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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

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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 3, sub-part 4 of a multi-part deliverable. Full details of the entire series can be found in ETSI TS 102 744-1-1 [i.1].

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 defines the Bearer Connection Layer operation of the Family SL satellite radio interface between the Radio Network Controller (RNC) and the User Equipment (UE) used in the satellite network. The Bearer Connection Layer (BCn) peer-to-peer interface is described in ETSI TS 102 744-3-3 [9].

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.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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

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

[2] ETSI TS 133 102: "Universal Mobile Telecommunications System (UMTS); 3G security; Security architecture (3GPP TS 33.102 Release 4)".

[3] ETSI TS 133 105: "Universal Mobile Telecommunications System (UMTS); Cryptographic algorithm requirements (3GPP TS 33.105 Release 4)".

[4] ETSI TS 135 201: "Universal Mobile Telecommunications System (UMTS); Specification of the 3GPP confidentiality and integrity algorithms; Document 1: f8 and f9 specifications (3GPP TS 35.201 Release 4)".

[5] ETSI TS 102 744-1-3: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 3: Satellite Radio Interface Overview".

[6] 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".

[7] 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".

[8] 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".

[9] 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".

[10] 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".

[11] 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

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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 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".

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the symbols given in ETSI TS 102 744-1-4 [6], clause 3 apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 744-1-4 [6], clause 3 apply.

4 General Architecture

4.0 Overview

The function of the satellite radio interface Bearer Connection Layer (BCn) is to provide a number of different data transport services to upper layers. Figure 4.1 illustrates the position of the Bearer Connection Layer within the Family SL air interface protocol stack. An overview of the radio interface layering and relationship to the Bearer Control Layer is provided in ETSI TS 102 744-1-3 [5], clause 4 and ETSI TS 102 744-3-3 [9], clause 4. An overview of the Bearer Connection Layer operation is provided in ETSI TS 102 744-1-3 [5], clause 6.

