

**Universal Mobile Telecommunications System (UMTS);
Circuit switched data bearer services
(3GPP TR 23.910 version 4.9.1 Release 4)**



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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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1 Scope

The present document provides an overview of the architecture and issues related to the provision of Circuit Switch Bearer Services in a 3G mobile network.

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 43.010: "GSM Public Land Mobile Network (PLMN) connection types".
- [2] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [3] 3GPP TS 22.100: "UMTS phase 1".
- [4] 3GPP TS 22.002: "Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)".
- [5] 3GPP TS 22.101: "Service principles".
- [6] 3GPP TS 22.105: "Services and service capabilities".
- [7] 3GPP TS 23.002: "Network architecture".
- [8] 3GPP TS 23.034: "High Speed Circuit Switched Data (HSCSD) -Stage 2".
- [9] 3GPP TS 23.101: "General UMTS Architecture".
- [10] 3GPP TS 23.107: "Quality of Service (QoS), concept and architecture".
- [11] 3GPP TS 24.022: "Radio Link Protocol (RLP) for circuit switched bearer and teleservices".
- [12] 3GPP TS 25.322: "Radio Link Control (RLC) protocol specification".
- [13] 3GPP TS 25.415: "UTRAN Iu Interface user plane protocols".
- [14] 3GPP TS 27.001: "General on Terminal Adaption Functions (TAF) for Mobile Station (MS)".
- [15] 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)".
- [16] 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".
- [17] ITU-T Recommendation T.30 "Procedures for document facsimile transmission in the general switched telephone network".
- [18] 3GPP TS 44.021: "Rate adaption on the Mobile Station - Base Station System (MS - BSS) interface".
- [19] 3GPP TS 48.020: "Rate adaption on the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface".
- [20] ITU-T Recommendation I.366.1: "Segmentation and Reassembly Service Specific Convergence Sublayer for the AAL type 2".

- [21] ITU-T Recommendation Q.2630.1: "AAL type 2 signalling protocol (Capability Set 1)".
- [22] 3GPP TS 29.415: "Customized Applications for Mobile network Enhanced Logic (CAMEL) Phase 3; CAMEL Application Part (CAP) specification".
- [23] ITU-T Recommendation I.363.2: "B-ISDN ATM Adaptation Layer specification : Type 2 AAL".
- [24] ITU-T Recommendation I.460: "Multiplexing, rate adaption and support of existing interfaces".
- [25] ITU-T Recommendation I.366.2: "AAL type 2 service specific convergence sublayer for narrow-band services".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, terms and definitions given in 3GPP TR 21.905 [2] apply.

3.2 Abbreviations

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

| | |
|--------|---|
| AAL2 | ATM Adaptation Layer 2 |
| AIUR | Air Interface User Rate |
| ATM | Asynchronous Transmission Mode |
| BC | Bearer Capability |
| BS | Bearer Service |
| BSSMAP | Base Station System Mobile Application Protocol |
| CE | Connection Element |
| CN | Core Network |
| CS | Circuit Switched |
| CT | Circuit |
| DCE | Data Communication Equipment |
| DTE | Data Terminal Equipment |
| DTX | Discontinuous Transmission |
| IE | Information Element |
| ITC | Information Transfer Capability |
| IWF | Interworking Function |
| MAP | Mobile Application Protocol |
| MSC | Mobile Services Switching Centre |
| MT | Mobile Termination |
| NT | Non-transparent |
| QoS | Quality of Service |
| RAB | Radio Access Bearer |
| RDI | Restricted Digital Information |
| RLC | Radio link control |
| RLP | Radio link protocol |
| RNL | Radio Network Layer |
| SAP | Service Access Point |
| SSCS | Service Specific Convergence Sublayer |
| SDU | Service Data Unit |
| T | Transparent |
| TAF | Terminal Adaption Function |
| TE | Terminal |
| UDI | Unrestricted Digital Information |
| UE | User Equipment |
| UP | User Plane |
| VLR | Visiting Location Register |
| WAIUR | Wanted Air Interface User Rate |

4 General

CS data services in UMTS (UMTS Bearer Services) are build on services provided by the Access Network. These Radio Access Bearer Services are invoked through the RNL-SAP provided by the Iu User Plane to the Non-access stratum on the Core Network side, and the corresponding SAP provided by the RLC to the Non-access stratum on the Terminal side. Transport within the CN (the CN Bearer services) is outside the scope of the present document. Interworking with External Bearer services is within the scope of the present document. (see figure 1).

