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Satellite Earth Stations and Systems (SES);
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Part 3: Control Plane and User Plane Specifications;
Sub-part 3: Bearer Connection Layer Interface

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Contents

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

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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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 (BCn) peer-to-peer interface of the Family SL satellite radio interface between the Radio Network Controller (RNC) and the User Equipment (UE) used in the satellite network.

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.

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 necessary for the application of the present document.

[1] 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".

[2] 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".

[3] 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".

[4] 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".

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 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 744-1-4 [2], clause 3 apply.

4 Bearer Connection Interface

4.1 Radio Interface Layering

As described in ETSI TS 102 744-1-3 [1], the satellite communication protocol is considered as a number of communication layers, as follows:

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

The satellite radio interface protocol stack is designed to seamlessly integrate with UMTS Non-Access Stratum entities, such as GPRS Mobility Management (GMM) and Mobility Management (MM), residing in the Core Network (CN) and in the upper layers of the User Equipment (UE).

The Bearer Connection Layer provides support to the Adaptation Layer, and uses the services provided by the Bearer Control Layer, as shown in Figure 4.1. The present document defines the Bearer Connection Layer peer-to-peer interface between the Radio Network Controller (RNC) and the UE, as shown in Figure 4.1.

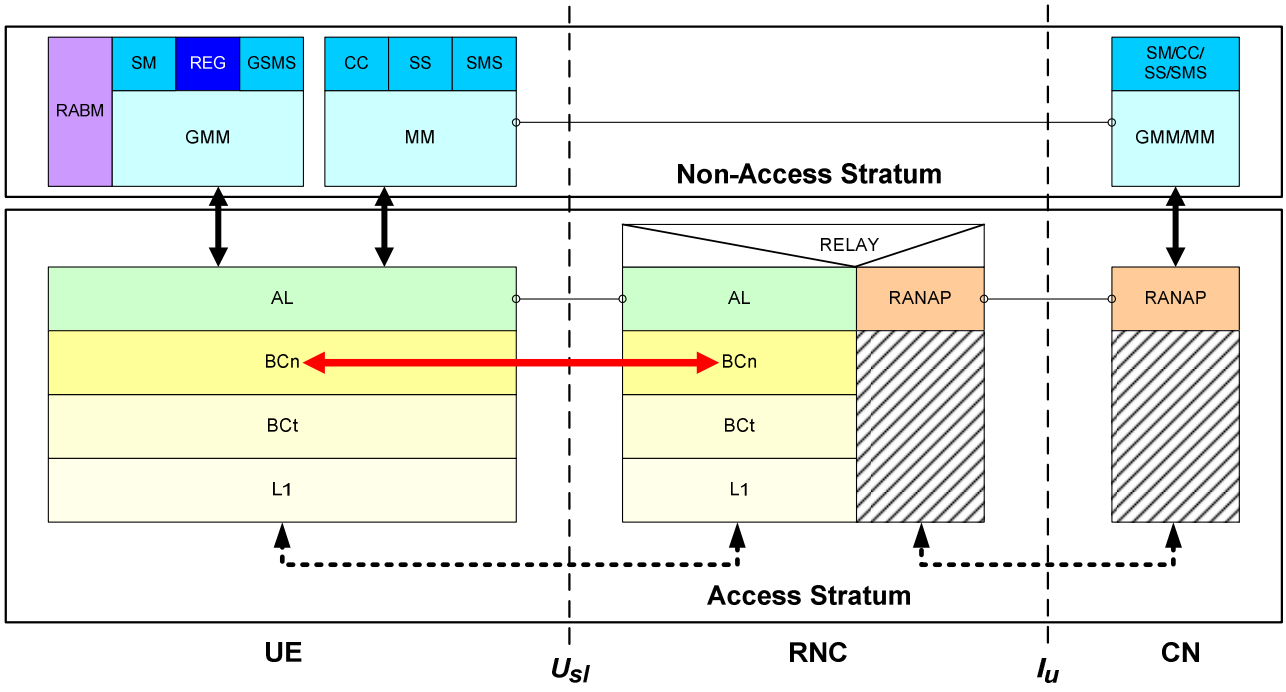

Figure 4.1: Control Plane Protocol Stack Layering (Bearer Connection Layer interface highlighted)

4.2 Bearer Connection Layer Responsibilities

The function of the satellite radio interface Bearer Connection Layer is to provide a number of different data transport services to upper layers. 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 functionality of the Bearer Connection Layer is therefore similar to that of the Radio Link Control (RLC) layer in UTRAN (UMTS Terrestrial Radio Access Network).