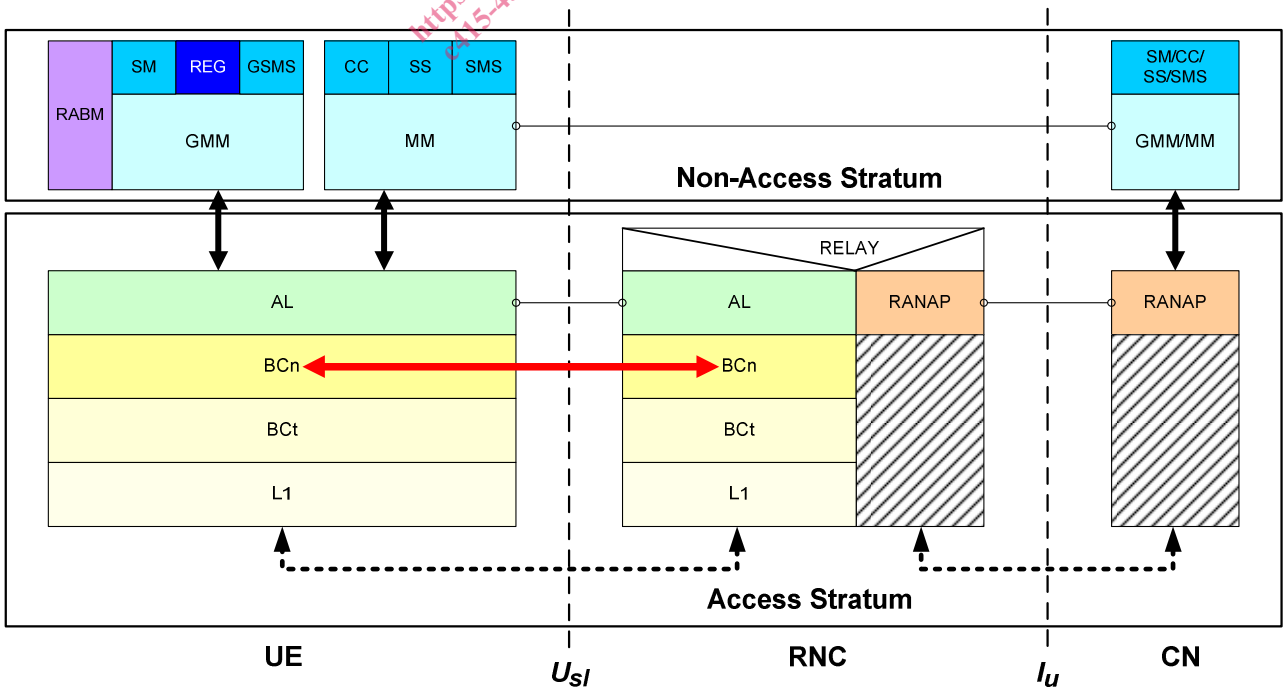

Figure 4.1: Bearer Connection Layer Position in Protocol Stack (Control Plane Illustrated)

The Bearer Connection Layer is generic to the radio interface and is responsible for the following:

- Queuing;
- QoS Policing;
- QoS Monitoring;
- Segmentation and Re-assembly;
- Ciphering; and
- Selectable ARQ.

The data transport services provided by the Bearer Connection Layer are used to carry signalling and data PDUs across the satellite radio interface. Three main data transport modes are supported:

- Acknowledged Mode (AM)
- Transparent Mode (TM)
- Unacknowledged (Numbered Frame) Mode (UM)

These are provided to the upper layers via a number of different service access points (SAP). The control plane and user plane architecture of the Bearer Connection Layer is illustrated in Figure 4.2 and Figure 4.3 respectively.

The following clauses describe the Bearer Connection Layer SAP primitives for the upper interface to the Adaptation Layer. The SAP primitives for the lower interface to the Bearer Control Layer are described in ETSI TS 102 744-3-2 [8].

4.1 Bearer Connection Layer Entities

4.1.0 General

The Bearer Connection Layer consists of a Bearer Connection Manager and instances of one of four possible data handlers (COM_DH, AM_DH, NUM_DH and TM_DH) with their associated Service Access Points (SAPs).

The Control Plane of each UE consists of an AM_DH for the UE Specific Signalling connection, a COM_DH for managing the Common Signalling connection and a Bearer Connection Manager. On the RNC side, the Control Plane consists of multiple sets of AM_DH and Bearer Connection Manager entities, one for each UE registered. It also has a COM_DH for each of the Primary Shared Access Bearer.