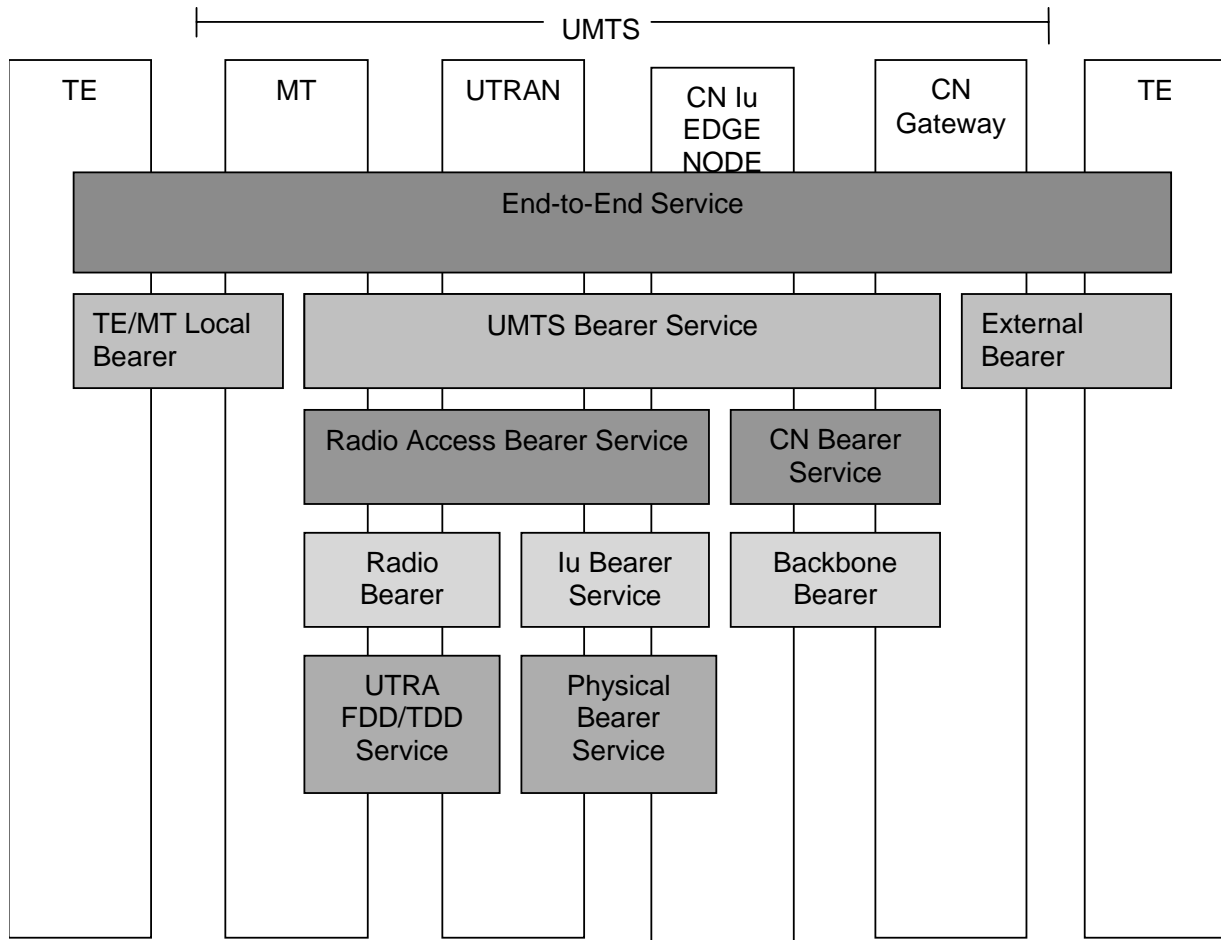


Figure 1: Service architecture

4.1 Limited set of UMTS PLMN connection models

4.1.1 Transparent data

Figure 2 shows the connection model for synchronous transparent CS data. In general all the user data bits are conveyed between the MT and the IWF as they are received from the TE. This implies that the RLC SDU/ Iu UP frame is transparent.

Figure 3 shows the connection model for asynchronous transparent CS data. The rate adaptation function RA0 from 3GPP TS 44.021 [18] (adapted to the RLC SDU size) is used for converting between asynchronous data and a synchronous bit stream. End-to-end flow control is not applicable in UMTS, thus no status bits are conveyed over RAN/UTRAN (see 3GPP TS 27.001 [14]).

