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TECHNICAL SPECIFICATION

Satellite Earth Stations and Systems (SES);
Family SL Satellite Radio Interface (Release 1);
Part 1: General Specifications;
Sub-part 3: Satellite Radio Interface Overview

Reference

DTS/SES-00299-1-3

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document is part 1, sub-part 3 of a multi-part deliverable. Full details of the entire series can be found in ETSI TS 102 744-1-1 [i.6].

Modal verbs terminology

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Introduction

This multi-part deliverable (Release 1) defines a satellite radio interface that provides UMTS services to users of mobile terminals via geostationary (GEO) satellites in the frequency range 1 518,000 MHz to 1 559,000 MHz (downlink) and 1 626,500 MHz to 1 660,500 MHz and 1 668,000 MHz to 1 675,000 MHz (uplink).

1 Scope

The present document provides an overview of the Family SL radio interface between the Radio Network Controller (RNC) and the User Equipment (UE). The Family SL radio interface operates in spectrum allocated to mobile satellite services (see ETSI TS 102 744-2-1 [i.7], clauses 5.1.2 and 6.1.2).

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 102 744-1-4: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 4: Applicable External Specifications, Symbols and Abbreviations".

[2] ETSI TS 102 744-3-6: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 6: Adaptation Layer Operation".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 125 413: "Universal Mobile Telecommunications System (UMTS); UTRAN Iu interface Radio Access Network Application Part (RANAP) signalling (3GPP TS 25.413 Release 4)".

[i.2] ETSI TS 125 301: "Universal Mobile Telecommunications System (UMTS); Radio Interface Protocol Architecture (3GPP TS 25.301 Release 4)".

[i.3] ETSI TS 125 322: "Universal Mobile Telecommunications System (UMTS); Radio Link Control (RLC) protocol specification (3GPP TS 25.322 Release 4)".

[i.4] ETSI TS 124 007: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile radio interface signalling layer 3; General Aspects (3GPP TS 24.007 Release 4)".

[i.5] ETSI TS 124 008: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008 Release 4)".

[i.6] ETSI TS 102 744-1-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 1: Services and Architectures".

[i.7] ETSI TS 102 744-2-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 2: Physical Layer Specifications; Sub-part 1: Physical Layer Interface".

[i.8] ETSI TS 102 744-2-2: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 2: Physical Layer Specifications; Sub-part 2: Radio Transmission and Reception".

[i.9] ETSI TS 102 744-3-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 1: Bearer Control Layer Interface".

[i.10] ETSI TS 102 744-3-2: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 2: Bearer Control Layer Operation".

[i.11] ETSI TS 102 744-3-3: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 3: Bearer Connection Layer Interface".

[i.12] ETSI TS 102 744-3-4: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 4: Bearer Connection Layer Operation".

[i.13] ETSI TS 102 744-3-5: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 5: Adaptation Layer Interface".

[i.14] ETSI TS 102 744-3-7: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 7: NAS Layer Interface Extensions for MBMS Services".

[i.15] ETSI TS 102 744-3-8: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 8: NAS Layer and User Plane Operation for MBMS Services".

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the symbols given in ETSI TS 102 744-1-4 [1], clause 3 apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 744-1-4 [1], clause 3 apply.

4 Introduction

4.1 Radio interface layering

4.1.0 General

The satellite radio interface is carried over a satellite link and consists of the Non-Access Stratum and Access Stratum layers.

The Non-Access Stratum is essentially unchanged from the UMTS Non-Access Stratum, as defined in ETSI TS 124 007 [i.4] and ETSI TS 124 008 [i.5], with some functional extensions to support new services, as described in ETSI TS 102 744-3-7 [i.14] and ETSI TS 102 744-3-8 [i.15].

The Access Stratum of the satellite radio interface provides a set of services that directly support the UMTS Non-Access Stratum Control Plane entities (such as GMM and MM) and User Plane functions residing in the Core Network in the upper layers of the Mobile Terminal.

As such there are a number of requirements on the Access Stratum protocols to ensure that the attributes of the satellite link (high delay, variable error rate, aperiodic disruptions) are countered. The satellite Access Stratum is considered as a number of communication layers, as follows:

- Adaptation Layer (AL);
- Bearer Connection Layer (BCn);
- Bearer Control Layer (BCt); and
- Physical Layer (L1).

Each layer communicates with its peer, the layer above and the layer below. For each layer there are a set of protocol unit definitions which are used to communicate with the peer. In addition between each layer there are a set of interface definitions which provide the mechanisms for control and transfer of information. An overview of the main functions of each of the layers of the Access Stratum is described in the present document, with the detailed specifications for the different layers provided in the sub-parts shown in Table 4.1.

Table 4.1: Mapping of Family SL Access Stratum Layer to Part/Sub-part

Family SL Access Stratum Layer	Described in Sub-part
Adaptation Layer (AL)	ETSI TS 102 744-3-5 [i.13] ETSI TS 102 744-3-6 [2]
Bearer Connection Layer (BCn)	ETSI TS 102 744-3-3 [i.11] ETSI TS 102 744-3-4 [i.12]
Bearer Control Layer (BCt)	ETSI TS 102 744-3-1 [i.9] ETSI TS 102 744-3-2 [i.10]
Physical Layer (L1)	ETSI TS 102 744-2-1 [i.7] ETSI TS 102 744-2-2 [i.8]

4.1.1 Control plane protocol stack

The Control Plane of the protocol stack is shown in Figure 4.1. The Access Stratum and the Non-Access Stratum are separately indicated in the diagram. The parts of the protocol stack that are modified for the Family SL satellite link relative to the standard 3GPP protocols are described in ETSI TS 102 744-1-1 [i.6], clause 6.

