INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

I.363.3

(08/96)

SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

Overall network aspects and functions – Protocol layer requirements

---

B-ISDN ATM Adaptation Layer specification: Type 3/4 AAL

ITU-T Recommendation I.363.3

(Previously CCITT Recommendation)

ITU-T I-SERIES RECOMMENDATIONS

INTEGRATED SERVICES DIGITAL NETWORK

GENERAL STRUCTURE	I.100–I.199
Terminology	I.110–I.119
Description of ISDNs	I.120–I.129
General modelling methods	I.130–I.139
Telecommunication network and service attributes	I.140–I.149
General description of asynchronous transfer mode	I.150–I.199
SERVICE CAPABILITIES	I.200–I.299
Scope	I.200–I.209
General aspects of services in ISDN	I.210–I.219
Common aspects of services in the ISDN	I.220–I.229
Bearer services supported by an ISDN	I.230–I.239
Teleservices supported by an ISDN	I.240–I.249
Supplementary services in ISDN	I.250–I.299
OVERALL NETWORK ASPECTS AND FUNCTIONS	I.300–I.399
Network functional principles	I.310–I.319
Reference models	I.320–I.329
Numbering, addressing and routing	I.330–I.339
Connection types	I.340–I.349
Performance objectives	I.350–I.359
Protocol layer requirements	**I.360–I.369**
General network requirements and functions	I.370–I.399
ISDN USER-NETWORK INTERFACES	I.400–I.499
Application of I-series Recommendations to ISDN user-network interfaces	I.420–I.429
Layer 1 Recommendations	I.430–I.439
Layer 2 Recommendations	I.440–I.449
Layer 3 Recommendations	I.450–I.459
Multiplexing, rate adaption and support of existing interfaces	I.460–I.469
Aspects of ISDN affecting terminal requirements	I.470–I.499
INTERNETWORK INTERFACES	I.500–I.599
MAINTENANCE PRINCIPLES	I.600–I.699
B-ISDN EQUIPMENT ASPECTS	I.700–I.799
ATM equipment	I.730–I.749
Management of ATM equipment	I.750–I.799

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION I.363.3

B-ISDN ATM ADAPTATION LAYER SPECIFICATION: TYPE 3/4 AAL

Summary

The ATM Adaptation Layer (AAL) type 3/4 enhances the service provided by the ATM layer to support functions required by the next higher layer. This AAL performs functions required by the user, control and management planes and supports the mapping between the ATM layer and the next higher layer.

The AAL type 3/4 supports the non-assured transfer of user data frames. An internal mulitplexing function allows the establishment of several concurrent AAL type 3/4 user connections on one ATM connection. On each such connection, the data sequence integrity is maintained and transmission errors are detected.

Two new appendices describe the multiplexing AAL type 3/4 connections on an ATM connection using the Multiplexing Identification (MID) field and one procedure for dynamic MID allocation.

Source

ITU-T Recommendation I.363 was prepared by the ITU-T Study Group XVIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993). The current revision which lead to different ITU-T Recommendations (e.g. ITU-T Recommendation I.363.3 for the AAL type 3/4) for the different AAL types was prepared and approved by the ITU-T Study Group 13 (1993-1996) on 27th of August 1996.

Keywords

Asynchronous Transfer Mode (ATM), ATM Adaptation Layer (AAL), Broadband Integrated Services Digital Network (B-ISDN).

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had/had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Page

Recommendation I.363.3

B-ISDN ATM ADAPTATION LAYER SPECIFICATION: TYPE 3/4 AAL

(Geneva, 1996)

1 Scope

This Recommendation describes the AAL type 3/4 and the interactions between the AAL type 3/4 Common Part and the next higher layer, and the AAL type 3/4 Common Part and the ATM layer, as well as AAL type 3/4 Common Part peer-to-peer operations.

This Recommendation is applicable to equipment to be attached to a B-ISDN User Network Interface (UNI) or B-ISDN Network Node Interface (NNI) when the services of the AAL type 3/4 are to be supported.

2 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation I.361 (1995), *B-ISDN ATM layer specification*.