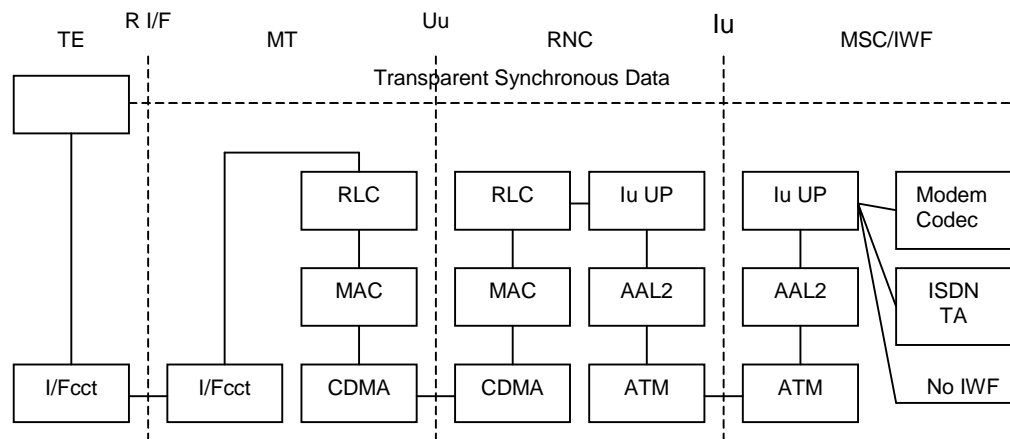


Figure 2: Connection model for Synchronous T CS data

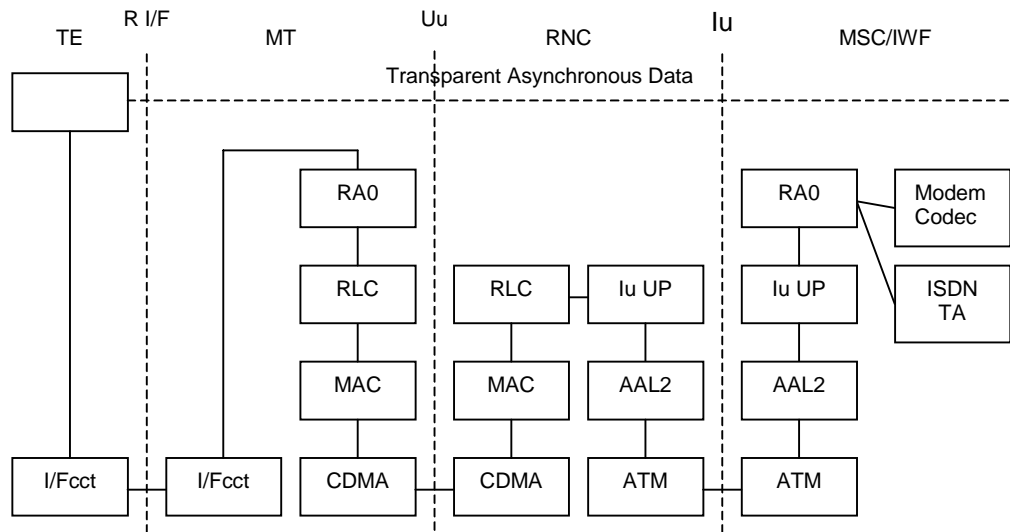


Figure 3: Connection model for Asynchronous T CS data

4.1.2 Non-transparent data

Figure 4 shows the connection model for asynchronous non-transparent CS data.