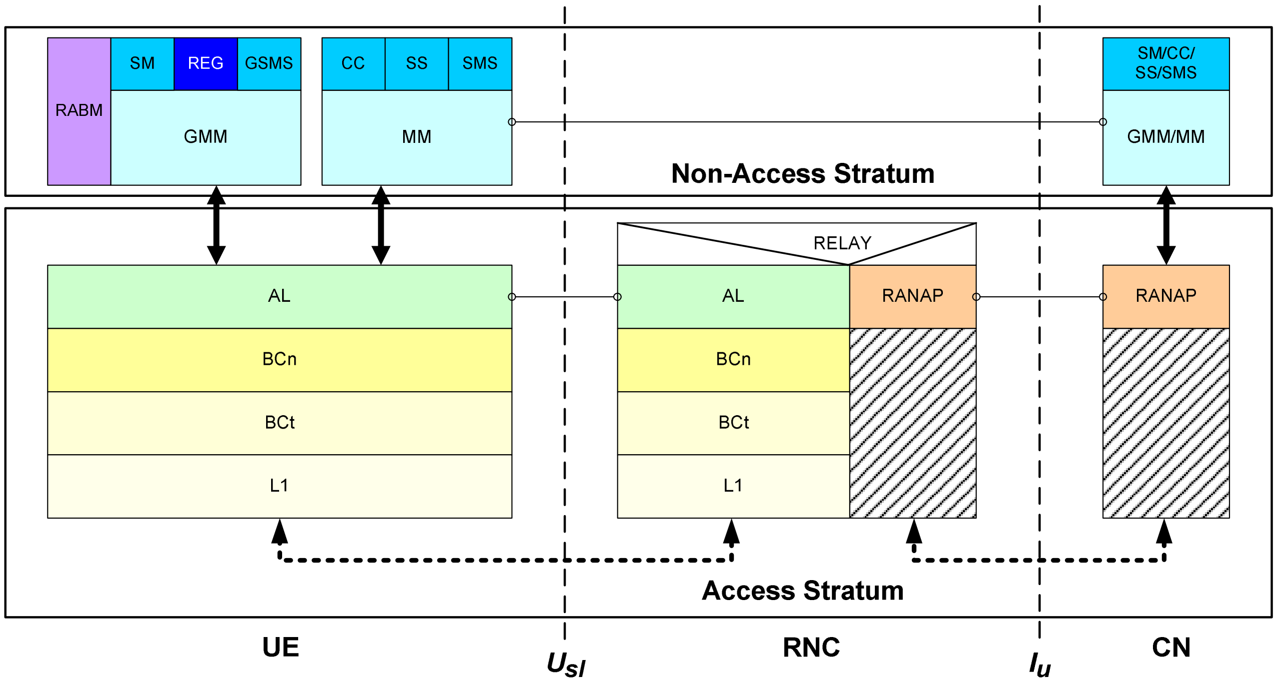

Figure 4.1: Control Plane Protocol Stack Layering

4.1.2 User plane protocol stack

The protocol stack for the User Plane of the Packet Switched Domain is shown in Figure 4.2.