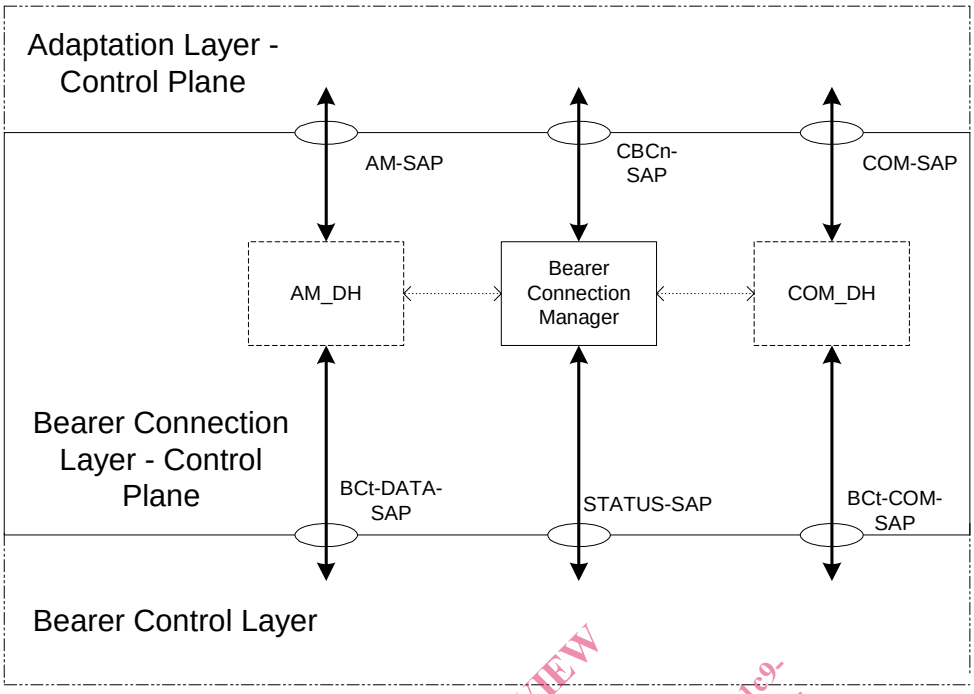

Figure 4.2: Bearer Connection Layer - Control Plane

The User Plane of each UE consists of a Bearer Connection Manager and one data handler (either TM_DH, NUM_DH or AM_DH) for each data connection that is set up. On the RNC side, the User Plane consists of multiple sets of these entities, one for each UE registered.

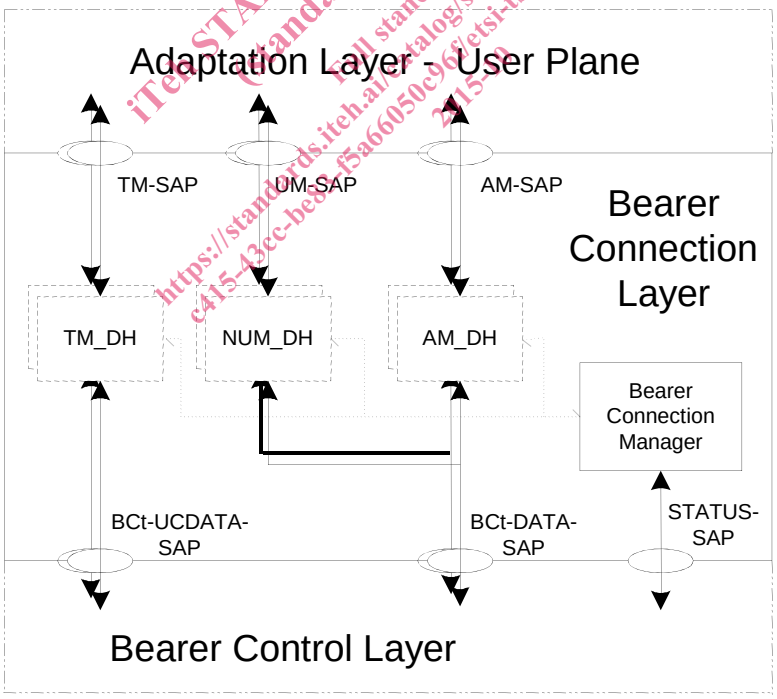

Figure 4.3: Bearer Connection Layer - User Plane

4.1.1 Bearer Connection Manager (BCnM)

The Bearer Connection Manager (BCnM) provides bearer connection management services to the Adaptation Layer via the CBCn-SAP. This includes the creation and removal of a particular connection, and the setting of its QoS parameters.

Four data handlers are supported by the Bearer Connection Layer:

- Acknowledged Mode Data Handler (AM_DH)
- Transparent Mode Data Handler (TM_DH)
- Numbered Frame Data Handler (NUM_DH)
- Common Signalling Data Handler (COM_DH)

These shall be created by the BCnM based on the requests received from the Adaptation Layer.

4.1.2 Acknowledged Mode Data Handler (AM_DH)

The Acknowledged Mode Data Handler shall be created when a reliable delivery message transport is required e.g. for packet data and signalling connections. In the control plane, it is used to transport UE Specific Signalling (UESS) messages from the Adaptation Layer (AL). Note that the SIG-SAP as defined in the Adaptation Layer (see ETSI TS 102 744-3-6 [11]) is an instance of the AM-SAP.

Reliable delivery of data is provided by the AM_DH using an ARQ mechanism. It can also guarantee the ordered delivery of packets and provide ciphering of data packets. The ciphered data Protocol Data Unit (PDU) is sent to the Bearer Control Layer via the BCt-DATA-SAP. Queue status in the AM_DH is reported to the Bearer Control Layer by the BCnM via the STATUS-SAP.

