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Technical Specification

Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Packet based Convergence Layer; Part 1: Common Part

Reference

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Foreword

This Technical Specification (TS) has been produced by ETSI Project Broadband Radio Access Networks (BRAN).

It defines the functionality required for the support of packet services over HIgh PErformance Radio Local Area Network Type 2 (HIPERLAN/2) [3]. Separate ETSI documents provide details on the system overview, data link control layer, radio link control sublayer, other convergence sublayers and conformance testing requirements for HIPERLAN/2.

The Packet based Convergence Layer is split into two parts, a Common Part and a Service Specific Part. The Common Part describes the functionality for adapting variable length packets/frames to the fixed size data units used at the Data Link Control (DLC) layer while the Service Specific Part describes the functionality required to support a certain protocol, e.g. Ethernet or IP. It is envisioned that several, independent, Service Specific Convergence Sublayers (SSCS) will be defined in the future as market requirements develop. The SSCSs all use the services of the Common Part and the DLC.

The present document is part 1 of a multi-part TS covering the Packet based Convergence Layer, as identified below:

Part 1: "Common Part";

Part 2: "Ethernet Service Specific Convergence Sublayer".

Further SSCSs will be added in the future.

1 Scope

The present document is applicable to HIPERLAN/2 equipment supporting packet services, such as Ethernet, IEEE 1394 [5] or IP.

The present document does only address the functionality required to transfer variable length packets/frames over the radio interface between an HIPERLAN/2 Access Point and Mobile Terminal. It does not address the requirements and technical characteristics for wired network interfaces at the Access Point and at the Mobile Terminal.

The Packet based Convergence Layer consists of a Common Part, defined in this document, and a Service Specific Part which consists of several Service Specific Convergence Sublayers (SSCS). The SSCSs are defined in separate documents. The Service Specific Convergence Sublayers all use the services provided by the Common Part and the HIPERLAN/2 Data Link Control (DLC) layer.

The task of the Common Part of the Packet based Convergence Layer is to adapt variable length packets/frames provided by the different Service Specific Convergence Sublayers to the fixed data unit size used in the HIPERLAN/2 DLC layer.

The present document does not address the requirements and technical characteristics for type approval and conformance testing. These are covered by separate documents.

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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETSI TS 101 761-1: "Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Data Link Control (DLC) Layer; Part 1: Basic Data Transport Functions".

[2] ETSI TS 101 761-2: "Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Data Link Control (DLC) layer; Part 2: Radio Link Control Protocol Basic Functions".

[3] ETSI TR 101 031 (V2.2): "Broadband Radio Access Networks (BRAN); HIgh PErformance Radio Locals Area Network (HIPERLAN) Type 2; Requirements and architectures for wireless broadband access".

[4] ITU-T Recommendation I.363.5 (08/96): "B-ISDN ATM Adaptation Layer specification: Type 5 AAL".

[5] IEEE Std 1394 (1995): "Standard for a High Performance Serial Bus".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

HIPERLAN/2: HIgh PErformance Radio Local Area Network Type 2, a short-range wireless LAN providing broadband local access. Standardized by ETSI Project BRAN

Maximum Transmission Unit (MTU): maximum packet size in octets that can be conveyed in one piece over a link

Protocol Data Unit (PDU): data unit exchanged between entities at the same ISO layer

Service Data Unit (SDU): data unit exchanged between adjacent ISO layers

3.2 Abbreviations

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

AAL	ATM Adaptation Layer
AP	Access Point
ATM	Asynchronous Transfer Mode
BRAN	Broadband Radio Access Networks (Project)
CEP	Connection End Point
CL	Convergence Layer
CPCS	Common Part Convergence Sublayer
C-SAP	Control Service Access Point
DLC	Data Link Control
DLCC	DLC Connection
DUC	DLC User Connection
ETSI	European Telecommunications Standards Institute
HIPERLAN/2	High Performance Radio Local Area Network Type 2
H/2	see HIPERLAN/2
IP	Internet Protocol
ISO	International Standards Organisation
LSB	Least Significant Bit
MAC	Medium Access Control
MIB	Management Information Base
MSB	Most Significant Bit
MT	Mobile Terminal
MTU	Maximum Transmission Unit
PAD	Padding field
PDU	Protocol Data Unit
RLC	Radio Link Control
SAP	Service Access Point
SAR	Segmentation And Reassembly
SDU	Service Data Unit
SNMP	Simple Network Management Protocol
SSCS	Service Specific Convergence Sublayer
TS	Technical Specification
U-SAP	User Service Access Point

4 Convergence Layer architecture

4.1 General

The Convergence Layer (CL) resides on top of the Data Link Control (DLC) layer. The task of the Convergence Layer is to adapt the service requirements of different Higher Layers to the services offered by the HIPERLAN/2 DLC layer.

Two types of Convergence Layers can be distinguished, a Cell based Convergence Layer and a Packet based Convergence Layer (see figure 4.1). Further Convergence Layers may be specified in the future. The Cell based Convergence Layer offers services to Higher Layers that use the fixed size ATM cell as the transfer unit.

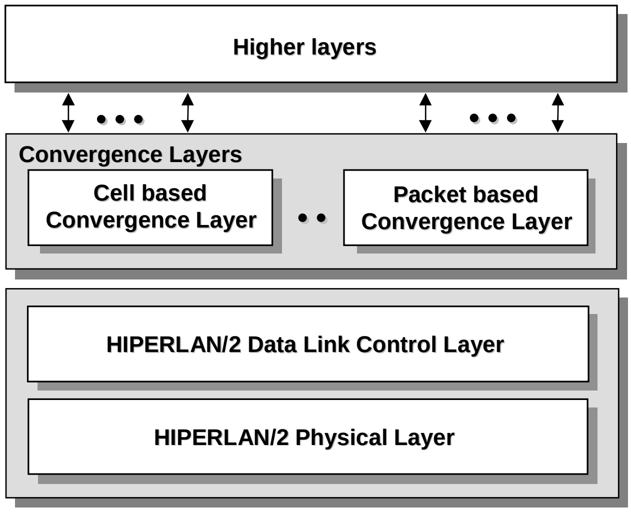


Figure 4.1: HIPERLAN/2 Convergence Layers

The Packet based Convergence Layer offers services to Higher Layers that use packets or frames of variable size or fixed size which exceed the ATM cell size. Typical examples of these are Ethernet and the Internet Protocol suite. The Packet based CL consists of two main parts, a Common Part and a Service Specific Part, which consists of several Service Specific Convergence Sublayers (SSCS). It is envisioned that several different Service Specific Convergence Sublayers will be specified by BRAN to meet the requirements of different Layer 2 and Layer 3 protocols.

4.2 Packet based Convergence Layer architecture

4.2.1 User plane architecture

The Packet based CL exchanges packets/frames of variable size with Higher Layers and it exchanges data units of fixed size with the DLC. This conversion of packets with a variable size into data units with a fixed size and vice versa is a function common to all supported Higher Layers and thus this functionality is part of the Common Part. The user plane of the Common Part is further subdivided into the Common Part Convergence Sublayer (CPCS) and the Segmentation And Reassembly (SAR) sublayer (see figure 4.2).