The Bearer Connection layer peer-peer interface definitions are described in the present document.

4.3 Bearer Connection Layer Overview

4.3.0 General

The Bearer Connection Layer performs peer-peer signalling via Bearer Connection Layer PDUs. The Bearer Connection Layer signalling mechanisms introduce an overhead on the layer above. This overhead is kept to a minimum.

4.3.1 Bearer Connection Layer PDUs

When registration is complete, and whenever a User Plane Connection is established, a Bearer Connection process is established which operates an HDLC-derived mechanism for support of the transfer of information between the RNC and the UE. This mechanism introduces an overhead to each User Plane Protocol Data Unit (PDU) or UE-Specific Signalling PDU transferred over the satellite. The overhead varies depending upon the number of segments required to transfer the payload, but is kept to a minimum where possible. When operating the ARQ protocol, the Bearer Connection process needs to signal to the peer to indicate the number of segments received/missing. This signalling is described within clause 5.1, Bearer Connection Layer PDU.

4.3.2 Bearer Connections

A Bearer Connection is a specific logical connection being handled by the Bearer Connection Layer, and this term is used to refer to the logical connection. Each Bearer Connection has an associated Bearer Connection ID, and has a single Bearer Connection process within the Bearer Connection Layer at both RNC and UE which handles the Bearer Connection. Note that for the case of a point-to-multi-point Bearer Connection, there is a single Bearer Connection process at the RNC and a single Bearer Connection process at each 'attached' UE.

4.3.3 Ciphering

For Bearer Connections operating in Acknowledged Mode (AM) or Unacknowledged Mode (UM), ciphering is also performed in the Bearer Connection Layer. Ciphering may be applied to the data segment of Information PDUs (see Figure 5.2) and Numbered PDUs (see Figure 5.6). A detailed description of how ciphering is performed in the Bearer Connection Layer can be found in ETSI TS 102 744-3-4 [4].

4.4 Conventions used in the present document

4.4.1 Presentation

The following conventions are applied throughout the present document:

- In the ASN.1 notation, variable names are always in lower case letters with hyphenation used to improve readability (e.g. ret-bct-pdu-header). Data Types in the ASN.1 always start with an upper case letter and may contain additional upper case letters to improve readability (e.g. ReturnBCtPDUHeader).
- In the explanatory text, these variables are referred to in italics (e.g. *ret-bct-pdu-header)*, while Data Types are shown in Helvetica typeface (e.g. BCnPDU).

The layout of the data structures defined in the ASN.1 is also shown in a graphical representation. In general, the variable names are presented in the same way they are presented in the ASN.1, with the following exceptions:

- insufficient space does not allow the complete variable name to be presented and it is therefore abbreviated;

- only one particular value can be assigned to a variable in the particular structure that is presented - in this case the variable is replaced by the appropriate numerical value;
- additional information may be added in brackets for explanatory reasons.

4.4.2 "Reserved" Fields and Values

Fields shown as Reserved BITSTRING (..) in the ASN.1 structures shall be set to zero by the sender and shall be ignored by the receiver.

Values not allocated in Distinguished Value Lists shall not be used by the sender and shall be ignored by the receiver.

NOTE: Distinguished Value Lists of type Integer are being used instead of the ENUMERATED data type, where the allocated number range is larger than the number of items to be enumerated.

4.4.3 Boolean Variables

BOOLEAN variables shall be encoded as follows:

```
TRUE    ::= 1
FALSE   ::= 0
```

4.4.4 ASN.1 Encoding Rules

The ASN.1 presentation provided in the present document for this interface specification is normative. The encoding rules used for this interface specification are provided in clause 4.3.4 of ETSI TS 102 744-3-1 [3].

