08.60.

The RA1'/RAA' function in the BSS shall be applied on each of the n substreams and there are no significant differences between the single slot case and the multislot case. 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 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 ~~0~~48.060.

11 THE RAA' FUNCTION

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

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

The format of the E-TRAU frame is specified in 3GPP TS 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 ~~0~~44.021.

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.

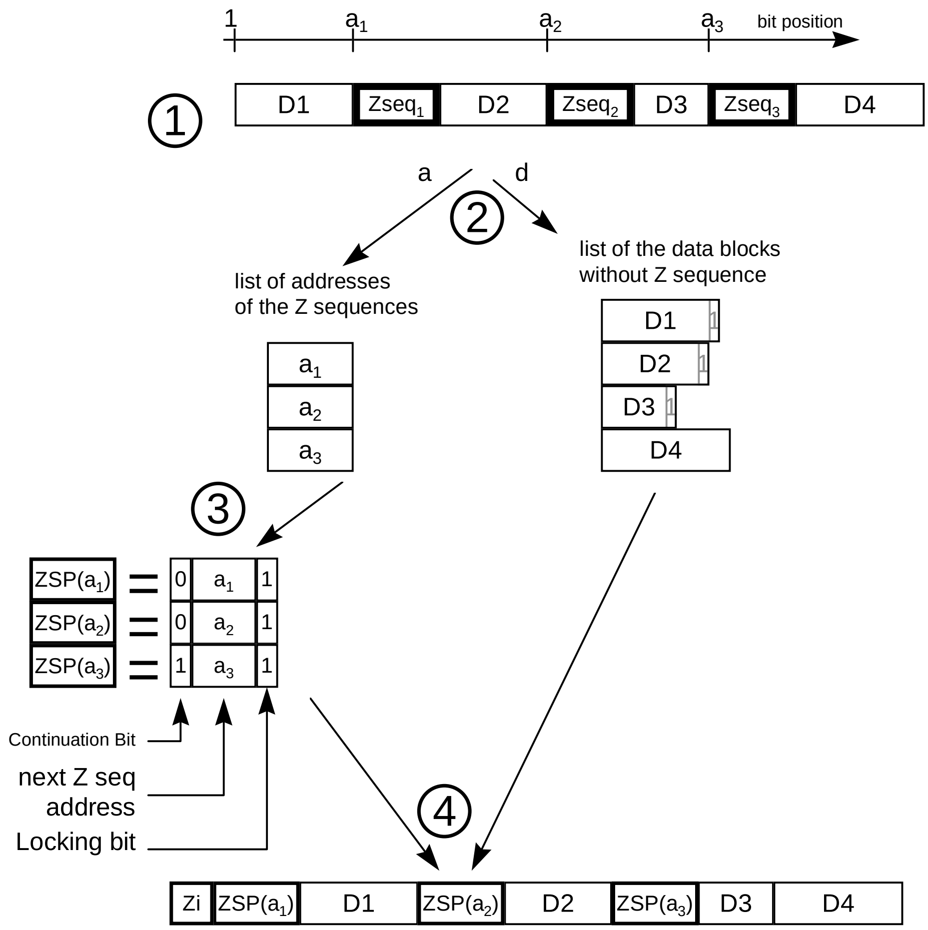

Figure 1

Step 1 :

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

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

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

Step 2 :

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

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

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

Step 3 :

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

at which address is the next Z sequence of the message

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

Step 4 :

The output 37 bit sub frame is built from:

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

the ZSP and D elements interleaved.

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

For special cases, refer to annex A.

11.3 A-TRAU Synchronisation Pattern

The frame synchronisation is obtained by means of the first two octets in each frame, with all bits coded binary "0" and the first bit in octet no 2 coded binary "1". The following 17 bit alignment pattern is used to achieve frame synchronisation :

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

12 THE RAA" FUNCTION

On the IWF side of the A interface, the RAA" function shall convert between the A-TRAU format and a synchronous stream. FPS shall be performed by this function as well, see subclause 11.2. In transparent operation, the RAA" function shall handle the M1 and M2 bits as specified for the RA1' function in 3GPP TS ~~0~~44.021.

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

13 The RA2 Function

Described in 3GPP TS ~~0~~44.021. The RA2 function shall be applied only for single slot operations.

14 The A-interface Multiplexing Function

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

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

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

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

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

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

v) For non-transparent multislot configurations, the lowest allowed subcircuits shall be used at call set up and after change of channel configuration except at downgrading. At downgrading any of the used subcircuits may be released in uplink direction. Always, the released subcircuit(s) in downlink direction shall be the same as the released subcircuit(s) in uplink direction. At a possible subsequent upgrading, the lowest available bit positions shall be used for the added substreams.

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

15 Support of non-transparent bearer services

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

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

The E2 and E3 bits in the modified ITU-T V.110 80 bit frames shown in Figure 3 (derived from the standard ITU-T V.110 frame shown in Figure 2) are used to indicate each consecutive sequence of ITU-T V.110 80 bit frames corresponding to the four modified ITU-T V.110 60 bit frames (Figure 4) received/transmitted in one radio interface frame. This allows 240 bit Radio Link Protocol frames to/from the MSC to be aligned with the 4x60 bit frames encoded by the radio subsystem channel coder as a single unit (see 3GPP TS ~~0~~45.003). The 8 bits consisting of the E2 and E3 bits in one of the above sequences is referred to as the Frame Start Identifier. The FSI value is 00 01 10 11. This value is assigned to the E2 and E3 bits as shown in Table7.

Table 7

	E2	E3
First Modified ITU-T V.110 80 bit frame	0	0
Second	0	1
Third	1	0
Fourth	1	1

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

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

Table 8 : Relationship between FNUR, AIUR, substream rate, number of substreams and intermediate rate

FNUR	AIUR	Number of Channels x Substream Rate	Channel Coding	Multislot Intermediate Rate
≤2,4 kbit/s	2,4 kbit/s	2-8 times duplication of each bit to reach 2,4 kbit/s	TCH/F4.8	8 kbit/s
4,8 kbit/s	4,8 kbit/s	4,8 kbit/s	TCH/F4.8	8 kbit/s
4,8 kbit/s	9,6 kbit/s	9,6 kbit/s	TCH/F9.6	16 kbit/s
9,6 kbit/s	9,6 kbit/s	2x4,8 kbit/s	2XTCH/F4.8	8 kbit/s
9,6 kbit/s	9,6 kbit/s	9,6 kbit/s	TCH/F9.6	16 kbit/s
14,4 kbit/s	14,4 kbit/s	3X4,8 kbit/s	3XTCH/F4.8	8 kbit/s
14,4 kbit/s	19,2 kbit/s	2X9,6 kbit/s	2XTCH/F9.6	16 kbit/s
19,2 kbit/s	19,2 kbit/s	4X4,8 kbit/s	4XTCH/F4.8	8 kbit/s
19,2 kbit/s	19,2 kbit/s	2X9,6 kbit/s	2XTCH/F9.6	16 kbit/s
28,8 kbit/s	28,8 kbit/s	3X9,6 kbit/s	3XTCH/F9.6	16 kbit/s
38,4	38,4 kbit/s	4X9,6 kbit/s	4XTCH/F9.6	16 kbit/s
NOTE: The table gives the relation between the FNUR, AIUR, Substream Rate, Channel Coding and Intermediate Rate. As an example: the wanted FNUR is 14,4 kbit/s and the selected channel coding is TCH/F9.6. The data stream is split into two substreams of 9,6 kbit/s yielding an AIUR of 19,2 kbit/s.				

15.1.1 Alignment

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

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

15.1.2 Support of Discontinuous Transmission (DTX)

The E1 bit in the modified ITU-T V.110 80 bit frame shown in Figure 3 shall be used in the direction MSC-BSS to indicate that DTX may be invoked (see 3GPP TS 24.022). The E1 bit in all of the four consecutive frames relating to the RLP frame to which DTX may be applied shall be set to 1. If DTX is not to be applied, the E1 bit shall be set to 0.

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

15.1.3 Order of Transmission

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

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

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

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

Because of that mapping, it is required, following a transmission break and at start up, to determine which A-TRAU frame of the stream is the first for a particular RLP frame. This is needed so that correct alignment with the radio subsystem can be achieved.

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

Table 9

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

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

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

	AIUR	Number of substreams x AIUR per substream	Channel Coding	Multislot intermediate Rate
	14,4 kbit/s	14,4 kbit/s	TCH/F14.4	16 kbit/s
	28,8 kbit/s	2X14,4 kbit/s	2XTCH/F14.4 1XTCH/F28,8	16 kbit/s
	43,2 kbit/s	3X14,4 kbit/s	3XTCH/F14.4 1XTCH/F43,2	16 kbit/s
	57,6 kbit/s	4X14,4 kbit/s	4XTCH/F14.4	16 kbit/s
	57,6 kbit/s	4X14,4 kbit/s	4XTCH/F14.4 2XTCH/F28,8	16 kbit/s
NOTE: The table gives the relation between AIUR, Substream Rate, Channel Coding and Intermediate Rate. As an example: the AIUR is 28,8 kbit/s and the selected channel coding is 14,5 kbit/s. The data stream is split into two substreams of 14,5 kbit/s yielding an AIUR of 28,8 kbit/s The same number of substreams is used in each direction, even if the AIURs in each direction differ. Superfluous substreams are filled with idle frames. These are inserted at the BTS or IWF and are discarded at the IWFor BTS respectively. At the IWF, the down link AIUR is determined by the out of band signalling (Assignment Complete, Handover Performed), whereas the up link AIUR is determined inband by examining the possible substream positions on the A interface.				

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15.2.1 Alignment

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

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

15.2.2 Support of Discontinuous Transmission (DTX)

The M2 bit in the A-TRAU frame shown in Figure 5 shall be used in the direction MSC to BSS to indicate that DTX may be invoked (see 3GPP TS 24.022). The M2 bit in all of the two consecutive A-TRAU frames relating to the RLP frame to which DTX may be applied shall be set to 1. If DTX is not to be applied, the M2 bit shall be set to 0.

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

16 Support of transparent bearer services

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

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

The ITU-T V.110 80 bit frame shall be used for transparent data on the A interface. These frames are transmitted on up to four substreams multiplexed into one stream sent over the A interface. The split/combine function is applied on the substreams as specified in clause 5 of 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 the V.110 frame is carried with a 8 kbits/s stream which occupies bit position (1). For user rates < 1 200bit/s asynchronous characters are padded with additional stop elements by the RA0 function (in the MSC/IWF) to fit into 600 bit/s synchronous RA1 rate prior to rate adaptation to 64 kbits/s.

No use of 4 kbit/s stream is foreseen.

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

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

16.1.2 User rate Adaptation on the A-interface, AIUR greater than 38,4 kbit/s

For AIUR of 48 kbit/s, 56 kbit/s and 64 kbit/s one stream consisting of ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS ~~0~~44.021 shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, is as specified in 3GPP TS ~~0~~44.021.

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

16.1.3 Relation between AIUR and the number of channels

Table11: Relationship between the AIUR, substream rate, channel coding, intermediate rate and number of channels

AIUR	Number of channels x Substream Rate	Channel Coding	(Multislot) intermediate Rate (Note1)
≤2,4 kbit/s	2-8 times duplication of each bit to reach 4,8 kbit/s	TCH/F4.8	8 kbit/s
4,8 kbit/s	4,8 kbit/s	TCH/F4.8	8 kbit/s
9,6 kbit/s	2X4,8 kbit/s	2XTCH/F4.8	8 kbit/s
9,6 kbit/s	9,6 kbit/s	TCH/F9.6	16 kbit/s
14,4 kbit/s	3X4,8 kbit/s	3XTCH/F4.8	8 kbit/s
14,4 kbit/s	2X9,6 kbit/s w/ padding	2XTCH/F9.6	16 kbit/s
19,2 kbit/s	4X4,8 kbit/s	4XTCH/F4.8	8 kbit/s
19,2 kbit/s	2X9,6 kbit/s	2XTCH/F9.6	16 kbit/s
28,8 kbit/s	3x9,6 kbit/s	3XTCH/F9.6	16 kbit/s
38,4 kbit/s	4X9,6 kbit/s	4XTCH/F9.6	16 kbit/s
48 kbit/s	5X9,6 kbit/s	5XTCH/F9.6	64 kbit/s
56 kbit/s	5X11,2 kbit/s	5XTCH/F9.6	64 kbit/s
64 kbit/s	66x11,2 kbit/s w/padd.	6XTCH/F9.6	64 kbit/s
NOTE: For AIURs ≤ 38,4 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate.			

16.1.4 Handling of status bits X, SA, SB

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

The handling of the status bits shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS 29.007 (MSC), 3GPP TS ~~0~~44.021 (BSS), 3GPP TS 27.001 (MS).

16.1.5 Handling of bits E1 to E7

Bits E1 to E3 shall be used according to ~~0~~44.021.

Bits E4 to E7 may be used for network independent clocking as indicated in 3GPP TS ~~0~~44.021.

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

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

The A-TRAU frame shall be used for transparent user data rates other than 32 kbit/s on the A interface. The A-TRAU frames are transmitted on up to four substreams multiplexed into one stream sent over the A interface. The split/combine function is applied on the substreams as specified in clause 7 of this TS. The relation between the AIUR and the number of channels is specified in table 12.

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

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

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

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

For AIUR of 64 kbit/s one stream consisting of ITU-T V.110 32 bit frames or 64 bit frames, as specified in 3GPP TS ~~0~~44.021 shall be transmitted over the A-interface. Splitting/Combining which occurs in the BSS, shall be as specified in 3GPP TS ~~0~~44.021.

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

16.2.3 Relation between AIUR and the number of channels

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

AIUR	Number of substreams x AIUR per substream	Channel Coding	Multislot intermediate Rate (note 1)
14,4 kbit/s	14,4 kbit/s	TCH/F14.4	16 kbit/s
28,8 kbit/s	2X14,4 kbit/s	TCH/F14.4 TCH/F28.8	16 kbit/s
32 kbit/s	1x32 kbit/s	TCH/F32.0	32 kbit/s
38,4 kbit/s	3X14,4 kbit/s w/padding	TCH/F14.4	16 kbit/s
48 kbit/s	4X14,4 kbit/s w/padding	TCH/F14.4	16 kbit/s
56 kbit/s	4X14,4 kbit/s w/padding 1x64.0 kbit/s (Note 2)	TCH/F14.4 TCH/F32.0	16 kbit/s 64 kbit/s
64kbit/s	5X14,4 kbit/s w/padding 1x64.0 kbit/s (Note 2)	TCH/F14.4 TCH/F32.0	64 kbit/s

NOTE 1: For AIURs ≤ 56 kbit/s this column indicates the multislot intermediate rate: for higher AIURs it indicates the intermediate rate.

NOTE 2: One substream over two air interface timeslots. No multislot intermediate rate.

16.2.4 Handling of status bits X and SB

The X and SB bits shall be carried over the A interface in a multiframe structure as described in subclause 8.1.1.1 of 3GPP TS ~~0~~44.021. SA bit is not carried over the A interface.

The handling of the status bits shall comply with the synchronisation procedures for transparent services which are as described in 3GPP TS 29.007 (MSC), 3GPP TS ~~0~~44.021 (BSS), 3GPP TS 27.001 (MS).

17 Frame Formats

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

Figure 2: The ITU-T V.110 80 bit frame for Transparent Data

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

Figure 3: The modified ITU-T V.110 80 bit frame for Non-Transparent Data

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

Figure 4: Modified ITU-T V.110 60 bit frame for Non-Transparent Data

octet number	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	
0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	
2	1	**C1**	**C2**	**C3**	**C4**	**C5**	**M1**	**M2**	
3	**Z1**	D1	D2	D3	D4	D5	D6	D7	
4	D8	D9	D10	D11	D12	D13	D14	D15	36 bit data field 1
5	D16	D17	D18	D19	D20	D21	D22	D23	
6	D24	D25	D26	D27	D28	D29	D30	D31	
7	D32	D33	D34	D35	D36	**Z2**	D1	D2	
8	D3	D4	D5	D6	D7	D8	D9	D10	
9	D11	D12	D13	D14	D15	D16	D17	D18	36 bit data field 2
10	D19	D20	D21	D22	D23	D24	D25	D26	
11	D27	D28	D29	D30	D31	D32	D33	D34	
12	D35	D36	**Z3**	D1	D2	D3	D4	D5	
13	D6	D7	D8	D9	D10	D11	D12	D13	
14	D14	D15	D16	D17	D18	D19	D20	D21	36 bit data field 3
15	D22	D23	D24	D25	D26	D27	D28	D29	
16	D30	D31	D32	D33	D34	D35	D36	**Z4**	
17	D1	D2	D3	D4	D5	D6	D7	D8	
18	D9	D10	D11	D12	D13	D14	D15	D16	36 bit data field 4
19	D17	D18	D19	D20	D21	D22	D23	D24	
20	D25	D26	D27	D28	D29	D30	D31	D32	
21	D33	D34	D35	D36	**Z5**	D1	D2	D3	
22	D4	D5	D6	D7	D8	D9	D10	D11	
23	D12	D13	D14	D15	D16	D17	D18	D19	36 bit data field 5
24	D20	D21	D22	D23	D24	D25	D26	D27	
25	D28	D29	D30	D31	D32	D33	D34	D35	
26	D36	**Z6**	D1	D2	D3	D4	D5	D6	
27	D7	D8	D9	D10	D11	D12	D13	D14	
28	D15	D16	D17	D18	D19	D20	D21	D22	36 bit data field 6
29	D23	D24	D25	D26	D27	D28	D29	D30	
30	D31	D32	D33	D34	D35	D36	**Z7**	D1	
31	D2	D3	D4	D5	D6	D7	D8	D9	
32	D10	D11	D12	D13	D14	D15	D16	D17	
33	D18	D19	D20	D21	D22	D23	D24	D25	36 bit data field 7
34	D26	D27	D28	D29	D30	D31	D32	D33	
35	D34	D35	D36	**Z8**	D1	D2	D3	D4	
36	D5	D6	D7	D8	D9	D10	D11	D12	
37	D13	D14	D15	D16	D17	D18	D19	D20	36 bit data field 8
38	D21	D22	D23	D24	D25	D26	D27	D28	
39	D29	D30	D31	D32	D33	D34	D35	D36	

Figure 5: A-TRAU 320 bit frame

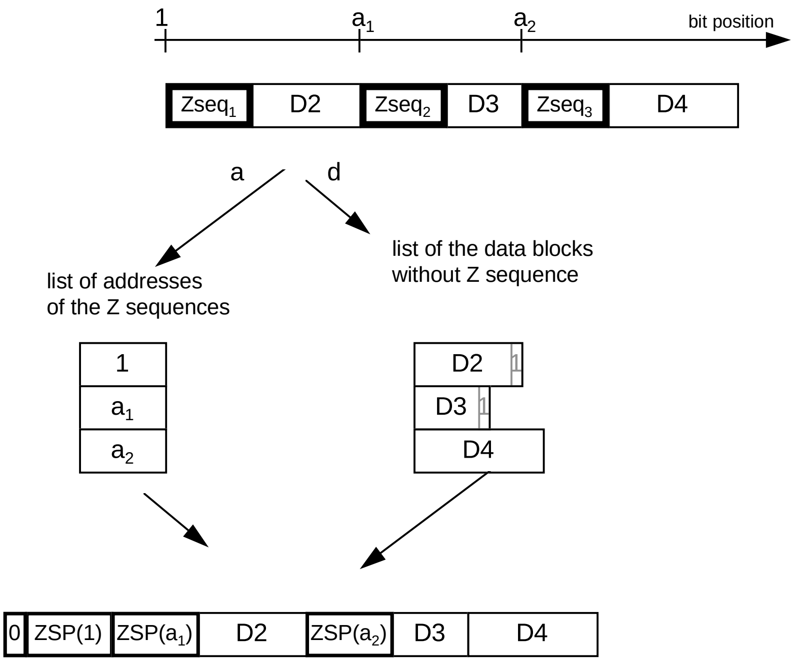
octet no.	bit number 0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	1	D1	D2	D3	D4	D5	D6	S1
2	1	D7	D8	D9	D10	D11	D12	X
3	1	D13	D14	D15	D16	D17	D18	S3
4	1	D19	D20	D21	D22	D23	D24	S4
5	1	E1	E2	E3	E4	E5	E6	E7
6	1	1	1	1	1	1	1	S6
7	1	1	1	1	1	1	1	X
8	1	1	1	1	1	1	1	S8
9	1	1	1	1	1	1	1	S9

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

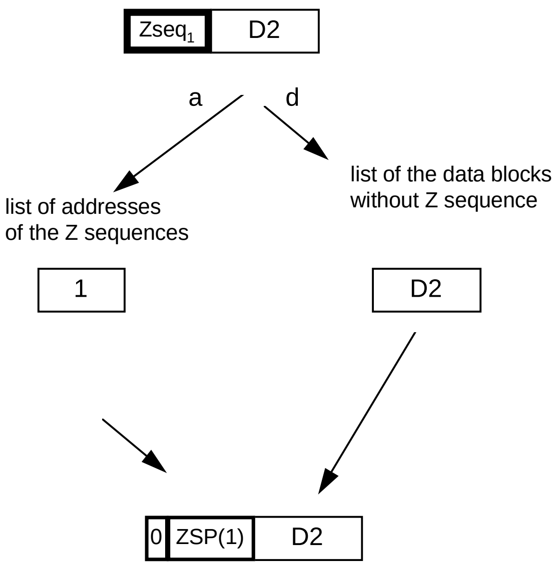
Annex A (informative): Frame Pattern Substitution

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 :



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



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 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 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
12-2000	TSG#10	NP-000604	A009		Removal of 1200/75 bit/s data rate and clean-up	8.2.0	8.3.0
03-2001	TSG#11	NP-010040	A013		Correction of downgrading procedure for HSCSD	8.3.0	8.4.0
03-2001	TSG#11				Upgraded to Release 4	8.4.0	4.0.0

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Core Network;
General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)
(Release 45)

Keywords

~~UMTS~~GERAN, GSM, A/Gb mode, UTRAN. Iu mode, terminal, adaption, network

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Contents

Foreword

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

The present document specifies the functions needed for terminal adaptation within the 3GPP system.

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 re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document is based on the principles of terminal adaptor functions presented in the ITU-T I-series of recommendations (I.460 to I.463).

The PLMN supports a wide range of voice and non-voice services in the same network. In order to enable non-voice traffic in the PLMN there is a need to connect various kinds of terminal equipment to the Mobile Termination (MT). The target of the present document is to outline the functions needed for the terminal adaptation.

~~In the~~The bearer services are described in 3GPP TS 22.002~~ the bearer services are described~~. ~~The ~~and the general network configuration is described in 3GPP TS 23.002. ~~and t~~The ~~GSM ~~A/Gb mode PLMN access reference configuration is defined in 3GPP TS ~~04~~24.002. The various connection types used in ~~the GSM~~an A/GB mode PLMN are presented in 3GPP TS 43.010. Terminology used in the present document is presented in ~~3GPP TS 01.04, ~~3GPP TR 21.905 and 3GPP TS 29.990. For support of data services between a PLMN and other networks see 3GPP TS 29.007.

The present document is valid for a 2^{nd} generation PLMN (~~GSM~~A/Gb mode) as well as for a 3^{rd} generation PLMN ~~(~~UTRAN Iu mode~~UMTS)~~. If text applies only for one of these systems it is explicitly mentioned by using the terms "A/Gb mode~~GSM~~" and "~~UMTS~~UTRAN Iu mode". If text applies to both of the systems, but a distinction between the ISDN/PSTN and the PLMN is necessary, the term "PLMN" is used.

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

- the dual Bearer Services "alternate speech/data" and "speech followed by data";
- the dedicated services for PAD and Packet access;
- BS 21 ... 26 and BS 31 ... 34.

From REL-4 onwards the following service is no longer required by a PLMN:

- the synchronous Bearer Service non-transparent (BS 30 NT).
- Non-transparent facsimile (TS 61/62 NT) for ~~GSM~~the A/Gb mode.

The support of these services is still optional. The specification of these services is not within the scope of the present document. For that, the reader is referred to former releases.

NOTE: Please note that the Gb interface does not play any role in the scope of the present document although the term “A/Gb mode” is used. GERAN Iu mode is for further study.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

[2] 3GPP TS 22.002: “~~"Digital cellular telecommunication system (Phase 2+); ~~Bearer Services (BS) supported by a ~~GSM ~~Public Land Mobile Network (PLMN)".

[3] 3GPP TS ~~02.03~~22.003: “~~"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; ~~Circuit Teleservices supported by a Public Land Mobile Network (PLMN).

[4] 3GPP TS 23.002: "Network architecture".

[5] 3GPP TS 43.010: “~~"3rd Generation Partnership Project; Technical Specification Group TSGN;~~ GSM~~ - UMTS~~ Public Land Mobile Network (PLMN) ~~access reference configuration~~Connection types~~ ~~".

[6] 3GPP TS 24.002: “~~"3rd Generation Partnership Project; Technical Specification Group TSGN;~~ GSM - UMTS Public Land Mobile Network (PLMN) access reference configuration ".

[7] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core Network Protocols -Stage 3".

[8] 3GPP TS 44.021: “~~"Digital cellular telecommunication system (Phase 2+); ~~Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[9] 3GPP TS 24.022: "Radio Link Protocol (RLP) for Circuit Switched Bearer and Teleservices".

[10] 3GPP TS 05.05: "~~Digital cellular telecommunication system (Phase 2+);~~ Radio transmission and reception".

[11] 3GPP TS 27.002: "Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[12] 3GPP TS 27.003: "Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[13] Void.

[14] Void.

[15] Void.

[16] Void.

[17] Void.

[18] Void.

[19] Void.

[20] Void.

[21] 3GPP TS 29.007: "General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[22] Void.

[23] Void.

[24] Void.

[25] Void.

[26] ITU-T Series V Recommendations: "Data communication over the Telephone network".

[27] Void.

[28] ITU-T Series X Recommendations: "Data Communication networks".

[29] Void

[30] ITU-T Recommendation X.150: "Data Communication Networks: Transmission, Signalling and Switching, Network Aspects, Maintenance and Administrative Arrangements".

[31] Void.

[32] ITU-T Recommendation V.250: "Serial asynchronous automatic dialling and control".

[33] ITU-T Recommendation V.54: "Loop Test Devices for Modems".

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

[35] ITU-T Recommendation I.460-I.463: "ISDN Overall Network Aspects and Functions, User Network Interfaces".

[36] ITU-T Recommendation Q.931 (05/98): "DSS 1 - ISDN user network interface layer 3 specification for basic call control".

[37] ETSI ETR 018: "Integrated Services Digital Network (ISDN), Application of the BC-, HLC-, LLC-Information elements by terminals supporting ISDN services".

[38] ISO/IEC 6429: "Information technology - Control functions for coded character sets".

[39] Void.

[40] Void.

[41] Void.

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

[43] 3GPP TS 23.034:" ~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ High Speed Circuit Switched Data (HSCSD) - Stage 2 "..

[44] Void.

[45] Void.

[46] 3GPP TR 21.905: " Vocabulary for 3GPP Specifications ~~3G Vocabulary~~".

[47] 3GPP TS 25.990: "Vocabulary for UTRAN".

[48] 3GPP TS 25.322: "Radio Link Control (RLC) Protocol Specification".

[49] Void.

[50] Mobile Internet Access Forum: "PIAFS Specification Ver. 1.1, 2.1".

[51] ITU-T Recommendation V.80: "In-band DCE control and synchronous data modes for asynchronous DTE".

[52] 3GPP TS ~~03.45~~43.045 " ~~Digital cellular telecommunications system (Phase 2+);~~Technical realization of facsimile group 3 transparent”.

[53] 3GPP TS 4~~0~~5.001 ~~" 3rd Generation Partnership Project; Technical Specification Group GERAN;Digital cellular telecommunications system (Phase 2+);~~ Physical layer on the radio path; General description”.

[54] 3GPP TS 22.034 " ~~3rd Generation Partnership Project; Technical Specification Group Services and System Aspects;~~ High Speed Circuit Switched Data (HSCSD); Stage 1”.

[55] 3GPP TS 23.107 " ~~3rd Generation Partnership Project; Technical Specification Group Services and System Aspects;~~ QoS Concept and Architecture”.

[56] 3GPP TS ~~08.20~~48.020 " ~~Digital cellular telecommunications system (Phase 2+);~~ Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface ”.

[57] 3GPP TS 22.001" ~~Digital cellular telecommunications system (Phase 2+); Technical Specification Group Services and System Aspects;~~ Principles of circuit telecommunication services supported by a Public Land Mobile Network (PLMN)”.

[58] ITU-T Recommendation I.440 " (see ITU-T Rec. Q.920) ”.

[59] ITU-T Recommendation I.450 " (see ITU-T Rec. Q.930) ”.

[60] ITU-T Recommendation H.223 " Multiplexing protocol for low bit rate multimedia communication”.

[61] ITU-T Recommendation H.245 " Control protocol for multimedia communication ”.

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

[63] ITU-T Recommendation V.22 " 1200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits”.

[64] ITU-T Recommendation V.22bis" 2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits ”.

[65] ITU-T Recommendation V.26ter" 2400 bits per second duplex modem using the echo cancellation technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits”.

[66] ITU-T Recommendation V.31" Electrical characteristics for single-current interchange circuits using optocouplers”.

[67] ITU-T Recommendation V.32" A family of 2-wire, duplex modems operating at data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits ”.

[68] ITU-T Recommendation V.34" A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits ”.

[69] ITU-T Recommendation V.42" Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion”.

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

[71] ITU-T Recommendation Q.920" ISDN user-network interface data link layer - General aspects ”.

[72] ITU-T Recommendation Q.930" ISDN user-network interface layer 3 - General aspects ”.

3 Definitions and abbreviations

3.1 Definitions

The term 'mobile station' (-MS-) in the present document is synonymous with the term 'user equipment' (UE) ~~in 3G terminology~~ as defined in 3GPP TR 21.905.

The term 'TE2' in the present document is synonymous with the term 'TE' ~~in 3G terminology~~ as defined in 3GPP TR 21.905.

The term 'MT2' in the present document is synonymous with the term 'MT' ~~in 3G terminology~~ as defined in 3GPP TR 21.905.

For the purposes of the present document the following internal definitions apply in addition to those given in 3GPP TS 21.905.

A/Gb mode: indicates that the text applies only to a system or sub-system which operate in A/Gb mode of operation, i.e. with a functional division that is in accordance with the use of an A or a Gb interface between the radio access network and the core network

Iu mode: indicates that the text applies only to a system or a sub-system which operates in Iu mode of operation, i.e. with a functional division that is in accordance with the use of an Iu-CS or Iu-PS interface between the radio access network and the core network

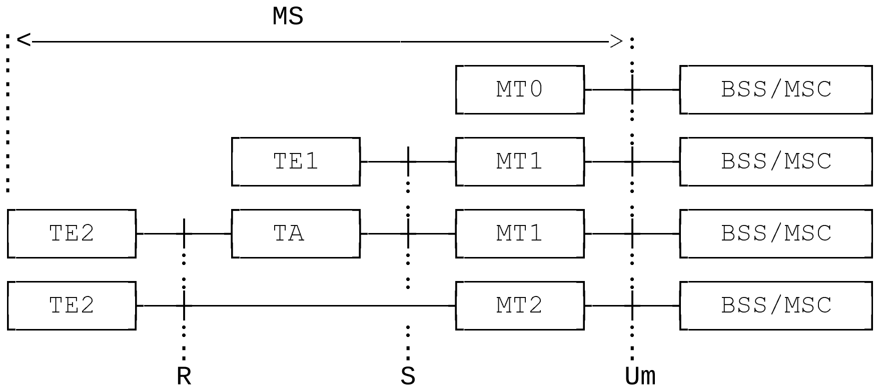
3.2 Abbreviations

In addition to those below, abbreviations used in the present document are listed in ~~3GPP TS 01.04,~~ 3GPP TR 21.905 or 3GPP TS 25.990.

CALL PROC	CALL PROCEEDING
CALL CONF	CALL CONFIRMED
CONNACK	CONNECT ACKNOWLEDGEMENT
EDGE channel	A general term referring to channels based on 8PSK modulation; i.e. TCH/F28.8, TCH/F32.0, and TCH/F43.2.
FTM	Frame Tunnelling Mode
PIAFS	PHS Internet Access Forum Standard
PHS	Personal Handyphone System

4 Access reference configuration

Figure 1 presents the reference configuration for access to a ~~GSM~~ A/Gb mode PLMN (see 3GPP TS 24.002).



:	reference point.
TE1:	ISDN terminal.
TE2:	V- or X-type terminal.
TA:	Terminal Adaptor.
BSS:	Base Station System.
MSC:	Mobile Switching Centre.

Figure 1: ~~GSM~~ A/Gb mode PLMN Access Reference Configuration

Within the scope of the present document the Mobile Termination MT0 means a fully integrated MS including data terminal and its adaptation functions. MT1 includes ISDN terminal adaptation functions and MT2 includes ITU-T V- or X-series terminal adaptation functions among other MT functions.

Figure 2 presents the access reference configuration for ~~UMTS~~UTRAN Iu mode. There is no reference point identified for the TAF. The TAF is considered as a part of the Mobile Termination.

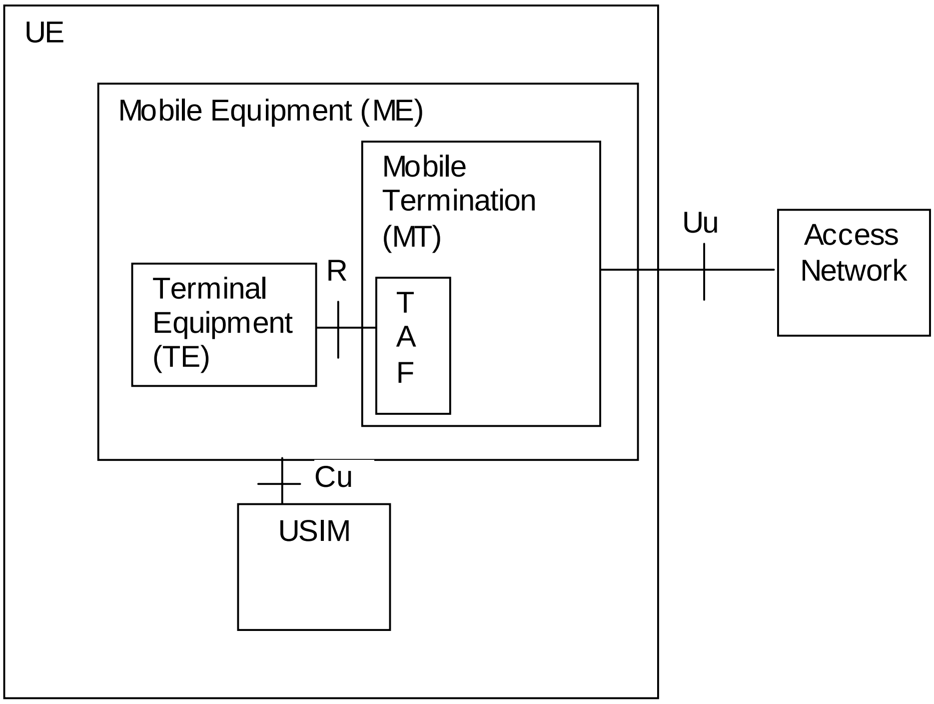


Figure 2: ~~UMTS~~ UTRAN Iu mode PLMN Access Reference Configuration

5 Functions to support data services

The main functions of the MT to support data services are:

- functions to ensure conformity of terminal service requests to network capability;
- physical connection of the reference points R and S;
- flow control of signalling and mapping of user signalling to/from ~~GSM~~ the PLMN access signalling;
- rate adaptation of user data (see 3GPP TS 44.021) and data formatting for the transmission SAP (3GPP TS 25.322);
- flow control of non-transparent user data and mapping of flow control for asynchronous data services;
- support of data integrity between the MS and the interworking function in the ~~GSM~~ the PLMN;
- end-to-end synchronization between terminals;
- filtering of status information;
- functions to support non-transparent bearer services e.g. termination of the Radio Link Protocol (RLP) and the Layer 2 Relay function (L2R) including optional data compression function (where applicable);
- terminal compatibility checking;
- optional support of local test loops.

In addition, functions to support autocalling and autoanswering are optionally specified in accordance with ITU-T Recommendation. V.250 (although the use of other autocalling/auto-answering procedures are not prohibited provided that mapping in a functionally equivalent way to 3GPP TS 24.008 call control is also provided).

Other functional entities may be envisaged apart from the TAF. One of the physical interface to all these functions is the DTE/DCE interface to the MT. Normally, this DTE/DCE interface is associated with the TAF, if available. Therefore the access to any of these other functional entities, if implemented, via the DCE/DTE interface, are triggered by appropriate command sequences which are described in the applicable specifications (although the use of other procedures is not prohibited provided that mapping in a functionally equivalent way is also provided). These command sequences shall be issued by the DTE only when the MT is in the appropriate command status and there is no data connection pending. They are interpreted by an MT internal control function and result in an association of the DTE/DCE interface with the addressed function, if available.

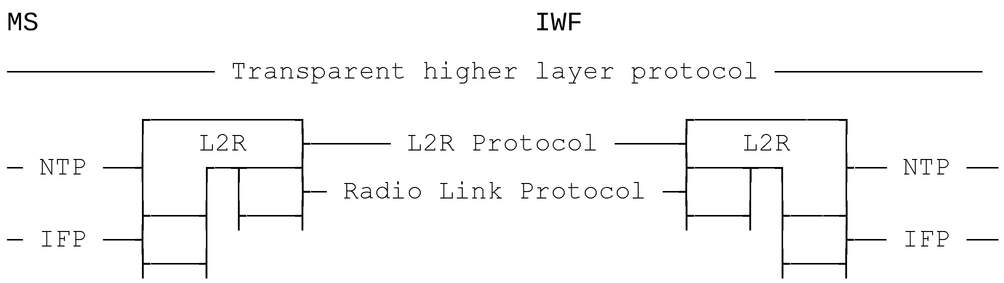
6 Support of non transparent Bearer Services

In order to support asynchronous non transparent bearer services a Layer 2 Relay (L2R) function is included in the mobile termination. The details of the particular L2R function for the different asynchronous non transparent bearer services are contained in the appropriate 3GPP 27-series Specification. This section describes the general aspects of the L2R function.

The Layer 2 Relay (L2R) function provides for the reliable transportation of known, i.e. asynchronous non transparent, user protocols across the radio interface of a ~~GSM~~ PLMN. The L2R functions are located in the Mobile Termination (MT) and the Interworking Function (IWF) associated with a Mobile Switching Centre (MSC). The L2R uses the services provided by the Radio Link Protocol (RLP) to transport the asynchronous non transparent protocol information between the MS and the IWF.

6.1 Functions of the Layer 2 Relay

The complete protocol reference models for data and telematic services are described in 3GPP TS 43.010. The subset of those protocol reference models relating to the L2R function is reproduced in figure 2A.



NTP Non Transparent Protocol
IFP Interface Protocol

Figure 2A

The Non Transparent Protocol (NTP) is normally a layer 2 protocol for OSI conformant protocols or an equivalent in the case of non OSI protocols. The Interface Protocol (IFP) is normally a layer 1 protocol for OSI conformant systems or equivalent for non OSI systems.

The L2R can be considered to consist of 3 sub-functions, see figure 3.

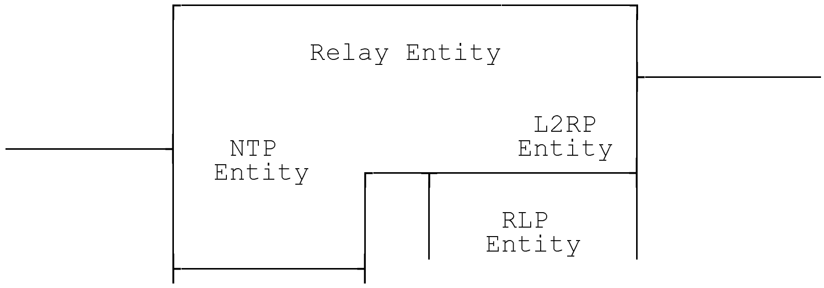


Figure 3

The 3 sub-functions are:

- a Non Transparent Protocol Entity;
- a L2R Protocol Entity;
- a Relay Entity.

The NTP-entity interfaces the L2R to the IFP-entity and provides an interface to the particular NTP.

The L2RP-entity interfaces the L2R to the RLP-entity and provides an interface to the appropriate L2R protocol.

The Relay-entity provides the mapping between the NTP-entity and the L2R-entity. If applicable, it contains the data compression function. The negotiable parameters are exchanged with the remote Relay-entity by means of the RLP XID frame.

It should be noted that the inter-layer interfaces within the MS and the IWF and within the L2R is not specified by 3GPP, The description given is for explanatory purposes only and is not intended to indicate a method of implementation. Therefore, the specification of the L2R is in terms of the peer-peer protocols. Generally, the non transparent and interface protocols are specified elsewhere, e.g. ITU-T Recommendations V.110 or V.120. Thus the main specification for the L2R consists of the L2R peer-peer protocols.

6.1.1 Layer 2 Relay in Frame Tunneling Mode

L2R is used in FTM to transport asynchronous HDLC (ref.[44]) frames between the MS and the IWF. In this case there is no NTP entity on the IWF side. Instead, the L2R entity interfaces a conversion function that performs a mapping between asynchronous and synchronous HDLC frames, which are transported on a UDI or RDI bearer with X.31 flag stuffing as rate adaptation. Consequently there is no error correction or flow control on the fixed network leg. (The HDLC FCS is used by the higher layer protocol, and error correction and flow control are performed end-to-end between the two DTEs.)

6.2 Radio Link Services Used

The L2R function uses services defined in 3GPP TS 24.022 (Radio Link Protocol).

6.3 Flow Control - General Description

A flow control active condition may take place under a number of circumstances:

- end to end flow control (DTE to DTE matter);
- backpressure (buffers filling);
- receive not ready (RLP condition).

It is possible that there may be an interaction between flow control active and inactive conditions in each circumstance.

6.3.1 End to End Flow Control

A DTE may wish to send a flow control active condition to another DTE.

Provisions exists in the L2R entity to transfer a flow control active condition (sent by its associated DTE) to the other L2R entity as soon as possible. This mechanism in the L2R entities allows such a flow control condition to be put ahead of any queuing which exists in the L2R entities.

Such a mechanism avoids undesirable build up of data buffers.

The L2R entity, receiving a flow control active condition from its associated DTE, stops sending data to that associated DTE immediately.

6.3.2 Back Pressure

The L2R and RLP entities have buffers which may become full to a predetermined threshold for a number of reasons, e.g. severe radio fading, failure or slowness of DTE to react to end to end flow control, certain RNR conditions. When this predetermined threshold is reached, a flow control active condition is sent to the associated DTE which is then prevented from sending any data. Subsequently, the flow control inactive condition is sent to the associated DTE when the L2R or RLP entities have indicated that there is sufficient free capacity in their buffers for data flow from the associated DTE to proceed.

The corresponding peer-layer procedure to assess the respective buffer conditions is a layer management matter and is not dealt with here. It is also considered an implementation matter to ensure that such procedure do not result in loss of data or considerable reduction in throughput.

In FTM, back pressure is not applicable towards the DTE on the fixed network side, because there is no flow control mechanism on the fixed network leg. Consequently buffer overflow may occur leading to loss of data, which is left to the higher layer protocol to handle.

6.3.3 Receive not Ready

When the RNR condition arises, an RLP indication is sent to the other RLP entity which in turn shall send a flow control active condition to its associated L2R entity. That L2R entity shall then send a flow control active condition to its associated DTE.
An RNR condition may result in the Execution of "back pressure" as mentioned under 6.3.2.

6.4 User initiated service level up and down grading (applies to ~~GSM~~ A/Gb mode only)

When the value of the negotiated UIMI parameter is greater than 0, the MS may at any time during the call, control, to some extent, the number of traffic channels to be used. This is done by signalling a higher or lower value for the wanted air interface user rate (WAIUR) and maximum number of traffic channels (mTCH). The network may assign an AIUR matching the WAIUR using up to mTCH traffic channels, provided that the resources are available (3GPP TS 22.034, 23.034 and 24.008).

If the value of the RLP optional feature 'Up signalling' is negotiated to 1, the MS may receive a suggestion from the network to initiate an upgrading. This occurs when the following condition holds:

The IWF:

1) is receiving user data from the fixed network side at a higher rate than the current AIUR; or

2) in symmetrical calls only, can send user data towards the fixed network side at a higher rate than the current AIUR.

The MS can detect the condition stated in 1) and 2) above by examining the value of the UP bit in the received RLP S and I+S frames. When the condition does not hold, the value of the UP bit is continuously 0. If the condition does hold, the number of 1s between two consecutive 0s indicates the number of traffic channels to upgrade by. There is no need to repeat this indication since the FCS protects it. For instance, if the UP bit sequence is ...01100... and the current number of assigned traffic channels is 2, then an upgrading 4 traffic channels is suggested.

NOTE: From MSC/IWF's perspective a TCH/F28.8 or TCH/F43.2 EDGE configuration is identical to a multislot 2×TCH/F14.4 or 3×TCH/F14.4 configuration. Therefore, a factor of 1/2 or 1/3 has to be applied to the suggested increase when the assigned up link channel is TCH/F28.8 or TCH/F43.2 respectively.

The MS may use the information signalled in the UP bit to find out when a service level upgrading may increase the data throughput. In order to initiate a service level upgrading, the value of UIMI shall be greater than the number of currently assigned channels.

In order to determine when to downgrade, the MS may compare the rate of received and sent information in the RLP frames to the AIUR. If the rate of received and sent information is less than the current AIUR the MS may initiate a downgrading.

User initiated service level up and down grading mechanism may also be used to modify the asymmetry preference, see subclause 6.5. This is achieved by sending a new value of the asymmetry preference in the BC-IE.

6.5 Asymmetry preference indication (applies to ~~GSM~~ A/Gb mode only)

The MS's classmark may restrict the possible number of channels or modulation that may be assigned by the network in one of the directions. This may result in an asymmetric transmission, i.e., different numbers of channels or modulations are assigned in each direction.

Asymmetric transmission may also result from a preference indication. At call set up, the MS may send an asymmetry preference indication in the BC-IE (see 3GPP TS 24.008). There are three options:

1) no preference;

2) up link biased asymmetry preferred;

3) down link biased asymmetry preferred.

If down or up link asymmetry preference is indicated, the network shall not assign EDGE channels on the unbiased link. If the network assigns EDGE channels on the biased link, it shall assign TCH/F14.4 on the unbiased link. The WAIUR shall then apply to the biased link.

7 Structure of the 3GPP TS 27-series of Specifications

The structure of the Specifications is as follows:

3GPP TS 27.001 General on Terminal Adaptation Functions for Mobile Stations.

3GPP TS 27.002 Terminal Adaptation Functions for Services using Asynchronous Bearer Capabilities.
This document defines the interfaces and terminal adaption functions integral to a MT which enable the attachment of Asynchronous Terminals to a MT.

3GPP TS 27.003 Terminal Adaptation Functions for Services using Synchronous Bearer Capabilities.
This document defines the interfaces and terminal adaptation functions integral to a MT which enable the attachment of Synchronous Terminals to a MT.

8 Functions common to all interfaces

8.1 Synchronization of the Traffic Channel

As long as there is no connection between the traffic channel and the interface to the TE this interface shall be terminated in the appropriate way.

Prior to exposing the traffic channel of a ~~GSM~~ PLMN connection to transmission of user data, the controlling entities of the connection shall assure the availability of the traffic channel(s). This is done by the so called synchronization process:

- starting on the indication of "physical connection established" resulting from the PLMN inherent outband signalling procedure. This indication is given on reception of the message CONNECT in case of MO calls, on reception of the message CONNACK in case of MT calls and on reception of the message MODIFY COMPLETE in case of in-call modification;
- ending by indicating the successful execution of this process to the controlling entity, which then takes care of the further use of the inband information (data, status).

During the call control phases (set-up and clear), the procedures at the V.-series and X.-series DTE interfaces may be mapped completely to the out-of-band signalling procedure. The state of the S-bits and X-bits during the call control phases are in this case irrelevant to the DTE interface procedures. However, the "ready for data" condition (i.e. CTs 106 and 109, in the case of V.-series interface, and I-circuit, in the case of X.-series interface) is derived from the status bits received by the TAF once synchronization is complete. Since half duplex operation is not supported by a ~~GSM~~ PLMN, status bit SB is not needed to signal the turn around of the connection.

8.1.1 Transparent services

8.1.1.1 Initial procedure for traffic channel types TCH/F4.8 and TCH/F9.6

With respect to the TAF, for the transparent bearer capability support the synchronization procedure with the channel codings 2.4, 4.8 and 9.6 kbit/s is as follows:

- sending of synchronization pattern 1/OFF (all data bits "1" / all status bits "OFF", all E-bits "1") to the IWF. In multislot transparent operation, the synchronisation pattern sent is 1/OFF with the exception of the bit positions S1, first X, S3, and S4 which contain the substream number and multiframe alignment pattern (Ref. 3GPP TS 44.021);
- searching for detection of the synchronization pattern received from the IWF, and in multislot operation, also searching for the multiframe alignment pattern "0000 1001 0110 0111 1100 0110 1110 101" (Ref. to 3GPP TS 44.021) in bit position S4 and substream numbers in bit positions S1, first X, and S3. The value of the bits E4-E7 shall not be checked.

8.1.1.2 Initial procedure for traffic channel types TCH/F14.4 and TCH/F28.8

With respect to the TAF, for the transparent bearer capability support, the procedure with the TCH/F14.4 or TCH/F28.8 is as follows:

- sending of synchronization pattern 1/OFF (all data bits "1" / status bits in M2 "OFF") to the network in the multiframe structure with the multiframe alignment pattern "0000 1001 0110 0111 1100 0110 1110 101" in the M1 (Ref. to 3GPP TS 44.021) and, in a multislot or TCH/F28.8 case, sending substream numbers in the bit M2;
- searching for the detection of the multiframe alignment pattern "0000 1001 0110 0111 1100 0110 1110 101" (Ref. to 3GPP TS 44.021) in the bit M1 originating from the network, and, in a multislot or TCH/F28.8 case, searching for substream numbers in the bit M2. (Any 5 bits sequence in the multiframe alignment pattern is unique, i.e. the multiframe alignment can take place by the recognition of five successive S1 bits).

8.1.1.3 Subsequent procedures for traffic channel types TCH/F4.8, TCH/F9.6, TCH/F14.4, and TCH/F28.8

When the synchronisation pattern and, in case of multislot, TCH/F14.4 or TCH/F28.8 operation the multiframe alignment pattern from the IWF have been recognized as a steady state (see note) the TAF continues sending the synchronization patterns to the IWF until a timer T (=500ms) expires.

NOTE: An idle frame sent by the BSS and received by the MS has the same pattern as the synchronization pattern 1/OFF.

At the moment when the message CONNECT (MO) or CONNACK (MT) is received at the MS, it is guaranteed that this pattern is received from the MSC/IWF with the exception of a loss of frame synchronization on the Abis interface.

The handling of frame stealing in case of 2400 bit/s full rate data channels is implementation dependent.

8.1.1.3.1 V.-series interface

During the synchronization process described above, i.e. while the synchronization pattern is being sent by the MT, CT106, 107 and 109 remain in the OFF condition.

After the expiration of the timer T of each allocated traffic channel for the call, the X and SB bits received from the IWF are mapped on to CT 106 and CT 109, respectively, at the MT/DTE interface according to the filtering process described in subclause 8.2. The received SA bit, if available, is ignored. The condition on CT107 is changed from "OFF" to "ON", the data bits received from the IWF are mapped to CT104, and CT103 is mapped to the data bits sent towards the IWF. The transmitted SA (if available), SB and X bits shall be set to "ON".

8.1.1.3.2 X.-series interface

Void.

8.1.1.3.3 S interface (I.420)

Void.

8.1.1.4 Procedures for RLC

With respect to the TAF for T bearer support, the procedure is as follows:

- no access stratum SDUs are transmitted until an access stratum SDU is received.

8.1.1.4.1 V-series interface

Until the first access stratum SDU is received at the transmission SAP, CT 106, 107 and 109 remain in the OFF condition. At the reception of the first SDU, CT 106, CT 107 and CT 109 are changed from OFF to ON at the DCE/DTE (TE/TAF) interface. The data received in each SDU are mapped to CT 104 and data on CT 103 are mapped to SDUs sent toward the RNC.

8.1.2 Non-transparent services

With respect to the TAF, for non-transparent bearer capability support, the synchronization procedure in ~~GSM~~ A/Gb mode is as follows:

- firstly, receiving frames on all allocated traffic channels for the call;
- secondly, initiating the RLP link establishment by sending a RLP-SABM across the radio interface.

In ~~UMTS~~UTRAN Iu mode, the TAF shall initiate the RLP after the physical connection has been established.

8.1.2.1 V.-series interface

During the synchronization process described above, i.e. while the synchronization pattern is being sent by the MT, CT106, 107 and 109 remain in the OFF condition.

When the RLP link has been established, CT107 shall be changed from "OFF" to "ON". From this time the information from/to the RLP, including status changes, shall be mapped by the L2R entity applicable to the particular bearer capability (3GPP TS 27.002 "L2R functionality").

8.1.2.2 X.-series interface

Void.

8.1.2.3 S interface (I.420) (does not apply to ~~UMTS~~UTRAN Iu mode)

Void.

8.1.3 Action on loss of synchronization

8.1.3.1 Loss at the TAF-radio interface

In ~~GSM~~A/Gb mode, if the TAF detects a loss of synchronisation on one or more channels, it initiates the re-synchronisation process. The TAF searches for the data frame structure in those channels in which the synchronisation has been lost according to the initial procedures described in subclauses 8.1.1 and 8.1.2. The information received from the channels shall continue to be processed as if the synchronisation had not been lost, i.e. corrupted data is forwarded towards RLP entity or TE during the re-synchronisation process. No action shall be taken on the frames being transmitted towards the MSC, other than to continue sending them normally.

In ~~UMTS~~UTRAN Iu mode, no action shall be taken.

8.1.3.2 Loss at the TAF-terminal interface

Void.

8.2 Filtering of Channel Control Information (~~GSM~~ A/Gb mode transparent mode only)

8.2.1 General

The DTEs used at the MS side of the PLMN conforms to ITU-T's DTE/DCE interface specifications, which assume basically an error-free environment, i.e.:

- limited distance, point-to-point local interconnection of the interface circuits for data and status;
- steady state signalling.

The envisaged use of these DTEs in the PLMN environment leads to the exposure of these "interconnections" to the PLMN radio channel. To assure proper operation even under these conditions appropriate measures have to be taken. In the non transparent case the RLP satisfies the requirement for both data and status lines.

In the transparent case the:

- data line aspects have to be dealt with end-to-end by the users; while
- status line aspects are of concern to the network, and are dealt with in the following.

8.2.2 Filtering process to be applied

Filtering of channel control information is relevant only at the MS side and in the transparent mode of operation. By applying filtering measures the condition of a DTE/DCE control interchange circuit, for which the DTE constitutes the information sink, is preserved until another condition is signalled for an "integration time" period by the channel control information (status bits) of the rate adaptation scheme.

The filtering mechanism is understood to reside between the rate adaptation function (information source) and the DTE (information sink). It receives the unfiltered condition of the respective control interchange circuit set according to the actual sequential appearance of the individual associated status bits and forwards the filtered condition to the DTE.

The filtering process starts when the traffic channel synchronization ends with the expiry of timer T.

8.2.2.1 V.-series interface

CT 106

In the transparent mode the remote inband control of this circuit is needed to support a modem retrain procedure.

OFF-ON transition at the MS authorizes the DTE to send data; if wrongly set, loss of data may occur.

ON-OFF transition at the MS causes the DTE to cease transmitting data; set wrongly may impair the performance in connection usage.

CT 109

In the transparent mode the remote inband control of this circuit is needed to:

- trigger the interpretation of received data;
- indicate to the DTE the state of the connection.

OFF-ON transition at the MS authorizes the DTE to rely on the condition of the received data interchange circuit, set wrongly may cause receipt of wrong data, while setting late may cause loss of data.

ON-OFF transition at the MS:

- causes the DTE to cease receiving data;
- may initiate release of the connection during a data phase by the DTE giving an ON-OFF transition on circuit 108/2.

Setting this condition wrongly may cause loss of data and potentially release the connection.

8.2.2.2 X.-series interface

Void.

8.2.2.3 Filtering mechanism

8.2.2.3.1 Traffic channel types TCH/F4.8 and TCH/F9.6

A filtering mechanism shall be provided by an integration process on those SB and X bits carrying status information in the V.110 frame or in the multiframe structure. The integration periods applied are:

V-series	Transition	Integration period	Status stream
CT 106	Off-On	1 s	X
CT 106	On-Off	1 s	X
CT 109	Off-On	200 ms	SB
CT 109	On-Off	5 s	SB

X-series	Transition	Integration period	Status stream
I-circuit	Off-On	40 ms	SB
I-circuit	On-Off	5 s	SB

The integration process shall ensure that the interchange circuits do not change state in response to spurious transitions of the status bits during the integration period.

The integration process shall operate reliably with error characteristics as specified in 3GPP TS 05.05.

8.2.2.3.2 Traffic channel type TCH/F14.4

To change the state of CT 109 (or I-circuit) or CT 106, it is required that at least two consecutive SB-bits or X-bits, respectively, carry the same value.

8.3 Terminal Compatibility Decision

The establishment of a mobile terminated connection depends on a positive decision on the terminal compatibility. The Mobile Station (MS) contributes to this process by performing (depending on the individual call set-up condition):

- a compatibility check;
- the selection of the appropriate terminal function; and
- the indication of compatibility requirements to the PLMN;

initiated by a call set-up request from the PLMN. The aforementioned functions shall be carried out as follows.

8.3.1 Compatibility Check

Annex B of 3GPP TS 24.008 applies, particularly clause B.3, subclauses B.3.1 and B.3.2. As regards the therein mentioned user-to-user compatibility checking the following applies:

When the calling user requests a service with user-to-user compatibility significance indicated by the presence of HLC and LLC information element in the call set-up request, the MS shall check that the service supported by the called user matches concerning the contents of the HLC/LLC information element. If a mismatch is detected, then the MS shall reject the offered call using the cause No.88 "Incompatible Destination".

8.3.2 Selection of Appropriate Terminal Function

The MS shall select the appropriate terminal functions following a positive result of the compatibility check and/or forwarding the indication of compatibility requirements to the PLMN.

8.3.3 Indication of Compatibility Requirements to the PLMN

8.3.3.1 Indication in case of Mobile terminating calls

In support of:

- PSTN originated calls; and
- ISDN originated calls using 3,1 kHz audio Bearer Capability (BC); as well as
- ISDN originated calls using unrestricted digital Bearer Capability but not specifying all parameters for deducing a Bearer Service.

Mobile specific requirements to be dealt with in the Bearer Capability information element the call confirmed message has been introduced in the call control protocol (3GPP TS 24.008). This also allows for renegotiation of specific parameters at the beginning of the connection set-up process. The specific parameters are:

a) mobile specific requirements:
    - Connection element (transparent/non transparent);
    - Structure (note 1);
    - Synchronous/Asynchronous (note 8);
    - Rate adaptation/other rate adaptation (note 9);
    - User information layer 2 protocol (note 1);

- Intermediate rate (note 2), (note 3);
- Modem Type (note 1), (note 3);
- User Rate (note 3);
- Compression ,
- Fixed network user rate, (note 3) (note 4);
- Other modem type, (note 3) (note 4);
- User initiated modification indication (note 4).

The following parameters are indicated by the MS to the network, only:

- Radio Channel Requirement;
- Acceptable channel codings (note 5);
- Maximum number of traffic channels, (note 5);
- Wanted air interface user rate (note 6) (note 7);
- Asymmetry preference indication (note 7).

NOTE 1: This parameter is correlated with the value of the parameter connection element.

NOTE 2: For non-transparent services this parameter is correlated with the value of the parameter negotiation of intermediate rate requested.

NOTE 3: Modification of these parameters may be proposed by the MS. The Network may accept it or not.

NOTE 4: This parameter shall be included by the MS only in case it was received from the network.

NOTE 5: This parameter shall be included only in case the parameter 'fixed network user rate' is included.

NOTE 6: This parameter shall be included only for non-transparent services and in case the parameter 'fixed network user rate' is included.

NOTE 7: This parameter has to be included if EDGE channel coding(s) are included in Acceptable channel codings. In cases where this parameter would not otherwise be included, the value is set to 'Air interface user rate not applicable' or 'User initiated modification not requested' or "No preference".

NOTE 8: For FTM and PIAFS, this parameter may be negotiated as in table B.4e. How the subscription for BS20 is assured, is an operator matter.

NOTE 9: For FTM, PIAFS or Multimedia, this parameter may be negotiated as in table B.4f.

b) requirements with effects at the partner terminal:

- Number of data bits;
- Number of stop bits;
- Parity.

The MS indicates the radio channel requirement in the call confirmed message. If the MS indicates the support of "dual" (HR and FR channels) the final decision, which radio channel is chosen, is done by the network in an RR message. The radio channel requirement is ignored in ~~UMTS~~UTRAN Iu mode, see Table B.5a in Annex B.

If the network proposes optional support of both transparent and non transparent connection elements, but does not indicate a user information layer 2 protocol, the MS shall set the appropriate value, if choosing non transparent in the call confirmed message and out-band flow control is not requested, see B.1.1.2.

Additionally the values of the parameters structure, modem type and intermediate rate have to be set in conformance with the values of the parameters radio channel requirements, negotiation of intermediate rate requested and connection element.

Subclause B.1.1.2 and table B.1 in the annex B describe the negotiation procedure. Annex B table B.4 describes the selection of the modem type and the dependence on the value of the parameter connection element. Annex B table B.4 describes the selection of the intermediate rate and user rate and their dependence upon the value of the NIRR parameter and the equipment capabilities.

The following MT cases can be deduced from the individual call set-up request conditions:

a) If the set-up does not contain a BC information element, the MS in the call confirmed message shall include any BC information (single or multiple BC-IE). In case of multiple BC-IEs one BC-IE shall indicate the information transfer capability "speech". A speech BC-IE together with a 3,1kHz multimedia BC-IE indicates the support of a fallback to speech (ref. to 3GPP TS 29.007 and 3GPP TS 24.008).

b) If the set-up message contains a single BC-IE, the MS in the call confirm message shall use either a single BC-IE, if it wants to negotiate mobile specific parameter values or, unless otherwise specified in annex B, no BC-IE, if it agrees with the requested ones.

c) If the set-up contains a multiple BC-IE, the MS in the call confirmed message shall use either a multiple BC-IE, if it wants to negotiate mobile specific parameter values or, unless otherwise specified in annex B, no BC-IE, if it agrees with the requested ones. In case of a 3,1kHz multimedia setup the MS may either accept the possibility of a fallback to speech by responding with two BC-IEs, or with no BC-IEs, or turn the call to a speech call by sending only a speech BC-IE in the call confirm message or turn the call to a multimedia only call (i.e. no fallback to speech allowed) by sending only a multimedia BC-IE, in the call confirm message. Alternatively, a single BC-IE, containing fax group 3 only, shall be used if a multiple BC-IE requesting speech alternate fax group 3 is received and the MS is not able to support the speech capability. Annex B, table B.7, describes the negotiation rules.

If the BC-IE contains 3,1 kHz ex PLMN, the MS is allowed to negotiate all mobile specific parameter values listed above. If the BC-IE contains facsimile group 3, the MS is allowed to negotiate the connection element (transparent/non transparent) only. In any case, if the set-up message requests a "single service", the MS shall not answer in the call confirmed message requesting a "dual service" and vice versa.

However, for dual services with repeat indicator set to circular (alternate) the MS may change the sequence of dual BC-IEs within the call confirmed message (preceded by the same value of the repeat indicator), if it wants to start with a different Bearer Capability than proposed by the network as the initial one.

In addition, the MS may propose to the network to modify User Rate, Modem Type and Intermediate Rate in the CALL CONFIRMED message. The network may accept or release the call.

If the BC-IE received from the network contains the parameters 'fixed network user rate', 'other modem type' and possibly the 'user initiated modification', the MS may either:

a) if in ~~GSM~~A/Gb mode, discard these parameters; or

b) include the possibly modified values for the 'fixed network user rate' and 'other modem type' in the BC-IE of the call confirmed message. The network might accept or reject the modified values. In this case the MS shall also include the parameters 'maximum number of traffic channels' and 'acceptable channel codings'. Additionally for non-transparent services, the MS shall also include the parameters 'wanted air interface user rate' and the 'user initiated modification indication'.

In case a), the MS shall use the fall-back bearer service indicated by the remaining parameters of the BC-IE on a single slot configuration (reference 3GPP TS 44.021).

In A/Gb mode~~GSM~~ case b), a single slot configuration shall be used by the MS, in case the 'maximum number of traffic channels' is set to "1 TCH" and the 'user initiated modification indication' is set either to "user initiated modification not required" or to "user initiated modification up to 1TCH may be requested"; other wise the MS shall use a multislot configuration (reference 3GPP TS 44.021).

In case the 'acceptable channel codings' is indicated by the MS, the decision which channel coding is used is done by the network and indicated to the mobile station with a RR message. This RR message may also assign an asymmetric channel coding. The 'acceptable channel codings' parameter takes precedence over the 'negotiation of intermediate rate requested' parameter for non-transparent services. Also the intermediate rate and user rate per traffic channel in a multislot configuration are not indicated by the 'intermediate rate' and 'user rate' parameters of the BC-IE, but depend on the chosen channel coding only.

If the MS receives a BC-IE in the SETUP message containing the parameters 'fixed network user rate', 'other modem type', the MS may include these parameters in the BC-IE of the CALL CONFIRMED message (i.e. octets 6d, 6e, 6f, and 6g ref. 3GPP TS 24.008), with parameter values negotiated according to Annex B. If no BC-IE is received in the SETUP message, the MS may include these parameters in the CALL CONFIRMED message. However, in this case, the network may release the call if it does not support these parameters.

If FNUR = 33.6 kbit/s is agreed on in the setup of a 3.1 kHz multimedia call, the modems may handshake to 31.2 or 28.8 kbit/s. In this case the MS receives a MODIFY message from the MSC to indicate the new data rate, and shall respond with a MODIFY COMPLETE message (ref. to 3GPP TS 24.008), if it supports the requested modification. If the MS does not support the requested modification, it shall respond with a MODIFY REJECT message. The MT shall indicate the new data rate to the TE (e.g. using the ITU-T V.80 inband signaling) in order to cause the TE to use stuffing to adapt the 31.2 or 28.8 kbit/s data rate to the 33.6 kbit/s traffic channel between the TE and IWF.

8.3.3.2 Indication in case of Mobile originating calls

In support of mobile originating calls the values of BC-IE parameters are requested in the set-up message from the MS. If the MS indicates the support of both transparent and non transparent connection elements the network shall return its choice in the call proceeding message. The MS is not allowed to indicate support of both transparent and non transparent, if the MS also requests out-band flow control, i.e. it does not indicate a layer 2 protocol.

Additionally the value of the parameter modem type has to be set depending on the value of the parameter connection element as described in annex B, table B.4a.

The set-up message contains a single or multiple BC-IE. In case of multiple BC-IEs one BC-IE shall indicate the information transfer capability "speech".

In case of a multimedia call the setup message contains either a multimedia BC-IE indicating a multimedia only call request (i.e. no fallback to speech allowed) or both a speech BC-IE and a 3,1kHz multimedia BC-IE to indicate the support/request of a fallback to speech (ref. 3GPP TS 29.007 and 3GPP TS 24.008).

If the set-up message requests a "single service", the network shall not answer in the call proceeding message requesting a "dual service" and vice versa. Alternatively the network shall answer with a single BC-IE containing fax group 3 if a multiple BC-IE requesting speech alternate fax group 3 is received but the network does not allow the use of this alternate service. Annex B, table B.7, describes the negotiation rules. If the MS requests a "dual service" the network is not allowed to change the sequence of the service.

If the set-up message indicates that negotiation of intermediate rate is requested then the network shall behave as described in annex B, table B.4b.

Unless otherwise specified in annex B, if no BC-IE parameter needs negotiation it is up to the network if it sends a CALL PROC message (with or without a BC-IE) towards the MS or not.

For multislot, TCH/F14.4, and EDGE operations and in ~~UMTS~~ UTRAN Iu mode the MS shall include an appropriate set of the parameters 'fixed network user rate', 'other modem type', 'maximum number of TCH' and 'acceptable channel codings' in the BC-IE of the SETUP message. If EDGE channel coding(s) are included in ACC in case of transparent calls, the 'Wanted air interface user rate'-parameter shall be set to 'Air interface user rate not applicable' and the 'User initiated modification indication'-parameter to 'User initiated modification not requested'. In a non-transparent multislot operation, the MS shall also include the parameters 'wanted air interface user rate' and 'user initiated modification indication' in the BC-IE of the SETUP message. In a non-transparent TCH/F14.4 or EDGE operation or in ~~UMTS~~ UTRAN Iu mode the MS shall also include the parameter 'wanted air interface user rate'. In non-transparent EDGE operation the MS shall also include the parameter 'asymmetry preference indication'. It shall also set the other parameters of the BC-IE (i.e. 'user rate') to values identifying fall-back values. Depending on the network two situations can be distinguished:

a) The network supports the requested operation:

- in this case the network shall include the parameter 'fixed network user rate', 'other modem type' and possibly 'user initiated modification' in the BC-IE(s) of the CALL PROCEEDING message, irrespective whether or not they contain modified values or just a copy of the received ones;

- the 'acceptable channel codings' indicated by the MS in the SETUP message takes precedence over the 'negotiation of intermediate rate requested' parameter for non-transparent services. The intermediate rate per traffic channel and the user rate per traffic channel is dependent on the chosen channel coding only. The chosen channel coding is indicated to the mobile station by the network with an RR message.

b) The network does not support the requested operation:

- in this case, in ~~GSM~~A/Gb mode, the BC-IE of the CALL PROCEEDING message does not contain the parameters fixed network user rate' and 'other modem type' or no BC-IE is included in the CALL PROCEEDING message at all. The mobile station shall then discard the parameters 'fixed network user rate', 'other modem type', 'maximum number of TCH', 'acceptable channel codings' 'wanted air interface user rate' and 'user initiated modification indication' sent with the SETUP message and apply the fall-back bearer service.

In case a), a single slot configuration shall be used by the MS, in case the 'maximum number of traffic channels' is set to "1 TCH" and the 'user initiated modification indication' is set either to "user initiated modification not requested" or to "user initiated modification up to 1TCH may be requested".

In case b), The MS shall use the fall-back bearer service indicated by the remaining parameters of the BC-IE on a single slot configuration (reference 3GPP TS 44.021).

If FNUR = 33.6 kbit/s is agreed on in the setup of a 3.1 kHz multimedia call, the modems may handshake to 31.2 or 28.8 kbit/s. In this case the MS receives a MODIFY message from the MSC to indicate the new data rate, and shall respond with a MODIFY COMPLETE message (ref. to 3GPP TS 24.008), if it supports the requested modification. If the MS does not support the requested modification, it shall respond with a MODIFY REJECT message. The MT shall indicate the new data rate to the TE (e.g. using the ITU-T V.80 inband signaling) in order to cause the TE to use stuffing to adapt the 31.2 or 28.8 kbit/s data rate to the 33.6 kbit/s traffic channel between the TE and IWF.

8.3.3.3 Differences in validity of BC parameter values in ~~GSM~~ A/Gb mode and UTRAN Iu mode~~UMTS~~

The validity of a BC parameter value, either in the SETUP or CALL CONFIRM message, may differ from GSM A/Gb mode to UTRAN Iu mode~~UMTS~~. Certain parameters are irrelevant in UTRAN Iu mode~~UMTS~~ and any value given is valid and ignored. These parameters may be available in the BC IE. For those parameters that are relevant in UTRAN Iu mode~~UMTS~~ and A/Gb mode~~GSM~~, certain values may be invalid in one of the systems. Invalid parameter values may cause rejection of the BC and subsequent release of the call.

Parameters that are ignored in UTRAN Iu mode~~UMTS~~ may be set to default values, or to specific values in view of an eventual handover to A/Gb mode~~GSM~~. Parameter values that are invalid in one system may result in unsuccessful handover from the other system.

Table B.5a in Annex B lists parameters that are ignored in UTRAN Iu mode~~UMTS~~ and parameter values which validity is different in A/Gb mode~~GSM~~ and UTRAN Iu mode~~UMTS~~.

8.4 Test Loops

In principle, both V -series and X -series interfaces allow for an activation of local or remote test loops by the terminal (ref. ITU-T V.54/X.150). A comprehensive solution of such test loops in a PLMN system has to consider the special conditions of the interface between the terminal (part of the MS) and the transmission equipment (part of the modem pool of a particular IWF within the MSC). In addition, the impact of the radiolink is to be taken into account with respect to the test objectives. Due to those special conditions a PLMN system is not capable to support remote test loops. It is an implementation choice to what extent the activation of local test loops by the terminal is supported in the MT.

8.5 Alternate speech/facsimile group 3

8.5.1 In case of A/Gb mode~~GSM~~

This alternate service may be initiated by a manual procedure where CT106, CT107, CT108.2 and CT109 are set in the OFF condition.

Selection of the data phase (from the speech phase) may be by manual intervention via the MS causing ICM by means of CT108.2 going to ON condition, refer to 3GPP TS 03.45. The ensuing data phase shall follow all the operational procedures as described in 3GPP 27-series.

Selection of the speech phase (from the data phase) may be by manual intervention via the MS causing ICM (phone off-hook condition at the MT and data call end condition at the TE).

During the ensuing speech phases, CT107, CT106 and CT109 shall be maintained in the OFF condition.

Subsequent re-selection of the data phase may be by manual intervention via the MS causing CT108.2 going to ON condition initiating ICM. At this point, re-synchronization shall take place as described in subclause 8.1 above.

8.5.2 In case of UTRAN Iu mode~~UMTS~~

Refer to section 9.2.1.1 and 9.2.2.1 in 3GPP TS 23.146.

8.6 Multislot configuration split/combine function

In multislot configurations using multiple parallel channels the data flow is split into substreams between the Spit/Combine-function in the TAF and the network.

8.6.1 Non-transparent data

In non-transparent data operations the N(S)-numbering in the RLP-header is used for controlling the order of the data in the substreames (reference 3GPP TS 24.022).

8.6.2 Transparent data

In transparent multislot configurations (TCH/F9.6 or TCH/F4.8) status bits S1, S3 and the X-bit between the D12 and D13 are used for transferring substream numbering information. This S4-bit is used for frame synchronization between the parallel substreames (reference 3GPP TS 44.021).

In case of a transparent multislot configuration using TCH/F14.4 channel coding, bit M1 in the 290-bit radio interface block is used for frame synchronization between the parallel substreams, whereas bit M2 carries status information, NIC codes and substream numbering as described in 3GPP TS 44.021.

In transparent TCH/F28.8 channels, bits M1 and M2 are used as described above for transparent TCH/F14.4 channels.

8.7 EDGE multiplexing function

In EDGE configurations the number of channels across the air interface and that of substreams between BTS and MSC do not necessarily match. In such cases a multiplexing function is included at MS and BTS (3GPP TS 44.021 and 3GPP TS 08.20). These functions distribute data between the substreams and radio channels.

8.8 Seamless data rate change

If the modems change the data rate during an ongoing multimedia call (using the ITU-T V.34 seamless data rate change mechanism), the MSC initiates a MODIFY message (ref. to 3GPP TS 24.008) to indicate the new data rate to the MS. The MT shall indicate the new data rate to the TE (e.g. using the ITU-T V.80 inband signaling) in order to cause the TE to use stuffing to adapt the 31.2 or 28.8 kbit/s data rate to the 33.6 kbit/s traffic channel between the TE and IWF.

Annex A (informative): List of Bearer Capability Elements

This annex lists the PLMN Bearer Capability Elements which need to be provided to support Terminal adaptation function to Interworking control procedures. Some parameters are ignored in ~~UMTS~~ UTRAN Iu mode although present in the BC-IE. The validity of parameter values may also differ from ~~GSM~~ A/Gb mode to ~~UMTS~~UTRAN Iu mode. The ignored parameters and the difference of parameter value validity in A/Gb mode~~GSM~~ and UTRAN Iu mode ~~UMTS~~ are listed in table B.5a in annex B.

Elements and their Values:

Information Transfer Capability:

This element is relevant between the IWF and the fixed network.

Values:
- Speech
- Unrestricted Digital
- Group 3 Facsimile (note 1)
- 3,1 kHz Ex PLMN (note 2)
- Restricted Digital (note 3)

NOTE 1: Used for facsimile transmission, unrestricted digital between MT and IWF and 3,1 kHz audio from IWF towards the fixed network.

NOTE 2: Unrestricted digital between MT and IWF and 3,1 kHz audio from IWF towards the fixed network.

NOTE 3: Unrestricted digital between MT and IWF and restricted digital information from IWF towards the fixed network; this value is signalled in the "Other ITC" element, due to a lack of further code points in the "ITC" element.

Transfer Mode:

This element is relevant between MT and IWF

Values:
- Circuit

Structure:

This element is relevant between MT and IWF.

Values:
- Service Data Unit Integrity (note 4)
- Unstructured (note 5)

NOTE 4: Applicable for connection element "non transparent".

NOTE 5: Applicable for connection element "transparent".

Configuration:

This element is relevant for a PLMN connection.

Values:
- Point to point

Establishment:

This element is relevant for a PLMN connection.

Values:
- Demand

Sync/Async:

This element is relevant between TE/TA and MT and between IWF and the fixed network.