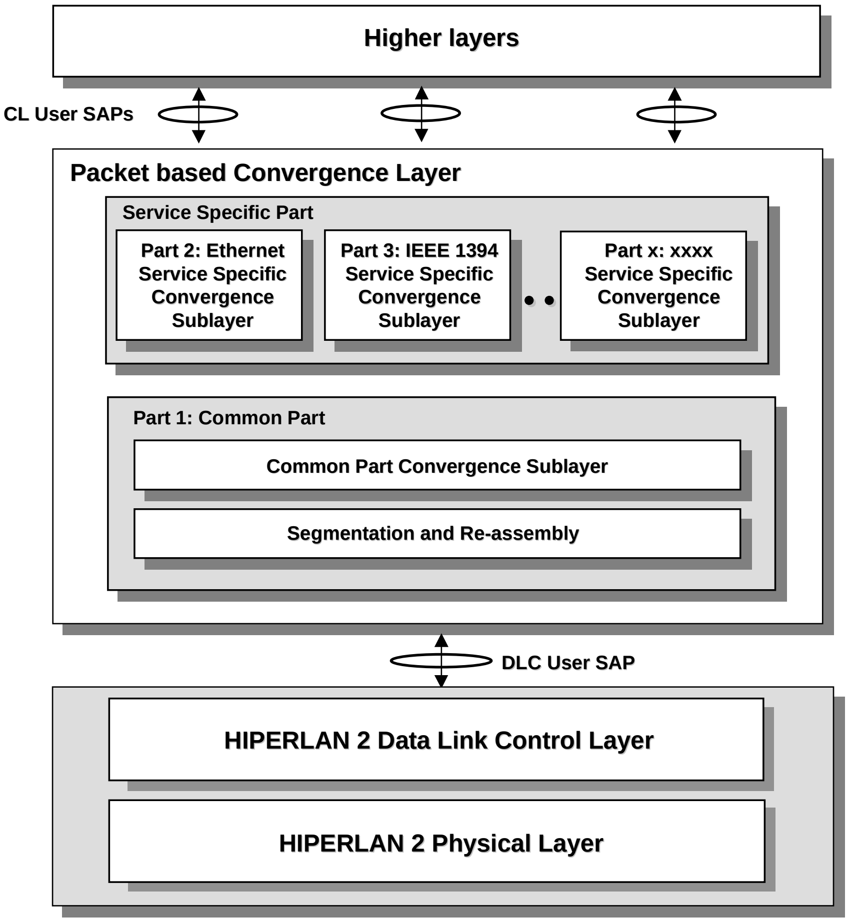


Figure 4.2: Packet based Convergence Layer - user plane

The main functions of the Common Part Convergence Sublayer are:

- to add padding and additional information to the packets received from the SSCS and pass the resulting packets to the SAR;
- to remove and interpret padding and information added at the peer CPCS from packets received from the SAR and pass them up to the SSCS.

The main functions of the Segmentation And Reassembly sublayer are:

- to segment the packets received from the CPCS into fixed size data units. These are then passed down to the DLC via the DLC User SAP (U-SAP);
- at the receiver, to copy the fixed size data units from the DLC into a reassembly buffer and pass the reassembled packet up to the CPCS.

The task of the Service Specific Part is to map specific service requirements of Higher Layers to the service offered by the DLC Layer and to convert packets received from the Higher Layer to the format expected at the CPCS and vice versa. As the requirements differ according to the Higher Layer, several SSCSs, each responsible for one specific Higher Layer, will be developed. The SSCSs that are supported are advertised and chosen at initial association.

4.2.2 Control plane architecture

The Packet based Convergence Layer also includes control plane procedures. The tasks of these are (not exhaustive):

- Convergence Layer selection at association time;
- Higher Layer parameter transfer and negotiation;
- mapping of Higher Layer connection management procedures to the DLC.

The Convergence Layer control plane interacts with the Radio Resource Control, Association Control and DLC Connection Control functions of the DLC control plane, i.e. the Radio Link Control sublayer (RLC), (see figure 4.3). The control plane procedures are defined in the SSCS. The Common Part is transparent to the control plane.

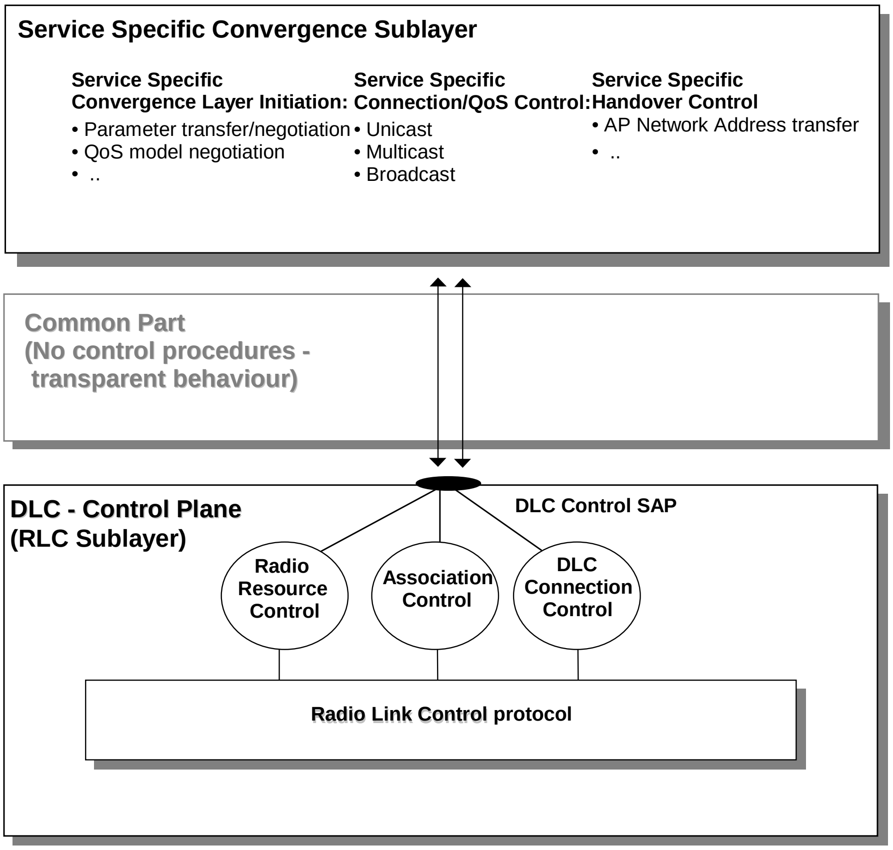


Figure 4.3: Packet based Convergence Layer - control plane

An SNMP Management Information Base (MIB) containing also Convergence Layer specific parameters for performance and fault monitoring and basic configuration will be defined in the HIPERLAN/2 Network Management specification TS 101 762 (see Bibliography).

5 Common Part - User Plane

5.1 General

While the previous clause provides an overview on the general Convergence Layer architecture and describes where the Common Part is located, the following clauses specify the user plane of the Common Part itself.

The user plane procedures of the Common Part provides the capability to transfer a (variable length) CPCS-SDU over a DLC user connection between an HIPERLAN/2 Access Point and Mobile Terminals.

Multiple instances of the Common Part, one for each DLC User Connection, may process the required segmentation and reassembly functionality for this service in parallel as the functional model in annex D shows. The segmentation and reassembly concept is to a great extent adopted from the functionality described in AAL5 [4]. The main difference is the relinquishment of a Cyclic Redundancy Check and that the Common Part only supports the message mode service.

Annex B contains SDL diagrams showing the procedures of the Common Part. An overview on how data units flow through the Convergence Layer, how the different PDUs of the Convergence Layer are structured and the naming conventions used is shown in annex C.

5.2 Primitives (informative)

The Common Part of the Packet based Convergence Layer exchanges service primitives with the Service Specific Convergence Sublayer (SSCS) and the DLC.

NOTE: The primitives are defined only for the purpose of describing layer-to-layer and sublayer-to-sublayer interactions. These primitives are defined as an abstract list of parameters, and their concrete realization may vary between implementations. No formal testing of primitives is intended. The following primitive definitions have no normative significance.