5 Connection Protocol Data Unit (PDU) structure

5.0 General

The Upper Layer PDUs (such as Adaptation Layer Signalling PDUs, Packet Data Convergence Protocol (PDCP) PDUs, etc.) are segmented into a sequence of Bearer Connection Layer Protocol Data Units (BCnPDUs), if required. The length of each Bearer Connection Layer PDU depends on the physical bearer characteristics and is determined by the Bearer Control sub-layer and signalled across the interface between Bearer Connection and Bearer Control processes.

5.1 Bearer Connection PDU (BCnPDU)

5.1.0 General

The Bearer Connection PDU (BCnPDU) is passed to the Bearer Control Sub-Layer across the Bearer Connection Layer to Control Sub-Layer interface. This PDU may contain either *raw-data* or a *formatted-pdu*. This choice is implied when setting up the Bearer Connection.

A *formatted-pdu* may contain either an *ack-mode-pdu* (if operating in Acknowledged Mode), a Sub-Segment (*sseg-pdu*), or Numbered (*n-pdu*) frames. An *ack-mode-pdu* may contain either an Information (*i-pdu*) or a Supervisory (*s-pdu)* Frame. The type of content of a *formatted-pdu* is identified by either the first, first and second or first, second and third bits of the formatted PDU.

```
BCnPDU ::=
    CHOICE {
        raw-pdu
            RawDataPDU,
        formatted-pdu
            CHOICE {
                ack-mode-pdu
                    CHOICE {
                        i-pdu
                            InformationPDU,
                        s-pdu
                            SupervisoryPDU,
                        sseg-pdu
                            SubSegmentPDU
                    },
```

```
            n-pdu
                NumberedPDU
        }
    }
```

5.1.1 RawDataPDU

This payload is used in the BCnPDU to carry user plane data when the Bearer Connection Process is operating in Transparent Mode (TM). Segmentation and reassembly and in-sequence delivery are not supported in this mode and would be the responsibility of the layers above. No overhead is added by the Bearer Connection Layer. The PDU has the following structure, with format as shown in Figure 5.1.

```
RawDataPDU ::=
    OCTET STRING
```

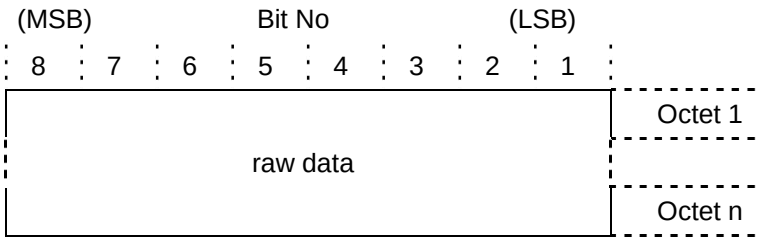

Figure 5.1: RawDataPDU Format

5.1.2 InformationPDU

This format is used to carry numbered data segments when the Bearer Connection process is operating in Acknowledged Mode (AM). The PDU has the following structure, with format as shown in Figure 5.2.

```
InformationPDU ::=
    SEQUENCE {
        i-flag
            BIT STRING (SIZE (1)),  -- encode as '0'B
        pf
            BOOLEAN,
        ns
            SequenceNum,
        nr
            SequenceNum,
        s-type
            BCnSegType,
        data-seg
            BConnData OPTIONAL
    }
```

NOTE: If ciphering is applied then *data-seg* is of type OCTETSTRING.