4.1.3 Transparent Mode Data Handler (TM_DH)

The transparent mode data handler (TM_DH) is created when a transparent data link is requested. This is primarily used to support circuit switched (CS) traffic. In transparent mode, no connection layer overhead is added to the data arriving from the layer above.

Data coming from the higher layer via the TM-SAP is buffered by the TM_DH before forwarding to the Bearer Control Layer. No ciphering is performed at the connection layer and the data is sent to the Bearer Control Layer via the BCt-UCDATA-SAP. The size of the buffer in TM_DH is always reported to the Bearer Control Layer by the BCnM via the STATUS-SAP.

4.1.4 Numbered Frame Data Handler (NUM_DH)

For Un-Acknowledged Mode data coming from the layer above via the UM-SAP, a Numbered Frame Data Handler (NUM_DH) shall be used. The NUM_DH provides in-sequence delivery, segmentation and re-assembly, and ciphering of data. However, packet delivery is not guaranteed. The ciphered data PDUs are sent to the Bearer Control Layer via the BCt-DATA-SAP.

4.1.5 Common Signalling Data Handler (COM_DH)

The Common Signalling Data Handler exists only in the control plane of the Bearer Connection Layer. This handler provides buffering for Common Signalling messages from the Adaptation Layer. It also supports the reporting of STATUS information via the STATUS-SAP to the control layer. No Ciphering is required for Common Signalling messages in the Connection Layer.

4.2 Interfaces to Upper Layers

4.2.1 User Plane Interfaces

4.2.1.0 General

Three SAPs (AM-SAP, UM-SAP and TM-SAP) are defined between the Bearer Connection Layer and the upper layers in the user plane. Their definitions are based on [1]. The primitives and parameters used are summarized below.

4.2.1.1 Acknowledged Mode (AM)-SAP Primitives and Parameters

Three primitives are defined for the AM-SAP, as shown in Table 4.1.

Table 4.1: Primitives at the AM-SAP

Primitive Name	Direction	Parameters
BCn_AM_DATA_REQ	To BCn Layer	Data-PDU, PDCP-Info, CNF, DiscardReq, MUI, BcnID, [Unsegmentable], [SUSP]
BCn_AM_DATA_IND	From BCn Layer	Data-PDU, PDCP-Info, DiscardInfo
BCn_AM_DATA_CNF	From BCn Layer	Status, MUI

The BCn_AM_DATA_REQ primitive is used by the higher layer to request transmission of a data PDU.

The BCn_AM_DATA_IND primitive is used by the BCn AM_DH to deliver a PDU to the higher layer entity.

The BCn_AM_DATA_CNF primitive is used by the BCn AM_DH to confirm to the higher layer entity that a data PDU has been successfully transmitted to the peer AM_DH, or to inform it that a data PDU has been discarded. The definitions of the parameters are as follows:

Data-PDU This is the higher layer data packet that is transferred.

PDCPInfo Optional parameter used by PDCP to transfer up to 5 bits of information to the peer PDCP entity.

CNF Confirmation Request, specifies whether higher layer requires confirmation of delivery of the PDU.

DiscardReq Indicates whether the higher layer requires notification when the PDU is discarded.

MUI Message Unit ID, identifies the higher layer PDU that is being confirmed or discarded.

BcnID Bearer Connection ID, used to identify the Bearer Connection used.

DiscardInfo Indicates to the higher layer that a PDU has been discarded. It is applicable only when in-sequence delivery is configured and it is to be used when the higher layer requires reliable data transfer.

Status Indicates whether a higher layer PDU is successfully transmitted or discarded.

Unsegmentable Optional parameter, indicating the fixed segment size to be used when transmitting this PDU.

SUSP Optional parameter used by the UESS AM_DH when in the suspended state, see clause 5.3.1.4.

4.2.1.2 Transparent Mode (TM) SAP Primitives and Parameters

Three primitives are defined for the transparent mode TM-SAP, as shown in Table 4.2.