5.2.1 Primitive types

Interface between sublayers

Two different primitives may be used between different sublayers. To indicate the absence of a Service Access Point these primitives differ from the primitives commonly used between different layers:

- inv (invoke), for a higher layer to request service from a lower layer;
- sig (signal), for a layer providing service to notify the next higher layer of any specific service related activity.

The defined types for each category of primitive are shown as a list in curly brackets.

EXAMPLE: CPCS_UNITDATA {inv, sig}

In this example, the defined types are invoke and signal.

5.2.2 Parameter definitions

Endpoint identifiers: some primitives contain an endpoint identifier. This identifier shall be used to distinguish primitives related to different protocol instances. As identifier, the DLC User Connection ID, which is the concatenation of a MAC_ID and DLCC_ID [1], shall be used. The coding of this identifier is a local matter and not defined in the present document. The identifier is defined as:

- DLC User Connection ID (DUC_ID)

Message unit: each piece of higher layer information that is included in the primitive is called a message unit. A series of one or more message units may be associated with each primitive where each separate unit is related to one information element in the corresponding lower layer message. The list of message units is derived from the message definitions by reference to the information elements that may contain information from or to the CL.

5.3 Common Part Convergence Sublayer

5.3.1 Interface to the Service Specific Convergence Sublayer

The following primitive is used for the data transfer service:

CPCS_UNITDATA {inv, sig}

Table 5.1

PARAMETER	INV	SIG
DLC User Connection ID (DUC_ID)	A	A
Message units (possible elements) Interface Data (CPCS-SDU)	A	A
NOTE: A = Always		

Interface Data (ID)

This parameter specifies the Interface Data unit exchanged between the CPCS and the SSCS entity. The Interface Data unit is an integral multiple of octets and corresponds to one CPCS-SDU.

5.3.2 Interface to the Segmentation and Reassembly Sublayer

The following primitive is used for the data transfer service:

SAR_UNITDATA {inv, sig}

Table 5.2

PARAMETER	INV	SIG
DLC User Connection ID (DUC_ID)	A	A
Message units (possible elements) Interface Data (SAR-SDU)	A	A
NOTE: A = Always		

Interface Data (ID)

This parameter specifies the Interface Data unit exchanged between the SAR and the CPCS entity. The Interface Data is an integral multiple of 48 octets and corresponds to one SAR-SDU.

5.3.3 Functionality

5.3.3.1 General

The CPCS functions are performed per CPCS-PDU. The CPCS provides several functions in support of the CPCS service user. The CPCS-SDU is passed across the CPCS interface in exactly one data unit. This service provides the transport of a single CPCS-SDU in one CPCS-PDU.

The functions implemented by the CPCS include:

a) Preservation of CPCS-SDU

This function provides the delineation and transparent transfer of CPCS-SDUs.

b) Error detection and handling

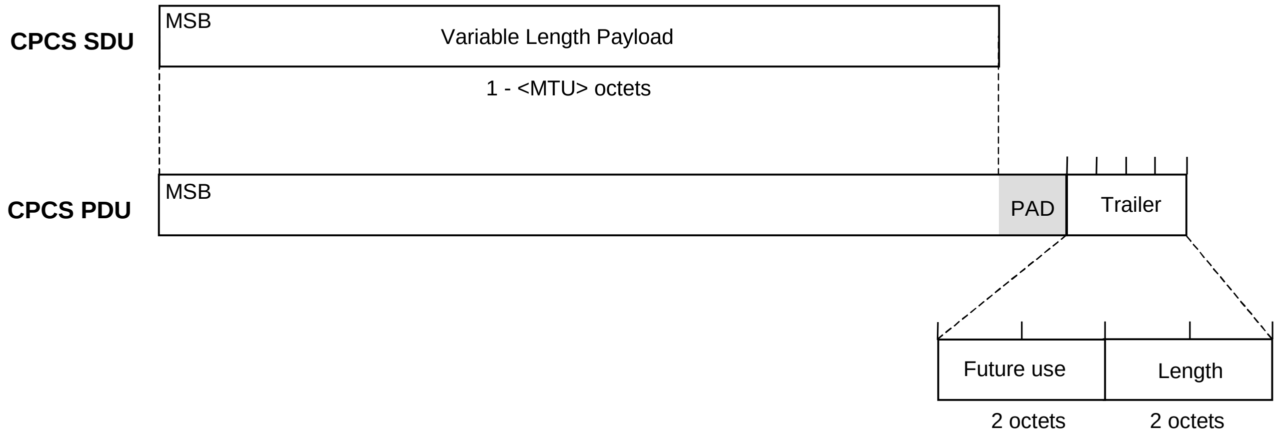
This function provides for the handling of CPCS-PDU corruption. Corrupted CPCS-PDUs are discarded. Examples of detected errors include received length and CPCS-PDU Length field mismatch including buffer overflow, and improperly formatted CPCS-PDUs.

c) Padding

A padding function provides for 48-octet alignment of the CPCS-PDU trailer.

5.3.3.2 Coding of the CPCS PDU

The CPCS functions require a 4-octet CPCS-PDU trailer. The CPCS-PDU trailer shall always be located in the last 4 octets of the last SAR-PDU (i.e. in the last segment) generated from the CPCS-PDU. A padding field shall provide for 48-octet alignment of the CPCS-PDU. The trailer together with the padding field and the CPCS-PDU payload (which corresponds to the CPCS SDU) shall comprise the CPCS-PDU. The size and position of the fields of the CPCS-PDU are given in figure 5.1, see also annex A.



NOTE: The <MTU> is described in sublclause 5.3.5.

Figure 5.1: CPCS-PDU format

CPCS-PDU payload

The CPCS-PDU payload shall be used to carry the CPCS-SDU. This field shall be octet aligned and can range from 1 to <MTU> octets in length.

Padding (PAD) field

Between the end of the CPCS-PDU payload and the CPCS-PDU trailer, there shall be 0-47 unused octets. These unused octets are called the Padding (PAD) field; they shall be strictly used as filler octets and shall not convey any information. Any coding may be used. This padding field shall complement the CPCS-PDU (including CPCS-PDU payload, padding field and CPCS-PDU trailer) to an integral multiple of 48 octets. The function of the padding is shown in figure 5.2.

Future use - 2 octets

This field is reserved for future use and shall be coded as zero "0".

Length field - 2 octets

The Length field shall be used to encode the length of the CPCS-PDU payload field. The length shall be binary encoded as number of octets. The most significant bit of the most significant octet shall be transmitted first.

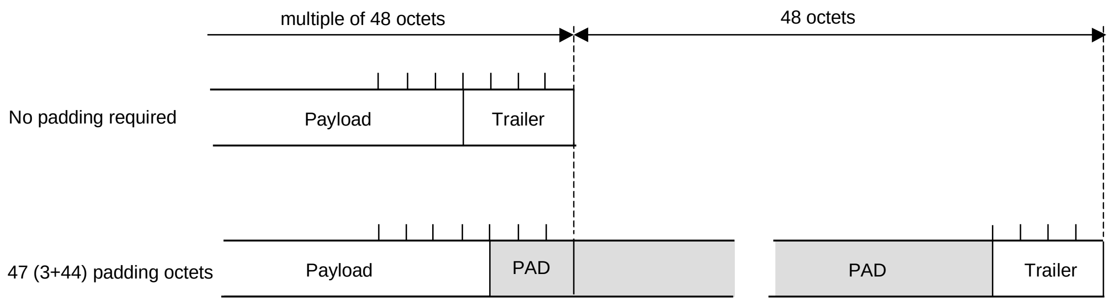


Figure 5.2: Examples how to use the PAD field

5.3.4 Procedures

5.3.4.1 General

The procedures defined in the following subclauses are symmetric. The description is valid for both the MT and AP.