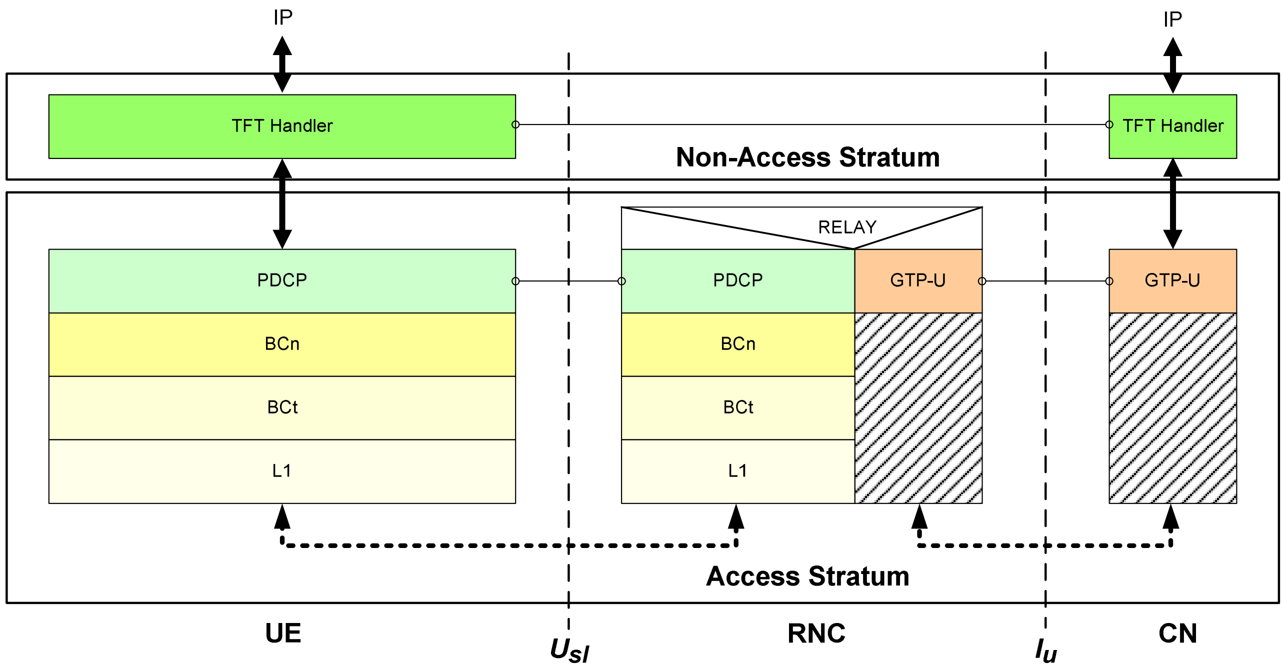

Figure 4.2: Packet Switched User Plane Protocol Stack Layering

For the Circuit Switched Domain, the lower layers (L1, BCt and BCn) of the protocol stack are identical, however, the PDCP and PPP/IP layers are replaced by the appropriate entity to provide Circuit Switched Services (e.g. Voice Codec or ISDN Interworking Function). Figure 4.3 illustrates the user plane protocol stack for the Circuit Switched domain.

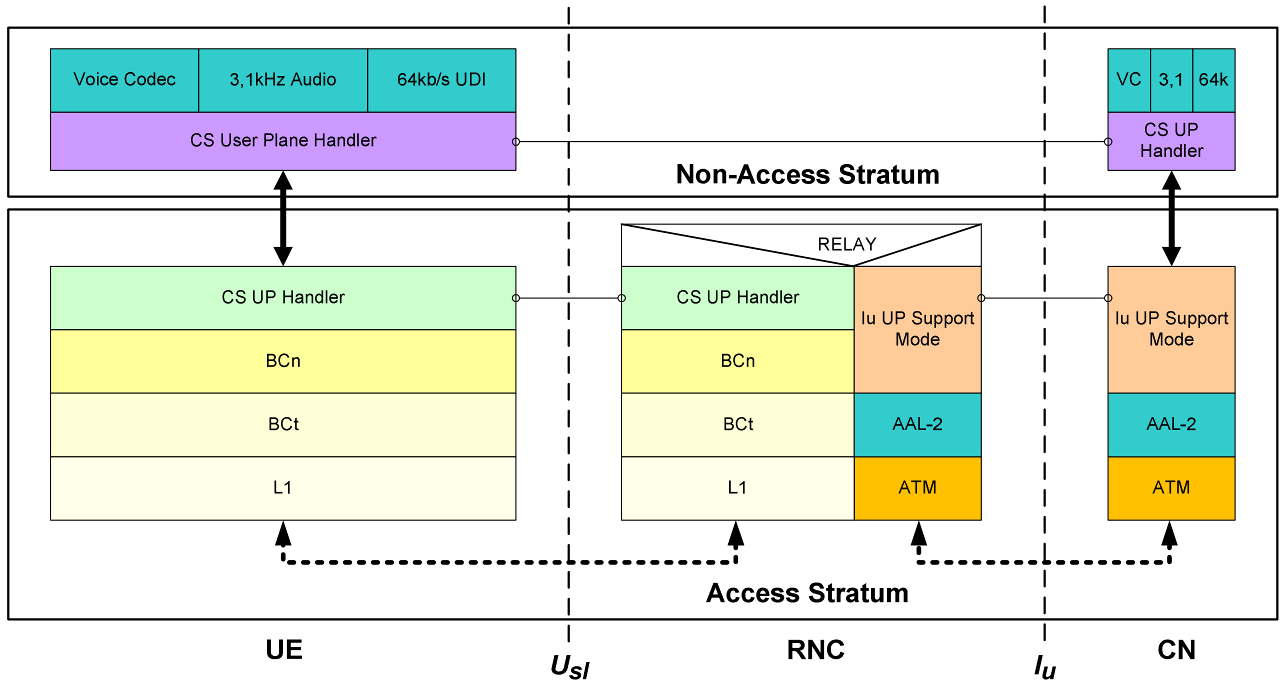

Figure 4.3: Circuit Switched User Plane Protocol Stack Layering

4.2 SDUs and PDUs

Each of the layers exchanges a set of Protocol Data Units (PDUs) with its peer using the capabilities of the lower layers to transport each PDU.

Each of the peer-layer entities exchanges a sequence of control messages called Signalling Data Units (SDUs) for the purpose of establishing, maintaining and terminating a connection. SDUs are always encapsulated within a Protocol Data Unit (PDU).

Each Protocol Data Unit may contain a higher layer PDU and/or one or more Signalling Data Units (SDUs). See Figures 4.4, 4.5 and 4.6.