Values: - Synchronous
- Asynchronous

Negotiation:

This element is relevant between MT and IWF.

Values: - In band negotiation not possible

User Rate:

This element is relevant between TE/TA and MT and between IWF and the fixed network, except in case the parameter FNUR is present.

Values: - 0.3 kbit/s
- 1.2 kbit/s
- 2.4 kbit/s
- 4.8 kbit/s
- 9.6 kbit/s
- 19.2 kbit/s (see note 6)

NOTE 6: This value cannot be signalled between MT and IWF, but it can be used according to the rules in 3GPP TS 29.007 (table 7A, 7B) for such connections.

Intermediate Rate:

This element is relevant between MT and BSS and BSS and IWF

Values: - 8 kbit/s
- 16 kbit/s

Network Independent Clock on Tx:

This element is relevant between TE/TA and MT in the transmit direction.

Values: - Not required
- Required

Network Independent Clock on Rx:

This element is relevant between TE/TA and MT in the receive direction.

Values: - Not accepted
- accepted

Number of Stop Bits:

This element is relevant between the TE/TA and MT and between IWF and fixed network in case of asynchronous transmission.

Values: - 1 bit
- 2 bit

Number of Data Bits Excluding Parity If Present:

This element is relevant between TE/TA and MT and between IWF and the fixed network in case of a character oriented mode of transmission.

Values: - 7 bit
- 8 bit

Parity Information:

This element is relevant between TE/TA and MT and between IWF and the fixed network for a character oriented mode of transmission.

Values: - Odd
- Even
- None
- Forced to 0
- Forced to 1

Duplex Mode:

This element is relevant between MT and IWF.

Values: - Full Duplex

Modem Type:

This element is relevant between the IWF and the fixed network in case of 3,1 kHz audio ex-PLMN information transfer capability.

Values: - V.21
- V.22
- V.22 bis
- V.26 ter
- V.32
- autobauding type 1
- none

Radio Channel Requirement:

This element is relevant between MT and BSS

Values: - Full Rate support only Mobile Station
- Dual Rate support Mobile Station/Half Rate preferred
- Dual Rate support Mobile Station/Full Rate preferred

Connection Element:

This element is relevant between MT and IWF

Values: - Transparent
- Non Transparent
- both, Transparent preferred
- both, Non transparent preferred

User Information Layer 2 Protocol:

This element is relevant between TE/TA and MT and between IWF and the fixed network.

Values: - ISO 6429
- Character oriented Protocol with no Flow Control mechanism

Signalling Access Protocol:

This element is relevant between TE/TA and MT.

Values: - I.440/450

Rate Adaptation:

This element is relevant between IWF and the fixed network.

Values: - V.110/X.30
- X.31 flagstuffing
- no rate adaptation
- V.120 (note 7)
- PIAFS (note 7)
- H.223 and H.245 (note 7)

NOTE 7: This value is signalled in the "Other Rate Adaption" element, due to a lack of further code points in the "Rate Adaption" element.

Coding Standard:

This element refers to the structure of the BC-IE defined in 3GPP TS 24.008.

Values: - GSM

User Information Layer 1 Protocol:

This element characterize the layer 1 protocol to be used between MT and BSS (Um interface) according to 3GPP TS 45.001~~05.01~~, or between the MT and the RNC (Uu interface).

Values: - default

Negotiation of Intermediate Rate requested:

This element is relevant between MT and BSS and BSS and IWF.

Values: - no meaning associated
- 6 kbit/s radio interface is requested for a full rate channel with a user rate up to and including 4,8 kbit/s, non transparent service

Compression:

This element is relevant between MT and IWF.

Values: - compression possible/allowed
- compression not possible/allowed

Rate adaption header / no header:

This element is relevant between IWF and the fixed network. It is only applicable for ITU-T V.120 rate adaptation.

Values: - Rate adaption header not included
- Rate adaption header included

Multiple frame establishment support in data link:

This element is relevant between IWF and the fixed network. It is only applicable for ITU-T V.120 rate adaptation.

Values: - Multiple frame establishment not supported. Only UI frames allowed.
- Multiple frame establishment supported.

Mode of operation:

This element is relevant between IWF and the fixed network. It is only applicable for ITU-T V.120 rate adaptation.

Values: - Bit transparent mode of operation
- Protocol sensitive mode of operation

Logical link identifier negotiation:

This element is relevant between IWF and the fixed network. It is only applicable for ITU-T V.120 rate adaptation.

Values:
- Default, LLI=256 only
- Full protocol negotiation (note 8)

NOTE 8: A connection over which protocol negotiation is executed as indicated in the "In-band / out-band negotiation" parameter.

Assignor / assignee:

This element is relevant between IWF and the fixed network. It is only applicable for ITU-T V.120 rate adaptation.

Values:
- Message originator is „default assignee"
- Message originator is „assignor only"

In-band / out-band negotiation:

This element is relevant between IWF and the fixed network. It is only applicable for ITU-T V.120 rate adaptation.

Values:
- Negotiation is done with USER INFORMATION messages on a temporary signalling connection
- Negotiation is done in-band using logical link zero.

Fixed network user rate, FNUR (Note 12)

This element is relevant between the IWF and the fixed network.

Values
- Fixed network user rate not applicable (note 9)
- 9,6 kbit/s
- 14,4 kbit/s
- 19,2 kbit/s
- 28,8 kbit/s
- 32,0 kbit/s
- 38,4 kbit/s
- 48,0 kbit/s
- 56,0 kbit/s
- 64,0 kbit/s

NOTE 9: Not used by currently specified services.

Wanted air interface user rate, WAIUR (note 12)

This element is relevant between the MT and the IWF

Values
- Air interface user rate not applicable
- 9,6 kbit/s
- 14,4 kbit/s
- 19,2 kbit/s
- 28,8 kbit/s
- 38,4 kbit/s
- 43,2 kbit/s
- 57,6 kbit/s
- interpreted by the network as 38,4 kbit/s (note 10)

NOTE 10: Certain code points, if used, are interpreted by the network as 38.4 kbit/s in this version of the protocol, ref 3GPP TS 24.008.

Acceptable channel codings, ACC (note 12)

This element is relevant between the MT and the IWF.

Value: - TCH/F4.8 acceptable
- TCH/F9.6 acceptable
- TCH/F14.4 acceptable
- TCH/F28.8 acceptable
- TCH/F32.0 acceptable (Applicable to multimedia 32, 56 and 64 kbit/s and synchronous transparent 56 and 64 kbit/s services only)
- TCH/F43.2 acceptable (Applicable to non-transparent services only.)

Maximum number of traffic channels, MaxNumTCH (Note 12)

This element is relevant between the MT and the IWF.

Value: - 1 TCH
- 2 TCH
- 3 TCH
- 4 TCH
- 5 TCH
- 6 TCH
- 7 TCH (note 11)
- 8 TCH (note 11)

NOTE11: Not used by currently specified services.

Other modem type, OMT (Note 12)

This element is relevant between the IWF and the fixed network in case of 3,1 kHz audio ex-PLMN

Values: - no other modem type specified in this field
- V.34

User initiated modification indication, UIMI (Note 12)

This element is relevant between the MT and the IWF.

Values: - user initiated modification not requested
- user initiated modification upto 1 TCH requested
- user initiated modification upto 2 TCH requested
- user initiated modification upto 3 TCH requested
- user initiated modification upto 4 TCH requested

Asymmetry preference indication (Note 12)

This element is relevant between the MT and the BSS.

Value: - no preference
- up link biased asymmetry preference
- down link biased asymmetry preference

NOTE 12: These GBS-related parameters are optional.

For a multislot configuration, the following applies to the parameters contained in the BC-IE:

- Half rate channels are not supported. The MS shall code the radio channel requirement as "Full rate support only MS" or "Dual rate support MS, full rate preferred'. In the second case, the network shall assign full rate channel(s) only.

- The 'fixed network user rate' and 'other modem type' (ref. table B.4a) takes precedence over the 'user rate' and 'modem type'.

- The ACC indicates which channel coding is acceptable and supported by the MS. In case of CE:NT the TCH/F4.8 and TCH/F9.6 acceptable is equivalent to the support of NIRR. If TCH/F4.8 acceptable only or TCH/F9.6 acceptable only or TCH/F14.4 acceptable only is indicated, the assigned channel type which can be chosen by the network is TCH/F4.8 or TCH/F9.6 or TCH/F14.4, respectively.

- The 'intermediate rate' parameter is overridden. The intermediate rate used per each TCH/F is derived from the chosen channel type:

channel type	**IR per TCH/F**
TCH/F4.8	8 kbit/s
TCH/F9.6	16 kbit/s
TCH/F14.4	intermediate rate is to be defined

- The user rate per TCH is derived from the chosen channel type:

channel type	**user rate per TCH**
TCH/F4.8	4.8 kbit/s
TCH/F9.6	9.6 kbit/s

For CE:T, the padding procedure described in 3GPP TS 44.021 can be applied.

Annex B (normative): Setting of Bearer Capability, Low Layer Compatibility and High Layer Compatibility Information Element for PLMN Bearer Services and PLMN TeleServices

B.0 Scope

This annex describes the relationship between the various parameters of the PLMN Bearer Capability Information Element (BC-IE), their validity and the possible settings with reference to each PLMN Bearer service/Teleservice defined in 3GPP TS 22.002 and 3GPP TS 22.003 and various occurrences during the connection control (clause B.1). Furthermore, the contents of the Low Layer (LLC) and the High Layer (HLC) Compatibility Information Elements are described (clause B.2).

B.1 Bearer Capability Information Element

B.1.1 Introduction

B.1.1.1 General Consideration

In general, the purpose of the bearer capability information element (BC-IE) is to request a particular bearer service to be provided by the network. This indication is carried by certain connection control messages which for the subject matter of the present document may be categorized into those messages:

- related to the call set-up phase; and
- those used during the established connection.

During the call set-up phase the PLMN BC-IE (single or multiple) is included in:

- the SETUP message generated by the requesting entity (either MS or MSC) to establish a mobile-originated or mobile-terminated call, respectively, and
    - the CALL CONFIRMED or CALL PROCEEDING messages, respectively, generated by the responding entity (either MS or MSC) in order to negotiate certain parameter values. If no BC-IE is contained in the SETUP message (a mobile terminatedcall with the single-numbering scheme) the CALL CONFIRMED message indicates the complete applicable BC-IE. The network may release the call if it does not support the service indicated by the BC-IE. Also, if the service does not match with the service requested from the fixed network terminal the MSC/IWF may release the call.

NOTE: In the latter case also the fixed network terminal may release the call.

During the established connection the PLMN BC-IE is included in the MODIFY, MODIFY COMPLETE, and MODIFY REJECT messages in order to change the service (bearer capability) or to change the maximum number of traffic channels and/or wanted air interface user rate when a non-transparent multislot data service is in use.

If the maximum number of traffic channels and/or wanted air interface user rate is to be changed, the BC-IE included in the MODIFY message shall not indicate a different bearer service than the one used at this stage of the connection - the values of the parameters 'maximum number of traffic channels' and/or 'wanted air interface user rate' may be changed, only.

The subsequent tables and subsections of clause B.1 deal with the representation of the individual contents of the PLMN BC-IE during the call set-up phase. For the use during the established connection refer to 3GPP TS 24.008.

With respect to the individual parameter settings at the MS the following cases may be distinguished (ref. 3GPP TS 27.002 and 3GPP TS 27.003):

- Mobile-originated call set up by a MS consisting of a MT with R interface:
  - The setting results from respective MMI actions and/or MT internal settings.
- Mobile-originated call set up by a MS consisting of a MT with S interface:
  - The setting of the PLMN BC is derived from the ISDN BC and LLC/HLC elements contained in the ISDN SETUP message received from the terminal. It is complemented by information resulting from respective MMI actions and/or MT internal settings.
- Mobile-terminated call set up to a MS consisting of a MT with R interface:
  - The BC related part of the compatibility check is carried out according to the knowledge of the MT concerning its implemented functions (i.e. answering the call). The requested field values of the non-negotiable parameters and the selected field values of the negotiable parameters determine the selection of the terminal function to be used for the intended connection.
- Mobile-terminated call set up to a MS consisting of a MT with S interface:
  - The PLMN BC received from the MSC is mapped by the MT onto an applicable ISDN BC. In some cases a HLC may be generated, if it is not otherwise available (e.g. for group 3 facsimile). The BC related part of the compatibility check is up to the terminal connected to the S interface of the MT, as is the selection of the terminal function (i.e. answering the call) to be used for the intended connection.

B.1.1.2 Interpretation of the Diagrams

The purpose of the subsequent diagrams is to achieve unambiguous representation of the individual contents of the PLMN BC-IE for the various occurrences during the call set-up phase, covering all bearer services and teleservices according to 3GPP TS 22.002 and 3GPP TS 22.003.

The basic principle adopted is a graphic scheme, or mask, wherein the ordinate designates the individual parameters of the PLMN BC-IE and the abscissa gives the possible field values of these parameters. The abbreviations used in these sections are defined in table B.5. The allowed content of any PLMN BC-IE is represented by a number of graphs connecting parameter values (abscissa points) of all parameters (ordinate points). Each graphic scheme is subdivided into two independent parts:

- "Layer/Protocol related" part; and
- "Radio Channel related" part.

The generation of all PLMN BC-IEs in all call set-up messages shall be in accordance with these graphs. Subclauses B.1.2 through B.1.11 show individual sets of graphs for each service group (BS/TS) and for each type of applicable Information Transfer Capability.

In addition, the following rules apply:

- Those parameters which have only one possible field value for all recognized services are shown in table B.5, where they are marked accordingly in the column "common setting of field values". They are not represented in the graphic scheme.
- Not all parameters of the PLMN BC-IE are relevant for each service (BS/TS). This is represented by specific abscissa points with a value of "NA" (Not Applicable) allocated to these parameters. The graphs pass through these points for each such parameter. The actual field value to be used in the PLMN BC-IE is marked in the column "default setting of field values (NA)" of table B.5. An abscissa point with a value of "NAV" (Not AVailable) indicates that the entire octet carrying this parameter (ref. table B.2 "General Structure of the PLMN BC-Information Element") shall be omitted.
- Unless FTM is applied, there is a particular dependency of the parameters "User Information Layer 2 Protocol (UIL2P)" and "Connection Element (CE)":
  - If the MS sends a PLMN BC-IE with a CE value other than "Transparent (T)", the parameter UIL2P is essential. Its field value must be set as indicated in the applicable graph.

- If the MSC sends a PLMN BC-IE in the SETUP message, the parameter UIL2P may also be absent in the case of the CE parameter value being other than "Transparent (T)".

- In case FTM is applied, the PLMN BC-IE shows a CE value "non-transparent", SA value "asynchronous", and RA value X.31 flag stuffing. The UIL2P is not available.
- Certain parameters of the PLMN BC-IE may be negotiated during the connection establishment phase. Table B.1 shows these parameters and the relations of their values in the SETUP message and in the CALL CONFIRMED/CALL PROCEEDING message, respectively, both for the mobile-originated and mobile-terminated case. A parameter may indicate a field value of one of the following types:
  - "requested value" indicating a request which cannot be changed by the responding entity;
  - "offered value" indicating a proposal which may be changed by the responding entity;
  - a particular choice value leaving it up to the responding entity which value ultimately applies;
  - "as requested" indicating that the requested value applies and is confirmed (by returning it);
  - "selected value" indicating that a particular value applies either out of the offered set or as a free choice out of the defined set of values;
  - "supported value" indicating a value supported by the responding entity.

Table B.1: BC-Parameters subject to negotiation procedure

Mobile Originated Call:

	Message	
BC-parameter	**SETUP**	**CALL PROC**
NDB	Requested value	as requested
NPB	Requested value	as requested
NSB	Requested value	as requested
CE	Requested value (T/NT)	as requested
	"both" with the preferred value indicated (e.g. both NT)	selected value (T/NT)
UIL2P	Requested value [9] or NAV [1]	as requested or NAV [4]
User Rate	Requested value	as requested
DC	Requested value [2]	as requested or "NO" [7]
FNUR	Requested value	supported value
Other MT	Requested value	supported value
UIMI	Requested value	supported value

Mobile Terminated Call:

	Message	
BC-parameter	**SETUP**	**CALL CONF**
NDB	Offered value	selected value (free choice)
NPB	offered value	selected value (free choice)
NSB	offered value	selected value (free choice)
CE	requested value (T/NT)	as requested or selected value (T/NT) (free choice) 3)
	"both" with the preferred value indicated (e.g. both NT)	selected value (T/NT)
Sync/ Asynchronous	requested value	as requested or selected value10)
Rate adaptation/Other rate adaptation	requested value	as requested or selected value11)
UIL2P	offered value 2) or NAV 4)	selected or NAV 1)
User Rate	offered value	selected value 5)
DC	requested value 2)	as requested or "NO" 7)
FNUR	offered value	selected value 6)
Other MT	offered value	selected value 6)
UIMI	offered value	selected value 8)

1) For CE:T only, out-band flow control, or RA:X.31 flag stuffing requested by the MS.
2) Not for CE:T.
3) When the SETUP message contains no BC-IE (single numbering scheme).
4) "NAV" shall not be interpreted as an out-band flow control request by the MS.
5) The modification of User Rate shall be in conjunction with Modem Type and Intermediate Rate.
6) The modification of the Fixed Network User Rate shall be in conjunction with the Modem Type and/or Other Modem Type.
7) In case of a Mobile Terminated Call, if the SETUP message does not contain a BC-IE, the MS shall behave as if the DC is set to "data compression not possible".
In case of a MO CALL or a MT CALL where no BC-IE is included in the CALL PROCEEDING or CALL CONFIRMED message, respectively, the MS or the network shall behave as if the DC was set to "data compression not possible" or "data compression not allowed", respectively.
8) Less or equal to the offered value.
9) Not for CT:T or FTM (i.e., CE:NT, SA:A, RA:X.31 flag stuffing).
10) For FTM and PIAFS, this parameter may be negotiated. See Table B.4e for details.
11) For FTM, PIAFS and Multimedia, this parameter may be negotiated. See Table B.4f for details.

Table B.2: General Structure of the BC-Information Element

OCTET	INFORMATION ELEMENT FIELD	
3	Radio channel requirements Coding standard Transfer mode Information Transfer Capability	
4	Structure Duplex mode Configuration Establishment Negotiation of Intermediate Rate Requested Compression	2)
5	Rate adaption Signalling access protocol	2)
5a	Other ITC Other rate adaption	2) 7)
5b	Rate adaption header / no header Multiple frame establishment support in data link Mode of operation Logical link identifier negotiation Assignor / assignee In-band / out-band negotiation	2) 3)
6	User information layer 1 protocol Synchronous / asynchronous	2)
6a	Number of stop bits Negotiation Number of data bits User rate	2)
6b	Intermediate rate NIC on transmission NIC on reception Parity information	2)
6c	Connection element Modem type	2)
6d	Fixed network user rate Other modem type	4)
6e	Maximum number of traffic channels Acceptable channel codings	4)
6f	Wanted air interface user rate User initiated modification indication	4)
6g	Acceptable Channel codings Asymmetry preference indication	5) 6)
7	User information layer 2 protocol	1) 2)

1) Octets optional.
2) Octets only available if the parameter "Information Transfer Capability" does not indicate "Speech".
3) For ITU-T V.120 rate adaption only.
4) Optional octets available only if the parameter "Information Transfer Capability" does not indicate "Speech".
5) Extension of the 'Acceptable channel codings' field in octet 6e in case EDGE channel codings are supported.
6) Only used if EDGE channels are among the 'Acceptable channel codings'. The value shall be set to 'no preference' in case the connection element is T.
7) For ITC=RDI or UIL1P=V.120, PIAFS, and 'H.223 and H.245' only.

Table B.3a: Selection of flow control method (for CE:NT with SA:A only)

	flow control method		
information element	in-band	out-band (3)	none
number of data bits	7 or 8	7 or 8	7 or 8
user information layer 2 protocol	ISO 6429 (1)	NAV	COPnoFlCt (2)

1) ISO6429 stands for "ISO 6429, codeset 0, DC1/DC3" and is applicable for 7 and 8 bit codes.

2) COPnoFlCt stands for a character oriented protocol with no flow control mechanism (no reserved characters for flow control).

3) "out-band" flow control requires ITU-T V.42 in case of PSTN or ITU-T V.110 in case of ISDN.
If the ITU-T V.110 flow control mechanism is not supported, where required, the call pending shall be terminated.
If the ITU-T V.42 functionality is not supported by the modem in the IWF or in the fixed network, the call shall be supported with a fallback to the non- ITU-T V.42 mode. In this case the IWF shall release the call if due to temporary throughput problems on the radio interface or initiation of flow control by the MS and the inability to flow control the fixed network modem an overflow of the L2R buffers occurs.
Note that a phase 1 network may release the call, if the ITU-T V.42 functionality is not provided by the IWF or the fixed network modem. As ITU-T V.42 does not apply to ITU-T V.21 modems, outband flow control can not be supported for these modem types.

Table B.4a: Modem Type subject to negotiation procedure

Mobile Originated Call:

	BC-parameter MT and OMT 6)	
BC-parameter CE	Message SETUP	Message CALL PROC
T	V-series	V-series
NT	V-series	V-series
	autobauding type 1	autobauding type 1 or V-series 1)
bothT or bothNT	V-series	V-series ´
	autobauding type 1	autobauding type 1 or V-series 1)2)

Mobile Terminated Call:

	BC-parameter MT and OMT 6)	
BC-parameter CE	Message SETUP	Message CALL CONF
T	V-series	V-series
NT	V-series	V-series or autobauding type 1 3)
	autobauding type 1	autobauding type 1 or V-series 4)
bothT or bothNT	V-series	V-series ´
	autobauding type 1	autobauding type 1 or V-series 4)5)

1) No autobauding capability in the IWF:MSC.
2) CE:T selected by IWF/MSC.
3) Free choice if the SETUP contains no BC-IE (single numbering scheme).
If the IWF/MSC has no autobauding capability, a V-series modem type is used.
4) When the MS does not allow the use of autobauding capability.
5) CE:T selected by the MS.
6) When the MT indicates "autobauding" , "modem for undefined interface" or "none", the OMT shall be set to "no other modem type". Any other values of the MT is overridden by the OMT value.

Table B.4b: Intermediate Rate negotiation procedure

If the user rate is 9.6 kbit/s the intermediate rate negotiation procedure is not applicable and NIRR shall be set to "No meaning".

Recipient of SETUP supports full rate, non transparent, 6 kbit/s radio interface rate and the user rate is up to/equal 4,8 kbit/s:

BC-parameter	Message SETUP	Message CALL CONF or CALL PROC
NIRR	6 kbit/s	6 kbit/s
IR	16 kbit/s	8 kbit/s
User Rate	up to/equal 4,8 kbit/s	as requested

NOTE 1: In case of a Mobile Terminated Call, if the SETUP message does not contain a BC-IE, the MS shall behave as if NIRR set to "No meaning".

In case of a MO CALL or a MT CALL where no BC-IE is included in the CALL PROCEEDING or CALL CONFIRMED message, respectively, the MS or the network shall behave as if the NIRR was set to "No meaning".

Recipient of SETUP does support full rate, non transparent, but not in connection with 6 kbit/s radio interface rate:

BC-parameter	Message SETUP	Message CALL CONF or CALL PROC
NIRR	6 kbit/s	No meaning
IR	16 kbit/s	16 kbit/s
User Rate	up to/equal 4,8 kbit/s	as requested

NOTE 2: If no other parameter needs negotiation, the CALL CONF/PROC message need not contain any BC-IE.

In case of a MO CALL or a MT CALL where no BC-IE is included in the CALL PROCEEDING or CALL CONFIRMED message, respectively, the MS or the network shall behave as if the NIRR was set to "No meaning".

NOTE 3: In case a GBS-operation is requested and acknowledged, the MS indicates the acceptable channel codings. The indicated acceptance of TCH/F4.8 is equivalent to the support of 6 kbit/s radio interface rate per TCH/F and therefore overrides the NIRR parameter.

Table B.4c Negotiation of fixed network user rate

BC-parameter	Message SETUP	Message CALL PROC/CONFIRMED
FNUR	requested value	equal or lower than the requested value

The network might accept the modified value or reject the call. The FNUR negotiation is applicable in case of a HSCSD-operation, only.

Table B.4d Negotiation of user initiated modification indication

BC-parameter	Message SETUP	Message CALL PROC/CONFIRMED
UIMI	offered value	equal to or a value indicating a request for modification to a lower number of traffic channels than offered

Table B.4e: Negotiation of Synchronous/Asynchronous

Mobile Terminated Call:

	BC-parameter Synchronous/Asynchronous	
Bearer type	Message SETUP	Message CALL CONF
FTM1)	Synchronous	Asynchronous
PIAFS2)	Synchronous	Asynchronous

1) This negotiation is possible, only if ITC=UDI or RDI, FNUR=64 or 56 kbit/sand CE=NT or "both" is signalled in the SETUP message. The MS shall signal FTM as specified in B.1.2.3 .

2) This negotiation is possible, only if ITC=UDI, FNUR=32 kbit/s and CE= "both" is signalled in the SETUP message. The UE shall signal PIAFS as specified in B.1.2.4

Table B.4f: Negotiation of Rate adaptation/Other rate adaptation

Mobile Terminated Call:

	BC-parameter Rate adaptation/Other rate adaptation	
Bearer type	Message SETUP	Message CALL CONF
FTM1)	V.110, I.460 and X.30	X.31 flag stuffing
PIAFS2)	V.110, I.460 and X.30	PIAFS
Multimedia	V.110, I.460 and X.303)	H.223 and H.245
	No rate adaptation5) 6)	H.223 and H.245

1) This negotiation is possible, only if ITC=UDI or RDI, FNUR=64 or 56 kbit/s and CE=NT or "both" is signalled in the SETUP message. The MS shall signal FTM as specified in B.1.2.3.

2) This negotiation is possible, only if ITC=UDI, FNUR=32 kbit/s and CE= "both" is signalled in the SETUP message. The UE shall signal PIAFS as specified in B.1.2.4.

3) This negotiation is possible, only if ITC=UDI or RDI, FNUR=32 or 56 kbit/s and CE=T or "both" is signalled in the SETUP message. The MS shall signal 3G-H.324/M as specified in B.1.3.1.3, B.1.3.1.4 and B.1.3.1.6.

4) Void.

5) This negotiation is possible, if ITC=3,1 kHz, FNUR=28.8 kbit/s, MT=V.34 and CE=T or “both” is signalled in the SETUP message. The MS shall signal 3G-H.324/M as specified in B.1.3.2.3.

6) This negotiation is possible, if ITC=UDI or RDI, FNUR=64 or 56 kbit/s and CE=T is signalled in the SETUP message. The MS shall signal 3G-H.324/M as specified in B.1.3.1.3, B.1.3.1.4, and B.1.3.1.5

Table B.5: BC parameter setting (part 1)

Abbreviations for Parameters and Values:		default setting of field values (NA)	common setting of field values
ITC...Information Transfer Capability:	- Speech		
	- UDI..Unrestricted Digital		
	- FAX3..Group 3 Facsimile		
	- 3,1 kHz..3,1 kHz Ex PLMN		
	- RDI..Restricted Digital		
TM....Transfer Mode:	- ci..Circuit	X	X
S.....Structure:	- SDU..Service Data Unit Integrity		
	- Unstructured	X	
C.....Configuration:	- pp..Point to point	X	X
E.....Establishment:	- de..Demand	X	X
SA....Sync/Async:	- S..Synchronous		
	- A..Asynchronous		
N.....Negotiation	- ibn..in band negotiation not possible	X	X
UR....User Rate:	- 0.3..0.3 kbit/s		
	- 1.2..1.2 kbit/s		
	- 2.4..2.4 kbit/s		
	- 4.8..4.8 kbit/s		
	- 9.6..9.6 kbit/s	X	
IR....Intermediate Rate:	- 8.. 8 kbit/s		
	- 16.. 16 kbit/s	X	
NICT..Network Independent Clock on Tx:	- not_required.. Not required	X	X
	- required		
NICR..Network Independent Clock on Rx:	- not_accepted..not accepted	X	X
	- accepted		
NSB...Number of Stop Bits:	- 1..1 bit	X	
	- 2..2 bit		
NDB...Number of Data Bits Excluding Parity If Present:	- 7.. 7 bit		
	- 8.. 8 bit	X	
NPB...Parity Information:	- Odd		
	- Even		
	- None	X	
	- 0.. Forced to 0		
	- 1.. Forced to 1		
UIL1P.User Information Layer 1 Protocol	- def..default layer 1 protocol	X	X

Table B.5: BC parameter setting (part 2)

Abbreviations for Parameters and Values		default setting of field values (NA)	common setting of field values
DM....Duplex Mode:	-		
	- fd.. Full Duplex	X	X
MT....Modem Type:	- V.21		
	- V.22		
	- V.22 bis		
	- V.26 ter		
	- V.32		
	- auto1.. autobauding type 1		
	- none	X	
RCR...Radio Channel Requirement:	- FR Full Rate support only Mobile Station		
	- dual HR Dual Rate support Mobile Station/ Half Rate preferred		
	- dual FR Dual Rate support Mobile Station/ Full Rate preferred		
CE....Connection Element:	- T.. Transparent		
	- NT.. Non Transparent		
	- bothT both transparent preferred		
	- bothNT both non Transparent preferred		
UIL2P.User Information Layer 2 Protocol:	- ISO6429..ISO6429,codeset 0,DC1/DC3		
	- COPnoFlCt..Character oriented protocol with no flow control mechanism		
SAP...Signalling Access Protocol:	- I.440.. I.440/450	X	
RA....Rate Adaptation:	- V.110.. V.110/X.30		
	- X.31Flag.. X.31 flagstuffing		
	- NO.. no rate adaptation	X	
	- V.120		
	- PIAFS		
	- H.223 and H.245		
CS....Coding Standard:	- GSM	X	X
NIRR..Negotiation of Intermediate Rate Requested:	NM..No Meaning associated with this value	X	
	6kbit/s..6kbit/s radio interface rate requested		
DC....Data Compression	- DC.. compression possible/allowed		
	- NO.. compression not possible/allowed	X	

Table B.5: BC parameter setting (part 3)

Abbreviations for Parameters and Values		default setting of field values (NA)	common setting of field values
FNUR...Fixed Network User Rate	- FNUR not applicable		
	- 9.6.. 9.6 kbit/s		
	- 14.4.. 14.4 kbit/s		
	- 19.2.. 19.2 kbit/s		
	- 28.8.. 28.8 kbit/s		
	- 32.0.. 32.0 kbit/s		
	- 33.6.. 33.6 kbit/s		
	- 38.4.. 38.4 kbit/s		
	- 48.0.. 48.0 kbit/s		
	- 56.0.. 56.0 kbit/s		
	- 64.0.. 64.0 kbit/s		
WAIUR...Wanted Air Interface User Rate	- WAIUR not applicable		
	- 9.6.. 9.6 kbit/s	X	
	- 14.4.. 14.4 kbit/s		
	- 19.2.. 19.2 kbit/s		
	- 28.8.. 28.8 kbit/s		
	- 38.4.. 38.4 kbit/s		
	- 43.2.. 43.2 kbit/s		
	- 57.6.. 57.6 kbit/s		
	- int 38.4.. interpreted by the network as 38.4 kbit/s		
ACC.........Acceptable channel codings	- 4.8.. TCH/F4.8 acceptable		
	- 9.6.. TCH/F9.6 acceptable		
	- 14.4..TCH/F14.4 acceptable		
	- 28.8..TCH/F28.8 acceptable		
	- 32.0..TCH/F32.0 acceptable		
	- 43.2..TCH/F43.2 acceptable		
	- none..No channel coding (defined by selecting none of the above		
MaxNumTCH...Maximum Number of Traffic Channels			
	- 1.. 1 TCH		
	- 2.. 2 TCH		
	- 3.. 3 TCH		
	- 4.. 4 TCH		
	- 5.. 5 TCH		
	- 6.. 6 TCH		
	- 7.. 7 TCH		
	- 8.. 8 TCH		
OMT...Other modem type	- no other MT.. no other modem type		
	- V.34.. V.34		
User initiated modification indication	- not req.. user initiated modification not required	X	
	- upto 1 TCH.. user initiated modification upto 1 TCH may be requested		
	- upto 2 TCH.. user initiated modification upto 2 TCH may be requested		
	- upto 3 TCH.. user initiated modification upto 3 TCH may be requested		
	- upto 4 TCH.. user initiated modification upto 4 TCH may be requested		
Asymmetry preference indication	- 00 no preference		
	- 01 up link biased asymmetry preferred		
	- 10 down link biased asymmetry preferred		

Table B.5a: Differences in parameter value validity in ~~GSM~~ A/Gb mode and ~~UMTS~~UTRAN Iu mode

Parameter / *value*	**~~GSM~~A/Gb mode**	**~~UMTS~~UTRAN Iu mode**
Radio Channel Requirements / *any*	valid	ignored
User rate / *any*	valid	ignored
Intermediate Rate / *any*	valid	ignored
NIC on transmission / *any*	valid	ignored
NIC on reception / *any*	valid	ignored
Negotiation of IR requested / *any*	valid	ignored
Acceptable Channel Codings / *any*	valid	ignored (Note 1)
Maximum number of traffic channels / *any*	valid	ignored (Note 1)
User initiated modification indication / *any*	valid	ignored
Asymmetry preference indication/ *any*	valid	ignored
Modem type /		
V.21, V.22, V.22bis, V.26ter	valid	invalid
V.32	valid	invalid for CE=T
Fixed Network User Rate /		
32 kbit/s	Invalid for CE = NT	valid
33.6 kbit/s	invalid	valid
9.6, 14.4, 19.2, 38.4, 48.0	valid	invalid for CE=T
28.8	valid	invalid for CE=T in the case of ITC=UDI
Other Rate adaptation /		
PIAFS	invalid	valid

NOTE: Although a parameter value is marked as "valid", the validity may be restricted by rules given elsewhere in the present document.

NOTE 1: This parameter is relevant in ~~UMTS~~ UTRAN Iu mode for NT calls for deciding which RLP version to negotiate in order to avoid renegotiation of RLP version in case of handover, see 3GPP TS 24.022 [9]. It is otherwise irrelevant for specifying the UTRAN Iu mode radio access bearer.

Table B.6: Channel combinations

Single Bearer and Teleservices

MS indication BC	Network selection CT CT
FR dual FR dual HR	FR FR or HR HR or FR

Alternate services

MS indication		Network selection				
BC(1)	BC(2)	CT(1)	CT(2)	Or	CT(1)	CT(2)
FR	FR	FR	FR			
FR	dual Rate	FR	FR			
dual Rate	dual Rate	FR	FR	Or	HR	HR
dual Rate	FR	FR	FR			

Followed-by services

MS indication		Network selection							
BC(1)	BC(2)	CT(1)	CT(2)	or	CT(1)	CT(2)	or	CT(1)	CT(2)
FR	FR	FR	FR						
FR	dual Rate	FR	FR						
dual Rate	dual Rate	FR	FR	or	HR	HR	or	FR	HR
dual Rate	FR	FR	FR						

BC Bearer Capability
CT Channel Type
dual Rate {dual FR | dual HR}

Table B.7: TS61/TS62 Negotiation rules

Mobile Originating Call

Subscription	SETUP	CALL PROCEED
TS61	TS61 s/f TS61 f/s	TS61 s/f or TS62 TS61 f/s or TS62
	TS62	TS62
TS62	TS61 s/f TS61 f/s	TS62 TS62
	TS62	TS62

Mobile Terminating Call

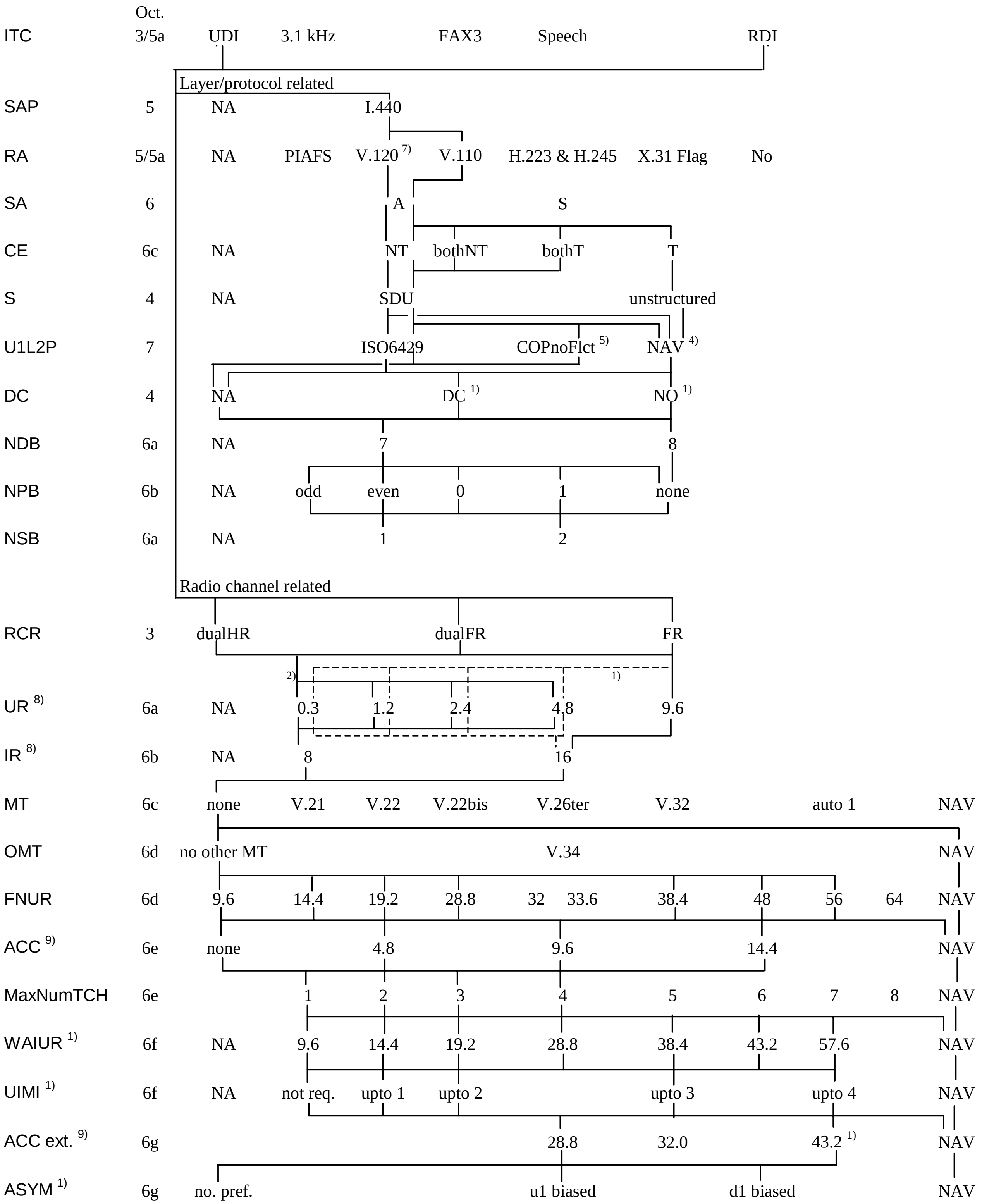
Subscription	SETUP	CALL CONFIRMED
TS61	TS61 s/f	TS61 s/f or TS61 f/s or TS62
	TS61 f/s	TS61 s/f or TS61 f/s or TS62
	TS62	TS62
	no BC	TS61 s/f or TS61 f/s or TS62
TS62	TS62	TS62
	no BC	TS62 (note)

s/f = speech then fax
f/s = fax then speech

NOTE: TS61 is also accepted if the VMSC supports TS61 and does not perform subscription checking on a CALL CONFIRMED message (see 3GPP TS 22.001 and 3GPP TS 29.007).

B.1.2 Bearer Service 20, Data Circuit Duplex Asynchronous

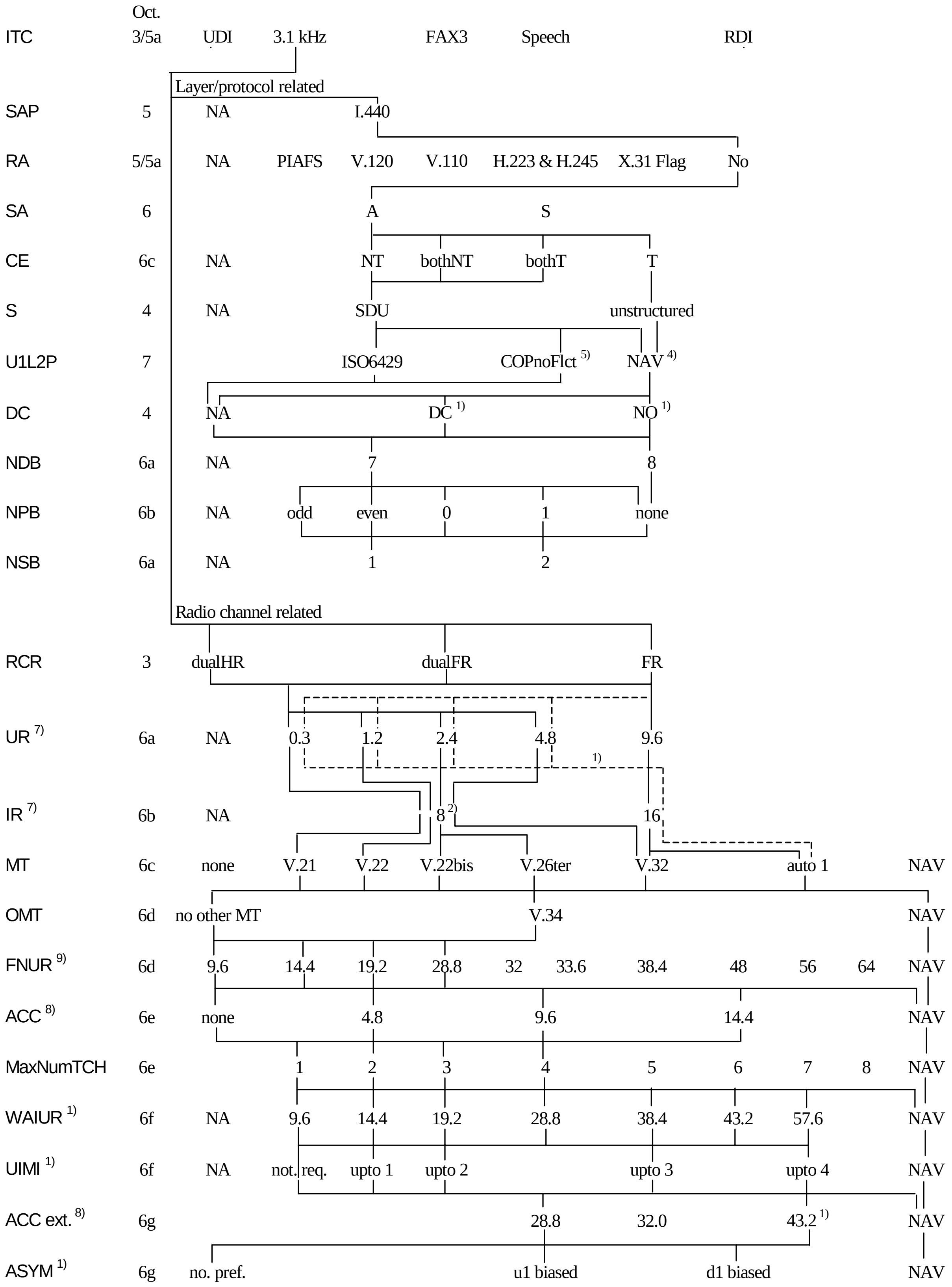
B.1.2.1 Unrestricted / restricted digital information transfer capability



1) for CE:NT or "both";
2) for CE:T only or CE:NT and NIRR:6kb/s (not for the SETUP message);
3) Void;
4) for MT CALLS in the SETUP message or MO/MT CALLS with "out-band" flow control requested;
5) for MO/MT CALLS with no flow control requested;

6) Void;
7) the V.120 relevant BC parameters (octet 5b) shall be set according to the LLC (see clause B.2);
8) IR and UR are overridden by FNUR, ACC and MaxNumTCH;
9) ACC may have several values simultaneously (bit map coding).

B.1.2.2 3,1 kHz audio ex-PLMN information transfer capability



1) for CE:NT or "both";
2) for CE:T only or CE:NT and NIRR:6kb/s (not for the SETUP message);
3) Void;
4) for MT CALLS in the SETUP message or MO/MT CALLS with "out-band" flow control requested (not for V.21 modem type);

5) for MO/MT CALLS with no flow control requested;
6) Void;
7) IR and UR are overridden by FNUR, ACC and MaxNumTCH.
8) ACC may have several values simultaneously (bit map coding).
9) in case of MT = auto1 the value of FNUR has no meaning.

B.1.2.3 Frame Tunnelling Mode

	Oct.												
ITC	3/5a	UDI	3.1 kHz		FAX3		Speech			RDI			
		Layer/protocol related											
SAP	5	NA		I.440									
RA	5/5a	NA	PIAFS	V.120	V.110		H.223 & H.245		X.31 Flag	No			
SA	6			A			S						
CE	6c	NA		NT	bothNT		bothT		T				
S	4	NA		SDU					unstructured				
U1L2P	7			ISO6429			COPnoFlct		NAV				
DC	4	NA			DC				NO				
NDB	6a	NA		7					8				
NPB	6b	NA	odd	even	0		1		none				
NSB	6a	NA		1			2						
		Radio channel related											
RCR	3	dualHR			dualFR				FR				
UR	6a	NA	0.3	1.2	2.4		4.8		9.6				
IR	6b	NA	8				16						
MT	6c	none	V.21	V.22	V.22bis		V.26ter		V.32		auto 1		NAV
OMT	6d	no other MT					V.34						NAV
FNUR	6d	9.6	14.4	19.2	28.8	32		33.6	38.4	48	56	64	NAV
ACC 1)	6e	none		4.8			9.6			14.4			NAV
MaxNumTCH	6e		1	2	3		4		5	6	7	8	NAV
WAIUR	6f	NA	9.6	14.4	19.2		28.8		38.4	43.2	57.6		NAV
UIMI	6f	NA	not req.	upto 1	upto 2				upto 3		upto 4		NAV
ACC ext. 1)	6g						28.8		32.0		43.2		NAV
ASYM	6g	no. pref.					u1 biased			d1 biased			NAV

1) ACC may have several values simultaneously (bit map coding).

B.1.2.4 PIAFS

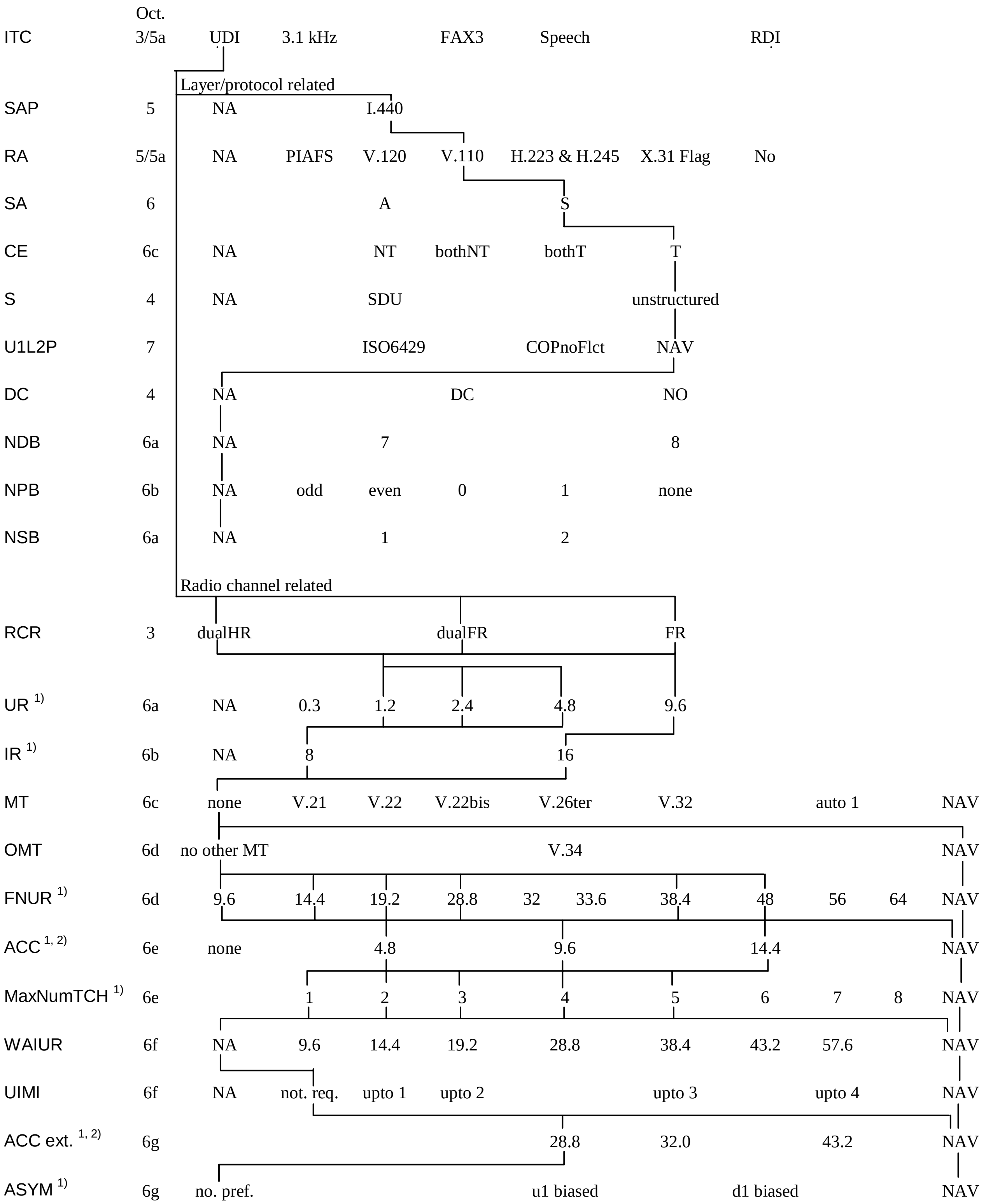
	Oct.										
ITC	3/5a	UDI	3.1 kHz		FAX3	Speech		RDI			
		Layer/protocol related									
SAP	5	NA		I.440							
RA	5/5a	NA	PIAFS	V.120	V.110	H.223 & H.245	X.31 Flag	No			
SA	6			A		S					
CE	6c	NA		NT	bothNT	bothT	T				
S	4	NA		SDU			unstructured				
U1L2P	7			ISO6429		COPnoFlct	NAV				
DC	4	NA			DC		NO				
NDB	6a	NA		7			8				
NPB	6b	NA	odd	even	0	1	none				
NSB	6a	NA		1		2					
		Radio channel related									
RCR	3	dualHR			dualFR		FR				
UR	6a	NA	0.3	1.2	2.4	4.8	9.6				
IR	6b	NA	8			16					
MT	6c	none	V.21	V.22	V.22bis	V.26ter	V.32		auto 1		NAV
OMT	6d	no other MT				V.34					NAV
FNUR	6d	9.6	14.4	19.2	28.8	32 33.6	38.4	48	56	64	NAV
ACC	6e	none		4.8		9.6		14.4			NAV
MaxNumTCH	6e		1	2	3	4	5	6	7	8	NAV
WAIUR	6f	NA	9.6	14.4	19.2	28.8	38.4	43.2	57.6		NAV
UIMI	6f	NA	not. req.	upto 1	upto 2		upto 3		upto 4		NAV
ACC ext.	6g					28.8	32.0		43.2		NAV
ASYM	6g	no. pref.				u1 biased		d1 biased			NAV

B.1.3 Bearer Service 30, Data Circuit Duplex Synchronous

B.1.3.1 Unrestricted/restricted digital information transfer capability

B.1.3.1.1 Transparent FNUR <= 48 kbit/s (TCH/F4.8, TCH/F9.6, TCH/14.4, TCH/F28.8)

Applies to ~~GSM/GERAN~~A/Gb mode only. No HO to/from UTRAN Iu mode



1) IR and UR are overridden by FNUR, ACC and MaxNumTCH.

2) ACC may have several values simultaneously (bit map coding).

B.1.3.1.2 X.32 Case

Void.

B.1.3.1.3 Transparent FNUR=56 kbit/s, including 3G-H.324/M, (TCH/F9.6, TCH/F32.0, UTRAN Iu mode)

	Oct.											
ITC	3/5a	UDI [3]	3.1 kHz	FAX3	Speech	RDI [3]						
		Layer/protocol related										
SAP	5	NA	I.440									
RA [3]	5/5a	NA	PIAFS	V.120	V.110 [3]	H.223 & H.245 [3]	X.31 Flag	No [3]				
SA	6	A	S									
CE	6c	NA	NT	bothNT	bothT	T						
S	4	NA	SDU	unstructured								
U1L2P	7	ISO6429	COPnoFlct	NAV								
DC	4	NA	DC	NO								
NDB	6a	NA	7	8								
NPB	6b	NA	odd	even	0	1	none					
NSB	6a	NA	1	2								
		Radio channel related										
RCR	3	dualHR	dualFR	FR								
UR [1]	6a	NA	0.3	1.2	2.4	4.8	9.6					
IR [1]	6b	NA	8	16								
MT	6c	none	V.21	V.22	V.22bis	V.26ter	V.32	auto 1	NAV			
OMT [5]	6d	no other MT	V.34	NAV								
FNUR [1, 5]	6d	9.6	14.4	19.2	28.8	32	33.6	38.4	48	56	64	NAV
ACC [1, 2]	6e	none	4.8	9.6	14.4	NAV [4]						
MaxNumTCH [1]	6e	1	2	3	4	5	6	7	8	NAV [4]		
WAIUR [1]	6f	NA	9.6	14.4	19.2	28.8	38.4	43.2 [1]	57.6	NAV		
UIMI [1]	6f	NA	not. req.	upto 1	upto 2	upto 3	upto 4	NAV				
ACC ext. [1, 2]	6g	28.8	32.0	43.2	NAV [4]							
ASYM [1]	6g	no. pref.	u1 biased	d1 biased	NAV							

1) IR and UR are overridden by FNUR, ACC and MaxNumTCH. IR and UR are not applicable to ~~UMTS~~UTRAN Iu mode.

2) ACC may have several values simultaneously (bit map coding). However, handover to/from UTRAN is not possible if the network assigns other traffic channels than TCH/F9.6 or TCH/F32.0.

3) In case ITC=UDI, RA shall be set to V.110. In case ITC=RDI, RA shall be set to H.223 & H.245 or No.

4) In case ACC and MaxNumTCH are not available operation is restricted to UTRAN.

5) The parameters FNUR and OMT are mandatory for this service.

B.1.3.1.4 Transparent FNUR = 56kbit/s, including 3G-H.324/M (TCH/F14.4)

Applies to ~~GSM/GERAN~~A/Gb mode only, no HO to/from UTRAN Iu mode

	Oct.												
ITC	3/5a	UDI [3]	3.1 kHz		FAX3		Speech			RDI [3]			
		Layer/protocol related											
SAP	5	NA		I.440									
RA [3]	5/5a	NA	PIAFS	V.120	V.110 [3]		H.223 & H.245 [3]		X.31 Flag	No [3]			
SA	6			A			S						
CE	6c	NA		NT	bothNT		bothT		T				
S	4	NA		SDU					unstructured				
U1L2P	7			ISO6429			COPnoFlct		NAV				
DC	4	NA			DC				NO				
NDB	6a	NA		7					8				
NPB	6b	NA	odd	even	0		1		none				
NSB	6a	NA		1			2						
		Radio channel related											
RCR	3	dualHR			dualFR				FR				
UR [1]	6a	NA	0.3	1.2	2.4		4.8		9.6				
IR [1]	6b	NA	8				16						
MT	6c	none	V.21	V.22	V.22bis		V.26ter		V.32		auto 1		NAV
OMT [4]	6d	no other MT					V.34						NAV
FNUR [1, 4]	6d	9.6	14.4	19.2	28.8	32		33.6	38.4	48	56	64	NAV
ACC [1, 2, 4]	6e	none		4.8			9.6			14.4			NAV
MaxNumTCH [1,4]	6e		1	2	3		4 [1]		5	6	7	8	NAV
WAIUR	6f	NA	9.6	14.4	19.2		28.8		38.4	43.2	57.6		NAV
UIMI	6f	NA	not. req.	upto 1	upto 2				upto 3		upto 4		NAV
ACC ext.	6g						28.8		32.0		43.2		NAV
ASYM	6g	no. pref.					u1 biased			d1 biased			NAV

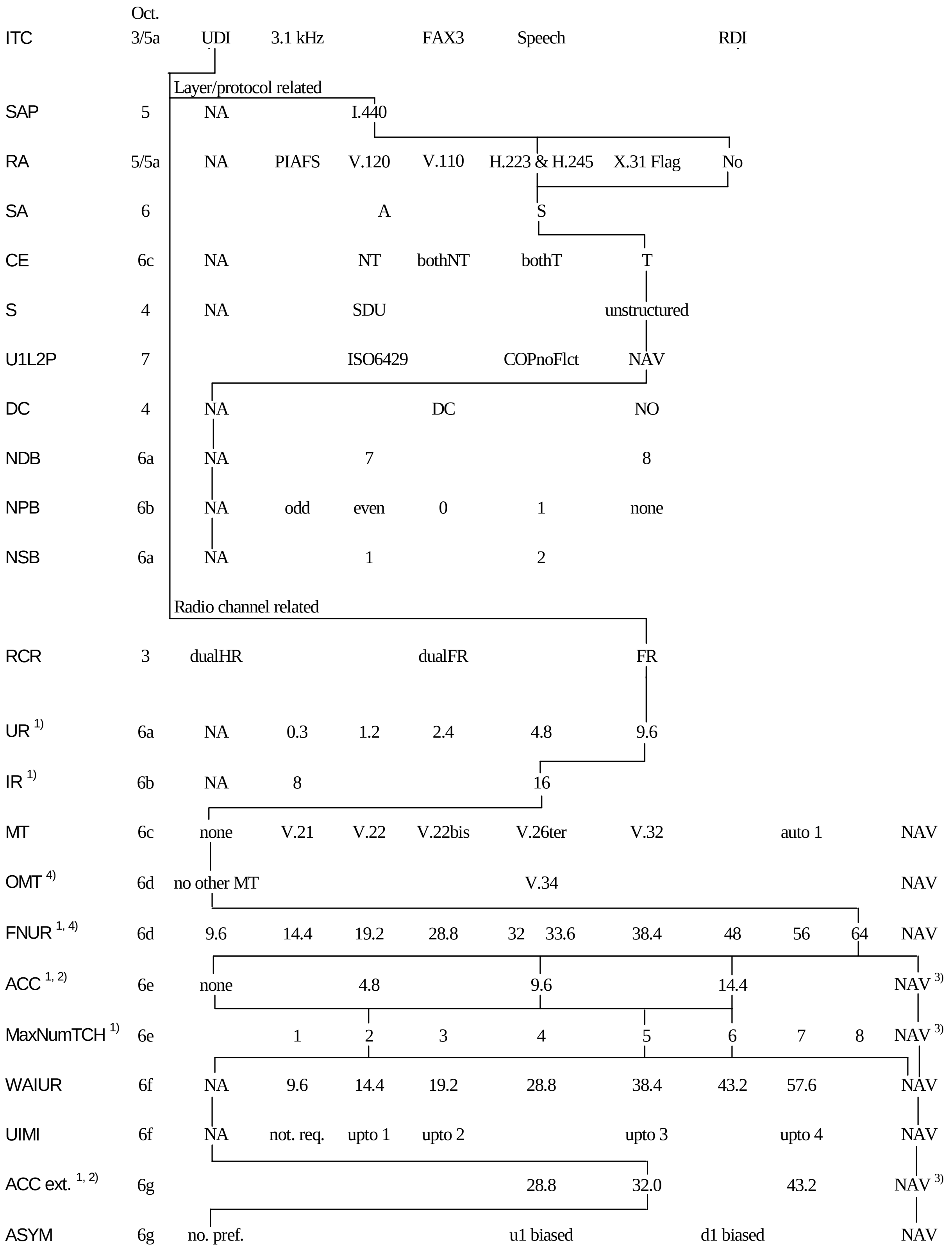
1) IR and UR are overridden by FNUR, ACC and MaxNumTCH.

2) ACC may have several values simultaneously (bit map coding).

3) In case ITC=UDI, RA shall be set to V.110. In case ITC=RDI, RA shall be set to H.223 & H.245 or No.

4) The parameters FNUR, OMT, ACC and MaxNumTCH are mandatory for this service.

B.1.3.1.5 Transparent FNUR = 64kbit/s, including 3G-H.324/M (TCH/F9.6, TCH/F14.4, TCH/F32.0, UTRAN Iu mode))



1) IR and UR are overridden by FNUR, ACC and MaxNumTCH. IR and UR are not applicable to ~~UMTS~~UTRAN Iu mode.

2) ACC may have several values simultaneously (bit map coding).

3) If ACC and MaxNumTCH are not available operation is restricted to UTRAN Iu mode.

4) The parameters FNUR and OMT are mandatory for this service.

B.1.3.1.6 3G-H.324/M, FNUR=32.0 kbit/s (TCH/F32.0, UTRAN Iu mode)

	Oct.												
ITC	3/5a	UDI	3.1 kHz		FAX3		Speech			RDI			
		Layer/protocol related											
SAP	5	NA		I.440									
RA	5/5a	NA	PIAFS	V.120	V.110		H.223 & H.245		X.31 Flag	No			
SA	6			A			S						
CE	6c	NA		NT	bothNT		bothT		T				
S	4	NA		SDU					unstructured				
U1L2P	7			ISO6429			COPnoFlct		NAV				
DC	4	NA			DC				NO				
NDB	6a	NA		7					8				
NPB	6b	NA	odd	even	0		1		none				
NSB	6a	NA		1			2						
		Radio channel related											
RCR	3	dualHR			dualFR				FR				
UR [3]	6a	NA	0.3	1.2	2.4		4.8		9.6				
IR [3]	6b	NA	8				16						
MT	6c	none	V.21	V.22	V.22bis		V.26ter		V.32		auto 1		NAV
OMT	6d	no other MT					V.34						NAV
FNUR	6d	9.6	14.4	19.2	28.8	32		33.6	38.4	48	56	64	NAV
ACC [1, 2]	6e	none		4.8			9.6			14.4			NAV [2]
MaxNumTCH [2]	6e	NA	1	2	3		4		5	6	7	8	NAV [2]
WAIUR	6f	NA	9.6	14.4	19.2		28.8		38.4	43.2	57.6		NAV
UIMI [2]	6f	NA	not. req.	upto 1	upto 2				upto 3		upto 4		NAV [2]
ACC ext. [1, 2]	6g	not accept.					28.8		32.0		43.2		NAV [2]
ASYM [2]	6g	no. pref.					u1 biased			d1 biased			NAV [2]

1) ACC may have several values simultaneously (bit map coding).

2) If ACC, UIMI, MaxNumTCH and ASYM are not available operation is restricted to UTRAN.

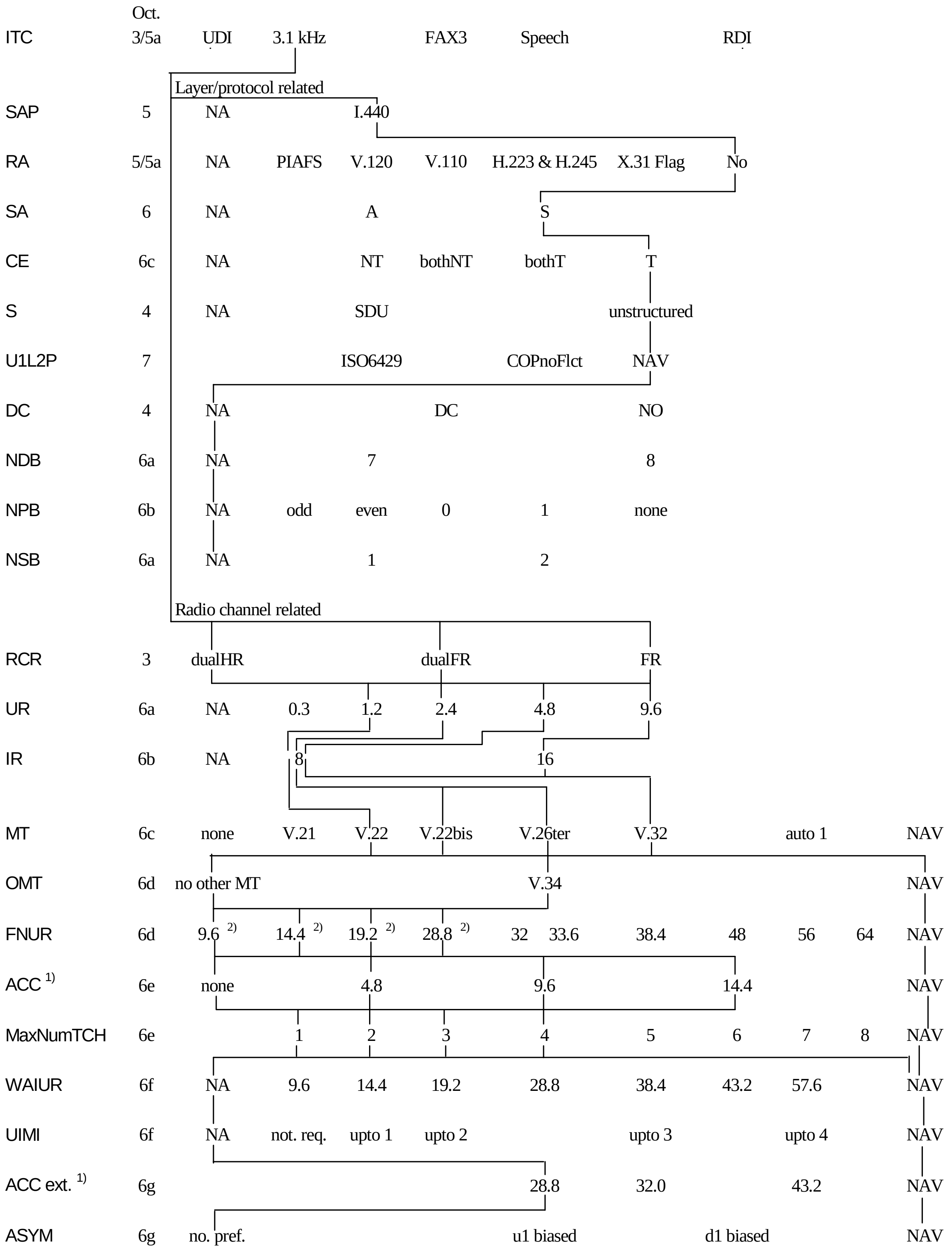
3) IR and UR are overridden by FNUR, ACC and MaxNumTCH. IR and UR are not applicable to ~~UMTS~~UTRAN Iu mode.

B.1.3.1.7 Synchronous transparent 56 kbit/s (RDI) and 64kbit/s (UDI) (UTRAN Iu mode)

See B.1.3.1.3 and B.1.3.1.5.

B.1.3.2 3,1 kHz audio ex-PLMN information transfer capability

B.1.3.2.1 Non-X.32 Cases

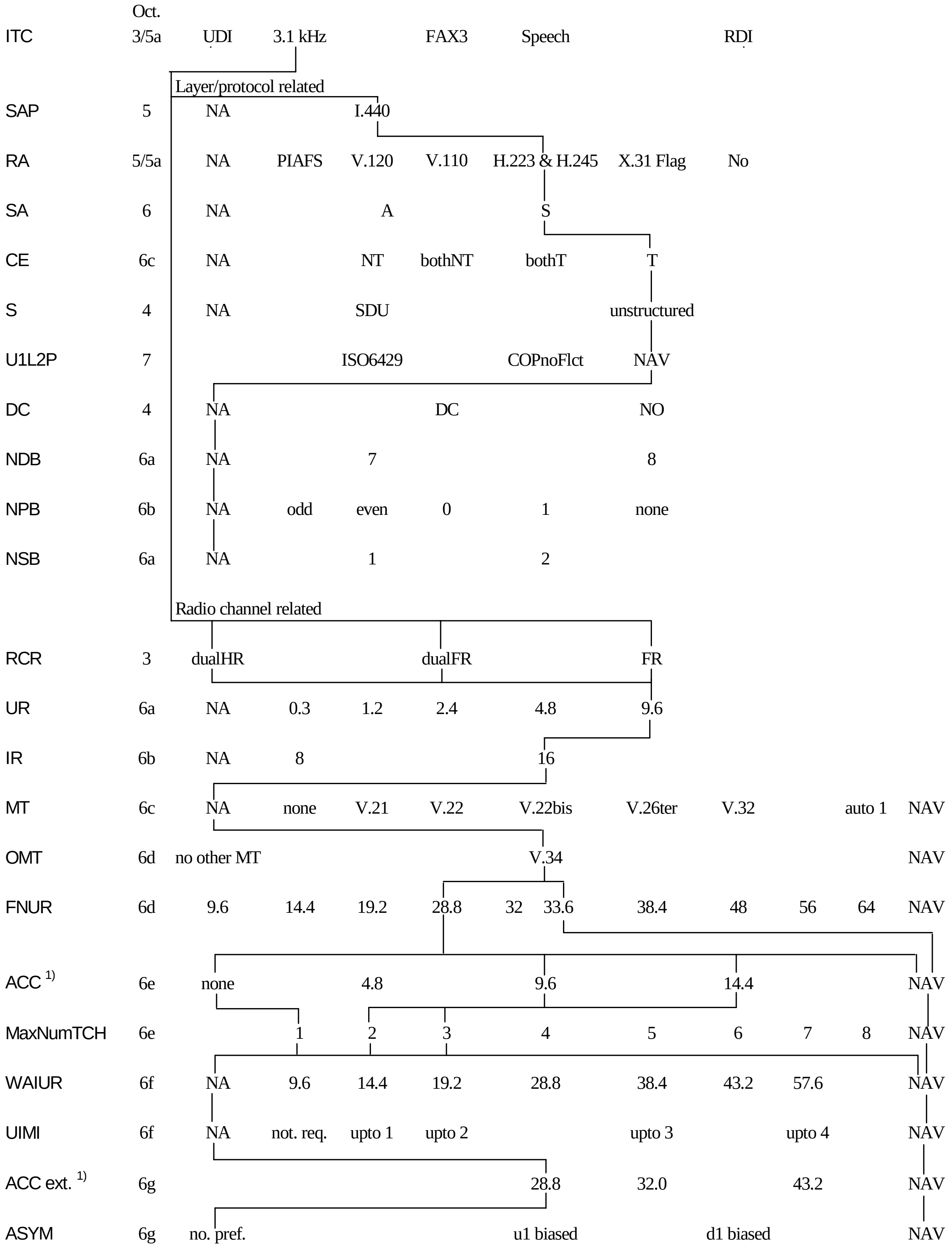


1) ACC may have several values simultaneously (bit map coding).

B.1.3.2.2 X.32 Case

Void.

B.1.3.2.3 3G-H.324/M Case



1) ACC may have several values simultaneously (bit map coding).

2) FNUR 33.6 kbit/s applies to UTRAN Iu mode only.

B.1.4 Bearer Service 40 ... 46, PAD Access Asynchronous

Void.

B.1.5 Bearer Service 50 ... 53 ,Data Packet Duplex Synchronous, Unrestricted digital information transfer capability

Void.

B.1.6 Bearer Service 61, Alternate Speech/Data

Void.

B.1.7 Bearer Service 81, Speech followed by Data

Void.

B.1.8 Teleservice 11 ... 12, Speech

	Oct.										
ITC	3/5a	UDI	3.1 kHz		FAX3	Speech		RDI			
		Layer/protocol related									
SAP	5	NA		I.440							NAV
RA	5/5a	NA	PIAFS	V.120	V.110	H.223 & H.245	X.31 Flag	No			NAV
SA	6	NA		A		S					NAV
CE	6c	NA		NT	bothNT	bothT	T				NAV
S	4	NA		SDU			unstructured				NAV
U1L2P	7			ISO6429		COPnoFlct					NAV
DC	4	NA			DC		NO				NAV
NDB	6a	NA		7			8				NAV
NPB	6b	NA	odd	even	0	1	none				NAV
NSB	6a	NA		1		2					NAV
		Radio channel related									
RCR	3	dualHR			dualFR		FR				
UR	6a	NA	0.3	1.2	2.4	4.8	9.6				NAV
IR	6b	NA	8			16					NAV
MT	6c	none	V.21	V.22	V.22bis	V.26ter	V.32		auto 1		NAV
OMT	6d	no other MT				V.34					NAV
FNUR	6d	9.6	14.4	19.2	28.8	32 33.6	38.4	48	56	64	NAV
ACC	6e	none		4.8		9.6		14.4			NAV
MaxNumTCH	6e		1	2	3	4	5	6	7	8	NAV
WAIUR	6f	NA	9.6	14.4	19.2	28.8	38.4	43.2	57.6		NAV
UIMI	6f	NA	not. req.	upto 1	upto 2		upto 3		upto 4		NAV
ACC ext.	6g					28.8	32.0		43.2		NAV
ASYM	6g	no. pref.				u1 biased		d1 biased			NAV

B.1.9 Teleservice 21 ... 23, Short Message

Not applicable.

B.1.10 Teleservice 61, Alternate Speech and Facsimile group 3

The information element of the "repeat indicator" is set to the value "circular for successive selection (alternate)".

B.1.10.1 Teleservice 61, Speech

Ref. subclause B.1.8.

B.1.10.2 Teleservice 61, Facsimile group 3 in A/Gb ,mode~~GSM~~

	Oct.										
ITC	3/5a	UDI	3.1 kHz		FAX3	Speech		RDI			
		Layer/protocol related									
SAP	5	NA		I.440							
RA	5/5a	NA	PIAFS	V.120	V.110	H.223 & H.245	X.31 Flag	No			
SA	6	NA		A		S					
CE	6c	NA		NT	bothNT	bothT	T				
S	4	NA		SDU			unstructured				
U1L2P	7			ISO6429		COPnoFlct	NAV				
DC	4	NA			DC		NO				
NDB	6a	NA		7			8				
NPB	6b	NA	odd	even	0	1	none				
NSB	6a	NA		1		2					
		Radio channel related									
RCR	3	dualHR			dualFR		FR				
UR	6a	NA	0.3	1.2	2.4	4.8	9.6				
IR	6b	NA	8			16					
MT	6c	none	V.21	V.22	V.22bis	V.26ter	V.32		auto 1		NAV
OMT	6d	no other MT				V.34					NAV
FNUR	6d	9.6	14.4	19.2	28.8	32 33.6	38.4	48	56	64	NAV
ACC 1)	6e	none		4.8		9.6		14.4			NAV
MaxNumTCH	6e		1	2	3	4	5	6	7	8	NAV
WAIUR	6f	NA	9.6	14.4	19.2	28.8	38.4	43.2	57.6		NAV
UIMI	6f	NA	not. req.	upto 1	upto 2		upto 3		upto 4		NAV
ACC ext.	6g					28.8	32.0		43.2		NAV
ASYM	6g	no. pref.				u1 biased		d1 biased			NAV

1) ACC may have several values simultaneously (bit map coding).

B.1.10.3 Teleservice 61, Facsimile group 3 in UTRAN Iu mode~~UMTS~~

	Oct.										
ITC	3/5a	UDI	3.1 kHz		FAX3	Speech		RDI			
		Layer/protocol related									
SAP	5	NA		I.440							
RA	5/5a	NA	PIAFS	V.120	V.110	H.223 & H.245	X.31 Flag	No			
SA	6	NA		A		S					
CE	6c	NA		NT	bothNT	bothT	T				
S	4	NA		SDU			unstructured				
U1L2P	7			ISO6429		COPnoFlct 3)	NAV				
DC	4	NA			DC		NO				
NDB	6a	NA		7			8				
NPB	6b	NA	odd	even	0	1	none				
NSB	6a	NA		1		2					
		Radio channel related									
RCR	3	dualHR			dualFR		FR				
UR	6a	NA	0.3	1.2	2.4	4.8	9.6				NAV
IR	6b	NA	8			16					NAV
MT	6c	none	V.21	V.22	V.22bis	V.26ter	V.32		auto 1		NAV
OMT	6d	no other MT				V.34					NAV
FNUR	6d	9.6	14.4	19.2	28.8	32 33.6	38.4	48	56	64	NAV
ACC	6e	none		4.8		9.6		14.4			NAV
MaxNumTCH	6e		1	2	3	4	5	6	7	8	NAV
WAIUR	6f	NA	9.6	14.4	19.2	28.8	38.4	43.2	57.6		NAV
UIMI	6f	NA	not. req.	upto 1	upto 2		upto 3		upto 4		NAV
ACC ext.	6g					28.8	32.0		43.2		NAV
ASYM	6g	no. pref.				u1 biased		d1 biased			NAV

B.1.11 Teleservice 62, Automatic Facsimile group 3

Ref. subclause B.1.10, the information element "repeat indicator" is not available/valid.

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 shall be included in the ACC and a '*' indicates that it may or may not be included.

NOTE 2: Padding Required, ref 3GPP TS 44.021.

NOTE 3: Air interface user rate 11,2 kbit/s, ref. 3GPP TS 44.021.

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, shall 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).

B.1.12.2 Non-transparent services

The MS is allowed to signal any combination of WAIUR, ACC and mTCH compliant to the following table. A combination is compliant to the table, if there exists at least one row that it is compliant to. A combination is compliant to a row if each parameter value meets the conditions given in that row. When a WAIUR, ACC, mTCH combination is compliant to a row, the network is allowed to assign any Channel Mode compliant to that row. The notes of the table provide further details on the compliance conditions.