5.3.4.2 Procedures at the sender

Upon reception of CPCS_UNITDATA invoke primitive, the CPCS-PDU shall be constructed as described in subclause 5.3.3.2 and passed to the SAR sublayer in a SAR_UNITDATA invoke primitive.

5.3.4.3 Procedures at the receiver

The CPCS receiver maintains the following parameter:

<Maximum Transmission Unit>

This parameter indicates the maximum SDU size in octets that may be delivered to a CPCS user. At the receiver, the value of this parameter shall be compared to the length of each CPCS-SDU before it is delivered. Any CPCS-SDU that has a length greater than Maximum Transmission Unit shall be discarded.

When the CPCS receiver receives a SAR_UNITDATA signal primitive from the SAR sublayer the following procedures are performed on the Interface Data (corresponds to one CPCS-PDU):

1) The Length field of the CPCS-PDU trailer is used to determine the length of the PAD field (length of received CPCS-PDU minus four (4) and minus the content of the Length field). If the PAD field is longer than 47 octets or not enough data has been received, the CPCS-PDU shall be discarded.

2) If the value of the Length field is zero (0), the CPCS-PDU shall be discarded.

3) If the value of the Length field is higher than the value of the <Maximum Transmission Unit>, the CPCS-PDU shall be discarded.

4) If the CPCS-PDU has not been discarded as a result of the previous checks, the receiver shall extract the Payload field (i.e. the CPCS-SDU) from the CPCS-PDU and deliver it to the CPCS user via a CPCS_UNITDATA signal primitive.

5.3.5 Maximum Transmission Unit

The used Maximum Transmission Unit (MTU) depends on the supported SSCS and is specified in the corresponding SSCS Technical Specification. The maximum value for the MTU is 65 535 octets.

5.4 Segmentation and Reassembly

5.4.1 Interface to the DLC

The DLC User SAP is specified in the DLC Basic TS [1]. The Convergence Layer requires an in-sequence delivery data transfer service from the DLC. The format of the SAR-PDU (which corresponds to the DLC-SDU) is shown in figure 5.3. The SAR procedures require that SAR-PDUs generated from different SAR-SDUs (corresponds to CPCS-PDUs) are not mixed.

5.4.2 Functionality

5.4.2.1 General

The SAR sublayer functions are performed on a SAR-PDU basis. The SAR sublayer accepts variable length SAR-SDUs that are integral multiples of 48 octets from the CPCS and generates SAR-PDUs containing 48 octets of SAR-SDU data plus fields containing CL Flags and CL Tag.

The functions implemented by the SAR include:

a) Preservation of SAR-SDU

This function preserves the SAR-SDU by providing for an "end of SAR-SDU" indication.

5.4.2.2 Coding of the SAR PDU

The SAR functions require a 12-bit SAR-PDU header that consists of a CL-Tag field (8 bits) and a CL-Flags field (4 bits). The SAR-PDU header together with the SAR-PDU payload shall comprise the SAR-PDU. The size and position of the fields of the SAR-PDU are given in figure 5.3, see also annex A.

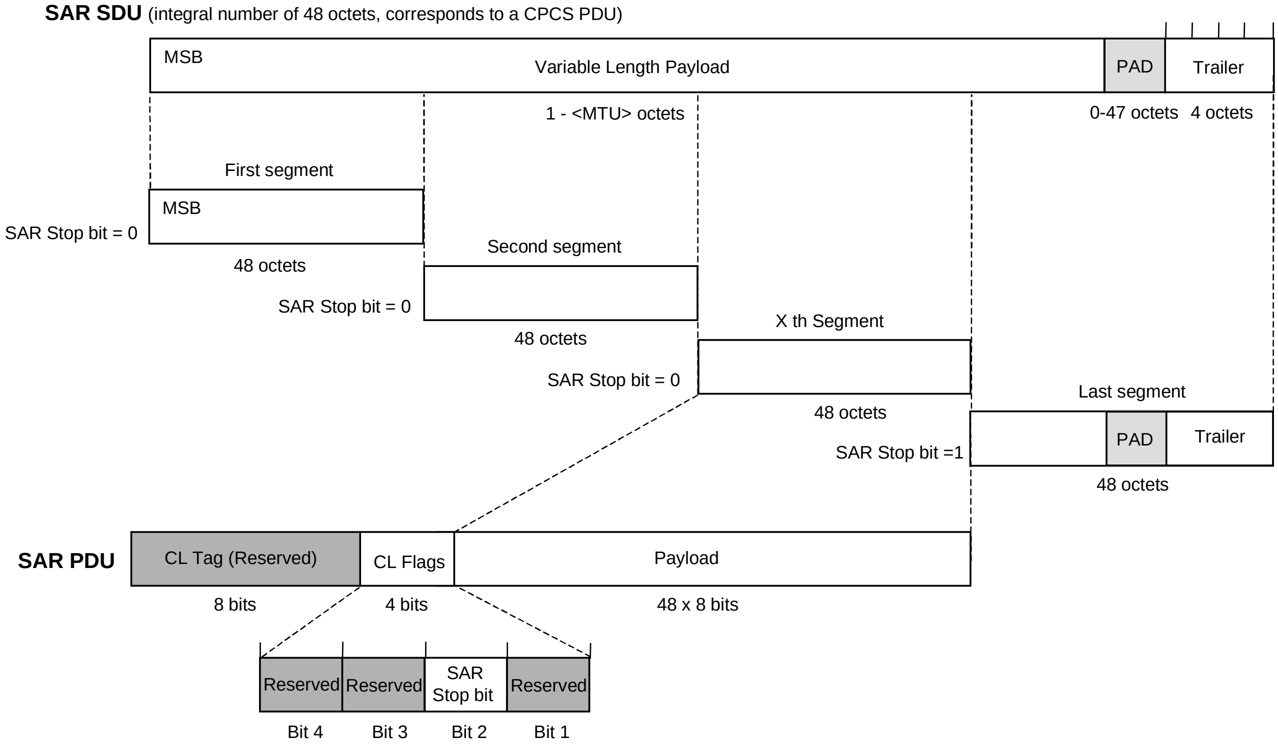


Figure 5.3: The SAR process and coding of the SAR PDU

Convergence Layer Tag (CL Tag) - 8 bits

This field is not used in the Packet based Convergence Layer. It is reserved for future use and shall be coded as zero "0".

Convergence Layer Flags (CL Flags) - 4 bits

The SAR Stop bit shall be transmitted in bit 2 of the CL Flags field. All other bits (i.e. bits 1, 3 and 4) are reserved for future use and shall be coded as zero "0".

SAR Payload - 48 octets

The payload shall consist of a 48 octets segment generated from the SAR-SDU.

5.4.3 Procedures

5.4.3.1 General

The procedures defined in the following subclauses are symmetric. The description is valid for both the MT and AP.

NOTE: It is assumed that the SAR receiver contains a reassembly buffer for storing received segments. However, the actual implementation is out of the scope of this document.

5.4.3.2 Procedures at the sender

The SAR sender shall perform the following procedures:

1) Upon reception of a SAR_UNITDATA invoke primitive, the SAR sender shall start the segmentation process. If the Interface Data (i.e. the SAR-SDU) has a length of more than 48 octets, the SAR sender will generate more than one SAR-PDU. In all SAR-PDUs, the SAR-PDU payload field shall be filled with 48 octets of CPCS information. A header consisting of the CL-Tag field and the CL-Flags field shall be added in front of the SAR-PDU payload.