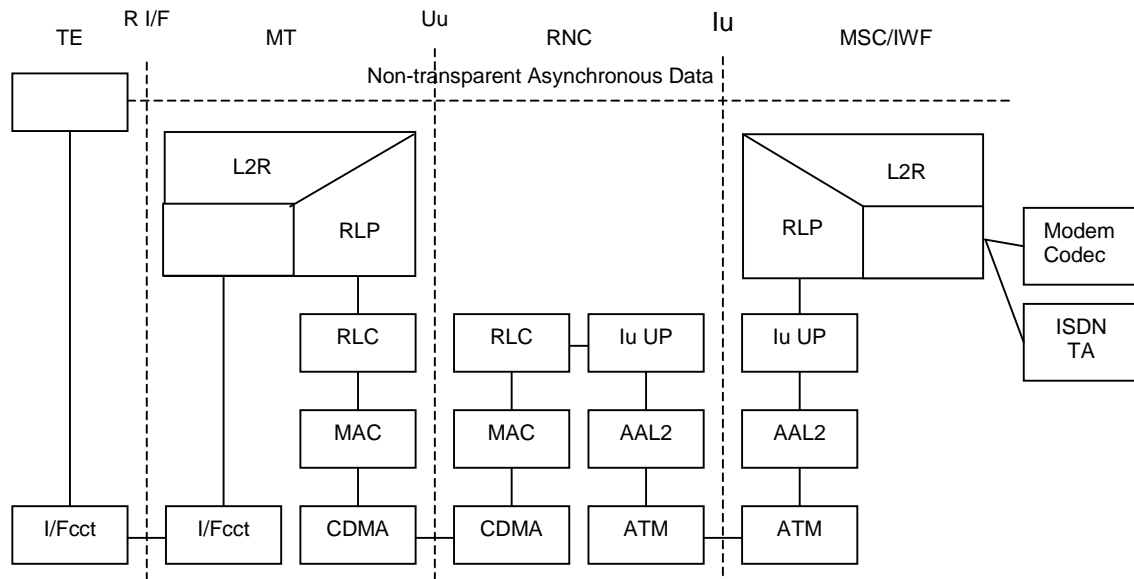


Figure 4: Connection model for Asynchronous NT CS data

5 Bearer Capabilities for UMTS Data Services

The UMTS bearer services are described by the UMTS BC-IE. Five services (or services categories) are currently distinguishable from the UMTS BC-IE:

- Speech.
- Transparent Data for support of Multimedia.
- Transparent Data.
- Non-transparent Fax.
- Non-transparent data.

Speech is currently not in the scope of the present document.

Each UMTS bearer service is supported by a Radio Access Bearers (RAB). The RABs in turn are described by the QoS parameters. There may be one or several RAB candidates for supporting a UMTS bearer service. The possible candidates are described by a mapping of the BC-IE to RAB QoS described in subclause 5.2.

5.1 Bearer Capabilities for UMTS Data Services

5.1.1 Transparent Data

This service is distinguished by the following BC-IE parameters:

- ITC = UDI or 3.1 kHz audio or Other ITC = RDI.
- CE = transparent.

For this service the FNUR at the setup is restricted to:

- 64 kbit/s, in case ITC = UDI.

- 56 kbit/s in case ITC = UDI or Other ITC = RDI.
- 28,8 kbit/s, in case ITC = 3,1 kHz audio.

NOTE: ITU-T Recommendation V.90 [16] is not supported in transparent mode, because asymmetric user rates are not supported in transparent mode.

5.1.2 Non-Transparent Fax

This service is distinguished by the following BC-IE parameters:

- ITC = Fax Group 3 (ITU-T Recommendation T.30 [17]).
- CE = non-transparent.

WAIUR shall not be more than 28.8 kbit/s. The possible AIURs are limited to 14,4 kbit/s and 28,8 kbit/s.

5.1.3 NT Data

This service is distinguished by the following BC-IE parameters:

- ITC = UDI or 3.1 kHz audio or Other ITC = RDI.
- CE = non-transparent.

The possible AIURs are limited to 14,4 kbit/s, 28,8 kbit/s and 57,6 kbit/s.

5.1.4 Transparent Data for Support of Multimedia

This service is distinguished by the following BC-IE parameters:

- ITC = UDI or 3.1 kHz audio or Other ITC = RDI.
- CE = transparent.
- Other rate adaptation = H.223 and H.245.

For this service the FNUR at the setup is restricted to:

- 64 kbit/s, in case ITC = UDI.
- 56 kbit/s in case Other ITC = RDI.
- 33,6 kbit/s, in case ITC = 3,1 kHz audio.
- 32 kbit/s, in case ITC = UDI.
- 28,8 kbit/s, in case ITC = 3,1 kHz audio.

NOTE: Transmission rates 31.2 kbit/s and 28.8 kbit/s negotiated by the modems in a 3.1 kHz multimedia call may be used with a rate adaptation to 33.6 kbit/s between the UE and the IWF (see 3GPP TS 27.001 [14] and 3GPP TS 29.007[15]). The negotiated values shall be provided by the MSC by way of a MODIFY message.