WAIUR (Note 7)	mTCH (Note 5)	ACC (Note 1,4)					Channel Mode (Note 2,3,6)				
		TCH/F4.8	TCH/F9.6	TCH/F14.4	TCH/F28.8	TCH/F43.2	TCH/F4.8	TCH/F9.6	TCH/F14.4	TCH/F28.8	TCH/F43.2
9.6 kbit/s	1	*	+	*	*	*	1	1	-	-	-
	2	+	*	*	*	*	1 - 2	1	-	-	-
14.4 kbit/s	1	*	*	+	*	*	1	1	1	-	-
	3	+	*	*	*	*	1 - 3	1 - 2	1	-	-
19.2 kbit/s	2	*	+	*	*	*	1 - 2	1 - 2	1	1	-
	4	+	*	*	*	*	1 - 4	1 - 2	1	1	-
28.8 kbit/s	1	*	*	*	+	*	1	1	1	1	-
	2	*	*	+	*	*	1 - 2	1 - 2	1 - 2	1	-
	3	*	+	*	*	*	1 - 3	1 - 3	1 - 2	1	-
38.4 kbit/s	4	*	+	*	*	*	1 - 4	1 - 4	1 - 3	1 – 2	1
43.2 kbit/s	1	*	*	*	*	+	1	1	1	1	1
	3	*	*	+	*	*	1 - 3	1 - 3	1 - 3	1 – 2	1
57.6 kbit/s	2	*	*	*	+	*	1 - 2	1 - 2	1 - 2	1 – 2	1
	4	*	*	+	*	*	1 - 4	1 - 4	1 - 4	1 – 2	1

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

NOTE 2: A '-' indicates that this channel coding cannot be used for this WAIUR.

NOTE 3: A certain channel coding may only be assigned if indicated as acceptable in the ACC.

NOTE 4: 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 5: The MS is allowed to signal higher values for mTCH than indicated in the table for the signalled WAIUR and ACC. Before initiating the assignment procedure, the MSC, if necessary, shall lower the value of the mTCH to the highest value applicable for the signalled WAIUR and ACC.

NOTE 6: Unless an EDGE channel is assigned in one direction at least, the same channel coding is assigned in both directions, and an equal or lesser number of channels is assigned in the up link direction than in the down link direction. If an EDGE channel is assigned in one direction, TCH/F14.4 or an EDGE channel is assigned in the other direction. If the user has indicated up or down link biased asymmetry preference, TCH/F14.4 is assigned in the unbiased direction. The number of channels assigned is the same in each direction unless restricted by the mobile classmark, and is always within the limits given in the corresponding column.

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

The final decision about the radio interface configuration is taken by the BSS during the Assignment procedure. The BSS may assign any number of TCH/F ranging from 1 to mTCH and use any of the channel codings among the ACC. The BSS shall try to reach the WAIUR if the resource situation allows it. The maximum possible AIUR shall not exceed the WAIUR unless the higher AIUR can be reached with a smaller number of TCH/F (ref. 3GPP TS 22.034).

The radio interface configuration may be changed by the BSS during the call as long as the channel coding used is among the ACC and the mTCH is not exceeded.

B.1.13 Assignment of radio access bearer parameters depending on FNUR and WAIUR

B.1.13.1 Transparent Services

Depending on the FNUR negotiated between the network and the MS, the network is allowed to assign any radio resources with a radio access bearer parameter indicating a Quality of Service specifying

QoS Parameter		Value	Comments
Traffic Class		Conversational	Subject to operator tuning
RAB Asymmetry Indicator		Symmetric	
Maximum bit rate		= guaranteed bit rate	
Guaranteed bit rate		FNUR = 64 .. 28,8 kbit/s	GBR for FNUR=56 kbit/s is 64 kbit/s (Note 1)
Delivery Order		Yes	
Maximum SDU size		640bits for FNUR = 32, 56 and 64 kbit/s 576 bits for FNUR = 28.8 kbit/s	(Note 2)
Transfer Delay		< 200 ms	Subject to operator tuning
Traffic Handling Priority		-	Not applicable for the conversational traffic class
Source statistics descriptor		Unknown	
SDU Parameters			
	SDU error ratio	-	Not applicable
	Residual bit error ratio	10^{-4}	Subject to operator tuning according to 3GPP TS 23.107. Operator may also choose different value for Multimedia and other transparent data services.
	Delivery of erroneous SDUs	-	No error detection in the core network
Note 1: In case the FNUR = 56 kbit/s, the GBR is set to 64 kbit/s. Last bit in each data octet is set to 1 Note 2: The maximum SDU size for bit rate 33.6 kbit/s is still under discussion.			

The final decision about the radio interface configuration is taken by the RNC during the Assignment procedure.

B.1.13.2 Non-transparent services

Depending on the WAIUR signalled by the MS, the network is allowed to assign any radio resources with a radio access bearer parameter indicating a Quality of Service specifying

QoS Parameter			Value	Comments
Traffic Class			Streaming	Subject to operator tuning
RAB Asymmetry Indicator			Symmetric	
Maximum bit rate			14.4, 28.8, 57.6 kbit/s	Maximum bit rate is set to the highest value ≤ WAIUR (Note 1)
Guaranteed bit rate			14.4, 28.8, 57.6 kbit/s	Operator may choose any of the possible values less or equal to WAIUR. (Note 1).
Delivery Order			Yes	
Maximum SDU size			576 bits	
Transfer Delay			250 ms	Subject to operator tuning
Traffic Handling Priority			-	Not applicable to the streaming traffic class
Source statistics descriptor			Unknown	
SDU Parameters				
	SDU error ratio		10 %	Subject to operator tuning
	Residual bit error ratio		10^{-3}	Subject to operator tuning.
	Delivery of erroneous SDUs		No error detection consideration	
	SDU format information			
		RAB Subflow Combination bit rate	57.6 kbit/s	(Note 2)
		RAB Subflow Combination bit rate	28.8 kbit/s	(Note 2)
		RAB Subflow Combination bit rate	14.4 kbit/s	
		RAB Subflow Combination bit rate	0 kbit/s	indicates DTX, RFCI is not assigned

NOTE 1: If WAIUR is less or equal to 14.4 kbit/s then GBR and MBR shall be set to 14.4 kbit/s.

NOTE 2: Only RAB subflow combination bit rates ≤ maximum bit rate shall be specified.

The final decision about the radio interface configuration is taken by the RNC during the Assignment procedure.

B.2 Low Layer/High Layer Compatibility Information Element

B.2.1 Introduction

B.2.1.1 General Consideration

The purpose of the Low Layer/High Layer Compatibility Information Element (LLC/HLC-IE) is to provide a means for additional end-to-end compatibility checking by an addressed entity (e.g. a remote user, an interworking unit or a high layer function network node). The LLC/HLC-IE may be manipulated by the PLMN to maintain consistency with the setup parameter negotiation between the mobile station and the network (ref. to 3GPP TS 29.007). The LLC/HLC-IE is transferred transparently by the ISDN between the call originating PLMN and the addressed entity.

With respect to the individual parameter settings at the MS the following cases may be distinguished (ref. 3GPP TS 27.002 and 3GPP TS 27.003):

- Mobile-originated call set up by a MS consisting of a MT with R interface:
  - The setting results from respective MMI actions and/or MT internal settings.
- Mobile-originated call set up by a MS consisting of a MT with S interface:
  - The LLC/HLC-IEs which are contained in the ISDN SETUP message received from the terminal are passed unchanged to the MSC.
- Mobile-terminated call set up to a MS consisting of a MT with R interface:
  - The LLC/HLC related part of the compatibility check is carried out according to the knowledge of the MT concerning its implemented functions (i.e. answering the call). The offered field values determine the selection of the terminal function for the intended connection.
- Mobile-terminated call set up to a MS consisting of a MT with S interface:
  - The LLC/HLC received from the MSC is passed to the terminal by the MT. The LLC/HLC related part of the compatibility check is up to the terminal connected to the S interface of the MT, as is the selection of the terminal function (i.e. answering the call).

Where applicable, the same settings and rules concerning LLC and/or HLC apply as for ISDN use (ref. ITU-T Recommendation Q.931 and ETR 018). However, considering that PLMN data transmission is based on ITU-T V.110 rate adaptation, the MS shall provide the LLC-IE for mobile-originated calls when using unrestricted or restricted digital information transfer capability. This is to assure the conveyance of the e.g. "ITU-T V.110" indication towards the called entity, as the comparable indication in the ISDN BC-IE may be lost. It shall also be possible to choose whether or not the LLC-IE is provided for the case of an information transfer capability "3,1 kHz audio ex PLMN".

There shall be no contradiction of the information between the BC-IE and LLC-IE at the originating side. However, as some parts of the bearer capability may be modified during the transport of the call, there should be minimum duplication of this information between the BC-IE and the LLC-IE.

If as a result of duplication, a contradiction occurs between the BC-IE and the LLC-IE at the terminating side, the receiving entity shall ignore the conflicting information in the LLC-IE.

B.2.1.2 Interpretation of the Tables

The individual contents of the LLC/HLC-IE are represented in the following tables. The indication of the applicable service group defines the link between the PLMN BC-IE and its associated LLC/HLC-IEs.

If the appropriate message includes multiple BC-IEs and if LLC and/or HLC information is available, multiple LLCs and HLCs shall be included in the message. The LLC/HLC associated with the BC-IE indicating speech shall be marked as "not applicable" (3GPP TS 24.008).

Legend:	{ xxxx | yyyy }	choice of values
	----	not relevant for this service (set to appropriate value)
	[zzzz]	optional

B.2.2 LLC Bearer Service 20

B.2.2.1 Unrestricted / restricted digital information transfer capability

Low layer compatibility information element:

Octet	Information element field	field value
3	Coding standard Information transfer capability	ITU-T { unrestricted digital | restricted digital }
4	Transfer mode Information transfer rate	circuit mode 64 kbit/s
5	User information layer 1 protocol	{ V.110/X.30 | V.120 }
5a	Synchronous / asynchronous Negotiation User rate	asynchronous in-band not possible { 0.3 | 1.2 | 2.4 | 4.8 | 9.6 | 14.4 | 19.2 | 28.8 | 38.4 | 48 | 56 } kbit/s
5b 2)	Intermediate rate NIC on Tx NIC on Rx Flow control on Tx Flow control on Rx	{ 8 | 16 } kbit/s ----- ----- { not required 1)| required } { not accepted 1)| accepted }
5b 3)	Rate adaption header / no header Multiple frame establishment support Mode of operation Assignor / assignee In-band / out-band negotiation	Rate adaption header included Multiple frame establishment supported Protocol sensitive mode of operation ----- -----
5c	Number of stop bits Number of data bits Parity	{ 1 | 2 } bits { 7 | 8 } bits { odd | even | none | forced to 0 | forced to 1 }
5d	Duplex mode Modem type	á[duplex] -----

1) only these values are applicable to Mobile Originated Calls.
2) octet 5b for V.110/X.30.
3) octet 5b for V.120.

B.2.2.2 3,1 kHz audio ex-PLMN information transfer capability

Low layer compatibility information element:

Octet	Information element field	field value
3	Coding standard Information transfer capability	ITU-T 3.1kHz audio
4	Transfer mode Information transfer rate	circuit mode 64 kbit/s
5	User information layer 1 protocol	{G.711 A-law | G.711 u-law (PCS-1900)}
5a	Synchronous / asynchronous Negotiation User rate	(may be set depending on user's requirement)
5b	Intermediate rate NIC on Tx NIC on Rx Flow control on Tx Flow control on Rx	not relevant but cannot be omitted in order to have octet 5d
5c	Number of stop bits Number of data bits Parity	(may be set depending on the user's requirement)
5d	Duplex mode Modem type	[duplex] [{V.21|V.22|V.22bis| V.26ter|V.32|V.34}]

NOTE: If octet 5d is not specified, the whole LLC is not required.

B.2.3 LLC Bearer Service 30

B.2.3.1 Unrestricted / restricted digital information transfer capability

Low layer compatibility information element:

Octet	Information element field	field value
3	Coding standard Information transfer capability	ITU-T { digital unrestricted | restricted digital }
4	Transfer mode Information transfer rate	circuit mode 64 kbit/s
5	User information layer 1 protocol	{ V.110/X.30 | X.31 flag stuffing | V.120 | H.223 and H.245 }
5a	Synchronous / asynchronous Negotiation User rate	synchronous in-band not possible { 0.3 | 1.2 | 2.4 | 4.8 | 9.6 | 1.2/0.075 | 14.4 | 19.2 | 28.8 | 32.0 | 38.4 | 48 | 56 } kbit/s
5b 2)	Intermediate rate NIC on Tx NIC on Rx Flow control on Tx Flow control on Rx	{ 8 | 16 } kbit/s { not required | required } { not accepted | accepted } ----- -----
5b 3)	Rate adaption header / no header Multiple frame establishment support Mode of operation Assignor / assignee In-band / out-band negotiation	Rate adaption header included Multiple frame establishment supported Protocol sensitive mode of operation ----- -----
5c 1)	Number of stop bits Number of data bits Parity	not relevant but cannot be omitted in order to have octet 5d
5d 1)	Duplex mode Modem type	[duplex] -----

1) If octet 5d is not specified, octet 5c may be omitted.
2) octet 5b for V.110/X.30.
3) octet 5b for V.120.

B.2.3.2 3,1 kHz audio ex-PLMN information transfer capability

Low layer compatibility information element:

Octet	Information element field	field value
3	Coding standard Information transfer capability	ITU-T 3.1kHz audio
4	Transfer mode Information transfer rate	circuit mode 64 kbit/s
5	User information layer 1 protocol	{G.711 A-law | G.711 u-law (PCS-1900)}
5a	Synchronous / asynchronous Negotiation User rate	(may be set depending on the user's requirement)
5b	Intermediate rate NIC on Tx NIC on Rx Flow control on Tx Flow control on Rx	not relevant but cannot be omitted in order to have octet 5d
5c	Number of stop bits Number of data bits Parity	(may be set depending on the user's requirement)
5d	Duplex mode Modem type	[duplex] [{ V.22 | V.22bis | V.26ter | V.32 | V.34 }]

NOTE: If octet 5d is not specified, octets 5a..5d may be omitted.

B.2.4 LLC Bearer Services 41 ... 46

Void.

B.2.5 LLC Bearer Services 51 ... 53

Void.

B.2.6 LLC Bearer Service 61

Void.

B.2.7 LLC Bearer Service 81

Void.

B.2.8 HLC Teleservices 11 ... 12

High layer compatibility information element:

Octet	Information element field	Field value
3	Coding standard Interpretation Presentation method of protocol profile	ITU-T first high layer characteristic identification to be used in the call high layer protocol profile
4	High layer characteristics identific.	Telephony

B.2.9 HLC Teleservices 21 ... 23

Not applicable.

B.2.10 HLC Teleservice 61

High layer compatibility information element:

Octet	Information element field	Field value
3	Coding standard Interpretation Presentation method of protocol profile	ITU-T first high layer characteristic identification to be used in the call high layer protocol profile
4	High layer characteristics identific.	Facsimile G2/G3

B.2.11 HLC Teleservice 62

High layer compatibility information element:

Octet	Information element field	Field value
3	Coding standard Interpretation Presentation method of protocol profile	ITU-T first high layer characteristic identification to be used in the call high layer protocol profile
4	High layer characteristics identific.	Facsimile G2/G3

CR-Form-v5

CHANGE REQUEST

⌘	**27.002**	**CR**	**008**	⌘ **rev**	**2**	⌘	Current version:	**4.0.0** ⌘

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

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

Title:	⌘	Terminology clarifications as requested by TSG GERAN	
Source:	⌘	CN3	
Work item code:	⌘	TEI_5	***Date:*** ⌘ 2001-11-27
Category:	⌘	**D** *Use one of the following categories:* ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	***Release:*** ⌘ REL-5 *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:	⌘	To avoid possible confusion due to new terminology adopted in 3GPP in order to differentiate between networks, Radio Access Technologies (RAT) and modes of operation. In addition some other editorial changes e.g., in the reference section have been done.
Summary of change:	⌘	Editorial changes throughout the whole specification.
Consequences if not approved:	⌘	LS from TSG GERAN and decision by TSG CN not complied with.

Clauses affected:	⌘	All	
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments:	⌘		

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

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

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

3GPP TS 27.002 V5~~4~~.0.0 (2000-12~~09~~)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Core Network;
Terminal Adaptation Functions (TAF)
for services using asynchronous bearer capabilities
(Release 5~~4~~)

Keywords

~~UMTS~~UTRAN Iu mode, A/Gb mode, Iu mode
GSM, terminal, adaption

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Contents

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 re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document defines the interfaces and Terminal Adaptation Functions (TAF) integral to a Mobile Termination (MT) which enable the use of asynchronous bearer services in the PLMN and the attachment of asynchronous terminals to a MT (see 3GPP TS ~~44.002~~24.002 [3] and 3GPP TS 23.101 [6]).

The general aspects of Terminal Adaptation Functions are contained in 3GPP TS 27.001 [10].

The present document covers support of these services for the following interfaces and procedures:

(i) ITU-T V.14 [16] procedures.
(ii) ITU-T V.21 [17] DTE/DCE interface.
(iii) ITU-T V.22bis [18] DTE/DCE interface.
(iv) ITU-T V.32 [24] DTE/DCE procedures.
(v) ITU-T I.420 [14] S interface.
(vi) ITU-T V.250 [22] signalling procedures.

The asynchronous data rates between the MT and the IWF are defined in 3GPP TS 22.002 [5].

NOTE: From GSM R99 onwards the following services are no longer required in a ~~GSM~~ PLMN:

- the dual Bearer Services "alternate speech/data" and "speech followed by data";
- the dedicated services for PAD and Packet access;
- the BS 21 ... 26 and BS 31 ... 34.

The support of these services is still optional. The specification of these services is not within the scope of the present document. For that, the reader is referred to GSM Release 98.

NOTE: Please note that the Gb interface does not play any role in the scope of the present document although the term “A/Gb mode” is used~~.~~. GERAN Iu mode is for further study.

1.1 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 41.004: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".~~Void.

[2] 3GPP TS 43.010: "~~Digital cellular telecommunication system (Phase 2+);~~ GSM Public Land Mobile Network (PLMN)-connection types".

[3] 3GPP TS ~~44~~24.002: "~~Digital cellular telecommunication system (Phase 2+);~~ GSM-UMTS Public Land Mobile Network (PLMN) access reference configuration".

[4] 3GPP TS 44.021: "~~Digital cellular telecommunication system (Phase 2+);~~ Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[5] 3GPP TS 22.002: "Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)".

[6] 3GPP TS 23.101: "General UMTS Architecture".

[7] 3GPP TR 23.910: "Circuit Switched Data Bearer Services".

[8] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols-Stage 3".

[9] 3GPP TS 24.022: "Radio Link Protocol (RLP) for Circuit Switched Bearer and Teleservices".

[10] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[11] 3GPP TS 27.007: "AT command set for 3G User Equipment (UE)".

[12] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications"~~"3G Vocabulary".~~

[13] 3GPP TS 29.007: "General requirements on Interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[14] ITU-T Recommendation I.420 (1998):"Basic user-network interface".

[15] ITU-T Recommendation V.4 (1988): "General structure of signals of international alphabet No.5 code for character oriented data transmission over public telephone networks".

[16] ITU-T Recommendation V.14 (1993): "Transmission of start-stop characters over synchronous bearer channels".

[17] ITU-T Recommendation V.21 (1988): "300 bits per second duplex modem standardized for use in the general switched telephone network".

[18] ITU-T Recommendation V.22bis (1988): "2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[19] ITU-T Recommendation V.24 (1996): "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".

[20] ITU-T Recommendation V.25 (1996): "Automatic answering equipment and general procedures for automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls".

[21] Void.

[22] ITU-T Recommendation V.250: "Serial asynchronous automatic dialling and control".

[23] ITU-T Recommendation V.28 (1993): "Electrical characteristics for unbalanced double-current interchange circuits".

[24] ITU-T Recommendation V.32 (1993): "A family of 2-wire, duplex modems operating at data signalling rates of up to 9600 bit/s for use in the general switched telephone network and on leased telephone-type circuits".

[25] ITU-T Recommendation V.42 (1996): "Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion".

[26] ITU-T Recommendation V.42 bis (1990): "Data compression procedures for data circuit-terminating equipment (DCE) using error correction procedures".

[27] ITU-T Recommendation V.110 (1996): "Support of data terminal equipments with V-Series interfaces by an integrated services digital network".

[28] ITU-T Recommendation X.28 (1997): "DTE/DCE interface for a start-stop mode Data Terminal Equipment accessing the Packet Assembly/Disassembly facility (PAD) in a public data network situated in the same country".

[29] Personal Computer Memory Card Association: "PCMCIA 2.1 or PC-Card 3.0 electrical specification or later revisions".

[30] Infrared Data Association IrDA "IrPHY Physical layer signalling standard".

[31] ISO 2110: "Data communication - 25-pole DTE/DCE interface connector and contact number assignments".

[32] ITU-T Recommendation Q.931: "ISDN user-network interface layer 3 specification for basic call control".

1.2 Abbreviations

In addition to the abbreviations used in the present document that are listed in ~~either 3GPP TS 41.004 [1] or~~ TR 21.905 [12] the following internal abbreviations are used:

~~ITU~~	~~International Telecommunications Union~~
CFI	Call Failure Indication
CRN	Call Request with Number
DIC	Disregard Incoming Call
IA5	International Alphabet no. 5
INC	INcoming Call
INV	INValid
ITU-T	ITU-Telecommunication Standardization Sector
VAL	VALid
~~XID~~	~~Exchange IDentification (frame)~~

1.3 Definitions

The term 'mobile station' (MS) in the present document is synonymous with the term 'user equipment' (UE) ~~in 3G terminology~~ as defined in 3GPP TR 21.905 [12].

The term 'TE2' in the present document is synonymous with the term 'TE' ~~in 3G terminology~~ as defined in 3GPP TR 21.905 [12].

The term 'MT2' in the present document is synonymous with the term 'MT' ~~in 3G terminology~~ as defined in 3GPP TR 21.905 [12].

In addition to the definitions used in the present document that are listed in TR 21.905 [12] the following internal definitions are used:

A/Gb mode: indicates that the text applies only to a system or sub-system which operate in A/Gb mode of operation, i.e. with a functional division that is in accordance with the use of an A or a Gb interface between the radio access network and the core network

Iu mode: indicates that the text applies only to a system or a sub-system which operates in Iu mode of operation, i.e. with a functional division that is in accordance with the use of an Iu-CS or Iu-PS interface between the radio access network and the core network

2 Reference Configuration

3GPP TS 27.001 [10], 3GPP TS 23.101 [6] and 3GPP TS ~~44~~24.002 [3] describe the basic reference configurations.

2.1 Customer Access Configuration

This configuration is as shown in figure 1 of 3GPP TS ~~44~~24.002 [3]. The present document specifically refers to the Mobile Terminations (MTs) which support terminals of the type TE1 and TE2 with asynchronous capabilities. The TAF is functionally a part of an MT1, MT2 or MT0 with an integral asynchronous data capability.

2.2 Terminal Adaptation Function (TAF)

The TAF provides facilities to allow manual or automatic call control functions associated with circuit switched services. The following functions are also included:

- Conversion of electrical, mechanical, functional and procedural characteristics of the ITU-T V series and ISDN type interfaces to those required by the PLMN.
- Bit rate adaptation of the ITU-T V series data signalling rates and the ISDN 64 kbit/s to that provided in the PLMN.
- The mapping functions necessary to convert automatic calling and/or automatic answering procedures of the ITU-T recommendation V.250 [22] and parameters for asynchronous operation.
- The mapping functions necessary to convert S interface signalling to the PLMN Dm channel signalling.
- Flow control (in some cases resulting in non-transparency of data as described in 4.3).
- Layer 2 Relaying (see annex A).
- In-call modification function.
- Synchronization procedure, which means the task of synchronizing the entry to and the exit from the data transfer phase between two user terminals. This is described in 3GPP TS 27.001 [10].
- Filtering of channel control information as described in 3GPP TS 27.001 [10].
- Terminal compatibility checking.
- Splitting and combining of the data flow in case of multiple substream data configurations.

3 Terminal Adaptation Functions for transparent services

3GPP TS 43.010 [2] defines connection types for the support of transparent services in ~~GSM~~ A/Gb mode whilst 3GPP TR 23.910 [7] defines connection types for transparent services in UTRAN Iu mode~~UMTS~~.

3.1 Rate Adaptation in A/Gb mode~~GSM~~

3GPP TS 44.021 [4] describes the rate adaptation scheme to be utilized over the Base Station (BS) to Mobile Station (MS) link. 3GPP TS 43.010 [2] refers to the rate adaptation elements to be provided in the MS.

3.1.1 Rate Adaptation - R interface

This is provided as indicated in 3GPP TS 44.021 [4].

3.1.2 Rate Adaptation - S Interface (ITU-T I.420 [14])

VOID

3.2 Interchange Circuit Signalling Mapping - ITU-T V-series interface

The interchange circuit signalling at the interface between the TE2 and the MT shall conform to ITU-T Recommendation V.24 [19]. The signals required at this interface are shown in table 3.

The mapping of these signals to the pins of a 25 pin D-type connector is given in ISO 2110 [31]. The mapping for a commonly used 9 pin connector is given in annex B.

3.2.1 Mapping of V.24 [19] circuits to status bits

Status bits SA, SB and X are used to convey channel control information associated with the data bits in the data transfer state. Table 1 shows the mapping scheme between the ITU-T V.24 [19] circuit numbers and the status bits for the transparent mode. It also shows how the unused status bits should be handled. It is derived from the general mapping scheme described in annex C. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition.

The transport of these status bits by the various channel codings is described in subsequent sections.

Table 1: Mapping scheme at the MT for the transparent mode

Signal at TE2/MT interface or condition within the MT	Mapping direction: MT to IWF	Mapping direction: IWF to MT
CT 105	not mapped (note 1)	
CT 106		from status bit X (note 7)
CT 107		not mapped (note 5)
CT 108/2	not mapped (note 6)	
CT 109		from status bit SB (note 7)
CT 133	not mapped (note 2)	
always ON	to status bit SA (note 3)	
always ON	to status bit SB (note 1)	
always ON	to status bit X (note 4)	
ignored by MT		from status bit SA (note 3)
NOTE 1: The SB bit towards the IWF, according to the General Mapping (annex C), could be used to carry CT 105. However, CT 105 should always be ON in the data transfer state since only duplex operation is supported. Also, many DTEs use the connector pin assigned to CT 105 for CT 133. No interchange circuit shall be mapped to the SB bit, which shall always be set to ON in the data transfer state. NOTE 2: CT 133 is not mapped since there is no flow control in transparent mode. NOTE 3: The SA bits in both directions are available only with certain channel codings. Therefore, for maximum compatibility, they should not be mapped. NOTE 4: The X bit towards the IWF is not mapped and shall always be set to ON in the data transfer state since there is no flow control in transparent mode. NOTE 5: CT 107 is controlled by the channel synchronisation process (07.01). NOTE 6: CT 108/2 may be used in the call setup and answering processes. NOTE 7: The status bits are filtered before being mapped to the ITU-T V.24 [19] circuits (3GPP TS 27.001 [10]).		

3.2.2 Single slot configurations (TCH/F9.6 or TCH/F4.8)

3GPP TS 44.021 [4] refers to the frame structure and identifies the use of the status bits for the carriage of signalling information in transparent mode. The S bits are put into two groups. SA is carried by bits S1, S3, S6, S8 and SB by bits S4, S9 in the ITU-T Recommendation V.110 [27] 80-bit intermediate rate frame.

3.2.3 Multislot configurations (TCH/F9.6 or TCH/F4.8)

In transparent multislot configurations, status bits S1, S3 and the X-bit between the D12 and D13 - in the ITU-T Recommendation V.110 [27] 80-bit intermediate rate frame - are used for transferring substream numbering information. The S4-bit is used for frame synchronization between the parallel substreams (reference 3GPP TS 44.021 [4]). The remaining S bits are put into two groups. SA is carried by bits S6, S8 and SB by bit S9. The remaining X bits can be used as described in subclause 3.2.1.

3.2.4 Channel codings TCH/F14.4, TCH/F28.8

For information on the mapping of the interchange circuit signalling bits in the 14,5 kbit/s multiframe structure, refer to 3GPP TS 44.021 [4]. There is no SA bit in this channel coding. Only the SB and X bits are carried.

3.3 Interface Signal Levels - R interface

The signal levels at the interface between the TE2 and the MT shall conform to ITU-T V.28 [23], or to IrDA IrPHY physical signalling standard specification [30], or to PCMCIA 2.1 [29], or to PC-Card 3.0 [29] electrical specification or to later revisions.

3.4 Call Establishment and Clearing Signalling Mapping

3.4.1 V-series interface Autocalling/answering

- These procedures are provided according to ITU-T Recommendation V.250 [22] and 3GPP TS 27.007 [11].
- For autocalling, during the call establishment phase, i.e. after signalling, calling tone according to ITU-T Recommendation V.25 [20] shall be generated in the IWF (3GPP TS 29.007 [13]).

During the call establishment phase:

- the states of the ITU-T Recommendation V.24 [19] interchange circuits shall be according to 3GPP TS 27.001 [10];
- the data and status bits from the IWF shall not be mapped;
- the data and status bits towards the IWF shall be according to 3GPP TS 27.001 [10].

3.4.2 S Interface (I.420) Signalling Mapping

Void.

3.4.3 Call Establishment Manual Operation - Utilizing the Unrestricted Digital Capability

In this case the user shall not hear network supervisory tones or answer tone. The data transfer phase shall be entered automatically.

3.4.4 V-series interface Call Clearing

This procedure is provided according to ITU-T Recommendation V.250 [22] and 3GPP TS 27.007 [11].

During the call clearing phase:

- the states of the ITU-T Recommendation V.24 [19] interchange circuits shall be according to ITU-T Recommendation V.24 [19];
- the data and status bits from the IWF shall not be mapped or used by the MT in any way;
- the data and status bits towards the IWF have no significance and may be set to 1 and OFF respectively.

4 Terminal Adaptation Functions for non-transparent services

3GPP TS 43.010 [2] defines connection types for the support of non-transparent services in ~~GSM~~ A/Gb mode whilst 3GPP TR 23.910 [7] defines connection types for non-transparent services in ~~UMTS.~~UTRAN Iu mode.

4.1 Data Structure

4.1.1 Data Structure on S Interface

Void.

4.1.2 Data Structure on R Interface

The protocol models for this are described in 3GPP TS 43.010 [2]. The data consists of 7 or 8 bit characters with additional start and stop elements. The 7 bit data can additionally have an associated parity bit, 8 bit data cannot have an additional parity bit.

The interchange circuit signalling at the interface between the TE2 and the MT shall conform to ITU-T Recommendation V.24 [19]. The signals required at this interface are shown in table 3.

The interface shall provide inband (XON/XOFF) and out of band (CT106) flow control. The use of CT133 for out of band flow control shall be implemented according to ITU-T Recommendation V.42 [25].

4.1.3 Data Structure Provided by the L2R Function to the RLP Function

See annex A.

4.2 Signalling Mapping

4.2.1 Interchange Circuit Signalling Mapping - ITU-T V-series interface

Status bits SA, SB and X are used to convey channel control information associated with the data bits in the data transfer state. Table 2 shows the mapping scheme between the ITU-T Recommendation V.24 [19] circuit numbers and the status bits for the non-transparent mode. It also shows how the unused status bits should be handled. It is derived from the general mapping scheme described in annex C. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition.

The transport of the status bits by the L2RCOP is described in annex A.

Table 2: Mapping scheme at the MT for the non-transparent mode

Signal at TE2/MT interface or condition within the MT	Mapping direction: MT to IWF	Mapping direction: IWF to MT
CT 105	not mapped (note 1)	
CT 106 (note 4)		from status bit X (note 7)
CT 107		not mapped (note 5)
CT 108/2	not mapped (note 6)	
CT 109		from status bit SB
CT 133 (note 8)	to status bit X (notes 3,8)	
always ON	to status bit SA (note 2)	
always ON	to status bit SB (note 1)	
ignored by MT		from status bit SA (note 2)

NOTE 1: The SB bit towards the IWF, according to the General Mapping (annex C), could be used to carry CT 105. However, CT 105 should always be ON in the data transfer state since only duplex operation is supported. Also, many DTEs use the connector pin assigned to CT 105 for CT 133. No interchange circuit shall be mapped to the SB bit which shall always be set to ON in the data transfer state.
NOTE 2: The SA bits (both directions) are not mapped since CTs 107 and 108/2 are handled locally (notes 5 and 6).
NOTE 3: The condition of status bit X towards the IWF may also be affected by the state of the receive buffer in the MT.
NOTE 4: The state of CT 106 (or other local flow control mechanism) may also be affected by the state of the transmit buffer in the MT and the state of the RLP (RR/RNR).
NOTE 5: CT 107 is controlled by the channel synchronisation process (3GPP TS 27.001 [10]).
NOTE 6: CT 108/2 may be used in the call setup and answering processes.
NOTE 7: For inband local flow control, changes in the condition of the status bit X from the IWF also result in the sending of XON or XOFF to the DTE.
NOTE 8: For inband local flow control, CT 133 is not mapped and the status bit X towards the IWF is controlled by the reception of XON and XOFF characters from the DTE.

4.2.2 Call Establishment and Clearing Signalling Mapping

This is identical to the transparent case with the exception of the transparent/non-transparent element, see clause 5.

In addition, the L2R/RLP shall give an explicit indication when the link into the connected network is established. If the link fails, an explicit "link lost" indication shall be given.

4.3 Flow Control

The passage of flow control information between L2Rs is described in annex A. subclauses 4.3.1, 4.3.2 and 4.3.3 describe the operation of the flow control mechanisms. These mechanisms apply for all the non-transparent services covered by the present document, with the exception of Character Orientated Protocol with No Flow Control which is treated in subclause 4.3.4.

4.3.1 Conditions Requiring Flow Control towards the Network

The L2R function shall send immediately a "flow control active" indication in the following circumstances:

(i) If the receive buffer from the radio side reaches a preset threshold (BACKPRESSURE).

(ii) If local flow control is initiated by the TE2 (see 4.3.3 a) or c)). On receipt of this flow control indication transmission of data from the receive buffer towards the TE2 is halted.

On removal of the buffer congestion or local flow control the L2R shall send a "flow control inactive" indication.

In addition, for the local flow control condition, transmission of data from the receive buffers shall be restarted.

4.3.2 Conditions Requiring Flow Control towards TE2

The L2R functions shall immediately activate local flow control (see 4.3.3 b) or d)) under the following circumstances:

(i) The transmit buffer reaches a pre-set threshold (BACKPRESSURE).

(ii) The L2R receives a "flow control active" indication.

On removal of buffer congestion or receipt of L2R/RLP "flow control inactive" the local flow control shall be removed.

4.3.3 Local Flow Control

Two methods of local flow control are allowed:

Outband:

a) From TE2: CT133 shall be turned OFF to indicate flow control active, and ON to indicate flow control inactive.

b) From TAF: CT106 shall be turned OFF to indicate flow control active, and ON to indicate flow control inactive.

Inband:

c) From TE2: XOFF (DC3) is sent to indicate flow control active. XON (DC1) is sent to indicate flow control inactive. The XON/XOFF characters received from the TE2 are extracted by the L2R from the data stream and are not sent across the radio interface. Where XON/XOFF is utilized then the TAF shall generate flow control active/inactive immediately, i.e. the XON/XOFF characters do not enter the transmit buffer.

d) From TAF: As from TE2.

If the outband method is used, the L2R shall pass the DC1/DC3 characters as data, i.e. no flow control indications shall be generated on receipt of DC1/DC3.

4.3.4 Character Orientated Protocol with No Flow Control

If the users layer 2 indicates Character Orientated Protocol with no flow control then no flow control is used, i.e. the X-bit is not set to OFF and DC1/DC3 characters are passed through as data.

4.4 Buffers

4.4.1 TX Buffers

Data received on CT103 from the TE2 shall be buffered such that if the MT is unable to transfer the data over the radio path then data is not lost.

The buffer shall be capable of holding the data. Its size is up to the implementers.

When the buffer is half full, TE2 shall be flow controlled as per 4.3.2, unless Character Orientated Protocol with No Flow Control is being used (see 4.3.4).

4.4.2 RX Buffers

Data for transfer to the TE2 on CT104 shall be buffered such that if the TE2 is unable to accept data then data transferred from the MT is not lost.

The buffer size should be up to the implementers.

When the buffer becomes half full, the L2R shall send a "flow control active" indication, unless Character Orientated Protocol with No Flow Control is being used.

4.5 Bit Transparency

Void.

4.6 Transportation of "BREAK" condition

The "BREAK" condition must be recognized by the L2R function and passed immediately to the IWF. The L2R shall generate a "BREAK" condition to the TE2 on receipt of a "BREAK" indication from the IWF.

Annex A describes how the L2R shall transport the "BREAK" indication.

4.7 Data Compression

L2R optionally includes a data compression function according to ITU-T V.42bis [26] that spans from the MS to the IWF in the MSC. The error correction function is provided by RLP instead of ITU-T Recommendation V.42 [25]. RLP XID is used to negotiate compression parameters. L2R includes the ITU-T V.42bis [26] control function especially for reinitializing in case of break recognition or RLP reset and error indication by the data compression function respectively.

Table 3: Minimum set of Interchange Circuits

Circuit Number	Circuit Name	Ground	Data		Control	
			To TE2	From TE2	To TE2	From TE2
CT102	Common return	x				
CT103	Trans-mitted data			x		
CT104	Received data return		x			
CT105	Request to send (note 2)					x
CT106	Ready for sending				x	
CT107	Data set ready				x	
CT108/2	Data terminal ready					x
CT109	Data channel received line signal detector				x	
CT125	Calling indicator (note 1)				x	
CT133	Ready for Receiving (note 2)					x

NOTE 1: CT125 is used with the automatic answering function of the TAF.

NOTE 2: CT105 and CT133 are assigned to the same connector pin on both the standard 25 pin connector (ISO 2110) and the commonly used 9 pin connector (annex B). When this pin is used for CT133 then on the DCE (MT) side of the interface CT 105 is treated as being always in the ON condition. Similarly, when this pin is being used for CT105 then on the DCE (MT) side of the interface CT 133 is treated as being always in the ON condition. As circuit 133 is used only in duplex operation and circuit 105 is used only in half duplex operation (which is not supported by GSM or UMTS) there should be no conflict.

5 Terminal interfacing to 3GPP TS 24.008 [8] Mapping

Only those elements/messages that are of particular relevance are considered.

Interface procedures not directly mappable to 3GPP TS 24.008 [8] are not considered. Mobile management procedures of 3GPP TS 24.008 [8] are not considered applicable.

Mapping of other call establishment or clearing messages to the S interface e.g. "Call proceeding" etc. has not been included. It is assumed these can be mapped directly and as such are of no relevance to the manual interfaces.

For the Alternate speech/group 3 facsimile service the TAF shall be able to generate a "Modify" message according to the defined procedure in 3GPP TS 24.008 [8].

5.1 Mobile Originated Calls

Call establishment is initiated by the keypad or DTE action:

a) Setup

Element	Derived from
	MMI
Called Address	Keypad
Called Sub Address	Keypad
HLC	Derived from internal settings or MMI infor- mation.
LLC	Same as HLC
BC	Same as HLC 3GPP TS 27.001 [10] gives allowed values

b) Release Complete

Element	Derived from
	MMI
Cause	Display (optional)

5.2 Mobile Terminated Calls

Call establishment is initiated by receipt of Setup at the MS:

a) Setup

Element	Mapped on to
	MMI
Called Address	Display (optional)
Called Sub Address	Display (optional)
HLC	Display (optional)
LLC	Display (optional)
BC	Display (optional)

b) Call Confirm

Information for the BC element in the call confirm shall be derived from e.g. MMI or by internal settings.

c) Connect

Connect is sent in response to connect from MMI.

5.3 Call Clearing

5.3.1 Mobile initiated

Call clearing is initiated by the keypad or DTE action:

Disconnect

Element	Derived from	
	MMI	ITU-T V.250 [22]
Cause	Keypad	See section 3.4.4

5.3.2 Network initiated

Call clearing is initiated by receipt of Disconnect at the MS:

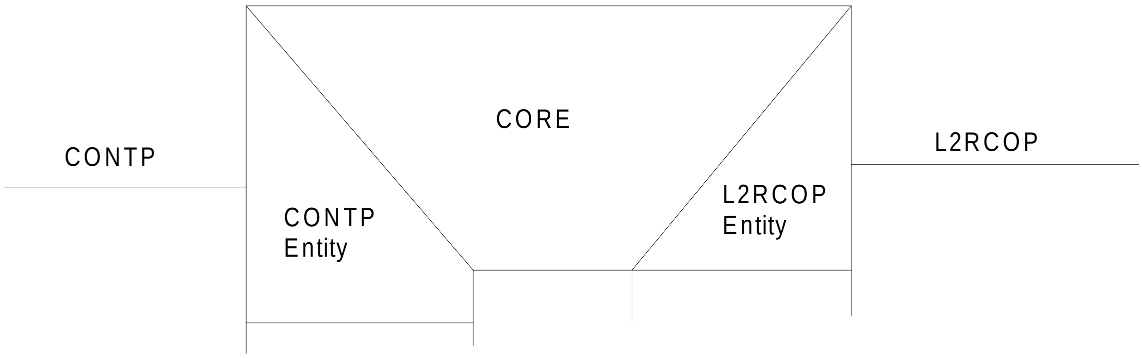
Disconnect

Element	Mapped on to	
	MMI	ITU-T V.250 [22]
Cause	Display (optional)	Unsolicited result codes

Annex A (normative): L2R Functionality

A.1 Introduction

This annex describes the L2R functionality for non-transparent character oriented protocols. The general aspects of L2Rs are described in 3GPP TS 27.001 [10]. Figure 1 shows the 3 sub-functions of a character oriented L2R.



CONTP	Character Oriented Non-Transparent Protocol.
CORE	Character Oriented Relay Entity.
L2RCOP	L2R Character Oriented Protocol.

Figure 1

Section 2 describes the L2R Character Oriented Protocol (L2RCOP) and section 3 the use of the L2RCOP.

A.2 The L2RCOP

Information is transferred between L2Rs in fixed length n octet Protocol Data Units (PDUs). This corresponds to the fixed length of the RLP frame information field. The octets within the L2RCOP-PDU are numbered 0 to n-1; octet 0 is transmitted first. The value of n depends on the negotiated RLP version and frame type (3GPP TS 24.022[9]). The bits within the octets are numbered 1 to 8; bit 1 is transmitted first.

The RLP version value 2 indicates RLP multi-link operation. The RLP version value 0 or 1 indicates RLP single-link operation.

- Each octet contains a status octet, an information octet or fill.

  Octet 0 contains either a status octet or a user information octet.

- Octet 0 shall always contain a status octet in case at least one status octet is transported in the L2RCOP PDU. In RLP-versions 0 and 1 a PDU always carries at least one status octet. In RLP version 2 a PDU carries status octet(s) only if actual status change(s) has taken place within the period represented by the PDU. Here the L2R status flag in the RLP version 2 header is set to 1 when status octet(s) is carried in the PDU.

- Status octets contain 3 status bits and 5 address bits. In cases where two status octets within the PDU are separated by more than 23 octets, the first status octet in octet m is followed by a pointer octet in octet m+1 forming a two-octet status field. The pointer octet contains one reserved bit and seven address bits indicating the number of characters between the status field and the second status octet.

- The 3 status bits correspond to SA, SB and X in ITU-T Recommendation V.110 [27]. The SA, SB and X bits use bit positions 8, 7 and 6 in the status octets. When a status bit changes the current state of all three bits shall be transmitted.

- Information octets are character octets or encoded character octets.

- Character octets are coded in the following way:

    - The first bit of the character received/transmitted corresponds to bit position 1 in the octet and the seventh bit corresponds to bit 7. For order of transmission of IA5 characters see ITU-T Recommendation V.4 [15].
    - 7 bit characters are padded with a 0 in bit position 8. Received parity (if used) is inserted in bit position 8, if parity is not used bit 8 is set to 0.
    - Any start/stop bits are removed by the L2R.
- Encoded character octets are provided by the compression function. They are encoded according to ITU-T Recommendation V.42bis [26].
- Information octets are inserted into L2RCOP-PDUs in order of transmission in octets 1 to n-1 for RLP single-link operation, in octets 1 to n-1 for RLP multi-link operation with status octet transportation, and in octets 0 to n-1 for multi-link operation with no status octet transportation.
- The address field in the status octets indicates the position of next status octet within the L2RCOP-PDU. This indicates the number of characters between status octets. Thus if two status octets are inserted into L2RCOP-PDU at offsets l and m the address value shall be defined by m-l-1. Address bit 2^0 corresponds to bit 1 in the status octets. Address bit 2^1 to bit 2 etc.
- Status octets are inserted in the character stream whenever a status change needs to be transmitted.
- Only address values 1 to n-2 (n-2 ≤ 23) in the address field of status octets are used for addressing purposes. The implication of not allowing address value 0 to be used for addressing is that two status octets cannot be sent after each other. The remaining codes are used to indicate:
    - Last status change, remainder of L2RCOP-PDU empty. Address field value 31.
    - Last status change, remainder of L2RCOP-PDU full of characters. Address field value 30.
    - Destructive break signal, remainder of L2RCOP-PDU empty. Address field value 29.
    - Destructive break acknowledge, remainder of L2RCOP-PDU empty. Address field value 28.
        - L2RCOP-PDU contains at least two status octets which are separated by more than 23 characters; the address-field value in the first octet of the two-octet status field is 27 and the address bits in the pointer octet of the status field indicate the number of characters between the two-octet status field and the next status octet.
    - Address field values from n-1 to 26 are reserved. In case of a PDU more than 25 octets in length, address field values from 24 to 26 are reserved.
- When it is necessary to insert a status octet into the character stream when no status change has occurred, e.g. to indicate that the reminder of a L2RCOP-PDU is empty or to indicate a break signal, the current status shall be repeated.
- In case when 64 data octets are carried by a 66-octet PDU, a status octet is carried in octet 0 and another status octet within the first 24 data octets. (The first status octet gives the address of the second status octet, which carries value 30 in its address field).

Three example*s* of an L2RCOP PDU are shown in figure 2.

	8	7	6	5	4	3	2	1	
0	SA	SB	x	0	0	0	1	1	
1	1	1	0	0	0	1	1	1	IA5 "G" (odd parity)
2	1	1	0	1	0	0	1	1	IA5 "S" (odd parity)
3	1	1	0	0	1	1	0	1	IA5 "M" (odd parity)
4	SA	SB	x	1	1	1	1	1	(last status change, rest of PDU empty)
. . .									
n-1									

Figure 2a: Single-link RLP and multi-link RLP with status octet transfer in PDU

	8	7	6	5	4	3	2	1	
0	1	1	0	1	0	0	1	1	IA5 "S" (odd parity)
1	1	1	0	0	0	1	1	1	IA5 "G" (odd parity)
2	1	1	0	1	0	0	1	1	IA5 "S" (odd parity)
3	1	1	0	0	1	1	0	1	IA5 "M" (odd parity)
4									
. . .									
n-1	1	1	0	0	1	1	0	1	IA5 "M" (odd parity)

Figure 2b: Multi-link RLP L2RCOP PDU with no status octet transfer

	8	7	6	5	4	3	2	1	
0	SA	SB	X	0	0	0	1	1	
1	1	1	0	0	1	1	0	1	IA5 "M" (odd parity)
2	1	1	0	0	0	0	0	1	IA5 "A" (odd parity)
3	1	1	0	1	0	0	1	0	IA5 "R" (odd parity)
4	SA	SB	X	1	1	0	1	1	
5	R	0	1	0	0	0	1	1	
.				. .					
41	SA	SB	X	0	0	0	0	1	
42	1	1	0	0	1	1	0	1	IA5 "K" (odd parity)
43	SA	SB	X	1	1	1	1	0	
. .				. .					
65	1	1	0	0	1	1	1	1	IA5 "O" (odd parity)

Figure 2c: A 66-octet RLP L2RCOP PDU with status octets separated by more than 23 octets

A.3 Use of the L2RCOP

The CORE relays status changes, break conditions and characters in both directions between the CONTP entity and the L2RCOP entity.

The L2RCOP entity performs the following functions.

A.3.1 Radio Link Connection Control

Given appropriate indications from the signalling mechanisms the L2RCOP entity uses the services of the radio link to establish and release the connection to its peer L2RCOP entity in the IWF.

A.3.2 Data Transfer

The L2RCOP entity shall assemble and disassemble L2RCOP-PDUs. Data characters are assembled into L2RCOP-PDUs until either:

- the PDU is full;
- the Radio Link service can accept another Radio Link service Data Unit.

L2RCOP-PDUs are transferred to the peer L2RCOP entity using the data transfer services of the radio link.

A.3.3 Status Transfer

The L2RCOP entity transfers interface status information between L2Rs using bits SA, SB and X in the status octets in L2RCOP-PDUs. Status changes are inserted in the L2RCOP-PDU in the position corresponding to the position in the character stream that the interface status change occurred. When the RLP is established or reset a L2RCOP-PDU with the current status values shall be sent.

The general mapping between ITU-T V.24 [19] interface circuit numbers and status bits is described in annex C. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition. The specific mapping at the MT for the non-transparent bearer service is given in subclause 4.2.1. The mapping schemes used at the IWF are given in 3GPP TS 29.007 [13].

A.3.4 Flow Control

Flow control information is transferred between L2Rs in 2 ways, these are:

- back pressure caused by L2R buffer conditions.
- use of the X-bit in status octets:
    - flow control active, X-bit = ONE.
    - flow control inactive, X-bit = ZERO.

A.3.5 Break

The transfer of break conditions between L2Rs is via the status octets with appropriate coding of the address field. Where the "Break Signal" is generated it shall conform to the definition shown in ITU-T Recommendation X.28 [28].

A.3.5.1 Normal Realization

The L2RCOP-PDU contains the mandatory status octet coded as the Destructive Break.

Upon the receipt of the "Break Signal", the L2R shall destroy any existing data in front of the Break Signal in the same direction, and all the buffered data in the other direction. The L2R shall then pass the Break Signal immediately on.

The termination of a break condition is indicated by sending an L2RCOP-PDU containing characters.

A.3.5.2 Realization in case of Data Compression is used

If the data compression function is used L2RCOP has to ensure the synchronization of the encoder and decoder according to ITU-T Recommendation V.42bis [26].

Upon receipt of a L2RCOP-PDU containing a status octet that signals a Destructive Break L2R destroys all data in the TX and RX buffer and re-initializes the compression function. Then L2R shall transmit an L2RCOP-PDU that contains the mandatory status octet coded as the Destructive Break Acknowledge. After that L2R shall restart the data transfer.

Upon an receipt of the "Break Signal" by the CONTP, the L2R destroys any existing data in the TX and RX buffer and shall then pass the Break Signal immediately by using L2RCOP-PDU containing a status octet coded as the Destructive Break. L2R shall wait for a L2RCOP-PDU containing a mandatory status octet coded as Destructive Break Acknowledge. Following data received by the CONTP shall be stored in the TX buffer. Data received in L2RCOP-PDUs shall be discarded. After reception of the L2RCOP-PDU containing a mandatory status octet coded as Destructive Break Acknowledge L2R shall re-initialize the data compression function and restart the data transfer.

Annex B (informative): Use of a 9 pin connector as an MT2 type interface

For asynchronous data communications many of the physical pins on a standard 25 pin D-type connector (ISO 2110 [31]) are not used. As a result many communication devices have only a 9 pin connector to allow them to be made smaller. This interface is a MT2 type providing the correct ITU-T Recommendation V.24 [19] signals are supported.

Table B1 gives the pin assignments for a 9 pin connector. Two variants are permitted:

1. Outband flow control

When outband (CT 133) flow control is required, pin number 7 carries CT 133 (Ready for Receiving). In this case CT 105 is not mapped to any physical pin. On the MT2 side of the interface, CT 105 is treated as being always in the ON condition.

2. No outband flow control

When no outband (CT 133) flow control is required, pin number 7 may carry CT 105 (Request to Send). In this case CT 133 is not mapped to any physical pin. On the MT2 side of the interface, CT 133 is treated as being always in the ON condition.

Table B1: Interchange circuit mappings

ITU-T V.24 [19] Circuit Number	Circuit Name	Pin Number
CT 102	Common ground	5
CT 103	TxD	3
CT 104	RxD	2
CT 105	RTS	7 (note)
CT 106	RFS (CTS)	8
CT 107	DSR	6
CT 108/2	DTR	4
CT 109	DCD	1
CT 125	CI	9
CT 133	RFR	7 (note)
NOTE: Only one of these mappings may exist at any one time.		

Annex C (informative): General mapping of ITU-T V.24 [19] circuits to channel status bits

In the data transfer state, status bits SA, SB and X can be used to convey channel control information associated with the data bits. Table C1 shows the general mapping scheme between the ITU-T V.24 [19] circuit numbers and the status bits. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition. The specific mappings for the various PLMN bearer types are given elsewhere in the present document.

Table C1: General mapping scheme at the MT

Signal at TE2/MT interface	Status bit direction: MT to IWF	Status bit direction: IWF to MT
CT 105 (note 3)	SB	
CT 106 (note 1)		X
CT 107		SA
CT 108/2	SA	
CT 109		SB
CT 133 (note 3)	X (note 2)	
NOTE 1: The condition of CT 106 may also be affected by the state of any transmit buffer in the MT. NOTE 2: The condition of Status bit X towards the IWF may also be affected by the state of any receive buffer in the MT. NOTE 3: CT105 and CT133 are assigned to the same connector pin on both the standard 25 pin connector (ISO 2110) and the commonly used 9 pin connector (annex B). When this pin is used for CT133 then on the MT side of the interface CT 105 is treated as being always in the ON condition. SB towards the IWF shall therefore also always be ON. Similarly, when this pin is being used for CT105 then on the MT side of the interface CT 133 is treated as being always in the ON condition. X towards the IWF shall therefore also always be ON. As circuit 133 is used only in duplex operation and circuit 105 is used only in half duplex operation (which is not supported by GSM or UMTS) there should be no conflict.		

3GPP TSG-CN WG3 Meeting #20 **Tdoc N3-010592**
Cancun, Mexico. 26th - 30th November 2001.

CR-Form-v5

CHANGE REQUEST

⌘ **27.003**	**CR 009**	⌘ **rev 2** ⌘	Current version:	**4.1.0** ⌘

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

Title:	⌘	Terminology clarifications as requested by TSG GERAN		
Source:	⌘	CN3		
Work item code:	⌘	TEI_5	***Date:*** ⌘	2001-11-27
Category:	⌘	**D**	***Release:*** ⌘	REL-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	To avoid possible confusion due to new terminology adopted in 3GPP in order to differentiate between networks, Radio Access Technologies (RAT) and modes of operation. In addition some other editorial changes e.g., in the reference section have been done.
Summary of change:	⌘	Editorial changes throughout the whole specification.
Consequences if not approved:	⌘	LS from TSG GERAN and decision by TSG CN not complied with.

Clauses affected:	⌘	All	
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments:	⌘		

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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.

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Annex A (normative):

3GPP TSG-CN WG3 Meeting #20 **_Tdoc N3-010593_**
Cancun, Mexico. 26th - 30th November 2001.

CR-Form-v5

CHANGE REQUEST

⌘ **23.910**	**CR 032**	⌘ **rev**	**1** ⌘	Current version:	**4.3.0** ⌘

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

Title: ⌘	Terminology clarifications as requested by TSG GERAN		
Source: ⌘	CN3		
Work item code: ⌘	TEI_5	***Date:*** ⌘	2001-11-27
Category: ⌘	**D**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	To avoid possible confusion due to new terminology adopted in 3GPP in order to differentiate between networks, Radio Access Technologies (RAT) and modes of operation. In addition some other editorial changes e.g., in the reference section have been done.
Summary of change: ⌘	Editorial changes throughout the whole specification.
Consequences if not approved: ⌘	LS from TSG GERAN and decision by TSG CN not complied with.

Clauses affected: ⌘	All	
Other specs affected: ⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments: ⌘		

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1 Scope

4.1 Limited set of ~~UMTS~~ UTRAN Iu mode PLMN connection models

CR-Form-v5

CHANGE REQUEST

⌘	**27.060**	**CR**	**016**	⌘ **rev**	**2**	⌘ Current version:	**4.0.0** ⌘

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

Title: ⌘	New terminology required by GERAN		
Source: ⌘	CN3		
Work item code: ⌘	TEI_5	***Date:*** ⌘	15.11.01
Category: ⌘	**D**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	New terminology required by GERAN
Summary of change: ⌘	Terms "A/Gb mode" and "Iu mode" are used instead of "GSM" and "UMTS"
Consequences if not approved: ⌘	Inconsistency with GERAN specs

Clauses affected: ⌘			
Other specs affected: ⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments: ⌘			

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3GPP TS 27.060 ~~V4~~V5.0.0 (2001-~~03~~12)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Core Network;
Packet Domain;
Mobile Station (MS) supporting Packet Switched Services
(Release ~~4~~5)

Keywords

3GPP, CN

3GPP

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Contents

Foreword

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

The present document defines the requirements for TE-MT interworking over the R-reference point for the Packet Domain, within the ~~GSM and~~ 3GPP systems.

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 re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

The present document defines the requirements for TE-MT interworking over the R-reference point for the Packet Domain, within the ~~GSM and~~ 3GPP systems. It is up to the manufacturer how to implement the various functions but the present document and existing 3GPP TS 27.001, 27.002, and 27.003 shall be followed where applicable.

It is the intention that the present document shall remain as the specification to develop a MS for support of Packet Switched services and its text includes references to ~~UMTS/GSM~~3GPP standards.

1 Scope

The ~~UMTS/GSM~~ (A/Gb and Iu mode) PLMN supports a wide range of voice and non-voice services in the same network. In order to enable non-voice traffic in the PLMN there is a need to connect various kinds of terminal equipments to the Mobile Station (MS). The present document defines the requirements for TE-MT interworking over the R-reference point for the Packet Domain , including the protocols and signalling needed to support Packet Switched services, as defined in 3GPP TS 22.060 and 3GPP TS 23.060.

The present document is valid for PLMN in A/Gb mode as well as for PLMN in Iu mode. If text applies only for one of these systems it is explicitly mentioned by using the terms "A/Gb mode" and "Iu mode". Please note, that the A interface does not play any role in the scope of this document although the term "A/Gb mode" is used.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TR 21.905: " Vocabulary for 3GPP Specifications". ~~3GPP TS 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".~~

[2] c~~3GPP TS 22.002: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Circuit Bearer Services (BS) supported by a GSM Public Land Mobile Network (PLMN)".~~

[3] 3GPP TS 22.060: "~~3rd Generation Partnership Project; Technical Specification Group Services and System Aspects;~~ General Packet Radio Service (GPRS); Service Description Stage 1".

[4] <VOID> ~~3GPP TS 23.002: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Network architecture".~~

[5] <VOID>~~3GPP TS 23.003: "3rd Generation Partnership Project; Technical Specification Group Core Network; Numbering, addressing and identification".~~

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

[7] <VOID>~~3GPP TS 23.122: "3rd Generation Partnership Project; Technical Specification Group Core Network; NAS Functions related to Mobile Station (MS) in idle mode".~~

[8] <VOID>~~3GPP TS 23.040: "3rd Generation Partnership Project; Technical Specification Group Terminals; Technical realization of the Short Message Service (SMS)".~~

[9] 3GPP TS 23.060: "~~3rd Generation Partnership Project; Technical Specification Group Services and System Aspects;~~ General Packet Radio Service (GPRS) Service Description Stage 2".

[10] <VOID>~~3GPP TS 04.02: "Digital cellular telecommunication system (Phase 2+); GSM Public Land Mobile Network (PLMN) access reference configuration".~~

[11] <VOID>~~3GPP TS 24.007: "3rd Generation Partnership Project; Technical Specification Group Core Network; Mobile radio interface signalling layer 3; General aspects".~~

[12] <VOID>~~3GPP TS 24.008: "3rd Generation Partnership Project; Universal Mobile Telecommunications System;Technical; Mobile radio interface layer 3 specification, Core Network Protocols - Stage 3".~~

[13] <VOID>~~3GPP TS 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control / Medium Access Control (RLC/MAC) protocol".~~

[14] <VOID>~~3GPP TS 04.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Logical Link Control (LLC)".~~

[15] <VOID>~~3GPP TS 24.065: "3rd Generation Partnership Project; Technical Specification Group Core Network; General Packet Radio Service (GPRS); Mobile Station (MS) - Serving GPRS Support Node (SGSN); Subnetwork Dependent Convergence Protocol (SNDCP)".~~

[16] 3GPP TS 27.007: "~~3rd Generation Partnership Project; Technical Specification Group Terminals;~~ AT command set for 3GPP User Equipment (UE)".

[17] 3GPP TS 29.061: "~~3rd Generation Partnership Project; Technical Specification Group Core Network; Packet Domain;~~ Interworking between the Public Land Mobile Network (PLMN) supporting Packet Based Services and Packet Data Networks (PDN)".

[18] ITU-T Recommendation E.164: "Numbering plan for the ISDN era".

[19] ITU-T Recommendation V.42 bis: "Data communication over the telephone network – Data compression procedures for data circuit-terminating equipment (DCE) using error correction procedures".

[20] <VOID>

[21] <VOID>

[22] <VOID>

[23] <VOID>

[24] <VOID>

[25] <VOID>

[26] IETF RFC 768 (1980): "User Datagram Protocol" (STD 6).

[27] IETF RFC 791 (1981): "Internet Protocol" (STD 5).

[28] IETF RFC 792 (1981): "Internet Control Message Protocol" (STD 5).

[29] IETF RFC 793 (1981): "Transmission Control Protocol" (STD 7).

[30] ITU-T Recommendation V.250 (ex V.25ter): "Serial asynchronous automatic dialling and control".

[31] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".

[32] ITU-T Recommendation V.28: "Electrical Chracteristics for unbalanced double-current interchange circuits".

[33] ITU-T Recommendation V.80: "In-band DCE control and synchronous data modes for asynchronous DTE".

[34] IETF RFC 1661 (1994): “The Point-to-Point Protocol (PPP)” (STD 51).

[35] IETF RFC 1662 (1994): “PPP in HDLC-like framing” (STD 51).

[36] IETF RFC 1700 (1994): “Assigned Numbers” (STD 2).

[37] IETF RFC 1570 (1994): ”PPP LCP Extensions“.

[38] IETF RFC 1989 (1996): ”PPP Link Quality Monitoring“.

[39] IETF RFC 1332 (1992): ”The PPP Internet Protocol Control Protocol (IPCP)“.

[40] IETF RFC 1877 (1995): "PPP IPCP Extensions for Name Server Addresses ".

[41] IETF RFC 2153 (1997): "PPP Vendor Extensions".

[42] IETF RFC 1334 (1992): "PPP Authentication Protocols".

[43] IETF RFC 1994 (1996): "PPP Challenge Handshake Authentication Protocol".

[44] IETF RFC 2686 (1999): "The Multi-Class Extension to Multi-Link PPP".

[45] IETF RFC 1990 (1996): "The PPP Multilink Protocol (MP)".

[46] IETF RFC 2472 (1998): "IP Version 6 over PPP".

3 Definitions abbreviations and symbols

3.1 Definitions

For the purposes of the present document, the following terms and definitions given in 3GPP TS 22.060 and 3GPP TS 23.060 and the following apply:

2G- / 3G-: prefixes 2G- and 3G- refers to functionality that supports only ~~GSM~~A/Gb mode ~~-~~or ~~UMTS~~Iu mode, respectively, e.g., 2G-SGSN refers only to the ~~GSM~~ A/Gb mode functionality of an SGSN. When the prefix is omitted, reference is made independently from the ~~GSM or UMTS~~A/Gb mode or Iu mode functionality.

A/Gb mode: indicates that the text applies only to a system or sub-system which operate in A/Gb mode of operation, i.e. with a functional division that is in accordance with the use of an A or a Gb interface between the radio access network and the core network

Iu mode: indicates that the text applies only to a system or a sub-system which operates in Iu mode of operation, i.e. with a functional division that is in accordance with the use of an Iu-CS or Iu-PS interface between the radio access network and the core network

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

APN	Access Point Name
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSN	GPRS Support Node
GTP-U	GPRS Tunnelling Protocol for user plane
HDLC	High Level Data Link Control
ICMP	Internet Control Message Protocol
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
LA	Location Area
LCP	Link Control Protocol
LLC	Logical Link Control
MAC	Medium Access Control
MCML	Multi-Class Multi-Link PPP
ME	Mobile Equipment
MP	Multilink PPP
MS	Mobile Station
MT	Mobile Termination
NCP	Network Control Protocol
PDCP	Packet Data Convergence Protocol
PDN	Packet Data Network

PDP	Packet Data Protocol , e.g., IP or PPP
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
PS	Packet Switched
PTM	Point To Multipoint
PTP	Point To Point
PVC	Permanent Virtual Circuit
RA	Routing Area
SGSN	Serving GPRS Support Node
SNDCP	SubNetwork Dependent Convergence Protocol
TCP	Transmission Control Protocol
TE	Terminal Equipment
TFT	Traffic Flow Template
UDP	User Datagram Protocol

3.3 Symbols

For the purposes of the present document, the following symbols apply:

Gb	Interface between a SGSN and a BSC.
Gi	Reference point between the Packet Domain and an external packet data network.
Gn	Interface between two GSNs within the same PLMN.
Gp	Interface between two GSNs in different PLMNs. The Gp interface allows support of Packet Domain network services across areas served by the co-operating PLMNs.
Gs	Interface between an SGSN and MSC.
Iu	Interface between the RNS and the core network. It is also considered as a reference point.
R	The reference point between a non-ISDN compatible TE and MT. Typically this reference point supports a standard serial interface.
Um	The interface between the MS and the ~~GSM~~ fixed network part in A/Gb mode . The Um interface is the ~~GSM~~ A/Gb mode network interface for providing packet data services over the radio to the MS. The MT part of the MS is used to access the GSM services through this interface.
Uu	Interface between the mobile station (MS) and the ~~UMTS~~ fixed network part in Iu mode. The Uu interface is the ~~UMTS~~ Iu mode network interface for providing packet data services over the radio to the MS. The MT part of the MS is used to access the UMTS services through this interface.

4 Access reference configuration

Figure 1 shows the relationship between the MS, its terminal equipment and the ~~UMTS/GSM network~~ PLMN in the overall Packet Domain environment.

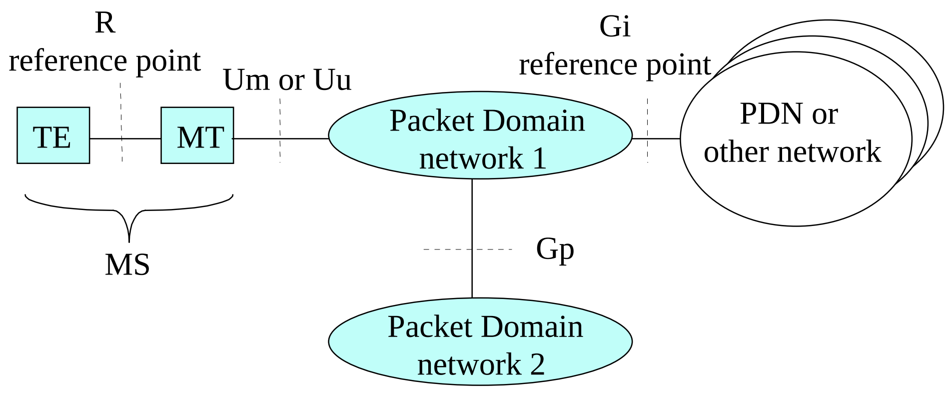


Figure 1: Packet Domain Access Interfaces and Reference Points

5 Functions to support data services

The main functions of the MT to support data services are:

- physical connection at the reference point R;
- flow control between TE and MT;
- mapping of user signalling to/from the Packet Domain bearer;
- mapping of packets belonging to different flows to appropriate PDP contexts;
- support of data integrity between the terminal equipment and the Packet Domain bearer;
- functions to support packet based data.

6 Interface to Packet Domain Bearer Services

~~6.1 GSM~~6.1 A/Gb mode

The following figure 2 shows the relationship of the ~~GSM~~ Packet Domain Bearer in A/Gb mode, terminating at the SNDCP layer, to the rest of the ~~GSM~~ Packet Domain in A/Gb mode environment. It is shown for reference purposes only and detailed information can be found in 3GPP TS 23.060.

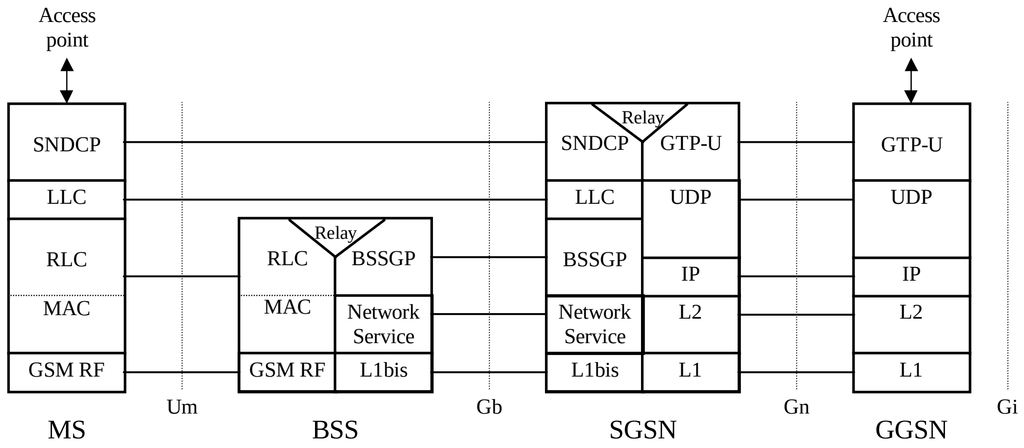


Figure 2: User Plane for Packet Domain services in ~~GSM~~A/Gb mode

~~6.2 UMTS~~6.2 Iu mode

The following figure 2a shows the relationship of the ~~UMTS~~ Packet Domain Bearer in Iu mode, terminating at the PDCP layer, to the rest of the ~~UMTS~~ Packet Domain in Iu mode environment. It is shown for reference purposes only and detailed information can be found in 3GPP TS 23.060.

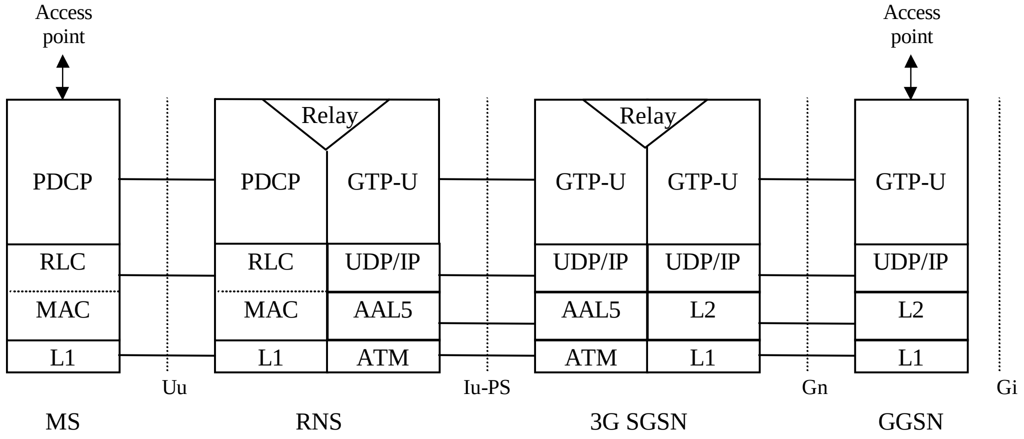


Figure 2a: User Plane for Packet Domain services in ~~UMTS~~Iu mode

7 Functions common to all configurations of a MS supporting Packet Switched Services

7.1 Mobile Station Modes of Operation

Three ~~GSM~~ MS modes of operation are identified for A/Gb mode.: Class A, B, and C.~~.~~ These modes of operation are described in 3GPP TS 23.060.

Three ~~UMTS~~ MS modes of operation are supported in ~~UMTS~~for Iu mode: A PS/CS mode of operation corresponds to class-A mode of operation in ~~GSM~~A/Gb mode. A PS mode of operation corresponds to class-C mode of operation in ~~GSM~~A/Gb mode. A CS mode of operation is out of scope in the present document.

7.2 Physical Interface

The physical interface between the TE and the MT may conform to ITU-T V.24/V.28, or to IrDA IrPHY physical standard specification, or to PCMCIA PC-Card electrical specification. All signal levels and their operation shall be as specified in 3GPP TS 27.001, 27.002, and 27.003.

7.3 Terminal context procedures

This subclause describes the relationships for PS Attach and Detach, and PDP Context Activation, Modification and Deactivation. The procedures for these functions are described in 3GPP TS 23.060.

7.3.1 PS Attach

The PS Attach shall be performed prior to activating a PDP context. The PS Attach may be performed automatically or manually depending on the manufacturer's implementation and configuration.

7.3.2 PS Detach

The PS Detach may be performed automatically or manually depending on the manufacturer's implementation and configuration. The following cases are valid:

- if the connection between the TE and MT is broken then the MT may perform the PS Detach procedure;
- if the network originates a PS Detach the MT may inform the TE;
- if the radio connection is broken then the MT may inform the TE;

- if the TE deactivates the last PDP context then the MT may perform the PS Detach procedure.

7.3.3 MS Originated PDP Context Activation

The PDP Context Activation procedure may be performed automatically or manually depending on the manufacturer’s implementation and configuration. Depending on the manufacturer’s implementation and configuration, 0, 1, or more PDP contexts can be active simultaneously.

7.3.4 MS Originated Secondary PDP Context Activation

The Secondary PDP Context Activation procedure may be performed automatically or manually depending on the manufacturer’s implementation and configuration. Depending on the manufacturer’s implementation and configuration, 0, 1, or more PDP contexts can be active simultaneously for the same PDP address.

7.3.5 Network Requested PDP Context Activation.

The network can request a PS attached MS to activate a specific PDP context.

7.3.6 MS-Initiated PDP Context Modification

The MS-Initiated PDP Context Modification procedure may be performed automatically or manually depending on the manufacturer’s implementation and configuration.

7.3.7 PDP Context Deactivation

The PDP Deactivation may be performed automatically or manually depending on the manufacturer’s implementation and configuration. The following cases are valid:

- if the connection between the MT and the TE is broken then the MT may perform the PDP Context Deactivation procedure;
- if the radio connection is broken then the MT may inform the TE;
- if the DHCP lease expires or the renewal is rejected by the DHCP server or the IP Address is changed during DHCP lease renewal, the TE may deactivate the PDP context.
- if the TE deactivates the last PDP context then the MT may perform the PS Detach procedure.

7.3.8 PDP context related parameters

7.3.8.1 2G-MS

It shall be possible to enquire and/or set the following parameters:

- requested quality of service;
- traffic flow template;
- compression on or off;
- TCP/IP header compression on or off;
- PDP address;
- PDP type;
- Access Point Name (APN);
- protocol configuration options (if required by the PDP type).

7.3.8.2 3G-MS

It shall be possible to enquire and/or set the following parameters:

- requested quality of service;
- traffic flow template;
- protocol control information compression, on or off;
- PDP address;
- PDP type;
- Access Point Name (APN);
- protocol configuration options (if required by the PDP type).

8 <VOID>

9 IP Based Services

All protocols that are supported by the underlying IP protocol are applicable in the Packet Domain environment. However there may be some limitations due to the RF environment.

The IP protocol can be run over various underlying protocols as shown in the figure 6.

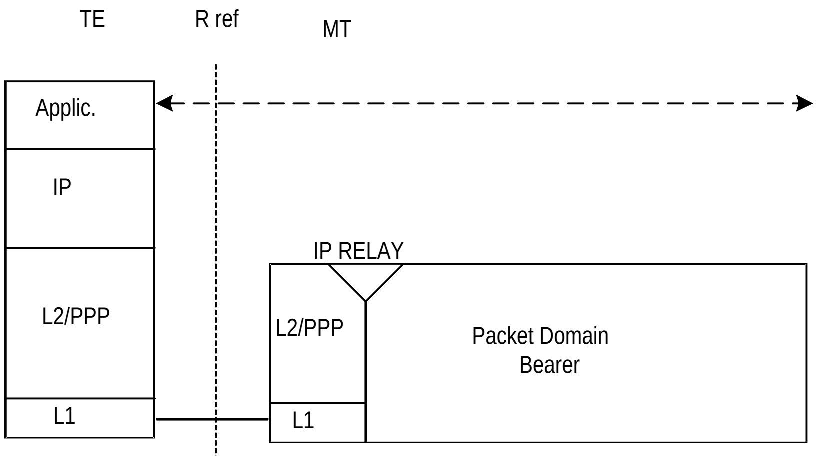


Figure 6: IP Based Services

PPP is a widely supported protocol in numerous operating systems and this alleviates the need for any Packet Domain specific protocol at the TE. PPP at the MT shall comply with the following specifications IETF STD 51 (RFC 1661, RFC 1662), RFC 1570, RFC 1989, RFC 1332, and optionally RFC 2472 for IPv6. The Domain Name Server information shall be delivered as defined in RFC 1877. The delivery of vendor-specific packets and options shall conform to RFC 2153.

As an alternative to PPP, an L2 protocol can be used which is defined as a manufacturer's operating system dependent protocol capable of carrying IP frames over the R reference point. An example for such an L2 protocol is the Multi-Class Multi-Link (MCML) PPP. The MCML is defined in RFC 2686 and is based on Multi-Link (MP) PPP which is defined in RFC 1990.