2) The SAR sender shall set the SAR Stop bit in the CL-Flags field for the last SAR-PDU generated from the Interface Data to "1". In all other cases (i.e. when the DLC_UNITDATA request does not contain the last segment generated from the SAR-SDU), the SAR Stop bit shall be set to "0". The sender shall trigger a DLC_UNITDATA request primitive containing the resulting SAR-PDU (corresponds to a DLC-SDU) for each segment generated from the SAR-SDU.

5.4.3.3 Procedures at the receiver

The receiver maintains the following parameters:

<Maximum Transmission Unit>

This is the same parameter as used in the CPCS receiver, see subclause 5.3.5.

<Reassembly timer>

The support of a reassembly timer is optional. The value of the timer is out of the scope of this document.

The SAR reciever shall perform the following procedures:

1) Upon reception of a DLC_UNITDATA indication primitive, the 48-octet SAR-PDU payload (the last 48 octets of the Interface Data received in the primitive) shall be copied to the reassembly buffer.

2) If the SAR Stop bit in the CL-Flags field is set to "0" and the received number of octets in the reassembly buffer is greater than the value of the parameter <Maximum Transmission Unit> plus 3, the receiver shall discard any information in the reassembly buffer.

3) If the SAR Stop bit in the CL-Flags field is set to "1" (indicating that the SAR-PDU contains the last segment of a SAR-SDU) and the data has not been discarded, the data in the reassembly buffer shall be delivered to the CPCS via a SAR_UNITDATA signal primitive. Data that is delivered is removed from the reassembly buffer.

If a reassembly timer is supported, the following procedures apply:

4) When the SAR receiver receives a DLC_UNITDATA indication primitive from the DLC with the SAR Stop bit set to "0", the reassembly timer shall be (re)started.

5) When the SAR receiver receives a DLC_UNITDATA indication primitive from the DLC with the SAR Stop bit set to "1", the reassembly timer shall be stopped

6) If the timer expires, the SAR receiver shall discard any information in the reassembly buffer.

6 Convergence Layer Version

The Convergence Layer Version number is an 8-bit field used in the RLC [2]. This field is split into two 4-bit subfields. The four most significant bits (bits 5 to 8) identify the version of the Common Part and the four least significant bits (bits 1 to 4) identify the version of the SSCS. The Convergence Layer Version number shall be set according to the table below to indicate the support of this edition (version 1) of the Common Part.

Bits 8 7 6 5 4 3 2 1	Meaning
0 0 0 1 x x x x	Packet CL, Common Part version 1 supported

7 Common Part MIB

The Management Information Base parameters for the Common Part of the Packet based Convergence Layer will be defined in the H/2 Network Management Technical Specification. These MIB parameters may be moved into this section in a future edition of the present document.

Annex A (normative): Coding of PDUs

PDUs are transferred between the Common Part and the underlying protocol layer in units of octets, in ascending numerical octet order (i.e. octet 1, 2, ..., n-1, n), see figure A.1 and A.2.

When a field is contained within a single octet, the highest bit number (i.e. the bit labelled 8) represents the high order or most significant bit (MSB).

In a multi-octet field the order (i.e. the significance) of bit values within each octet decreases as the octet number increases.

Bits 8 7 6 5 4 3 2 1	Octets
MSB Payload (CPCS-SDU)	1
	..
LSB	L
PADDING (PAD = 0-47 octets)	L+1
	L+PAD
Future use	L+PAD+1
	L+PAD+2
MSB Length (L)	L+PAD+3
LSB	L+PAD+4

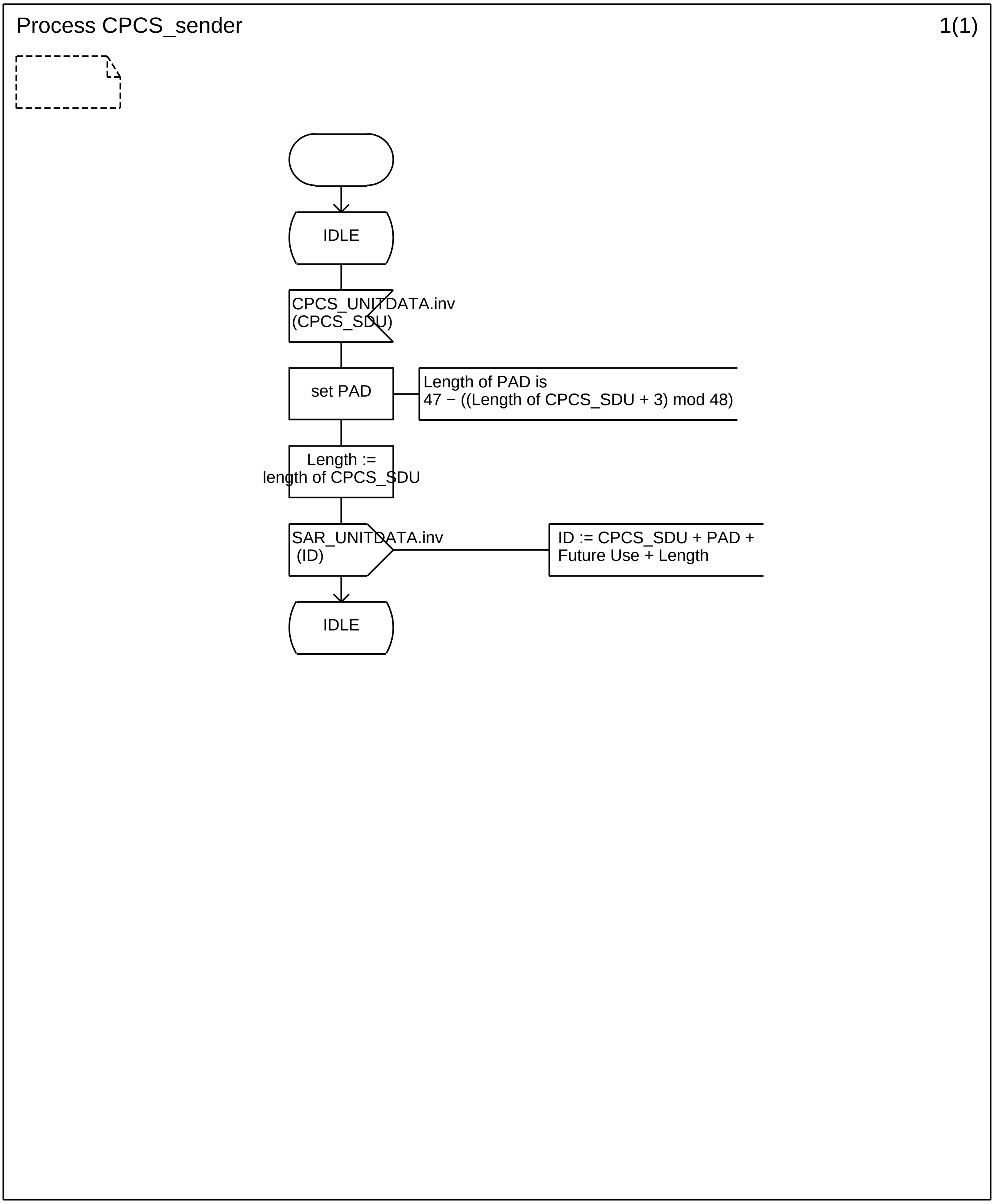
Figure A.1: CPCS-PDU

8 (MSB)	7	6	5	4	3	2	1 (LSB)	Octets
				CL Tag				1
CL Tag (cont.)				MSB CL Flags LSB				2
MSB Payload								3
								4
								49
							LSB	50