Where a lower layer cannot support the transmission of the SDU or higher layer PDU, a layer may be required to segment the SDU or higher layer PDU into a sequence of PDUs. In this case each PDU in the sequence of PDUs transferred to the peer contains a segment of the SDU or higher layer PDU. At the peer, this sequence of PDUs is reassembled into the SDU or higher layer PDU before being processed or passed to the higher layer. This process is termed segmentation and reassembly. Only the Bearer Connection Layer supports segmentation and reassembly.

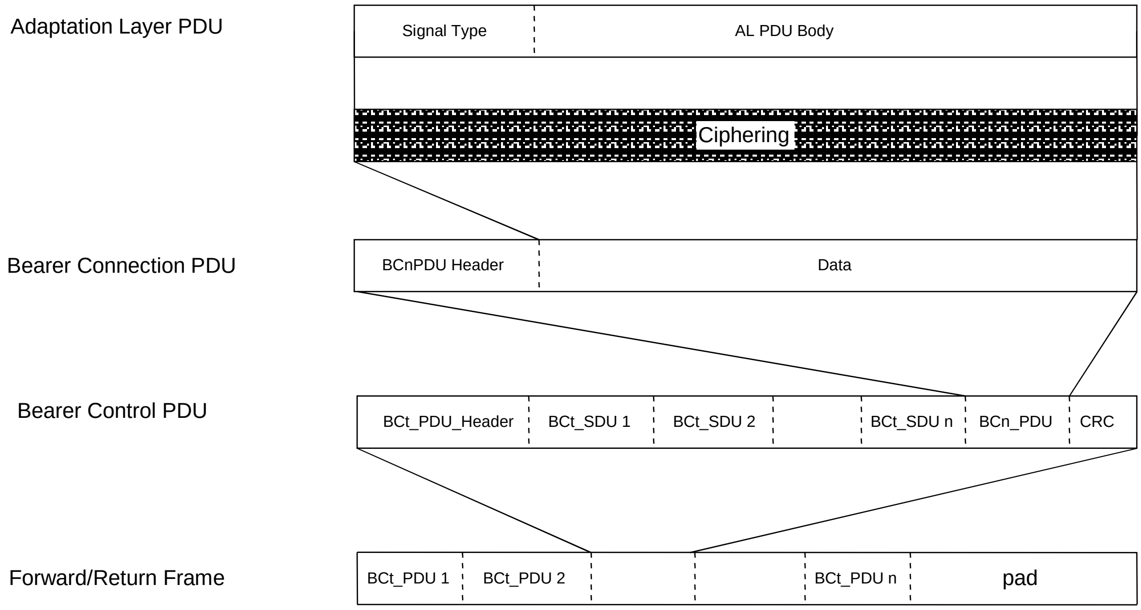

Figure 4.4: Adaptation Layer PDU Transmit Hierarchy (PDU Encapsulation) (Control Plane)

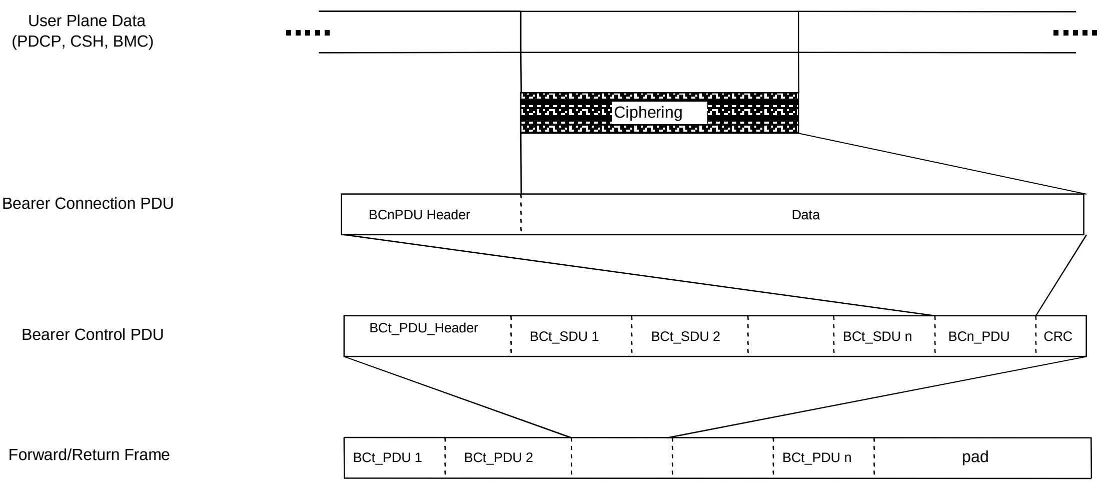

Figure 4.5: User Plane Data Transmit Hierarchy (PDU Encapsulation) (Acknowledged and Unacknowledged Modes)