Table 4.2: Primitives at the TM-SAP

Primitive Name	Direction	Parameters
BCn_TM_DATA_REQ	To BCn Layer	Data-PDU, DiscardReq, MUI, BcnID, [Unsegmentable]
BCn_TM_DATA_IND	From BCn Layer	Data-PDU, Err_ind
BCn_TM_DATA_CNF	From BCn Layer	MUI

The BCn_TM_DATA_REQ primitive is used by the higher layer to request transmission of a data PDU in transparent mode.

The BCn_TM_DATA_IND primitive is used by the BCn TM_DH to deliver to the higher layer a PDU that has been transmitted in transparent mode.

The BCn_TM_DATA_CNF primitive is used by the BCn TM_DH to inform the higher layer of a discarded data PDU.

The parameter definitions are the same as in AM-SAP, with the following addition:

Err_ind Error indicator, indicates that the PDU is erroneous. This is used to support the "delivery of Erroneous PDU" mode of operation.

4.2.1.3 Unacknowledged Mode (UM) SAP Primitives and Parameters

Three primitives are defined for the UM-SAP, as shown in Table 4.3.

Table 4.3: Primitives at the UM-SAP

Primitive Name	Direction	Parameters
BCn_UM_DATA_REQ	To BCn Layer	Data-PDU, PDCP-info, DiscardReq, MUI, BcnID, [Unsegmentable]
BCn_UM_DATA_IND	From BCn Layer	Data-PDU, PDCP-info
BCn_UM_DATA_CNF	From BCn Layer	MUI

The BCn_UM_DATA_REQ primitive is used by the higher layer to request transmission of a data PDU in un-acknowledged mode.

The BCn_UM_DATA_IND primitive is used by the BCn NUM_DH to deliver to the higher layer a PDU that has been transmitted in un-acknowledged mode.

The BCn_UM_DATA_CNF primitive is used by the BCn NUM_DH to confirm to the higher layer of a discarded data PDU.

The parameter definitions are the same as in AM-SAP.

4.2.2 Control Plane Interfaces

4.2.2.0 General

In the Control Plane, the Bearer Connection Layer interfaces to the Adaptation Layer above. Three SAPs are used in the control plane, namely AM-SAP, CBCn-SAP and COM-SAP.

The AM-SAP in the control plane is used for transporting UE specific signalling messages between Adaptation Layer peers. The Adaptation Layer SIG-SAP is an instance of AM-SAP and carries the same definitions (see clause 4.2.1.1) except that it is connected to the AL instead of the PDCP Layer in the User Plane.

4.2.2.1 CBCn-SAP Primitives and Parameters

The CBCn-SAP is used for the exchange of control messages between the Bearer Connection Layer and the Adaptation Layer. The following primitives are defined for the CBCn-SAP, as shown in Tables 4.4 to 4.6.

Table 4.4: Primitives at the CBCn-SAP common to UE and RNC

Primitive Name	Direction	Parameters
CBCn_CREATE_REJ	To AL	ALPD, BcnID, Rejection Cause
CBCn_MODIFY_REJ	To AL	ALPD, BcnID, Rejection Cause
CBCn_DESTROY_REQ	To BCn layer	ALPD, SEQUENCE OF {BcnID(SIG-SAP / DATA-SAP)}
CBCn_DESTROY_CNF	To AL	ALPD, SEQUENCE OF {BcnID}
CBCn_SECURITY_REQ	To BCn layer	ALPD, Mode (Start / Modify), CK, START, SEQUENCE OF {BcnID, UL Activation Time, DL Activation Time}
CBCn_SECURITY_CNF	To AL	ALPD, SEQUENCE OF {BcnID}
CBCn_FAILURE_IND	To AL	ALPD, BcnID, Failure Cause
CBCn_SUSPEND_REQ	To BCn layer	ALPD, SEQUENCE OF {BcnID}
CBCn_SUSPEND_CNF	To AL	ALPD, SEQUENCE OF {BcnID, Next BCn Send Sequence Number / Frame Number}
CBCn_SUSPEND_REJ	To AL	ALPD, SEQUENCE OF {BcnID}, Rejection Cause
CBCn_RESUME_REQ	To BCn	ALPD, SEQUENCE OF {BcnID}
CBCn_RESUME_CNF	To AL	ALPD, SEQUENCE OF {BcnID}