5.2 BC-IE to RAB QoS Mapping

Since UMTS bearer services are described by BC-IEs and RABs by QoS parameters, this subclause provides implicitly a mapping between the UMTS bearer services and the possible RABs that support them. The QoS mapping is based on 3GPP TS 23.107[10].

5.2.1 Non-transparent services, including Fax

| Service identified by the BC IE | Non-transparent data | Comments |
|--|---------------------------------------|---|
| Traffic Class | Streaming | Subject to operator tuning |
| RAB Asymmetry Indicator | Symmetric | |
| Maximum bit rate (1) | 14,4 kbit/s, 28,8 kbit/s, 57.6 kbit/s | Maximum bit rate is set to the highest value \leq WAIUR (Note 1) |
| Guaranteed bit rate | 14,4 kbit/s, 28,8 kbit/s, 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 | | |
| 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 \leq maximum bit rate shall be specified. | | |

5.2.2 Transparent Data, including Multimedia

| Service identified by the BC IE | Transparent data and BS for support of multimedia service | Comments |
|---------------------------------|--|---|
| Traffic Class | Conversational | Subject to operator tuning |
| Maximum bit rate | = guaranteed bit rate | |
| Guaranteed bit rate | FNUR = 64 .. 28.8 kbit/s (Note 2) | GBR for FNUR=56 kbit/s is 64 kbit/s (Note 1) |
| Delivery Order | Yes | |
| Maximum SDU size | 640 bits for FNUR=32, 56 and 64 kbit/s 576 bits for FNUR=28.8 kbit/s 672 bits for FNUR=33.6 kbit/s | |
| 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 [10]. 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: If the FNUR is changed as a result of a MODIFY procedure during the call, the guaranteed bit rate is not changed.

6 Iu and Nb User Plane

6.1 NT services

On the Iu interface and if TDM is not used on the Nb interfaces between the access network and the IWF this paragraph is applicable, except for the Nb interface in the case of inter-MSC relocation. The Iu and Nb user planes are used in support mode, see 3GPP TS 25.415 [13] and 3GPP TS 29.415 [22]. Each SDU corresponds to one RLP frame and, consequently, is 576 bits long. Each SDU is transported in one Iu or Nb UP PDU of Type 1. The range of AIUR values is 14,4 kbit/s, 28,8 kbit/s, 57,6 kbit/s, limited by the maximum bit rate, and varies with the transmission period on the Uu interface, which is 10 ms, 20 ms or 40 ms. A change in the transmission period is signalled to the IWF through the Iu and Nb UP protocols. The Iu or Nb UP primitive Iu- or Nb-UP-DATA-REQUEST is invoked each time an RLP frame is ready to be sent from the IWF towards the UE. DTX indication is not used.

For Inter-MSC relocation this paragraph is applicable for the Nb interface between the access network and the IWF. The Nb UP protocol is applied in support mode and the SDU size is 320 bits, transmitted every 5 ms. PDU type 0 is used. The data within the PDU is encoded as A-TRAU' frames.

If TDM is not used, then between the IWF and the fixed network (ISDN or PSTN), the Nb UP protocol is applied in support mode and the SDU size is 320 bits, transmitted every 5 ms. PDU type 0 is used.

6.2 T services

On the Iu interface, the Iu UP is used in transparent mode, see 3GPP TS 25.415 [13]. The payload of the Iu and Nb frames will consist of user data bits only for synchronous data, and RA0 synchronous bit streams for asynchronous data.

On the Iu interface, the payload (SDU) size is fixed, determined by the bit rate. Following table shows SDU size defined by GSM Association - IMT-2000 Steering Group (Typical Radio Interface Parameter Sets). AAL2 is used. The AAL2 SSCS layer must be supported for segmentation and re-assembly.

| Bit rate | SDU size (= RLC PDU payload size) |
|--------------|-----------------------------------|
| 28.8 kbit/s | 576 bits |
| 33.6 kbit/s | 672 bits |
| 32 kbit/s | 640 bits |
| 56/64 kbit/s | 640 bits |

The primitive Iu-UP_UNIT-DATA-REQUEST is invoked at regular intervals in order to have a constant bit rate (every SDU).

If TDM is not used at the Nb interface, then the Nb UP protocol is applied in support mode and the SDU size is 320 bits, transmitted every 5 ms. PDU type 0 is used.