[2] ITU-T Recommendation X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model.*

[3] ITU-T Recommendation X.210 (1993), *Information technology – Open Systems Interconnection – Basic Reference Model: Convention for the definition of OSI services.*

3 Definitions

This Recommendation is based upon the concepts developed in Recommendations X.200 [2] and X.210 [3]. Details of the data unit naming convention used in this Recommendation can be found in Annex A.

4 Abbreviations

This Recommendation uses the following abbreviations:

AAL	ATM Adaptation Layer
AAL-SAP	AAL Service Access Point
AAL-SDU	AAL Service Data Unit
AL	Alignment
ATM	Asynchronous Transfer Mode
ATM-SDU	ATM Service Data Unit
BASize	Buffer Allocation Size

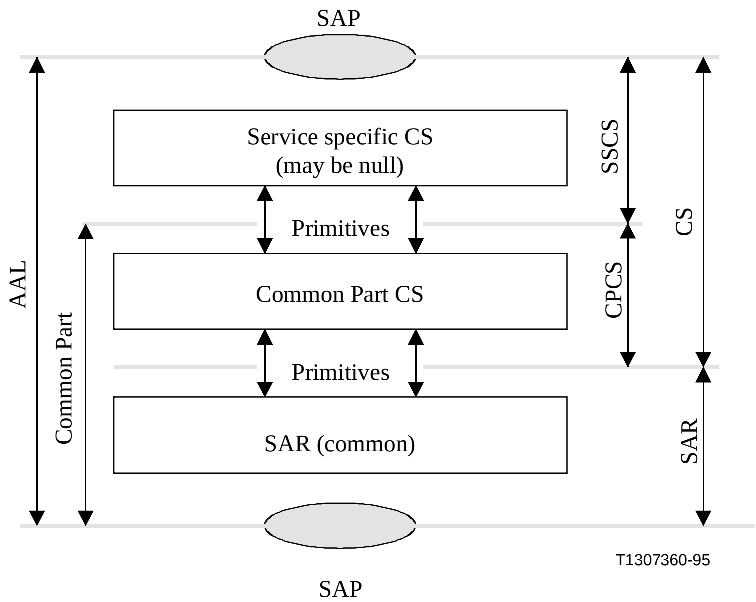
BOM	Beginning of Message
Btag	Beginning Tag
CEP	Connection Endpoint
COM	Continuation of Message
CPCS	Common Part Convergence Sublayer
CPCS-IDU	CPCS Interface Data Unit
CPCS-PDU	CPCS Protocol Data Unit
CPCS-SDU	CPCS Service Data Unit
CPI	Common Part Indicator
CRC	Cyclic Redundancy Check
CS	Convergence Sublayer
EOM	End of Message
Etag	End Tag
ID	Interface Data
Length	Length of CPCS-PDU Payload
LI	Length Indication
LSB	Least Significant Bit
M	More
MID	Multiplexing Identification
ML	Maximum Length
MM	Message Mode
MSB	Most Significant Bit
NNI	Network Node Interface
PAD	Padding
QOS	Quality of Service
RS	Reception Status
SAR	Segmentation and Reassembly (Sublayer)
SAR-PDU	SAR Protocol Data Unit
SAR-SDU	SAR Service Data Unit
SM	Streaming Mode
SN	Sequence Number
SSCS	Service Specific Convergence Sublayer
SSCS-PDU	SSCS Protocol Data Unit
SSM	Single Segment Message
ST	Segment Type
UNI	User Network Interface

5 Conventions

The AAL type 3/4 receives from the ATM layer the information in the form of a 48-octet ATM Service Data Unit (ATM-SDU). The AAL passes to the ATM layer information in the form of a 48-octet ATM-SDU. The primitives between the ATM layer and the AAL type 3/4 are defined in Recommendation I.361 [1].

6 Framework of AAL type 3/4

The Convergence Sublayer (CS) has been subdivided into the Common Part CS (CPCS) and the Service Specific CS (SSCS) as shown in Figure 1. The CPCS and the SAR sublayer are called the "Common Part of the AAL type 3/4". Further clarification can be found in Annex B.