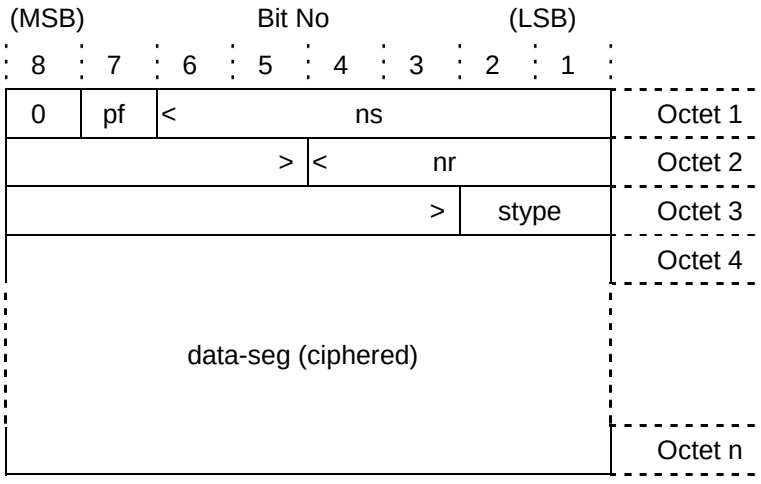

Figure 5.2: InformationPDU Format

The Poll Flag *pf* is set to '1' to request an acknowledgement from the remote peer. The parameter *ns* is the number of the item being sent in the message by the transmitting end (Send sequence number) while the parameter *nr* is the number of the item which the transmitting end expects to receive next (Receive sequence number). The parameter *s-type* specifies the type of the data segment (*data-seg*) carried in this Information message.

When a discarded data segment is retransmitted, either the *pdu-data* part of the BConnData structure or the complete *data-seg* part shall be omitted. The receiving end shall recognize both formats as a valid discarded data segment.

5.1.3 SupervisoryPDU

5.1.3.0 General

Supervisory PDUs are used to carry control messages when the Bearer Connection process is operating in Acknowledged mode. Two types of messages, ReadyReceive and SelectiveReject, are defined and are identified by the second two bits in the message header.

```
SupervisoryPDU ::=
    SEQUENCE{
        s-flag
            BIT STRING (SIZE (2)), -- encode as '10'B,
        s-content
            CHOICE {
                rr
                    ReadyReceive,
                srej
                    SelectiveReject
                }
    }
```

5.1.3.1 ReadyReceive

The ReadyReceive message is used for the acknowledgement of received data and to indicate the readiness to receive more data. The message has the following structure, with format as shown in Figures 5.3 and 5.4:

```
ReadyReceive ::=
    SEQUENCE {
        sc-flag
            BIT STRING (SIZE (2)), -- encode as'00'B,
        rr-content
            CHOICE {
                rr-ack
                    SEQUENCE {
                        pf
                            BOOLEAN, -- encode as FALSE
                        nr
                            SequenceNum
                        },
                rr-poll
                    SEQUENCE {
                        pf
                            BOOLEAN, -- encode as TRUE
                        ns
                            SequenceNum
                        }
            },
        reserved
            BIT STRING (SIZE (1))
    }
```

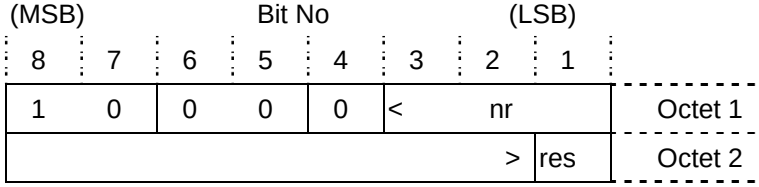

Figure 5.3: ReadyReceive Message used as Acknowledge (*pf* = 0)

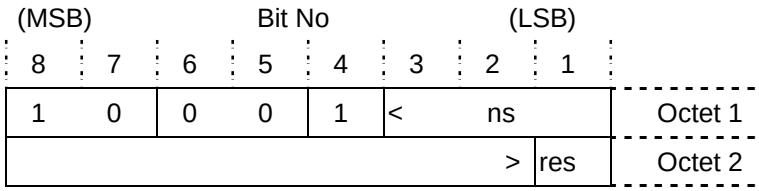

Figure 5.4: ReadyReceive Message used as Poll (*pf* = 1)

In the ReadyReceive message, the Poll Flag *pf* is used to indicate whether the message is being used as an Acknowledge (see Figure 5.3) or Poll (see Figure 5.4). If the ReadyReceive message is used as an Acknowledge (*pf* = 0), the parameter *nr* is the number of the segment which the transmitting end expects to receive next (Receive sequence number). If the message is used as a Poll (*pf* = 1) the parameter *ns* is the number of the last transmitted segment (Send sequence number).