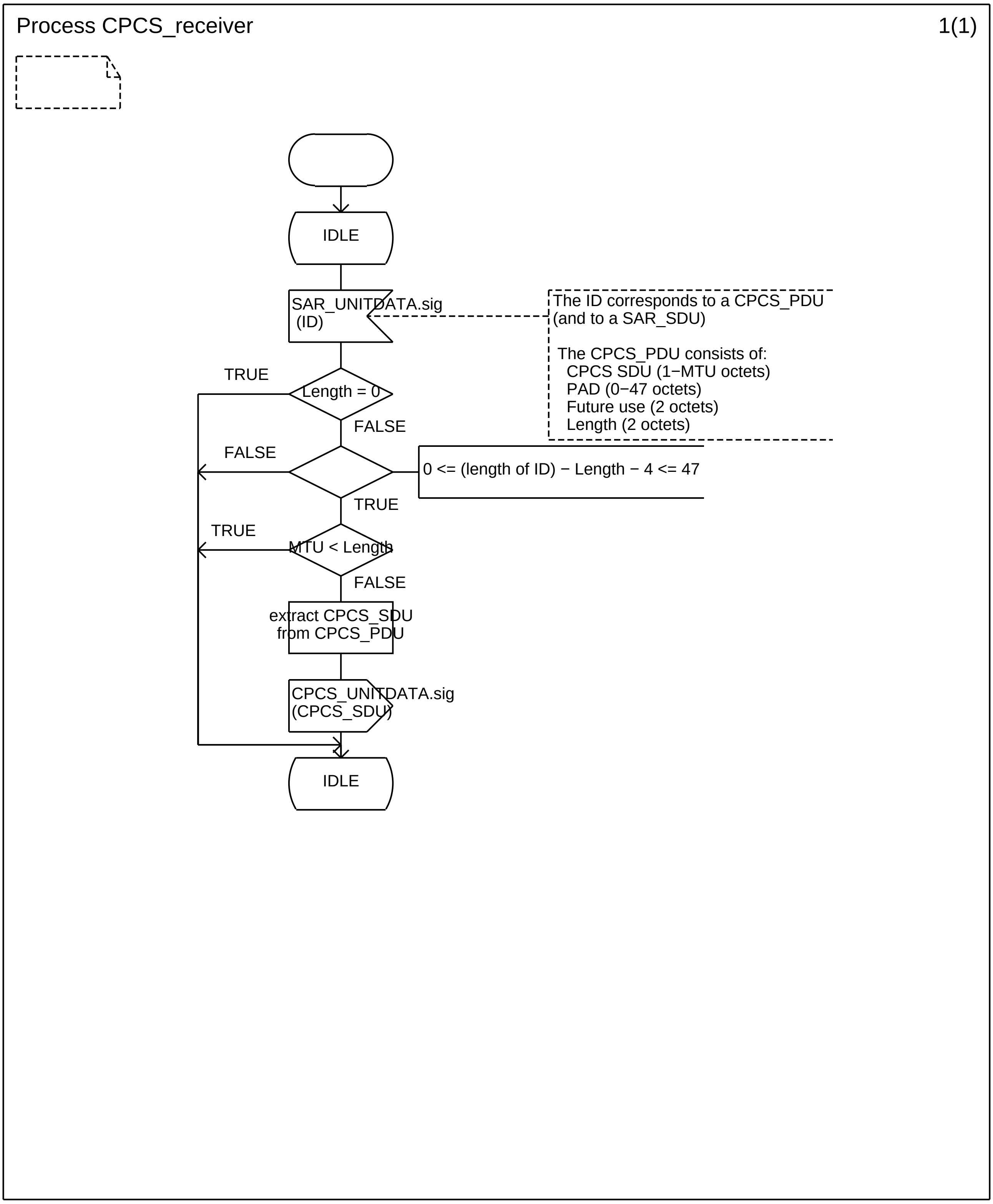
Figure A.2: SAR-PDU (corresponds to a DLC-SDU)