CS	Convergence Sublayer
CPCS	Common Party Convergence Sublayer
SAR	Segmentation and Reassembly Sublayer
SAP	Service Access Point
SSCS	Service Specific Convergence Sublayer

Figure 1/I.363.3 – Structure of the AAL type 3/4

Different SSCS protocols, to support specific AAL services, or groups of services, may be defined. The SSCS may also be null, in the sense that it only provides for the mapping of the equivalent primitives of the AAL to those of the CPCS and vice versa. SSCS protocols are specified in separate Recommendations.

The AAL type 3/4 provides the capabilities to transfer the AAL-SDU from one AAL-SAP to another AAL-SAP through the ATM network (see Figure 2). The AAL users will have the capability to select a given AAL-SAP associated with the QOS required to transport that AAL-SDU (for example, delay and loss sensitive QOS).

The AAL type 3/4 in non-assured operation provides the capability to transfer the AAL-SDUs from one AAL-SAP to more than one AAL-SAP through the ATM Network (see Figure 3).

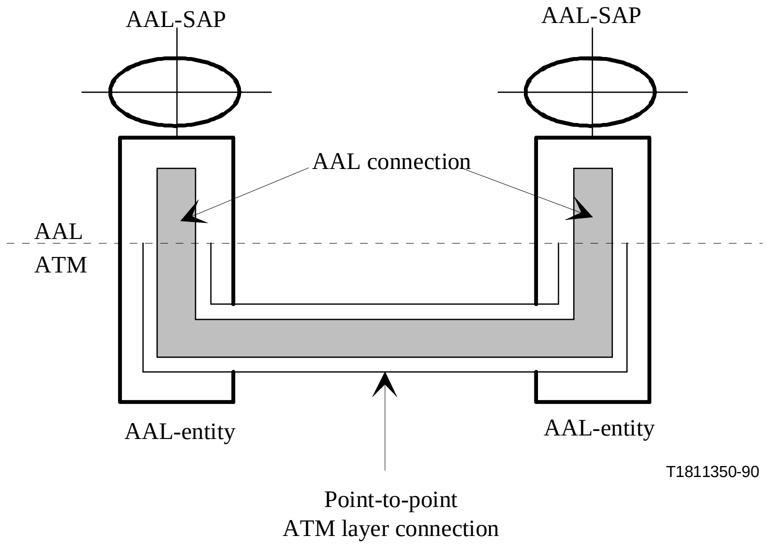


Figure 2/I.363.3 – Point-to-point AAL connection

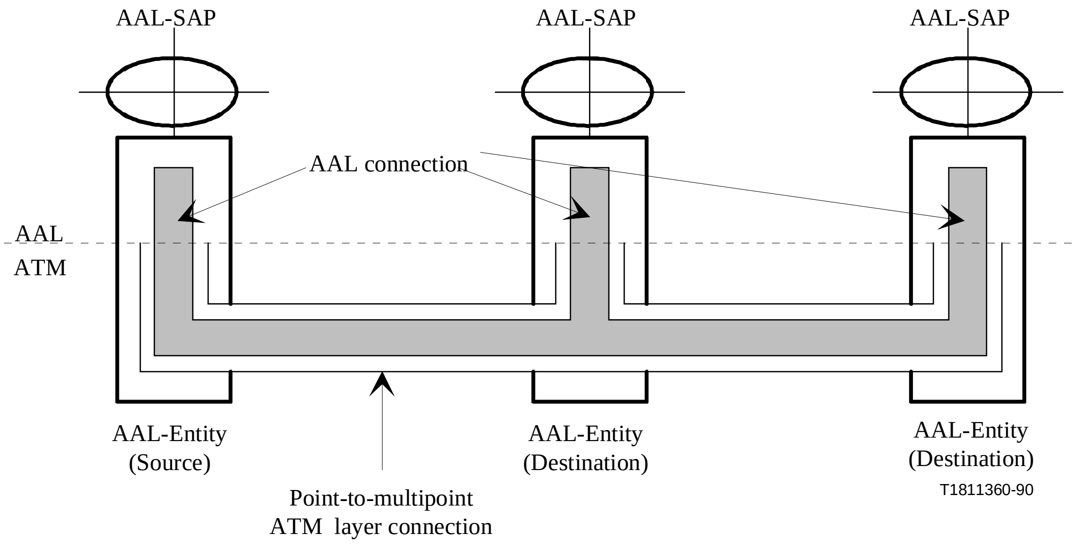
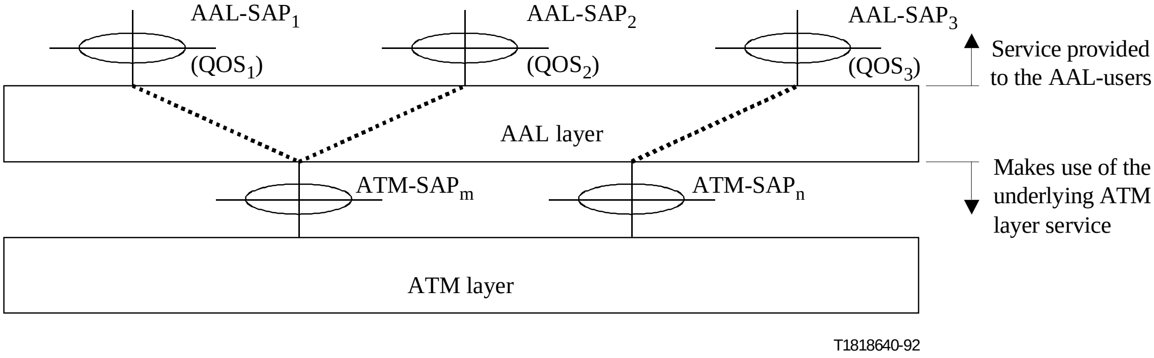