9.1 Example mapping of functions between the R reference point and the Packet Domain bearer for IP over PPP

The following example illustrates the case when the IP over PPP functionality is used in the MT. The example does not include all the details of PPP, but only describes the logical operation of PPP connection establishment, host authentication and IP configuration.

Each interface at the R reference point can support only one PPP connection and each PPP connection can support only one IP session. Therefore, in PPP mode only one IP PDP context can be activated per interface at the R reference point. However, it is possible for a PCMCIA card (or other multiplexed interfaces) to support multiple virtual interfaces (communications ports) at the R reference point. Multiple PPP connections and IP contexts are possible in this case.

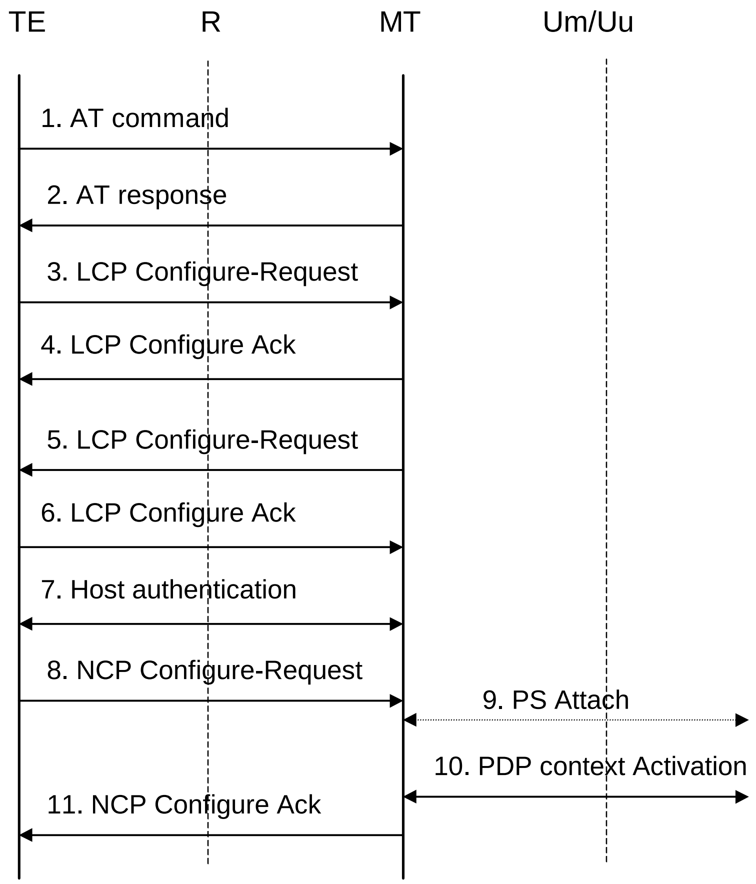


Figure 7: IP Over PPP Based Service

1) The TE issues AT commands to set up parameters and enter PPP mode (refer to subclause on AT commands for further details).

2) The MT sends AT responses to the TE.

3) The PPP protocol in the TE sends a LCP Configure-Request. This command is to establish a PPP link between the TE and the MT.

4) The MT returns LCP Configure-Ack to the TE to confirm that the PPP link has been established. The MT might previously have sent a LCP Configure-Nak in order to reject some options proposed by the TE. This in turn might have triggered a retransmission of the LCP Configure-Request with different options.

5) The PPP protocol in the MT sends a LCP Configure-Request in order to negotiate for the authentication protocol used for authentication of the host TE towards the MT. The MT shall initially negotiate for CHAP, and if this is unsuccessful, for PAP.

6) The TE returns a LCP Configure-Ack to the MT to confirm the use of the specified authentication protocol. The MT might previously have sent a LCP Configure-Nak in order to reject the protocol proposed by the TE. This in turn might have triggered a retransmission of the LCP Configure-Request with different options.

7) If the negotiated authentication protocol is either of CHAP or PAP, the TE authenticates itself towards the MT by means of that protocol. The MT stores the necessary authentication data and sends a locally generated positive acknowledgement of the authentication to the TE. If none of the protocols is supported by the host TE no authentication shall be performed. Refer to 3GPP TS 29.061 for further details on the authentication.

8) The PPP protocol in the TE sends to the MT a NCP Configure-Request. This command activates the IP protocol.

9) If the MS is not yet PS attached, the MT performs the PS Attach procedure as described in 3GPP TS 23.060.

10) The MT performs a PDP Context Activation as described in 3GPP TS 23.60. IP configuration parameters may be carried between the MT and the network in the Protocol Configuration Options IE in PDP Context Activation messages. The Protocol Configuration Options IE sent to the network may contain zero or one NCP Configure-Request packet (in addition to any LCP and authentication packets). The Protocol Configuration Options IE received from the network may contain zero or one NCP Configure-Ack, zero or one Configure-Nak and/or zero or one Configure-Reject packets (in addition to any LCP and authentication packets).

11) Based on the information received in the Protocol Configuration Options IE, the MT acknowledges to the PPP protocol in the TE that the IP protocol is now activated by sending a NCP Configure-Ack command. Before sending a NCP Configure-Ack, the MT might previously have sent a NCP Configure-Nak and/or Configure-Reject in order to reject some IP parameters proposed by the TE. This in turn might have triggered a retransmission of the NCP Configure-Request with different parameter values. The decision to reject a specific parameter or parameter value may be based on the information received from the network in the Protocol Configuration Options IE. NCP Configure-Ack may also carry IP protocol related parameters such as dynamic IP address to the TE. The MT shall also pass name server information to the TE if the TE has requested for it and if this information is provided by the GGSN. Other packet types and options may optionally be delivered. The MT may choose to immediately deactivate the PDP context due to the information received from the network in the Protocol Configurations Options IE.

9.2 Example mapping of functions between the R reference point and the Packet Domain bearer for IP over MCML PPP

When MCML is used instead of standard PPP [34] at the R-reference point, it is possible to support multiple IP sessions on one MCML connection. This is achieved by using an additional MP header after the standard PPP header. MCML provides two different MP headers, a 2-byte header to have four IP sessions and a 4-byte header to have sixteen IP sessions multiplexed over the MCML connection.

Since both MP and MCML closely follow the PPP connection establishment and negotiation model described in subclause 9.1, it is not replicated in this subclause. The major difference is the additional negotiation capabilities used during the LCP configuration negotiation [44], [45].

10 PPP Based Services

By means of the PDP type ‘PPP’ the Packet Domain may support interworking with networks based on the point-to-point protocol (PPP), as well as with networks based on any protocol supported by PPP through one of its Network Control Protocols (NCPs). It may also support interworking by means of tunnelled PPP, by e.g. the Layer Two Tunnelling Protocol (L2TP). The protocol configurations are depicted in figures 8a and 8b.

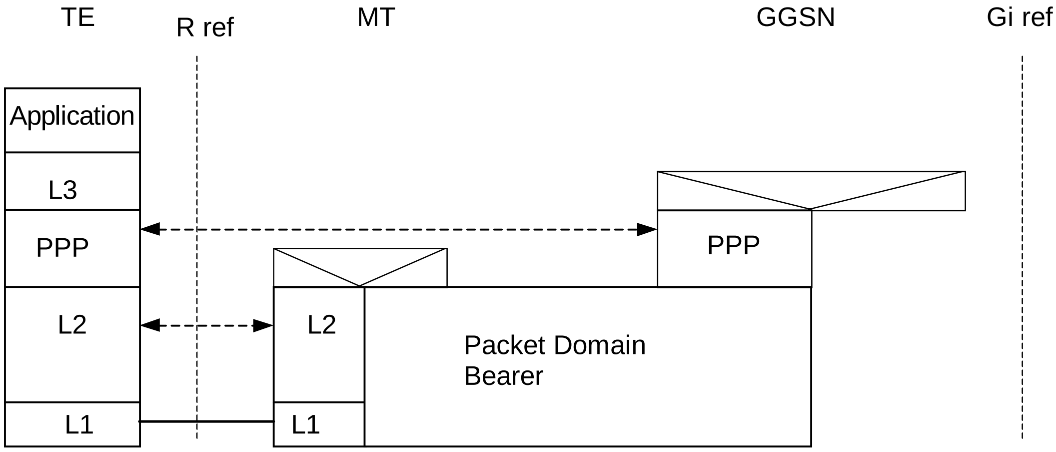
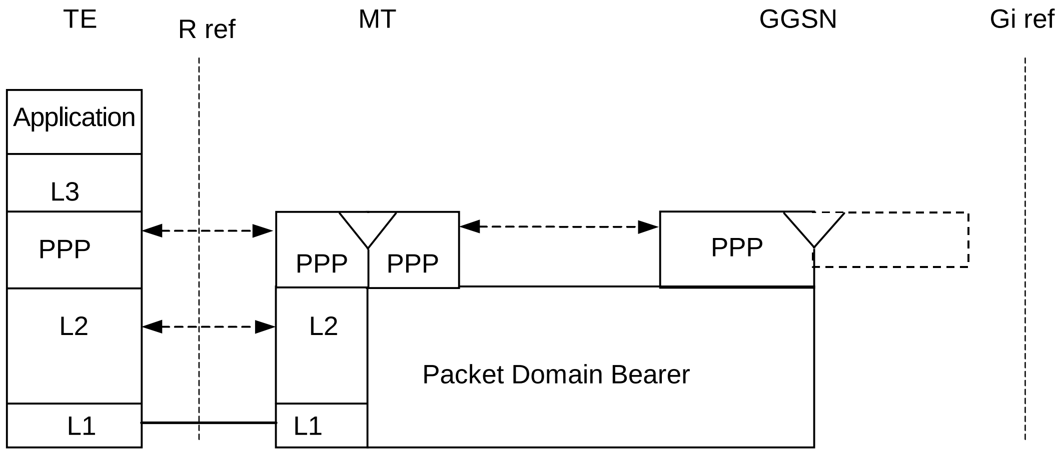


Figure 8a: PPP Based Services (transparent PPP negotiation)



NOTE. In the above case the 'L2' protocol is compliant with [35].

Figure 8b: PPP Based Services (relayed PPP negotiation)

The ‘L3’ protocol is a network layer protocol supported by one of the PPP NCP’s. All protocols currently supported by NCP’s are listed in [36].

The PPP is a widely supported protocol in numerous operating systems and this alleviates the need for any Packet Domain specific protocol at the TE. PPP at the GGSN shall comply with [34]. The Domain Name Server information shall be delivered as defined in [40]. The delivery of any vendor-specific packets and options shall conform to [41].

The ‘L2’ protocol may be the link layer protocol defined for the PPP suite [35]. As an alternative an 'L2' protocol can be used which is defined as a manufacturer’s operating system dependent protocol capable of carrying PPP frames over the R reference point. In case the link layer protocol defined for the PPP suite [35] is used as 'L2' protocol, the MT may negotiate LCP options related to the 'L2' framing (e.g. 'ACCM' [35], 'ACFC' [34] and 'FCS-Alternatives' [37]), with the TE. The MT shall remove the 'L1' and 'L2' specific framing from PPP frames in the uplink direction and add it in the downlink direction (see figure 8b).

10.1 Example mapping of functions between the R reference point and the Packet Domain bearer (transparent PPP negotiation)

The following example illustrates the case when the PPP negotiation is carried out transparently between the TE and the GGSN. The example does not include all the details of PPP, but only describes the logical operation of PPP LCP, host authentication and PPP NCP negotiations.

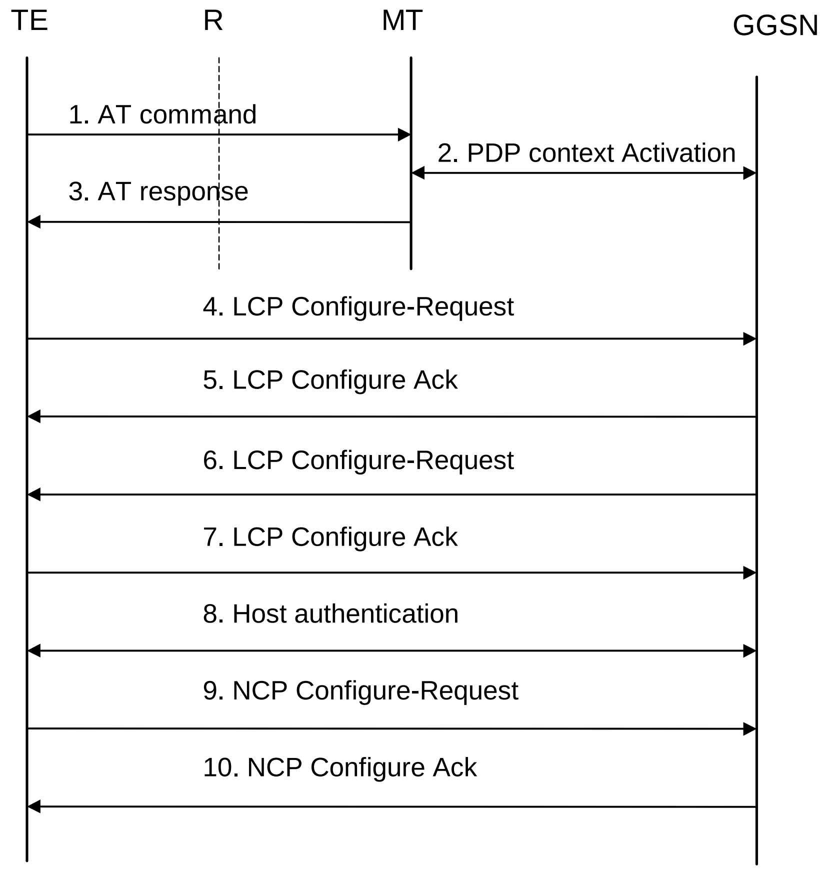


Figure 9a: PPP Based Service (transparent PPP negotiation)

1) The TE issues AT commands to set up parameters and activate a PDP Context (refer to sub-clause on AT commands for further details).

2) The MT performs a PDP Context Activation as described in 3GPP TS 23.060.

3) The MT sends AT responses to the TE.

4) The PPP protocol in the TE sends an LCP Configure-Request. This command establishes a PPP link between the TE and the GGSN.

5) The GGSN returns an LCP Configure-Ack to the TE to confirm that the PPP link has been established. The GGSN might previously have sent an LCP Configure-Nak in order to reject some options proposed by the TE. This in turn might have triggered a retransmission of the LCP Configure-Request with different options.

6) The PPP protocol in the GGSN sends an LCP Configure-Request in order to negotiate for the authentication protocol used for authentication of the host TE towards the GGSN.

7) The TE returns an LCP Configure-Ack to the GGSN to confirm the use of the specified authentication protocol. The GGSN might previously have sent an LCP Configure-Nak in order to reject the protocol proposed by the TE. This in turn might have triggered a retransmission of the LCP Configure-Request with different options.

8) The TE authenticates itself towards the GGSN by means of the negotiated protocol. If no authentication protocol can be negotiated the GGSN may reject the PPP connection. Refer to 3GPP TS 09.61 for further details on the authentication.

9) The PPP protocol in the TE sends to the GGSN an NCP Configure-Request. This command activates the network layer protocol.

10) The GGSN acknowledges to the PPP protocol in the TE that the network layer protocol is now activated by sending an NCP Configure-Ack command. Before sending an NCP Configure-Ack, the GGSN might previously have sent an NCP Configure-Nak in order to reject some parameters proposed by the TE. This in turn might have triggered a retransmission of the NCP Configure-Request with different parameter values.

10.2 Example mapping of functions between the R reference point and the Packet Domain bearer (relayed PPP negotiation)

The following example illustrates the case where the link layer protocol defined for the PPP suite [35] is used as 'L2' protocol. The LCP options related to the 'L2' framing (e.g. 'ACCM', 'ACFC' and 'FCS-Alternatives') are negotiated between the TE and the MT. All other PPP negotiation is relayed transparently between the TE and the GGSN. The example does not include all the details of PPP, but only describes the logical operation of PPP LCP, host authentication and PPP NCP negotiations.

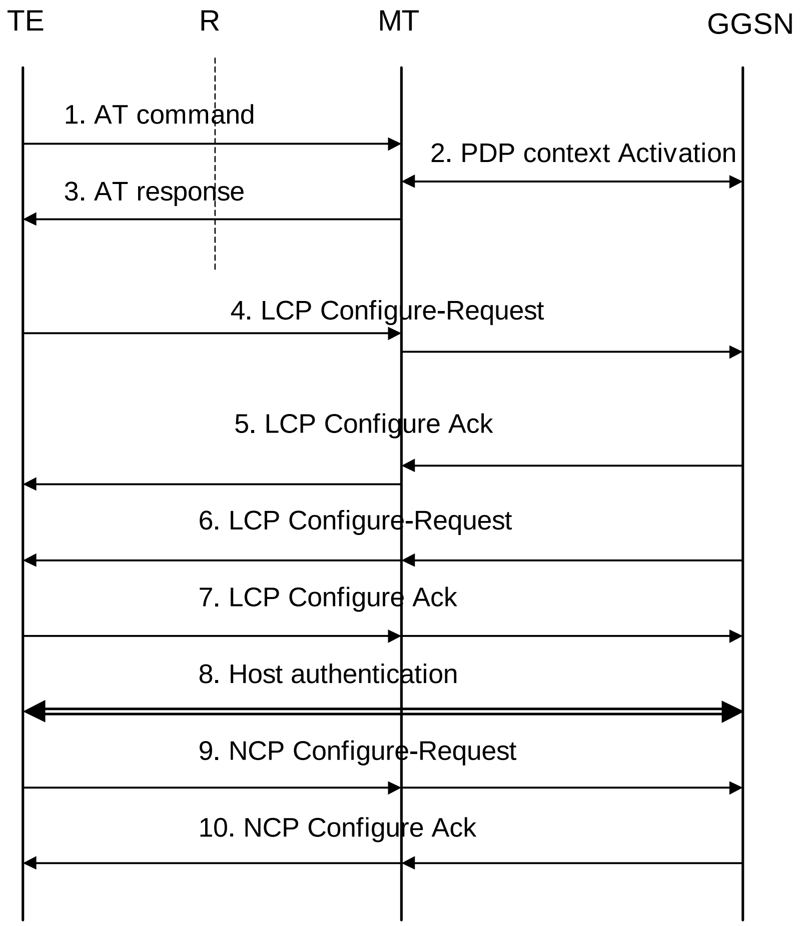


Figure 9b: PPP Based Service (relayed PPP negotiation)

1) The TE issues AT commands to set up parameters and activate a PDP Context (refer to sub-clause on AT commands for further details).

2) The MT performs a PDP Context Activation as described in 3GPP TS 23.060.

3) The MT sends AT responses to the TE.

4) The PPP protocol in the TE sends an LCP Configure-Request. If the request contains options related to the 'L2' framing these are negotiated by the MT. The LCP Configure-Request shall subsequently be relayed to the GGSN.

5) The GGSN returns an LCP Configure-Ack to the MT. The MT may change the value(s) of any options related to 'L2' framing and thereafter return an LCP Configure-Ack to the TE to confirm that the PPP link has been established. The MT might previously have sent an LCP Configure-Nak to the TE in order to reject some options proposed by the TE. This in turn might have triggered a retransmission of the LCP Configure-Request with different options.

6) The PPP protocol in the GGSN sends an LCP Configure-Request in order to negotiate for e.g. the authentication protocol used for authentication of the host TE towards the GGSN. The request is relayed to the TE.

7) The TE returns an LCP Configure-Ack to the MT to confirm the use of e.g. the specified authentication protocol. The acknowledgement is relayed to the GGSN. The GGSN might previously have sent an LCP Configure-Nak in order to reject the protocol proposed by the TE. This in turn might have triggered a retransmission of the LCP Configure-Request with different options.

8) The TE authenticates itself towards the GGSN by means of the negotiated protocol. The messages are relayed transparently by the MT. If no authentication protocol can be negotiated the GGSN may reject the PPP connection. Refer to 3GPP TS 29.061 for further details on the authentication.

9) The PPP protocol in the TE sends an NCP Configure-Request to the MT, which relays it transparently to the GGSN.

10) The GGSN acknowledges to the PPP protocol in the TE that the network layer protocol is now activated, by sending an NCP Configure-Ack command, transparently relayed by the MT. Before sending an NCP Configure-Ack, the GGSN might previously have sent an NCP Configure-Nak in order to reject some parameters proposed by the TE. This in turn might have triggered a retransmission of the NCP Configure-Request with different parameter values.

11 Internet Hosted Octet Stream Service (IHOSS)

Void.

12 AT commands

3GPP TS 27.007 defines commands that a TE may use to control a MT supporting Packet Switched services, via either a non-multiplexed character-stream interface or a mutliplexed character stream interface (27.010). A non-multiplexed character stream interface places certain limitations on the functionality of the interface. For example, it is not possible for the MT to send control information to the TE or for the TE to send commands to the MT whilst the interface is in the V.250 online data state unless the layer 2 protocol itself supports this feature. However, a manufacturer-specific escape mechanism may be provided to enable the TE to switch the MT into the V.250 online command state. It is anticipated that MTs will vary widely in functionality. At one extreme, a class A or PS/CS MT might support multiple PDP types as well as circuit switched data, and use multiple external networks and QoS profiles. At the other extreme a class C or PS MT might support only a single PDP type using a single external network, and rely on the HLR to contain the context definition.

A comprehensive set of Packet Domain -specific AT commands is defined in 3GPP TS 27.007 to provide the flexibility needed by the more complex MT. The commands are designed to be expandable to accommodate new PDP types and interface protocols, merely by defining new values for many of the parameters. Multiple contexts may be activated if the interface link-layer protocol is able to support them. The commands use the extended information and error message capabilities described in 3GPP TS 27.007.

For MTs of intermediate complexity, most commands have simplified forms where certain parameters may be omitted.

For the simplest MTs, and for backwards compatibility with existing communications software, it is possible to control access to the Packet Domain using existing modem-compatible commands. A special dial-string syntax is defined for use with the D command. This "modem compatible" mode of operation is described in 3GPP TS 27.007.

Subclause 12.2 contains examples of command sequences for a number of applications.

Annex A of the present document lists the AT commands for the Packet Domain. They are fully defined in 3GPP TS 27.007.

12.1 General on AT commands

The following subclauses describe how the AT commands are used for the Packet Domain. The AT commands themselves are fully described in 3GPP TS 27.007. Reference to the particular AT command names are shown only for clarity. In all case refer to 3GPP TS 27.007 for the latest descriptions.

12.1.1 Interaction of AT commands, Packet Domain management and PDPs

State machines may be used to describe the behaviour of:

- AT commands (ITU-T V.250);
- PDP context management (3GPP TS 23.060);
- PDP startup, data transfer and termination (Packet Data Protocol specifications);
- the layer 2 protocol (if any) used across the TE-MT interface (layer 2 protocol specifications).

This subclause does not attempt to describe in detail how these state machines interact but rather to give some general guidance on their relationships.

12.1.1.1 AT commands and responses

AT commands may be issued and responses received by the TE only when the TE and MT are in V.250 command state.

The possibility of suspending the PDP and/or layer 2 protocol and entering V.250 online command state is not considered here; neither is the use of a multiplexed interface where the PDP and the AT commands use separate logical channels.

12.1.1.2 PDP and layer 2 protocol operation

The PDP (across the TE-MT interface) may startup, transfer data and terminate only when the TE and MT are in V.250 online data state. It may be necessary to startup a layer 2 protocol across the interface before starting the PDP. The PDP startup procedure may provide information needed for the PDP context activation procedure (see subclause 10.1.1.3.2).

12.1.1.3 Management of Packet Switched services

A particular PDP may be used to transfer data only when a context is active for that PDP. Before a context can be activated, the MT must be attached to the Packet Domain network.

In order to provide flexibility and support a variety of types of MT and PDP, AT commands are provided which give the TE explicit control over attachment and detachment (+CGATT), and context activation and deactivation (+CGACT) procedures. These commands allow the TE to retain control of the MT, and receive status information from the MT, after these actions have been performed.

12.1.1.3.1 PS attachment

The MT may be attached and detached using the +CGATT command. However, it may not be necessary to use the command since attachment may occur:

- on power up or reset;

- when an attempt is made to activate a context either explicitly (+CGACT) or as a result of a PDP startup - procedure;
- when the mobile class is changed (+CGCLASS).

Similarly, detachment may occur:

- as a result of a PDP termination procedure (if no other Packet Switched services are active);
- when the mobile class is changed (+CGCLASS).

12.1.1.3.2 PDP context activation

Certain information must be provided to the network in order for a context activation attempt to be successful. The TE may provide some of this information to the MT during the PDP startup procedure rather than through AT command procedures. In this case the context activation cannot be initiated by the +CGACT command but rather on receipt of the appropriate information during the PDP startup.

12.1.2 Use of default context parameter values

The activate context request message sent by the MT to the network contains a number of parameters whose values can usefully be set by the TE. Under certain circumstances the values for some or all of the parameters need not be provided by the TE, either via AT commands or the PDP startup procedure. The storage of context information in the SIM is not considered in the present document. Rules concerning what values shall be sent by the MT to the network under various circumstances are given in 3GPP TS 23.060.

One particular rule that is designed to simplify operation in modem compatibility mode is that if there is only one PDP context subscription in the HLR then all of PDP type, PDP address and APN may be omitted.

12.1.2.1 PDP type

This may be omitted:

- when the MT supports only one PDP type (it will be provided by the MT); or
- according to the rules given in 3GPP TS 23.060.

12.1.2.2 PDP address (of the MS)

This shall be omitted when:

- a dynamic address is required; or
- according to the rules given in 3GPP TS 23.060.

12.1.2.3 Access Point Name

This may be omitted:

- according to the rules given in 3GPP TS 23.060.

12.1.2.4 QoS Requested

This may be omitted when:

- the default subscribed QoS is acceptable.

12.1.2.5 PDP Configuration Options

These shall be omitted:

- when none are required for the PDP concerned; or

- according to the rules given for the PDP.

12.2 Example command sequences for dial-compatibility mode

12.2.1 PPP in dial compatibility mode

12.2.1.1 Mobile initiated IP context activation

In this mode of operation, the MT behaves like an originating modem and accepts the normal V.250 commands associated with placing and clearing a call to a dial-up PPP server. Although the procedures for setting up the IP context are initiated from the mobile end, IP-based sessions, for example the File Transfer Protocol (FTP), may be initiated from either end once the context is active.

For this example it is assumed that:

- the user has subscribed to only one PDP context (of type IP) and therefore no context parameter values are needed;
- the MT supports only PPP at the MT-TE interface and therefore no layer 2 protocol need be specified.

A possible sequence of events is:

- the MT begins in V.25 command state:
    - TE -> MT: AT<Packet Domain-specific configuration commands, if required>;
    - MT -> TE: OK.
- the TE sends a dial command requesting the Packet Switched service:
    - TE -> MT: ATD*99#;
    - MT -> TE CONNECT.
- the MT enters V.250 online data state:
    - TE starts up PPP (LCP exchange);
    - TE -> MT: LCP Configure-request;
    - MT -> TE: LCP Configure-ack:
        - PPP Authentication may take place (optional);
        - TE starts up IP (NCP for IP exchange):
            - TE -> MT: NCP(IP) Configure-request;
            - MT <-> network: MT performs the PS-attach procedure if the MT is not currently attached;
            - MT <-> network: MT performs the IP context activation procedure;
            - MT -> TE: NCP(IP) Configure-ack;
            - TE <-> MT< - > network: IP packets may now be transferred.
        - TE stops IP (optional):
            - TE-> MT: NCP(IP) Terminate-Request); this
            - MT<-> network: MT performs the IP context deactivation procedure); is
            - MT -> TE: NCP(IP) Terminate-Ack) optional.
        - TE stops PPP:

- TE-> MT: LCP Terminate-Request;
- MT <-> network: MT performs the IP context deactivation procedure if it has not already done so;
- MT <-> network: MT may perform the PS-detach procedure if no other Packet Switched services are active;
- MT -> TE: LCP Terminate-Ack.

- *the MT returns to V.250 command state and issues the final result code :*
  - MT -> TE NO CARRIER.

The TE may recognise this as a return to V.250 command state. However, if it is using procedures intended for controlling modems, it may attempt to force a disconnect since in the modem case it cannot rely on the remote modem dropping the carrier. It will use some combination of:

- TE -> MT: TE drops circuit 108/2 (Data Terminal Ready);
- TE -> MT: escape sequence (e.g. +++);
- TE -> MT: ATH.

The MT should respond according to V.250 even if it is already in command state.

If the connection is lost at any time, the MT shuts down PPP, returns to V.250 command state and issues the final result code:

- MT -> TE NO CARRIER.

12.2.1.2 Network requested IP context activation

In this mode of operation, the MT behaves like an answering modem and accepts the normal V.250 commands associated with answering a call to a PPP server. Although the procedures for setting up the IP context are initiated from the network end, IP-based sessions, for example the File Transfer Protocol (FTP), may be initiated from either end once the context is active.

Two example sequences of events are given, for the cases of automatic and manual answering:

Case 1: automatic answering

The MT begins in V.250 command state:

- TE -> MT: AT<Packet Domain -specific configuration commands, if required >.

The TE sets automatic answering mode:

- TE -> MT: ATS0=1:
  - MT <- > network: MT performs the PS-attach procedure if the MT is not currently attached.

Subsequently:

- network -> MT: Request PDP Context Activation message;
- MT -> TE: RING.

The MT returns the intermediate result code:

- MT -> TE CONNECT,

and enters V.250 online data state.

The TE and MT perform the PPP and IP startup procedures which include the MT requesting the network to activate the IP context.

Case 2: manual answering

The MT begins in V.250 command state:

- TE -> MT: AT<Packet Domain -specific configuration commands, if required >.

The TE sets manual answering mode and requests a PS-attach (if necessary):

- TE -> MT: ATS0=0;
- TE -> MT: AT+CGATT=1;
- MT <- > network: MT performs the PS-attach procedure if the MT is not currently attached;
- network -> MT: Request PDP Context Activation message;
- MT -> TE: RING.

The TE answers manually:

- TE -> MT: ATA;
- MT -> TE CONNECT,

and enters V.250 online data state.

The TE and MT perform the PPP and IP startup procedures which include the MT requesting the network to activate the IP context:

or the TE rejects the connection:

- TE -> MT: ATH.

and remains in V.250 command state.

Annex A (informative): Summary of AT commands for the Packet Domain

This informative annex lists the AT commands for the Packet Domain that are fully described in 3GPP TS 27.007.

Table A.1: Summary of AT commands for the packet domain

Command	Description
+CGACT	PDP context activate or deactivate
+CGANS	Manual response to a network request for PDP context activation
+CGATT	PS attach or detach
+CGAUTO	Automatic response to a network request for PDP context activation
+CGCLASS	PS mobile station class
+CGCLOSP	<VOID>
+CGCLPAD	<VOID>
+CGDATA	Enter data state
+CGDCONT	Define PDP context
+CGEREP	Control unsolicited PS event reporting
+CGPADDR	Show PDP address
+CGREG	Packet Domain network registration status
+CGQMIN	Quality of service profile (minimum acceptable)
+CGQREQ	Quality of service profile (requested)
+CGSMS	Select service for MO SMS messages

Table A.2: Summary of Packet Domain Extensions to existing ~~GSM~~ A/Gb mode AT commands

Command	Description
+CEER	Extended error report (refer to 27.007)
+CMEE	Report mobile equipment error (refer to 27.007)
+CR	Service reporting control (refer to 27.007)
+CRC	Cellular result codes (refer to 27.007)

Table A.3: Summary of AT commands for Packet Domain modem compatibility mode

Command	Description
A	Answer – manual acceptance of a network request for PDP context activation
D	Dial – request Packet Domain service
H	On-hook - manual rejection of a network request for PDP context activation
S0	Automatic answering control - automatic acceptance of a network request for PDP context activation

Annex B (informative): Octet Stream Protocol (OSP) PDP type

Void

Annex C (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
05-1999					Transferred to 3GPP CN1	6.2.1	
03-1999	TSG#03				Approved at CN#03		3.0.0
06-1999	TSG#04		001		Correction to +CGAUTO command	3.0.0	3.1.0
06-1999	TSG#04		002		Move AT commands	3.0.0	3.1.0
06-1999	TSG#04		003		Access to PDN's and ISP's with the PDP-type PPP	3.0.0	3.1.0
06-1999	TSG#04		004		Internet Hosted Octet Stream Service (IHOSS) and Octet Stream Protocol (OSP)	3.0.0	3.1.0
09-1999	TSG#05		005		ATD Commands	3.1.0	3.2.0
12-1999	TSG#06		006		IPCP Negotiation Interworking at the MT	3.2.0	3.3.0
12-1999	TSG#06		007		Clarification on the PPP LCP Negotiation for PDP type PPP.	3.2.0	3.3.0
12-1999	TSG#06		008		Streamlining	3.2.0	3.3.0
12-1999	TSG#06		009		Parallel Handling of Multiple User Application Flows	3.2.0	3.3.0
03-2000	TSG#07		010		Correction of the support for IPv6 for the MS	3.3.0	3.4.0
03-2000	TSG#07		011		TSG CN1 Vocabulary Alignment	3.3.0	3.4.0
03-2000	TSG#07		012		Removal of X.25.	3.3.0	3.4.0
03-2000	TSG#07		013		Specification reference section clean-up	3.3.0	3.4.0
03-2001	TSG#11	NP-010044	014		DHCP lease Renewal	3.4.0	3.5.0
03-2001	TSG#11	NP-010044	015		Removal of IHOSS and OSP	3.4.0	3.5.0
03-2001	TSG#11				Upgraded to Release 4	3.5.0	4.0.0

3GPP TSG-CN WG3 Meeting #20 **Tdoc N3-010596**
Cancun, Mexico, 26th - 30th November 2001.

CR-Form-v5

CHANGE REQUEST

⌘	**24.022**	**CR**	**006**	⌘ **rev**	**3**	⌘ Current version:	**4.0.0** ⌘

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

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

Title: ⌘	New terminology required by TSG GERAN		
Source: ⌘	CN3		
Work item code: ⌘	TEI_5	***Date:*** ⌘	29.11.01
Category: ⌘	**D**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	New terminology required by TSG GERAN
Summary of change: ⌘	Terms "A/Gb mode" and "Iu mode" are used instead of "GSM" and "UMTS" Update of references for to release 5 Addition of abbreviations and definitions
Consequences if not approved: ⌘	Inconsistency with GERAN specs

Clauses affected: ⌘	See attached pages
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://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

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

1 Scope

The present document specifies the Radio Link Protocol (RLP) for circuit switched data transmission within ~~the GSM and UMTS~~an PLMN. RLP covers the Layer 2 functionality of the ISO OSI Reference Model (IS 7498). It is based on ideas contained in IS 3309, IS 4335 and IS 7809 (HDLC of ISO) as well as ITU-T X.25 and Q.92x (LAP-B and LAP-D of ITU, respectively.) RLP has been tailored to the special needs of digital radio transmission. RLP provides to its users the OSI Data Link Service (IS 8886).

RLP is intended for use with non-transparent data-transfer. Protocol conversion may be provided for a variety of protocol configurations. Those foreseen immediately are:

- character-mode protocols using start-stop transmission (IA5);
- X.25 LAP-B.

For reasons of better presentation, material about protocol conversion has been placed within those Specifications concerned with the relevant Terminal Adapters, i.e. 3GPP TS 27.002 for the asynchronous case and 3GPP TS 27.003 for the synchronous case. Care must be taken that that material also applies to Interworking Functions; see ~~3GPP TS 29.006 and~~ 3GPP TS 29.007.

The present document is valid for a PLMN in A/Gb mode as well as in Iu mode. If text applies only for one of these systems it is explicitly mentioned by using the terms "A/Gb mode" and "Iu mode". Please note, that the Gb interface does not play any role in the scope of this document although the term "A/Gb mode" is used.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

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

[2] 3GPP TS ~~04.21~~44.021: "~~Digital cellular telecommunication system (Phase 2+);~~ Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[3] 3GPP TS ~~08.04~~48.004: "~~Digital cellular telecommunications system (Phase 2+);~~ Base Station System - Mobile-services Switching Centre(BSS - MSC) interface Layer 1 specification".

[4] 3GPP TS ~~08.20~~48.020: "~~Digital cellular telecommunications system (Phase 2+);~~ Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[5] 3GPP TS 25.410: "UTRAN I_u Interface: General Aspects and Principles".

[6] 3GPP TS 25.411: "UTRAN I_u Interface Layer 1".

[7] 3GPP TS 25.414: "UTRAN I_u Interface Data Transport and Transport Signalling".

[8] 3GPP TS 25.415: "Iu Interface CN-UTRAN User Plane Protocols".

[9] 3GPP TS 27.001: "~~3GPP; TSG CN;~~ General on Terminal Adaptation Functions (TAF) for Mobile Stations".

[10] 3GPP TS 27.002: "~~3GPP; TSG CN;~~ Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[11] 3GPP TS 27.003: "~~3GPP; TSG CN;~~ Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[12] ~~3GPP TS 29.006: "3GPP; TSG CN; Interworking between a Public Land Mobile Network (PLMN) and a Packet Switched Public Data Network/Integrated Services Digital Network (PSPDN/ISDN) for the support of packet switched data transmission services".~~void

[13] 3GPP TS 29.007: "~~3GPP; TSG CN;~~ General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[14] ITU-T Recommendation Q.920: "ISDN user-network interface data link layer - General aspects".

[15] ITU-T Recommendation Q.921: "ISDN user-network interface - data link".

[16] ITU-T Recommendation Q.921bis: "Abstract test suites for LAPD conformance tests".

[17] ITU-T Recommendation Q.922: "ISDN data link layer specification for frame mode bearer services".

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

[19] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for terminals operating in Packet Mode and connected to Public Data Networks by dedicated Circuit".

[20] ISO/IEC Recommendation 4335: "Information technology - Telecommunications and information exchange between systems - High level data link control (HDLC) procedures - Elements of procedures".

[21] ISO Recommendation 3309: "Information technology - Telecommunications and information exchange between systems - High level data link control (HDLC) procedures - Frame structure".

[22] ISO Recommendation 7498: "Information processing systems - Open Systems Interconnection - Basic Reference Model".

[23] ISO Recommendation 8885: "Information technology - Telecommunication and information exchange between systems - High-level data link control (HDLC) procedures - General purpose XID frame information field content and format".

[24] ISO Recommendation 8886: "Information technology - Telecommunication and information exchange between systems - Data link service definitions for Open Systems interconnection".

[25] ISO Recommendation 8509: "Information processing systems - Open Systems Interconnection - Service conventions".

[26] ISO/IEC Recommendation 7809: "Information technology - Telecommunication and information exchange between systems - High-level data link control (HDLC) procedures - Classes of procedures".

[27] ISO Recommendation 7776: "Information processing systems - High-level data link control procedures - Description of the X.25 LAPB-compatible DTE data link procedures".

2.1 Definitions and abbreviations

In addition to the following, abbreviations used in the present document are listed in 3GPP TR 21.905 [1].

~~Abbreviations used in the present document are listed in 3GPP TS 01.04 [1].~~

ABM Asynchronous Balanced Mode
ADM Asynchronous Disconnected Mode
ATM: Asynchronous Transfer Mode.
C/R Command/Response bit
DISC Disconnect frame

DM	Disconnected Mode frame
DTX	Discontinuous Transmission
FCS	Frame Check Sequence
L2R	Layer 2 Relay function
N(R)	Receive sequence number
N(S)	Send sequence number
NULL	Null information frame
P/F	Poll/Final bit
RLP	Radio Link Protocol
REJ	Reject frame
REMAP	Remap frame
RNR	Receive Nor ready frame
RR	Receive Ready frame
SABM	Set Asynchronous Balanced Mode frame
SREJ	Selected reject frame
STM:	Synchronous Transfer Mode.
TEST	Test frame
UA	Unnumbered Acknowledge frame
UI	Unnumbered Information frame
XID	Exchange Identification frame

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

A/Gb mode: A system or a subsystem operates in A/Gb mode if an A or Gb interface is used between the radio access network and the core network.

backwards compatibility: RLP defines several backwards-compatible versions. That means that a newer version can interwork with an older one without changing the older one. This is realized by a fall back mechanism during XID exchange.

command: instruction represented in the RLP header, causing the receiving RLP entity to execute a specific function.

frame check sequence: field of redundant information based on a cyclic code, used for error detection.

I + S frame: RLP frame that is used for user information transfer, carrying supervisory information piggyback.

improper frame: RLP frame having an FCS error or having a header the contents of which is inconsistent with this Specification.

Iu mode: A system or a subsystem operates in Iu mode if an Iu-CS or Iu-PS interface is used between the radio access network and the core network.

non-transparent: in PLMN data transmission, a configuration where at layer 2, protocol information of the fixed network is mapped on RLP elements, and vice versa.

piggybacking: means by which one and the same frame can carry both user information and RLP related supervisory information.

response: reply represented in the RLP-header, by which the sending RLP entity reports back about its status.

RLP frame: sequence of contiguous bits, representing an RLP procedural element.

RLP header: that part of an RLP frame that encodes either a command or a response, located at the beginning of the RLP frame.

S frame: RLP frame that contains supervisory information in the absence of user information.

transparent: in PLMN data transmission, a configuration where at layer 2 (and also at the layers above) no protocol conversion takes place.

U frame: RLP frame that contains unnumbered protocol control information.

~~**STM:** Synchronous Transfer Mode.~~

~~**ATM:** Asynchronous Transfer Mode.~~

3 Introduction

Three versions of RLP are defined:

- RLP version 0: single-link basic version;
- RLP version 1: single-link extended version (e.g. extended by data compression);
- RLP version 2: multi-link version.

RLP uses one physical link (single-link) or from 1 up to 4 (multi-link) substreams on one or more physical links. However, the RLP multi-link version is designed to be able to support up to 8 physical links. If, in the call set-up signalling, either end indicates that it cannot support multi-link operation, neither end shall require usage of RLP-versions higher than 1. If the BC negotiation during call set-up results in a possibility for multi-link operation during the call, both ends shall require and accept RLP version 2 only.

If the BC-IE sent by the ~~MS~~UE in the SETUP or CALL CONFIRM message indicates negotiation during call set-up results in "maximum number of traffic channels" = "1 TCH" and WAIUR ≤ 14.4 kbit/s and the BC-IE sent by the ~~MS~~UE in the CALL CONFIRM message (MT case) or by the MSC in the CALL PROCEEDING message (MO case) indicates UIMI = "not required/not allowed" or "up to 1 TCH/F allowed/may be requested/allowed", this is shall be interpreted as if at least one end does not support multi-link operation, and neither end shall require RLP version higher than 1.

RLP makes use of an underlying FEC (Forward Error Correction) mechanism. For RLP to perform adequately it is assumed that the basic radio channel together with FEC provides for a block error rate of less than 10 %, where a block consists of 240 or 576 bits (Further study on the BLER for 576-bit blocks is needed). Furthermore, it is assumed that in case of multi-link RLP the difference of the delay between all physical links is less than timer T4.

In ~~GSM~~A/Gb mode, RLP frames are sent in strict alignment with the radio transmission. (For details, see 3GPP TS ~~04.21~~44.021). RLP frames are of a fixed size of 240 (TCH/F4.8 and TCH/F9.6 channel codings) or 576 bits (TCH/F14.4, TCH/F28.8 and TCH/F43.2 channel codings). Whenever a frame is to be sent, the RLP entity has to provide the necessary protocol information to be contained in it. In ~~UMTS~~Iu mode, the RLP frame size does not depend on the channel coding, only 576 bit frames are used.

RLP entities running only in an ~~UMTS~~Iu mode environment need only to support the 576 bit frame length. The REMAP function is not necessary. RLP entities running in both of the systems have to support the REMAP function. In a handover from ~~UMTS~~Iu mode to ~~GSM~~A/Gb mode the frame either stays 576 bits long or changes from 576 bits to 240 bits incurring a REMAP. In a handover from ~~GSM~~A/Gb mode to ~~UMTS~~Iu mode the frame either stays 576 bits long or changes from 240 bits to 576 bits incurring a REMAP.

Provision is made for discontinuous transmission (DTX).

RLP spans from the ~~Mobile Station~~User Equipment (~~MS~~UE) to the interworking function (IWF), located at the nearest Mobile Switching Centre (MSC), or beyond. Depending on the exact location of the IWF, handover of the ~~MS~~UE may result in link-reset or even total loss of the connection.

The ~~MS~~UE shall initiate the RLP link. In addition the MSC/IWF may initiate the RLP link.

In the terminology of HDLC, RLP is used in a balanced configuration, employing asynchronous operation, i.e. either station has the right to set-up, reset, or disconnect a link at any time. Procedural means are provided for to deal with contentious situations, should they ever occur.

RLP is full-duplex in the sense that it allows for information to be transferred in both directions simultaneously.

4 Frame structure

4.1 Basic frame structure

In ~~GSM~~A/Gb mode, an RLP-frame has a fixed length of either 240 bits, used when the channel coding is TCH/F4.8 or TCH/F9.6, or 576 bits, used when the channel coding is TCH/F14.4, TCH/F28.8 or TCH/F43.2. In ~~UMTS~~Iu mode, the RLP-frame has a fixed length of 576 bits.

A frame consists of a header, an information field, and an FCS (frame check sequence) field. The size of the components depends on the radio channel type, RLP version and on the RLP frame. As a benefit of using strict alignment with underlying radio transmission there is no need for frame delimiters (like flags etc.) in RLP. In consequence, there is no "bit-stuffing" necessary in order to achieve code transparency.

Next section modified

5.2.2.6 Exchange Identification, XID (11101)

The information field is to be interpreted as exchange identification. This frame is used to negotiate and renegotiate parameters of RLP and layer 2 Relay function. XID frames can be sent in both ADM and ABM.

The negotiation procedure is one step i.e. one side will start the process by sending an XID command, offering a certain set of parameters from the applicable parameter repertoire (see table 1) the sending entity wants to negotiate proposing values within the allowed range. In return, the other side will send an XID response, either confirming these parameter values by returning the requested values, or offering higher or lower ones in their place (see table 1 for sense of negotiation), except when the indicated RLP version is a lower one where a limited set of those parameters presented in the XID command may be answered according to the negotiated version. In RLP versions higher than "0", any unrecognisable parameters will be ignored. Default values will apply to those parameters which are not commented upon by the responding side (see subclause 5.4 for default values). This normally will end the negotiation process. XID frames are always used with the P/F-bit set to "1".

Without any prior XID exchange, default values will apply (see subclause 5.4). A negotiation of data compression parameters (see table 1) is only allowed in ADM. In addition, in RLP version 2, negotiation of RLP version N°(see table 1) is only allowed in ADM.

In the case of a collision of XID commands, all XID commands shall be ignored. The ~~MS~~UE shall restart the parameter negotiation on expiry of T1, while the Interworking Function shall do so on expiry of twice the value of T1. An unsuccessful XID exchange shall be repeated on expiry of T1. After N2 times of unsuccessful repetition, the link shall be disconnected.

In table 1 a list of parameters is given which constitute the parameter repertoire. In addition, the format of the XID information field is given.

Table 1: XID parameters

Parameter Name	Type	Length	Format (87654321)	Units	Sense of Negotiation	Valid in Versions
RLP version N°	1	1	bbbbbbbb (note1)	./.	down	≥ 0
IWF to ~~MS~~UE window size	2	1	00bbbbbb	./.	down	0..1
IWF to ~~MS~~UE window size	2	1	00bbbbbb	8	down	≥ 2
~~MS~~UE to IWF window size	3	1	00bbbbbb	./.	down	0..1
~~MS~~UE to IWF window size	3	1	00bbbbbb	8	down	≥ 2
Acknowledgement Timer(T1)	4	1	bbbbbbbb	10ms	up	≥ 0
Retransmission attempts (N2)	5	1	bbbbbbbb	./.	up	≥ 0
Reply delay (T2) (note 2)	6	1	bbbbbbbb	10ms	up	≥ 0
Compression P_T P_0 P_1 low P_1 high P_2	7	4	aaaa 00bb cccccccc cccccccc dddddddd	./. ./. ./. ./.	none see [15] down down	≥ 1
Re-sequencing timer (T4) **	8	1	bbbbbbbb	10 ms	up	≥ 2
Optional features	9	1	bbbbbbbb	./.	down	≥ 2
NOTE 1: Characters "a", "b", "c" and "d" indicate a bit which is part of the parameter value in question. Parameters indicated by "a" are not negotiable. NOTE 2: In case of negotiation of this parameter it may be necessary to negotiate also the other timer values (e.g. "Acknowledgement timer" (T1)).						

The type and length are encoded within one octet, the type field occupying bits 8 to 5 and the length field occupying bits 4 to 1; 1 resp. 5 being the least significant bit. The least significant bit shall always be transmitted first.

A parameter item consists of the type/length-octet followed by the value of that parameter, where the length-indicator gives the number of octets the value actually occupies. Such parameter items may be arranged in arbitrary order, with the exception of the RLP version number, which shall be sent first in RLP versions higher than "0". The parameter items must begin in the first octet of the XID-information field and follow on contiguously. The parameter list is delimited by parameter type zero.

Next section modified

5.2.2.9 REMAP (10001)

A REMAP-exchange can only take place in ABM following a change of channel coding. REMAP frames are always used with the P/F-bit set to "0". The exchange is started by the mobile-end which sends a REMAP command U-frame in the information field of which the RLP-entity indicates the N(R) of the frame - according to the 'old' frame format - from which the network-end should resend the information mapped into a frame format corresponding to the new channel coding. The mobile-end sends a REMAP-frame on every sending opportunity until a responding REMAP-frame is received from the network-end. The network-end answers by sending a REMAP U-frame with the C/R-bit set to 'Response'. In the information-field the network-end indicates the N(R)-number of the frame from which the mobile-end should remap the information into the new frame format. The network-end responds to all REMAP-commands it receives as long as it is in the REMAP synchronisation state. The network sends a numbered S frame with poll bit P=1 or an I+S frame after the first REMAP frame to the ~~mobile station~~user equipment to compel it to acknowledge the end of the REMAP condition. This frame is guarded by T1. Upon reception of an I+S frame or an S frame with the final bit F=1 from the ~~MS~~UE, the IWF exists the REMAP synchronisation state. Any REMAP-acknowledgement that may arrive at the mobile-end after one of them has been received is discarded by the mobile-end. The RLP shall supervise the synchronisation state by a timer with the value of N2*T1. If the network-end does not receive an appropriate U-frame within N2*T1, it enters ADM. If the mobile-end does not receive a response within N2×T1 measured from the transmission of the first command, it enters ADM.

In addition to the N(R)-information the REMAP-frame information field can include any XID-parameters that should be renegotiated because of the change of channel coding. The procedures concerning these XID-parameters are as defined in subclause 5.2.2.6 (Exchange Identification) except that the mobile-end always starts the negotiation. Also the mapping of the parameters is as defined in subclause 5.2.2.6 (Exchange Identification) except that the first two octets in the REMAP information field are occupied by the N(R)-number (The LSB is transmitted first). The information field shall always include parameter type zero, which delimits the XID-parameter list.

After the change of channel coding, default values according to the new channel coding apply until new values have been negotiated by the REMAP or XID procedure. Default values according to the new channel coding also apply for those XID parameters that are not included in the REMAP information field. Values for XID parameters whose negotiation is only allowed in ADM remain valid after change of channel coding.

Header 16 bits	N(R) 6 bits	xxxxxxxxxx	XID parameters	00000000	xxxxxx	FCS 24 bits

Information field either 200 or 536 bits x= don't care

a) version 0 and 1

Header 16 bits	N(R) 9 bits	xxxxxxx	XID parameters	00000000	xxxxxx	FCS 24 bits

Information field either 200 or 536 bits x= don't care

b) version 2

Figure 3: REMAP U-frame format

Next section modified

5.2.3.9 Upgrading Proposal bit, UP bit

In version 2, the UP bit in the S and I+S frame headers may be used by the IWF to indicate to the ~~MS~~UE that a service level upgrading will increase the throughput, and is used in accordance with 3GPP TS 27.001 and 29.007. The usage of the UP bit is negotiated by XID exchange.

Next section modified

5.5 List of system parameters

The system parameters are as follows.

Table 2: RLP parameter values

Name	Range of values	Default value	Recommended value
Version N°	0 – 2	0	2
k ~~MS~~UE $\Rightarrow$ IWF (for N° = 0/1)	0 – 61	61	61
k ~~MS~~UE $\Rightarrow$ IWF (for N° = 2)	0 - k_{max} (note 3)	480	240 (note 2)
k IWF $\Rightarrow$ ~~MS~~UE (for N° = 0/1)	0 – 61	61	61
k IWF $\Rightarrow$ ~~MS~~UE (for N° = 2)	0 - k_{max} (note 3)	480	240 (note 2)
T1 (note 1)	> 420 ms (version2) > 380 ms > 440 ms > 600 ms	520 ms (fullrate on 14,5, 29,0 or 43,5 kbit/s) 480 ms (fullrate on 12 kbit/s) 540 ms (fullrate on 6 kbit/s) 780 ms (halfrate)	520 ms (fullrate on 14,5, 29,0 or 43,5 kbit/s) 480 ms (fullrate on 12 kbit/s) 540 ms (fullrate on 6 kbit/s) 780 ms (halfrate)
T2 (note 1)		< 80 ms (fullrate on 14,5, 29,0 or 43,5 kbit/s) < 80 ms (fulrate on 12 kbit/s) < 80 ms (fullrate on 6 kbit/s) < 80 ms (halfrate)	< 80 ms (fullrate on 14,5, 29,0 or 43,5 kbit/s) < 80 ms (fullrate on 12 kbit/s) < 80 ms (fullrate on 6 kbit/s) < 80 ms (halfrate)
N2	> 0	6	6
P_T	0	0	0
P_0	0 – 3	0	3
P_1	512 – 65535	512	2048
P_2	6 – 250	6	20
T4 (note 1)	> 25 ms	30 ms 50 ms (fullrate on 14.5, 29.0 or 43.5 kbit/s)	30 ms 50 ms (fullrate on 14.5, 29.0 or 43.5 kbit/s)
Optional feature, Up signalling	0 – 1	0	1

NOTE 1: The timer values shall fulfil the formula:
- T1 > T2 + T4 + (2 * transmission delay) for multi-link operation;
- T1 > T2 + (2 * transmission delay) for single link operation.

For ~~GSM~~A/Gb mode the values apply according to indicated channel types, for ~~UMTS~~Iu mode the values apply according to "fullrate on 14.5" Timer T4 is ignored in ~~UMTS~~Iu mode and in single-link operation.

NOTE 2: This value is recommended in the case of 4 physical links.

NOTE 3: The maximum window size shall fulfil the formula:
- kmax < 496 - n * (1 + T4 / 20 ms), where n denotes the number of channels.

Any value k within the given range may be chosen.
However, to avoid transmission delay the value k should be:
- k > n * (2 * transmission delay) / 20 ms.

Next section modified

5.5.7 Optional features

The format of the optional features parameters is an octet where each bit position represents an optional feature that can be negotiated. The optional features are:

Bit position	Optional feature name
1	Up signalling
2	(Not yet assigned)
3	(Not yet assigned)
4	(Not yet assigned)
5	(Not yet assigned)
6	(Not yet assigned)
7	(Not yet assigned)
8	(Not yet assigned)

The 'Optional Features' parameter is negotiated bitwise in the downward sense, meaning that the value of bit *i* in the XID response shall be less or equal to the value of bit *i* in the XID command.

Up signalling: If the negotiated value of the 'Up signalling' feature is 1, then the UP bit in the S and I+S frame header is used for indicating an upgrading proposal to the ~~MS~~UE, otherwise the UP bit is ignored (don't care). This optional feature is only applicable for ~~GSM~~A/Gb mode.

5.6 Support for discontinuous transmission (DTX)

In both ADM and ABM, whenever the RLP entity has no numbered or unnumbered supervisory commands/responses and no information transfer frames pending transmission, the RLP entity shall indicate to the lower layer that the DTX function may be invoked.

5.6.1 In case of ~~GSM~~A/Gb mode

Protocol of lower layer conforms to 3GPP TS ~~08.04~~48.004, 3GPP TS ~~08.20~~48.020 and 3GPP TS ~~04.21~~44.021. ~~GSM~~A/Gb mode specification assumes STM for lower layer protocol. Even if there is no data to be sent, some transmission is needed on STM. RLP acts as follows in case of DTX.

In case DTX is invoked, in ADM a NULL-frame will be sent, and in ABM a RR or RNR S-frame will be sent.

5.6.2 In case of ~~UMTS~~Iu mode

Protocol of lower layer conforms to 3GPP TS 25.410, 3GPP TS 25.411, 3GPP TS 25.414 and 3GPP TS 25.415. ~~UMTS~~Iu mode specification assumes ATM for lower layer protocol. When there is no data to be sent, no transmission is available on ATM. In consideration of transmission efficiency, no transmission is suitable. RLP acts as follows in case of DTX.

In case DTX is invoked, in ADM and ABM no frame will be sent.

3GPP TSG-CN WG3 Meeting #20 **_Tdoc N3-010597_**
Cancun, Mexico, 26th - 30th November 2001.

CR-Form-v5

CHANGE REQUEST

⌘ **29.007**	**CR 044**	⌘ **rev**	**3** ⌘	Current version:	**4.2.0** ⌘

*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 [ ] Radio Access Network [ ] Core Network [X]

Title: ⌘	New terminology required by TSG GERAN		
Source: ⌘	CN3		
Work item code: ⌘	TEI_5	***Date:*** ⌘	29.11.01
Category: ⌘	**D**	***Release:*** ⌘	REL-5
	Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	New terminology required by TSG GERAN
Summary of change: ⌘	Terms "A/Gb mode" and "Iu mode" are used instead of "GSM" and "UMTS" Update of references for to release 5 and definitions
Consequences if not approved: ⌘	Inconsistency with GERAN specs

Clauses affected: ⌘	See attached pages	
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

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1 Scope

The present document identifies the Mobile-services Switching Centre/Interworking Functions (MSC/IWFs) and requirements to support interworking between:

a) PLMN and PSTN;

b) PLMN and ISDN;

for circuit switched services in the PLMN. It is not possible to treat ISDN and PSTN as one type of network, even when both ISDN and PSTN subscribers are served by the same exchange because of the limitations of the PSTN subscribers access i.e. analogue connection without D-channel signalling.

Within the present document, the requirements for voice and non-voice (data) calls are considered separately.

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

- the dual Bearer Services "alternate speech/data" (BS 61) and "speech followed by data" (BS 81);
- the dedicated services for PAD (BS 4x) and Packet access (BS 5x);
- the single asynchronous and synchronous Bearer Services (BS 21..26, BS 31..34).

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

- the synchronous Bearer Service non-transparent (BS 30 NT).
- the Basic Packet access
- Non-transparent facsimile (TS 61/62 NT) for ~~GSM~~the A/Gb mode.

If a PLMN still provides these services it shall fulfil the specification of former releases.

The present document is valid for a ~~2nd generation~~ PLMN (~~(~~in~~GSM~~A/Gb mode) as well as ~~for a 3rd generation PLMN (UMTS~~in Iu mode~~)~~. If text applies only for one of these systems it is explicitly mentioned by using the terms "~~GSM~~A/Gb mode" and "~~UMTS~~Iu mode". If text applies to both of the systems, but a distinction between the ISDN/PSTN and the PLMN is necessary, the term "PLMN" is used. Please note, that the Gb interface does not play any role in the scope of this document although the term "A/Gb mode" is used.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document.*

[1] ITU-T Recommendation G.711: "Pulse code modulation (PCM) of voice frequencies".

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

[3] ITU-T Recommendation I.464: "Multiplexing, rate adaption and support of existing interfaces for restricted 64 kbit/s transfer capability".

[4] ITU-T Recommendation Q.922 (1992): "DSS 1 Data link layer: ISDN data link layer specification for frame mode bearer services".

[5] ITU-T Recommendation Q.931 (05/98): "DSS 1 - ISDN user network interface layer 3 specification for basic call control".

[6] ITU-T Recommendation V.22: "1200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[7] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".

[8] ITU-T Recommendation V.25: "Automatic answering equipment and/or parallel automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls".

[9] ITU-T Recommendation V.32: "A family of 2-wire, duplex modems operating at data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits".

[10] ITU-T Recommendation V.32bis: "A duplex modem operating at data signalling rates of up to 14 400 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits"

[11] ITU-T Recommendation V.34: "A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits".

[12] ITU-T Recommendation V.42: "Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion".

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

[14] ITU-T Recommendation V.90: "A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream".

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

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

[17] ETSI ETR 018: "Integrated Services Digital Network (ISDN); Application of the Bearer Capability (BC), High Layer Compatibility (HLC) and Low Layer Compatibility (LLC) information elements by terminals supporting ISDN services".

[18] ETSI ETS 300 102-1 Edition 1 (1990): "Integrated Services Digital Network (ISDN); User-network interface layer 3 Specifications for basic call control".

[19] ETSI EN 300 403-1 V1.2.2 (1998-04): "Integrated Services Digital Network (ISDN); Digital Sunscriber Signalling System No. One (DSS1) protocol; Signalling network layer for circuit-mode basic call control; Part 1: Protocol specification".

[20] 3GPP TS 41.~~001~~103: " GSM Release 5 specifications ~~Digital cellular telecommunication system (Phase 2+); GSM Release 1999 Specifications~~".

[21] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".~~3GPP TS 41.004: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".~~

[22] 3GPP TS ~~42~~22.001: "~~Digital cellular telecommunication system (Phase 2+);~~ Principles of telecommunication services supported by a ~~GSM~~ Public Land Mobile Network (PLMN)".

[23] 3GPP TS ~~42~~22.003: "~~Digital cellular telecommunications system (Phase 2+);~~Circuit Teleservices supported by a ~~GSM~~ Public Land Mobile Network (PLMN)".

[24] 3GPP TR 43.010: "~~Digital cellular telecommunications system (Phase 2+);~~ GSM PLMN Connection types".

[25] 3GPP TS 43.045: "~~Digital cellular telecommunications system (Phase 2+);~~ Technical realization of facsimile group 3 transparent".

[26] 3GPP TS 43.050: "~~Digital cellular telecommunications system (Phase 2+);~~ Transmission planning aspects of the speech service in the GSM Public Land Mobile Network (PLMN) system".

[27] 3GPP TS 44.021: "~~Digital cellular telecommunications system (Phase 2+);~~ Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".

[28] 3GPP TS 48.020: "~~Digital cellular telecommunication system (Phase 2+);~~ Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".

[29] 3GPP TS 48.060: "~~Digital cellular telecommunications system (Phase 2+);~~ Inband control of remote transcoders and rate adaptors for ~~Enhanced Full Rate (EFR) and~~ full rate traffic channels".

[30] ~~3GPP TS 49.002~~GSM 09.02 : "Digital cellular telecommunications system (Phase ~~2+~~1); Mobile Application Part (MAP) specification".

[31] 3GPP TS 49.003: "~~Digital cellular telecommunication system (Phase 2+);~~ Signalling requirements on interworking between the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN) and the Public Land Mobile Network (PLMN)".

[32] 3GPP TS 21.~~101~~103: "3rd Generation mobile system Release 5 specifications ~~3rd Generation Partnership Project; Technical Specification Group: Release 1999 Specifications~~".

[33] 3GPP TS 22.002: "Circuit Bearer Services (BS) supported by a ~~GSM~~ Public Land Mobile Network (PLMN)".

[34] 3GPP TS 22.004: "General on supplementary services".

[35] 3GPP TS 23.003: "Numbering, addressing and identification".

[36] 3GPP TS 23.008: "Organization of subscriber data".

[37] 3GPP TS 23.011: "Technical realization of supplementary services".

[38] 3GPP TS 23.146: "Technical realization of facsimile group 3 non-transparent".

[39] 3GPP TS 23.054: "Description for the use of a Shared Inter Working Function in a GSM PLMN; Stage 2".

[40] 3GPP TS 24.008: "Mobile radio interface layer 3 specification".

[41] 3GPP TS 24.022: "Radio Link Protocol (RLP) for circuit switched Bearer and Teleservices ".

[42] 3GPP TS 25.415: "Iu Interface CN-UTRAN User Plane Protocols".

[43] 3GPP TS 27.001: "General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[44] 3GPP TS 27.002: "Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities".

[45] 3GPP TS 27.003: "Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities".

[46] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[47] 3GPP TS 24.002: " GSM - UMTS Public Land Mobile Network (PLMN) access reference configuration ".~~.~~

[48] ISO/IEC 3309: "Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - Frame structure".

[49] IETF RFC 1662: "PPP in HDLC-like framing".

[50] Mobile Internet Access Forum: "PIAFS Specification Ver. 1.1, 2.1".

[51] ITU-T Recommendation V.8: "Procedures for starting sessions of data transmission over the public switched telephone network".

[52] 3GPP TS 26.111: "Codec for Circuit Switched Multimedia Telephony Service; Modifications to H.324".

[53] 3GPP TR 23.910: " Circuit Switched Data Bearer Services".

[54] ITU-T Recommendation H.223: "Multiplexing protocol for low bit rate multimedia communication".

[55] ITU-T Recommendation H.223, Annex A: "Multiplexing protocol for low bit rate multimedia communication over low error-prone channels".

[56] ITU-T Recommendation H.223, Annex B: "Multiplexing protocol for low bit rate multimedia communication over moderate error-prone channels".

[57] ITU-T Recommendation H.223, Annex C: "Multiplexing protocol for low bit rate multimedia communication over highly error-prone channels".

[58] ITU-T Recommendation H.324: "Terminal for low bit-rate multimedia communication".

[59] ITU-T Recommendation H.221: “Frame structure for a 64 to 1920 kbit/s channel in audiovisual teleservices”.

[60] ITU-T Recommendation H.242: “System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s”.

[61] ITU-T Recommendation H.245: “Control protocol for multimedia communication”.

[62] ITU-T Recommendation V.8 bis: “Procedures for the identification and selection of common modes of operation between data circuit-terminating equipments (DCEs) and between data terminal equipments (DTEs) over the public switched telephone network and on leased point-to-point telephone-type circuits”.

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

[64] ITU-T Recommendation V.22bis (1988): "2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[65] ITU-T Recommendation V.23: “600/1200-baud modem standardized for use in the general switched telephone network”.

[66] ITU-T Recommendation V.26: “2400 bits per second modem standardized for use on 4-wire leased telephone-type circuits”.

[67] ITU-T Recommendation V.26 bis: “2400/1200 bits per second modem standardized for use in the general switched telephone network”.

[68] ITU-T Recommendation V.26 ter: "2400 bits per second duplex modem using the echo cancellation technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[69] ITU-T Recommendation V.27: “4800 bits per second modem with manual equalizer standardized for use on leased telephone-type circuits”.

[70] ITU-T Recommendation V.27 bis: “4800/2400 bits per second modem with automatic equalizer standardized for use on leased telephone-type circuits”.

[71] ITU-T Recommendation V.29: "9 600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits".

[72] ITU-T Recommendation Q.921: “ISDN user-network interface - Data link layer specification”.

[73] ITU-T Recommendation X.21: “Interface between Data Terminal Equipment and Data Circuit-terminating Equipment for synchronous operation on public data networks”.

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

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

[76] ITU-T Recommendation X.31: “Support of packet mode terminal equipment by an ISDN”.

[77] ITU-T Recommendation X.75: “Packet-switched signalling system between public networks providing data transmission services”.

[78] ISO 2110: "Data communication - 25-pole DTE/DCE interface connector and contact number assignments".

[79] ISO/IEC 6429: "Information technology - Control functions for coded character sets".

[80] 3GPP TS 29.415: "Core Network Nb Interface User Plane Protocols"

[81] ITU-T I.366.2: "AAL type 2 service specific convergence sublayer for trunking".

[82] 3GPP TS 29.232: "Media Gateway Controller; Media Gateway interface; Stage 3"

3 Definitions and abbreviations

Use is made of the following terms within the present document. These terms refer to information requirements necessary to support interworking functions, some of these terms will be identifiable with their use in other ~~GSM~~ 3GPP specifications.

bearer capability information: specific information defining the lower layer characteristics required within the network.

low layer compatibility information: information defining the lower layer characteristics of the terminal.

high layer compatibility information: information defining the higher layer characteristics of the terminal.

compatibility information: this term subsumes the entirety of Bearer Capability, Low Layer Compatibility, High Layer Compatibility, Progress Indicator and Address Information conveyed out-of-band prior to call establishment for the support of compatibility checking and terminal/function/service selection at the ISDN-type user-network interface.

protocol identifier: information defining the specific protocols utilized for the support of data transfer by a terminal.

progress indicator: information supplied to indicate to the terminal that network interworking has taken place.

out-of-band parameter exchange: information exchanged via an associated or non-associated signalling link e.g. SS No 7.

PSTN: subscriber to network interface supports only analogue terminals.

ISDN: subscriber to network interface supports digital or analogue terminals, plus a standardized user to network associated signalling system and a standardized internetwork signalling system.

autobauding type 1: this information element value may be contained in the setup or call confirm messages from the ~~MS~~UE in association with a non transparent data service. This implies that the MSC/IWF may select any speed and modem type according to what it can negotiate with the remote modem on the PSTN/ISDN. The parameters User Rate and FNUR (Fixed Network User Rate), if present, has no meaning when Modem Type is autobauding type 1.

multi self selecting speed modem: this term applies to V series modems capable of handling one or more lower speeds as a fall back position. When such a modem is requested in the call setup or call confirm message from the ~~MS~~UE in association with a non transparent service, the MSC/IWF may select any of the speeds supported according to the negotiation with the remote modem on the PSTN/ISDN. The parameters User Rate and FNUR (Fixed Network User Rate), if present, has no meaning when Modem Type is autobauding type 1.

unrestricted 64 kbit/s network: a digital network which has 64 kbit/s octet-structured Information Transfer Capability (ITC) with no restrictions on the contents of each octet.

restricted 64 kbit/s network: ITU-T I.464 defines "'restricted 64 kbit/s transfer capability" as "64 kbit/s octet-structured capability with the exception that an all-zero octet is not permitted". In the present document, the term "restricted 64 kbit/s network" refers not only to networks with the I.464 restriction but also to those in which the 8th bit of each octet is unusable for data transmission.

directly connected restricted 64 kbit/s network: restricted 64 kbit/s network which is connected directly to the MSC/IWF.

indirectly connected restricted 64 kbit/s network: restricted 64 kbit/s network which is connected to the MSC/IWF via an unrestricted 64 kbit/s network.

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

A/Gb mode: A system or a subsystem operates in A/Gb mode if an A or Gb interface is used between the radio access network and the core network.

Iu mode: A system or a subsystem operates in Iu mode if an Iu-CS or Iu-PS interface is used between the radio access network and the core network.

3.1 Abbreviations

In addition to the following, abbreviations used in the present document are listed in 3GPP ~~TS~~ TR ~~41.004~~21.905 [21].

ADPCM	Adaptive Differential Pulse Coded Modulation
BS	Bearer Service
DP	Dial Pulse
DSS1	Digital Subscriber Signalling 1
FTM	Frame Tunnelling Mode
ITC	Information Transfer Capability
LE	Local Exchange
NT	Network Termination
NT	non-transparent
PABX	Private Automatic Branch Exchange
PIAFS	PHS Internet Access Forum Standard
PPP	Point to Point Protocol
SPC	Stored Program Control
SS No.7	Signalling System No.7
T	transparent
TE	Terminal Equipment
TA	Terminal Adaptor
TS	Teleservice
TS	Technical Specification
TUP	Telephone User Part (of Signalling System No.7)
UNI	User Network Interface

4 Introduction

Since the numbering plan for the ISDN era (E.164) includes the numbering plan for the telephone network (E.163), it is not possible to distinguish by the number whether a given subscriber is a PSTN or ISDN subscriber. Further, in some countries both PSTN and ISDN subscribers will be connected to the same exchange, so the only difference for this type of combined network will be in the nature of the customer access. In the present document a PSTN is considered to support only an analogue interface towards the subscriber. An ISDN shall be considered to support digital interface towards the subscriber. In addition, the ISDN is considered to support a standardized outband signalling protocol both between the subscriber and the network and within the network, i.e. DSS1 and ISUP, thus enabling the generation and transport of Compatibility Information for compatibility checking and terminal/function/service selection at the user-network interface as well as for MSC/IWF selection.

There now exist networks which do not fall into either of these categories in that they provide for digital connectivity from subscriber to subscriber through the network. The subscribers have access to a wide range of services by a limited set of standard multi-purpose user network interfaces. However, these networks do not support the standardized inter-exchange signalling protocol throughout, in that they are e.g. using TUP or National User Part (NUP). These types of network support 64 kbit/s connections, so in service support are comparable to ISDN, however, the signalling system provided may not support transport of all Compatibility Information allowed for in the standardized ISDN signalling. The present document will therefore identify interworking to PSTN and ISDN on the principle of the network characteristics as identified in the previous paragraph. The aforementioned existing networks then constitute one particular case in the ISDN interworking scenarios. These cases will be itemized when the implication of the various degrees of exhaustiveness of the Compatibility Information - delivered via the ISDN - used for deducting a ~~GSM~~ PLMN Basic Service needs to be set forth.

When two dissimilar networks are required to interwork in order to support a communication between two subscribers, one on each network, a number of Interworking Functions (MSC/IWFs) are required to support the communication. Some of these are related to the differences in signalling and are dealt with in 3GPP TS 49.003.

Examples of other aspects of interworking are:

a) the need or otherwise of echo control devices;

b) the need or otherwise of modem pools and network-based rate adaptation.

For the purposes of determining the required MSC/IWFs, it is necessary, however, to consider separately each type of interworking (i.e. PLMN-ISDN and PLMN-PSTN) since, in the worst case, "PSTN" could refer to an essentially analogue network with electromechanical switching not controlled by software and without common-channel signalling.

Some facilities associated with alternate speech and facsimile group 3 may not be available with version 1 of the MAP (~~3GPP TS 49.002~~GSM 09.02). Version 1 of the Mobile Application Part (MAP) does not support in-call modification and channel mode modification following an inter-MSC handover.

5 Void

6 Network Characteristics

6.1 Key Characteristics of Networks Concerned

Table 1: Key Characteristics of Networks Concerned

Characteristic	PLMN	ISDN	PSTN
Subscriber Interface	Digital	Digital	Analogue
User-network signalling	3GPP TS 24.008	DSS1, other UNIs	loop-disconnect and DTMF
User-terminal equipment supported	see 3GPP TS 24.002	Digital TE (ISDN NT, TE1 or TE2+TA) see e.g. I.411	Analogue TE (e.g. dial pulse telephones PABXs modem equipped DTEs)
Inter-exchange signalling	SS No.7 ISUP TUP+, MAP	SS No.7 ISUP TUP+, TUP, NUP	Channel associated (e.g. R2, No.4, No.5) or common channel (e.g. No.6)
Transmission facilities	Digital	Digital	Analogue
Exchange types	Digital	Digital	Analogue/digital
Information transfer mode	Circuit	Circuit	Circuit
Information transfer capability	Speech, digital unrestricted, alternate speech/ group 3 fax etc.	Speech, digital unrestricted, 3,1 kHz audio, video etc.	3,1 kHz audio (voice/voice- band data)

6.1.1 Characteristics of PLMNs

The PLMN is fully defined in the Technical Specifications summarised in 3GPP TS ~~41.001~~41.103 for a 2nd generation PLMN (~~GSM~~A/Gb mode) or in 3GPP TS 21.~~101~~103 for a 3rd generation PLMN (~~UMTS~~Iu mode).

6.1.2 Characteristics of PSTNs

Because of the efforts at an early stage to standardize ISDNs in different countries, the differences between any two ISDNs will be small compared with the differences between PSTNs, which have evolved in different ways in different countries. In some cases the evolution has occurred over many decades, and therefore each PSTN is distinct, and for a recommendation on interworking, it is necessary to make certain assumptions about a generalized PSTN.

Whilst the key characteristics of PSTNs are given in table 1 above, the specific MSC/IWFs needed to allow interworking between a PLMN and a PSTN will depend on the nature of the PSTN concerned.

Table 2 below gives a number of categories that can be used to classify PSTNs and a number of possibilities within each category.

Table 2: Characteristics of PSTNs

Category	Possibilities within Category
Type of subscriber signalling	a) PSTN with loop disconnect subscriber signalling (10 pps)
	b) PSTN with DTMF subscriber signalling
Type of interexchange signalling	a) PSTN with channel-associated signalling
	b) PSTN with common-channel signalling
Type of interexchange transmission	a) Analogue
	b) Digital
Type of exchange switching	a) PSTN with electro-mechanical switching
	b) PSTN with electronic (non-digital) switching
	c) PSTN with electronic digital switching
Type of exchange control	a) Non-SPC
	b) SPC
NOTE: Under each category, it is possible that a PSTN will have a combination of the possibilities rather than only one.	

6.1.3 Characteristics of ISDN

For the "standardized ISDN" in principle taken into account here, these are defined in the ETS/ITU-T-series.

7 Interworking classifications

7.1 Service interworking

Service interworking is required when the Teleservices at the calling and called terminals are different. No service interworking, except for facsimile group 3 (Teleservice 61 or 62 interworking with standard facsimile group 3 service), has been identified as a requirement of the PLMN system for PSTN/ISDN network based services.

7.2 Network interworking

Network interworking is required whenever a PLMN and a non-PLMN together are involved to provide an end to end connection and may be required in instances of PLMN to PLMN connections.

The concept of Bearer Services was developed for the ISDN and has been extended to the PLMN. A bearer service is defined (in 3GPP TS 2~~4~~2.001) as.

A type of telecommunication service that provides the capability for the transmission of signals between user-network interfaces.