5.1.3.2 SelectiveReject

The SelectiveReject message is used to request segments to be retransmitted and, if *pf* is set, the acknowledgement of received data. The message has the following structure, with format as defined in Figure 5.5:

```
SelectiveReject ::=
    SEQUENCE {
        sc-flag
            BIT STRING (SIZE (2)),  -- encode as '01'B,
        pf
            BOOLEAN,
        nr
            SequenceNum,
        reserved
            BOOLEAN,
        num-sel
            INTEGER (0..maxNumSel),
        nrs
            SEQUENCE SIZE (0 ..maxNumSel) OF SequenceNum,
        pad
            BIT STRING (SIZE (0..7)
    }
```

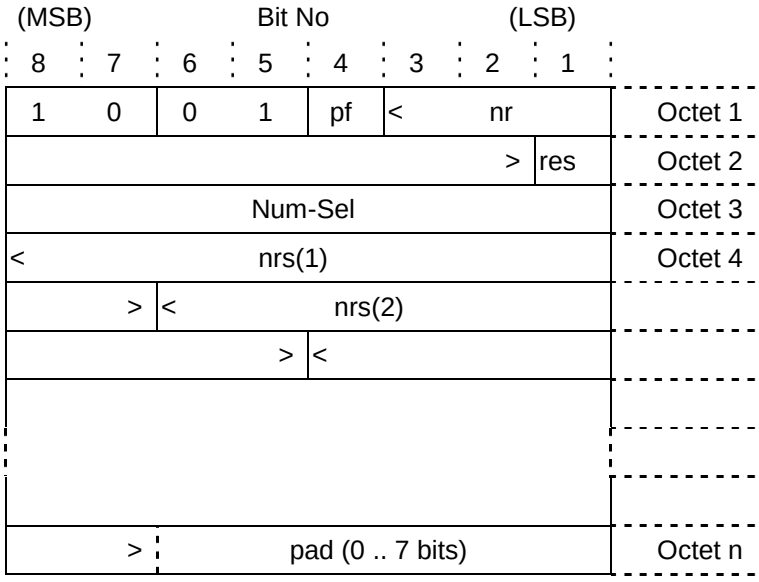

Figure 5.5: SelectiveReject Message Format

In the SelectiveReject message the Poll Flag *pf* is set to '1' to indicate that the message is being used as a Poll Response. The number of the first segment for which retransmission is requested from the peer is contained in the parameter *nr* immediately after the *pf* field. Further segments can be requested to be retransmitted by the peer, with those segment numbers carried in the list of retransmission selections *nrs*. The number of items in this list is signalled in the parameter *num-sel*. It should be noted that a *num-sel* equal to zero is possible, and in this case there is only one segment requested to be retransmitted and *nrs* is empty. The *pad* field is used to pad the end of the message to the nearest octet boundary.

5.1.4 NumberedPDU

The data type NumberedPDU is used to carry data segments when the Bearer Connection process is operating in Unacknowledged Mode (UM) and in-sequence delivery to the layers above is mandatory. Segmentation and reassembly (subject to a successful transfer of all segments over the radio interface) are also supported. The PDU has the following structure, with format as shown in Figure 5.6.

```
NumberedPDU ::=
    SEQUENCE {
        n-flag
            BIT STRING (SIZE (3)), -- encode as '111'B,
        hfn-flag
            BIT STRING (SIZE (1)),
        ns
            SequenceNum,
        s-type
            BCnSegType,
        data-seg
            BConnData
    }
```

NOTE: If ciphering is applied then *data-seg* is of type OCTETSTRING.

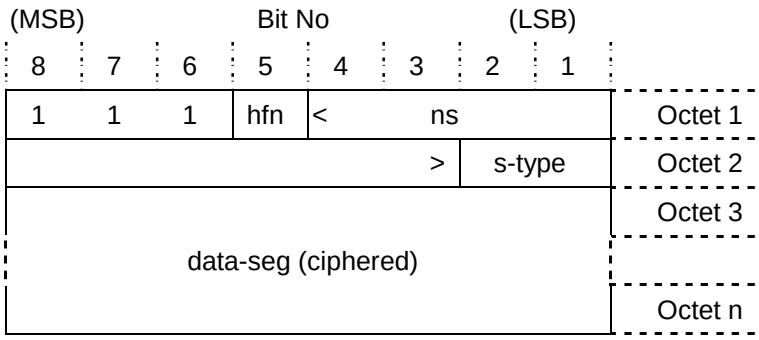

Figure 5.6: Numbered Message Format

The *hfn-flag* carries a copy of the second most least significant bit (LSB) of the Bearer Connection Hyperframe Number (BCN HFN) (see ETSI TS 102 744-3-4 [4]) maintained at the sender. It can be used to regain synchronization of ciphering after a prolonged blockage. The parameter *s-type* specifies the type of the data segment (*data-seg*) within this Information message. The parameter *ns* is the number of the item being sent in the message by the transmitting end (Send sequence number).