Figure 3/I.363.3 – Point-to-multipoint AAL connection

AAL type 3/4 makes use of the service provided by the underlying ATM layer (see Figure 4). Multiple AAL connections may be associated with a single ATM layer connection, allowing SAR-PDU multiplexing at the AAL. The AAL user selects the QOS provided by the AAL type 3/4 through the choice of the AAL-SAP used for data transfer.



QOS Quality of Service

Figure 4/I.363.3 – Relation between AAL-SAP and ATM-SAP

7 Service provided by the Common Part of the AAL type 3/4

The Common Part of the AAL type 3/4 provides the capabilities to transfer the CPCS-SDU from one CPCS user to another CPCS user, or, when the AAL type 3/4 is operated in non-assured modes to one or more of the CPCS user through the ATM network.

Two modes of service are defined: message and streaming:

i) *Message Mode service* – The CPCS-SDU is passed across the CPCS interface in exactly one CPCS-IDU. This service provides the transport of a single CPCS-SDU in one CPCS-PDU.

ii) *Streaming Mode service* – The CPCS-SDU is passed across the CPCS interface in one or more CPCS-IDUs. The transfer of these CPCS-IDUs across the CPCS interface may occur separated in time. This service provides the transport of all the CPCS-IDUs belonging to a single CPCS-SDU in one CPCS-PDU. An internal pipelining function in the CPCS may be applied which provides the means by which the sending CPCS-entity initiates the transfer to the receiving CPCS-entity before it has the complete CPCS-SDU available. The Streaming Mode service includes an abort service by which the discarding of a CPCS-SDU partially transferred across the interface can be requested.

Both modes of service may offer the following peer-to-peer operational procedures:

– Integral CPCS-SDU may be delivered, lost, or corrupted.

– Lost and corrupted CPCS-SDUs will not be corrected by retransmission. An optional feature may be provided to allow corrupted CPCS-SDUs to be delivered to the user (the corrupted data delivery option is for further study).

– Flow control may be provided as an option; however, this option is for further study.

NOTE – If assured operations are required, they must be provided by the SSCS or by higher layers.

The CPCS has the following service characteristics:

– Non-assured transfer of user data frames with any length measured in octets from 1 to 65 535 octets and with the possibility of further extension (how much it can be extended is for further study).

– One or more "CPCS connections" may be established between two CPCS peer entities utilizing one ATM connection (no switching of CPCS connections will be supported). The maximum number of CPCS connections that can be established is defined by the end system with the lowest capacity.

– The CPCS connections will be established by management or by the control plane.

– Error detection and optional indication (cell loss or gain).
– CPCS-SDU sequence integrity on each CPCS connection.

The functional model for the AAL type 3/4 as contained in Annex C shows the interrelation between the SAR, CPCS and SSCS sublayers, and the SAR and CPCS primitives.