Bearer services are described by a number of attributes, where an attribute is defined as a specified characteristic of an object or element whose values distinguish that object or element from others.

For the purpose of the present document, a PSTN is assumed to provide a bearer service which equates to an ISDN 3,1 kHz audio bearer service.

Refer to 3GPP TS 22.002 for complete list of bearer services. Refer to 3GPP TS 24.008 for coding of Bearer Capabilities. Refer to 3GPP TS 27.001 for the allowed combinations of parameter value settings.

Table 3: Bearer Service Interworking

<table>
<tr><th>Bearer service category in PLMN</th><th>Bearer Service in PLMN</th><th>Bearer service in ISDN</th><th>Service in PSTN</th></tr>
<tr><td>Circuit mode unstructured with
unrestricted digital capability
Transparent and Non-transparent</td><td>Asynchronous Data general</td><td rowspan="2">Cct mode structured
64 kbit/s unrestricted</td><td rowspan="2">Not Applicable</td></tr>
<tr><td>Circuit mode unstructured with
unrestricted digital capability
Transparent</td><td>Synchronous Data general</td></tr>
<tr><td>3,1 kHz Audio Ex PLMN
Transparent and Non-transparent</td><td>Asynchronous Data general</td><td rowspan="2">Cct Mode
3,1 kHz Audio</td><td rowspan="2">Cct Mode
3,1 kHz Audio</td></tr>
<tr><td>3,1 kHz Audio Ex PLMN
Transparent</td><td>Synchronous Data general</td></tr>
</table>

Table 4: Network interworking of Teleservices

Teleservice in PLMN	Lower layer capabilities addressed in the PLMN Bearer Capabilities IE	Bearer service in ISDN	Service in PSTN
Telephony	Unstructured with speech capability	Speech or Cct mode 3,1 kHz audio	Cct Mode 3,1 kHz audio
Emergency calls	Unstructured with speech capability		
Alternate speech/ facsimile group 3	Data Cct duplex synchronous (~~GSM~~A/Gb mode) / asynchronous (~~UMTS~~Iu mode) access alternate speech group 3 fax	Cct mode 3,1 kHz audio	Cct mode 3,1 kHz audio
Automatic Facsimile group 3	Data Cct duplex synchronous (~~GSM~~A/Gb mode) / asynchronous (~~UMTS~~Iu mode) access group 3 fax	Cct mode 3,1 kHz audio	

This table does not identify any relationship between Teleservices in the PLMN with those in the ISDN/PSTN, it is merely to identify the interworking of the lower network layers of that teleservice with the network layers i.e. bearer service in the ISDN/PSTN.

7.3 Signalling interworking

See 3GPP TS 49.003[31].

7.4 Numbering

See 3GPP TS 23.003[35]

7.5 Supplementary service interworking

For general aspects of supplementary services refer to 3GPP TS 22.004[34] and 23.011[37].

Not every supplementary service may be used in combination with each basic service. The applicability of each supplementary service for a basic service is defined in 3GPP TS 22.004[34].

8 Compatibility and subscription checking

Compatibility checking is carried out on the following items:

a) Low layer compatibility - utilizing low layer compatibility and bearer capability information elements.

b) High layer compatibility - utilizing high layer compatibility information element.

The use of the progress indicator for compatibility checking is outside the scope of the present document.

Indication of compatibility requirements is carried out as described in subclauses 9.2.2 and 10.2.2.

For subscription checking, relevant for the interworking described in clauses 9 and 10 of the present document, refer to 3GPP TS ~~42~~22.001.

9 Interworking to PSTN

9.1 Speech Calls

9.1.1 Interworking indications to PLMN terminal

An indication to inform the PLMN terminal that:

i) instead of receiving out-of-band indications for certain types of failure conditions, a tone or announcement will be received in-band from the PSTN.

ii) the available compatibility information will be not exhaustive for deducing a PLMN Basic Service and there will be a limitation on address - the terminal may be required to accept the call on the basis of indicating its compatibility requirements.

iii) (if a DTE) in-band handshaking signals should be anticipated.

9.1.2 Transmission aspects

Includes control of Speech Processing and Echo Control Devices, see 3GPP TS 43.050.

9.1.3 Generation of In-band Tones and Announcements (PLMN-PSTN)

In-band tones and announcements shall be provided for all speech and 3,1 kHz audio bearer services between a PLMN and a PSTN.

9.2 Data Calls

Low Layer Compatibility Checking on the received PLMN bearer capability information element will be carried out by the MSC/IWF to check if the call setup is compatible to the bearer service (3,1 kHz audio) provided by a PSTN and to the IWFs provided by the PLMN.

In case the call setup does not conform to these requirements (e.g. an information transfer capability value "unrestricted digital information" is requested), the call shall fail with an error cause indicating that the network is unable to support the service requested.

As well as compatibility checking subscription checking shall be performed. If the subscription check fails the call setup shall be rejected.

For the case where the ~~MS~~UE offers negotiable values in the PLMN bearer capability information element (e.g. both transparent and non-transparent connection element) refer to the definitions specified in 3GPP TS 27.001.

For interworking of data calls between a PLMN and a PSTN a modem will be utilized to provide the interworking function.

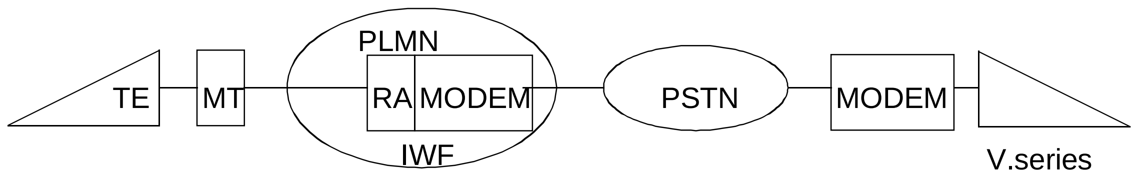


Figure 1: PLMN PSTN interworking for circuit switched calls

9.2.1 Network interworking mobile originated

9.2.1.1 Selection of interworking function

The interworking function will need to negotiate with the user to establish the appropriate modem selection e.g. data rate, modulation scheme, etc. In addition, it will also be required to convert the signalling format, from a combination of out of band and in band, to that suitable for controlling the modem and the autocalling line procedure function where applicable. In the following modem selection procedures it is assumed that the interworking function and modems will be associated with each MSC. As an alternative, a centralized interworking function is possible as a network provider option. This is specified in 3GPP TS 23.054.

For a data call originated by a circuit mode data terminal on the PLMN, the modem selection is done by using the element "modem type" in the call set-up message (bearer capability).

In addition, other elements of the call setup will indicate the user rate, etc. to be used via that modem. The use of this information however means that the network is only able to select a modem from the modem pool which conforms to the speed which the terminal is utilizing at the DTE/DCE interface at the ~~MS~~UE (e.g. V.22 for 1 200 bps). The exception to this is where the user has selected the non transparent service in which case either an autobauding or multi self selecting speed modem (e.g. V.32) may be used.

In case the PLMN-BC(s) received with the set-up message indicated a multislot, 14.4kbit/s, and EDGE-operation (refer to 3GPP TS 27.001) and the network does not support any of the required such services, the PLMN-BC(s) sent with the call proceeding message shall not contain the "fixed network user rate", "other modem type" and "user initiated modification indicator" parameters - the MSC shall discard the multislot or 14.4kbit/s and/or EDGE-related parameters and use the fall-back bearer service indicated by the remaining parameters of the PLMN-BS(s) on a singleslot configuration (refer to 3GPP TS 48.020 and 3GPP TS 44.021) on the MSC/IWF-~~BSS~~ RAN link. The MSC/IWF shall modify the relevant parameters in a possibly present LLC accordingly.

If the MSC supports the multislot, 14.4kbit/s and/or EDGE-operation, the PLMN-BC(s) shall include the "fixed network user rate", "other modem type" and if applicable the "user initiated modification indicator" parameters. The MSC shall apply a singleslot configuration when the "maximum number of traffic channels" indicates '1 TCH' and the "user initiated modification indicator" indicates either 'user initiated modification not requested' or 'user initiated modification up to 1 TCH/F requested', otherwise a multislot configuration (refer to 3GPP TS 48.020 and 3GPP TS 44.021) shall be used on the MSC/IWF-~~BSS~~ RAN link. In case the ~~MS~~UE signals an ACC containing TCH/F4.8 only and the network does not support TCH/F4.8 channel coding, then the MSC may act as if TCH/F9.6 were included in the ACC.

In case the PLMN-BC(s) received with the set-up message did not indicate a multislot, 14.4kbit/s or EDGE-operation, the MSC shall not include the "fixed network user rate", "other modem type" and "user initiated modification indicator" parameters in the PLMN-BC(s) of the call proceeding message - the MSC shall use a singleslot configuration on the MSC/IWF-~~BSS~~ RAN link.

The MSC may negotiate parameters with the ~~MS~~UE according to the rules defined in 3GPP TS 27.001. For multislot, 14,4 kbit/s, and EDGE-operations the MSC/IWF shall modify the relevant parameters in a possibly present LLC accordingly.

9.2.1.2 Modem Selection

In general terms the indication of the bearer capability parameter "Information Transfer Capability" will be utilized in the call set-up message to determine when the modem should be selected in the call.

In case of single calls, the modem function shall operate in the calling mode in case of mobile originated calls and in the answering mode in case of mobile terminated calls.

In case of dual data calls (alternate speech/facsimile group 3) the operation mode of the modem (working in calling or answering mode) depend on the initial call setup direction and on the optional parameter "Reverse Call Setup Direction" information element of the MODIFY message. If this information element is omitted the direction is derived from the initial call setup direction, i.e. the mode is the same as in case of single calls.

For the attribute value "3,1 kHz audio Ex PLMN" and "facsimile group 3", the modem will be selected immediately. The line procedure according to V.25 will then be carried out using the appropriate modem functions.

For the Teleservice 61 "Alternate speech/facsimile group 3", (if speech is selected as the first service), the modem is made available but not selected until the subscriber indicates the change of service request (see subclause 9.3).

For "alternate speech/facsimile group 3" calls refer to 3GPP TS 43.045 (~~GSM~~A/Gb mode) and 3GPP TS 23.146 (~~UMTS~~Iu mode).

9.2.1.3 Mapping of BC-IE from PLMN to ISUP (or other)

As it cannot be determined from the called address whether the distant network is a PSTN or an ISDN the same mapping takes place as for ISDN calls (see table 7A), if ISDN signalling is used between different MSCs (e.g. on the link VMSC - GMSC).

9.2.2 Network Interworking Mobile terminated PSTN Originated

This subclause describes the interworking of calls where the calling subscriber cannot generate or communicate Compatibility Information exhaustive for deducing a PLMN Basic Service to a PLMN (gateway MSC/interrogating node) because of lack of ISDN signalling capability. Thus the HLR is relieved from any compatibility checking for such calls.

Two methods of allocating ~~MS~~UE International ISDN Numbers (MSISDNs) are allowed: Firstly, a separate MSISDN may be allocated for each service, or service option, which a subscriber uses for incoming calls; or, alternatively, a single number, applicable for all incoming calls is used.

It should be noted that it is possible for both schemes to co-exist within the PLMN and that they are not mutually exclusive.

a) Multiple MSISDNs are used ("The Multi-numbering Scheme"). See figure 2.

b) A single MSISDN is used ("The Single-numbering Scheme"). See figure 3.

9.2.2.1 Multi-numbering Scheme

In this scheme, the HPLMN will allocate a number of MSISDNs to a subscriber and associate with each of these numbers a Bearer Capability to identify a Bearer or a Teleservice. This Bearer Capability comprises a complete PLMN Bearer Capability (PLMN BC) information element with contents according to 3GPP TS 27.001 and coded as per 3GPP TS 24.008. In either case, when the HLR receives an interrogation relating to an incoming call (i.e. the MAP "Send Routing Information" procedure), it requests a roaming number (MSRN) from the VLR. This request will contain the PLMN BC reflecting the service associated with the called MSISDN, i.e. the PLMN BC is passed to the VLR within the MAP parameter "GSM Bearer Capability" of the message "Provide Roaming Number".

At the VMSC, when the incoming call arrives, the PLMN BC associated with the MSRN are retrieved from the VLR and sent to the ~~MS~~UE at call set-up.

Where the PLMN specific parameter "connection element" contained in the retrieved PLMN BC-IE, indicates dual capabilities then the VMSC shall set it according to its capabilities/preferences. Additionally the parameters correlated to "connection element" shall be modified in accordance with 3GPP TS 27.001.

The same applies to the parameter modem type if "autobauding type 1" is indicated but the IWF does not support this feature. The parameter "data compression" may also be modified according to the capabilities of the IWF.

Where single capabilities are indicated then the VMSC shall use the requested values if it is able to support the service requested. If it is unable to support the requested service then it shall set them according to its capabilities/preferences.

Where the Compatibility Information is provided in a degree exhaustive to deduce a PLMN Basic Service (see application rules in subclause 10.2.2), then the VMSC in providing the PLMN BC IE in the setup message shall set the PLMN specific parameters to its capabilities/preferences.

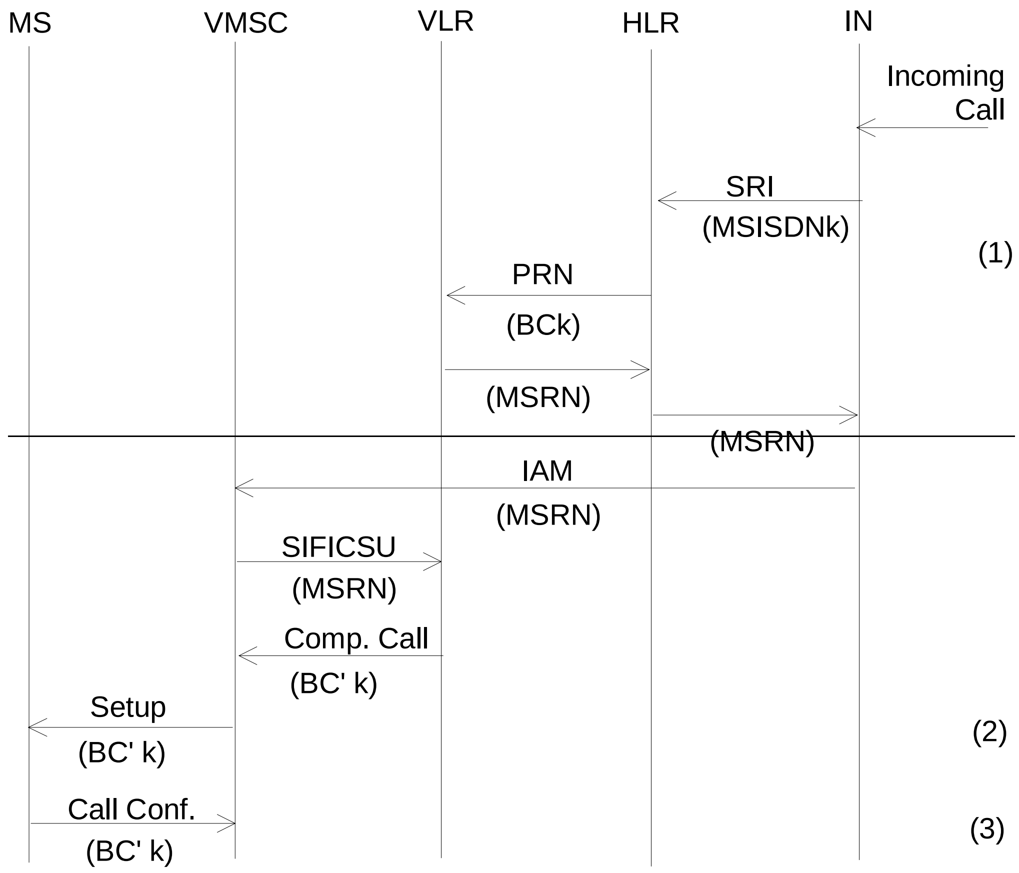
On receipt of a Set-up message containing the compatibility information, the ~~MS~~UE will analyse the contents to decide whether the service can be supported (with or without modification, see 3GPP TS 27.001) and the call will be accepted or rejected as appropriate.

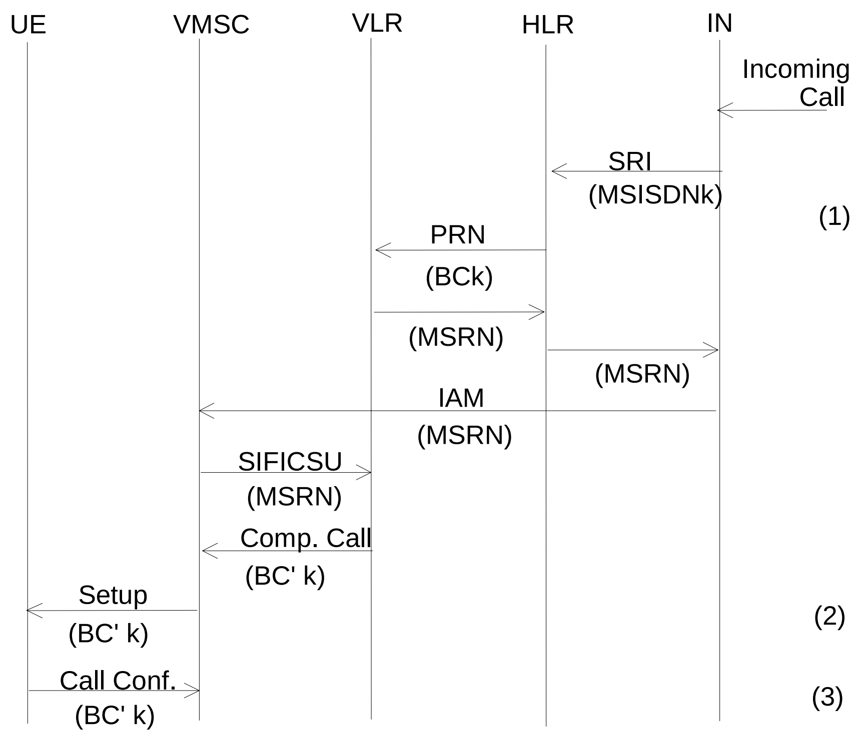
These negotiable parameters in the PLMN BC-IE are: Connection Element (Transparent\non-transparent), Data Compression, number of data bits, number of stop bits and parity as well as the correlated parameters Structure, Intermediate Rate, Modem Type and User Information Layer 2 Protocol. For multislot, 14,4 kbit/s or EDGE--operations additionally the parameters Fixed Network User Rate, Other Modem Type and User Initiated Modification Indicator can be negotiated. For FTM, PIAFS and Multimedia, Rate adaption/Other rate adaption can be negotiated. For FTM and PIAFS, Synchronous/asynchronous can be negotiated, see 3GPP TS 27.001. This negotiation takes place by means of the ~~MS~~UE reflecting back to the MSC a complete bearer capability information element in the call confirm message, with the relevant parameters changed. If this does not take place (i.e. if there is no PLMN BC present in the call confirmed message), than the MSC will assume that the values originally transmitted to the ~~MS~~UE are accepted.

In case the PLMN-BC sent with the set-up message contained the "fixed network user rate", "other modem type" and "user initiated modification parameter" parameters and no multislot, 14,4 kbit/s, and/or EDGE--related parameters (refer to 3GPP TS 27.001) are received in the PLMN-BC of the call confirmed message or no PLMN-BC is received, the MSC shall discard the "fixed network user rate", "other modem type" and "user initiated modification parameter" parameters - the MSC shall use the fall-back bearer service indicated by the remaining parameters of the PLMN-BC on a singleslot configuration (refer to 3GPP TS 48.020 and 3GPP TS 44.021) on the MSC/IWF~~-BSS~~ RAN link.

On the other hand, if the PLMN-BC received with the call confirmed message contain(s) multislot, 14.4kbit/s or EDGE-related parameters the MSC shall apply a singleslot configuration when the "maximum number of traffic channels" indicates '1 TCH' and the "user initiated modification indicator" indicates either 'user initiated modification not requested' or 'user initiated modification upto 1 TCH/F requested', otherwise a multislot configuration (refer to 3GPP TS 48.020 and 3GPP TS 44.021) shall be used on the MSC/IWF~~-BSS~~ RAN link. In case the ~~MS~~UE signals an ACC containing TCH/F4.8 only and the network does not support TCH/F4.8 channel coding, then the MSC may act as if TCH/F9.6 were included in the ACC.

In addition the ~~MS~~UE may propose to the network to modify the User Rate as well as the correlated parameters Modem Type and Intermediate Rate in the CALL CONFIRMED message. The network may accept or release the call. For multislot, 14.4kbit/s or EDGE--operations, the ~~MS~~UE may also propose to the network to modify the Fixed Network User Rate and Other Modem Type parameters (see 3GPP TS 27.001).





NOTES: (1) The HLR translates the received MSISDN_ called address (MSISDNk) into the relevant bearer capability information (BCk).

(2) Some parameters of BCk may be provided/modified according to the MSC's capabilities/preferences. See subclause 9.2.2.

(3) In the "Call Confirm" message, the ~~MS~~UE may modify some parameters of the BC. See subclause 9.2.2.

Abbr.:

SRI -	Send Routing Information.
PRN -	Provide Roaming Number.
MSRN -	Mobile Station Roaming Number.
IAM -	Initial Address Message.
SIFICSU -	Send Information For Incoming Call Set Up.

Figure 2: Call Flow for a mobile terminated, PSTN originated call where the compatibility information provided are not exhaustive for deducing a PLMN Bearer Service; HLR uses multiple MSISDN numbers with corresponding BCs

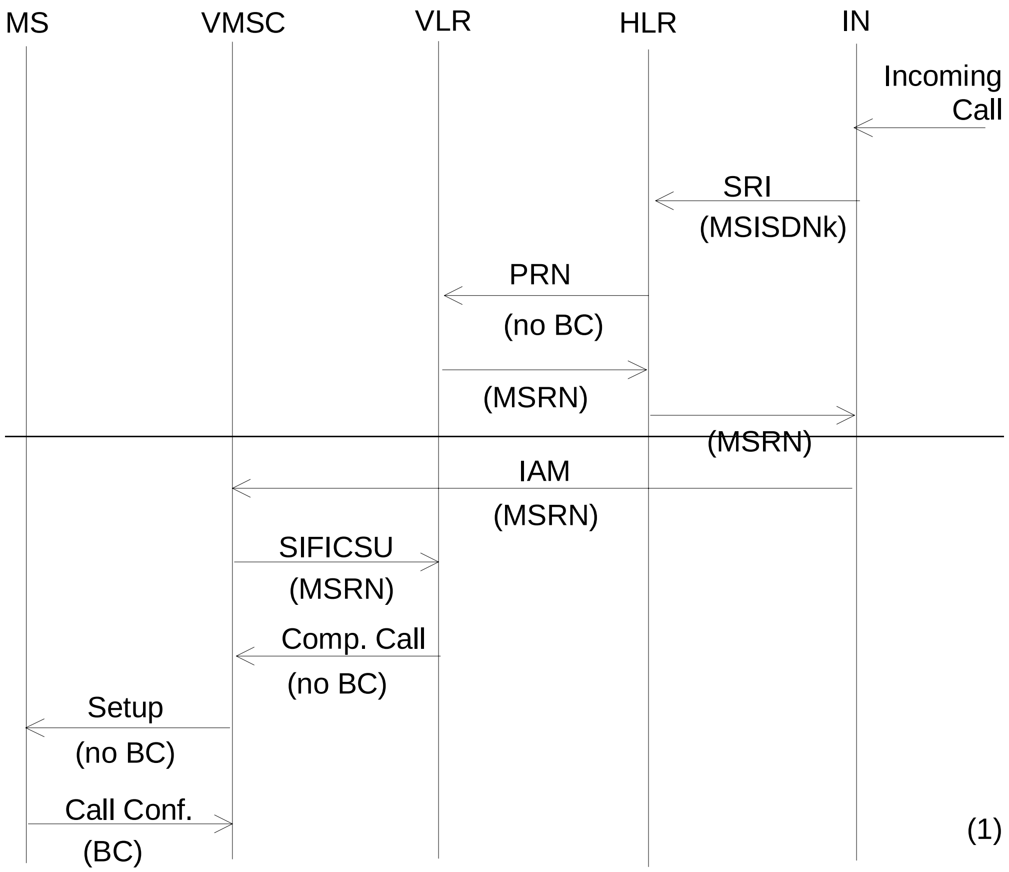
9.2.2.2 Single-numbering Scheme

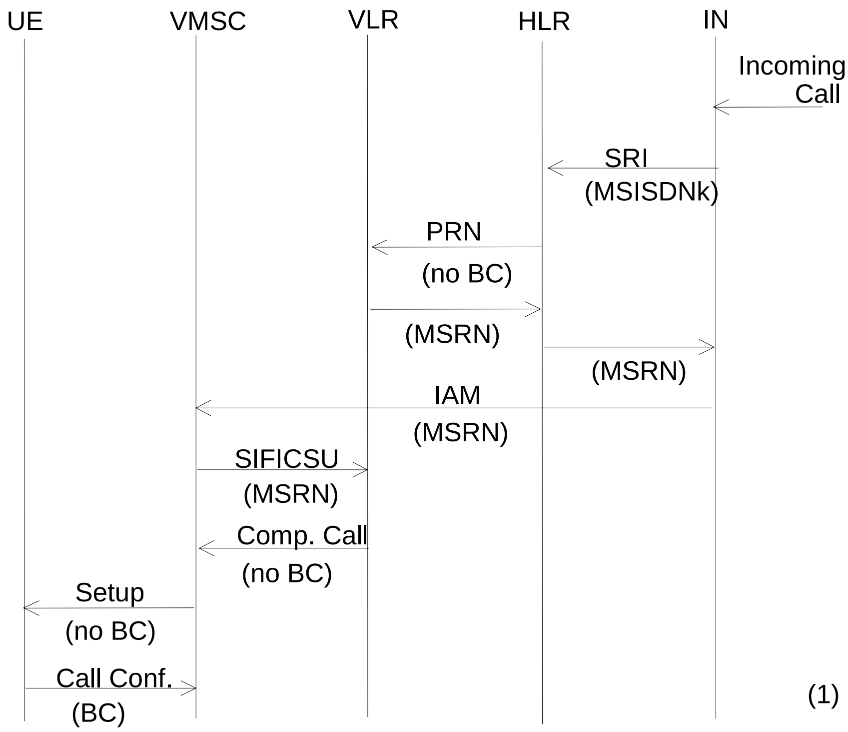
In the single-numbering scheme, the HPLMN will allocate one MSISDN to a subscriber, applicable to all services.

In this case, when the HLR receives an interrogation relating to an incoming call without compatibility information exhaustive for deducing a PLMN Basic Service (i.e. the MAP "Send Routing Information" procedure), the request to the VLR for a roaming number will not contain compatibility information i.e. a PLMN BC.

At the VLR, when the incoming call arrives, there is no PLMN BC associated with the MSRN and so the call set-up to the mobile will not contain the PLMN BC element.

In this case, the ~~MS~~UE will return a complete single or dual PLMN BC in the Call Confirmed message, indicating the service required by the mobile subscriber. The VMSC will analyse this PLMN BC and optionally perform subscription checking (see 3GPP TS ~~4~~22.001). If the requested PLMN BC can be supported the call is established, otherwise the call will be released.





NOTE: (1) This BC is derived from information stored in the ~~MS~~UE, according to its configuration.
(2) Abbreviations: see figure 2.

Figure 3: Call Flow for a mobile terminated, PSTN originated call where the compatibility information provided are not exhaustive for deducing a PLMN Bearer Service; HLR uses single MSISDN numbers (no corresponding BC stored). Per call MSRN allocation

9.2.3 Transparent service support

The protocol stacks for transparent services are specified in 3GPP TR 43.010 (~~GSM~~A/Gb mode) and in 3GPP TR 23.910 (~~UMTS~~Iu mode).

In ~~UMTS~~Iu mode, the transparent services are based in the Iu User Plane protocol specified in 3GPP TS 25.415.

In ~~GSM~~ A/Gb mode the rate adaptation scheme shall be utilized on the ~~BSS~~ RAN to MSC link as identified in 3GPP TS 48.020. The transcoding function will generate the 64 kbit/s rate adapted format utilizing the 8 and 16 kbit/s intermediate data rates. The MSC to MSC/IWF link (e.g. in the case of handover) will utilize the same 64 kbit/s rate adaptation scheme as that indicated in 3GPP TS 48.020.

For the transparent service support the MSC/IWF will select the modem and speed based on the Compatibility information contained in either the call set-up or call confirmed message reference subclause 9.2.1 and 9.2.2. Where the modem type indicated is one of the multi-speed versions, e.g. V.32, then the MSC/IWF will restrict the modem to the speed indicated in the call set-up and call confirmed message, respectively, i.e. will inhibit the modem from changing speed, irrespective of the conditions, error rate, encountered on the PSTN link. This scenario is also applicable for the use of "autobauding" modems, in that only the specifically requested modem type and speed will be selected at the MSC/IWF (however Facsimile Group 3 can use channel mode modify).

9.2.3.1 ~~Structure of the MSC/IWF for UMTS~~Structure of the MSC/IWF for Iu mode

The transmission towards the RNC is based on AAL2. The Iu UP is used in the transparent mode.

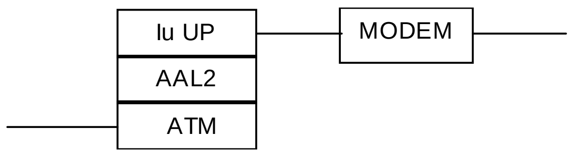


Figure 4: Structure of MSC/IWF

~~9.2.3.2 Structure of the MSC/IWF for GSM~~9.2.3.2 Structure of the MSC/IWF for A/Gb mode

The rate adaptation process is a reverse of that provided in the Terminal Adaptation function of the ~~MS~~UE. The rate adaptation RA1 is based on the ITU-T V.110 80 bit frame for TCH/F2.4, TCH/F4.8 and TCH/F9.6 and on A-TRAU frame for TCH/F14.4. 3GPP TS 44.021 and 48.020, respectively, refer to the rate adaptation mechanisms to be provided. For multislot configurations refer to 3GPP TR 43.010.

NOTE: From MSC/IWF's perspective a TCH/F28.8 EDGE configuration is identical to a multislot 2×TCH/F14.4 configuration.

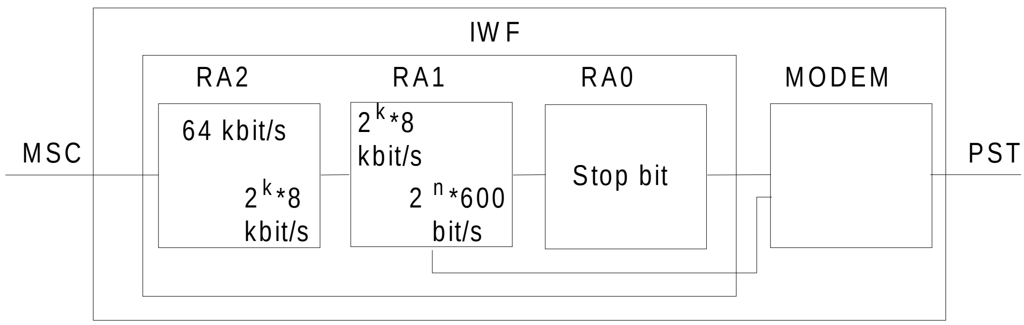


Figure 5: Rate adaptation schematic

In case of asynchronous bearer services and the facsimile teleservices in the transparent mode, the IWF shall disregard the value of bits E4, E5, E6 and E7 in the data transmission phase.

9.2.3.3 Mapping of signalling ~~MS~~UE/MSC/IWF to modem interface requirements

This process also is a reverse of the function provided in the Terminal Adaptation function of the ~~MS~~UE for the mapping of DTE/DCE signalling information to Dm channel and in band signalling information. 3GPP TS 27.002, and 3GPP TS 27.003 refer.

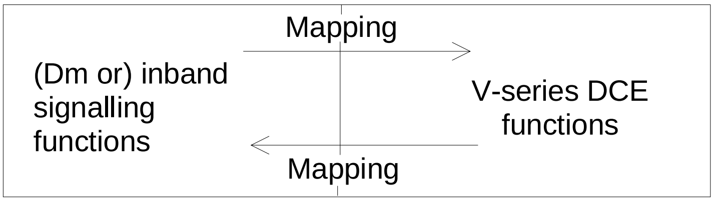


Figure 6: Signalling mapping schematic

Status bits SA, SB and X can be used to convey channel control information associated with the data bits in the data transfer state. Table 5 shows the mapping scheme between the V.24 circuit numbers corresponding to the V-series DCE functions and the status bits for the transparent mode. It also shows how the unused status bits should be handled. It is derived from the General Mapping scheme described in annex B. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition.

The transport of these status bits by the various channel codings is described in 3GPP TS 44.021 and 48.020 for ~~GSM~~A/Gb mode. For ~~UMTS~~ Iu mode refer to 3GPP TR 23.910.

NOTE Although the interface to the modem is described in terms of V.24 interchange circuit functions, this does not imply that such circuits need to be physically realised.

Table 5: Mapping scheme at the IWF for the transparent mode

Mapping direction: ~~MS~~UE to IWF	Mapping direction: IWF to ~~MS~~UE	Signal at IWF modem interface or condition within the IWF
always ON (note 1)		CT 105
	to status bit X	CT 106
	not mapped (note 5)	CT 107
not mapped (note 6)		CT 108
	to status bit SB	CT 109
always ON (note 2)		CT 133
from status bit SA (note 3)		ignored by IWF
from status bit SB (note 1)		ignored by IWF
from status bit X (note 4)		ignored by IWF
	to status bit SA (note 3)	always ON
NOTE 1: The SB bit towards the IWF, according to the General Mapping (annex B), could be used to carry CT 105 from the mobile DTE to the modem in the IWF. However, CT 105 should always be ON at the DTE interface in the data transfer state since only duplex operation is supported. Also, many DTEs use the connector pin assigned to CT 105 for CT 133. Therefore, CT 105 shall always be set to ON at the IWF modem during the data transfer state. NOTE 2: CT 133 is not mapped since there is no flow control in transparent mode. NOTE 3: The SA bits in both directions are available only with certain channel codings. Therefore, for maximum compatibility, they should not be mapped. NOTE 4: The X bit towards the IWF is not mapped since there is no flow control in transparent mode. NOTE 5: CT 107 is not used by the IWF. NOTE 6: CT 108 is used in the call setup and answering processes.		

In general it is not required for the modem in the MSC/IWF to support a "remote looping" request from a modem in the PSTN. In addition the invocation of a "remote looping" request from the mobile subscriber to a modem in the PSTN need not be supported (see also 3GPP TS 27.001). Specific test loops for mobile subscribers to contact may be provided at the network operators discretion.

9.2.3.4 Establishment of end-to-end terminal synchronizations

Prior to exposing the traffic channel of a PLMN connection to transmission of user data, the controlling entities of the connection shall assure of the availability of the traffic channel. This is done by a so called synchronizations process:

- starting on the indication of "physical connection established" resulting from the PLMN-inherent outband signalling procedure. This indication is given on sending the message CONNECT in case of MOC, CONNECT ACKNOWLEDGEMENT in case of MTC and MODIFY COMPLETE (which is sent after reception of the ASSIGN COMPLETE message) in case of in-call modification;

- ending by indicating the successful execution of this process to the controlling entity, which then takes care of the further use of the inband information (data, status).

Network interworking within an MSC/IWF is concerned with the terminating side (to the ~~MS /~~UE) and the transit side (to the fixed network) of a connection. Both sides have to be treated individually related to the synchronizations process.

9.2.3.4.1 Terminating side (towards the ~~MS /~~UE)

9.2.3.4.1.1 ~~GSM~~ Traffic channel types TCH/F4.8 and TCH/F9.6 for A/Gb mode

With respect to the terminating side the procedure is as follows:

- sending of synchronizations pattern 1/OFF (all data bits"1"/all status bits "OFF") to the ~~MS~~UE using the RA1/RA2 rate adaptation function. In multislot transparent operation, the synchronisation pattern sent is 1/OFF with the exception of the bit positions S1, first X, S3, and S4 which contain the substream number and multiframe alignment pattern (Ref. 3GPP TS 44.021);

- searching for detection of the synchronizations pattern from the ~~MS~~UE within valid V.110 frames, and in multislot operation, also searching for the multiframe alignment pattern "0000 1001 0110 0111 1100 0110 1110 101" (Ref. to 3GPP TS 44.021) in bit position S4 and substream numbers in bit positions S1, first X, and S3. This implies that the E1, E2 and E3 bit of the V.110 frame shall be checked for the appropriate user rate in order to distinguish the synchronization pattern from the ~~BSS~~ RAN idle data frame;

- timer T (= 500 ms) is started for each of the allocated traffic channel(s) of the call on receipt of the synchronizations pattern from the ~~MS~~UE;

- when the frame alignment pattern and, in case of multislot operation, the multiframe alignment pattern have been recognized as a steady state, the MSC/IWF continues sending the synchronizations patterns to the ~~MS~~UE until a timer T expires.

9.2.3.4.1.2 ~~GSM~~ Traffic channel type TCH/F14.4 for A/Gb mode

With respect to the terminating side the procedure is as follows:

- sending A-TRAU frames with the data rate set in the bits C1-C4 (TS 48.020) and data bits set to one, sending the multiframe structure with the alignment pattern (bit M1) and with the status bits OFF (bit M2) and, in a multislot case, sending substream numbers (bit M2);

- searching for the detection of the multiframe alignment pattern "0000 1001 0110 0111 1100 0110 1110 101" (TS 44.021) in the bit M1 and, in a multislot case, searching for substream numbers in the bit M2. (Any 5 bit sequence in the multiframe alignment pattern is unique, i.e. the multiframe alignment can take place by recognition of five successive M1 bits);

- timer T (= 500 ms) is started for each of the allocated traffic channel(s) of the call on receipt of the synchronizations pattern from the ~~MS~~UE;

- when the frame alignment pattern and the multiframe alignment pattern have been recognized as a steady state, the MSC/IWF continues sending the synchronizations patterns to the ~~MS~~UE until a timer T expires.

9.2.3.4.1.3 ~~UMTS~~ User Plane for Iu mode

The IWF does not send any frame down link until the modem connection has been established and the modems have synchronised. Thereafter the IWF through connects, mapping data from the fixed network side onto frames that are sent toward the ~~MS~~UE, and mapping data in the received frames to the fixed network side.

9.2.3.4.2 Transit side (towards the fixed network)

With respect to the transit side the procedure is as follows:

- at the start of timer T for each of the allocated traffic channel(s) of the call, circuit 108 to the selected modem associated with the connection will be switched from the "OFF" to "ON" condition, thus initiating the establishment of the modem connection. In the case of mobile originated calls, this initiates the auto calling sequence and after signalling, calling tone according to V.25 shall be generated by the modem in the IWF;
- the interchange circuits towards the modem (with the exception of CT108) are held in the OFF condition until timer T expires, when they are switched to ON;
- from this time, after the expiration of the timer T of every allocated traffic channel, the information on CT106 and CT109 from the IWF Modem are directly mapped to the SB and X bits toward the ~~MS~~UE. For TCH/F14.4 the SB and X bits are mapped to the M2 multiframe bits according to 3GPP TS 44.021. The IWF is allowed to map CT104 to the data bits sent towards the ~~MS~~UE and to map data bits received from the ~~MS~~UE to CT103.

9.2.3.5 Network Independent Clocking (NIC)

The network independent clocking function applies only to ~~GSM~~A/Gb mode. It is invoked by the VMSC/IWF when the service requested (MO or MT) is 3,1 kHz Ex PLMN and synchronous. The above rule applies irrespective of the information contained in the 3GPP TS 24.008 setup message regarding NIC. For all other services NIC is not used.

Within the ~~GSM network~~ PLMNthe coding of the values for bits associated with NIC is specified in 3GPP TS 44.021/48.020. In the forward (transmitting) direction the multiframes shall be coded in exact accordance with that specified in those ~~GSM~~ specifications. Bit E6 is set to "1" in alternate modified V.110 frames at the transmitter. However, the use of this bit at the receiver for monitoring frame synchronization, or any other purpose, is not specified and is left to the discretion of the implementer.

A "perfect linear block Code" is used in C1-C5, whose error correction properties may be utilized in the receiver, in order to ensure reliable operation of NIC.

The NIC sending function shall recognize when the difference between the applicable clock speed of the ~~GSM network~~PLMN and the interface speed generates a positive or negative whole bit requirement. When this positive or negative condition occurs, the NIC codewords specified in 3GPP TS 44.021 are used to transport this condition to the receiving NIC function. Transmission of the codeword shall clear the positive or negative condition related to that codeword at the sending function. The sending function shall not send more than one positive or negative compensation within a contiguous period of time corresponding to 10 000 user data bits minus the maximum NIC code framing delay (e.g. in the case of TCH/F2.4, TCH/F4.8 or TCH/F9.6, the number of user data bits necessary to make up an even number of V.110 frames between compensation). NIC compensation is coded in two V.110 frames in the case of TCH/F2.4, TCH/F4.8 or TCH/F9.6 and in one multiframe in the case of TCH/F14.4. This results from the requirements to compensate for maximum clock differences of ±100 parts per million. If the receiving function receives NIC compensations in the average more often than a contiguous period of time corresponding to 10000 user data bits, there is no guarantee that data will not be lost.

The NIC receiving function shall provide the capability to support the compensation requirements of the sending function. This compensation is managed by manipulating the clock speed of the interface, within the standard constraints of that interface.

Overall, the compensation functions shall be capable of managing clock tolerances of ±100 parts per million.

Action on loss of synchronization.

If five consecutive NIC multiframes in the V.110 frame have incorrect framing bit values in E7 or if the A-TRAU multiframe synchronisation is lost, the receiver shall stop applying clocking compensation to the received data. Resynchronization will be attempted and compensation will resume when synchronization is achieved.

9.2.4 Non-transparent service support

The protocol stacks for non-transparent services are specified in 3GPP TR 43.010 (~~GSM~~A/Gb mode) and in 3GPP TR 23.910 (~~UMTS~~Iu mode). Both of the systems use the Radio Link Protocol (RLP) specified in 3GPP TS 24.022.

In ~~UMTS~~Iu mode, the non-transparent services are based in the Iu User Plane protocol specified in 3GPP TS 25.415.

In ~~GSM~~ A/Gb mode the corresponding necessary support concerning the rate adaptation scheme shall be utilized on the ~~BSS~~RAN-MSC link as identified in 3GPP TS 48.020.

For the non-transparent service support the MSC/IWF will select the modem and speed based on the Compatibility information contained in either the call set-up or call confirmed message, reference subclauses 9.2.1 and 9.2.2. Where the Modem Type indicated is autobauding type 1, the MSC/IWF may select any speed and modem type according to what it can negotiate with the remote modem. In this case User Rate and Fixed Network User Rate, if present, has no meaning.

~~9.2.4.1 Structure of the MSC/IWF for UMTS~~9.2.4.1 Structure of the MSC/IWF for Iu mode

The transmission towards the RNC is based on AAL2. The Iu UP is used in the support mode. The RLP/L2R extends to the ~~MS~~UE.

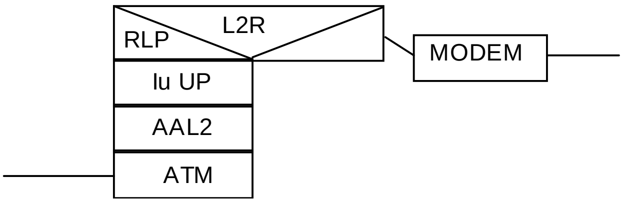


Figure 7: Structure of MSC/IWF

~~9.2.4.2 Structure of the MSC/IWF for GSM~~9.2.4.2 Structure of the MSC/IWF for A/Gb mode

The rate adaptation process will be the same as for the transparent case (see figure 5), except that a TCH/F43.2 channel coding is also supported. From MSC/IWF's perspective a TCH/F43.2 EDGE configuration is identical to a multislot 3×TCH/F14.4 configuration.

3GPP TR 43.010 identifies the protocol layer structures for the non-transparent case, the physical layer to the PSTN is provided by means of a modem.

9.2.4.3 Re-constitution of user data

3GPP TS 24.022 refers to the frame of user data in the radio link protocol. The layer 2 relay functions in the ~~MS~~UE and the MSC/IWF (identified in 3GPP TR 43.010) contain the mechanism for packing and unpacking the user data into the L2R protocol data units.

9.2.4.4 Layer 2 relay functionality

Specific functionality is required of the L2R dependant upon the service which is being requested to be supported. The selection of the appropriate L2R function will be determined by the MSC/IWF on the basis of the bearer capability information signalled in either the call set-up request, or call confirmation messages. The prime information element being transparent or non transparent service indication. In addition the particular L2R function will be selected on the basis of the users layer 2 indication - type of protocol to be terminated and mode of flow control to be applied (see appropriate clauses of the 3GPP TS 27 series).

The specific interaction between the L2R function and the RLP function and the L2R frame structure will be the same as that detailed in the annex to the appropriate 3GPP TS 27 series.

9.2.4.5 In band signalling mapping flow control

This entails the L2R function providing the means of controlling and responding to flow control functions of the modem plus any synchronization requirements related to flow control. For asynchronous services a specific rule applies for flow control (see 3GPP TS 27.001).

The flow control function chosen will be dependent upon the information contained or not contained in the "user information layer 2" information element of the PLMN BC received from the ~~MS~~UE.

If flow control is provided, irrespective of the type used the L2R function shall:

(a) provide immediate indication of flow control to the fixed network on receipt of flow control request from the ~~MS~~UE; and/or

(b) provide immediate indication of flow control to the ~~MS~~UE on receipt of flow control request from the fixed network i.e. in the next available L2R status octet to be transmitted.

Where in-band (X-on/X-off) flow control is in use, then the X-on/X-off characters will not be passed across the radio interface.

For outband flow control refer to subclause 9.2.4.9.

If no flow control is provided, the involved end systems are responsible for performing in-band flow control on their own by taking into account the buffer capacity of the MSC/IWF stated below.

9.2.4.5.1 Conditions requiring flow control towards the fixed network

The L2R function will initiate flow control - if flow control is present - in the following circumstances:

1) the transmit buffer reaches a preset threshold (BACK PRESSURE);

2) the L2R function receives an explicit "flow control active" indication.

No flow control initiation/removal will take place at the L2R function and loss of data may occur if no flow control is provided.

On removal of buffer congestion or receipt of L2R "flow control inactive" the flow control will be removed.

9.2.4.5.2 Conditions requiring flow control towards the ~~MS~~UE

The L2R function will transmit to the ~~MS~~UE an explicit "flow control active indication" if flow control is provided in the following circumstances:

1) if the receive buffer from the radio side reaches a preset threshold (BACK PRESSURE);

2) if a flow control indication is received from the fixed network customer. On receipt of this flow control indication, transmission of data from the receive buffers towards the fixed network terminal is halted.

On removal of the buffer congestion or fixed network flow control indication, the L2R function will send a "flow control inactive" indication towards the ~~MS~~UE. In addition, for the fixed network indication, transmission of data from the receive buffers will be restarted.

If no flow control is provided at the L2R function, no flow control initiation/removal will take place by the MSC/IWF. Data might be lost without any indication by the MSC/IWF to the end systems involved.

9.2.4.6 Data buffers

9.2.4.6.1 Transmit buffers (towards ~~MS~~UE)

Incoming data from the fixed network customer shall be buffered such that if the MSC/IWF is unable to transfer data over the radio path the data is not lost.

The buffer shall be capable of holding the data. Its size is up to the implementers. When the buffer is half full flow control towards the fixed network shall be initiated if flow control is provided as per subclause 9.2.4.5.1.

9.2.4.6.2 Receive buffers (from ~~MS~~UE)

Incoming data from the ~~MS~~UE is buffered such that if the fixed network terminal is unable to accept the data then it is not lost.

The buffer shall be capable of holding the data. Its size is up to the implementers. When the buffer becomes half full, the L2R function will send a "flow control active" indication towards the ~~MS~~UE if flow control is provided at the L2R function, as per subclause 9.2.4.5.2.

9.2.4.7 Transportation of the Break condition

The "BREAK" condition shall be recognized by the L2R function and passed immediately to the ~~MS~~UE. The L2R will generate a "BREAK" condition towards the fixed network on receipt of a break indication from the ~~MS~~UE. The action of the "BREAK" on the L2R transmit and receive and the length of the "BREAK" signal to be generated towards the fixed network is described in 3GPP TS 27.002.

9.2.4.8 In band signalling mapping modem status information

Status information is carried between the modem in the IWF and the terminal adaptation function in the ~~MS~~UE by the L2R function. The L2RCOP entity transfers interface status information between L2Rs via the status octets SA, SB and X in L2RCOP-PDUs (3GPP TS 27.002). Table 6 shows the mapping scheme between the V.24 circuit numbers corresponding to the V-series DCE functions and the status bits for the non-transparent mode. It also shows how the unused status bits should be handled. It is derived from the general mapping scheme described in annex B. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition.

NOTE Although the interface to the modem is described in terms of V.24 interchange circuit functions, this does not imply that such circuits need to be physically realised.

Table 6: Mapping scheme at the IWF for the non-transparent mode

Mapping direction: ~~MS~~UE to IWF	Mapping direction: IWF to ~~MS~~UE	Signal at IWF modem interface or condition within the IWF
always ON (note 1)		CT 105
	to status bit X (notes 4, 7)	CT 106 (note 7)
	not mapped (note 5)	CT 107
not mapped (note 6)		CT 108
	to status bit SB	CT 109
from status bit X (note 8)		CT 133 (notes 3, 8)
from status bit SA (note 2)		ignored by IWF
from status bit SB (note 1)		ignored by IWF
	to status bit SA (note 2)	always ON

NOTE 1: The SB bit towards the IWF, according to the General Mapping (annex B), could be used to carry CT 105 from the mobile DTE to the modem in the IWF. However, CT 105 should always be ON at the DTE interface in the data transfer state since only duplex operation is supported. Also, many DTEs use the connector pin assigned to CT 105 for CT 133. Therefore, CT 105 shall always be set to ON at the IWF modem during the data transfer state.
NOTE 2: The SA bits (both directions) are not mapped since CTs 107 and 108 are handled locally (notes 5 and 6).
NOTE 3: The condition of CT 133 (or other flow control mechanism) may also be affected by the state of the L2R transmit buffer (towards the ~~MS~~UE) in the IWF and the state of RLP (RR/RNR).
NOTE 4: The condition of status bit X towards the ~~MS~~UE may also be affected by the state of the L2R receive buffer (from the ~~MS~~UE) in the IWF.
NOTE 5: CT 107 is not used by the IWF.
NOTE 6: CT 108 is used in the call setup and answering processes.
NOTE 7: For inband flow control, CT 106 is not mapped and the status bit X towards the ~~MS~~UE is controlled by the reception of XON and XOFF characters from the modem.
NOTE 8: For inband flow control, changes in the condition of the status bit X from the ~~MS~~UE result in the sending of XON or XOFF to the modem. CT 133 is always set to ON.

9.2.4.9 Support of out-band flow control

Out-band flow control in case of the asynchronous bearer service requires V.42 functionality in the modems in the MSC/IWF and the fixed network.

If this functionality is requested by the ~~MS~~UE but cannot be provided by the MSC/IWF or the remote (fixed network) modem for any reason, the call shall be supported without V.42 functionality (fall back to the non-error correction mode according to V.42).

This implies that no flow control initiation/removal (refer to subclause 9.2.4.5.1) is possible towards the fixed network. In this case the L2R transmit buffers in the IWF (towards the ~~MS~~UE, refer to subclause 9.2.4.6.1) shall overbridge temporary throughput problems on the radio interface and the case where the ~~MS~~UE initiates flow control. The IWF however shall release the connection if an overflow of these buffers occurs.

9.2.4.10 Establishment of end-to-end terminal synchronizations

Prior to exposing the traffic channel of a PLMN connection to transmission of user data, the controlling entities of the connection shall assure of the availability of the traffic channel. This is done by a so called synchronization process:

- starting on the indication of "physical connection established" resulting from the PLMN-inherent outband signalling procedure. This indication is given on sending the message CONNECT in case of MOC, CONNECT ACKNOWLEDGEMENT in case of MTC and MODIFY COMPLETE (which is sent after reception of the ASSIGN COMPLETE message) in case of in-call modification;

- ending by indicating the successful execution of this process to the controlling entity, which then takes care of the further use of the in-band information (data, status).

Network interworking within an MSC/IWF is concerned with the terminating side (to the ~~MS~~UE) and the transit side (to the fixed network) of a connection. Both sides shall be treated individually related to the synchronization process.

9.2.4.10.1 Terminating side (towards the ~~MS /~~ UE)

With respect to the terminating side the procedure in ~~GSM~~ A/Gb mode is as follows:

- reception of V.110 or A-TRAU frames on all allocated traffic channels for the call is required before the MSC/IWF shall reply with an RLP-UA frame to the MT's RLP link establishment request (if the MSC/IWF initiates the RLP link establishment, reception of V.110 frames or A-TRAU on all allocated traffic channels for the call shall be detected first);

- waiting for the RLP link establishment by the MT (in addition the MSC/IWF may initiate the RLP establishment).

In ~~UMTS~~ Iu mode at the IWF, the synchronisation of modems on the transit network is performed after establishment of the physical connection. The RLP establishment may be initiated by the IWF, but is normally initiated by the ~~MS~~UE. If the modems synchronise before the RLP has been established, the IWF stores the information received from the other modem in the L2R buffers.

9.2.4.10.2 Transit side (towards the fixed network)

Depending upon implementation - CT108 will be turned ON to enable the autocalling/autoanswering function of the selected modem either when the RLP has been established or in parallel to RLP establishment. If CT 108 is turned ON in parallel to the RLP establishment, the modem connection may be established before the RLP is established. In this case, data received from the transit side during RLP establishment shall be stored within the L2R buffers until the RLP establishment at the terminating side has been finished. When the RLP has been established, the information from/to the RLP including status changes will be mapped by the L2R entity applicable to the particular bearer capability. After signalling, for MO calls, calling tone according to V.25 shall be generated by the modem in the IWF.

9.2.4.11 Data compression

When data compression is invoked within a non-transparent bearer service, interworking to the fixed network is realized as follows.

The PLMN BC is used to indicate the interworking modem type and user rate. The modems shall try to negotiate data compression and flow control. If negotiation of data compression fails in the fixed network, the call continues with data compression between ~~MS~~UE and IWF only.

9.2.4.12 Service level up and down grading

Service level up and down grading is only applicable for ~~GSM~~A/Gb mode. If the value of the RLP parameter "UP signalling" is negotiated to 1, the IWF shall send a suggestion to the ~~MS~~UE to initiate an upgrading whenever the following condition holds:

The IWF:

1) is receiving user data from the fixed network side at a higher rate than the current AIUR; or

2) in symmetrical calls only, can send user data towards the fixed network side at a higher rate than the current AIUR.

When the above condition does not hold, the IWF sets the value of the UP bit continuously to 0. When the condition above does hold, the IWF indicates the number of traffic channels to upgrade by, by sending that number of 1s between two consecutive 0s in the UP bit sequence. This indication is not repeated since the FCS protects it. For instance, if the current number of traffic channels is two and an upgrading to four traffic channels is suggested, the UP bit sequence shall be ..01100... How the IWF detects the condition and additional details for setting and resetting of the UP bit, e.g., hysteresis levels, may depend on implementation. NOTE: From MSC/IWF's perspective a TCH/F28.8 or TCH/F43.2 EDGE configuration is identical to a multislot 2×TCH/F14.4 or 3×TCH/F14.4 configuration. In this case, rather than suggesting the number of channels to add, the IWF suggests a number of 14.4 substreams to add and therefor a factor of 1/2 or 1/3 shall be applied to the suggested increase when the assigned up link channel is TCH/F28.8 or TCH/F43.2 respectively.

9.2.5 DTE/DCE interface (Filtering)

The DTEs taken into account for the PLMN at the ~~MS~~UE side conform to ITU-T's DTE/DCE interface specifications, which assume basically an error-free environment, i.e.:

- limited distance, point-to-point local interconnection of the interface circuits for data and status;
- steady state signalling.

The envisaged use of these DTE's in the PLMN environment leads to the exposure of these "interconnections" - which may, in the ISDN case, lead to the ISDN Rate Adaptation rather than to a Modem in the MSC/IWF - to the PLMN Radio Channel. To assure proper operation even under these conditions appropriate measures shall be taken. In the "non-transparent case" the RLP satisfies the requirement for both data and status lines. In the "transparent" case, the:

- data line aspects shall be dealt with end-to-end between the users; while
- status line aspects are of concern to the network which are dealt with in the following.

The use of the channel control information for the remote control of the DTE/DCE control interchange-circuits between the ~~MS~~UE and the MSC/IWF (the conveyance of which is supported by the rate adaptation scheme adopted for PLMN application) requires alignment to the particular transmission occurrences in the traffic channel to be taken into account within the PLMN. In principle this can be best achieved by:

- relying only on the PLMN outband signalling as far as connection control is concerned;
- eliminating the dependence upon the transmission of channel control information via the radio link.

Support for this strategy is given to a certain extent by the confinement of PLMN data connections to:

- full duplex operation (no turning round of the connection is required);

- switched service (demand access);

- mapping of connection-control relevant conditions of the DTE/DCE control interchange-circuits to/from outband PLMN signalling according to 3GPP TS 24.008 after successful traffic channel synchronization;

- flow control by a network entity supported only in non-transparent mode;

- support of connections with the same user data rate only (no TA to TA end-to-end flow control in case of transparent mode).

The only DTE/DCE control interchange-circuit conditions, which actually are not covered by the above confinements, are the indications of readiness for data transmission, i.e. CT106/109 in case of V.-series interface and I-circuit of X.-series interface. As the effect of a condition change of the afore-mentioned DTE/DCE interchange-circuits depends on the:

- phase within the course of the connection;

- direction of change (ON-OFF or OFF-ON).

The required precaution to be applied (Filtering) shall be determined individually in view of:

- function deduced from the change;

- resilience of the connection needed;

- error condition possibly invoked due to a delay in performing the condition change of the control interchange circuit;

- potential loss of performance in connection usage.

The details of the filtering function are laid down in 3GPP TS 27- series. Filtering of channel control information is only relevant at the ~~MS~~UE side in the transparent mode of operation.

9.3 Interworking Alternate Speech / Facsimile Group 3 Calls

9.3.1 General

The procedure for the alternate speech/facsimile group 3 services is invoked at ~~MS~~UE-MSC link during the call set-up phase. This service is invoked by indication of repeated bearer capability information elements in the setup message and/or call confirmed message respectively (preceded by a repeat indicator "circular"), one indicating speech and the other indicating facsimile group 3. The facsimile service requested will be indicated by the information transfer capability "facsimile group 3", as for a normal single call. The bearer capability first indicated i.e. speech or facsimile group 3 determines the first selection required of the network by the subscriber. Depending on the type of service requested and direction of call establishment (M0/MT, see relevant clauses of 3GPP TS 27 series) low layer and high layer capabilities may also be included. The MSC/IWF will perform both compatibility checking and subscription checking on both sets of capabilities as for normal data calls. If either the subscription check or the compatibility check fails then the call will be rejected. The only exception to this is when TS61/TS62 negotiation takes place, see 3GPP TS 27.001.

The applicable rules for provision of supplementary services are laid down in 3GPP TS 22.004.

The "speech" phase of the call, when invoked is handled by the transcoder and will utilize normal telephony teleservice interworking requirements and mobile network capabilities. This includes any requirements for echo cancellers etc. as indicated in subclause 9.1. The "facsimile group 3" phase of the call, when invoked, shall utilize the appropriate data interworking capability (IWF including modem) and shall use the transparent mobile network capability in ~~GSM~~ A/Gb mode or the non-transparent mobile network capability in ~~UMTS~~Iu mode.

The network shall provide, for service and operational reasons, a rapid and reliable changeover of capability upon request from the mobile user. This changeover may involve the disabling, by-passing or introduction of particular network functions (e.g. speech coder, modem etc.) and change of the channel configuration on the radio interface. This changeover is initiated on the receipt of the "MODIFY" message (see 3GPP TS 24.008) from the ~~MS~~UE. The network itself will not initiate a changeover.

9.3.2 Mobile originated PSTN terminated calls

The call is set up in the normal manner (but with repeated bearer capability information elements as described in subclause 9.3.1 and handled by the MSC/IWF as indicated in the general clause.

9.3.3 PSTN originated mobile terminated calls

The call set up request for this particular service is performed in a similar manner to that indicated in subclause 9.2 for normal PSTN originated calls.

When multiple MSISDNs are used by the HLR ("Multi-numbering scheme"), one PLMN BC-IE with the ITC value set to "alternate speech/facsimile group 3, starting with speech" is passed to the VLR in the MAP operation "provide roaming number". The VLR stores this information against the MSRN.

When the call arrives at the visited MSC this information is retrieved from the VLR and sent to the ~~MS~~UE in the setup message as defined in 3GPP TS 27.001.

If the ITC of the PLMN BC-IE retrieved from the VLR has the value "alternate speech/facsimile group 3, starting with speech" this PLMN BC-IE shall be mapped to two PLMN BC-IEs (preceded by a repeat indicator "circular"), one representing speech, the other representing facsimile group 3. The order in which these two PLMN BC-IEs are sent towards the ~~MS~~UE, in the setup message, is a network option.

In order to allow auto answering mode for the facsimile phase (i.e. the call starts automatically with the facsimile phase), the ~~MS~~UE can reflect back to MSC the dual Bearer Capability in the Call Confirm message with the BC elements interchanged to those in the original Call Set-up message (i.e. facsimile element first or negotiate to facsimile only, see subclause 9.2.2 and 3GPP TS 27.001). In all other aspects it is handled as indicated for mobile originated.

NOTE: However, the PLMN specific parameters "connection element" and "radio channel requirements" of the retrieved PLMN BC-IE may be modified, or added in line with the principles identified in subclause 9.2.2.

When a single MSISDN is allocated to the subscriber ("single numbering scheme"), the call is handled as described in case b) of subclause 9.2.2. In the "call confirmed" message, however, two PLMN BC-IEs are preceded by a repeat indicator "circular", with the first PLMN BC-IE indicating the initial phase of the connection.

9.4 3G-H.324/M calls over 3,1kHz audio

In case of 3G-H.324/M calls over 3.1kHz audio, the IWF shall provide the V.34 modem modulation and the V.8 procedure with the indication of H.324 support in the call function category of the V.8 handshaking. H.223 & H.245 flow is not terminated in the modem function.

The performance of V.8bis by the modem function is FFS.

9.4.1 Mobile originated multimedia call

9.4.1.1 Call setup

The setup message sent by the ~~MS~~UE contains either a multimedia BC-IE indicating a multimedia only call request (i.e. no fallback to speech allowed) or both a speech BC-IE and a 3.1kHz multimedia BC-IE to indicate the support of a fallback to speech (ref. to TS 27.001 and TS 24.008).

The MSC shall not accept a requested service to which the user has no subscription. On the condition the user has the required subscriptions (i.e. to multimedia and/or speech) the following applies:

- in case of a multimedia only BC-IE the MSC may accept the setup as such or with modifications sent to the ~~MS~~UE in the call proceeding message (ref. to TS 27.001);
- in case of both a speech BC-IE and a 3.1kHz multimedia BC-IE the MSC may either accept the possibility of a fallback to speech by responding with two BC-IEs or with no BC-IEs or turn the call to a speech call by sending only a speech BC-IE in the call confirm message or turn the call to a multimedia only call by sending only a multimedia BC-IE in the call confirm message (Ref. to TS 27.001).

The IWF V.34 modem shall initiate the ITU-T V.8 handshaking and indicate the support of H.324/M in the call function category of the V.8 handshaking. If the called party's modem does not indicate a H.324 support in its V.8 inband signalling response, the IWF may clear the call. If the called party responds with a modem answering tone but there is no V.8 response at all, the IWF shall clear the call.

If FNUR = 33.6 kbit/s is agreed on in the setup, the IWF shall configure its V.34 modem to operate in automode with an upper data rate limit of 33.6 kbit/s and a lower data rate limit of 28.8 kbit/s. If the modems handshake to 31.2 or 28.8 kbit/s, the MSC shall initiate a MODIFY message (ref. to TS 24.008) to indicate the new data rate to the ~~MS~~UE. HDLC flag stuffing or the stuffing mode defined in ITU-T recommendation H.223 (Annexes A, B and C) shall be used to adapt the 31.2 or 28.8 kbit/s data rate to the 33.6 kbit/s traffic channel between the ~~MS~~UE and the IWF. In order to be able to use the correct stuffing pattern, the IWF shall detect the stuffing mode patterns exchanged between the multimedia terminals after the traffic channel setup (ref. to ITU-T recommendation H.324). The IWF may start the stuffing immediately after the detection of the used method. In downlink stuffing the IWF inserts stuffing patterns between the H.223 frames. In uplink stuffing the IWF removes stuffing patterns from between the H.223 frames received from the ~~MS~~UE. If the ~~MS~~UE responds with a MODIFY REJECT message, the MSC shall clear the call.

9.4.1.2 Fallback to speech after setup

If the MSC has accepted the possibility of a fallback to speech and the IWF modem does not recognize the answering tone of the called modem within the expiration of a timer started at the reception of the answer message, the MSC IWF shall initiate an In Call Modification procedure (ref. to TS 24.008) in order to fall back to a speech mode. As a result of the procedure the IWF resource shall be released and a speech channel shall be set up between the calling ~~MS~~UE and the fixed network. If the fallback fails e.g. due to a failing In Call Modification procedure, the IWF shall clear the call.

A recommended minimum value for the timer is 3 seconds (ref. to the ITU-T V.25 recommendation).

9.4.2 Mobile terminated multimedia call

9.4.2.1 Call setup

If the user has a subscription to both the multimedia bearer service and the speech teleservice and if the network supports both services and the fallback functionality, the MSC shall send both a multimedia BC-IE and a speech BC-IE in the setup message to the ~~mobile station~~user equipment. If the user has a subscription only to the multimedia bearer service the MSC shall send only a multimedia BC-IE.

In case of both a speech BC-IE and a 3,1 kHz multimedia BC-IE in the setup the ~~mobile station~~user equipment may either accept the possibility of a fallback to speech by responding with two BC-IEs or with no BC-IEs or turn the call to a speech call by sending only a speech BC-IE in the call confirm message or to a multimedia only call (i.e. no fallback to speech allowed) by sending only a multimedia BC-IE in the call confirm message. In case of a multimedia only BC-IE in the setup the ~~MS~~UE may accept the setup as such or with modifications sent to the MSC in the call confirm message.

If no service definition is available in the network, the MSC shall send no BC-IE(s) to the ~~mobile station~~user equipment in the call setup. The MSC shall perform a subscription check to the multimedia and/or speech service(s) requested by the ~~mobile station~~user equipment in the call confirm message and shall not accept a requested service to which the user has no subscription.

The IWF V.34 modem shall await the ITU-T V.8 handshaking to be initiated by the calling party's modem and shall recognize the support of H.324 in the call function category of the incoming V.8 handshaking. If the calling party's modem does not indicate a H.324 support in its V.8 inband signalling, the IWF may clear the call. If the calling modem tries to handshake another than V.34 modem scheme, the IWF shall clear the call.

If FNUR = 33.6 kbit/s is agreed on in the setup, the IWF shall configure its V.34 modem to operate in automode with an upper data rate limit of 33.6 kbit/s and a lower data rate limit of 28.8 kbit/s. If the modems handshake to 31.2 or 28.8 kbit/s, the MSC shall initiate a MODIFY message (ref. to TS 24.008) to indicate the new data rate to the ~~MS~~UE. HDLC flag stuffing or the stuffing mode defined in ITU-T recommendation H.223 (Annexes A, B and C) shall be used to adapt the 31.2 or 28.8 kbit/s data rate to the 33.6 kbit/s traffic channel between the ~~MS~~UE and the IWF. In order to be able to use the correct stuffing pattern, the IWF shall detect the stuffing mode patterns exchanged between the multimedia terminals after the traffic channel setup (ref. to ITU-T recommendation H.324). The IWF may start the stuffing immediately after the detection of the used method. In downlink stuffing the IWF inserts stuffing patterns between the H.223 frames. In uplink stuffing the IWF removes stuffing patterns from between the H.223 frames received from the ~~MS~~UE. If the ~~MS~~UE responds with a MODIFY REJECT message, the MSC shall clear the call.

9.4.2.2 Fallback to speech after setup

If the MSC supports a fallback to speech and the user has a subscription to the speech service and the ~~mobile station~~user equipment accepts the possibility of a fallback to speech in the call confirm message and the IWF modem does not recognize a call tone nor a V.8 Call Indication nor a V.8 Call Menu within the expiration of a timer started at the sending of the ANSam answer tone (i.e. the calling party is not a V.34 modem), the IWF shall initiate an In Call Modification procedure (ref. to TS 24.008) in order to fall back to a speech mode. As a result of the procedure the IWF resource shall be released and a speech channel shall be set up between the called ~~MS~~UE and the fixed network. If the fallback fails e.g. due to a missing subscription to speech or a failing In Call Modification procedure, the IWF shall clear the call.

A recommended minimum timer value is 3 seconds (ref. to the ITU-T V.8 recommendation).

9.4.3 Seamless data rate change

If the modems change the data rate during an ongoing multimedia call (using the ITU-T V.34 seamless data rate change mechanism), the MSC shall initiate a MODIFY message (ref. to TS 24.008) to indicate the new data rate to the ~~MS~~UE. HDLC flag stuffing or the stuffing mode defined in ITU-T recommendation H.223 (Annexes A, B and C) shall be used to adapt the 31.2 or 28.8 kbit/s data rate to the 33.6 kbit/s traffic channel between the ~~MS~~UE and the IWF. The stuffing pattern found out during the traffic channel setup (ref. to subclauses Call setup) is used. The IWF may start the stuffing immediately after the detection of the data rate change by the modems.

10 Interworking to the ISDN

The interworking to the ISDN is specified on the principle of the network supporting standardized associated signalling protocol as outlined in clause 6, i.e. DSS1 and ISUP. An ISDN not complying with this definition differs - for the purpose of the present document - in that it does not support the compatibility information to that degree necessary for deducing a PLMN Basic Service. These networks will find their reflection in the following where those implications are to be set out.

The calling address sent in a mobile originated call to the ISDN is always the basic MSISDN even if the ISDN user shall use a different MSISDN (multi numbering scheme, see 9.2.2 case a) for a mobile terminated call (call back) as only the basic MSISDN is available at the VLR (see 3GPP TS 29.002).

The scope of this clause is to describe the handling of the content of the Information Elements where "content" is understood to be the value of the parameter fields of the Information Elements, namely BC-IE, HLC and LLC, after the length indicator. For the transport of these Information Elements within the PLMN refer to 3GPP TS 29.002.

The handling of multislot, 14.4kbit/s, or EDGE-related parameter of the call control signalling and the applicability of single- or multislot configurations (refer to 3GPP TS 48.020 and 3GPP TS 44.021) is the same as for the PSTN interworking cases. For multislot, 14.4kbit/s, or EDGE-operations, the ~~MS~~UE may also propose to the network to modify the Fixed Network User Rate and Other Modem Type parameters (see 3GPP TS 27.001). In case a transparent service is used, the call shall be released. For a non-transparent service with flow control, the MSC/IWF shall use towards the fixed network the unmodified "fixed network user rate" and shall use the "wanted air interface user rate" towards the ~~mobile station~~user equipment.

10.1 Speech Calls

Since at the interworking point the transcoder provides for A-law or µ-law (PCS-1900) PCM at 64 kbit/s, no particular interworking is required. It is anticipated that the ISDN Teleservice Telephony and ISDN Bearer Service speech, respectively would be used. Transmission aspects are covered in 3GPP TS 43.050. Any further requirements are a national matter.

10.2 Data Calls

In this case it is assumed that the ISDN bearer service 3,1 kHz audio shall only be interworked by means of a modem pool in the PLMN. If a network operator provides this facility, then the MSC/IWF operation will be similar to that described for interworking to the PSTN.

Where the bearer capability information indicates that the call is a circuit switched unrestricted digital call, then the MSC/IWF shall select the appropriate rate adapted ISDN and PLMN bearer services.

10.2.1 Network interworking mobile originated

Low layer compatibility checking of the mobile originated call is carried out by the MSC/IWF to determine the appropriate bearer service selection in the ISDN. This will entail the MSC/IWF in mapping appropriately the PLMN BC-IE to the ISDN BC-IE (bearer capability information element). If it is not possible for the MSC/IWF to provide a bearer service match, then the MSC/IWF shall fail the call and indicate the reason to the user.

The ~~MS~~UE shall provide further compatibility information (LLC/HLC-IEs) if required for defining end-to-end compatibility.

As well as compatibility checking, subscription checking should be performed.

The selection of the MSC/IWF will be by means of the bearer capability information within the call set up message. The mobile subscriber shall be able to select the unrestricted digital capability, which the MSC/IWF will map to the same capability in the ISDN call set up message. If an interworking point is encountered within the ISDN which does not support this service request, then either a call release message including an appropriate error cause or progress message is returned to the PLMN, indicating that the ISDN network is unable to support the service requested. In the case of a call release message the network shall release the call. In the case of progress message the network releases the call or forwards it (see 3GPP TS 24.008) to the mobile which will release the call.

10.2.2 Network interworking mobile terminated

10.2.2.1 General

This subclause describes the interworking of calls where the calling subscriber can communicate ISDN compatibility information with exhaustive contents for deducing a PLMN Basic Service to a PLMN (gateway MSC/interrogating node) i.e. by means of ISDN signalling.

The GMSC shall perform a mapping of the received Basic Service Information for the transport to the HLR, for details of this transport refer to 3GPP TS 29.002.

Compatibility checking of the low layers of the ISDN originated call is carried out by the MSC/IWF to determine the appropriate bearer service selection in the PLMN. This will entail the MSC/IWF in mapping appropriately the ISDN BC/LLC-IE to the PLMN BC-IE.

As well as compatibility checking, subscription checking should be performed. If either the subscription check or the compatibility check fails then the call will be rejected.

For ISDN originated calls it will not be possible to signal mobile specific requirements e.g. transparent/non transparent, full/half rate channel. Therefore the MSC/IWF shall select a default setting appropriate to the visited PLMN's network capabilities. In general it will be beneficial, where a network supports both full and half rate channels and transparent/non transparent capabilities, to indicate so in the appropriate PLMN BC field of 3GPP TS 24.008. The mobile subscriber has the option to indicate in the call confirmation message a change to this default setting according to the rules specified in 3GPP TS 27.001. The appropriate MSC/IWF shall be selected on the basis of this requirement.

10.2.2.2 Functions in GMSC

At call Set-up, the interrogating node passes in the "send routing information" to the HLR, the ISDN BC, LLC and HLC received in the initial address message. The coding of these parameters shall comply with Q.931 (05/98). For MT calls, and for backward compatibility purposes only, the mapping of the modem type according to ETS 300-102-1 (12/90) shall also be accepted, see note 12 of table 7B.

10.2.2.3 Functions in HLR

According to the contents of the Compatibility Information, i.e. the ISDN BC, LLC and HLC received, the HLR applies one of the following alternatives:

1) no ISDN BC is received, or one from which a PLMN Basic Service cannot be deduced with the information Transfer Capability field set to "3,1 kHz audio" but without any associated modem type[1] in the ISDN BC and LLC, or without HLC indication of group 3 facsimile. Two cases shall be considered:

   a) the called MSISDN has a corresponding PLMN BC-IE stored in the HLR (see option a) of 9.2.2); then the service attached to this number in the HLR tables is applicable and the corresponding PLMN BC-IE is passed to the VLR in "provide roaming number". See figure 6;

   b) the called MSISDN has no corresponding PLMN BC-IE stored in the HLR (see option b in 9.2.2). In this case no PLMN BC is passed to the VLR in the "provide roaming number" message.

2) compatibility Information is received from which a PLMN Basic Service can be deduced, i.e. the ITC field in the ISDN BC received is "unrestricted digital" and the fields for the applicable user layer 1 protocol and user rate (except for the 64kbit/s case, see Note 22 Table 7B) are available (either in the ISDN BC or LLC), or the ITC field is "3,1 kHz audio", and a modem type, user rate, etc. is indicated but the HLC does not indicate "facsimile group 3". The received ISDN BC (and possibly LLC plus HLC) is then considered applicable regardless of the kind of MSISDN received (PLMN BC associated or not) and either the equivalent PLMN BC or the original ISDN BC/LLC is sent to the VLR. Additionally in both cases the originally received HLC may also be sent to the VLR, see figure 7.

   In exception to this the BC stored in the HLR is regarded valid if one of the following cases applies:

   - If ITC = UDI/RDI and User Rate = 32 kbit/s /56 kbit/s and User information layer 1 protocol = V.110, I.460/X.30 and the stored BC indicates FTM, PIAFS or Multimedia.

   - If ITC = 3,1 kHz audio and User Rate = 28.8 kbit/s and Modem Type = V.34 and the stored BC indicates Multimedia.

   When the HLR interworks with a phase 1 ~~GSM~~ VPLMN (VLR/VMSC), then the HLR shall convert the ISDN BC to the equivalent ~~GSM~~ PLMN BC, and forward to the VLR. In this case however no LLC can be forwarded.

3) Compatibility Information is received from which the PLMN Teleservice category Facsimile transmission can be deduced i.e. the ITC field in the ISDN BC received is "3,1kHz audio" and the HLC indicates "facsimile group 3" (see figure 7), the following two cases shall be considered:

   a) the called MSISDN has a corresponding PLMN BC stored in the HLR (either stating TS 61 or TS 62). In this case the service attached to the MSISDN in the HLR tables is applicable and the corresponding PLMN BC is passed to the VLR in the "provide roaming number" message, see also subclause 10.3.1.3;

   b) the called MSISDN has no corresponding PLMN BC stored in the HLR. In this case the HLR shall forward the appropriate PLMN BC to the VLR in line with the subscribers subscription to Teleservice TS 61 or 62.