6.2.1 Avoidance of delay at RNC

The TTI-to-CPS Packet packaging delay can be avoided by choosing the length of the CPS packet payload so that the payloads of an integer number of CPS Packets fill one TTI. The contents of the whole TTI can be sent further towards the MSC immediately after the reception without waiting for the next TTI.

6.2.2 Recovery from the loss of ATM cells

The ATM cell loss rate is estimated to be very small (less than 10^{-6} ... 10^{-8}), the quality of transmission being comparable to that of a high quality ISDN.

The following happens if a cell is lost (see ITU-T Recommendation I.363.2 [23]):

- At least one CPS packet is distorted.
- The distorted CPS packet(s) is/are discarded by the receiver.

- If only one CPS packet is discarded, the upper layer can identify the event by the UI/SSSAR sequence number, and consequently insert a fill sequence of the length of a CPS payload field to the correct place in the bit stream. ITU-T Recommendation I.366.1 [20] (SSSAR) describes that UI takes value between 0 and 26 for final data and value 27 for more data, but UI should take value 26 for final data considering compatibility with other SSSAR specifications. When UI works as sequence number by repetition of 27 and 26, CPS packet payload size is equal to half a SDU size. This CPS packet payload size also satisfies the requirement described in subclause 6.2.1. CPS packet payload size is set by ITU-T Recommendation Q.2630.1 [21] over Iu interface.
- If more than one CPS packets are discarded, the upper layer can identify the event by monitoring the buffer level at the ATM/TDM interface or by monitoring the reception of CPS packets with a timer. (The modulo 2 sequence number cannot indicate the loss of two consecutive CPS packets). The following figures apply for the 40 octet payload field.
- Worst case: 2 packets lost $\Rightarrow 2 \times 40 \text{ octets} \times 8 \text{ bits/octet} = 64 \text{ kbit/s} = 10 \text{ ms}$, i.e. buffer level decreased by 80 octets.
- Consequently, recovery with fill inserted in the correct place is possible, if the ATM cell jitter (i.e. transmission delay variation) is less than 5 ms. With a bigger jitter fill may be inserted in a wrong place in the TDM bit stream.

7 RLC

The RLC shall be used in transparent mode for T and NT services.

8 Initial Synchronisation and resynchronisation

8.1 Modem services (3.1 kHz audio)

8.1.1 Transparent Case

The IWF does not send any SDUs 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 SDUs that are sent toward the MS, and mapping data in the received SDUs to the fixed network side.

The MS sends no SDUs until an SDU is received at the transmission SAP. Until the first access stratum SDU is received, 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 in the received SDUs are mapped to CT 104 and data on CT 103 are mapped to SDUs sent toward the RNC.

8.1.2 Non-Transparent Case

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. If the modems synchronise before the RLP has been established, the IWF stores the information received from the other modem in the L2R buffers.

The UE initiates the RLP after the physical connection has been established. When the RLP link has been established, CT107 at the DCE/DTE interface will be changed from "OFF" to "ON". From this time the information from/to the RLP, including status changes, will be mapped by the L2R entity.

8.2 Digital services

8.2.1 Transparent case

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.

8.2.2 Non-Transparent case

The procedures are the same as for the modem case.

8.3 Loss of synchronisation

The PLMN side is not synchronous so loss of synchronisation is not possible. For T services, SDUs may be lost or arrive irregularly, which handling is implementation dependent.

Loss of synchronisation on the fixed network side is handled as in GSM.

9 Call Control

BC-IE negotiation procedures and mapping to ISDN are specified in 3GPP TS 27.001 [14] and 3GPP TS 29.007 [15]. BC-IE parameter values shall be restricted as indicated in subclause 5.1. See also 3GPP TS 27.001 [14], annex B, table B.5a for further details on the validity of parameter values in GSM.

10 Handover Issues

10.1 Signalling issues

10.1.1 Loss of BC Information during Handover from GSM to UMTS

In the case of inter-MSC handover from GSM to UMTS, the serving GSM MSC/VLR sends a MAP message Prepare Handover carrying the BSSMAP message Handover Request. This message includes the parameter Channel Type, indicating whether radio resources are to be allocated for speech or data (parameter 'Speech or data indicator') and, among other data, the type of data service (transparent/non transparent) and the user rates (both included in the parameter 'Channel rate and type').

As no other bearer capability related parameters are received, it is not possible to distinguish between any other services than 'speech', 'data transparent' and 'data non-transparent'.