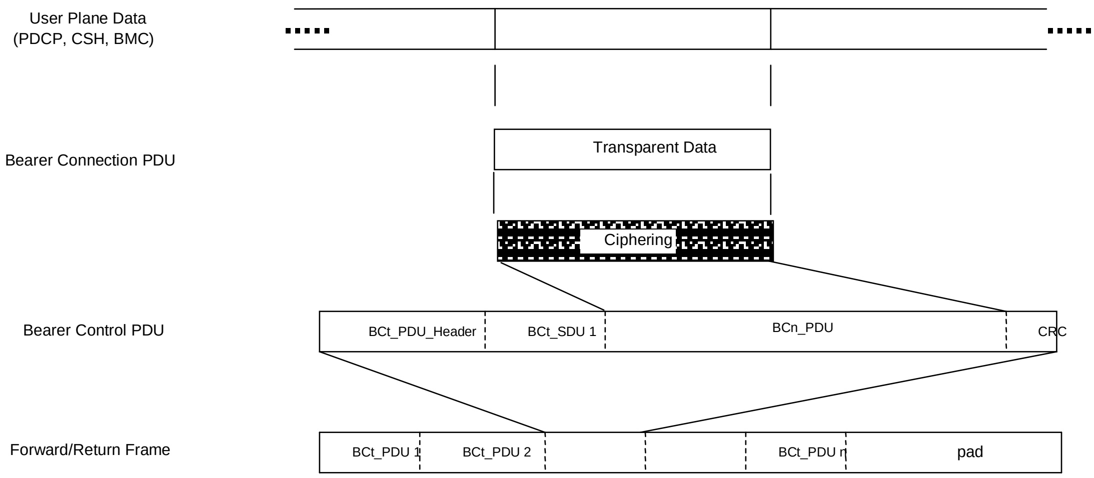

Figure 4.6: User Plane Data Transmit Hierarchy (PDU Encapsulation) (Transparent Mode)

5 Physical Layer

5.1 Shared Access Bearers

The Shared Access Bearers refer to specific physical bearers which support the transfer of data between the RNC and the UEs. Shared Access Bearers can support more than one connection at a time: the mechanisms for sharing of the resource involve a combination of techniques, where each individual packet transferred over a Shared Access Bearer has an address which allows the originator and destination of the information to be determined.

The configuration of the satellite network is such that the traffic is concentrated through a few Satellite Access Stations (SAS), whereby the control of the resources held by the RNC (within the SAS) and used to carry the traffic is also the responsibility of the RNC. Each RNC operates independently, and the network configuration can be considered to be a star configuration.

Channels in the forward direction are allocated on a Time-Division-Multiplex (TDM) basis, and in the return direction on a Time-Division-Multiple-Access basis. Due to the limitations of the channel allocation mechanisms and the capabilities of the UEs, channels are also limited in bandwidth, such that the resources are additionally operated in both directions on a Frequency-Division Multiple-Access (FDMA) basis. Each RNC manages a set of forward (RNS-to-UE) and return (UE-to-RNS) channels.

5.2 Physical Layer Roles

At the transmitter, the physical layer is responsible for the correct encoding, scrambling and interleaving of the frames or slots, and modulating and filtering the sequence of symbols and transmitting these at the correct frequency, time and power level.

At the receiver, the physical layer is responsible for the correct reception, filtering, demodulation, timing and power measurement of received bursts, and the subsequent decoding, frame-level descrambling and deinterleaving of the frames or slots as appropriate. The physical layer passes an entire frame or slot together with measurement information to the bearer control object responsible for managing it.

A number of different Physical Layer Bearer Types provide data rates in the range of 3,0 kbit/s to 858 kbit/s. These bearer types are used to maximize the performance over the satellite links and to achieve the data rates required to support the UMTS services.

5.3 Physical Layer Characteristics

5.3.1 Range of Bearer Types and Subtypes

The physical layer defines a range of bearer types; operating with a range of modulation schemes (as described below) in the forward and return directions.

In the forward direction, the following bearer types are available:

- QPSK bearer operating at a symbol rate of 8,4 kBd (for Global Beam Signalling only);
- QPSK bearers and 16-QAM bearer both operating at a symbol rate of 33,6 kBd;
- 16-QAM bearer operating at a symbol rate of 151,2 kBd;
- QPSK, 16-QAM, 32-QAM and 64-QAM bearers operating at a symbol rate of 84 kBd; and
- QPSK, 16-QAM, 32-QAM and 64-QAM bearers operating at a symbol rate of 168 kBd.

In the return direction, the following bearer types are available:

- π/4-QPSK bearers with symbol rates of 16,8 kBd, 33,6 kBd, 67,2 kBd and 151,2 kBd;
- 16-QAM bearers with symbol rates of 33,6 kBd, 67,2 kBd and 151,2 kBd;
- QPSK, 16-QAM, 32-QAM and 64-QAM bearers operating at a symbol rate of 84 kBd; and
- QPSK, 16-QAM, 32-QAM and 64-QAM bearers operating at a symbol rate of 168 kBd.

5.3.2 Variable Coding Rate

Each bearer type comprises a set of subtypes with a range of different coding rates. This is achieved by puncturing the turbo-code generated parity streams using one of a number of pre-defined puncturing matrices, such that each subtype has a different coding rate. The steps in the coding rate provide nominally 1dB steps in the C/No that is required to achieve the nominal burst error rate performance of less than or equal to 1E-03.

The bearer subtypes are used to adapt the coding rate to suit the prevailing radio channel conditions, so that the net user data rate can be optimized for a range of possible channel conditions, as described in clause 6.4.