      For TS 61 the value of the PLMN BC-IE parameter "Information Transfer Capability" shall be set to "alternate speech/facsimile group 3, starting with speech".

      In both cases the HLC IE should be passed to the VLR in the "provide roaming number" message.

      Alternatively the HLR may forward the originally received ISDN/LLC/HLC, when interworking with a phase 2 ~~GSM~~ VLR ~~or a UMTS VLR, respectively~~.

4) In the case where Compatibility Information received does not allow for deducing a PLMN Bearer Service but an ISDN BC is received with the ITC field indicating "unrestricted digital", but without the fields indicating applicable "user layer 1 protocol", user rate, etc., neither in the ISDN BC or the ISDN LLC then the following shall apply. The call is managed as for an ~~udi~~ UDI call according to subclause 9.2.2, i.e. either the "multi numbering" or "single numbering" scenario is applied depending on which capability is provided by home PLMN/HLR.

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1 "Modem type" in connection with the ITC value "3,1 kHz audio" means hereafter that either an ISDN BC modem type value is present or the autobauding modem function is indicated (see note 16 of table 7B)

10.2.2.4 Functions in VMSC

At the VMSC, when the incoming call arrives, the LLC/HLC and the PLMN or ISDN BC associated with the MSRN is retrieved from the VLR. LLC and HLC are sent with the PLMN BC in general to the ~~MS~~UE at call set-up. In particular, however the following rules apply:

1) If the Initial Address Message (IAM) contains no ISDN BC and there is no PLMN or ISDN BC/LLC/HLC retrieved from the VLR, the call is handled as subclause 9.2.2 case b.

2) If there is no ISDN BC in the IAM but a PLMN or ISDN BC/LLC/HLC was signalled in the "provide roaming number" message, the retrieved PLMN or ISDN BC/LLC/HLC applies.

3) If there is an ISDN BC in the IAM with the ITC field set to "3,1 kHz audio" but without any associated modem type or indication of facsimile group 3 in the HLC, the PLMN or ISDN BC/LLC/HLC retrieved from the VLR is considered as applicable when it exists. If no PLMN or ISDN BC is retrieved from the VLR, the call is handled as in subclause 9.2.2 case b.

4) If the ISDN BC received in the IAM has the ITC field set to the value "unrestricted digital information" and the fields for the applicable "user layer 1 protocol" and "user rate" (except for the 64kbit/s case, see note 22 table 7B) are available (either in the ISDN BC or ISDN LLC), or if 3,1 kHz audio and a modem type is indicated, this ISDN BC is applicable regardless of what has been retrieved from the VLR. In this case the ISDN BC shall be mapped to an appropriate PLMN BC (refer to table 7B).

   In exception to this the BC stored in the VLR is retrieved and send to the ~~MS~~UE if one of the following cases applies:

   If ITC = UDI/RDI and User Rate = 32 kbit/s /56 kbit/s and User information layer 1 protocol = V.110, I.460/X.30 and the stored BC indicates FTM, PIAFS or Multimedia.

   If ITC = 3,1 kHz audio and User Rate = 28,8 kbit/s and Modem Type = V.34 and the stored BC indicates Multimedia.

5) If the ISDN BC received in the IAM has the ITC field set to the value "3,1kHz audio" and a HLC "facsimile group 3" is indicated, the PLMN BC retrieved from the VLR is applicable when it exists. If a PLMN BC-IE with the parameter "information transfer capability" set to "alternate speech/facsimile group 3, starting with speech" (stating TS61) is retrieved from the VLR, this shall be mapped to two PLMN BC-IE preceded by a repeat indicator, one representing speech, the other representing facsimile group 3.

   When no PLMN BC is retrieved from the VLR, either two PLMN BCs preceded by a repeat indicator (stating Teleservice TS 61), or a single PLMN BC-IE (stating TS 62), are sent in the setup message, depending whether TS 61 or TS 62 is subscribed (see also subclause 10.3.1.3).

   In case of TS 61, the order in which the two PLMN BC-IEs are sent towards the ~~MS~~UE, in the setup message, is a network option.

6) If the ISDN BC received in the IAM has a ITC value "unrestricted digital information" but without applicable "user layer 1 protocol" and "user rate", etc. fields, neither in the ISDN BC nor ISDN LLC, then the PLMN or ISDN BC/LLC retrieved from the VLR is applicable, if available otherwise subclause 9.2.2 case b applies.

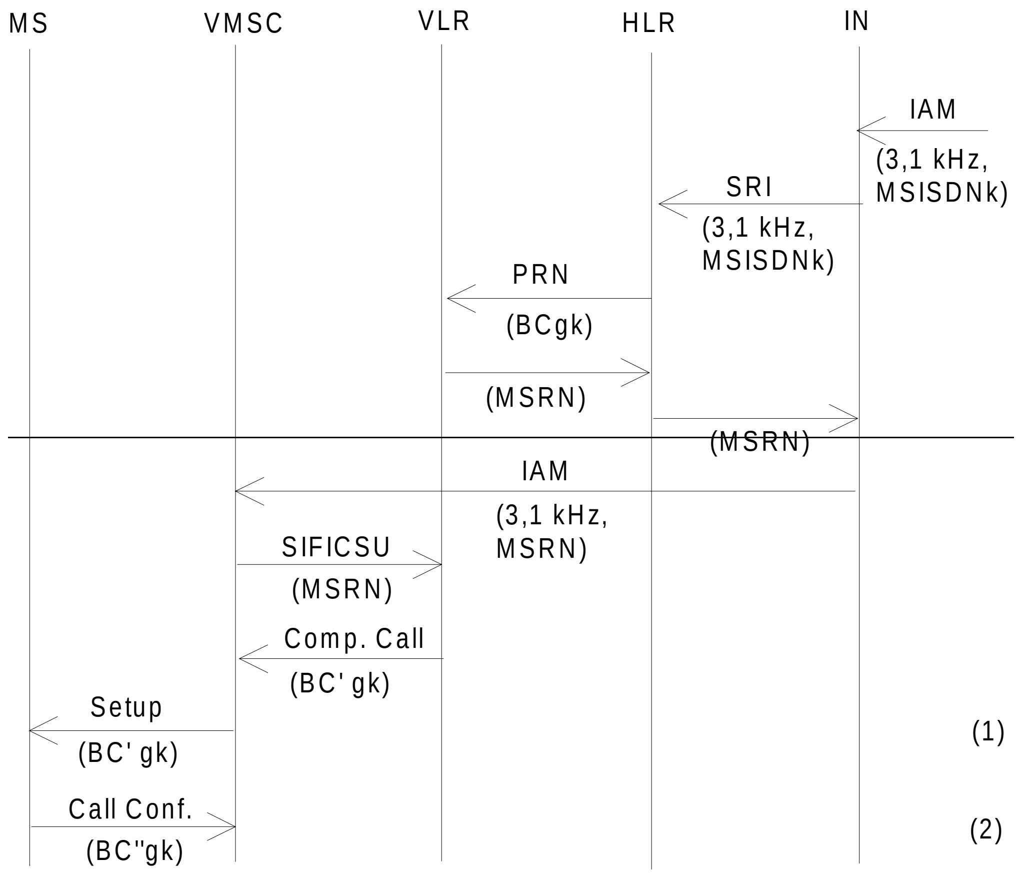
   In case of an ISDN BC/LLC/HLC was attached to the MSRN this shall be mapped to an appropriate PLMN BC (refer to table 7B). However in both cases (PLMN or ISDN BC attached) the PLMN specific parameters of the PLMN BC-IEs may be added/modified in line with procedures identified in subclause 9.2.2.

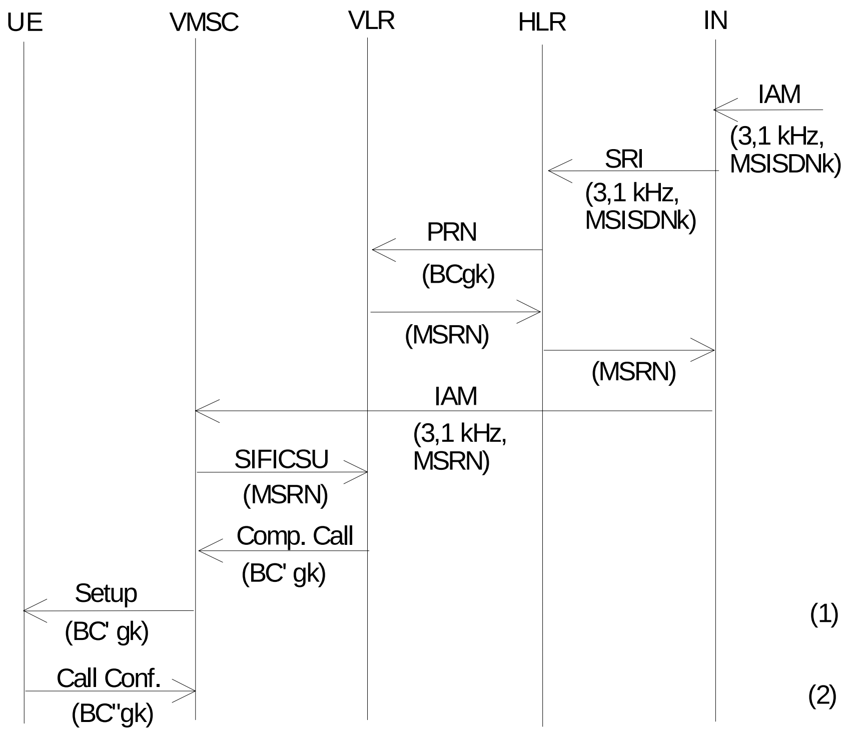
7) If the ISDN BC received in the IAM has the ITC field set to the value "Speech" and the ITC field of the ISDN BC received with the IAM differs from the ITC field of the BC stored in the VLR for this call, the VLR BC/LLC/HLC is considered applicable. If no PLMN or ISDN BC is retrieved from the VLR, the call is handled as in subclause 9.2.2 case b.

In all cases when no PLMN or ISDN BC is retrieved from the VLR and no ISDN Compatibility information allowing deduction of a PLMN Bearer Service is available, then no PLMN BC is inserted by the VMSC and subclause 9.2.2 case b applies.

The mapping between PLMN and ISDN BCs is shown in table 7.

10.2.2.5 Call Flows

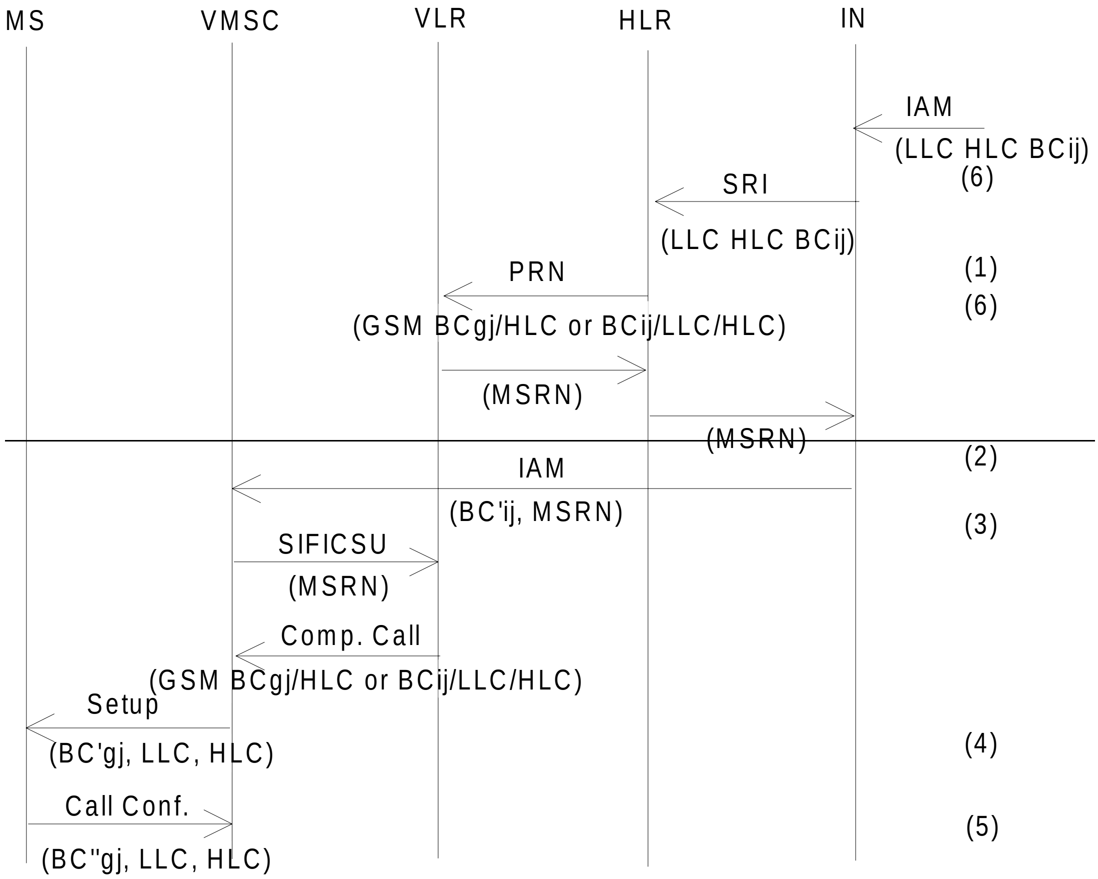


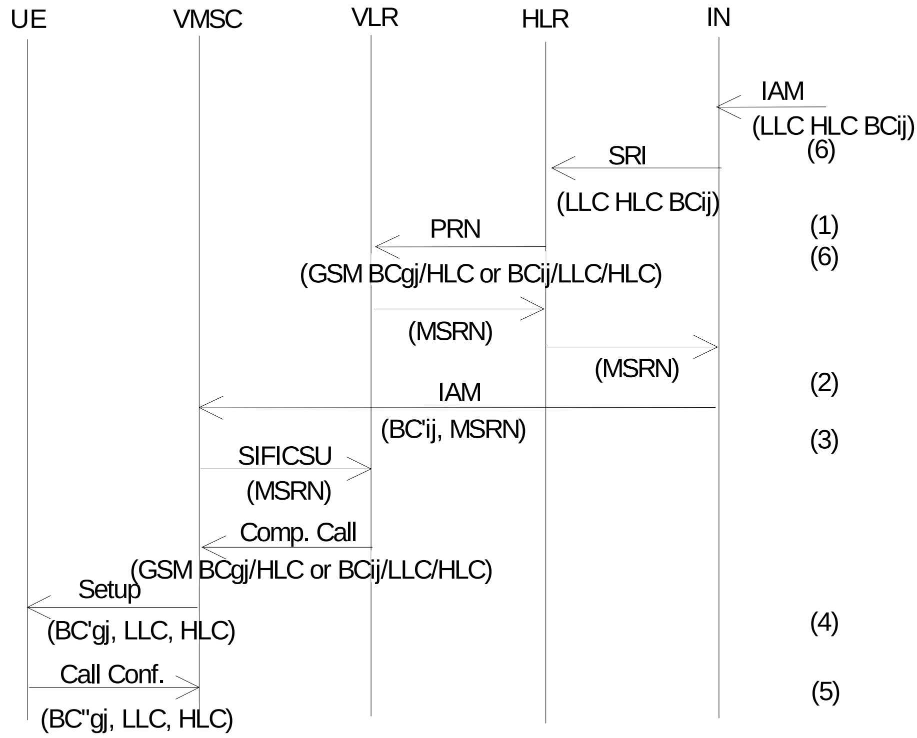


Abbreviations: see figure 2.

NOTE: (1) Some parameters of BCgk may be provided/modified according to the MSC's capabilities/preferences. See subclause 9.2.2.
(2) In the "Call Confirm" message, the ~~MS~~UE may modify some parameters of the PLMN BC. See subclause 9.2.2.

Figure 8: Call Flow for a mobile terminated, ISDN originated call where compatibility information provided are not exhaustive for deducing a PLMN Bearer Service, but Information Transfer Capability = 3,1 kHz audio, no modem type and no HLC IE indicating facsimile group 3 HLR stores PLMN BC against MSISDN number multi-numbering scheme





NOTES: (1) BCij denotes ISDN BC*; BCgj is the corresponding PLMN BC.
(2) Assumes signalling capabilities permit the transfer of BC between IN and VMSC. If this is not the case, the VLR uses the stored BC/LLC/HLC.
(3) BC'ij denotes BCij as maybe modified by intervening networks.
(4) Some parameters of BCgk may be provided/modified according to the MSC's capabilities/preferences. See subclause 9.2.2.
(5) In the "Call Confirm" message, the ~~MS~~UE may modify some parameters of the BC. See subclause 9.2.2.
(6) For details on how the BC, HLC, and LLC are transported, refer to 3GPP TS 29.002.
* HLC and LLC refers to ISDN values.
(7) Abbreviations: see figure 2.

Figure 9: Call Flow for a mobile terminated, ISDN originated call where compatibility information provided are sufficient information to deduce a PLMN Bearer Service or Information Transfer Capability = 3,1 kHz audio with HLC IE indicating facsimile group 3

10.2.2.6 Mapping Functions

The following tables (7A + 7B) show that only the ISDN BC is used for mapping (exceptions are indicated).

NOTE: The ISDN/ PLMN BC-IE mapping shall be performed as specified in tables 7A and 7B. This shall be done to allow setup of a compatible end-to-end connection between two MSs or one ~~MS~~UE and an ISDN terminal.

In the following tables 7A and 7B the comparison is drawn between parameters in the PLMN call set up request message and that of the ISDN call set up request message. In some cases no comparable values are available and these will be marked as such. In these cases reference will need to be made to the table of network interworking in 3GPP TS 29.007 to identify the appropriate choice. In some cases it is not necessary to support a particular option, and in this case those parameters will be annotated appropriately.

The PLMN parameters and values are as in 3GPP TS 24.008 in combination as in 3GPP TS 27.001. The ISDN parameters and values are as in Q.931 (05/98).

Table 7A: Comparable setting of parameters in PLMN and ISDN: Mobile Originated

Octet	PLMN BC parameter value	Octet	ISDN BC parameter value
1	**Bearer Capability IEI**	1	**Bearer Capability IEI**
2	**Length of BC contents**	2	**Length of BC contents**
3 #7..6	**Radio channel requirement** half rate channel full rate channel dual, full, rate preferred dual, half rate preferred		No comparable field
3 #5	**Coding Standard** GSM standard coding	3 #7..6	**Coding Standard** CCITT standardized coding
3 #4	**Transfer mode** circuit mode packet mode (note7)	4 #7..6	Transfer mode circuit mode packet mode
3 #3..1	**Information transfer capability** speech unrestricted digital 3,1 kHz audio ex PLMN facsimile group 3 (note 1) other ITC (see octet 5a)	3 #5..1	**Information transfer capability** speech unrestricted digital 3,1 kHz audio 3,1 kHz audio no comparable value
5a #7..6	**Other ITC** restricted digital		(note 18)
4 #7	**Compression** (note 14) data compression allowed data compression not allowed		No comparable field
4 #6..5	**Structure** SDU integrity unstructured	4a #7..5	**Structure** (note 4)
4 #4	**Duplex mode** half duplex full duplex	5d #7	**Duplex mode** half duplex full duplex
4 #3	**Configuration** point to point	4a #4..3	**Configuration** (note 4)
4 #1	**Establishment** demand	4a #2..1	**Establishment** (note 4)
4	**NIRR** (note 12) no meaning Data $\leq$ 4.8kbit/s, FR nt, 6kbit/s radio interface is requested		No comparable field
5 #5..4	**Rate adaptation** no rate adaptation (note 2) V.110, I.460/X.30 rate adaptation CCITT X.31 flag stuffing No comparable value(note 11) No comparable value(note 11) No comparable value(note 11) other rate adaptation (see octet 5a)	5 #5..1	**User information layer 1 protocol** no comparable value CCITT standardized rate adaption V.110, I.460/X.30 (note 25) Recommendation G.711 µ-law Recommendation G.711 A-law (note 3) Recommendation G.721 32 kbit/s ADPCM and I.460 No comparable value
5a #5..4	**Other rate adaptation** V.120 (note 17) PIAFS (note 27) H.223 & H.245		No comparable value H.223 & H.245 (note 26)
5 #3..1	**Signalling access protocol** I.440/I.450 X.21 (note 24) X.28, ded.PAD, indiv.NUI (note 24) X.28, ded PAD, univ.NUI (note 24) X.28, non-ded PAD (note 24) X.32 (note 24)		No comparable field
6 #1	**Synchronous/asynchronous** synchronous asynchronous	5a #7	**Synchronous/asynchronous** synchronous asynchronous (note 25)
6	**User info. layer 1 protocol**	5	**User info. layer 1 protocol**

Octet	PLMN BC parameter value	Octet	ISDN BC parameter value
#5..2	default layer 1 protocol	#5..1	see section under rate adaptation for 3GPP TS 24.008 above
6a #7	**Number of stop bits** 1 bit 2 bits	5c #7..6	**Number of stop bits** 1 bit 2 bits
6a #6	**Negotiation** In band neg. not possible no comparable value	5a #6	**Negotiation** In band neg. not possible In band neg. possible (note 10)
6a #5	**Number of data bits** 7 bits 8 bits	5c #5..4	**Number of data bits excluding parity if present** 7 bits 8 bits
6a #4..1	**User rate** 0.3 kbit/s 1.2 kbit/s 2.4 kbit/s 4.8 kbit/s 9.6 kbit/s 12 kbit/s (note 7) 1.2 kbit/s / 75 bit/s (note 24) any value no comparable value	5a #5..1	**User rate** 0.3 kbit/s 1.2 kbit/s 2.4 kbit/s 4.8 kbit/s 9.6 kbit/s 12 kbit/s 75 bit/s / 1.2 kbit/s 19.2 kbit/s (note 14) Ebits or inband negotiation (note 10)
6b #7..6	**Intermediate rate** 8 kbit/s 16 kbit/s any value	5b #7..6	**Intermediate rate** (note 13) 8 kbit/s or not used 16 kbit/s or not used 32 kbit/s or not used (note 14)
6b #5	**NIC on Tx** does not require requires (note7)	5b #5b	**NIC on Tx** does not require requires (note 8)
6b #4	**NIC on Rx** cannot accept can accept (note 7)	5b #4	**NIC on Rx** cannot accept can accept (note 8)
6b #3..1	**Parity information** odd even none forced to 0 forced to 1	5c #3..1	**Parity information** odd even none forced to 0 forced to 1
6c #7..6	**Connection element** transparent non-transparent (RLP) both, transp. preferred both, non-transp. preferred		No comparable field
6c #5..1	**Modem type** none V.21 V.22 V.22bis V.23 (note 24) V.26ter V.32 modem for undef. interface autobauding type 1	5d #6..1	**Modem type** no comparable value (note 5) V.21 V.22 V.22bis V.23 V.26ter V.32 No comparable value (note 5) No comparable value (note 5, note 10)
7 #5..1	**User info. layer 2 protocol** X.25 link level (note 24) ISO 6429, codeset 0 COPnoFlCt videotex profile 1 (note 7) X.75 layer 2 modified (CAPI) (note 24)	6	**User info.layer 2 prot.** (note 6) X.25 link level no comparable value no comparable value no comparable value X.25 link level
6d #5..1	**Fixed network user rate** (note 15) FNUR not applicable (note 7) 9,6 kbit/s 12 kbit/s (note 7) 14,4 kbit/s	5a #5..1	**User rate** no comparable value 9,6 kbit/s 12 kbit/s 14,4 kbit/s

Octet	PLMN BC parameter value	Octet	ISDN BC parameter value
	19,2 kbit/s 28,8 kbit/s 32.0 kbit/s 33.6 kbit/s 38,4 kbit/s 48,0 kbit/s 56,0 kbit/s 64,0 kbit/s		19,2 kbit/s 28,8 kbit/s 32.0 kbit/s no comparable value 38,4 kbit/s 48,0 kbit/s 56,0 kbit/s no comparable value (note 16)
6e #3..1	**Maximum number of traffic channels** 1 TCH 2 TCH 3 TCH 4 TCH 5 TCH 6 TCH 7 TCH (note 7) 8 TCH (note 7)		No comparable field
6f #4..1	**Wanted air interface user rate (note 23)** air interface user rate not applicable (note 7) 9,6 kbit/s 14,4 kbit/s 19,2 kbit/s 28,8 kbit/s 38,4 kbit/s 43,2 kbit/s 57,6 kbit/s interpreted by the network as 38.4 kbit/s (note 7)		No comparable field
6d #7..6	**Other modem type** (note 15) No other modem type V.34	5d #6..1	**Modem type** no comparable value V.34
6e #7..4	**Acceptable channel coding(s)** TCH/F4.8 acceptable (note 19) TCH/F9.6 acceptable TCH/F14.4 acceptable		No comparable field
6f #7..5	**User initiated modification indicator (note 23)** User initiated modification not required User initiated modification upto 1 TCH/F may be requested User initiated modification upto 2 TCH/F may be requested User initiated modification upto 3 TCH/F may be requested User initiated modification upto 4 TCH/F may be requested		No comparable field
6g #7..5	**Acceptable channel coding(s) (note 20)** TCH/F28.8 acceptable TCH/F32.0 acceptable TCH/F43.2 acceptable (note 22)		No comparable field
6g #4..3	**Asymmetry preference indication (Note 23)** no preference up link biased asymmetry preference down link biased asymmetry preference		No comparable field

General Notes

The application rules for coding the information elements ISDN-BC/LLC/HLC as set out in ETR 018 and Q.931 (05/98) shall apply.

Other field values in the ISDN BC-IE not supported in 3GPP TS 24.008 are:

Information transfer rate: In this case default 64 kbit/s is selected.

Flow control on transmission:

Flow control on reception: This shall be selected if outband flow control applies. Outband flow control is indicated by the absence of the UIL2P parameter for non-transparent connections.

User information layer 3 protocol: Octet 7 shall not be sent unless specific application rules are given for particular cases (to be defined by PLMN). End-to-end significant User Information layer 3 protocol shall be sent by LLC.

Notes regarding particular entries in table 7A:

NOTE 1: In the case where PLMN BC "Information Transfer Capability" indicates "Facsimile group 3" and only a single PLMN BC is contained in the call set-up request then this shall be mapped to an ISDN BC with:

- coding standard: CCITT;
- information transfer capability: 3,1 kHz audio;
- transfer mode: circuit;
- information transfer rate: 64 kbit/s;
- user layer 1 protocol: G711 A-law or µ-law (PCS-1900); and
- if an HLC is not present, the network will insert a "Facsimile group 2/3" HLC;
- if an HLC element is present, the network will pass it through unmodified.

In the case where PLMN BC "Information Transfer Capability" indicates "Facsimile group 3" and two PLMN BCs are contained in the call set-up request, then the same ISDN BC as mentioned above is created. If the first PLMN BC indicates "facsimile group 3" an HLC "facsimile group 2/3" will be inserted by the network (if not received from the ~~MS~~UE). However if the first PLMN BC indicates "speech", the network will not send a HLC, irrespective where a HLC was received from the ~~MS~~UE or not.

NOTE 2: This value is present in combination with information transfer capability parameter value "3,1 kHz audio Ex PLMN" or "facsimile group 3" and will therefore be mapped to the value "Recommendation G.711 A-law" or Recommendation G.711 µ-law" (PCS-1900) of the Q.931 (05/98) parameter user layer 1 protocol (see note 3).

NOTE 3: The value "Recommendation G.711 A-law" or "Recommendation G.711 µ-law" (PCS-1900) applies only when the Q.931 (05/98) parameter information transfer capability indicates "3,1 kHz audio" or "speech".

NOTE 4: When interworking with an ISDN according to ETS 300 102-1 octets 4a and 4b shall not be included because default values apply. In an ISDN according to Q.931 (05/98) these octets no more exist.

NOTE 5: In this case octet 5d shall not be included.

NOTE 6: Octet 6 shall not be sent unless specific application rules are given for a particular case (PLMN specified). End-to-end significant user information layer 2 protocol shall be sent by LLC.

NOTE 7: Not used for currently defined Bearer Services and Teleservices.

NOTE 8: These values will only be set if the "Information Transfer Capability" indicates "3,1 kHz audio", synchronous data transmission is used and octet 5b of the ISDN BC is present.

NOTE 9: (VOID).

NOTE 10: The PLMN BC-IE parameter value "autobauding modem type 1" will be mapped to the ISDN BC-IE parameter values "inband negotiation possible" and "user rate indicated by E-bits specified in ITU-T Recommendation I.460 or may be negotiated inband" (octet 5a of ISDN BC-IE). In case of data compression high speed modems, like V.32bis, V.34 and/or V.90 may be used in the IWF. Autobauding may also be used to support user rates less than 9.6 kbit/s towards the PSTN.

NOTE 11: The ITC value of the PLMN BC-IE "speech", "3,1 kHz audio Ex PLMN" will indicate these requirements.

NOTE 12: For the use of NIRR see 3GPP TS 27.001.

NOTE 13: The value of the Intermediate Rate field of the ISDN Bearer Capability information element shall only depend on the values of the User Rate and the Information Transfer Capability in the same information element. The correspondence is:

Intermediate Rate = not used if User Rate > than 19.2 kbit/s.
Intermediate Rate = 32 kbit/s if User Rate = 19,2 kbit/s or 14.4 kbit/s.
Intermediate Rate = 16 kbit/s if User Rate = 9,6 kbit/s.
Intermediate Rate = 8 kbit/s otherwise.

In case of Audio calls the value of the Intermediate Rate may be set to "not used".

NOTE 14: If compression is supported by the MSC and "data compression allowed" is indicated, then the ISDN user rate for UDI calls shall be set as follows. If the parameter "FNUR" is present the ISDN user rate shall be set to this value. Otherwise the PLMN user rate shall be mapped to an equal or any higher ISDN user rate value (in case of V.110 the highest ISDN user rate shall be 19,2 kbit/s). The Intermediate Rate shall be set to an appropriate value.(see subclause 10.2.4.11).

In case of "3,1 kHz audio" the modem shall try to negotiate data compression and flow control (see subclause 9.2.4.11). In case of "autobauding type 1" high speed modems may be used (see note 10).

NOTE 15: User rate of the PLMN -BC is overridden by the fixed network user rate of the PLMN BC-IE if available. When the MT indicates „autobauding", „modem for undefined interface" or „none", the other modem type shall be set to „no other modem type"; any other value of the modem type is overridden by the other modem type value (see 3GPP TS 27.001). In ~~UMTS~~Iu mode, if octet 6d is not present in the PLMN BC, the MSC shall reject the call. The support of user rates lower than 9.6 kbit/s in ~~UMTS~~ Iu mode are only possible in the scope of autobauding (see note 10).

NOTE 16: The ISDN-BC will consist of the octets 1 to 4 only, coded:

Coding standard:	CCITT
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64 kbit/s

NOTE 17: V.120 interworking is selected.

If an LLC element is not present, the network will insert an LLC. If an LLC is present it may be modified. The PLMN -BC parameters negotiated with the ~~MS~~UE shall be mapped to the LLC parameters. The LLC parameter Rate Adaptation will be set to "V.120".

When interworking with unrestricted 64 kbit/s networks the ISDN BC shall be coded according to note 16.

NOTE 18: When the MSC is directly connected to a restricted 64 kbit/s network, the ISDN BC-IE is coded with an ITC = RDI.
When indirectly interworking with a restricted 64 kbit/s network the ISDN BC-IE shall be coded according to ETR 018, as shown below:

Coding standard:	CCITT
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	V.110/X.30
Synchronous/Asynchronous:	synchronous
Negotiation:	In-band negotiation not possible
User rate:	56 kbit/s

If an LLC element is not present, the network will insert an LLC. If an LLC is present it may be modified. The PLMN -BC parameters negotiated with the ~~MS~~UE shall be mapped to the LLC parameters according to the rules in this table. The LLC parameter Information Transfer Capability will be set to „restricted digital"

NOTE 19: In case the ~~MS~~UE signals an ACC containing TCH/F4.8 only and the network does not support TCH/F4.8 channel coding, then the MSC may act as if TCH/F9.6 were included in the ACC.

NOTE 20: Extension of the 'Acceptable channel codings' field in octet 6e in case EDGE channel codings are supported.

NOTE 21: Void

NOTE 22: Only applicable for non-transparent services.

NOTE 23: This parameter shall be included if EDGE channel codings are indicated in ACC. In cases where this parameter would not otherwise be included, the value is set to 'Air interface user rate not applicable' or 'User initiated modification not requested' or 'No preference'.

NOTE 24: This value was used by services defined for former ~~GSM~~ PLMN releases and does not need to be supported.

NOTE 25: The case of FTM is identified by Rate adaptation in the PLMN BC-IE set to "CCITT X.31 flag stuffing", Connection element set to "non-transparent", and Synchronous/asynchronous set to "asynchronous". The parameter values shall be set according to Note 16 in case FNUR is 64 kbit/s and according to Note 18 if Other ITC is RDI.

NOTE 26: In the case FNUR=64 kbit/s the ISDN BC-IE shall be coded as follows:

Coding standard:	ITU-T
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	H.223 and H.245

In the case FNUR=56 kbit/s the ISDN BC-IE shall be coded as in note 18.

In the case FNUR=32 kbit/s the ISDN BC-IE shall be coded as follows:

Coding standard:	ITU-T
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	V.110, I.460 & X.30
Synchronous/Asynchronous:	synchronous
Negotiation:	In-band negotiation not possible
User rate:	32 kbit/s

In the case FNUR=28.8 kbit/s the ISDN BC-IE shall be coded as follows:

Coding standard:	ITU-T
Information Transfer capability:	3,1 kHz Audio
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	G.711 A-law or µ-law
Synchronous/Asynchronous:	synchronous
Negotiation:	In-band negotiation not possible
Modem type:	V.34
User rate:	28.8 kbit/s

In the case FNUR=33.6 kbit/s the ISDN BC-IE shall be coded as follows:

Coding standard:	ITU-T
Information Transfer capability:	3,1 kHz Audio
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	G.711 A-law or μ-law

NOTE 27: In the case the FNUR=32 kbit/s the ISDN BC-IE shall be coded for PIAFS as follows:

Coding standard:	ITU-T
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	V.110, I.460 and X.30
Synchronous/Asynchronous:	synchronous
Negotiation:	In-band negotiation not possible
User rate:	32 kbit/s

In the case of a FNUR=64 kbit/s the ISDN BC-IE shall be coded for PIAFS as in note 16.

Table 7B: Comparable setting of parameters in PLMN and ISDN: Mobile Terminated

Octet	ISDN BC parameter value	Octet	PLMN BC parameter value
1	**Bearer Capability IEI**	1	**Bearer Capability IEI**
2	**Length of BC contents**	2	**Length of BC contents**
	no comparable field	3 #7..6	**Radio channel requirement** full rate channel (these bits are spare in the network to ~~MS~~UE direction)
3 #7..6	**Coding standard** CCITT standardized coding	3 #5	**Coding standard** GSM standardized coding
3 #5..1	**Information transfer capability** speech unrestricted digital 3,1 kHz audio no comparable value no comparable value 7 kHz audio video (note 23)	3 #3..1 5a #7..6	**Information transfer capability** speech unrestricted digital 3,1 kHz audio ex PLMN (note2) facsimile group 3 (note 3) other ITC (see octet 5a) not supported not supported **Other ITC** restricted digital
4 #7..6	**Transfer mode** circuit mode packet mode	3 #4	**Transfer mode** circuit mode not supported
4 #5..1	**Information transfer rate** 64 kbit/s		no comparable field
	No comparable field	4 #7	**Compression** (note 18) data compression possible data compression not possible
	No comparable field (note 4)	(4) 4 #6..5	**Structure** (note 9) SDU integrity unstructured
4a #4..3	No comparable field (note 4)	4 #3	**Configuration** point-to-point (note 5)
	No comparable field	4 #2	**NIRR** (note 17) No meaning Data ≤ 4.8 kbit/s, FR nt, 6 kbit/s radio interface requested
4a #2..1	No comparable field (note 4)	4 #1	**Establishment** demand (note 5)
4b #7..6			
4b #5..1			
5 #5..1	**User information layer 1 protocol** no comparable value CCITT V.110, I.460 / X.30 G.711 A-law CCITT X.31 flag stuffing no comparable value No comparable value H.221 & H.242(note 28) H.223 & H.245	5 #5..4 5a #5..4	**Rate adaption** no rate adaption (note 11) V.110, I.460/X.30 rate adaption no comparable value not supported other rate adaption (see octet 5a) **Other rate adaptation** V.120 (note 24) PIAFS H.223 & H.245 H.223 & H.245
	no comparable field	5 #3..1	**Signalling access protocol** I.440/I.450 X.21 (note 26) X.28, ded.PAD, indiv.NUI (note 26) X.28, ded.PAD, univ.NUI (note 26) X.28, non-ded.PAD (note 26) X.32 (note 26)
	any of the above values	6 #5..2	**User information layer 1 protocol** default layer 1 protocol
5a #7	**Synchronous / asynchronous** synchronous asynchronous	6 #1	**Synchronous/asynchronous** synchronous asynchronous
5a	**Negotiation**	6a	**Negotiation**

Octet	ISDN BC parameter value	Octet	PLMN BC parameter value
#6	not possible inband neg, possible (note 16)	#6	not possible no comparable value
5a #5..1	**User rate** 0,3 kbit/s 1,2 kbit/s 2,4 kbit/s 4,8 kbit/s 9,6 kbit/s 12 kbit/s rate is indicated by Ebit as specified in rec. I.460 0,6 kbit/s 3,6 kbit/s 7,2 kbit/s 8 kbit/s 14,4 kbit/s 16 kbit/s 19.2 kbit/s 28.8 kbit/s 32 kbit/s 38.4 kbit/s 48 kbit/s 56 kbit/s 57.6 kbit/s 0,1345 kbit/s 0,1 kbit/s 75 bit/s / 1,2 kbit/s 1,2 kbit/s / 75 bit/s 0,110 kbit/s 0,2 kbit/s	6a #4..1	**User rate (note 18 and 29)** 0,3 kbit/s 1,2 kbit/s 2,4 kbit/s 4,8 kbit/s 9,6 kbit/s 12 kbit/s (note 13) (note 16) not supported not supported not supported not supported (note 20) not supported (note 20) (note 20) (note 20) (note 20) (note 20) (note 20) not supported not supported not supported not supported not supported not supported not supported
5b #7..6	**Intermediate rate** not used (note 19) 8 kbit/s 16 kbit/s 32 kbit/s	6b #7..6	**Intermediate rate** (note 6) (note 18) 8 or 16 kbit/s 8 kbit/s 16 kbit/s
5b #5	**NIC on Tx** (note 14) does not require requires	6b #5	**NIC on Tx** does not require requires (note 13)
5b #4	**NIC on Rx** (note 14) cannot accept can accept	6b #4	**NIC on Rx** cannot accept can accept (note 13)
5b #3	**Flow control on Tx** (note 15) Not Required Required		no comparable field
5b #2	**Flow control on Rx** (note 15) Cannot Accept Accept		no comparable field
5c #7..6	**Number of stop bits** 1 bit 2 bits not used 1.5 bits	6a #7	**Number of stop bits** 1 bit 2 bits no comparable value not supported
5c #5..4	**Number of data bits** 7 bits 8 bits not used 5 bits	6a #5	**Number of data bits** 7 bits 8 bits no comparable value not supported
5c #3..1	**Parity information** odd even none forced to 0 forced to 1	6b #3..1	**Parity information** odd even none forced to 0 forced to 1
	no comparable field	6c #7..6	**Connection element** (note 1) transparent non-transparent (RLP) both, transp. preferred

Octet	ISDN BC parameter value	Octet	PLMN BC parameter value
			both, non-transp preferred
5d #7	**Duplex mode** half duplex full duplex	4 #4	**Duplex mode** half duplex (note 13) full duplex (note 5)
5d #6..1	**Modem type** reserved V.21 V.22 V.22bis V.23 V.26ter V.32 V.26 V.26bis V.27 V.27bis V.29 no comparable value	6c #5..1	**Modem type** (note 12) none (note 7) V.21 V.22 V.22bis not supported V.26ter V.32 not supported not supported not supported not supported not supported autobauding type 1 (note 16)
5a #5..1	**User rate** no comparable value 9,6 kbit/s 14,4 kbit/s 19,2 kbit/s 28,8 kbit/s 32.0 kbit/s 38,4 kbit/s 48 kbit/s 56 kbit/s no comparable value	6d #5..1	**Fixed network user rate** (note 20) FNUR not applicable 9,6 kbit/s 14,4 kbit/s 19,2 kbit/s 28,8 kbit/s 32.0 kbit/s (note 27) 38,4 kbit/s 48,0 kbit/s 56,0 kbit/s 64,0 kbit/s (note 22)
	Modem type no comparable value (note 21) V.34	6d #7..6	**Other modem type** No other modem type V.34
	No comparable field	6f #7..5	**User initiated modification indicator (note 1) (note 25)** User initiated modification not required User initiated modification upto 1 TCH/F may be requested User initiated modification upto 2 TCH/F may be requested User initiated modification upto 3 TCH/F may be requested User initiated modification upto 4 TCH/F may be requested
6 #5..1	**User information layer 2 protocol (note 10)** Q.921 (I.441) X.25, link level no comparable value	7	**User information layer 2 protocol (note 8)** no comparable value not supported ISO 6429, codeset 0
7	**User information layer 3 protocol (note 10)** Q.931 (I.451) X.25, packet level		 not supported not supported

General notes:

1) Other ISDN BC parameter values than those listed in the table, if indicated in the BC-IE, will be rejected by clearing the call, exception see mapping note 4.

2) Only the PLMN BC parameter values listed in the table may be generated (comparable values) during a mobile-terminated call by mapping the ISDN BC parameter values, exception see (10).

3) According to Q.931 (05/98) and 3GPP TS 24.008, respectively, the octets are counted from 1 to n onwards; the bit position in a particular octet is indicated by #x..y, with {x,y} = 1..8 (bit 1 is the least and bit 8 the most significant bit).

4) If octets 5 to 5d of the ISDN BC are absent but present in the LLC, the LLC octets should apply for the mapping as indicated above. In the case of V.120 interworking (see note 24) these LLC octets shall apply.

5) If within the ISDN BC the parameters information transfer capability indicates "3,1 kHz audio" and user layer 1 protocol indicates "G711 A-law" or "G.711 µ-law" (PCS-1900) but no modem type is available and the HLC does not indicate "facsimile group 3", octets 5 to 5d of the LLC, if available, apply for the above mapping procedure.

6) The number of octets which shall be encoded for the PLMN BC-IE must comply to encoding rules in 3GPP TS 24.008 and the combination of the different parameter values shall be in accordance to 3GPP TS 27.001.

Notes regarding particular entries in table 7B:

1) This PLMN parameter value is inserted according to user rate requirements and network capabilities / preferences.

2) This PLMN parameter value is inserted, if the information transfer capability in ISDN BC is "3,1kHz audio" and a comparable modem type is specified.

3) This PLMN parameter value is inserted, if the information transfer capability is "3,1 kHz audio" and the content of the HLC-IE, if any, indicates "facsimile group 2/3", (for details refer to subclause 10.2.2 case 3 for HLR action and case 5 for VMSC action). Note that via MAP the value "alternate speech/facsimile group 3 - starting with speech" shall be used, when TS 61 applies.

4) When interworking with an ISDN according to ETS 300 102-1, octets 4a and 4b may be present. The values are ignored and PLMN values are set according to notes 5 and 9.

5) This PLMN parameter value is inserted if the comparable ISDN parameter value is missing.

6) The value of the Intermediate Rate field of the ~~GSM~~ PLMN Bearer Capability information element shall only depend on the value of the user rate in the same information element. If the connection element is "transparent", the value is 16 kbit/s, if the user rate is 9.6 or 12 kbit/s, and 8 kbit/s otherwise. For any other connection element setting the value is 16 kbit/s.

7) This PLMN BC parameter value is inserted, if the PLMN BC parameter "Information Transfer Capability" indicates "Unrestricted digital information", "facsimile group 3" or "alternate speech/facsimile group 3, starting with speech".

8) Where the network indicates "asynchronous" and connection elements "non-transparent", "both, transparent preferred" or "both, non-transparent preferred" , then the ~~GSM~~ PLMN BC should be forwarded without parameter user information layer 2 protocol, see also (10).

9) The PLMN parameter value shall be set to "unstructured" where the network indicates connection element "transparent". Where the network indicates connection elements "non transparent" "both, transparent preferred" or "both, non transparent preferred" the value of the parameter structure shall be set to "SDU Integrity".

10) Mapping of parameter values of this octet to PLMN BC parameters and values are subject to specific application rules, i.e. unless otherwise explicitly stated in an appropriate TS mapping to PLMN BC parameters shall not take place.

11) This value shall be used when the value of the PLMN BC parameter "Information Transfer Capability" indicates the value "3,1 kHz audio ex PLMN", "facsimile group 3" or "alternate speech/facsimile group 3, starting with speech" which is reserved for MAP operations.

12) The modem encoding of both Q.931 (05/98) and ETS 300 102-1 version 1 shall be accepted and mapped according to 3GPP TS 24.008.

13) Value not used for currently defined bearer services and Teleservices.

14) NIC is only supported in ~~GSM~~ A/Gb mode for "3,1 kHz Ex PLMN audio" interworking with synchronous data transmission.

15) Because the required flow control mechanism can not be indicated to the ~~MS~~UE (refer to 3GPP TS 27.001), the network shall check if the flow control mechanism selected by the ~~MS~~UE and indicated in the CALL CONFIRMED message suits to the requirements requested by the ISDN terminal adaptor. In case of a mismatch the call shall be released in the IWF.

Because an asymmetric flow control mechanism (with respect to transmitting and receiving side) is not supported in the PLMN, the different values of the ISDN BC-IE parameters "flow control on Tx" and "flow control on Rx" shall be interpreted in the following way:

- "Flow control on Rx" set to "accepted" matches with "outband flow control", irrespective of the value of the parameter "flow control on Tx".
- "Flow control on Rx" set to "not accepted" and "flow control on Tx" set to "not required" matches with "inband flow control" and "no flow control".
- where "Flow control on Rx" is set to "not accepted" and "flow control on Tx" to "required" the call shall be released by the IWF.

16) If in case of 3,1 kHz audio interworking "inband negotiation possible" is indicated and the parameter user rate is set to "rate is indicated by E bits specified in Recommendation I.460 or may be negotiated inband" the user rate in the PLMN BC-IE shall be set according to a network preferred value. If ISDN-BC parameter modem type is present, its value shall be ignored. The PLMN-BC parameter modem type shall be set according to the user rate in case of connection element "transparent" and to "autobauding type 1" in case of connection element "non transparent", "both, transparent preferred" or "both, non transparent preferred". In case of data compression high speed modems, like V.32bis, V.34 and/or V.90 may be used in the IWF. Autobauding may also be used to support user rates less than 9.6 kbit/s towards the PSTN.

For unrestricted digital interworking the call shall be rejected if these values are indicated.
If the PLMN-BC parameter modem type indicates "autobauding type 1" or "none", then the PLMN-BC parameter other modem type shall be set to "no other modem type".

17) For the use of NIRR see 3GPP TS 27.001. The VMSC shall set this parameter dependent upon its capabilities and preferences.

18) If compression is supported by the MSC, the value "data compression possible" may be set. Depending on the capabilities of the MSC, the user rate value and the intermediate rate value is set to an appropriate value.

19) Only applicable if the parameter ISDN-BC ITC indicates "3,1 kHz audio" and for "UDI" calls if User Rate > "19,2 kbit/s".

20) The user rate of the PLMN BC is set to the value for the fall-back bearer service. In case the ~~mobile station~~user equipment does not support the fixed network user rate (i.e. the call confirmation message does not contain the fixed network user rate parameter), the network may release the call for a transparent connection element.

21) The modem type parameter of the PLMN -BC is taken into account, only.

22) In case no LLC is received and the ISDN-BC received consists of octets 1 to 4 only, coded:

Coding standard:	CCITT
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64kbit/s

the following PLMN -BC parameters, shall be set to:

fixed network user rate:	64 kbit/s
connection element:	transparent
	bothNT or bothT (If IWF supports FTM or PIAFS)

The other parameters of the PLMN -BC shall be set to values indicating a fall-back service.

23) When the MSC is directly connected to a restricted 64 kbit/s network, the ISDN BC-IE is coded with an ITC = RDI.
An ISDN BC-IE, as specified in ETR 018 and shown below, shall be taken to indicate that interworking with an indirectly connected restricted 64 kbit/s network is required:

Coding standard:	CCITT
Information Transfer capability:	UDI
Transfer mode:	circuit
Information transfer rate:	64 kbit/s
User information layer 1 protocol:	V.110/X.30
Synchronous/Asynchronous:	synchronous
Negotiation:	In-band negotiation not possible
User rate:	56 kbit/s

In this case the PLMN BC parameter Information Transfer Capability is set to „Other ITC" and Other ITC parameter is set to „restricted digital".If ISDN LLC exists, all the corresponding fields in the PLMN BC shall be derived from the ISDN LLC. Otherwise, the corresponding fields in the ~~UMTS~~ PLMN BC shall be derived from the ISDN BC. In the above both case, Connection element is set as follows.

Connection element:	transparent bothNT or bothT (If IWF supports FTM)

24) V.120 interworking is required if the ISDN LLC parameter User Information Layer 1 Protocol is set to „V.120". In this case the PLMN BC parameter Rate Adaptation is set to „Other rate adaptation" and Other Rate Adaptation parameter is set to „V.120". All the corresponding fields in the ~~GSM~~ PLMN BC shall be derived from the ISDN LLC.

25) This parameter is only included in case of non-transparent multislot connections.

26) This value was used by services defined for former ~~GSM~~ PLMN releases and does not need to be supported.

27) Following BC parameters in SETUP message shall be set to:

Fixed network user rate	32 kbit/s
Connection element	transparent (for multimedia) bothNT or bothT (If IWF supports PIAFS, ~~UMTS~~ UTRAN Iu mode only)

28) UIL1P is set to "H.221 & H.242" or "H.223 & H.245" by H.324/I. In the case where UIL1P is set to "H.221 and H.242", this should be mapped to "H.223 & H.245".

29) In ~~UMTS~~Iu mode, if the User Rate of the ISDN BC is less than 9,6 kbit/s and the Connection Element is mapped to "NT", then FNUR is fixed to 9,6 kbit/s.

10.2.3 Transparent service support

The protocol stacks for transparent services are specified in 3GPP TR 43.010 (~~GSM~~A/Gb mode) and in 3GPP TR 23.910 (~~UMTS~~Iu mode).

In ~~UMTS~~Iu mode, the transparent services are based in the Iu User Plane protocol specified in 3GPP TS 25.415.

In ~~GSM~~ A/Gb mode identifies the rate adaptation scheme shall be utilized on the ~~BSS~~ RAN to MSC link as identified in 3GPP TS 48.020. The transcoding function will generate the 64 kbit/s rate adapted format utilizing the 8 and 16 kbit/s intermediate data rates. The MSC - MSC/IWF will utilize the same rate adaptation scheme as that indicated in 3GPP TS 48.020, i.e. adapted to 64 kbit/s.

~~10.2.3.1 Structure of the MSC/IWF for UMTS~~10.2.3.1 Structure of the MSC/IWF for Iu mode

The transmission towards the RNC is based on AAL2. The Iu UP is used in the transparent mode.

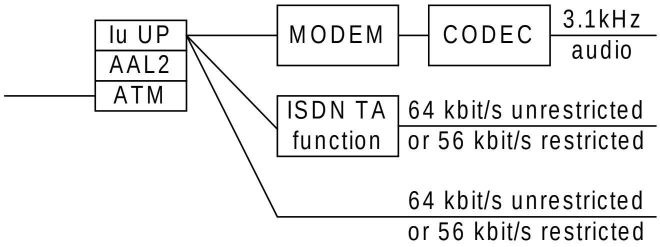


Figure 10: Structure of the MSC/IWF (transparent)

~~10.2.3.2 Structure of the MSC/IWF for GSM~~10.2.3.2 Structure of the MSC/IWF for A/Gb mode

When interworking to the unrestricted digital bearer service rate adaptation according to ITU-T V.110 will be necessary within the MSC/IWF. For multislot, TCH/F14.4 or EDGE operations MSC/IWF shall adapt the data stream as defined in 3GPP TS 44.021 and 3GPP TS 48.020.

NOTE: From the perspective of MSC/IWF, a TCH/F28.8 EDGE configuration is identical to a multislot 2×TCH/F14.4 configuration.

When interworking to the 3,1 kHz audio service, then the same process as for the PSTN case is necessary (section 9.2.3.2).

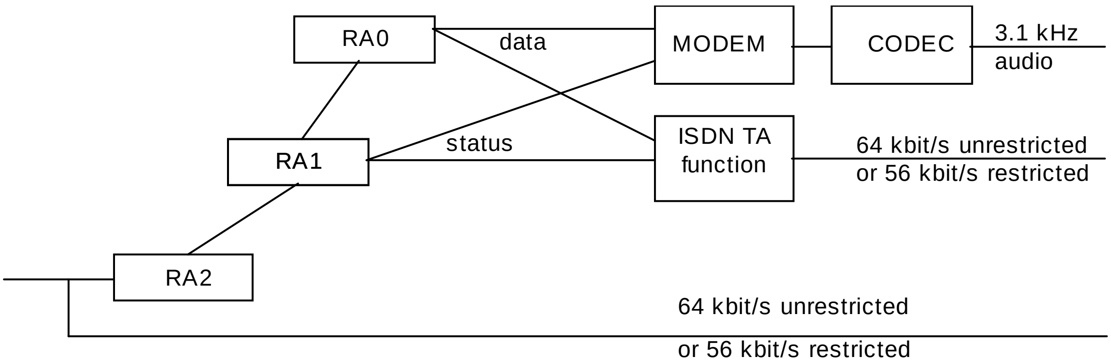


Figure 11: Structure of the MSC/IWF (transparent)

10.2.3.3 Mapping of signalling ~~MS~~UE/MSC/IWF to modem or ISDN (V.110) TA-function interface requirements

For the 3,1 kHz audio interworking case see subclause 9.2.3.3.

Status bits SA, SB and X can be used to convey channel control information associated with the data bits in the data transfer state. Table 8 shows the mapping scheme between the V.24 circuit numbers corresponding to the V-series DCE functions and the status bits for the transparent mode. It also shows how the unused status bits should be handled. It is derived from the General Mapping scheme described in annex B. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition.

The transport of these status bits by the various channel codings is described in 3GPP TS 44.021 and 48.020 for ~~GSM~~A/Gb mode. For ~~UMTS~~ Iu mode refer to 3GPP TR 23.910.

NOTE Although the interface to the ISDN TA function is described in terms of V.24 interchange circuit functions, this does not imply that such circuits need to be physically realised.

Table 8: Mapping scheme at the IWF for the transparent mode

Mapping direction: ~~MS~~UE to IWF	Mapping direction: IWF to ~~MS~~UE	Signal at IWF ISDN TA interface or condition within the IWF
always ON (note 1)		CT 105
	to status bit X	CT 106
	not mapped (note 5)	CT 107
not mapped (note 6)		CT 108
	to status bit SB	CT 109
always ON (note 2)		CT 133
from status bit SA (note 3)		ignored by IWF
from status bit SB (note 1)		ignored by IWF
from status bit X (note 4)		ignored by IWF
	to status bit SA (note 3)	always ON

NOTE 1: The SB bit towards the IWF, according to the General Mapping (annex B), could be used to carry CT 105 from the mobile DTE to the ISDN TA function in the IWF. However, CT 105 should always be ON at the DTE interface in the data transfer state since only duplex operation is supported. Also, many DTEs use the connector pin assigned to CT 105 for CT 133. Therefore, CT 105 shall always be set to ON at the IWF ISDN TA function during the data transfer state.
NOTE 2: CT 133 is not mapped since there is no flow control in transparent mode.
NOTE 3: The SA bits in both directions are available only with certain channel codings. Therefore, for maximum compatibility, they should not be mapped.
NOTE 4: The X bit towards the IWF is not mapped since there is no flow control in transparent mode.
NOTE 5: CT 107 is not used by the IWF.
NOTE 6: CT 108 is used in the call setup and answering processes.

10.2.3.4 Establishment of end-to-end terminal synchronizations

Prior to exposing the traffic channel of a PLMN connection to transmission of user data, the controlling entities of the connection shall assure of the availability of the traffic channel. This is done by a so called synchronizations process:

- starting on the indication of "physical connection established" resulting from the PLMN-inherent outband signalling procedure This indication is given on sending the message CONNECT in case of MOC, CONNECT ACKNOWLEDGEMENT in case of MTC and MODIFY COMPLETE (which is sent after reception of the ASSIGN COMPLETE message) in case of in-call modification;

- ending by indicating the successful execution of this process to the controlling entity, which then takes care of the further use of the inband information (data, status).

Network interworking within an MSC/IWF is concerned with the terminating side (to the ~~MS /~~UE) and the transit side (to the fixed network) of a connection. Both sides shall be treated individually related to the synchronizations process.

10.2.3.4.1 Terminating side (towards the ~~MS /~~UE)

10.2.3.4.1.1 ~~GSM~~ Traffic channel types TCH/F4.8 and TCH/F9.6 for A/Gb mode

With respect to the terminating side the procedure is as follows:

- sending of synchronizations pattern 1/OFF (all data bits "1"/all status bits "OFF") to the ~~MS~~UE using the RA1/RA2 rate adaptation function. In multislot transparent operation, the synchronisation pattern sent is 1/OFF with the exception of the bit positions S1, first X, S3, and S4 which contain the substream number and multiframe alignment pattern (Ref. 3GPP TS 44.021);

- searching for detection of the synchronizations pattern from the ~~MS~~UE within valid V.110 frames, and in multislot operation, also searching for the multiframe alignment pattern "0000 1001 0110 0111 1100 0110 1110 101" (Ref. to 3GPP TS 44.021) in bit position S4 and substream numbers in bit positions S1, first X, and S3. This implies that the E1, E2 and E3 bit of the V.110 frame shall be checked for the appropriate user rate in order to distinguish the synchronization pattern from the ~~BSS~~ RAN idle data frame.

- Timer T (= 500 ms) is started for each of the allocated traffic channel(s) of the call on receipt of the synchronizations pattern from the ~~MS~~UE.
- When the frame alignment pattern and, in case of multislot operation, the multiframe alignment pattern have been recognized as a steady state, the MSC/IWF continues sending the synchronizations patterns to the ~~MS~~UE until a timer T expires.

10.2.3.4.1.2 ~~GSM~~ Traffic channel type TCH/F14.4 for A/Gb mode

With respect to the terminating side the procedure is as follows:

- Sending A-TRAU frames with the data rate set in the bits C1-C4 (TS 48.020) and data bits set to one, sending the multiframe structure with the alignment pattern (bit M1) and with the status bits OFF (bit M2) and, in a multislot case, sending substream numbers (bit M2).
- Searching for the detection of the multiframe alignment pattern „0000 1001 0110 0111 1100 0110 1110 101" (TS 44.021) in the bit M1 and, in a multislot case, searching for substream numbers in the bit M2. (Any 5 bit sequence in the multiframe alignment pattern is unique, i.e. the multiframe alignment can take place by recognition of five successive M1 bits).
- Timer T (= 500 ms) is started for each of the allocated traffic channel(s) of the call on receipt of the synchronizations pattern from the ~~MS~~UE.
- When the frame alignment pattern and the multiframe alignment pattern have been recognized as a steady state, the MSC/IWF continues sending the synchronizations patterns to the ~~MS~~UE until a timer T expires.

10.2.3.4.1.3 ~~UMTS~~ User Plane for Iu mode

The procedures are the same as for the modem case, but, depending on implementation, the IWF may through connect before the fixed network leg has been synchronised.

10.2.3.4.2 Transit side (towards the fixed network).

In case of interworking to the ISDN "3,1 kHz audio" bearer service the synchronization process is as for the PSTN interworking case (see subclause 9.2.3.4.2).

In case of V.110 interworking to the ISDN unrestricted digital bearer service the following synchronization process shall be performed.

The interchange circuits towards the V.110 ISDN TA function are held in the OFF condition until timer T expires, when they are switched to ON.

From this time, after the expiration of the timer T of every allocated traffic channel, the information on CT106 and CT109 from the IWF V.110 ISDN TA function are directly mapped to the X and SB bits, respectively, towards the ~~MS~~UE. For TCH/F14.4 the X and SB bits are mapped to the M2 multiframe bits according to 3GPP TS 44.021. Circuit 108 to the selected V.110 ISDN TA function associated with the connection will be switched from the "OFF" to "ON" condition, thus initiating the synchronization process on the fixed network according to ITU-T V.110. The IWF is allowed to map CT 104 to the data bits sent towards the ~~MS~~UE and to map data bits received from the ~~MS~~UE to CT 103.

10.2.3.5 Network independent Clocking (NIC)

Due to the incompatibility between the ISDN and the ~~GSM~~ PLMN requirements for NIC interworking is not provided between these two formats. As such no NIC function is required in providing interworking to the ISDN. In this case, the IWF shall disregard the value of bits E4, E5, E6 and E7 in the data transmission phase.

10.2.4 Non-transparent service support

The protocol stacks for non-transparent services are specified in 3GPP TR 43.010 (~~GSM~~A/Gb mode) and in 3GPP TR 23.910 (~~UMTS~~Iu mode). Both of the systems use the Radio Link Protocol (RLP) specified in 3GPP TS 24.022.

In ~~UMTS~~Iu mode, the non-transparent services are based in the Iu User Plane protocol specified in 3GPP TS 25.415.

In ~~GSM~~ A/Gb mode the corresponding necessary support concerning the rate adaptation scheme shall be utilized on the ~~BSS~~RAN-MSC link as identified in 3GPP TS 48.020.

For the non-transparent service support the MSC/IWF will select the modem and speed based on the Compatibility information contained in either the call set-up or call confirmed message, reference subclauses 9.2.1 and 9.2.2. Where the Modem Type indicated is autobauding type 1, the MSC/IWF may select any speed and modem type according to what it can negotiate with the remote modem. In this case User Rate and Fixed Network User Rate, if present, has no meaning.

~~10.2.4.1 Structure of the MSC/IWF for UMTS~~10.2.4.1 Structure of the MSC/IWF for Iu mode

The transmission towards the RNC is based on AAL2. The Iu UP is used in the support mode. The RLP/L2R extends to the ~~MS~~UE.

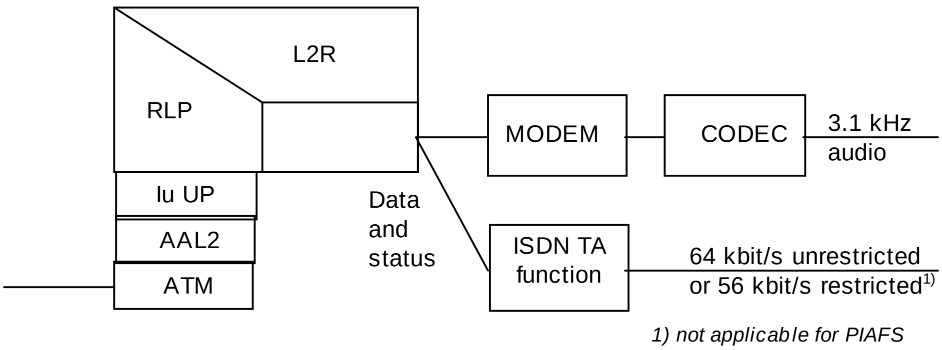


Figure 12: Structure of the MSC/IWF (non-transparent)

10.2.4.2 ~~Structure of the MSC/IWF for GSM~~Structure of the MSC/IWF for A/Gb mode

The rate adaptation process will be the same as for the transparent case~~.~~, except that a TCH/F43.2 channel coding is also supported. From MSC/IWF's perspective a TCH/F43.2 EDGE configuration is identical to a multislot 3×TCH/F14.4 configuration.

3GPP TR 43.010 identifies the protocol layer structure for the non-transparent case, the MSC/IWF provides the inverse of the action in the ~~MS~~UE terminal adaptation function. For a multislot configuration refer to 3GPP TR 43.010.

The V.110, V.120 and PIAFS ISDN TA (terminal adapter) functions provide the same functionality and operational behaviour as fixed ISDN terminal adapters that conform to the corresponding ITU-T Recommendations (V.110 or V.120).

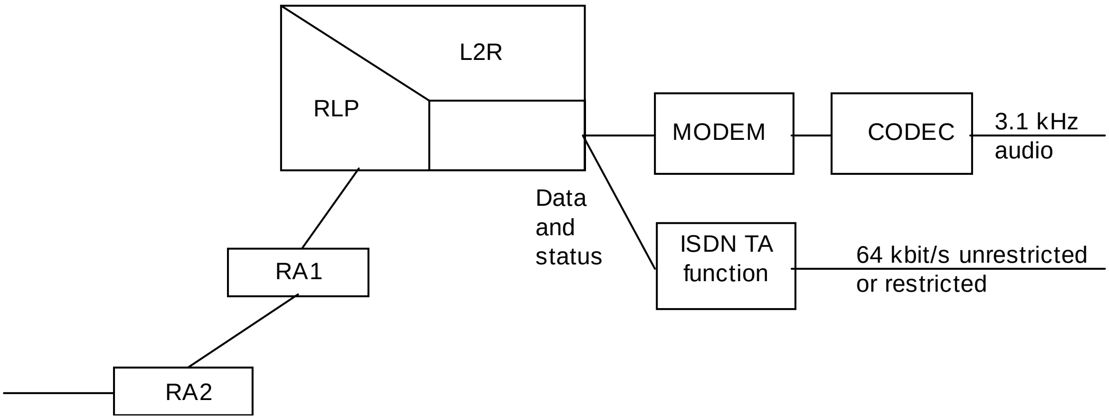


Figure 13: Structure of the MSC/IWF (non-transparent)

10.2.4.3 Re-constitution of user data

3GPP TS 24.022 refers to the frame of user data in the radio link protocol. The layer 2 relay functions in the ~~MS~~UE and the MSC/IWF (identified in 3GPP TS 43.010 and 3GPP TS 23.910) contain the mechanism for packing and unpacking the user data into the L2R protocol data units.

10.2.4.4 Layer 2 relay functionality

Specific functionality is required on the L2R dependant upon the service which is being requested to be supported. The selection of the appropriate L2R function will be determined by the MSC/IWF on the basis of the bearer capability information signalled in the call set-up request, or call confirmation message. The prime information element being transparent or non transparent service indication. In addition the particular L2R function - type of protocol to be terminated and mode of flow control to be applied (see appropriate subclauses in 3GPP TS 27 series) - will be selected on the basis of the user's layer 2 indication.

The specific interaction between the L2R function and the RLP function and the L2R frame structure will be the same as that detailed in the Annex to the appropriate 3GPP TS 27 series.

10.2.4.5 In band signalling mapping flow control

This entails the L2R function providing the means of controlling and responding to flow control function of the modem (or in the rate adapted frame) plus any synchronizations requirements related to flow control. For for asynchronous services a specific rule applies for flow control (see 3GPP TS 27.001).

In case of interworking to the ISDN "3,1kHz audio" bearer service the flow control process is as for the PSTN interworking case (see subclause 9.2.4.5). In case of interworking to the ISDN unrestricted digital bearer service the following procedures apply:

The flow control function chosen will be dependent upon the availability of the "user information layer 2" information element of the PLMN BC and if available its value.

For V.110 interworking, outband flow control will be by means of the "X" bit in the V.110 frame to the ISDN.

For V.120 interworking, outband flow control shall be as follows. In Multiple frame acknowledged mode the functions of the data link control sublayer (send RNR or withhold update of the sequence state variable V(R)) shall be used. In Unacknowledged mode the RR bit in the Control State octet shall be used.

For PIAFS interworking, outband flow control shall be as follows. The functions of the data link control sublayer (withhold update of the frame number) shall be used.

If flow control is provided irrespective of the type used, the L2R function shall:

a) provide immediate indication of flow control to the fixed network on receipt of flow control request from the ~~MS~~UE; and/or

b) provide immediate indication of flow control to the ~~MS~~UE on receipt of flow control request from the fixed network i.e. in the next available L2R status octet to be transmitted.

Where in band (X-on/X-off) flow control is in use, then the X-on/X-off characters will not be passed across the radio interface.

If no flow control is provided the involved end systems are responsible for performing in-band flow control on their own by taking into account the buffer capacity of the MSC/IWF as stated below.

10.2.4.5.1 Conditions requiring flow control - if flow control is provided - towards the fixed network

The L2R function will initiate flow control in the following circumstances:

1) the transmit buffer to the radio side reaches a preset threshold (BACK PRESSURE);

2) the L2R function receives a "flow control active" indication.

On removal of buffer congestion or receipt of L2R "flow control inactive" the flow control will be removed.

No flow initiation/removal will take place at the L2R function and loss of data may occur, if no flow control is provided.

10.2.4.5.2 Conditions requiring flow control towards the ~~MS~~UE

The L2R function will transmit to the ~~MS~~UE a "flow control active indication", if flow control is provided, in the following circumstances:

1) if the receive buffer from the radio side reaches a preset threshold (BACK PRESSURE);

2) if a flow control indication is received from the fixed network customer. On receipt of this flow control indication, transmission of data from the receive buffers towards the fixed network terminal is halted.

On removal of the buffer congestion or fixed network flow control indication, the L2R function will send a "flow control inactive" indication towards the ~~MS~~UE. In addition, for the fixed network indication, transmission of data from the receive buffers will be restarted.

If no flow control is provided at the L2R function, no flow control initiation/removal will take place by the MSC/IWF. Data might be lost without any indication by the MSC/IWF to the end systems involved.

10.2.4.6 Data buffers

10.2.4.6.1 Transmit buffers (towards ~~MS~~UE)

Incoming data from the fixed network customer shall be buffered such that if the MSC/IWF is unable to transfer data over the radio path the data is not lost.

The buffer shall be capable of holding the data. Its size is up to the implementers. When the buffer is half full flow control towards the fixed network shall be initiated if flow control is provided as per subclause 10.2.4.5.1.

10.2.4.6.2 Receive buffers (from ~~MS~~UE)

Incoming data from the ~~MS~~UE is buffered such that if the fixed network terminal is unable to accept the data then it is not lost.

The buffer shall be capable of holding the data. Its size is up to the implementers. When the buffer becomes half full, the L2R function will send a "flow control active" indication towards the ~~MS~~UE if flow control is provided at the L2R function, as per subclause 10.2.4.5.2.

10.2.4.7 BREAK Indication

The BREAK indication is managed as detailed in subclause 9.2.4.7.

When V.120 rate adaptation is being used in protocol sensitive asynchronous mode on the ISDN, the L2R break condition shall map on to the BR bit of the V.120 header octet.

10.2.4.8 Signalling mapping of modem or ISDN (V.110, V.120 or PIAFS) TA-function status information

Status information is carried between the modem or ISDN (V.110, V.120or PIAFS) TA-function in the IWF and the terminal adaption function in the ~~MS~~UE by the L2R function. The L2RCOP entity transfers interface status information between L2Rs via the status octets SA, SB and X in L2RCOP-PDUs (3GPP TS 27.002). Table 9 shows the mapping scheme between the V.24 circuit numbers corresponding to the V-series DCE functions and the status bits for the non-transparent mode. It also shows how the unused status bits should be handled. It is derived from the General Mapping scheme described in annex B. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition.

NOTE. Although the interface to the ISDN TA function is described in terms of V.24 interchange circuit functions, this does not imply that such circuits need to be physically realised.

Table 9: Mapping scheme at the IWF for the non-transparent mode

Mapping direction: ~~MS~~UE to IWF	Mapping direction: IWF to ~~MS~~UE	Signal at IWF ISDN TA interface or condition within the IWF
always ON (note 1)		CT 105
	to status bit X (notes 4, 7)	CT 106 (note 7)
	not mapped (note 5)	CT 107
not mapped (note 6)		CT 108
	to status bit SB	CT 109
from status bit X (note 8)		CT 133 (notes 3, 8)
from status bit SA (note 2)		ignored by IWF
from status bit SB (note 1)		ignored by IWF
	to status bit SA (note 2)	always ON

NOTE 1: The SB bit towards the IWF, according to the General Mapping (annex B), could be used to carry CT 105 from the mobile DTE to the ISDN TA function in the IWF. However, CT 105 should always be ON at the mobile DTE interface in the data transfer state since only duplex operation is supported. Also, many DTEs use the connector pin assigned to CT 105 for CT 133. Therefore, CT 105 shall always be set to ON at the ISDN TA function during the data transfer state.

NOTE 2: The SA bits (both directions) are not mapped since CTs 107 and 108 are handled locally (notes 5, 6).

NOTE 3: The condition of CT 133 (or other flow control mechanism) may also be affected by the state of the L2R transmit buffer (towards the ~~MS~~UE) in the IWF and the state of RLP (RR/RNR).

NOTE 4: The condition of status bit X towards the ~~MS~~UE may also be affected by the state of the L2R receive buffer in the IWF (from the ~~MS~~UE).

NOTE 5: CT 107 is not used by the IWF.

NOTE 6: CT 108 is used in the call setup and answering processes.

NOTE 7: For inband flow control, CT 106 is not mapped and the status bit X towards the ~~MS~~UE is controlled by the reception of XON and XOFF characters from the ISDN TA function.

NOTE 8: For inband flow control, changes in the condition of the status bit X from the ~~MS~~UE result in the sending of XON or XOFF to the ISDN TA function. CT 133 is always set to ON.

10.2.4.9 Support of out-band flow control

Out-band flow control in the case of V.110 rate adaption requires V.110 TA to TA "end-to-end flow control" as defined therein. If this functionality is requested by ~~MS~~UE but cannot be supported by the MSC/IWF for any reason (refer also to note 15 of table 7B) the call pending shall be released.

For V.120 interworking, outband flow control shall be as follows. In Multiple frame acknowledged mode the functions of the data link control sublayer (send RNR or withhold update of the sequence state variable V(R)) shall be used. In Unacknowledged mode the RR bit in the Control State octet shall be used.

10.2.4.10 Synchronizations

In case of interworking to the ISDN "3,1kHz audio" bearer service the synchronization process is as for the PSTN interworking case (see subclause 9.2.3.4). In case of interworking to the ISDN unrestricted digital bearer service the following synchronization process shall be performed:

10.2.4.10.1 V.110 and V.120 Frame synchronizations

The ISDN frame synchronizations will need to be mapped to the frame synchronizations utilized on the MSC/IWF to MSC link.

10.2.4.10.2 RLP Frame start indication

The frame start indication is defined in 3GPP TS 48.020. Link establishment and frame error recovery are defined in 3GPP TS 24.022.

10.2.4.10.3 L2R Frame synchronizations

The synchronizations of user data and its interaction between the L2R function and RLP function are defined in 3GPP TS 27 series.

10.2.4.10.4 Establishment of end-to-end terminal synchronizations

Prior to exposing the traffic channel of a PLMN connection to transmission of user data, the controlling entities of the connection shall assure of the availability of the traffic channel. This is done by a so called synchronization process:

- starting on the indication of "physical connection established" resulting from the PLMN-inherent outband signalling procedure This indication is given on sending the message CONNECT in case of MOC, CONNECT ACKNOWLEDGEMENT in case of MTC and MODIFY COMPLETE (which is sent after reception of the ASSIGN COMPLETE message) in case of in-call modification;

- ending by indicating the successful execution of this process to the controlling entity, which then takes care of the further use of the in-band information (data, status).

Network interworking within an MSC/IWF is concerned with the terminating side (to the ~~MS~~UE) and the transit side (to the fixed network) of a connection. Both sides shall be treated individually related to the synchronization process.

10.2.4.10.4.1 Terminating side (towards the ~~MS~~UE)

The procedures are the same as for the modem case.

10.2.4.10.4.2 Transit side (towards the fixed network)

Depending upon implementation, the synchronization of the V.110 or V.120 rate adaptation protocol on the ISDN transit network may be performed either after RLP establishment or in parallel to the RLP establishment. In case of the parallel establishment, data received from the transit side during RLP establishment shall be stored within the L2R buffers until the RLP establishment at the terminating side has been finished. When the RLP has been established and on recognizing frame alignment the information from/to the RLP is mapped by the L2R entity applicable to this particular bearer capability.

For V.110 rate adaptation on the ISDN, the synchronization process consists of sending the V.110 frame structure and looking for incoming frame synchronization according to the procedures in ITU-T V.110.

For V.120 rate adaptation the following applies. In Multiple frame acknowledged mode, data (I frames) may be sent following an exchange of SABME and UA in the traffic channel. In Unacknowledged mode, data (UI frames) may be sent immediately after an ISUP CONNECT or CONNECT COMPLETE message has been received on the ISDN signalling channel. Optionally, an XID exchange may take place in the traffic channel to verify link integrity.

Note. V.120 allows UI frames to be sent in Multiple frame acknowledged mode at any time in addition to I frames. Whilst the IWF shall not follow this procedure when sending frames, such a sequence of I and UI frames may be received by the IWF. Although not specified in V.120, it is recommended that the IWF should deliver to the ~~MS~~UE, the contents of the sequence of I and UI frames in the order in which they are received.

For PIAFS rate adaptation the following applies. Data frame is sent following an exchange of initial negotiation and control frame in the traffic channel.