Annex B (informative): SDL diagrams

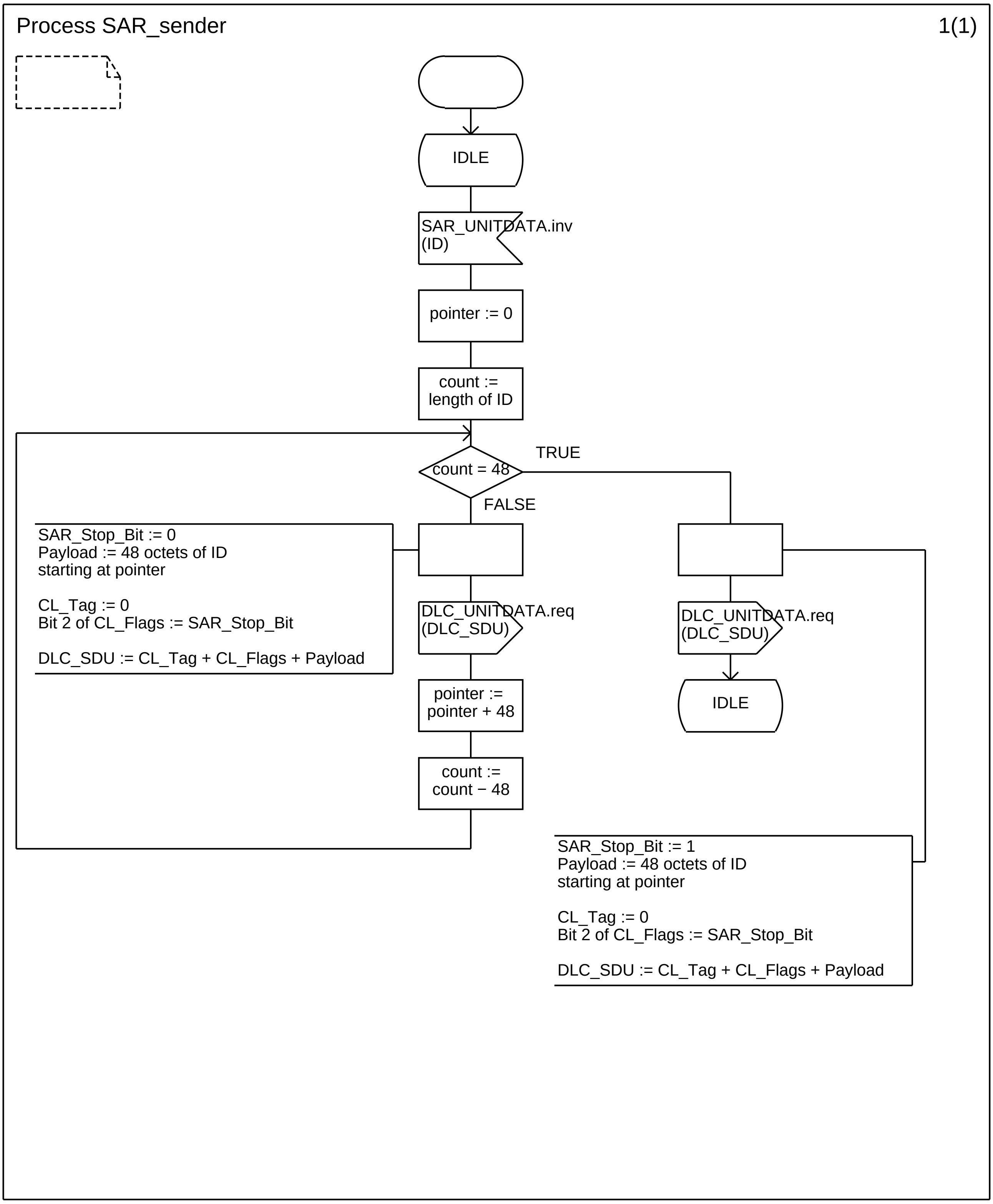
B.1 CPCS sender



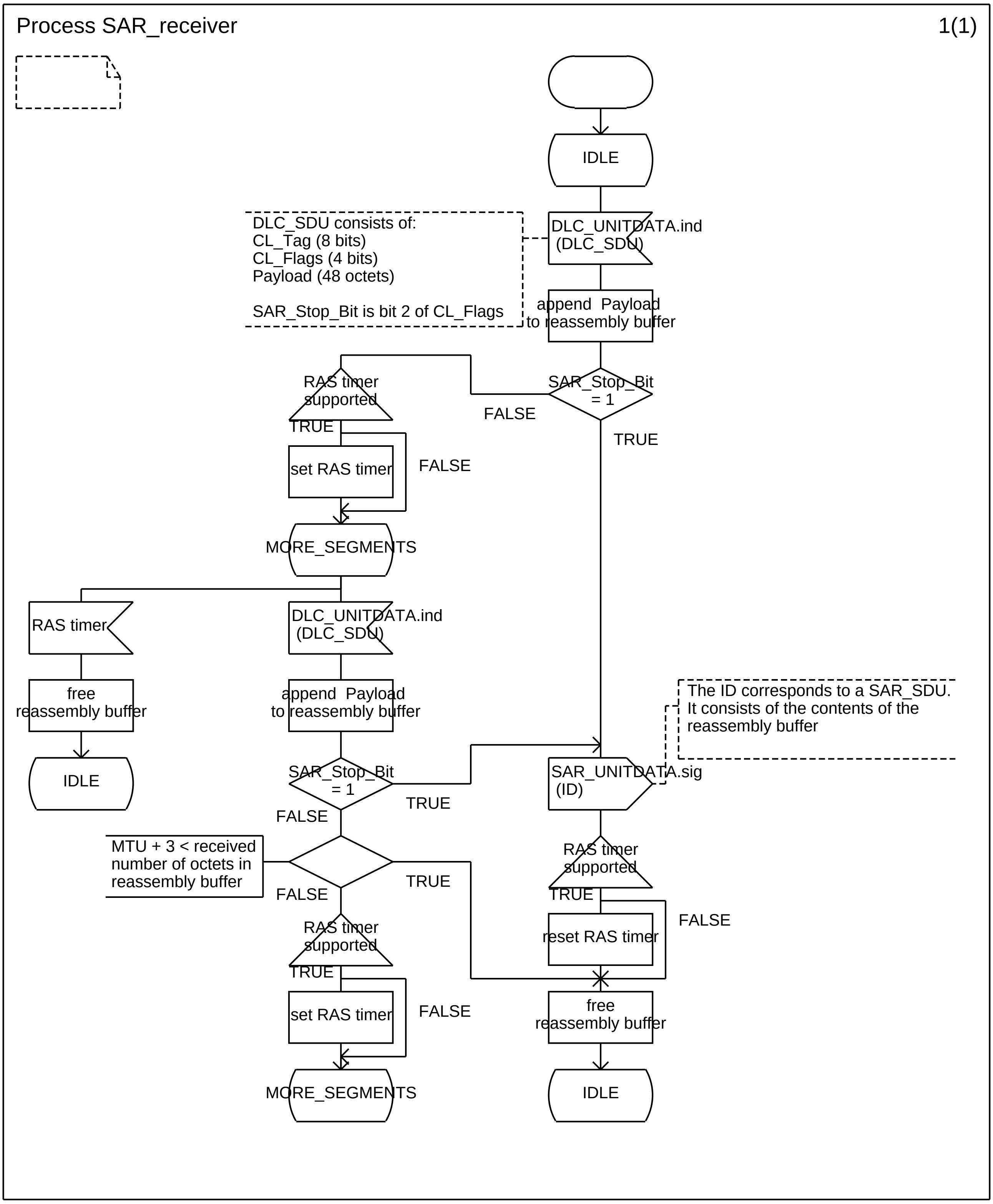
B.2 CPCS receiver



B.3 SAR sender



B.4 SAR receiver



Annex C (informative): Data unit naming convention

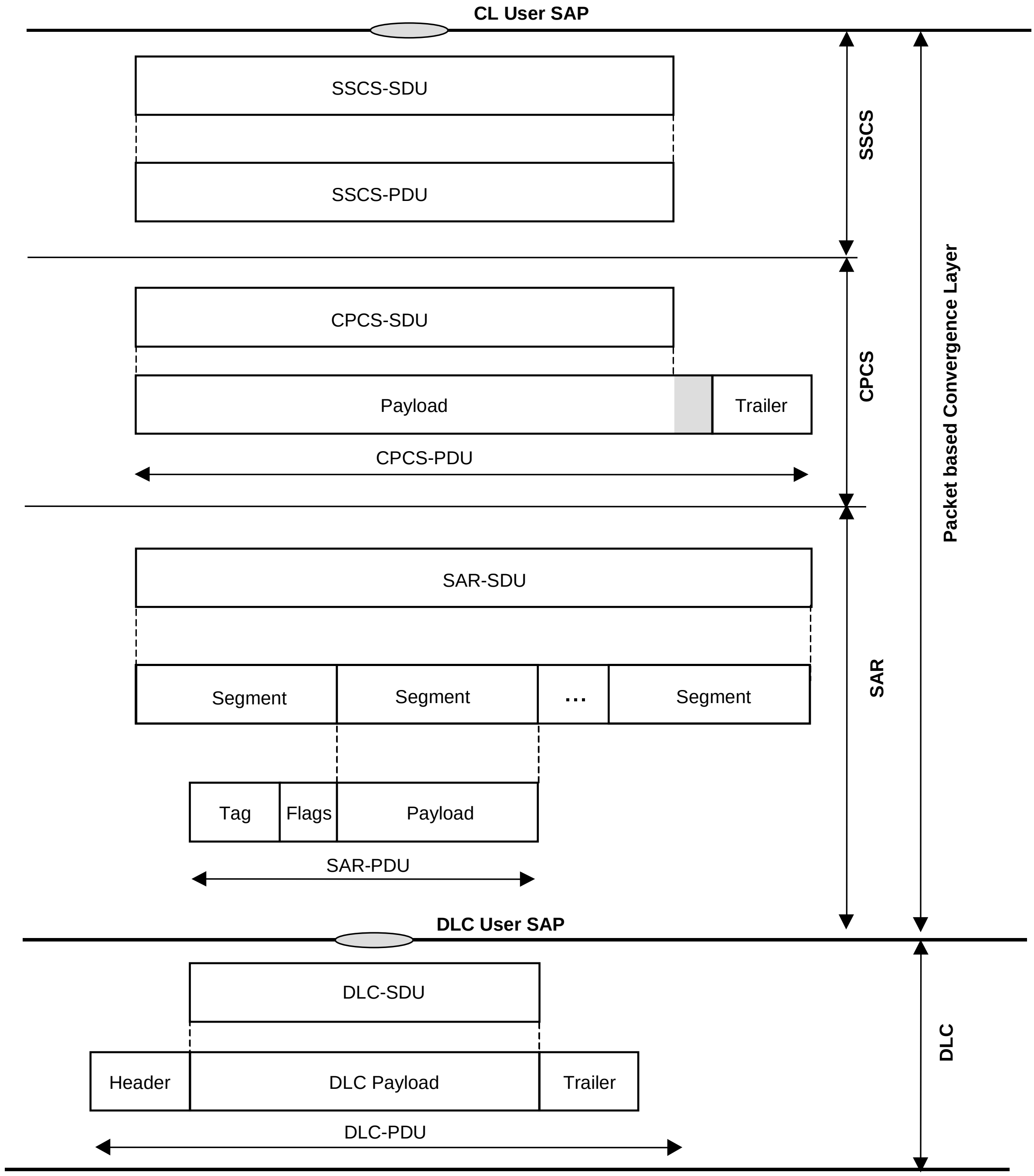


Figure C.1: Data unit naming conventions for the Packet based Convergence Layer

Annex D (informative): Functional model

D.1 Sender

