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Technical Specification

Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Terminal Adaptation Functions (TAF) for services using asynchronous bearer capabilities (3GPP TS 27.002 version 3.5.0 Release 1999)

GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

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Foreword

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Contents

Foreword

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

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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 04.02 [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 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.

Descriptions related to facsimile are not applied to UMTS but to GSM.

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 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".

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

[3]   3GPP TS 04.02: "Digital cellular telecommunication system (Phase 2+); GSM Public Land Mobile Network (PLMN) access reference configuration".

[4]   3GPP TS 04.21: "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: "3G Vocabulary".

[13]   3GPP TS 29.007: "General requirements on Interworking between the PLMN and the ISDN or 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 01.04 [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.

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.

2 Reference Configuration

3GPP TS 27.001 [10], 3GPP TS 23.101 [6] and 3GPP TS 04.02 [3] describe the basic reference configurations.

2.1 Customer Access Configuration

This configuration is as shown in figure 1 of 3GPP TS 04.02 [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 03.10 [2] defines connection types for the support of transparent services in GSM whilst 3GPP TR 23.910 [7] defines connection types for transparent services in UMTS.

3.1 Rate Adaptation in GSM

3GPP TS 04.21 [4] describes the rate adaptation scheme to be utilized over the Base Station (BS) to Mobile Station (MS) link. 3GPP TS 03.10 [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 04.21 [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 04.21 [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 04.21 [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 04.21 [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 03.10 [2] defines connection types for the support of non-transparent services in GSM whilst 3GPP TR 23.910 [7] defines connection types for non-transparent services in UMTS.

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 03.10 [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.
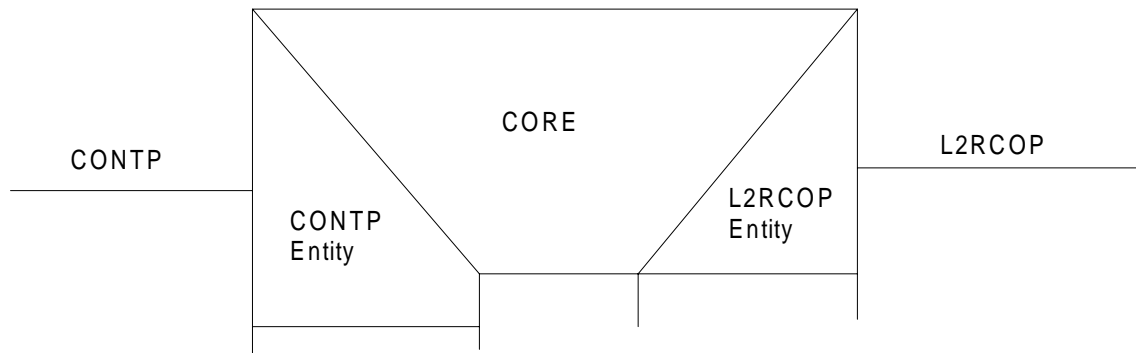
CONTP   Character Oriented Non-Transparent Protocol.
CORE   Character Oriented Relay Entity.
L2RCOP L2R Character Oriented Protocol.

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.		

Annex D (informative): Change history

Change history						
TSG CN#	**Spec**	**Version**	**CR**	**Phase**	**New Version**	**Subject/Comment**
Apr 1999	GSM 07.02	7.0.0				Transferred to 3GPP CN1
CN#03	27.002				3.0.0	Approved at CN#03
CN#04	27.002	3.0.0	001	R99	3.1.0	Introduction of EDGE channel codings into the specifications [E-mail approval]
CN#06	27.002	3.1.0	002	R99	3.2.0	Service clean-up for Release 99
CN#07	27.002	3.2.0	003	R99	3.3.0	UMTS Clean Up
CN#08	27.002	3.3.0	004	R99	3.4.0	Adaptations for UMTS
CN#09	27.002	3.4.0	005	R99	3.5.0	Deletion of UMTS NT-RT FAX from R99
CN#09	27.002	3.4.0	006	R99	3.5.0	Modification from V.25bis to V.250

History

Document history		
V3.2.0	January 2000	Publication
V3.3.0	March 2000	Publication
V3.4.0	June 2000	Publication
V3.5.0	September 2000	Publication