10.2.4.11 Data compression

When data compression is invoked within a non-transparent bearer service, interworking to the ISDN is realized by mapping the PLMN user rate to at least the same user rate in the ISDN. When the ISDN user rate is the same flow control will ensure data integrity, but the overall performance will be slow. When the ISDN user rate is higher the overall performance may be faster.

10.2.4.12 Additional aspects of V.120 Interworking

V.120 rate adaptation may be invoked with asynchronous services only. V.120 is applicable to both UDI and RDI connections.

10.2.4.12.1 V.120 Signalling parameters

The signalling parameters relevant to V.120 will be carried in the ISDN LLC and PLMN BC and PLMN LLC information elements. The mapping of the parameter values takes place in the MSC/IWF.

For mobile terminated calls both single-numbering and multi-numbering scenarios may apply, as defined in subclause 9.2.2. The HLR shall not store an ISDN LLC with the MSISDN.

10.2.4.12.2 V.120 Protocol parameters

The following restrictions apply for the parameters relevant for V.120:

- BS 20 NT will use the protocol sensitive asynchronous mode. As a consequence, the rate adaption header shall always be present.
- Only the default logical link will be established, i.e. the LLI negotiation value is "Default, LLI=256 only".
- V.120 recommends the use of the multiple frame acknowledged information transfer procedure for the protocol sensitive mode of operation.
- The IWF shall use the default value for the V.120 window size and the default value for the maximum transmit information field size. It shall be able to receive frames with the default maximum size.

NOTE: V.120 does not specify the values for these and other HDLC-related parameters directly. They are specified in Q.922 (1992) section 5.9. The information field includes the V.120 terminal adaption data field, the rate adaption header and the header extension (Control State octet), if present.

10.2.4.12.3 Data compression on the ISDN

Whilst V.110 rate adaptation does not support standardized data compression, V.42bis data compression may be used with V.120 protocol sensitive asynchronous mode. This is described in V.120 (10/96) annex C.

10.2.4.12.4 Use of the V.120 Control State (header extension) octet

The bits in the V.120 Control State octet are not used for the control of V.24 interface circuits. In unacknowledged mode the RR bit in the Control State octet is used to carry flow control information between the peer terminal adaption protocol entities. In acknowledged mode the Control State octet is not required.

10.2.4.13 Interworking with restricted 64 kbit/s networks

10.2.4.13.1 Rate adaptation

Both V.110 and V.120 rate adaption protocols may be used on a restricted 64 kbit/s network.

For V.110 rate adaption, the procedure is described in ITU-T Rec. I.464. The RA2 function shall set the 8th bit of each octet in the 64 kbit/s stream to binary 1. A consequence of this is that the highest permitted intermediate rate is 32 kbit/s. At the receiver, the 8th bit shall be ignored.

Rec. V.120 states that the user data shall be rate adapted to 56 kbit/s by using only the first 7 bits of each octet in the 64 kbit/s stream. The 8th bit shall be set to binary 1. At the receiver, the 8th bit shall be ignored.

10.2.4.13.2 MSC - ISDN signalling

When interworking indirectly with restricted 64 kbit/s networks the ISDN BC information element shall be coded according to ETR 018 (as shown in the notes to tables 7A and 7B). The information corresponding to the ~~GSM~~ PLMN BC-IE shall be communicated in the ISDN LLC-IE which shall be provided by the ~~MS~~UE for mobile originated calls.

In the case of direct interworking, an ITC = RDI in the ~~GSM~~ PLMN BC-IE maps on to an ITC = RDI in the ISDN BC-IE for both MO and MT calls.

10.2.4.14 Service level up and down grading

Text in 9.2.4.~~13~~ 12 applies here as well.

10.2.4.15 Interworking in Frame Tunneling Mode

Figure 14 below shows the protocol stack used for FTM. The interface between the two asynchronous-synchronous conversion functions in the IWF and the remote terminal adapter (TA) is a 64 kbit/s UDI or a 56 kbit/s RDI connection. X.31 flag stuffing is used to adapt the rate between the two conversion functions. Data transparency is provided through bit stuffing.

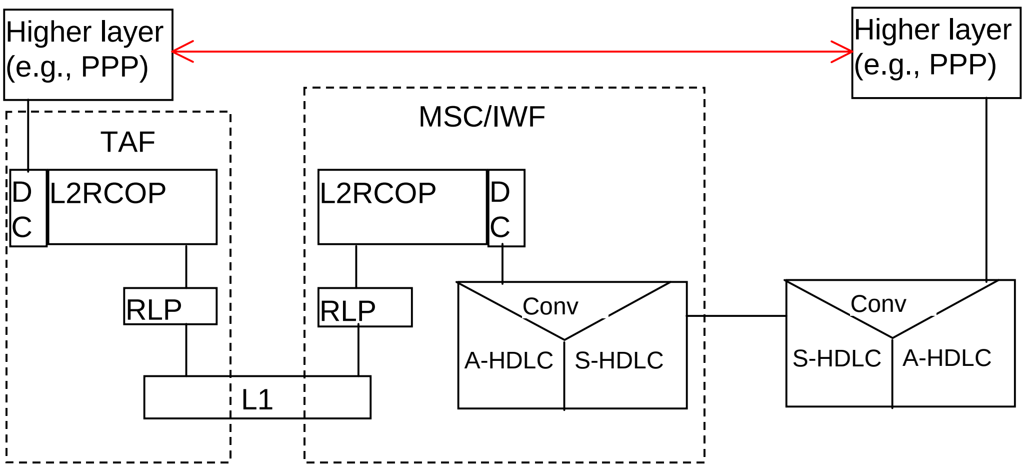


Figure 14: The FTM protocol stack

Data compression between the TAF and the IWF is optionally applied. The asynchronous to synchronous HDLC conversion follows from ISO/IEC 3309[48].

A particular aspect of the asynchronous HDLC protocol is the provision of control character transparency. This means that flags (0x7E) and the control escape character (0x7D) are escaped, by insertion of the control escape character in front of the character to be escaped, and that the 6th bit of the escaped character is complemented (i.e., the escaped character is XOR'ed with 0x20). ISO/IEC 3309[48] allows additional control characters to be escaped by prior agreement or negotiation between the peer entities. For instance, in PPP [49], a negotiation procedure is defined using an Asynchronous Control Character Map (ACCM). By examining the contents of the HDLC frames that pass through it, the IWF shall identify whether the higher layer protocol is PPP, in which case, it shall detect and interpret the ACCM negotiation result. If PPP is used, the conversion function in the IWF shall apply a default ACCM until another is negotiated.

10.2.4.16 Additional aspects of PIAFS Interworking

PIAFS has several U-Plane protocol suites, but "Data Transmission Protocol (fixed rate)"[50] is only applied for ~~UMTS~~ UTRAN Iu mode ~~R'99~~ in consideration of simplicity. Details of frame structure and retransmission procedure etc. conform to reference [50].

In case of 32kbit/s mode, IWF performs rate adaptation based on I.460 for fixed network.

In case of 64 kbit/s mode, restriction on throughput may be caused by ~~co-ordination with GSM (~~the maximum frame length of 572bits in RLP ~~is 572bits in UMTS)~~.

10.2.5 DTE/DCE interface (Filtering)

This is described in section 9.2.5.

10.3 Interworking Alternate speech facsimile group 3 calls

10.3.1 Alternate speech data bearer interworking

10.3.1.1 General

The procedure for the alternate speech/facsimile group 3 service is invoked at the ~~MS~~UE-MSC link during the call set-up phase. This service is invoked by indication of repeated bearer capability information elements in the setup message and/or call confirmed message, respectively (preceded by a repeat indicator "circular"), one indicating speech and the other indicating "facsimile group 3" plus user rate etc., as for normal single calls. The bearer capability first indicated i.e. speech or facsimile determines the first selection required of the network by the subscriber. Depending on the type of service requested and direction of call establishment (M0/MT, see relevant clauses of the 3GPP TS 27 series) low layer and high layer capabilities may also be included. The MSC/IWF will perform both compatibility checking and subscription checking for mobile originated calls and optionally for mobile terminated calls (single numbering scheme) on both sets of capabilities as for normal data calls. If either the subscription check or the compatibility check fails then the call shall be rejected. The only exception to this is when TS61/TS62 negotiation takes place, see 3GPP TS 27.001.

As regards the supplementary services the application rules are laid down in 3GPP TS 22.004.

The speech phase of the call, when invoked, is handled by the transcoder and will utilize the normal telephony teleservice interworking requirements and mobile network capabilities. The Facsimile group 3 phase of the call, when invoked, shall utilize the appropriate data interworking capability (e.g. IWF) and shall use the transparent mobile network capability in ~~GSM~~ A/Gb mode or the non-transparent mobile network capability in ~~UMTS~~Iu mode.

The network shall provide, for service and operational reasons, a rapid and reliable changeover of capability upon request from the mobile user. This changeover may involve the disabling, by-passing or introduction of particular network functions (e.g. speech coder, modem etc.) and change of the channel configuration on the radio interface. This changeover is initiated on the receipt of the "MODIFY" message (see 3GPP TS 24.008) from the ~~MS~~UE. The network itself will not initiate a changeover.

10.3.1.2 Mobile originated ISDN terminated

If one bearer capability information element indicates the ITC value "facsimile group 3", the call set up is as for the PSTN case. Interworking is provided to the ISDN bearer service 3,1 kHz audio for the whole connection, including the speech phase. The MODIFY message (see 3GPP TS 24.008) will be generated by the mobile subscriber. This message is not transmitted to the ISDN, i.e. no outband correlation between the user on the fixed network and the mobile user will be possible. In this instance it is necessary for change of network capabilities to be carried out in the mobile network.

10.3.1.3 ISDN originated mobile terminated

In principle this is handled as for normal ISDN originated call.

When the calling user however indicates an ISDN BC-IE with an ITC value "3,1 kHz audio" and a HLC "facsimile group 3", i.e. the call arrives at the PLMN with compatibility information allowing for deducing the Teleservice "Facsimile transmission", the call setup is as described in subclause 10.2.2 (case 3 in HLR, case 5 in VMSC).

In the information transfer phase the call is dealt with as indicated in the previous paragraph.

10.4 3G-H.324/M calls over UDI/RDI

3G-H.324/M calls provide UDI/RDI(e.g. 32 kbit/s transparent data, 56 kbit/s transparent data or 64 kbit/s transparent data). H.223 and H.245 flow is not terminated in the MSC.

3G-H.324 calls over 64 kbit/s transparent data and 56kbit/s transparent data can be connected to H.324/I calls over UDI/RDI. H.223 protocol is transparent to IWF.

In case of 3G-H.324M calls over 32 kbit/s, IWF which performs rate adaptation between 64kbit/s and 32kbit/s is used. Rate adaptation is based on ITU-T I.460.

The support of IWF which transcodes the multiplexes and the content of control, audio, video and data in MSC is FFS.

11 ~~Interworking between GSM and UMTS~~Interworking between A/Gb mode MSC and Iu mode MSC

~~11.1 Handover from UMTS to GSM~~11.1 Handover from Iu mode MSC to A/Gb mode MSC

After a handover from ~~UMTS~~ an Iu mode MSC to ~~GSM~~ an A/Gb mode MSC the user plane between the anchor MSC and the visited MSC shall comply to the standard ~~GSM~~ A-interface protocols, i.e:

- A-TRAU or modified V.110 frames as defined in 3GPP TS 44.021 [27] and 3GPP TS 48.020 [28];
- up to four 16kbit/s substreams are multiplexed in one 64kbit/s channel (Split/Combine function and Multiplexing function as defined in 3GPP TS 44.021 [27] and 3GPP TS 48.020 [28]).

~~11.2 Handover from GSM to UMTS~~11.2 Handover from A/Gb mode MSC to Iu mode MSC

After a handover from ~~GSM~~ an A/Gb mode MSC to ~~UMTS~~ an Iu mode MSC the user plane between the anchor MSC and the visited MSC shall comply to the A-TRAU' protocol except for FNUR = 56 kbit/s (ITC=RDI) and FNUR = 64 kbit/s (ITC=UDI). For both exceptions a plain 64 kbit/s channel is used between the MSCs.

The A-TRAU' protocol is defined as follows:

- A-TRAU' frames are transmitted in regular intervals of 10ms;

- an A-TRAU' frame consists of two consecutive A-TRAU frames (as defined in 3GPP TS 48.020 [28]) each with a length of 320 bit;
- the A-TRAU' protocol is used on a plain 64 kbit/s channel without substreams;
- the same A-TRAU' format is used for the transparent and non-transparent transmission mode;
- in transparent mode the number of data bits in an A-TRAU' frame depend on the user rate only, each user rate corresponds to a fixed number of data bits (see below);
- in non-transparent mode A-TRAU' frames contain always complete RLP frames, rate adaptation is performed by means of the M2 bit;
- the M1-bit is used to identify 1st and 2nd frame in both transmission modes.

11.2.1 Frame layout for the different transparent user rates

The number of data bits in an A-TRAU' frame depend on the user rate only, each user rate corresponds to a fixed number of data bits in an A-TRAU' frame.

Table 10: A-TRAU' frame layout for transparent user rate

Date Rate	Number of data bits per A-TRAU' frame
33.6 kbit/s	336
28.8 kbit/s	288

The data bits are inserted in the A-TRAU' frame starting with D1 of Data field 1 of the first A-TRAU frame. The unused bits are filled with binary '1'.

11.2.2 A-TRAU' frame format

One A-TRAU' frame consists of two consecutive A-TRAU frames. Figure 15 shows the format of one A-TRAU frame.

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 15: A-TRAU 320 bit frame

Data Bits (Dxx):

The 288 data bits of an A-TRAU frame are divided in eight fields of 36 bits.

Control bits (C Bits):

C1 to C4:

The Control bits C1 to C4 define the used data rate. C1 to C4 in the first A-TRAU frame indicate the data rate in send direction.

C1 to C4 in the second A-TRAU frame indicate the used data rate in backward direction. This is required for Rate Control that is required in uplink direction. For details on Rate Control see 3GPP TS 25.415 [42].

Table 11: A-TRAU' control bits

C1	C2	C3	C4	Radio Interface User Rate
1	0	1	1	57,6 kbit/s
1	0	1	0	33,6 kbit/s
1	0	0	0	28,8 kbit/s
0	1	1	1	14,4 kbit/s

C5:

C5 is not used, it is set to binary '1'.

Bit M1:

An A-TRAU' frame is made of two consecutive A-TRAU which build the transport container for 576 data bits. Bit M1 is used to determine the order of the A-TRAU frames within an A-TRAU' frame.

The two M1 bits are referred to as the Frame Start Identifier. The FSI value is 01. These values are assigned to the M1 bit as shown below:

Table 12: Frame Start Identifier

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

Bit M2:

The M2 bit is used to indicate 'valid' A-TRAU' frames. The M2 bit in both of the two consecutive A-TRAU frames relating to an A-TRAU' frame shall have the same value.

Transparent mode:

In transparent mode M2 is clamped to binary '0'.

Non-transparent mode:

In non-transparent mode M2 is used for DTX. If DTX is applied, M2 is set to binary '1'. If DTX is not to be applied, M2 bit is set to binary '0'. The DTX handling is used in both directions for rate adaptation purpose. This means that the sending entity will insert 'fill RLP-frames' with DTX set to binary '1' in case no RLP-frame is available.

Fill frames are also sent in order to adapt the RLP transmission frequency to the AIUR. The ratio between RLP frames and ‘fill’ RLP frames is defined in the following table:

Table 13: RLP transmission frequency

AIUR	Ratio between RLP and ‘fill’ RLP frames
57.6 kbit/s	Only valid frames
28.8 kbit/s	1 valid frame followed by 1 ‘fill’ frame
14.4 kbit/s	1 valid frame followed by 3 ‘fill’ frames

Z bits:

The bits Zi are used for Framing Pattern Substitution mechanism. This mechanism is defined in 3GPP TS 48.020 [28].

Mapping of A-TRAU’ frames to PCM time slots:

A-TRAU’ frames shall be mapped octet aligned to PCM time slots. I.e. bit number 0 to 7 of each octet of an A-TRAU’ frame shall be mapped to bit number 0 to 7 of the PCM time slot.

11.3 Handover within ~~3G~~ Iu mode PLMNs

After a handover from a ~~3G~~ Iu mode MSC to another ~~3G~~ Iu mode MSC the user plane between the anchor MSC or MGW and the visited MSC or MGW shall comply to:

- the Iu UP protocol if both MSC are connected via an ATM interface;
- the A-TRAU' protocol if both MSCs are connected via a TDM interface except for the transparent case FNUR = 32 kbit/s (ITC = UDI or RDI), FNUR = 56 kbit/s (ITC=RDI) and FNUR = 64 kbit/s (ITC=UDI). For these exceptions a plain 64 kbit/s channel is used between the MSCs. The rate adaptation between 64 kbit/s and 32 kbit/s is based on ITU-T I.460 [2].
- the Nb UP protocol if both MGWs are connected via an ATM interface or IP interface

11.4 Handover for 56kbit/s

The FNUR = 56 kbit/s in transparent mode can be supported in ~~GSM~~ A/Gb mode by two configurations:

1. without IWF with the following channel codings
    - 2*TCH/F32.0
    - 5*TCH/F9.6
2. with IWF with the following channel coding
    - 4*TCH/F14.4

The FNUR = 56 kbit/s in transparent mode is supported in ~~UMTS~~ Iu mode by a configuration without IWF only. Therefore handover for 56kbit/s in transparent mode between ~~UMTS~~ Iu mode MSC and ~~GSM~~ A/Gb mode can be supported only for configurations without IWF.

Note: Handover between configurations with and without IWF are also not supported within ~~GSM~~A/Gb mode.

11.5 Transport within the Core Network

The Nb UP protocol is used to transport user data in the Core Network, see 3GPP TS 29.415 [80]. Figure 16 below shows different cases to consider:

1. Transport on the access side of the IWF
2. Transport beyond the IWF, i.e., between the IWF and the fixed network

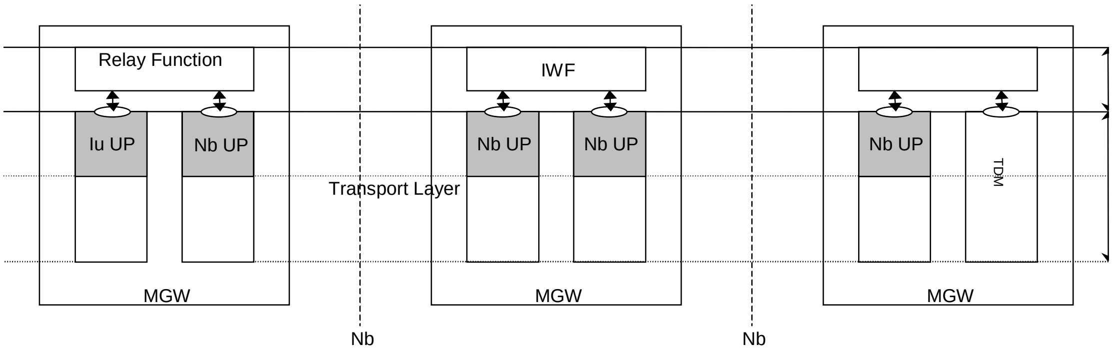


Figure 16: Transport of data within the Core Network

11.5.1 Transport on the access side of the IWF

This section is applicable in cases where the IWF is not interfacing an Iu UP layer protocol entity, as a result of, e.g., at handover.

11.5.1.1 Non-transparent case

The Nb UP is used in support mode. The same SDU sizes and transmission intervals that are used on the Iu interface are used over the Nb interface, see 3GPP TR 29.310 [53] and 3GPP TS 27.001 [43]. A Relay Function (see 3GPP TS 29.232 [82]) is used to relay the user data and control information (such as rate control) in MGWs between the MGW where the IWF is residing and the Iu interface.

11.5.1.2 Transparent case

The Nb UP is used in transparent mode. The same SDU sizes and transmission intervals that are used on the Iu interface are used over the Nb interface, see 3GPP TR 29.310 [53] and 3GPP TS 27.001 [43]. The PDUs are passed unmodified through all MGWs between the MGW where the IWF is residing and the Iu interface.

Note: Transmission in case of user rate 33.6 kbit/s is FFS.

11.5.2 Transport beyond the IWF

11.5.2.1 UDI and RDI

The data is transported in a 64 kbit/s bit stream, formatted in SDUs of 40 octets and transmitted every 5 ms, in accordance with Annex P of ITU-T I.366.2 [81]. PDU type 0 is used, i.e., payload CRC is applied.

At the border between the CN and the fixed (ISDN) network, conversion between Nb UP and TDM shall be applied. In case of RDI interworking, the 56 kbit/s RDI bit stream is transmitted within the CN as 64 kbit/s bit stream where the last bit of each octet is ignored. For this reason the octet alignment shall be preserved in the SDUs transported in the CN.

11.5.2.2 Modem

The modem signals are PCM encoded and transported on a 64 kbit/s bit stream. The transmission is otherwise identical to the UDI/RDI case, see Section 11.5.2.1

12 Frame Synchronization

Potentially two links are involved in the MSC/IWF regarding the need for frame synchronization, i.e the link towards the ~~MS~~UE and the link towards the fixed network. The links towards the ~~MS~~UE are covered by 3GPP TS 48.020 and 48.060 for ~~GSM~~ A/Gb mode and 3GPP TS 25.415 for ~~UMTS~~Iu mode. For the link towards the fixed network, the appropriate sections of ITU-T V-series modem, V.110, V.120 and PIAFS Recommendations apply.

12.1 Initial frame synchronization

12.1.1 Terminating side (towards the ~~MS /~~ UE)

In ~~UMTS~~Iu mode, the terminating side is not synchronous.

In ~~GSM~~A/Gb mode, for transparent/non-transparent and interworking to the PSTN or ISDN the interface to the ~~BSS~~ RAN is managed as follows. As soon as the outband signalling exchange indicates that the traffic channel is available the MSC/IWF will start sending frames with the frame contents set as indicated in subclause 9.2.3.4.1 towards the ~~BSS~~RAN. The MSC/IWF will seek to attain V.110 or A-TRAU frame synchronization on the incoming data from the ~~BSS~~RAN. V.110 synchronization will be considered to be completed in line with the procedures described in subclause 9.2.3.4.1.1. A-TRAU frame synchronization will be considered to be completed in line with the procedures described in subclause 9.2.3.4.1.2. The incoming data will only be considered valid once the frame synchronization procedure defined in subclause 9.2.3.4.1 is complete. For non-transparent interworking to the PSTN or ISDN, the procedures described in subclause 9.2.4.10.1 shall be followed.

12.1.2 Transit side (towards the fixed network)

12.1.2.1 Interworking to the PSTN

In the case of interworking to the PSTN the procedures for initial synchronization for the transparent services are covered in subclause 9.2.3.4.2 and the non-transparent services in subclause 9.2.4.10.2.

12.1.2.2 Interworking to the ISDN

In the case of interworking to the ISDN the procedures for initial synchronization for the transparent services are covered in subclause 10.2.3.4.2 and the non-transparent services in subclause 10.2.4.10.4.2.

12.2 Action on loss of frame synchronization

The IWF should attempt to recover synchronization as described in the following subsections. If the resynchronization attempt fails, the IWF may clear the call.

12.2.1 Loss on the transit side (towards the fixed network)

If loss of frame synchronization is detected from the fixed network in line with the procedures specified in the ITU-T or PIAFS recommendation applicable to the type of interworking (V.110, V.120, PIAFS or V-series modem), then re-synchronization is initiated in line with the procedures specified in that recommendation. No change of behaviour of the MSC/IWF on the ~~BSS~~RAN/MSC link is necessary.

12.2.2 Loss on the terminating side (towards the ~~MS~~UE)

In ~~UMTS~~Iu mode, the terminating side is not synchronous, so loss of synchronisation is not possible. For T services, frames may be lost or arrive irregularly, which handling is implementation dependent.

In ~~GSM~~A/Gb mode, if the MSC/IWF detects a loss of frame synchronisation on one or more substreams on the ~~BSS~~RAN/MSC link, the MSC/IWF initiates a re-synchronisation on the substreams in question as specified in the following.

The MSC/IWF shall detect a loss of V.110 frame synchronisation in line with the rules specified in ITU-T V.110. The MSC/IWF shall detect a loss of A-TRAU frame synchronisation when an A-TRAU frame has been received with at least one error in the synchronisation pattern (ref 3GPP TS 48.020).

If loss of synchronization is detected on the ~~BSS~~RAN/MSC link then a re-synchronization process should be initiated. However for this link to the ~~BSS~~ RAN it is only necessary to search for the frame alignment pattern incoming from the ~~BSS~~RAN. In the case of A-TRAU the synchronisation shall take care of the multiframe alignment according to subclause 9.2.3.4.1.2 and the MSC/IWF shall set the control bit UFE (Uplink Frame Error, see 3GPP TS 48.020) in the next downlink A-TRAU frame to indicate the framing error to the ~~BSS~~RAN.

There shall be no action regarding the outgoing frame towards the ~~BSS~~RAN, other than to continue sending the rate adapted frames made up of the incoming data from the fixed network. During the re-synchronization process data shall continue to be sent towards the fixed network via the modem or ISDN (V.110, V.120, or PIAFS) TA-function as if the frame synchronization were still available. The mapping of the status bits is unchanged during re-synchronization.

Once synchronization has been re-attained the RLP will recover any possible loss of data on the ~~BSS~~RAN/MSC link in the case of non-transparent services. The indication of UFE will be stopped in the case of A-TRAU.

13 Call Clearing

When a call is to be cleared, the MSC/IWF shall handle both the links, towards the ~~MS~~UE as well as towards the fixed network.

At the link towards the ~~MS~~UE out-band (3GPP TS 24.008) signalling shall be used. Changes in the in-band status bits shall not be used to signal call clearing.

At the link towards the fixed network, the clearing procedures appropriate to the fixed network shall be used, together with any additional procedures described in the ITU-T recommendation applicable to the type of interworking (V.110, V.120, PIAFS or V-series modem).

Annex A (informative): SDLs

The following SDLs are intended to assist in the interpretation of the text in subclause 10.2.2 and are not intended to indicate implementation requirements. Therefore these SDLs are informative only.

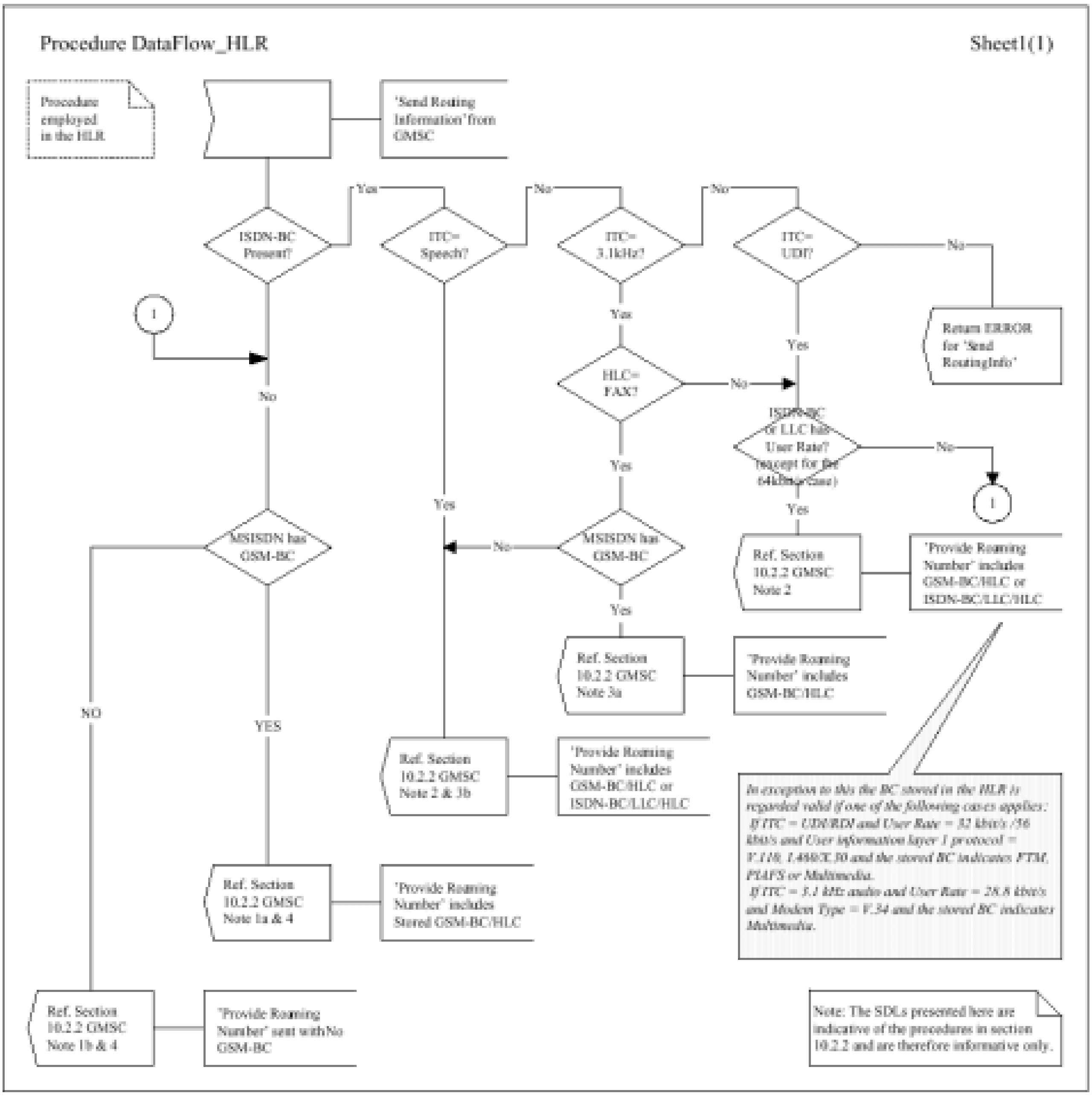


Figure A.1 (Sheet 1 of 1): Procedures in the HLR

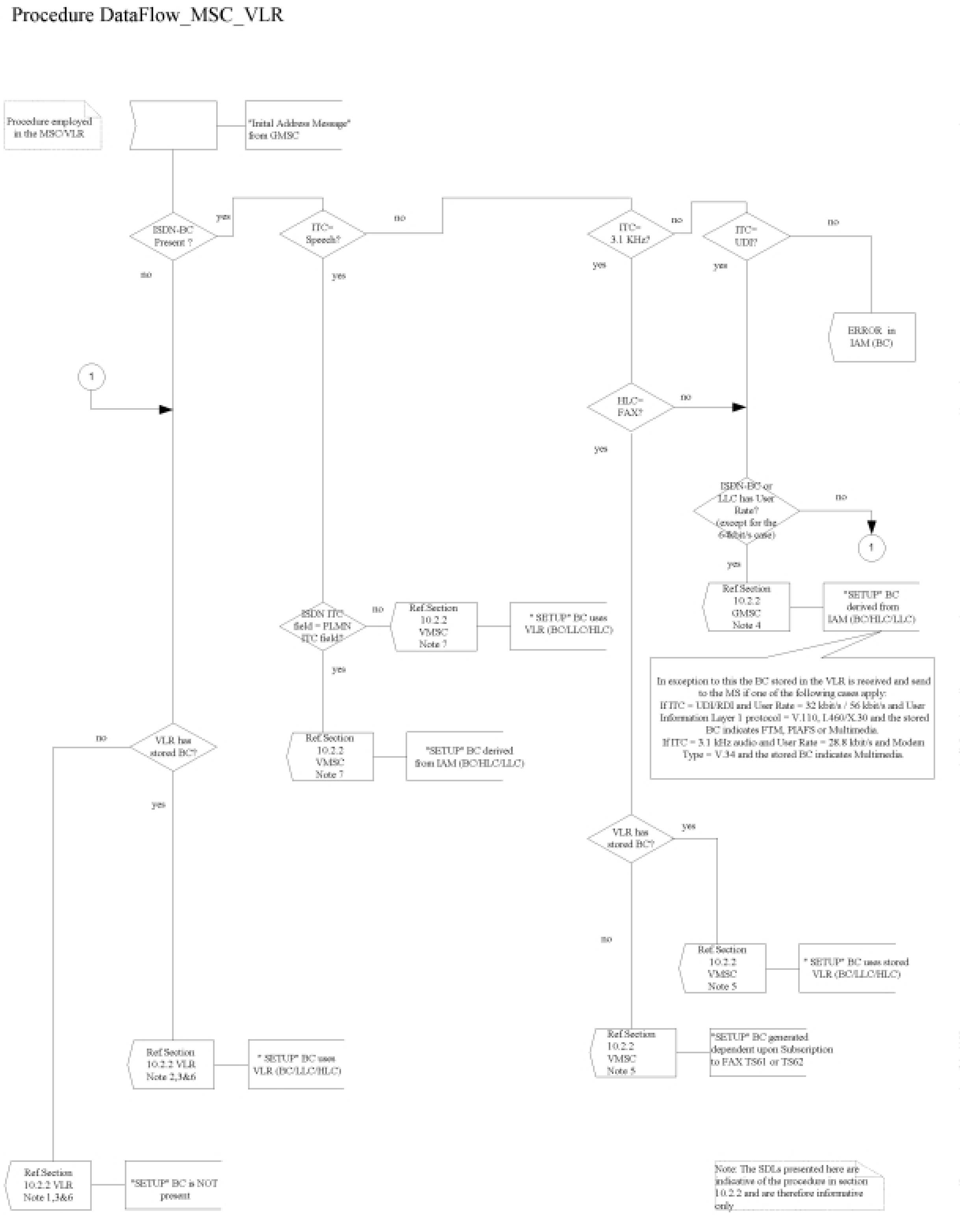


Figure A.2 (Sheet 1 of 1): Procedures in the MSC/VLR

Annex B (informative): General mapping of V.24 circuits to channel status bits

In the data transfer state, status bits SA, SB and X can be used to convey channel control information associated with the data bits. Table C1 shows the general mapping scheme between the V.24 circuit numbers and the status bits in the IWF. A binary 0 corresponds to the ON condition, a binary 1 to the OFF condition. The specific mappings for the various ~~GSM~~ PLMN bearer types are given elsewhere in the present document.

Since the V.24 circuits that are outputs from a DCE are inputs to a DTE (and vice versa), this mapping is the reverse of that used in the MT (3GPP TS 27.002, 3GPP TS 27.003).

For example, CT 109 is an output from the modem in the IWF and maps on to SB towards the MT. In the MT, SB is mapped on to CT 109 which is an input to the attached DTE.

Table B1: General mapping scheme at the IWF

Status bit direction: ~~MS~~UE to IWF	Status bit direction: IWF to ~~MS~~UE	Signal at IWF modem interface
SB		105 (note 3)
	X (note 1)	106
	SA	107
SA		108
	SB	109
X		133 (notes 2 and 3)

NOTE 1: The condition of X towards the ~~MS~~UE may also be affected by the state of any transmit buffer in the IWF.

NOTE 2: The condition of CT 133 towards the modem may also be affected by the state of any receive buffer in the IWF or layer 2 flow control condition between the MT and IWF.

NOTE 3: CT105 and CT133 are assigned to the same connector pin on both the standard 25 pin connector (ISO/IEC 2110 [78]) and the commonly used 9 pin connector (annex B). When this pin is used for CT133 at the DTE/MT interface then on the MT side of the interface CT 105 is treated as being always in the ON condition. SB towards the IWF will therefore also always be ON.
Similarly, when this pin is being used for CT105 then on the MT side of the interface CT 133 is treated as being always in the ON condition. X towards the IWF will therefore also always be ON.
As circuit 133 is used only in duplex operation and circuit 105 is used only in half duplex operation (which is not supported by ~~GSM/UMTS~~the PLMN) there should be no conflict.

3GPP TSG-CN WG3 Meeting #20
Cancun, Mexico. 26th - 30th November 2001.

Tdoc N3-010598

CR-Form-v5

CHANGE REQUEST

⌘	**29.061**	**CR**	**035**	⌘ **rev**	**2**	⌘	Current version:	**4.2.0** ⌘

*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 [ ] Radio Access Network [ ] Core Network [X]

Title:	⌘	New terminology required by GERAN		
Source:	⌘	CN3		
Work item code:	⌘	TEI_5	***Date:*** ⌘	16.11.01
Category:	⌘	**D**	***Release:*** ⌘	REL-5
		Use one of the following categories: ***F*** *(correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	New terminology required by GERAN
Summary of change:	⌘	Terms "A/Gb mode" and "Iu mode" are used instead of "GSM" and "UMTS"
Consequences if not approved:	⌘	Inconsistency with GERAN specs

Clauses affected:	⌘			
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments:	⌘			

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3GPP TS 29.061 V~~4.2.0~~ 5.0.0 (2001-~~09~~12)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Core Network;
Packet Domain;
Interworking between the Public Land Mobile Network (PLMN) supporting Packet Based Services and Packet Data Networks (PDN)
(Release ~~4~~5)

Keywords

UMTS, GSM, packet mode, interworking, PLMN, PDN

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Contents

Foreword

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

The present document describes the network interworking for the Packet Domain. Interworking to various external networks is defined together with the interworking for data forwarding while subscribers roam within the 3GPP system.

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 re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document defines the requirements for Packet Domain interworking between a:

a) PLMN and PDN;

b) PLMN and PLMN.

The present document is valid for a PLMN in A/Gb mode as well as for a PLMN in Iu mode. If text applies only for one of these systems it is explicitly mentioned by using the terms "A/Gb mode" and "Iu mode". Please note, that the A interface does not play any role in the scope of this document although the term "A/Gb mode" is used.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3GPP TR 21.905: " Vocabulary for 3GPP Specifications". ~~3GPP TS 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".~~

[2] 3GPP TS 22.060: "~~3rd Generation Partnership Project: Technical Specification Group Services and System Aspects;~~ General Packet Radio Service (GPRS): Stage 1 Service Description".

[3] 3GPP TS 23.060: "~~3rd Generation Partnership Project: Technical Specification Services and System Aspects;~~ General Packet Radio Service (GPRS); Service Description Stage 2".

[4] <VOID>~~3GPP TS 03.61: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Point to Multipoint Multicast Service Description; Stage 2".~~

[5] <VOID>~~3GPP TS 03.62: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Point to Multipoint Group Call Service Description; Stage 2".~~

[6] <VOID>~~3GPP TS 03.64: "Digital cellular telecommunications system (Phase 2+);General Packet Radio Service (GPRS); Overall description of the Radio interface; Stage 2".~~

[7] <VOID>~~3GPP TS 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control / Medium Access Control (RLC/MAC) protocol".~~

[8] <VOID>~~3GPP TS 04.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Logical Link Control (LLC)".~~

[9] <VOID> ~~3GPP TS 24.065: "3rd Generation Partnership Project: Technical Specification Group Core Network; General Packet Radio Service (GPRS); Mobile Station (MS) - Serving GPRS Support Node(SGSN); Subnetwork Dependent Convergence Protocol (SNDCP)".~~

[10] 3GPP TS 27.060: "~~3rd Generation Partnership Project: Technical Specification Group Core Network;~~ Packet Domain; Mobile Station (MS) supporting Packet Switched Services".

[11] ITU-T Recommendation E.164: "Numbering plan for the ISDN era".

[12] <VOID>

[13] <VOID>

[14] <VOID>

[15] IETF RFC 768 (1980): "User Datagram Protocol" (STD 6).

[16] IETF RFC 791 (1981): "Internet Protocol" (STD 5).

[17] IETF RFC 792 (1981): "Internet Control Message Protocol" (STD 5).

[18] IETF RFC 793 (1981): "Transmission Control Protocol" (STD 7).

[19] IETF RFC 1034 (1987): "Domain Names - Concepts and Facilities" (STD 7).

[20] <VOID>

[21] IETF RFC 1661 and 1662 (1994): "The Point-to-Point Protocol (PPP)" (STD 51).

[22] IETF RFC 1700 (1994): "Assigned Numbers" (STD 2).3.

[23] ~~UMTS~~ 3GPP TS 4~~2~~4.008: "Mobile radio interface layer 3 specification; Core Network Protocols – Stage 3".

[24] ~~UMTS~~ 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".

[25] IETF RFC2794 (2000), Pat R. Calhoun and Charles E. Perkins: "Mobile IP Network Address Identifier Extension for IPv4", March 2000.

[26] IETF RFC 2131 (1997): "Dynamic Host Configuration Protocol".

[27] IETF RFC 1542 (1993): "Clarification and Extensions for the Bootstrap Protocol".

[28] IETF RFC2373 (1998): "IP version 6 Addressing Architecture".

[29] IETF RFC 2462 (1998): "IPv6 Stateless Address Autoconfiguration".

[30] IETF RFC 2002 (1996), C. Perkins: "IP Mobility Support".

[31] IETF RFC 2486 (1999), B. Aboba and M. Beadles: "The Network Access Identifier".

[32] IETF RFC1112 (1989), S.E. Deering: "Host extensions for IP multicasting".

[33] IETF RFC2236 (1997), W. Fenner: "Internet Group Management Protocol, Version 2".

[34] IETF RFC2362 (1998), D. Estrin and al: "Protocol Independent Multicast-Sparse Mode (PIM-SM)".

[35] IETF RFC1075 (1988), D. Waitzman and al: "Distance Vector Multicast Routing Protocol".

[36] IETF RFC1585 (1994), J. Moy: "MOSPF"..

[37] IETF RFC2290 (1998), J. Solomon, S. Glass: "Mobile-IPv4 Configuration Option for PPP IPCP "

[38] IETF RFC2865 (2000), C. Rigney, S. Willens, A. Rubens, W. Simpson: "Remote Authentication Dial In User Service (RADIUS)".

[39] IETF RFC2866 (2000), C. Rigney, Livingston: " RADIUS Accounting ".

[40] 3GPP TS 23.003: "~~3rd Generation Partnership Project; Technical Specification Group Core Network;~~ Numbering, addressing and identification".

3 Definitions, abbreviations and symbols

3.1 Definitions

For the purposes of the present document, the following terms and definitions given in ~~UMTS~~ 3GPPTS 22.060 and ~~UMTS~~ 3GPP TS 23.060 and the following apply:

2G- / 3G-: prefixes 2G- and 3G- refers to functionality that supports only ~~GSM~~ A/Gb mode GPRS or ~~UMTS~~Iu mode, respectively, e.g., 2G-SGSN refers only to the ~~GSM~~ A/b mode GPRS functionality of an SGSN. When the prefix is omitted, reference is made independently from the ~~GSM~~ A/Gb mode GPRS or ~~UMTS~~ Iu mode functionality.

A/Gb mode: indicates that the text applies only to a system or sub-system which operate in A/Gb mode of operation, i.e. with a functional division that is in accordance with the use of an A or a Gb interface between the radio access network and the core network

Iu mode: indicates that the text applies only to a system or a sub-system which operates in Iu mode of operation, i.e. with a functional division that is in accordance with the use of an Iu-CS or Iu-PS interface between the radio access network and the core network

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

APN	Access Point Name
ATM	Asynchronous Transfer Mode
BG	Border Gateway
CHAP	Challenge Handshake Authentication Protocol
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DVMRP	Distance Vector Multicast Routing Protocol
GGSN	Gateway GPRS Support Node
GTP-U	GPRS Tunnelling Protocol for user plane
ICMP	Internet Control Message Protocol
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
LAC	L2TP Access Concentrator
LAN	Local Area Network
LNS	L2TP Network Server
MIP	Mobile IP
MOSPF	Multicast Open Shortest Path First
MS	Mobile Station
MT	Mobile Terminal
MTU	Maximum Transfer Unit
NAI	Network Access Identifier
PAP	Password Authentication Protocol
PDCP	Packet Data Convergence Protocol
PDN	Packet Data Network
PDU	Protocol Data Unit
PIM-SM	Protocol Independant Multicast – Sparse Mode
PPP	Point-to-Point Protocol
PS	Packet Switched
RADIUS	Remote Authentication Dial In User Service
SGSN	Serving GPRS Support Node

SMDS	Switched Multimegabit Data Service
TCP	Transmission Control Protocol
TE	Terminal Equipment
TEID	Tunnel End-point Identifier
UDP	User Datagram Protocol

3.3 Symbols

For the purposes of the present document, the following symbols apply:

Gb	Interface between an SGSN and a BSC.
Gi	Reference point between Packet Domain and an external packet data network.
Gn	Interface between two GSNs within the same PLMN.
Gp	Interface between two GSNs in different PLMNs. The Gp interface allows support of Packet Domain network services across areas served by the co-operating PLMNs.
Gs	Interface between an SGSN and MSC.
Iu	Interface between the RNS and the core network. It is also considered as a reference point.
R	The reference point between a non-ISDN compatible TE and MT. Typically this reference point supports a standard serial interface.
Um	The interface between the MS and the ~~GSM~~ fixed network part in A/Gb mode. The Um interface is the ~~GSM~~ A/Gb mode network interface for providing packet data services over the radio to the MS. The MT part of the MS is used to access the GSM services through this interface.
Uu	Interface between the mobile station (MS) and the ~~UMTS~~ fixed network part in Iu mode. The Uu interface is the ~~UMTS~~ Iu mode network interface for providing packet data services over the radio to the MS. The MT part of the MS is used to access the UMTS services through this interface.

4 Network characteristics

4.1 Key characteristics of PLMN

The PLMN is fully defined in the ~~UMTS~~ 3GPP technical specifications. The Packet Domain related key characteristics are found in 3GPP TS 22.060 and 3GPP TS 23.060.

4.2 Key characteristics of PSDN

<VOID>

4.3 Key characteristics of IP Networks

The Internet is a conglomeration of networks utilising a common set of protocols. IP protocols are defined in the relevant IETF STD specifications and RFCs. The networks topologies may be based on LANs (e.g. ethernet), Point to Point leased lines, PSTN, ISDN, X.25 or WANs using switched technology (e.g. SMDS, ATM).

5 Interworking Classifications

5.1 Service Interworking

Service interworking is required when the Teleservice at the calling and called terminals are different. For Packet Domain, service interworking is not applicable at the Gi reference point.

5.2 Network Interworking

Network interworking is required whenever a PLMN is involved in communications with another network to provide end-to-end communications. The PLMN shall interconnect in a manner consistent with that of a normal Packet Data Network (type defined by the requirements e.g. IP). Interworking appears exactly like that of Packet Data Networks.

5.3 Numbering and Addressing

See 3GPP TS 23.003 and the relevant section for IP addressing below.

6 Access reference configuration

Figure 1 shows the relationship between the MS, its terminal equipment and the ~~UMTS/GSM~~PLMN network in the overall Packet Domain environment.

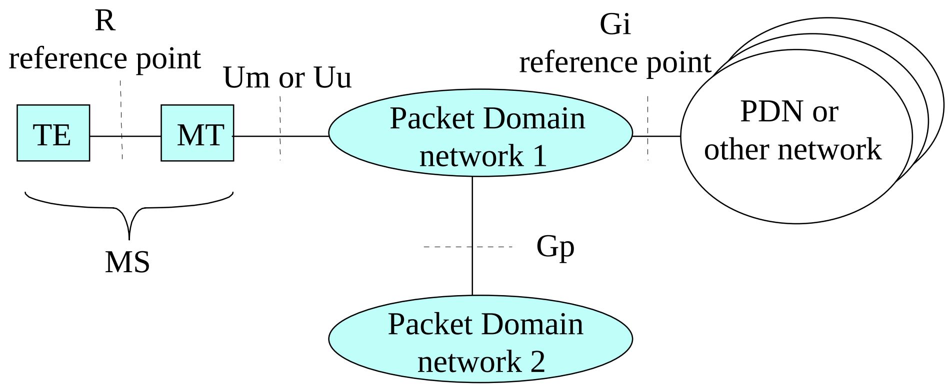


Figure 1: Packet Domain Access Interfaces and Reference Points

7 Interface to Packet Domain Bearer Services

~~7.1 GSM~~7.1 A/Gb mode

The following figure 2a shows the relationship of the ~~GSM~~ Packet Domain Bearer in A/Gb mode terminating at the SNDCP layer to the rest of the ~~GSM~~ A/Gb mode Packet Domain environment. It is shown for reference purposes only and detailed information can be found in 3GPP TS 23.060.

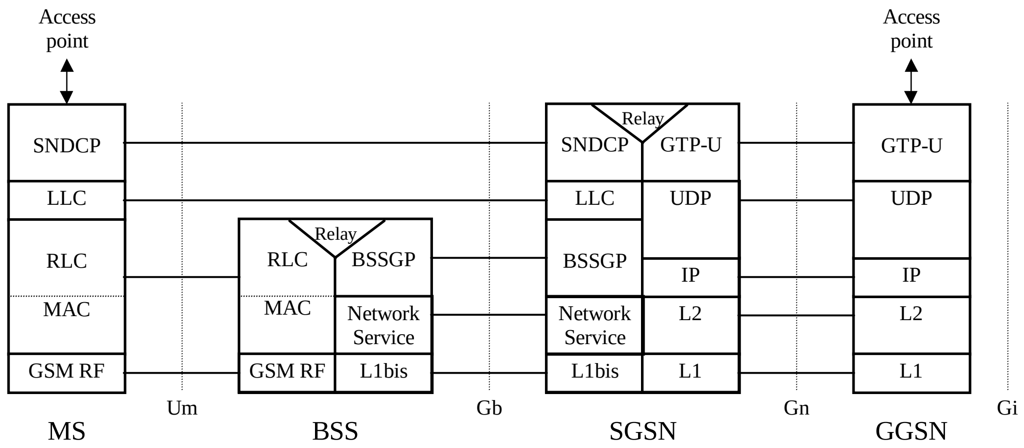


Figure 2a: User Plane for Packet Domain services in ~~GSM~~A/Gb mode

~~7.2 UMTS~~7.2 Iu mode

The following figure 2b shows the relationship of the ~~UMTS~~ Packet Domain Bearer in Iu mode, terminating at the PDCP layer, to the rest of the ~~UMTS~~ Iu mode Packet Domain environment. It is shown for reference purposes only and detailed information can be found in 3GPP TS 23.060.

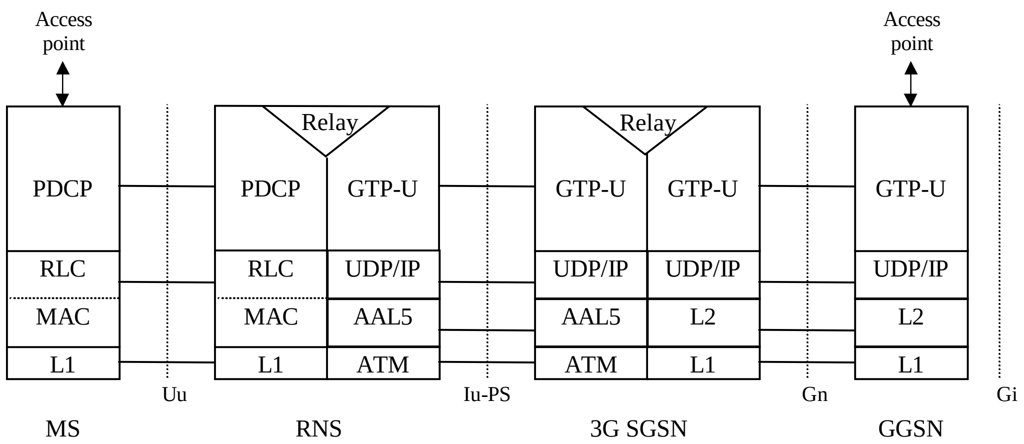


Figure 2b: User Plane for Packet Domain services in ~~UMTS~~Iu mode

8 Subscription checking

Subscription is checked during the PS Attach procedure and also during the PDP Context Activation procedure as described in 3GPP TS 23.060. The GGSN implicitly checks its internal context related to the destination address for each mobile terminated packet. If there is a context associated with the PDP address the packet shall be forwarded to the MS, otherwise the packet shall be discarded or rejected depending on the implemented protocol.

9 Message Screening

Screening functions reside within the Packet Domain as described in 3GPP TS 22.060 and 3GPP TS 23.060. Screening may be applicable for only certain protocols. Screening is outside the scope of the present document.

10 Interworking with PSDN (X.75/X.25)

<VOID>

11 Interworking with PDN (IP)

11.1 General

Packet Domain shall support interworking with networks based on the Internet Protocol (IP). These interworked networks may be either intranets or the Internet.

11.2 PDN Interworking Model

When interworking with the IP networks, the Packet Domain can operate IPv4 or Ipv6. The interworking point with IP networks is at the Gi reference point as shown in figure 7.

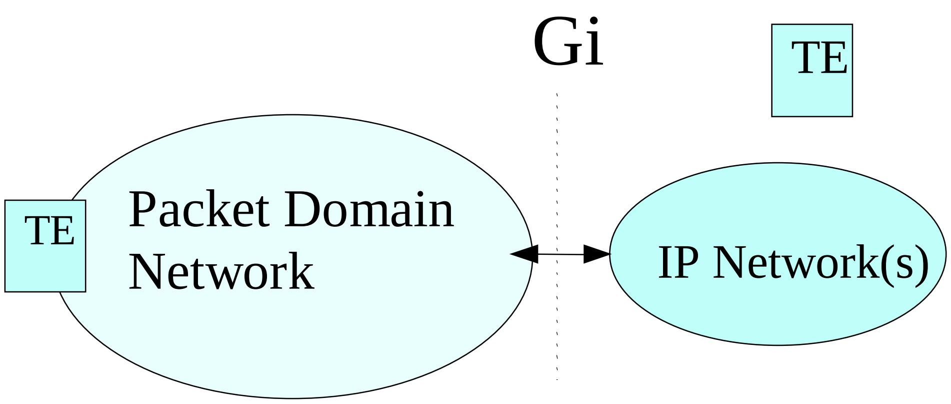


Figure 7: IP network interworking

The GGSN for interworking with the IP network is the access point of the Packet Domain (see figure 8). In this case the Packet Domain network will look like any other IP network or subnetwork.

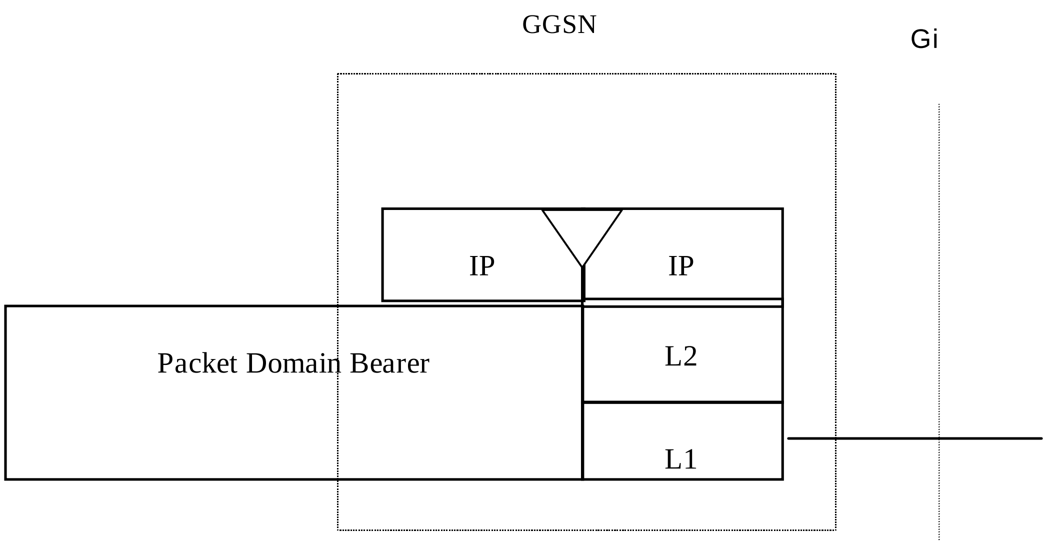


Figure 8: The protocol stacks for the IP / Gi reference point

Typically in the IP networks, the interworking with subnetworks is done via IP routers. The Gi reference point is between the GGSN and the external IP network. From the external IP network's point of view, the GGSN is seen as a normal IP router. The L2 and L1 layers are operator specific.

It is out of the scope of the present document to standardise the router functions and the used protocols in the Gi reference point.

Interworking with user defined ISPs and private/public IP networks is subject to interconnect agreements between the network operators.

No user data or header compression is done in the GGSN.

11.2.1 Access to Internet, Intranet or ISP through Packet Domain

The access to Internet, Intranet or ISP may involve specific functions such as : user authentication, user's authorization, end to end encryption between MS and Intranet/ISP, allocation of a dynamic address belonging to the PLMN/Intranet/ISP addressing space, etc.

For this purpose the Packet Domain may offer:

- either direct transparent access to the Internet; or
- a non transparent access to the Intranet/ISP. In this case the Packet Domain, i.e. the GGSN, takes part in the functions listed above.

The mechanisms for host configuration and user authentication described in this section and its sub-sections are only applicable to the activation of the first context activated for a specific PDP address (using the ‘PDP Context Activation Procedure’). The activation of any subsequent PDP contexts for that PDP address, using the ‘Secondary PDP Context Activation Procedure’, as well as the use of TFTs, is described in 3GPP TS 23.060.

11.2.1.1 Transparent access to the Internet

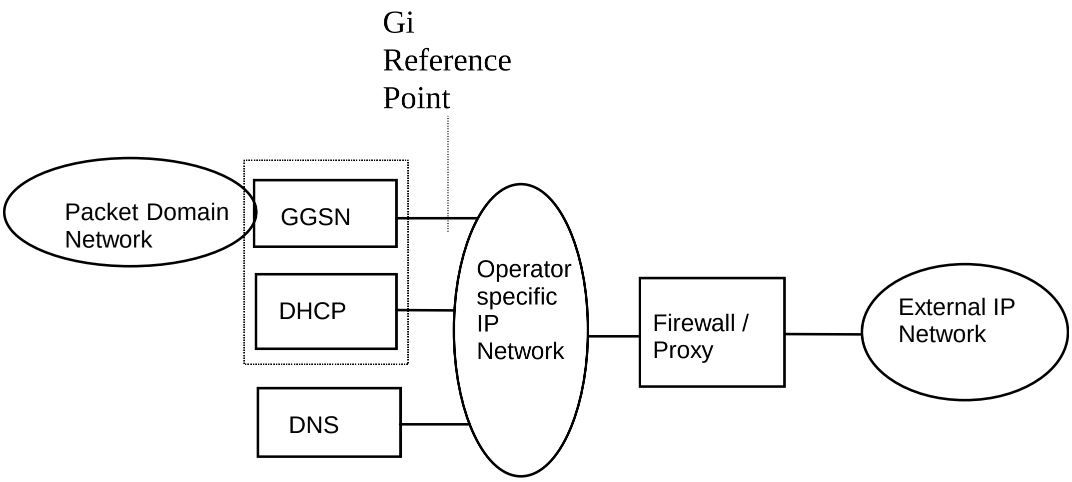


Figure 9: Example of the PDN Interworking Model, transparent case

In this case (see figure 9):

- the MS is given an address belonging to the operator addressing space. The address is given either at subscription in which case it is a static address or at PDP context activation in which case it is a dynamic address. This address is used for packet forwarding between the Internet and the GGSN and within the GGSN. In IPv6, the address given is the link-local address. Thus, for the IPv6 it is not necessary to use a DHCP implementation for the address allocation, but any unique identifier for the MS in the GGSN is sufficient;
- the MS need not send any authentication request at PDP context activation and the GGSN need not take any part in the user authentication/authorization process.

The transparent case provides at least a basic ISP service. As a consequence of this it may therefore provide a bearer service for a tunnel to a private Intranet.

NB The remainder of this subclause deals with this specific case.

- The user level configuration may be carried out between the TE and the intranet, the Packet Domain network is transparent to this procedure.

The used protocol stack is depicted in figure 10.

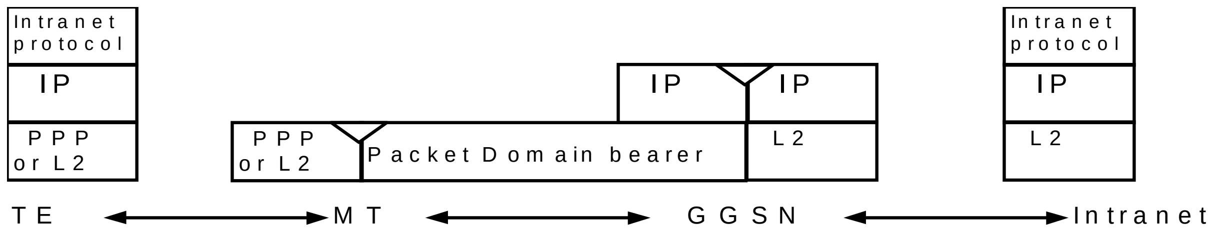


Figure 10: Transparent access to an Intranet

The communication between the PLMN and the Intranet may be performed over any network, even an insecure network e.g. the Internet. There is no specific security protocol between GGSN and the Intranet because security is ensured on an end to end basis between MS and the intranet by the «Intranet protocol».

User authentication and encryption of user data are done within the «Intranet protocol» if either of them is needed. This «Intranet protocol» may also carry private (IP) addresses belonging to the address space of the Intranet.

An example of an «Intranet protocol» is IPsec (see RFC 1825). If IPsec is used for this purpose then IPsec authentication header or security header may be used for user (data) authentication and for the confidentiality of user data (see RFC 1826 and RFC 1827). In this case private IP tunnelling within public IP takes place.

11.2.1.2 Non Transparent access to an Intranet or ISP

In this case:

- the MS is given an address belonging to the Intranet/ISP addressing space. The address is given either at subscription in which case it is a static address or at PDP context activation in which case it is a dynamic address. This address is used for packet forwarding within the GGSN and for packet forwarding on the Intranet/ISP. This requires a link between the GGSN and an address allocation server, like Radius, DHCP, …, belonging to the Intranet/ISP;

- the MS shall send an authentication request at PDP context activation and the GGSN requests user authentication from a server, like Radius, DHCP, …, belonging to the Intranet/ISP;

- the protocol configuration options are retrieved (if requested by the MS at PDP context activation) from some server (Radius or DHCP, …) belonging to the Intranet/ISP;

- the communication between the Packet Domain and the Intranet/ISP may be performed over any network, even an insecure e.g. the Internet. In case of an insecure connection between the GGSN and the Intranet/ISP there may be a specific security protocol in between. This security protocol is defined by mutual agreement between PLMN operator and Intranet/ISP administrator.

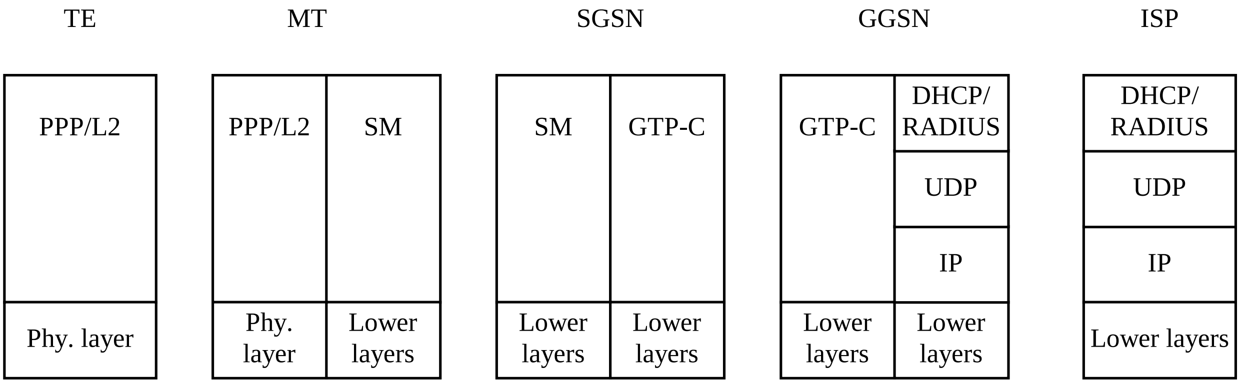


Figure 11a: Signalling plane of non transparent case

The following description bullet items describe the signal flow.

1) The TE sends an AT-command to the MT to set up parameters and enter PPP mode. The MT responds with an AT-response.

2) LCP negotiates Maximum-Receive-Unit and authentication protocol. The negotiated authentication protocol is, either CHAP, PAP or 'none'. The MT shall try to negotiate for CHAP as first priority.

3) If the negotiated authentication protocol is either of CHAP or PAP, the TE authenticates itself towards the MT by means of that protocol. The MT stores the necessary authentication data and sends a forced positive acknowledgement of the authentication to the TE.

4) The TE requests IP configuration by sending the IPCP Configure-Request message to the MT indicating either the static IP address that shall be used or that an IP-address shall be dynamically allocated.

5) The MT sends the Activate PDP context request message to the SGSN, including the Protocol Configuration Options. The SGSN sends the Create PDP context req message to the chosen GGSN including the unmodified Protocol Configuration Options.

6) The GGSN deduces from the APN:

   - the server(s) to be used for address allocation, authentication and protocol configuration options retrieval;

   - the protocol like Radius, DHCP, … to be used with this / those server(s);

   - the communication and security feature needed to dialogue with this / those server(s) e.g. tunnel, IPSec security association, dial-up connection (using possibly PPP), …

   As an example the GGSN may use one of the following options:

   - RADIUS for authentication and IP-address allocation.. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN;

   - RADIUS for authentication and DHCP for host configuration and address allocation. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN. After a successful authentication, the DHCP client discovers the DHCP server(s) in the ISP/Intranet and receives host configuration data.

- If the received Protocol Configurations Options IE contains a PPP IPCP Configure-Request packet, the GGSN shall analyse all the contained IPCP options and their requested values. In accordance with the relevant PPP [20] the GGSN shall respond with the following messages:

  - zero or one PPP IPCP Configure-Reject packet containing options not supported and options which values cannot be returned;

  - zero or one PPP IPCP Configure-Nak packet containing options that are supported but has requested values that are incorrect/unsupported; and

  - zero or one PPP IPCP Configure-Ack packet containing options that are supported and has requested values that are correct/supported.

Any returned PPP IPCP packets shall be contained in the Protocol Configurations Options IE.

7) The GGSN sends back to the SGSN a Create PDP Context Response message, containing the Protocol Configuration Options IE. The cause value shall be set according to the outcome of the host -authentication and -configuration. . A PDP context activation shall not be rejected solely due to the presence of unsupported or incorrect PPP IPCP options or option values, received from the MS in the Protocol Configurations Options IE. The MS may however later decide to immediately deactivate the activated PDP context due to the information received in the Protocol Configurations Options IE received from the network.

8) Depending on the cause value received in the Create PDP Context Response the SGSN sends either an Activate PDP Context Accept or an Activate PDP Context Reject, to the MS.

   If Protocol Configuration Options are received from the GGSN, the SGSN shall relay those to the MS. The MT sends either the configuration-ack packet (e.g. IPCP Configure Ack in PPP case), the configure-nack packet in case of dynamic address allocation (e.g. IPCP Configure Nack in PPP case), or a link Terminate request (LCP Terminate-Request in PPP case) back to the TE. In the case where a configure-nack packet was sent by the MT, a local negotiation may take place at the R reference point (i.e. the TE proposes the new value to the MT), after which a configuration-ack packet is sent to the TE.

9) In case a configuration-ack packet was sent to the TE, the link from the TE to the external ISP/Intranet is established and IP packets may be exchanged.

   In case a link terminate request packet was sent to the TE, the TE and MT negotiates for link termination. The MT may then send a final AT-response to inform the TE about the rejected PDP Context activation.

A link terminate request packet (such as LCP Terminate-request in PPP case) causes a PDP context deactivation.

EXAMPLE: In the following example PPP is used as layer 2 protocol over the R reference point.

The MT acts as a PPP server and translates Protocol Configuration Options into SM message IEs. GTP-C carries this information unchanged to the GGSN which uses the information e.g. for DHCP or RADIUS authentication and host configuration. The result of the host authentication and configuration is carried via GTP-C to the SGSN which relays the information to the MT. The MT sends an IPCP Configure-Ack to the TE with the appropriate options included.

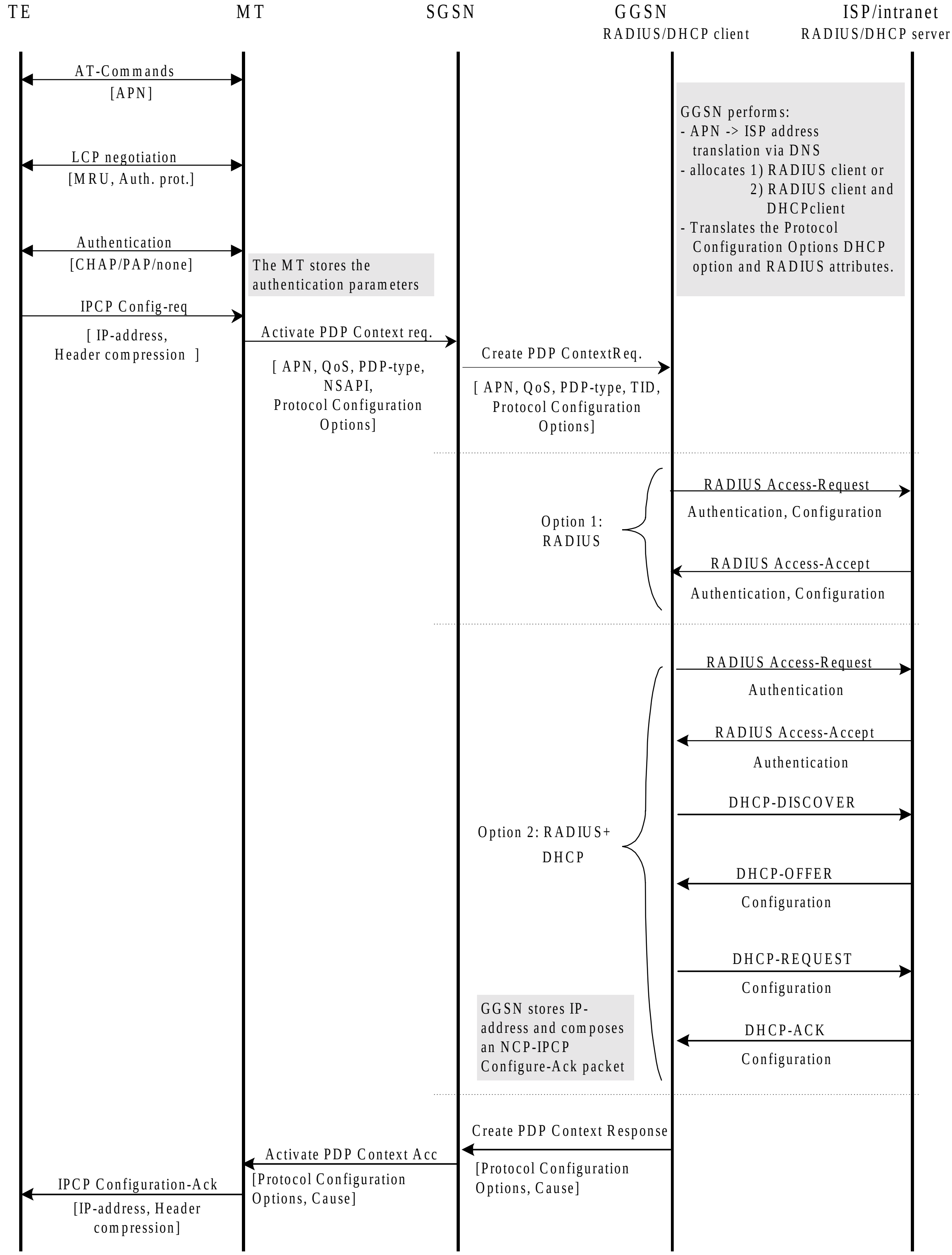


Figure 11b: PDP Context Activation for the Non-transparent IP case

11.2.1.3 Access to Internet, Intranet or ISP with Mobile IPv4

General

A way to allow users to roam from one environment to another, between fixed and mobile, between public and private as well as between different public systems is to use Mobile IP [30]. Mobile IP (MIP) is a mobility management protocol developed by IETF. The Mobile IP Foreign Agent (FA) [30] is located in the Core Network in the GGSN. MIP also uses a Home Agent (HA) [30] which may or may not be located in ~~GSM/UMTS network~~PLMN.

Interworking model for MIP

A FA is located in the GGSN. The interface between the GGSN and the FA will probably not be standardised as the GGSN/FA is considered being one integrated node. The mapping between these two is a matter of implementation. Each FA must be configured with at least one care-of address. In addition a FA must maintain a list that combines IP addresses with TEIDs of all the visiting MSs that have registered with the FA. IP packets destined for the MS are intercepted by the HA and tunneled to the MS's care-of address, i.e. the FA. The FA de-tunnels the packets and forwards the packets to the MS. Mobile IP related signalling between the MS and the FA is done in the user plane. MIP registration messages [30] are sent with UDP.

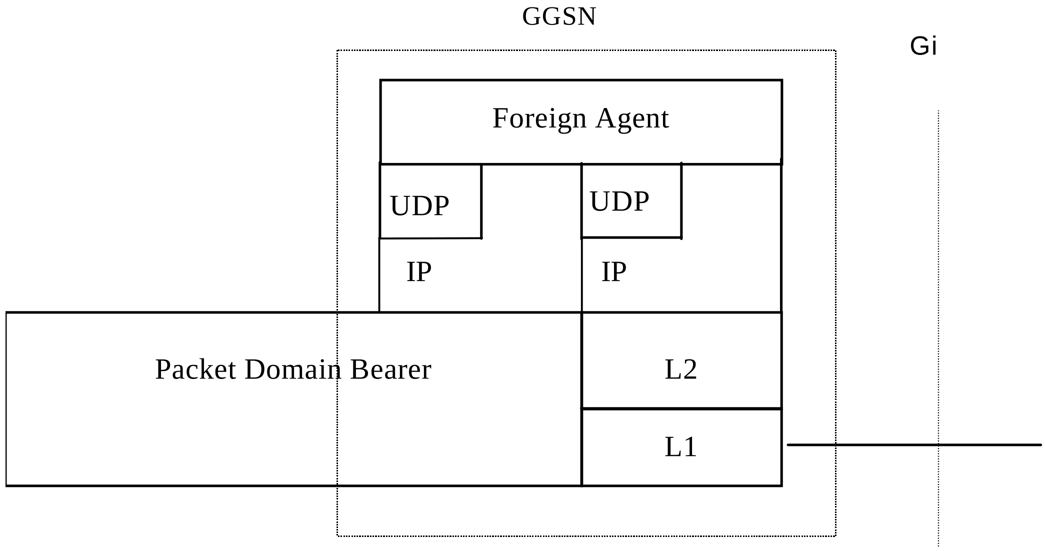


Figure 11c: The protocol stacks for the Gi IP reference point in the MIP signalling plane

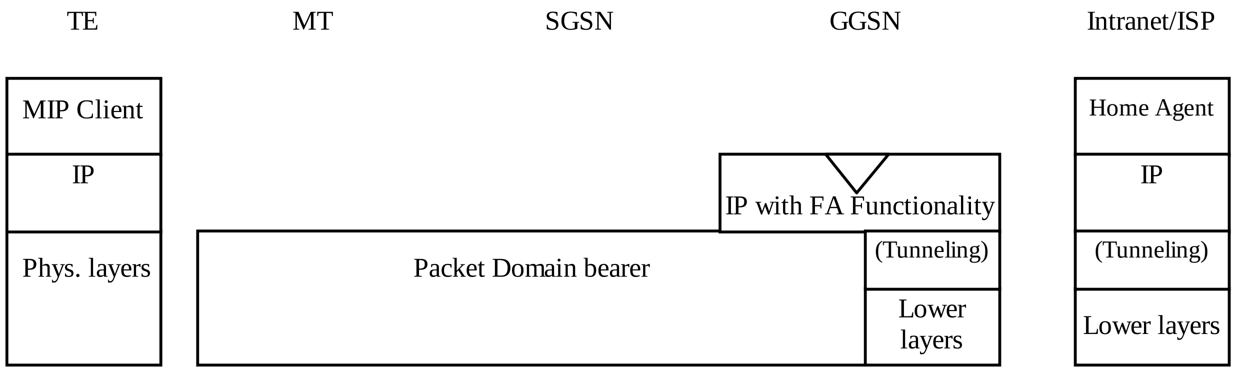


Figure 11d: Protocol stacks for user access with MIP

In figure 11d: "(Tunneling)" is intended to show asymmetric traffic flow. Tunneling (IP-in-IP) is only used in the direction from the ISP towards the MT.

Authentication of the user is supported in Mobile IPv4. This authentication mechanism may involve communication with an authentication server (e.g. RADIUS), although this is not shown in figure 11d.

Address allocation - at PDP context activation no IP address is allocated to the MS indicated by 0.0.0.0. in the "Requested PDP Address" field. If the MS does not have a static IP address which it could register with the HA, it will acquire a dynamic IP address from the HA [25]. After completion of the PDP activation the SGSN is informed of the assigned IP address by means of the GGSN initiated PDP Context Modification Procedure.

An example of a signalling scheme, shown in figure 11e, is described below. In this example the MS is separated into a TE and MT, with AT commands and PPP used in-between (see 3GPP TS 27.060). The PS attach procedures have been omitted for clarity.