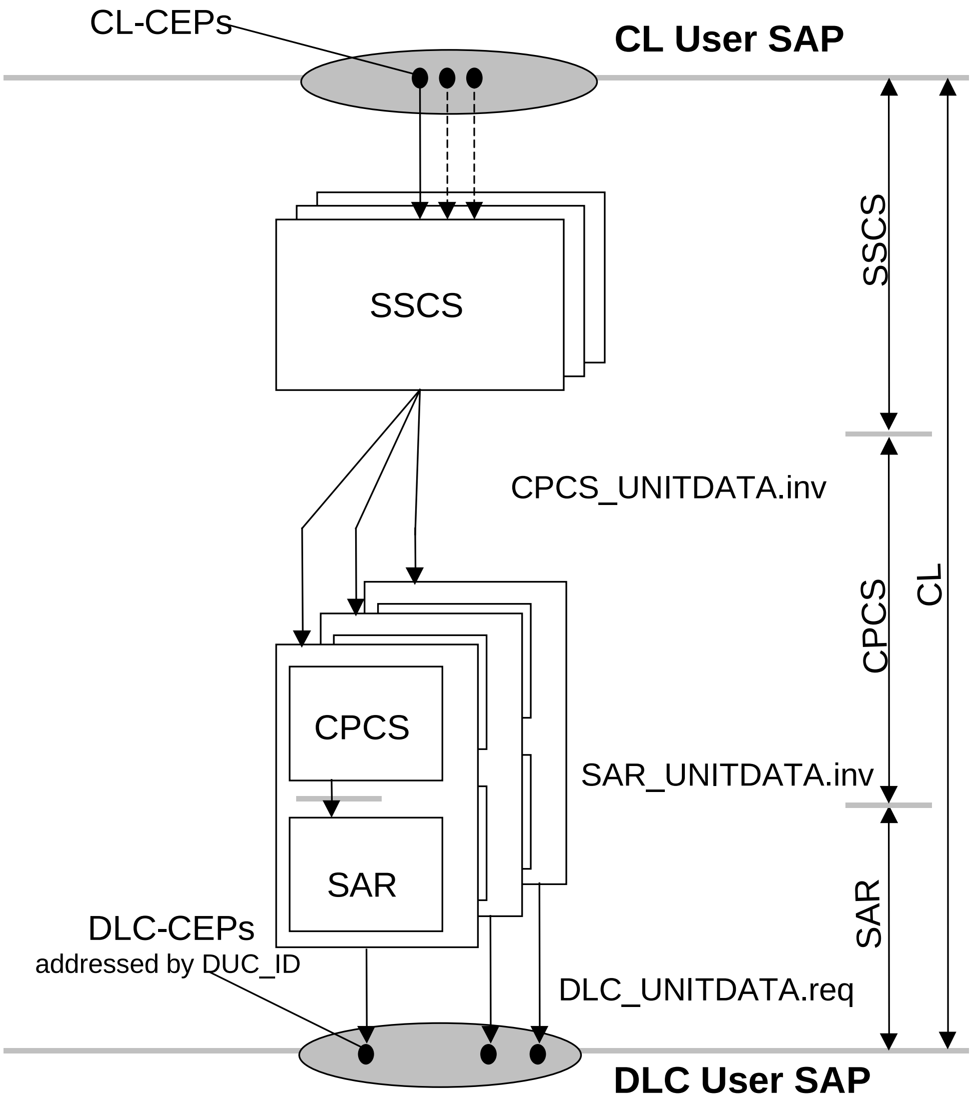


Figure D.1: Functional model for the Packet based CL sender

D.2 Receiver

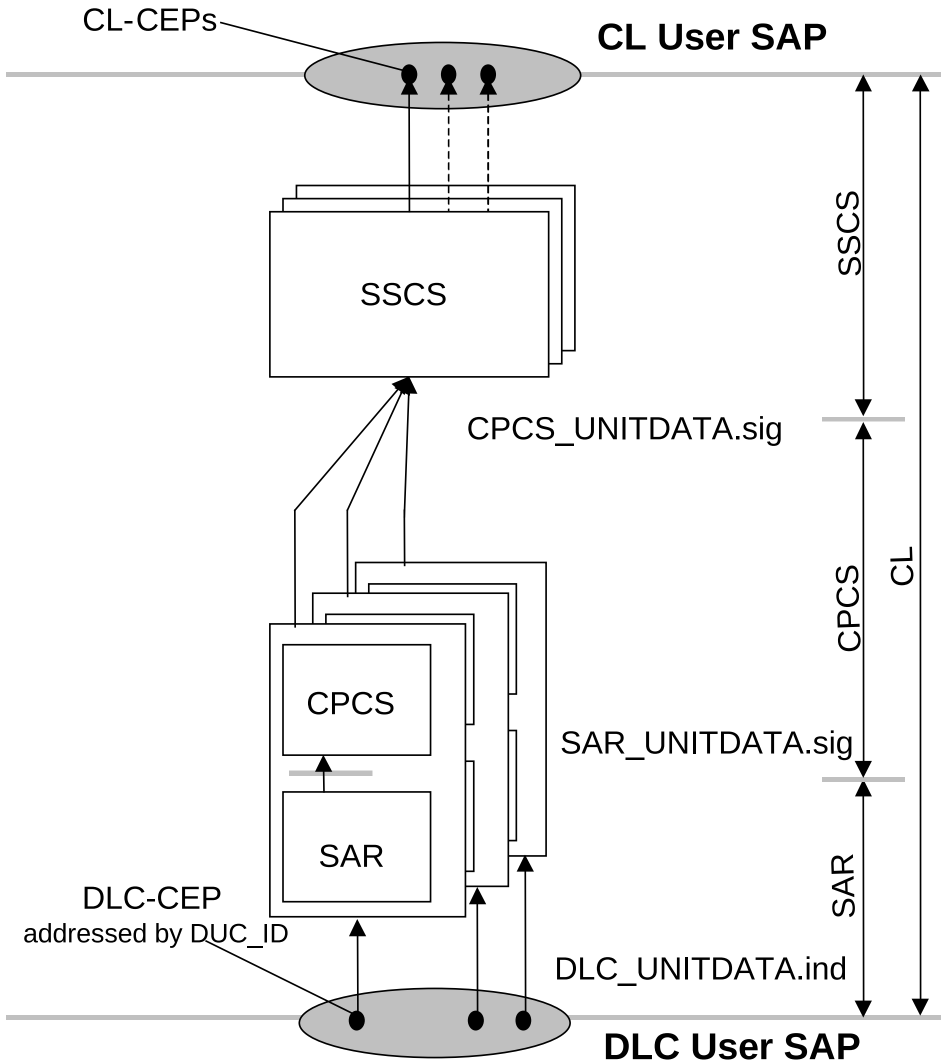


Figure D.2: Functional model for the Packet based CL receiver

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- ETSI TS 101 762: "Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Network Management".

History

Document history		
V1.1.1	April 2000	Publication