The mapping into QoS radio access parameters would be done as described in subclause 5.2, limited to the services 'speech', 'data, non-transparent' and 'data, transparent'.

10.1.2 Handover from UMTS to GSM

In case a UMTS call is set up in the CN, the BC IE parameters are mapped into QoS RAB parameters at call setup.

If the CN has to perform a handover towards GSM, the non-anchor MSC needs to perform an assignment based on GSM traffic channel parameters.

In case of handover from UMTS to GSM, the anchor MSC maps the BC IE parameters into GSM traffic channel parameters. This requires that the BC IE is coded according to GSM protocol requirements, i.e. all those parameters ignored in UMTS should nevertheless be correctly specified by the UE in order to perform a handover to GSM.

10.2 User Plane

10.2.1 Handover from UMTS to GSM

After a handover from UMTS to GSM 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 [18] and 3GPP TS 48.020 [19].
 - up to four 16kbit/s substreams are multiplexed in one 64 kbit/s channel (Split/Combine function and Multiplexing function as defined in 3GPP TS 44.021 [18] and 3GPP TS 48.020 [19]).
- the Nb UP protocol if the anchor MSC or MGW and the visited MSC or MGW are connected via an ATM interface or IP interface. The NbUP shall be configured in support mode, 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 Recommendation I.366.2 [25]. PDU type 0 is used, i.e., payload CRC is applied. This is needed for the framing to be handled the same for all transports but the Frame Quality Classification control shall be ignored (3GUP property Delivery Of Erroneous SDUs = yes) and therefore interim nodes shall only pass on the CRC. The data is encoded between MSC-B/MGW-B (non-Anchor) and MSC-A/MGW-A (Anchor) as for the TDM case.

10.2.2 Handover from GSM to UMTS

After a handover from GSM to UMTS 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 Nb UP protocol if the anchor MSC or MGW and the visited MSC or MGW are connected via an ATM interface or IP interface. The NbUP shall be configured in support mode, 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 Recommendation I.366.2 [25]. PDU type 0 is used, i.e., payload CRC is applied. This is needed for the framing to be handled the same for all transports but the Frame Quality Classification control shall be ignored (3GUP property Delivery Of Erroneous SDUs = yes) and therefore interim nodes shall only pass on the CRC. The data is encoded between MSC-B/MGW-B (non-Anchor) and MSC-A/MGW-A (Anchor) as for the TDM case (A-TRAU' protocol or plain 64kbit/s).

The A-TRAU' protocol is defined as follows:

- A-TRAU' frames are transmitted in regular intervals of 10 ms;
- an A-TRAU' frame consists of two consecutive A-TRAU frames (as defined in 3GPP TS 48.020 [19]) 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.

10.2.2.1 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.

| 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'.

10.2.2.2 A-TRAU' frame format

One A-TRAU' frame consists of two consecutive A-TRAU frames. Figure 5 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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

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 [13].

| 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:

| | 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.

| 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 [19].

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.

10.2.3 Handover within 3G PLMNs

After a handover from a 3G MSC to another 3G MSC the user plane between the anchor MSC or MGW and the visited MSC or MGW shall comply to:

- the A-TRAU' protocol if both MSC are connected via a TDM interface except for the transparent cases FNUR = 32 kbit/s (ITC = UDI), FNUR = 56 kbit/s (ITC=TDI) 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 64kbit/s and 32kbit/s is based on ITU-T Recommendation I.460 [24].
- the Nb UP protocol if the anchor MSC or MGW and the visited MSC or MGW are connected via an ATM interface or IP interface. The Nb UP shall be configured in support mode, 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 Recommendation ITU-T I.366.2 [25]. PDU type 0 is used, i.e., payload CRC is applied. This is needed for the framing to be handled the same for all transports but the Frame Quality Classification control shall be ignored (3GPP property Delivery Of Erroneous SDUs = yes) and therefore interim nodes shall only pass on the CRC. The data is encoded between MSC-B/MGW-B (non-Anchor) and MSC-A/MGW-A (Anchor) as for the TDM case (A-TRAU' protocol or plain 64kbit/s).

10.2.4 Handover for 56 kbit/s

The FNUR = 56 kbit/s in transparent mode can be supported in GSM 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 by a configuration without IWF only. Therefore handover for 56 kbit/s in transparent mode between UMTS and GSM can be supported only for configurations without IWF.