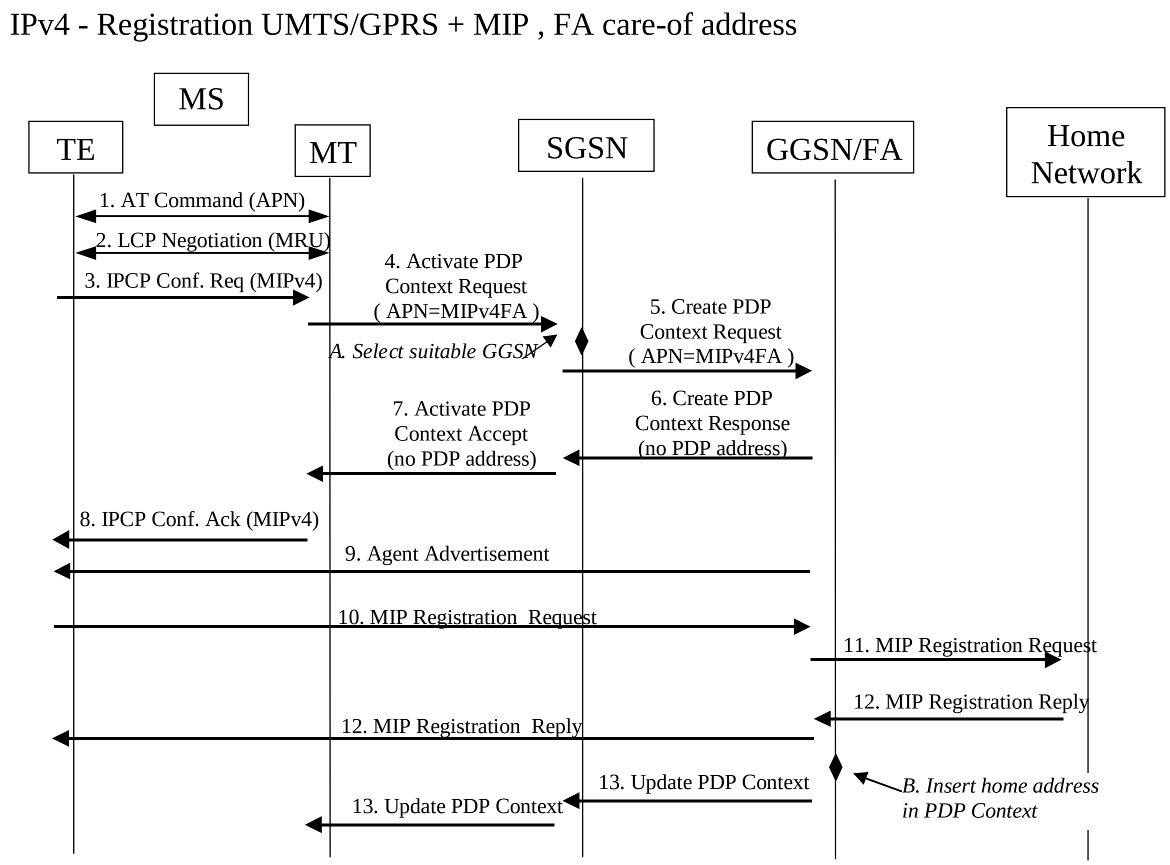


Figure 11e: Example of PDP Context activation with Mobile IP registration (the PS attach procedure not included)

1. The AT command carries parameters that the MT needs to request the PDP Context Activation. The important parameter here, is the APN (Access Point Name), see clause A below. The AT command is followed by a setup of the PPP connection between the MT and the TE.

2. As part of the PPP connection, LCP negotiates Maximum-Receive-Unit between the TE and the MT. No PPP authentication is required when using MIPv4.

3. As part of the PPP connection, the TE sends an IPCP Configure Request using the MIPv4 configuration option (see [37]). The TE sends either its Home Address or a null address (i.e. 0.0.0.0) if the Network Address identifier is used (see [25]).

4. The MT sends the "Activate PDP Context Request" to the SGSN. The message includes various parameters of which the "APN" (Access Point Name) and the "Requested PDP Address" are of interest here. The TE/MT may use APN to select a reference point to a certain external network or to select a service. APN is a logical name referring to the external packet data network or to a service that the subscriber wishes to connect to. The "Requested PDP Address" should be omitted for all MS's using Mobile IP. This is done irrespective of if the TE has a permanently assigned Mobile IP address from its Mobile IP home network, a previously assigned dynamic home address from its Mobile IP home network or if it wishes the Mobile IP home network to allocate a "new" dynamic home address.

A. The SGSN will base the choice of GGSN based on the APN that is given by the MS.

5. The SGSN requests the selected GGSN to set up a PDP Context for the MS. The PDP address and APN fields are the same as in the "Activate PDP Context Request" message.

6. A Create PDP Context Response is sent from the GGSN/FA to the SGSN. If the creation of PDP Context was successful, some parameters will be returned to the SGSN, if not, an error code will be returned. If the GGSN has been configured, by the operator, to use a Foreign Agent for the requested APN, the PDP address returned by the GGSN shall be set to 0.0.0.0. indicating that the PDP address shall be reset by the MS with a Home Agent after the PDP context activation procedure.

7. The Activate PDP Context Accept message is sent by the SGSN to the MT and contains similar information as the Create PDP Context Response message.

8. The MT sends an IPCP Configure Ack to the TE in order to terminate the PPP connection phase.

9. The Agent Advertisement [30] is an ICMP (Internet Control Message Protocol) Router Advertisement message with a mobility agent advertisement extension. The latter part contains parameters of the FA that the mobile node needs, among those are one or more care-of addresses that the FA offers. This message should be sent, in the Packet Domain user plane, as an IP limited broadcast message, i.e. destination address 255.255.255.255, however only on the TEID for the requesting MS to avoid broadcast over the radio interface.

10. The Mobile IP Registration Request is sent from the mobile node to the GGSN/FA across the Packet Domain backbone as user traffic. The mobile node includes its (permanent) home address as a parameter [30]. Alternatively, it can request a temporary address assigned by the home network by sending 0.0.0.0 as its home address, and include the Network Access Identifier (NAI) in a Mobile-Node-NAI Extension [25], [31].

11. The FA forwards the Mobile IP Registration Request to the home network of the mobile node, where a home agent (HA) processes it. Meanwhile, the GGSN/FA needs to store the home address of the mobile node or the NAI and the local link address of the MS, i.e. the TEID (Tunnel Endpoint ID).

12. The Registration Reply is sent from the home network to the FA, which extracts the information it needs and forwards the message to the mobile node in the Packet Domain user plane. As the FA/GGSN knows the TEID and the NAI or home address, it can pass it on to the correct MS.

B. The GGSN/FA extracts the home address from the Mobile IP Registration Reply message and updates its GGSN PDP Context.

13. The GGSN triggers a "GGSN initiated PDP Context modification procedure" in order to update the PDP address in the SGSN and in the MT.

11.3 Numbering and Addressing

In the case of interworking with public IP networks (such as the Internet), the PLMN operator shall use public network addresses. These public addresses can be reserved from the responsible IP numbering body, or from an ISP with which the PLMN operator has an agreement.

In the case of interworking with private IP networks, two scenarios can be identified:

1. the GPRS operator manages internally the subnetwork addresses. Each private network is assigned a unique subnetwork address. Normal routing functions are used to route packets to the appropriate private network;

2. each private network manages its own addressing. In general this will result in different private networks having overlapping address ranges. A logically separate connection (e.g. an IP in IP tunnel or layer 2 virtual circuit) is used between the GGSN and each private network. In this case the IP address alone is not necessarily unique. The pair of values, Access Point Name (APN) and IP address, is unique.

The PLMN operator allocates the IP addresses for the subscribers in either of the following ways.

- The PLMN operator allocates a static IP address when the subscription record is built. The IP address is reserved from a pool of free IP addresses. Each external network has its own pool of addresses.

- The PLMN operator allocates (either on its own or in conjunction with the external network) a dynamic IP address when the MS performs the PDP Context Activation procedure with dynamic address allocation as described in 3GPP TS 23.060.

11.4 Charging

The PLMN operator may define the accuracy of the charging mechanism using one of the following categories:

- every source/destination pair is logged separately;
- source/destination pairs are logged to an accuracy of subnetworks;
- source/destination pairs are logged to an accuracy of connection types (e.g., external data network, corporate network, another mobile).

11.5 Domain Name System Server (DNS Server)

Provision of Domain Name services shall be provided by the PLMN operators in the transparent case and the ISP in the non transparent case. (DNS documentation is provided in RFC 1034 and RFC 1035).

11.6 Screening

The way the PLMN is performing the operator controlled screening and the subscription controlled screening is out of the scope of the present document. These functions may be done, for example, in a firewall.

11.7 IP Multicast access

The Packet Domain could allow access to IP Multicast traffic coming from an external network. The support of IP-Multicast in the Packet Domain is optional.

In order for the Packet Core Network to support Multicast traffic that will allow the MS to subscribe to multicast groups from outside the PLMN, the GGSN shall support IGMP and one or more Inter-Router Multicast protocols, such as DVMRP, MOSPF, or PIM-SM.

IGMP is an integral part of IP. All hosts wishing to receive IP multicasts are required to implement IGMP (or equivalent) and class-D IP addresses. IGMP messages are encapsulated in IP datagrams.

To be able to deliver IP-Multicast packets to the appropriate TEs, the GGSN may have an IP-Multicast proxy functionality.

The IP-Multicast proxy will perform the following tasks:

NOTE: In this example it is assumed that IGMP is used as a Host-Router Multicast protocol.

- maintain a list of mobiles that joined one or more Multicast groups. This list is built/updated each time the GGSN receives an IGMP Join Message from the mobile;
- send, based on this maintained list of mobiles, multicast routing information to the routers attached to the Packet Domain, allowing them to route multicast packets;
- upon reception by the GGSN of multicast packets, make and send a copy as Point-to-Point packets, to each mobile of the group.

IP-Multicast traffic can only be handled after an MS has attached to the Packet Domain, and Activated PDP context(s) (including possibly authentication) to the preferred ISP/external network. The Multicast traffic is handled at the application level from a Packet Domain perspective and is sent over UDP/IP.

The following figure 12 depicts the protocol configuration for handling Multicast traffic (control plane). The Multicast traffic handling affects the GGSN by the introduction of the IP-Multicast proxy and the support for an Inter-Router Multicast protocol and a host-router multicast protocol.

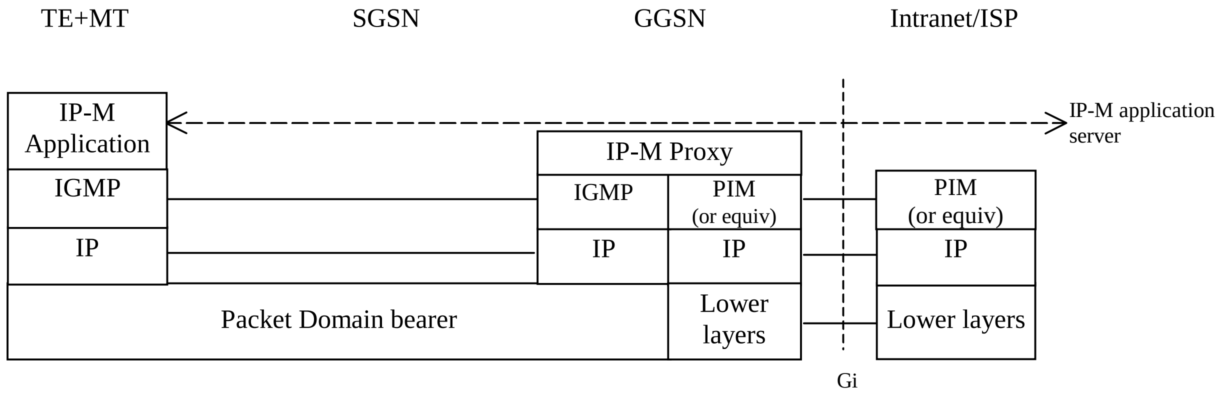


Figure 12: Protocol configuration for IP-Multicast handling (control plane)

12 Interworking with PDN (PPP)

12.1 General

By means of the PDP type 'PPP' Packet Domain may support interworking with networks based on the point-to-point protocol (PPP), as well as with networks based on any protocol supported by PPP through one of its Network Control Protocols (NCPs). All protocols currently supported by PPP NCP's are listed in [21]. It may also support interworking by means of tunnelled PPP, by e.g. the Layer Two Tunnelling Protocol (L2TP).

12.2 PDN Interworking Model

The interworking point is at the Gi reference point. The GGSN for interworking with the ISP/PDN is the access point of the Packet Domain (see figure 13). The GGSN will either terminate the PPP connection towards the MS or may further relay PPP frames to the PDN. The PPP frames may be tunnelled in e.g. L2TP.

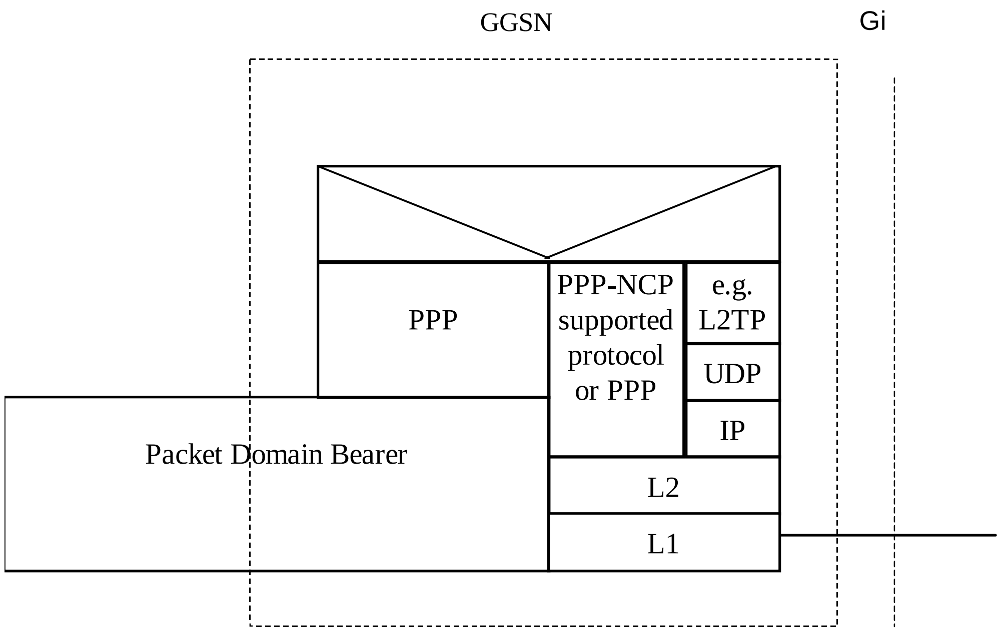


Figure 13: The protocol stacks for the Gi PPP reference point

In case the external PDN is an IP based network and the GGSN terminates PPP the same description applies as specified in subclause 11.2.

In case the GGSN tunnels PPP frames to the PDN, the GGSN may behave like a LAC towards the external network.

12.2.1 Virtual dial-up- and direct Access to PDNs, or ISPs through Packet Domain

The access to PDNs, or ISPs may involve specific functions such as: user authentication, user's authorization, end to end encryption between MS and PDN/ISP, allocation of a dynamic address belonging to the PLMN/PDN/ISP addressing space, etc.

For this purpose the PLMN may offer, based on configuration data:

- direct access to an IP based Intranet/ISP using a protocol configuration as depicted in figure 14. Here DHCP and/or RADIUS are used between the GGSN and Intranet/ISP for performing the specific functions mentioned above. The Packet Domain may also offer access to networks based on any protocol supported by PPP through one of its Network Control Protocols (NCPs);

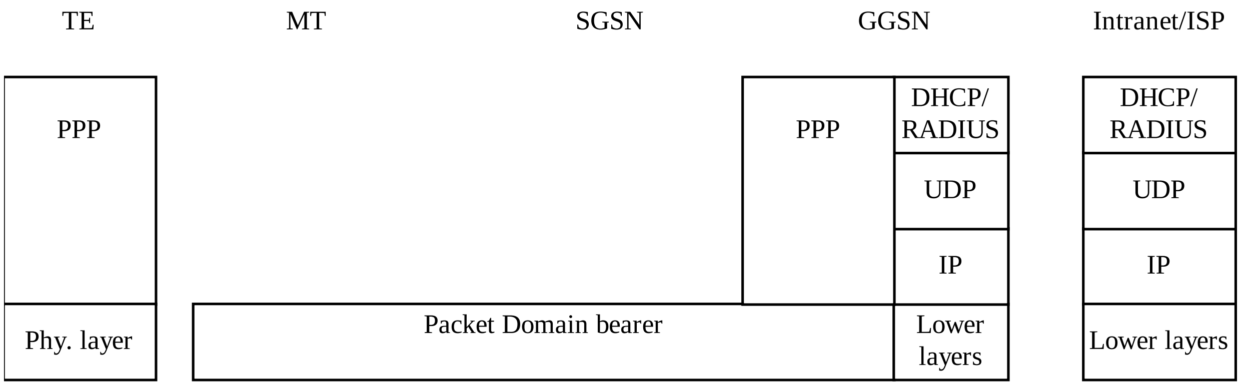


Figure 14: Protocol stack for direct access to IP-based Intranets/ISPs

- virtual dial-up access to a PDN with PPP frame tunnelling as depicted in figure 15.

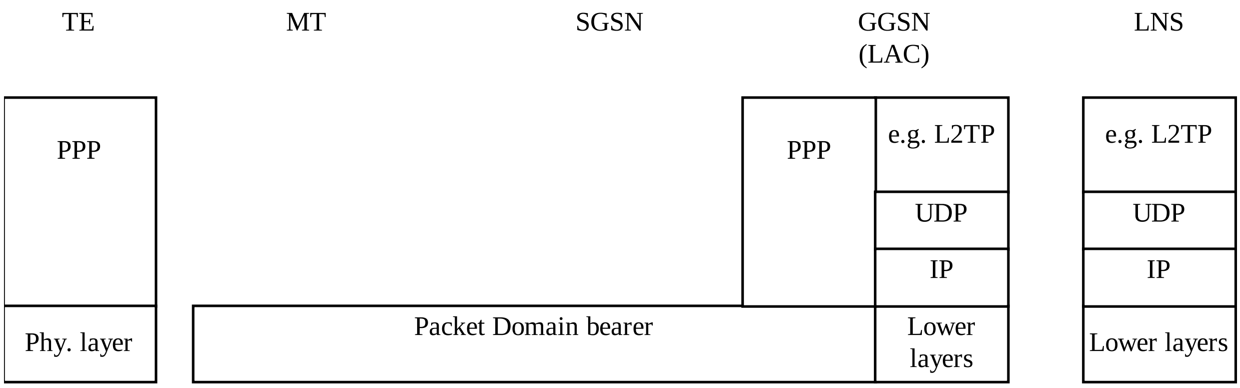


Figure 15: Protocol stack for virtual dial-up access with PPP frame tunnelling

12.2.1.1 Procedural description

In this case:

- the MS is given an address belonging to the Intranet/ISP addressing space. The address is given either at subscription in which case it is a static address or at PDP context activation in which case it is a dynamic address. This address is used for packet forwarding within the GGSN and for packet forwarding on the

Intranet/ISP. This requires a link between the GGSN and an address allocation server, such as Radius, or DHCP, belonging to the Intranet/ISP;

- the communication between the Packet Domain and the Intranet/ISP may be performed over any network, even an insecure e.g. the Internet. In case of an insecure connection between the GGSN and the Intranet/ISP there may be a specific security protocol in between. This security protocol is defined by mutual agreement between PLMN operator and Intranet/ISP administrator.

The following description bullet items describe the signal flow.

1) The TE sends an AT-command to the MT to set up parameters.

2) The MT sends the Activate PDP context request message to the SGSN which sends the Create PDP context request message to the chosen GGSN.

3) The GGSN deduces from the APN:

   - the server(s) to be used for address allocation and authentication;

   - the protocol such as Radius, DHCP or L2TP to be used with this / those server(s);

   - the communication and security feature needed to dialogue with this / those server(s) e.g. tunnel ,IPSec security association, dial-up connection (using possibly PPP).

   As an example the GGSN may use one of the following options:

   - RADIUS for authentication and IP-address allocation. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN;

   - RADIUS for authentication and DHCP for host configuration and address allocation. The RADIUS server responds with either an Access-Accept or an Access-Reject to the RADIUS client in the GGSN. After a successful authentication, the DHCP client discovers the DHCP server(s) in the ISP/Intranet and receives host configuration data;

   - L2TP for forwarding PPP frames to a L2TP Network Server.

4) The GGSN sends back to the SGSN a Create PDP Context Response message.

5) Depending on the cause value received in the Create PDP Context Response the SGSN may either send the Activate PDP Context Accept message or send the Activate PDP Context Reject message to the MS.

6) The MT responds with an AT-response that may indicate whether the context activation was successful or not. In the case of a non-successful context activation the response may also indicate the cause.

   In case of a successful context activation, the TE will start its PPP protocol after the LLC link has been established. The LCP, Authentication and IPCP (in case of IP) negotiations are then carried out. During these negotiations the GGSN may acknowledge values, for any LCP options related to 'L2' framing (e.g. 'ACCM', 'ACFC' and 'FCS-Alternatives'), as proposed by the MT, which itself is forwarding these negotiations from the TE.

NOTE: With the <PDP Type>"PPP" the MT may provide a PPP relay (or proxy) function between the TE and GGSN. This gives the opportunity for the MT to intercept the 'L2' framing end to end negotiations.

EXAMPLE: In the following example the successful PDP context activation is shown.

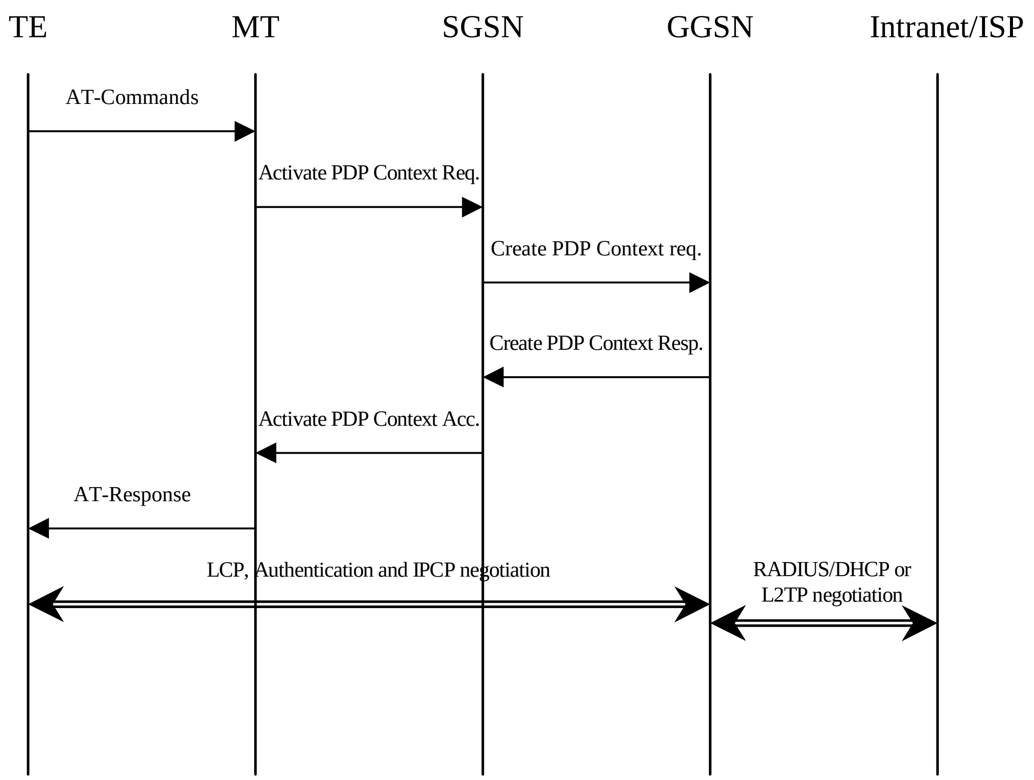


Figure 16a

13 Interworking with PDN (DHCP)

13.1 General

In current LAN environments the most commonly used configuration protocol is DHCP (Dynamic Host Configuration Protocol, [20]). It provides a mechanism for passing a large set of configuration parameters to hosts connected to a TCP/IP network (IP address, sub-net mask, domain name, MTU, etc.) in an automatic manner. Moreover DHCP may assign IP addresses to clients for a finite lease time, allowing for sequential reassignment of addresses to different users.

The lease time is chosen by the administrator of the DHCP server (in the external network), and is therefore out of the scope of this specification.

The Packet Domain offers the end user the possibility to run DHCP end-to-end the same way as he does when connected directly to a LAN (e.g. an enterprise Intranet). No modifications should be required in common implementations of DHCP clients and servers. However a Packet Domain-specific DHCP relay agent [21] is needed in the GGSN so as to allow correct routing of DHCP requests and replies between the TE and the DHCP servers.

At PDP context activation no IP address is allocated, this is done afterwards through DHCP. After the TE's configuration has been completed by DHCP, the PDP context is updated by means of the GGSN-initiated PDP Context Modification Procedure in order to reflect the newly assigned IP address.

In the following cases the corresponding PDP context shall be deactivated and the whole procedure starting with PDP context activation shall be restarted by the MS

- if the DHCP lease expires
- if the DHCP renewal is rejected by the DHCP server
- if the IP address is changed during the renewal process. Usually when the lease is renewed, the IP address remains unchanged. However, if for any reason (e.g. poor configuration of the DHCP server), a different IP address is allocated during the lease renewal process the PDP Context shall be deactivated.

13.2 PDN Interworking Model for DHCP

A DHCP relay agent shall be located in the GGSN used for interworking with the IP network as illustrated in the following figure 16b.

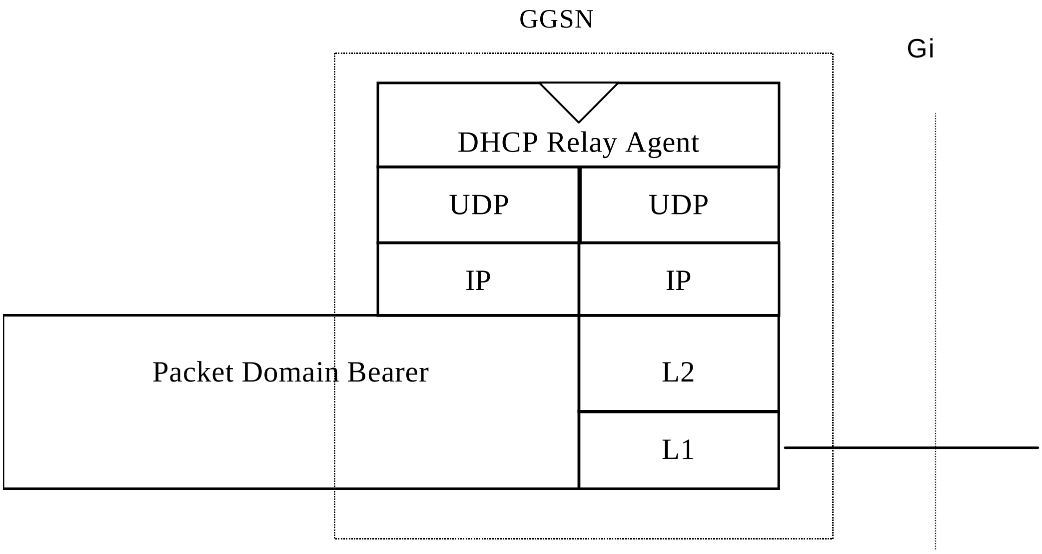


Figure 16b: The protocol stacks for the Gi IP reference point for DHCP

The DHCP relay agent relays the requests received from the DHCP client to the DHCP server(s), and the replies received from the server(s) to the corresponding client. The DHCP relay agent allows for the replies from DHCP servers to be delivered to the correct terminal, as the logical connection from the MT terminates in the GGSN, and consequently only the GGSN holds enough information to locate the DHCP client. How the DHCP relay agent identifies the MT based on the DHCP messages is out of the scope of ~~UMTS~~ 3GPP standardisation.

DHCP provides mechanisms for user authentication and integrity protection, but does not offer any message confidentiality, therefore additional mechanisms (e.g. IPsec tunnel) may be provided if the link towards the external network is not secure. However this is out of the scope of the present document.

Apart from the particulars mentioned above, this model is basically the same as the one for interworking with IP networks described elsewhere in the present document. Using DHCP corresponds to the transparent access case as the GGSN does not take part in the functions of authentication, authorisation, address allocation, etc.

13.2.1 Address allocation by the Intranet or ISP

The MS is given an address belonging to the Intranet/ISP addressing space. The address is given dynamically immediately after the PDP context activation. This address is used for packet forwarding between the Intranet/ISP and the GGSN and within the GGSN.

The MS may authenticate itself to the Intranet/ISP by means of the relevant DHCP procedures (DHCP authentication is currently described in an Internet Draft).

The protocol configuration options are retrieved from the DHCP server belonging to the Intranet/ISP.

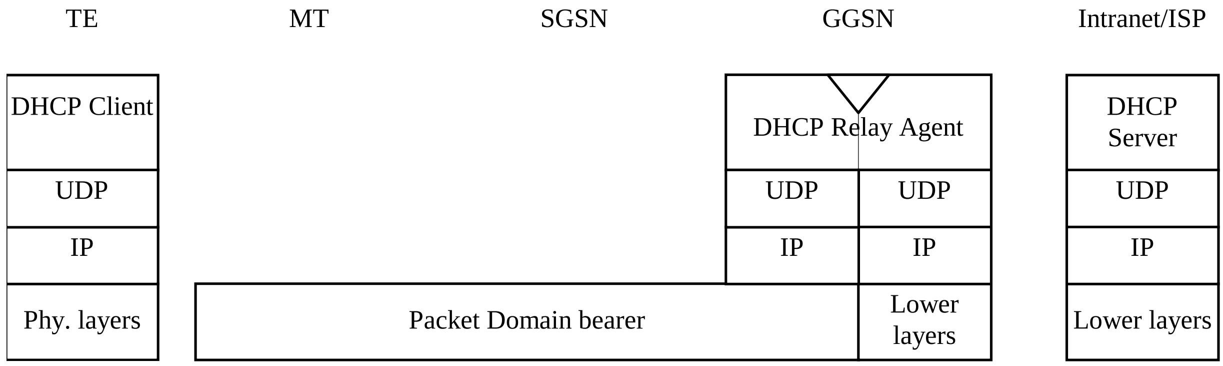


Figure 16c: Protocol stack for access with DHCP end-to-end

The following description bullet items describe the signal flow. For a detailed description of the DHCP messages refer to [26], [27]. The end-to-end protocol configuration is depicted in figure 16c.

1) The TE and MT exchange several AT commands carrying the QoS and other parameters requested by the TE, and requesting the activation of a PDP context of PDP type IP. The TE selects the APN of the configured Intranet/ISP offering a DHCP service, or the APN consisting of the Reserved Service Label for DHCP that the user has subscribed to. In the latter case the TE will be connected to a PLMN operator-configured service provider offering a DHCP service (according to the APN selection rules).

2) The MT sends the Activate PDP Context Request message to the SGSN with an empty PDP address field.

3) The SGSN selects a GGSN based on the APN requested by the MS and sends a Create PDP Context Request message to that GGSN. The GGSN replies with a Create PDP Context Response message. If the GGSN has not been configured by the operator to use external PDN address allocation with DHCP for the requested APN, the cause shall be set to 'Service not supported'. No IP address is assigned at this point; the PDP address returned by the GGSN is set to 0.0.0.0, indicating that the IP address is not yet assigned and shall be negotiated by the TE with the Intranet/ISP after the PDP context activation procedure.

4) Depending on the cause value received in the Create PDP Context Response the SGSN sends either an Activate PDP Context Accept or an Activate PDP Context Reject back to the MT. In case of a successful activation the PDP context is established with the PDP address set to 0.0.0.0.

5) Upon reception of the Activate PDP Context Accept, the MT sends an AT response to the TE that acknowledges the completion of the PDP context activation procedure.

6) The TE sends a DHCPDISCOVER message with the IP destination address set to the limited broadcast address (all 1s). The GGSN will pass the DHCPDISCOVER to the DHCP relay agent which will relay the request to the DHCP server configured for the APN of the PDP context. If more than one DHCP server is configured for a given APN, the request will be sent to all of them. The DHCP relay agent will add enough information to the DHCPDISCOVER message to be able to relay the replies back to the MS. How this is done is out of the scope of ~~UMTS~~ 3GPP standardisation.

7) DHCP servers receiving the DHCPDISCOVER request reply by sending a DHCPOFFER message including an offered IP address. The DHCP relay agent forwards the replies to the proper MS.

8) The TE chooses one of the possibly several DHCPOFFERs and sends a DHCPREQUEST confirming its choice and requesting additional configuration information. The relay agent relays the DHCPOFFER as explained in step 6.

9) The selected DHCP server receives the DHCPREQUEST and replies with a DHCPACK containing the configuration information requested by the TE. The DHCP relay agent relays the DHCPACK to the TE.

10) The DHCP relay agent passes the allocated IP address to the GGSN which stores it in the corresponding PDP context. The GGSN then initiates a PDP context modification procedure by sending an Update PDP Context Request to the appropriate SGSN with the End User Address information element set to the allocated IP address.

11) The SGSN sends a Modify PDP Context Request to the MT with the allocated IP address in the PDP Address information element. The MT acknowledges by sending a Modify PDP Context Accept to the SGSN.

12) The SGSN sends an Update PDP Context Response to the GGSN. The PDP context has been successfully updated with the allocated IP address.

EXAMPLE: In the following example a successful PDP context activation with use of DHCP from end to end is shown.

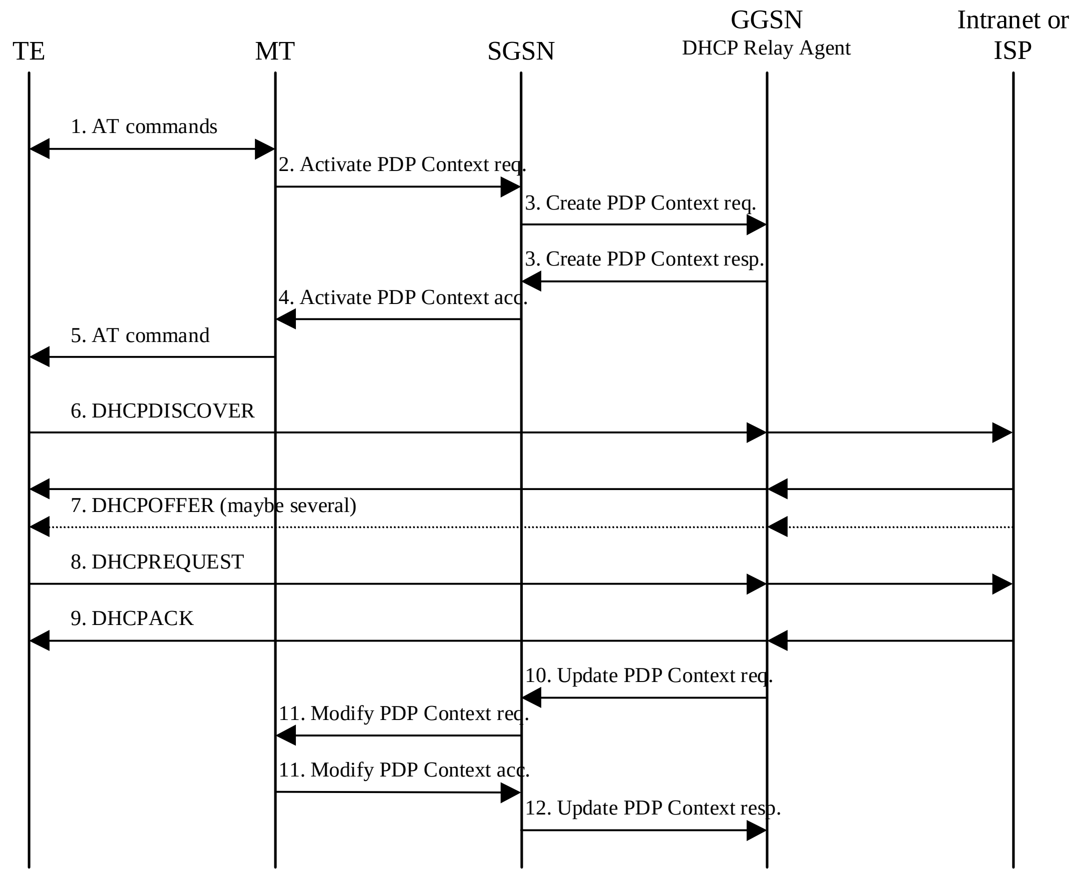


Figure 16d

14 Internet Hosted Octet Stream Service (IHOSS)

Void.

15 Interworking between Packet Domains

The primary reason for the interworking between Packet Domains is to support roaming subscribers as described in TS 23.060. The general model for Packet Domain interworking is shown in figure 21.

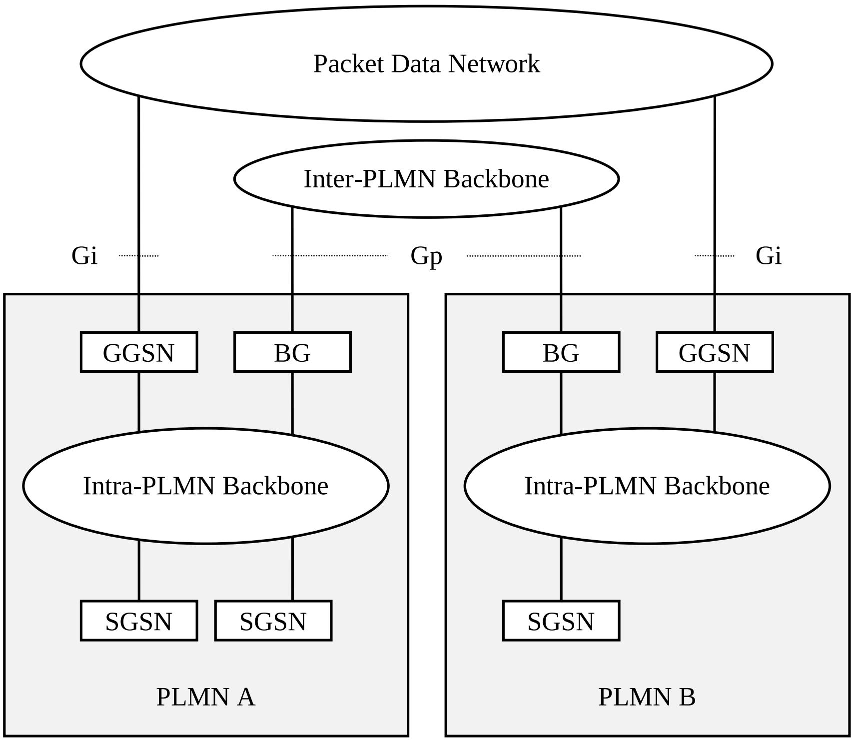


Figure 21: General interworking between Packet Domains to support roaming subscribers.

For roaming subscribers that have a PDP address allocated from the HPLMN a forwarding route between the HPLMN and the VPLMN is created. This route is used for both mobile terminated and mobile originated data traffic. The communication is done via the BGs (Border Gateways) as described in 3GPP TS 23.060.

The procedures to set the link between the SGSN in the VPLMN and the GGSN in the HPLMN are described in 3GPP TS 23.060.

The inter-PLMN link may be any packet data network or dedicated link as described in 3GPP TS 23.060. The PLMN operators may have a dedicated inter-PLMN link to fulfil the QoS requirements of a certain protocol.

15.1 Security Agreements

Each PLMN operator may support IPsec (RFC 1825) and accompanying specifications for authentication (RFC 1826) and encryption (RFC 1827) as a basic set of security functionality in its border gateways. The PLMN operators may decide to use other security protocols based on bilateral agreements.

15.2 Routing protocol agreements

Each PLMN operator may support BGP (RFC 1771) as a basic set of routing functionality in its border gateways. The PLMN operators may decide to use other routing protocols based on bilateral agreements.

15.3 Charging agreements

Sharing the cost of the inter-PLMN link is subject to the agreement between the PLMN operators.

There may be a requirement to collect charging information in the Border Gateway (see figure 21 in clause 15) and this is down to the normal interconnect agreement between PLMN and PDN operators.

16 Usage of RADIUS on Gi interface

A GGSN may, on a per APN basis, use RADIUS authentication to authenticate a user and RADIUS accounting to provide information to an AAA (Authentication, Authorization and Accounting) server.

16.1 RADIUS Authentication

RADIUS Authentication shall be used according to RFC2865 [38].

The RADIUS client function may reside in a GGSN. When the GGSN receives a Create PDP Context request message the RADIUS client function may send the authentication information to an authentication server, which is identified during the APN provisioning.

The authentication server checks that the user can be accepted. The response (when positive) may contain network information, such as an IP address for the user.

The information delivered during the Radius authentication can be used to automatically correlate the users identity (the MSISDN or IMSI) to the IP-address, assigned/confirmed by the GGSN or the authentication server respectively. The same procedure applies, in case of sending the authentication to a 'proxy' authentication server.

RADIUS Authentication is only applicable to the primary PDP context. When the GGSN receives an Access-Accept message from the authentication server it shall complete the PDP context activation procedure. If Access-Reject or no response is received, the GGSN shall reject the PDP Context Activation attempt with a suitable cause code, e.g. User Authentication failed.

16.2 RADIUS Accounting

RADIUS Accounting shall be used according to RFC 2866 [39].

The RADIUS accounting client function may reside in a GGSN. The RADIUS accounting client may send information to an accounting server, which is identified during the APN provisioning. The accounting server may store this information and use it to automatically identify the user. This information can be trusted because the GPRS network has authenticated the subscriber (i.e. SIM card and possibly other authentication methods).

RADIUS Accounting-Request Start and Stop messages may be used during both primary and secondary PDP context activation and deactivation procedures respectively.

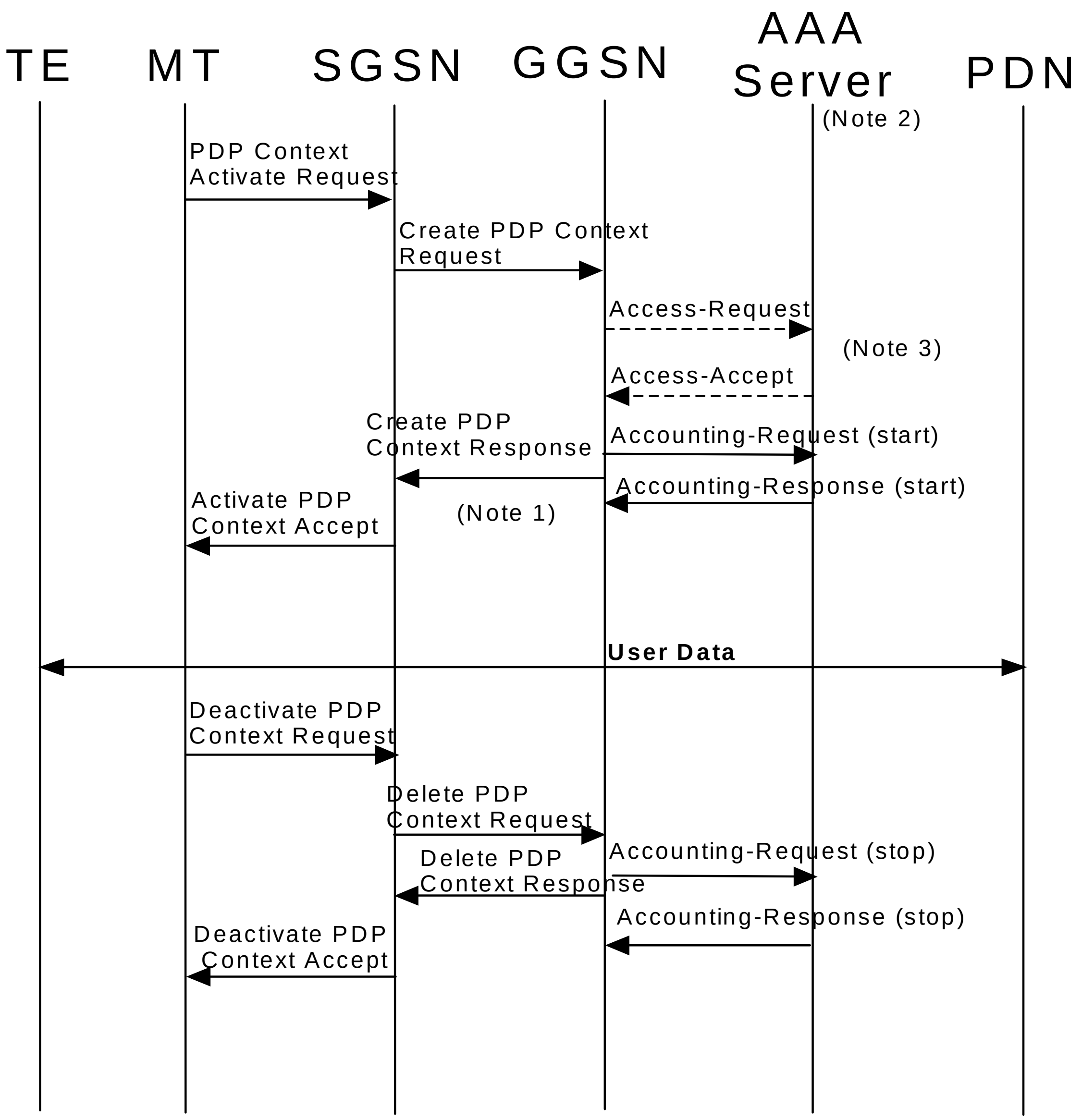
The use of Accounting-Request STOP and in addition the Accounting ON and Accounting OFF messages may be used to ensure that information stored in the accounting server is synchronised with the GGSN information.

If the AAA server is used for IP address assignment, then, upon reception of a RADIUS Accounting-Request STOP message for all PDP contexts associated to a session defined by APN and IMSI or MSISDN, the AAA server may make the associated IP address available for assignment.
In order to avoid race conditions, the GGSN shall include a 3GPP Vendor-Specific sub-attribute "Session Stop indicator" when it sends the Accounting-Request STOP for the last PDP context of a PDP session and the PDP session is terminated (i.e. the IP address and all GTP tunnels can be released). The AAA server shall not assume the PDP session terminated until an Accounting-Request STOP with the Session Stop indicator is received.

16.3 Authentication and accounting message flows

16.3.1 IP PDP type

The figure 14 represents the RADIUS message flows between a GGSN and an Authentication, Authorization and Accounting (AAA) server.



NOTE 1: If some external applications require RADIUS Accounting request (Start) information before they can process user packets, then the selected APN (GGSN) may be configured in such a way that the GGSN drops user data until the Accounting Response (START) is received from the AAA server. Both Authentication and Accounting servers may be optional and separately configured for each APN.

NOTE 2: Separate accounting and authentication servers may be used.

NOTE 3: The Access-Request message shall be used for primary PDP context only.

Figure 14: RADIUS message flow for PDP type IP (successful user authentication case)

When a GGSN receives a Create PDP Context Request message for a given APN, the GGSN may (depending on the configuration for this APN) send a RADIUS Access-Request to an AAA server. The AAA server authenticates and authorizes the user. If RADIUS is also responsible for IP address allocation the AAA server shall return the allocated IP address in the Access-Accept message.

Even if the GGSN was not involved in user authentication (e.g. transparent network access mode), it may send a RADIUS Accounting-Request START message to an AAA server. This message contains parameters, e.g. the tuple which includes the user-id and IP address, to be used by application servers (e.g. WAP gateway) in order to identify the user. This message also indicates to the AAA server that the user session has started. User data forwarding at the GGSN may not be allowed before the Accounting Response START is received. If this is the case, the GGSN drops user data until the Accounting Response START is received. This is configurable per APN.

When the GGSN receives a Delete PDP Context Request message and providing a RADIUS Accounting-Request START message was sent previously, the GGSN shall send a RADIUS Accounting-Request STOP message to the AAA server, which indicates the termination of this particular user session. The GGSN shall immediately send a Delete PDP context response, without waiting for an Accounting-Response STOP message from the AAA server.

The AAA server shall deallocate the IP address (if any) initially allocated to the subscriber, if there is no session for the subscriber.

Accounting-Request ON and Accounting-Request OFF messages may be sent from the GGSN to the AAA server to ensure the correct synchronization of the session information in the GGSN and the AAA server.

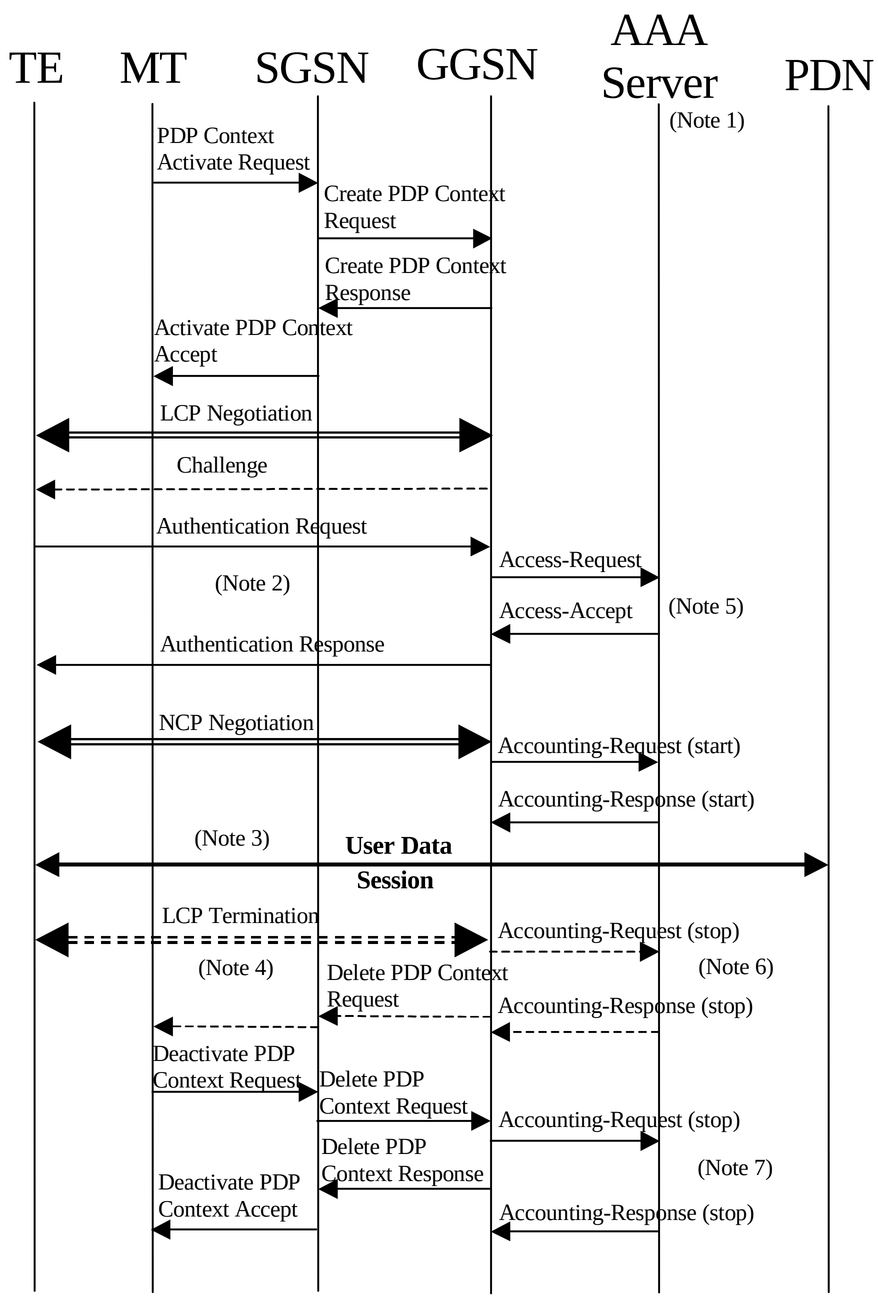
The GGSN may send an Accounting-Request ON message to the AAA server to indicate that a restart has occurred. The AAA server may then release the associated resources.

Prior to a scheduled restart, the GGSN may send Accounting-Request OFF message to the AAA server. The AAA server may then release the associated resources.

If an Access-Challenge is sent to the GGSN when an Access-Request message is pending and when IP PDP type is used, the GGSN shall silently discard the Access-Challenge message and it shall treat an Access-Challenge as though it had received an Access-Reject instead [38].

16.3.2 PPP PDP type

The figure 15 describes the RADIUS message flows between a GGSN and an Authentication, Authorization and Accounting (AAA) server for the case where PPP is terminated at the GGSN. The case where PPP is relayed to an LNS is beyond the scope of this specification.



NOTE 1: Separate accounting and Authentication servers may be used.

NOTE 2: Actual messages depend on the used authentication protocol (e.g. PAP, CHAP)

NOTE 3: User data may not be allowed before the Accounting Response (START) is received. If this is the case, the GGSN drops user data until the Accounting Response (START) is received.

NOTE 4: An LCP termination procedure may be performed. Either the MS or the GGSN may initiate the context deactivation.

NOTE 5: The Access-Request message shall be used for primary PDP context only.

NOTE 6: Network Initiated deactivation

NOTE 7: User Initiated deactivation

Figure 15: RADIUS message flow for PDP type PPP (successful user authentication case)

When a GGSN receives a Create PDP Context Request message for a given APN, the GGSN shall immediately send a Create PDP context response back to the SGSN. After PPP link setup, the authentication phase may take place. During Authentication phase, the GGSN sends a RADIUS Access-Request to an AAA server. The AAA server authenticates and authorizes the user. If RADIUS is also responsible for IP address allocation the AAA server shall return the allocated IP address in the Access-Accept message (if the user was authenticated).

If the user is not authenticated, the GGSN shall send a Delete PDP context request to the SGSN.

Even if the GGSN was not involved in user authentication (e.g. for PPP no authentication may be selected), it may send a RADIUS Accounting-Request START message to an AAA server. This message contains parameters, e.g. a tuple which includes the user-id and IP address, to be used by application servers (e.g. WAP gateway) in order to identify the user. This message also indicates to the AAA server that the user session has started, and the QoS parameters associated to the session.

User data forwarding at the GGSN may not be allowed before the Accounting Response START is received. If this is the case, the GGSN drops user data until the Accounting Response START is received. This is configurable per APN.

When the GGSN receives a Delete PDP Context Request message and providing a RADIUS Accounting-Request START message was sent previously, the GGSN shall send a RADIUS Accounting-Request STOP message to the AAA server, which indicates the termination of this particular user session. The GGSN shall immediately send a Delete PDP context response, without waiting for an Accounting-Response STOP message from the AAA server.

The AAA server shall deallocate the IP address (if any) initially allocated to the subscriber.

Accounting-Request ON and Accounting-Request OFF messages may be sent from the GGSN to the AAA server to ensure the correct synchronization of the session information in the GGSN and the AAA server.

The GGSN may send an Accounting-Request ON message to the AAA server to indicate that a restart has occurred. The AAA server may then release the associated resources.

Prior to a scheduled restart, the GGSN may send Accounting-Request OFF message to the AAA server, the AAA server may then release the associated resources.

If an Access-Challenge is sent to the GGSN when using PPP PDP type, the GGSN shall handle it by PPP CHAP providing PPP CHAP was the selected Authentication protocol. If CHAP authentication was not selected, authentication shall fail [38].

16.4 List of RADIUS attributes

The following tables describe the actual content of the RADIUS messages exchanged between the GGSN and the AAA server. Other RADIUS attributes may be used as defined in RADIUS RFC(s). Unless otherwise stated, when the encoding scheme of an attribute is specified as UTF-8 encoding, this shall be interpreted as UTF-8 hexadecimal encoding.

16.4.1 Access-Request message (sent from the GGSN to AAA server)

The table 1 describes the attributes of the Access-Request message.

Table 1: The attributes of the Access-Request message

Attr #	Attribute Name	Description	Content	Presence Requirement
1	User-Name	Username is provided by the user (extracted from the Protocol Configuration Options (PCO) field of the Create PDP Context Request message) or PPP authentication phase (if PPP PDP type is used). If no username is available a generic username, configurable on a per APN basis, shall be present.	String	Mandatory
2	User-Password	User password provided by the user if PAP is used (extracted from the PCO field of the Create PDP Context Request message) or PPP authentication phase (if PPP PDP type is used). If no password is available a generic password, configurable on a per APN basis, shall be present.	String	Conditional Note 1
3	CHAP-Password	User password provided by the user if CHAP is used (extracted from the PCO field of the Create PDP Context Request message) or PPP authentication phase (if PPP PDP type is used).	String	Conditional Note 2
4	NAS-IP-Address	IP address of the GGSN for communication with the AAA server.	IPv4	Conditional Note 3
32	NAS-Identifier	Hostname of the GGSN for communication with the AAA server.	String	Conditional Note 3
6	Service-Type	Indicates the type of service for this user	Framed	Optional
7	Framed-Protocol	Indicates the type of protocol for this user	7 (GPRS PDP Context)	Optional
8	Framed-IP-Address	IP address allocated for this user	IPv4	Conditional
9	Framed-IP-Netmask	Netmask for the user IP address	IPv4	Conditional
30	Called-Station-Id	Identifier for the target network	APN (UTF-8 encoded)	Mandatory
31	Calling-Station-Id	Identifier for the MS	MSISDN in international format according to 3GPP TS 23.003, UTF-8 encoded decimal. Note that there are no leading characters in front of the country code.	Mandatory
60	CHAP-Challenge	Challenge if CHAP is used (extracted from the PCO field of the Create PDP Context Request message) or PPP authentication phase (if PPP PDP type is used).	String	Conditional Note 2
61	NAS-Port-Type	Port type for the GGSN	As per RFC 2865	Optional
26/10415	3GPP Vendor-Specific	Sub-attributes according sub-clause 16.4.7	See sub-clause 16.4.7	Optional except sub-attribute 3 which is conditional

NOTE 1: Shall be present if PAP is used.

NOTE 2: Shall be present if CHAP is used.

NOTE 3: Either NAS-IP-Address or NAS-Identifier shall be present.

16.4.2 Access-Accept (sent from AAA server to GGSN)

The table 2 describes the attributes of the Access-Accept message.

Table 2: The attributes of the Access-Accept message

Attr #	Attribute Name	Description	Content	Presence Requirement
1	User-Name	Username received in the Access-Request message or a substitute username provided by the AAA server. If the User-Name has been received in the Access-Accept message, this user-name shall be used in preference to the above	String	Optional
6	Service-Type	Indicates the type of service for this user	Framed	Optional
7	Framed-Protocol	Indicates the type of protocol for this user	7 (GPRS PDP Context)	Optional
8	Framed-IP-Address	IP address allocated for this user, if the AAA server is used to allocate IP address.	IPv4	Conditional
9	Framed-IP-Netmask	Netmask for the user IP address, if the AAA server is used to allocate IP netmask.	IPv4	Conditional
12	Framed-IP-MTU	MTU for the user towards this particular APN, MTU shall be less or equal to 1500	String	Optional
25	Class	Identifier to be used in all subsequent accounting messages.	String	Optional (NOTE 4)
27	Session-Timeout	Indicates the timeout value (in seconds) for the user session	32 bit unsigned Integer	Optional
28	Idle-Timeout	Indicates the timeout value (in seconds) for idle user session	32 bit unsigned Integer	Optional
26/311	MS- primary-DNS-server	Contains the primary DNS server address for this APN	Ipv4	Optional
26/311	MS-Secondary-DNS-Server	Contains the secondary DNS server address for this APN	IPv4	Optional
26/311	MS-Primary-NBNS-Server	Contains the primary NetBios name server address for this APN	IPv4	Optional
26/311	MS-Secondary-NBNS-Server	Contains the secondary NetBios server address for this APN	IPv4	Optional
NOTE 4: The presence of this attribute is conditional upon this attribute being received in the Access-Accept message				

16.4.3 Accounting-Request START (sent from GGSN to AAA server)

The table 3 describes the attributes of the Accounting-Request START message.

Table 3: The attributes of the Accounting-Request START message

Attr #	Attribute Name	Description	Content	Presence Requirement
1	User-Name	Username provided by the user (extracted from the PCO field of the Create PDP Context Request message) or PPP authentication phase (if PPP PDP type is used). If no username is available a generic username, configurable on a per APN basis, shall be present. If the User-Name has been received in the Access-Accept message, this user-name shall be used in preference to the above	String	Optional
4	NAS-IP-Address	GGSN IP address for communication with the AAA server.	IPv4	Conditional Note 3
32	NAS-Identifier	Hostname of the GGSN for communication with the AAA server.	String	Conditional Note 3
6	Service-Type	Indicates the type of service for this user	Framed	Optional
7	Framed Protocol	Indicates the type of protocol for this user	7 (GPRS PDP Context)	Optional

8	Framed-IP-Address	User IP address	IPv4	Mandatory
25	Class	Received in the access accept	String	Conditional (NOTE 4)
30	Called-Station-Id	Identifier for the target network	APN (UTF-8 encoded)	Mandatory
31	Calling-Station-Id	Identifier for the MS	MSISDN in international format according to 3GPP TS 23.003, UTF-8 encoded decimal. Note that there are no leading characters in front of the country code.	Mandatory
40	Acct-Status-Type	Type of accounting message	START	Mandatory
41	Acct-Delay-Time	Indicates how many seconds the GGSN has been trying to send this record for, and can be subtracted from the time of arrival on the AAA server to find the approximate time (in seconds) of the event generating this Accounting-Request.	32 unsigned integer	Optional
44	Acct-Session-Id	User session identifier.	GGSN IP address and Charging-ID concatenated in a UTF-8 encoded hexadecimal. NOTE: The GGSN IP address is the same as that used in the GCDRs.	Mandatory
45	Acct-Authentic	Authentication method	RADIUS or LOCAL	Optional
61	NAS-Port-Type	Port type for the GGSN	As per RFC 2865	Optional
26/10415	3GPP Vendor-Specific	Sub-attributes according sub-clause 16.4.7.	See sub-clause 16.4.7	Optional except sub-attribute 3 which is conditional
NOTE 3: Either NAS-IP-Address or NAS-Identifier shall be present. NOTE 4: The presence of this attribute is conditional upon this attribute being received in the Access-Accept message				

16.4.4 Accounting Request STOP (sent from GGSN to AAA server)

The table 4 describes the attributes of the Accounting-Request STOP message.

Table 4: The attributes of the Accounting-Request STOP message

Attr #	Attribute Name	Description	Content	Presence Requirement
1	User-Name	Username provided by the user (extracted from the PCO field of the Create PDP Context Request message) or PPP authentication phase (if PPP PDP type is used). If no username is available a generic username, configurable on a per APN basis, shall be present. If the User-Name has been received in the Access-Accept message, this user-name shall be used in preference to the	String	Optional

		above		
4	NAS-IP-Address	IP address of the GGSN for communication with the AAA server.	IPv4	Conditional Note 3
32	NAS-Identifier	Hostname of the GGSN for communication with the AAA server.	String	Conditional Note 3
6	Service-Type	Indicates the type of service for this user	Framed	Optional
7	Framed Protocol	Indicates the type of protocol for this user	7 (GPRS PDP Context)	Optional
8	Framed-IP-Address	User IP address	IPv4	Mandatory
25	Class	Received in the access accept	String	Optional (NOTE 4)
30	Called-Station-Id	Identifier for the target network	APN (UTF-8 encoded)	Mandatory
31	Calling-Station-Id	Identifier for the MS	MSISDN in international format according to 3GPP TS 23.003, UTF-8 encoded. Note that there are no leading characters in front of the country code.	Mandatory
40	Acct-Status-Type	Indicates the type of accounting request	STOP	Mandatory
41	Acct-Delay-Time	Indicates how many seconds the GGSN has been trying to send this record for, and can be subtracted from the time of arrival on the AAA server to find the approximate time of the event generating this Accounting-Request	Second	Optional
42	Acct-Input-Octets	GGSN counted number of octets sent by the user for the PDP context	32 bit unsigned integer	Optional
43	Acct-Output-Octets	GGSN counted number of octets received by the user for the PDP context	32 bit unsigned integer	Optional
44	Acct-Session-Id	User session identifier.	GGSN IP address and Charging-ID concatenated in a UTF-8 encoded hexadecimal. NOTE: The GGSN IP address is the same as that used in the GCDRs.	Mandatory
45	Acct-Authentic	Authentication method	RADIUS or LOCAL	Optional
46	Acct-Session-Time	Duration of the session	Second	Optional
47	Acct-Input-Packets	GGSN counted number of packets sent by the user	Packet	Optional
48	Acct-Output-Packets	GGSN counted number of packets received by the user	Packet	Optional
49	Acct-Terminate-Cause	Indicate how the session was terminated	See RFC 2866	Optional
61	NAS-Port-Type	Port type for the GGSN	As per RFC 2865	Optional
26/10415	3GPP Vendor-Specific	Sub-attributes according to sub-clause 16.4.7.	See sub-clause 16.4.7	Optional except sub-attribute 3 which is conditional

NOTE 3: Either NAS-IP-Address or NAS-Identifier shall be present.

NOTE 4: The presence of this attribute is conditional upon this attribute being received in the Access-Accept message

16.4.5 Accounting Request ON (optionally sent from GGSN to AAA server)

The table 5 describes the attributes of the Accounting-Request ON message.

Table 5: The attributes of the Accounting-Request ON message

Attr #	Attribute Name	Description	Content	Presence Requirement
4	NAS-IP-Address	IP address of the GGSN for communication with the AAA server.	IPv4	Conditional Note 3
30	Called-Station-ID	Identifier for the target network.	APN (UTF-8 encoded)	Optional
32	NAS-Identifier	Hostname of the GGSN for communication with the AAA server.	String	Conditional Note 3
NOTE 3: Either NAS-IP-Address or NAS-Identifier shall be present.				

16.4.6 Accounting Request OFF (optionally sent from GGSN to AAA server)

The table 6 describes the attributes of the Accounting-Request OFF message.

Table 6: The attributes of the Accounting-Request OFF message

Attr #	Attribute Name	Description	Content	Presence Requirement
4	NAS-IP-Address	IP address of the GGSN for communication with the AAA server.	IPv4	Conditional Note 3
30	Called-Station-ID	Identifier for the target network.	APN (UTF-8 encoded)	Optional
32	NAS-Identifier	Hostname of the GGSN for communication with the AAA server.	String	Conditional Note 3
NOTE 3: Either NAS-IP-Address or NAS-Identifier shall be present.				

16.4.7 Sub-attributes of the 3GPP Vendor-Specific attribute

The table 7 describes the sub-attributes of the 3GPP Vendor-Specific attribute of the Access-Request, Accounting-Request START and Accounting-Request STOP message.

Table 7: The sub-attributes of the 3GPP Vendor-Specific attribute of the Access-Request, Accounting-Request START and Accounting-Request STOP message

Sub-attr #	Sub-attribute Name	Description	Presence Requirement	Associated attribute (Location of Sub-attr)
1	3GPP-IMSI	IMSI for this user	Optional	Access-Request, Accounting-Request START
2	3GPP-Charging-Id	Charging ID for this PDP Context (this together with the GGSN-Address constitutes a unique identifier for the PDP context).	Optional	Access-Request, Accounting-Request START
3	3GPP-PDP Type	Type of PDP context, e.g. IP or PPP	Conditional (mandatory if attribute 7 is present)	Access-Request
4	3GPP-CG-Address	Charging Gateway IP address	Optional	Access-Request, Accounting-Request START
5	3GPP-GPRS-QoS-Profile	QoS profile received	Optional	Access-Request, Accounting-Request START
6	3GPP-SGSN-Address	SGSN IP address that is used by the GTP control plane for the handling of control messages. It may be used to identify the PLMN to which the user is attached.	Optional	Access-Request, Accounting-Request START
7	3GPP-GGSN-Address	GGSN IP address that is used by the GTP control plane for the context establishment. It is the same as the GGSN IP address used in the GCDRs.	Optional	Access-Request, Accounting-Request START
8	3GPP-IMSI-MCC-MNC	MCC and MNC extracted from the user's IMSI (first 5 or 6 digits, as applicable from the presented IMSI).	Optional	Access-Request, Accounting-Request START
9	3GPP-GGSN- MCC-MNC	MCC-MNC of the network the GGSN belongs to.	Optional	Access-Request, Accounting-Request START
10	3GPP-NSAPI	Identifies a particular PDP context for the associated PDN and MSISDN/IMSI from creation to deletion.	Optional	Access-Request, Accounting-Request START, Access-Request STOP

11	3GPP- Session-Stop-Indicator	Indicateds to the AAA server that the last PDP context of a session is released and that the PDP session has been terminated.	Optional	Accounting Request STOP
12	3GPP- Selection-Mode	Contains the Selection mode for this PDP Context received in the Create PDP Context Request Message	Optional	Access-Request, Accounting-Request START
13	3GPP-Charging-Characteristics	Contains the charging characteristics for this PDP Context received in the Create PDP Context Request Message (only available in R99 and later releases)	Optional	Access-Request, Accounting-Request START

The RADIUS vendor Attribute is encoded as follows (as per RFC 2865)

Bits

Octets	8 7 6 5 4 3 2 1
1	Type = 26
2	Length = n
3	Vendor id octet 1
4	Vendor id octet 2
5	Vendor id octet 3
6	Vendor id octet 4
7-n	String

n>=7

3GPP Vendor Id = 10415

The string part is encoded as follows:

Bits

Octets	8 7 6 5 4 3 2 1
1	3GPP type =
2	3GPP Length = m
3 –m	3GPP value

m>=2 and m<= 248

The 3GPP specific attributes encoding is clarified below.

1 - 3GPP-*IMSI*

Bits

Octets	8 7 6 5 4 3 2 1
1	3GPP type = 1
2	3GPP Length= 15
3	IMSI digit1 (UTF-8 encoded)
4	IMSI digit2 (UTF-8 encoded)
5	IMSI digit3 (UTF-8 encoded)
6	IMSI digit4 (UTF-8 encoded)
7	IMSI digit5 (UTF-8 encoded)
8	IMSI digit6 (UTF-8 encoded)
9-15	IMSI digits 7-15 (UTF-8 encoded)

3GPP Type: 1

Length: L =17

IMSI value: Text:

This is the UTF-8 encoded IMSI; If the MNC is only 2 digits (e.g. MNC = 78), its encoding shall be with a leading ‘0’, (e.g. “078”).

2 - 3GPP-*Charging ID*

Bits

Octets	8 7 6 5 4 3 2 1
1	3GPP type = 2
2	3GPP Length= 6
3	Charging ID value Octet 1
4	Charging ID value Octet 2
5	Charging ID value Octet 3
6	Charging ID value Octet 4

3GPP Type: 2

Length: 6

Charging ID value: 32 bits unsigned integer

3- 3GPP-*PDP type*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 3							
2	3GPP Length= 6							
3	PDP type octet 1							
4	PDP type octet 2							
5	PDP type octet 3							
6	PDP type octet 4							

3GPP Type: 3

Length: 6

PDP type value: Unsigned 32 bits integer

PDP type octet possible values:

0 = IP

1 = PPP

4 - 3GPP-*Charging Gateway address*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 4							
2	3GPP Length= 6							
3	Charging GW addr Octet 1							
4	Charging GW addr Octet 2							
5	Charging GW addr Octet 3							
6	Charging GW addr Octet 4							

3GPP Type: 4

Length: 6

Charging GW address value: Address

5 - 3GPP-*GPRS QoS profile*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 5							
2	3GPP Length= L							
3 -L	UTF-8 encoded QoS profile							

3GPP Type: 5

Length: 24 (release 99) or 8 (release 98)

QoS profile value: Text

UTF-8 encoded QoS profile syntax:

"<Release indicator> – <release specific QoS IE UTF-8 encoding>"

<Release indicator> = UTF-8 encoded number :

"98" = Release 98

"99"= Release 99

<release specific QoS profile UTF-8 encoding> = UTF-8 encoded QoS profile for the release indicated by the release indicator.

The UTF-8 encoding of a QoS IE is defined as follows: each octet is described by 2 UTF-8 encoded digits, defining its hexadecimal representation. The QoS profile definition is in 3G TS 24.008

The release 98 QoS profile data is 3 octets long, which then results in a 6 octets UTF-8 encoded string,

The release 99 QoS profile data is 11 octets long, which results in a 22 octets UTF-8 encoded string.

6 - 3GPP-*SGSN address*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 6							
2	3GPP Length= 6							
3	SGSN addr Octet 1							
4	SGSN addr Octet 2							
5	SGSN addr Octet 3							
6	SGSN addr Octet 4							

3GPP Type: 6

Length: 6

SGSN address value: Address

7 - 3GPP-*GGSN address*

Octets	Bits 8 7 6 5 4 3 2 1
1	3GPP type = 7
2	3GPP Length= 6
3	GGSN addr Octet 1
4	GGSN addr Octet 2
5	GGSN addr Octet 3
6	GGSN addr Octet 4

3GPP Type: 7

Length: 6

GGSN address value: Address

8 - 3GPP-*IMSI MCC-MNC*

Octets	Bits 8 7 6 5 4 3 2 1
1	3GPP type = 8
2	3GPP Length= 8
3	MCC digit1 (UTF-8 encoded)
4	MCC digit2 (UTF-8 encoded)
5	MCC digit3 (UTF-8 encoded)
6	MNC digit1 (UTF-8 encoded)
7	MNC digit2 (UTF-8 encoded)
8	MNC digit3 (UTF-8 encoded)

3GPP Type: 8

Length: 8

MS address value: text

This is the UTF-8 encoding of the MS MCC-MNC values. If the MNC is only 2 digits (e.g. MNC = 78), its encoding shall be with a leading '0', (e.g. "078").

9 - 3GPP-*GGSN MCC-MNC*

Octets	Bits 8 7 6 5 4 3 2 1
1	3GPP type = 9
2	3GPP Length= 8
3	MCC digit1 (UTF-8 encoded)
4	MCC digit2 (UTF-8 encoded)
5	MCC digit3 (UTF-8 encoded)
6	MNC digit1 (UTF-8 encoded)
7	MNC digit2 (UTF-8 encoded)
8	MNC digit3 (UTF-8 encoded)

3GPP Type: 9

Length: 8

GGSN address value: text

This is the UTF-8 encoding of the GGSN MCC-MNC values. If the MNC is only 2 digits (e.g. MNC = 78), its encoding shall be with a leading '0', (e.g. "078").

10 - 3GPP-*NSAPI*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 10							
2	3GPP Length= 6							
3	NSAPI							

3GPP Type: 10

Length: 3

NSAPI value: text

It is the value of the NSAPI of the PDP context the RADIUS message is related to. It is encoded as its hexadecimal representation, using 1UTF-8 encoded digit.

11 - 3GPP-*Session Stop Indicator*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 11							
2	3GPP Length= 2							

3GPP Type: 11

Length: 2

There is no value field for this Vendor Specific Attribute.

12 - 3GPP-Selection-Mode

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 12							
2	3GPP Length= 1							
3	UTF-8 encoded Selection mode string							

3GPP Type: 12

Length: 3

Selection mode value: Text

The format of this attribute shall be a character string consisting of a single digit, mapping from the binary value of the selection mode in the Create PDP Context message [24]. Where TS 29.060 provides for interpretation of the value, e.g. map ‘3’ to ‘2’, this shall be done by the GGSN.

13 - 3GPP-*Charging-Characteristics*

Bits

Octets	8	7	6	5	4	3	2	1
1	3GPP type = 13							
2	3GPP Length= 6							
3-6	UTF-8 encoded Charging Characteristics value							

3GPP Type: 13

Length: 6

Charging characteristics value: Text

The charging characteristics is value is the value of the 2 octets value field taken from the GTP IE described in 29.060section 7.7.23.

Each octet of this IE field value is represented via 2 UTF-8 encoded digits, defining its hexadecimal representation.

Annex A (informative): Interworking PCS1900 with PSDNs

<VOID>

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
	Apr 1999				Transferred to 3GPP CN1	7.0.0	
05-1999	TSG#03				Approved at CN#03		3.0.0
06-1999	TSG#04		001		Access to PDNs and ISPs with the PDP-type PPP	3.0.0	3.1.0
06-1999	TSG#04		002		GPRS Internet Hosted Octet Stream Service (IHOSS)	3.0.0	3.1.0
12-1999	TSG#06		003		Clarification on the PPP LCP Negotiation for PDP Type PPP	3.1.0	3.2.0
12-1999	TSG#06		004		Enhancement to Numbering and Addressing to Include the APN	3.1.0	3.2.0
12-1999	TSG#06		005		IPCP Negotiation Interworking at the MT for Non-Transparent IP	3.1.0	3.2.0
12-1999	TSG#06		006		Mobile IP Issues	3.1.0	3.2.0
12-1999	TSG#06		007		Access to an Intranet/ISP with DHCP End to End	3.1.0	3.2.0
12-1999	TSG#06		008		Streamlining	3.1.0	3.2.0
03-2000	TSG#07		009		Specification reference section clean-up	3.2.0	3.3.0
03-2000	TSG#07		010		Support for the IP-Multicast protocol	3.2.0	3.3.0
03-2000	TSG#07		011		Correction for the support of IPv6	3.2.0	3.3.0
03-2000	TSG#07		012		Removal of X.25.	3.2.0	3.3.0
03-2000	TSG#07		013		TSG CN1 Vocabulary Alignment	3.2.0	3.3.0
09-2000	TSG#09		014		Corrections to MobileIP	3.3.0	3.4.0
03-2001	TSG#11	NP-010044	015		DHCP Lease Renewal	3.4.0	3.5.0
03-2001	TSG#11	NP-010044	016		Removal of IHOSS and OSP	3.4.0	3.5.0
03-2001	TSG#11				Upgraded to Release 4	3.5.0	4.0.0
06-2001	TSG#12	NP-010256	018		Clarifications on the non-transparent access mode	4.0.0	4.1.0
06-2001	TSG#12	NP-010256	020		Set the use of PPP between the MT and TE as an option when interworking with MIPv4	4.0.0	4.1.0
09-2001	TSG#13	NP-010530	021	5	Standard method for information delivery (MSISDN; IP address…) between GPRS and external PDN using RADIUS	4.1.0	4.2.0