NOTE: The signalling between the UE and the RNC allows combination of the modulation, the symbol rate and the coding rate to be selected to achieve optimum performance for different UEs and different conditions.

5.3.3 Unique Words

The coding rate used in each burst is signalled by the choice of unique word used for the burst. This allows each burst to be correctly demodulated and decoded without a-priori knowledge of the coding rate.

Distributed Unique Words are used on some return bursts to improve the performance of the synchronization algorithms in the presence of fast fading that typically occurs with aeronautical and land vehicular communication environments.

In the return direction, the Unique Words (or Distributed Unique Words) for the π/4-QPSK bearers are turbo-encoded to assist with identifying correct acquisition of bursts by the RNS.

6 Bearer Control Layer operation

6.1 Role of the Bearer Control Layer

The Bearer Control Layer is responsible for controlling the access to the physical layer (channel resource) for each of the connections which are established.

When User Equipment (UEs) transmit on the physical layer, the UE physical layer characteristics need to be continuously monitored, and corrected where necessary. The Bearer Control Layer is responsible for these low-level aspects of UE behaviour, which includes providing control and correction for:

- selection of the appropriate Primary Shared Access Bearer for initial access to the RNC;
- initial timing offset due to UE position;
- delta timing corrections due to UE or satellite movement;
- power and/or coding rate adjustments (link adaptation) of UE transmissions due to UE location relative to the satellite or power amplifier variations; and
- coding rate adjustments of transmissions from the RNC.

In addition, the Bearer Control Layer is responsible for ensuring fairness between connections, and managing the access to the physical layer, by providing the following for the connections which are operating:

- admission control;
- broadcast of system information;
- scheduling of resources in forward and return directions;
- packing and unpacking of packets into frames (including addressing of information);
- ciphering; and
- support for sleep mode operation.

The Bearer Control Layer also provides the transport for the System Information from the RNC to the UEs .

The Bearer Control Layer is also responsible for ensuring that an appropriate level of resource is maintained within the RNC. This involves the following:

- traffic monitoring and trend analysis;
- requesting and releasing physical and logical resources.

All of the above tasks are managed by a single component of the Bearer Control Layer - the Bearer Control process. Each Bearer Control process operates in a single spot beam and so, in order to support all spot beams, the number of Bearer Control processes shall be at least equal to the number of spot beams. There may be more than one Bearer Control processes for a particular spot beam.

UEs with multiple transmit/receivers may support multiple active Bearer Control processes or may be limited to a single active Bearer Control process.

The Bearer Control Layer supports the dynamic moving of connections between Bearer Control processes (handover).

6.2 Initial Timing Correction

The propagation path for the radio signals can differ in length considerably, owing to the variance in geographical locations of the UEs. To ensure that the UE transmissions do not interfere with each other, the radio interface provides a guard time between UE transmissions and the RNC provides timing correction information to each UE transmitter, relative to a reference at the RNC receiver. The Bearer Control Layer is responsible for monitoring and correcting timing errors.

Two methods of Initial Timing Correction are available for UEs:

GPS Assisted Initial Timing: In this case the UE calculates the correct transmission time based on its own position (available from a built-in GPS receiver) and the satellite position and then transmits an initial access burst accordingly.

RNC Assisted Initial Timing: If the accuracy of the GPS position is insufficient to support the method described above, the UE may transmit a initial random access burst during a period of time on the shared resource which has been allocated by the RNC for the purpose of random access communications from UEs without adequate timing information. On receiving such a transmission from a UE, the RNC measures the timing offset and return a timing correction command to the UE.

6.3 Subsequent Timing Corrections

Once the initial timing offsets have been corrected, the timing of transmissions from each individual UE is continuously monitored, and, when necessary, a differential correction mechanism is provided. A timing uncertainty rate may be provided to the UE by the RNC whenever timing correction information is provided. This allows the UE to determine a time when it may not have sufficiently accurate timing information to allow operation in a single allocated slot. Normally, if the UE is not transmitting, this inaccuracy is allowed to accumulate. If the timing uncertainty at the UE is greater than the specified guard time when the UE needs to communicate, it shall offset its transmission by the amount of the uncertainty, and select a sequence of time-slots in which random access communications may take place. The sequence of time-slots shall be sufficiently long to allow the uncertainty to be accommodated. The UE shall indicate within the transmission that it does not have timing information and this will cause the RNC to return an appropriate differential timing correction.

6.4 Coding Rate and Transmit Power Adjustments

The Bearer Control Layer uses coding rate and/or transmit power adjustments to maintain the packet error rate (PER) of both the forward and return links at a level appropriate to maintain the QoS of each connection. This uses a link adaptation function in the Bearer Control Layer, which evaluates the signal-to-noise ratio of the received signal, communicates it back to its peer entity, which in turn adjusts the coding rate and/or the transmitted power level accordingly.

NOTE: This link adaptation is designed to track long-term channel variations by adjusting the power and coding rate accordingly. Discrete events and short-term fading are covered by the fading margin in the link budgets.