5.1.5 SubSegmentPDU

This format is used to carry subsegments when the Bearer Connection process is operating in Acknowledged Mode (AM). The PDU has the following structure, with format as shown in Figure 5.7.

```
SubSegmentPDU ::=
    SEQUENCE {
        sg-flag
            BIT STRING (SIZE (3)),  -- encode as '101'B,
        reserved
            BIT STRING (SIZE (1)),
        ns
            SequenceNum,
        nr
            SequenceNum,
        pf
            BOOLEAN,
```

```
        s-type
            BCnSegType,
        eos
            BOOLEAN,
        ssegn
            INTEGER (0..15),
        sub-data-seg
            OCTET STRING
    }
```

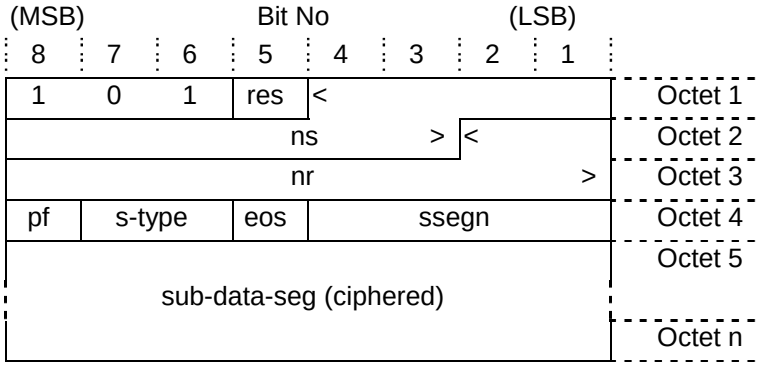

Figure 5.7: SubSegmentPDU Message Format

The fields *ns* and *s-type* shall contain the sequence number and segment type of the original InformationPDU from which the subsegment has been derived. The fields *pf* and *nr* contain the poll-final flag and the receive sequence number and shall be updated in accordance with the same rules that apply to retransmitted InformationPDUs (see ETSI TS 102 744-3-4 [4]).

The *eos* field marks the last in a sequence of sub-segments while *ssegn* is the sub-segment number in the range from 0 to 15 allowing retransmitted InformationPDUs to be split into up to 16 sub-segments. The field *sub-data-seg* carries a subsegment of the *data-seg* from the I-frame that is being retransmitted in a series of SubSegmentPDUs.

5.2 Parameters

5.2.1 BcnSegType

This parameter type is used to specify the type of the data segment being sent in a message.

```
BcnSegType ::=
    INTEGER {
        com (0),
        bom (1),
        eom (2),
        ssm (3)
    } (0..3)
```

Four different data segment types are possible:

`bom` Beginning of Message, the first segment in a multi-segment message.

`Com` Continuation of Message, an intermediate segment in a multi-segment message.

`Eom` End of Message, the last segment in a multi-segment message, or an unformatted message.

`Ssm` Single Segment Message, the only segment of the message.

5.2.2 BconnData

5.2.2.0 General

This parameter type defines the structure of the data segment and depends on the value of the *s-type* parameter. The parameter has the following structure, with format as shown in Figures 5.8 to 5.10.

```
BconnData ::=
    CHOICE {
        com
            OCTET STRING,
        bom
            SEQUENCE {
                pdcp-info
                    PdcpInfo,
                pdu-length
                    PDULength,
                pdu-data
                    OCTET STRING
            },
        eom
            OCTET STRING,
        ssm
            SEQUENCE {
                pdcp-info
                    PdcpInfo,
                reserved
                    BIT STRING (SIZE (3)),
                pdu-data
                    OCTET STRING
            }
    }
```

NOTE: The *reserved* field is included to ensure that the subsequent information resides on an octet boundary when no length field is included.