Annex A:

Change history

| Change history | | | | | | | |
|----------------|--------|-----------|-----|-----|--|-------|-------|
| Date | TSG # | TSG Doc. | CR | Rev | Subject/Comment | Old | New |
| 03-2000 | TSG#07 | NP-000053 | | | Approved to be placed under TSG Change control | 2.0.0 | 3.0.0 |
| 06-2000 | TSG#08 | NP-000223 | 001 | | Deletion of T 56 kbit/s for UDI | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000223 | 002 | | Residual bit error ratio in Transparent Data | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000223 | 003 | | Adding the value of GBR of NT services | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000223 | 004 | | Indication of discontinuous transfer for NT data | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000229 | 005 | | Clarification of luUP in Transparent | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000223 | 006 | | Clarification for 56 and 64 kbit/s | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000223 | 007 | | Alignment with 29.007 | 3.0.0 | 3.1.0 |
| 06-2000 | TSG#08 | NP-000229 | 008 | | Clarification of luUP PDU Type for NT data | 3.0.0 | 3.1.0 |
| 09-2000 | TSG#09 | NP-000359 | 010 | | Transparent 32 kbit/s data rate with I.460 rate adaptation | 3.1.0 | 4.0.0 |
| 09-2000 | TSG#09 | NP-000369 | 013 | | Cleanup of RAB parameter setting | 3.1.0 | 4.0.0 |
| 09-2000 | TSG#09 | NP-000427 | 015 | | Delivery of erroneous SDUs parameter value | 3.1.0 | 4.0.0 |
| 09-2000 | TSG#09 | NP-000481 | 017 | | 3.1 kHz multimedia calls at 33.6 kbit/s data rate | 3.1.0 | 4.0.0 |
| 10-2000 | | | | | Correction to references | 4.0.0 | 4.0.1 |
| 12-2000 | TSG#10 | NP-000605 | 019 | | Handover for 56kbit/s | 4.0.1 | 4.1.0 |
| 03-2001 | TSG#11 | NP-010041 | 021 | | A-TRAU' correction | 4.1.0 | 4.2.0 |
| 03-2001 | TSG#11 | NP-010043 | 025 | | Correction of service's scope | 4.1.0 | 4.2.0 |
| 03-2001 | TSG#11 | NP-010045 | 026 | | Introduction of Nb UP | 4.1.0 | 4.2.0 |
| 03-2001 | TSG#11 | NP-010041 | 027 | | A-TRAU' correction | 4.1.0 | 4.2.0 |
| 03-2001 | TSG#11 | NP-010042 | 028 | | RAB- assignment request (RAB parameter) | 4.1.0 | 4.2.0 |
| 06-2001 | TSG#12 | NP-010255 | 030 | | Connection models for CSD and editorial changes. | 4.2.0 | 4.3.0 |
| 12-2001 | TSG#14 | NP-010410 | 031 | | SDU size for transparent data at 33.6 kbit/s | 4.3.0 | 4.4.0 |
| 09-2002 | TSG#17 | NP-020404 | 034 | | Handling of M2 Bit for Handover | 4.4.0 | 4.5.0 |
| 09-2002 | TSG#17 | NP-020404 | 037 | | Removal of SDU error ratio for NT services | 4.4.0 | 4.5.0 |
| 09-2002 | TSG#17 | NP-020406 | 040 | | Handling of CSD calls and Inter-MSC Relocation | 4.4.0 | 4.5.0 |
| 12-2002 | TSG#18 | NP-020616 | 043 | 1 | Use of lu UP in support mode for transparent data services at the Nb interface | 4.5.0 | 4.6.0 |
| 03-2003 | TSG#19 | NP-030076 | 044 | 1 | Use of Nb UP protocol after inter-MSC handover | 4.6.0 | 4.7.0 |
| 09-2003 | TSG#21 | NP-030327 | 046 | 1 | Clarification of Handover description | 4.7.0 | 4.8.0 |
| 03-2005 | TSG#27 | NP-050098 | 049 | 2 | Nb transport for handover between UMTS and GSM | 4.8.0 | 4.9.0 |
| 06-2005 | | | | | Correction to change history | 4.9.0 | 4.9.1 |

History

| Document history | | |
|------------------|----------------|-------------------------|
| V4.2.0 | March 2001 | Publication |
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| V4.8.0 | September 2003 | Publication |
| V4.9.0 | March 2005 | Publication (Withdrawn) |
| V4.9.1 | June 2005 | Publication |