In the return direction, the RNC measures the carrier-to-noise density ratio (C/No) of each received return burst and averages this over a configurable number of bursts. Based upon the burst type, subtype and UE class, the RNC calculates a link margin and signals this to the UE as a set of control parameters. These parameters do not directly define a single bearer subtype, but point to a set of useable bearer subtypes on all the return bearer types. The UE is then allowed to trade off transmit power vs. coding rate: e.g. to select a lower transmit power plus lower coding rate to conserve battery power and/or a higher transmit power plus higher coding rate to provide a higher net data rate to the user. This feature is controllable from the RNC.

In the forward direction, the UE measures the C/No on the forward link, averages this over a configurable number of frames and reports the results to the RNC. The forward link bearers are transmitted with a constant (but configurable) power level. However, the coding rate of the individual FEC-blocks is selected individually by the RNC to optimize the usage of the bearer while maintaining the appropriate QoS for each UE. The first FEC block (which typically contains broadcast signalling information) in each forward frame is always coded so that the least capable UE can decode it; but the coding rate for the subsequent FEC-blocks depends on the reported C/No observed by the specific UEs using that portion of the forward frame.

6.5 Admission Control

Admission control is the process of determining whether sufficient resources exist at the RNC to allow a new connection to be accepted. Whenever a connection is requested, the quality of service parameters for the connection is used to determine whether the aggregate Quality of Service commitments would exceed a threshold specified by the RNC operator. The threshold is a function of the number of and type of the bearers over which the traffic is being distributed, and is therefore calculated independently for each spot-beam. In line with the UMTS Quality of Service classification Conversational, Interactive, Streaming and Background Classes are supported.

6.6 Scheduling

Scheduling is the process of allocating resources to each connection being serviced on the set of bearers being managed by the RNC. The scheduling process is driven primarily by the connection Quality of Service parameters, together with information about the state of the queues for each connection being serviced.

Depending upon the class of connection specified during admission control, and the range of Quality of Service parameters specified for a particular connection, the connection may be allocated resources on a continuous basis. In addition, the queue status (which includes the delivery times necessary to meet the desired latency figures) of each connection which has data waiting to be transferred is used to determine the priority of servicing each connection. Delivery time information for the data held in the queue is transferred within the queue status.

6.7 Packing and Unpacking of Bearer Control PDUs

The Bearer Control process is responsible for creating the frame or slot structure necessary for transmission on the physical layer, including calculation of Cyclic Redundancy Check (CRC) bits, and specifying the timing for transmission to the hardware. In addition, the Bearer Control process is responsible for checking the CRC bits at the receiver and decoding the received frames or slots.

6.8 Ciphering

The Bearer Control Layer carries out the ciphering and de-ciphering of PDUs in Transparent Mode only.

6.9 Support for Sleep Mode

The Bearer Control process is responsible for managing the sleep-mode operation of UEs. This involves transmission of sleep-mode parameters during registration, and the control of transmission of signalling and control information to UEs which are operating in sleep-mode. The sleep-mode parameters being used by a UE may be modified by the RNC whenever the UE is in an "active" or "on" state.

NOTE: This typically takes place if a particular connection is being initiated where the connection QoS is incompatible with the sleep mode interval previously specified.

6.10 Different UE Classes

The Bearer Control Layer is responsible for support of UEs which have different capabilities. A set of UE classes are defined (see ETSI TS 102 744-2-2 [i.8]), which are primarily differentiated based on the antenna size, available transmitter EIRP and receiver G/T. Furthermore, the types of physical bearers may be restricted for some UE classes.

6.11 Transmission of System Information

The Bearer Control Layer is also responsible for the transmission of System Information. System Information can be grouped into:

- Non-Access Stratum (NAS) System Information relevant to UMTS Layer 3 such as Location and Routing Area Codes, Network Mode of Operation and Attach Flag.

- Access Stratum (AS) System Information relevant to the Adaptation Layer such as Access Control, PLMN ID, Common Signalling Retry, Spot Beam Maps and Primary Bearer.

- Bearer Control System Information relevant to the Bearer Control and Physical Layers such as Satellite Position and State Vectors, Bearer Tables, Return Bearer Type and Initial Random Access Burst, etc.

All System Information is carried by the Bearer Control Layer as Bearer Control Signalling Data Units (BCtSDUs) and/or Attribute Value Pairs (AVPs) inside BCtSDUs.

7 Bearer Connection Layer operation

7.1 Role of the Bearer Connection Layer

The Bearer Connection Layer performs a number of functions:

- buffering and flow control of information from the interface to the layer above;
- QoS policing (shaping of information streams where required);
- segmentation and reassembly of information;
- Automatic Repeat Request (ARQ) (if required for the particular connection); and
- ciphering.

In summary, the Bearer Connection Layer provides functions and services which are similar to those provided by the UTRAN Radio Link Control (RLC) Layer (see ETSI TS 125 301 [i.2]). The Bearer Connection Layer provides Acknowledged Mode (AM), Unacknowledged Mode (UM) and Transparent Mode (TM) Connections, which are equivalent to the RLC modes defined in ETSI TS 125 322 [i.3].

7.2 Buffering and Flow Control

The Bearer Connection Layer contains an input buffer for the Protocol Data Units (PDUs) from the layer above (Adaptation Layer, PDCP Layer or an entity in the Circuit Switched Domain e.g. voice codec).