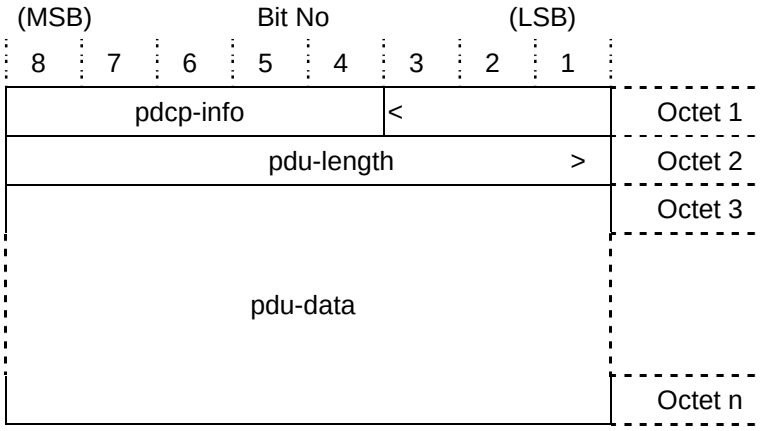

Figure 5.8: Structure of bom data segment

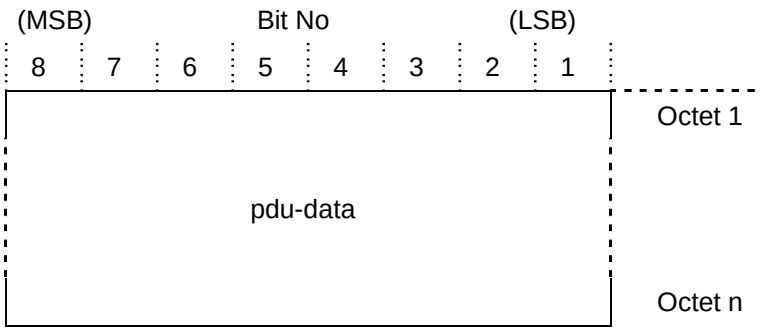

Figure 5.9: Structure of com and eom data segments

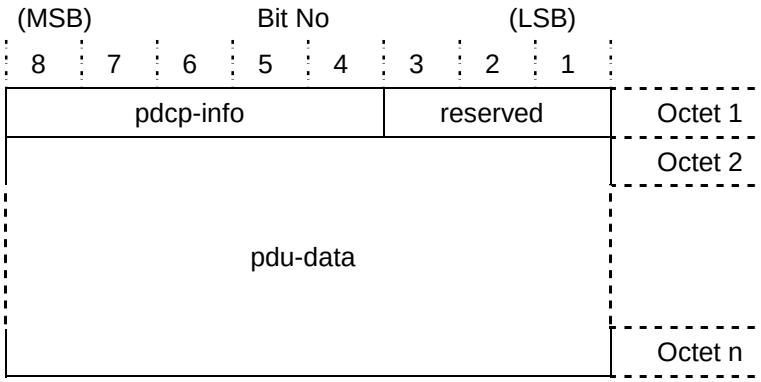

Figure 5.10: Structure of Single Segment Message (ssm) data segment

5.2.2.1 PdcpInfo

The PdcpInfo field within the BconnData structure are used to carry information and control flags that are exchanged between peer PDCP processes using a bom or ssm message.

```
PdcpInfo::=  BIT STRING (SIZE (5))
```

5.2.3 SequenceNum

The SequenceNum data type is used to describe *ns*, *nr*, or elements in the *nrs* field.

```
SequenceNum ::=
    INTEGER (0..1023)
```

5.2.4 PDULength

The PDULength field is used to specify the total length of *pdu-data* carried in a multi-segment message.

```
PDULength ::=
    INTEGER (0..2047)
```

Annex A (normative): ASN.1

This annex collates the data structures in ASN.1 notation from the present document in alphabetical order, in a format that may be used in a program code compiler.

The code is reproduced in a text file that is contained in archive ts_1027440303v010101p0.zip which accompanies the present document.

History

Document history		
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