A header is added to each PDU that allow signalling and data to be discriminated and is also used to transmit additional information, such as total PDU length, when a PDU is transmitted using multiple segments. The PDU length information assists with the detection of missing segments for connections where ARQ is not supported, and also assists with detection of PDUs which may have been discarded from a transmit window buffer in the Bearer Connection Layer peer.

When the data in the input buffer approaches the maximum buffer size, the Bearer Connection Layer is responsible for asserting flow-control to the layer above. The information held in the transmit buffer may have a maximum lifetime - this is termed a "discard latency" which may be specified separately for each connection. If the information remains in the buffer for a period longer than the discard latency then it is removed from the buffer and discarded. This behaviour is specifiable within the Quality of Service parameters and protects against certain error situations where information may be retransmitted by a higher layer protocol.

7.3 QoS Policing

Each Connection is established with a certain set of Quality of Service (QoS) parameters (which may be the default set). Every PDU which is received from the layer above is tagged with a required delivery time (and other information used for local management) which should be achieved in order to meet the QoS commitments for the connection.

This function also incorporates flow shaping algorithms, to prevent any connection from competing for resources at a rate higher than that specified during connection establishment. In the event that information is submitted to the Bearer Connection Layer at a rate higher than that requested, the Bearer Connection Layer may service the connection at a higher rate only if resources exist within the network which would otherwise not be utilized. Alternatively, if as a result of a connection submitting data at a higher rate than negotiated, the queue size for that connection within the Bearer Connection Layer increases, the Bearer Connection Layer flow controls the source, and possibly discards data. Data may be discarded within the Bearer Connection Layer if either the source does not respond to the flow-control request and local buffer resources becoming insufficient, or if the discard latency is reached.

7.4 Segmentation and Reassembly

The Bearer Connection Layer can transfer large PDCP layer PDUs (maximum of 2 047 octets). These larger PDUs do not fit within the transmit frame size of any particular shared access bearer, and the PDUs therefore need to be segmented by the transmitting connection layer process, and reassembled within the receiving connection layer process. For connections where it is important to detect missing segments, or where segments may be delivered out-of-order by the bearer control, each segment transmitted by the Bearer Connection Layer may have a sequence number associated with it, where the sequence number is used to reassemble the PDU correctly and detect missing segments. Sequence numbering may be deselected for particular service types, depending upon the capabilities of the specific Bearer Control Layer.

7.5 ARQ

The Bearer Connection Layer supports an optional ARQ mechanism to provide reliable transmission, whereby information is delivered error-free and in-sequence. The ARQ selectively requests retransmission of particular segments which are errored or otherwise missing from the received information stream. The ARQ mechanisms are described in detail in ETSI TS 102 744-3-4 [i.12].

7.6 Ciphering

The Bearer Connection Layer also carries out the ciphering and de-ciphering of PDUs in Acknowledged Mode and Unacknowledged Mode (i.e. the non-transparent modes). Ciphering is controlled by the Adaptation Layer.

7.7 Connection QoS Parameters

Each connection is associated with a set of QoS parameters , which include the following:

- Rate Parameters: Mean Rate and Peak Rate;
- Delay Parameters: Target Latency and Discard Latency; and
- Connection Type and Priority.

NOTE: The Connection QoS parameters are distinct from the UMTS QoS RAB Parameters specified in [i.1]. However, a mapping between these two sets is performed in the RNC.

The QoS parameters determine the resources which need to be committed within the Bearer Control Layer to support the connection. This allows the network to have a degree of resilience to variations in the traffic characteristics of a particular application, and keeps the network efficiency as high as possible.

7.8 Connection types

Each connection has a specific type, with point-point connections being characterized as either non-ARQ or ARQ. Connections with ARQ require additional overhead, and shall only forward information when it has been completely received. Connections which do not operate an ARQ mechanism may be configured to discard incomplete or out-of-sequence PDUs, or forward the information to the layer above regardless. Point-Multipoint connections are unable to support ARQ, but may support the retransmission of information within a connection to improve the information error rate - this form of connection requires the provision of sequence numbering within the Bearer Connection Layer although an ARQ mechanism is not implemented.

8 Adaptation Layer operation

8.1 Role of the Adaptation Layer

The Adaptation Layer is responsible for the following:

- Registration Management: responsible for spot beam selection, system information handling, NAS system information notification, performs registration and deregistration procedures (with RAN), control of ciphering for the UE specific signalling connection, integrity protection, and GPS position encryption and reporting.

- GMM Handling: providing RRC-like services to the GPRS Mobility Management (GMM) in the Non-Access Stratum - as a transparent conduit for Layer 3 GMM messages including integrity protection.

- MM Handling: same as GMM Handling but providing services to Mobility Management (MM) to the Circuit Switched Domain in the Non-Access Stratum.

- Radio Bearer Control: handling signalling related to setup, modification, and release of radio bearers, control of ciphering, configuring user plane protocol layers and entities and notifying NAS entities of resource assignments.

In summary, the Adaptation Layer provides functions similar to those provided by the UTRAN Radio Resource Control (RRC) Layer to the extent that it is relevant to the satellite radio interface. Further details on the function and operation of the Adaptation Layer can be found in ETSI TS 102 744-3-6 [2], clause 4.

History

Document history		
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