7.1 Primitives for the AAL type 3/4

These primitives are service specific and are contained in separate Recommendations on SSCS protocols.

The SSCS may be null in the sense that it only provides for the mapping of the equivalent primitives of the AAL to CPCS and vice versa. In this case, the primitives for the AAL are equivalent to those for the CPCS (7.2) but identified as AAL-UNITDATA request, AAL-UNITDATA indication, AAL-U-Abort request, AAL-U-Abort indication and AAL-P-Abort indication, consistent with the primitive naming convention at a SAP.

7.2 Primitives for the CPCS of the AAL type 3/4

As there exists no Service Access Point (SAP) between the sublayers of the AAL type 3/4, the primitives are called "invoke" and "signal" instead of the conventional "request" and "indication" to highlight the absence of the SAP.

7.2.1 Primitives for the data transfer service

– *CPCS-UNITDATA invoke and the CPCS-UNITDATA signal*

These primitives are used for the data transfer. The following parameters are defined:

– **Interface Data (ID)**: This parameter specifies the interface data unit exchanged between the CPCS and the SSCS entity. The interface data is an integral multiple of one octet. If the CPCS entity is operating in the message mode service, the interface data represents a complete CPCS-SDU; when operating in the streaming mode service, the interface data does not necessarily represent a complete CPCS-SDU.
– **More (M)**: In the message mode service, this parameter is not used. In the streaming mode service, this parameter specifies whether the Interface Data communicated contains a beginning/continuation of a CPCS-SDU or the end of/complete CPCS-SDU.
– **Maximum Length (ML)**: In the message mode service, this parameter is not used. In the streaming mode service, this parameter indicates the maximum length of the CPCS-SDU. This parameter is required with the first invoke or signal primitive related to a certain CPCS-SDU; in all other cases, this parameter is not used.
– **Reception Status (RS)**: This parameter indicates that the interface data delivered may be corrupted. This parameter is only utilized if the corrupted data delivery option is used.

Depending on the service mode (message or streaming mode service, discarding or delivery of corrupted data), not all parameters are required. This is summarized in Table 1.

Table 1/I.363.3 – Parameters of the CPCS-UNITDATA

Parameter	Type	MM	SM	Comments
Interface Data (ID)	invoke signal	M M	M M	Whole or partial CPCS-SDU
More (M)	invoke signal	– –	M M	M = 0 End of CPCS-SDU M = 1 Not end of CPCS-SDU
Maximum Length (ML)	invoke signal	– –	M* O*	Maximum length of CPCS-SDU
Reception Status (RS)	invoke signal	– O	– O	Indication of corrupted data

MM Message Mode service

SM Streaming Mode service

M Mandatory

O Optional

– Not present

M* Mandatory with the first invoke or signal primitive related to a certain CPCS-SDU, otherwise absent.

O* Optional with the first invoke or signal primitive related to a certain CPCS-SDU, otherwise absent.

7.2.2 Primitives for the abort service

These primitives are used in the streaming mode service:

a) *CPCS-U-Abort invoke and CPCS-U-Abort signal*

These primitives are used by the sending CPCS user to invoke the abort service and to signal to the receiving CPCS user that a partially delivered CPCS-SDU is to be discarded by instruction from its peer entity. No parameters are defined.

This primitive is not used in message mode.

b) *CPCS-P-Abort signal*

This primitive is used by the CPCS entity to signal to its user that a partially delivered CPCS-SDU is to be discarded due to the occurrence of some error in the CPCS or below. No parameters are defined.

This primitive is not used in message mode.

7.3 Primitives for the SAR sublayer of the AAL type 3/4

These primitives model the exchange of information between the SAR sublayer and the CPCS.

As there exists no Service Access Point (SAP) between the sublayers of the AAL type 3/4, the primitives are called "invoke" and "signal" instead of the conventional "request" and "indication" to highlight the absence of the SAP.

7.3.1 Primitives for the data transfer service

– *SAR-UNITDATA invoke and the SAR-UNITDATA signal*

These primitives are used for the data transfer. The following parameters are defined:

1) **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 one octet. The interface data does not necessarily represent a complete SAR-SDU.

2) **More (M)**: This parameter specifies whether the interface data communicated contains the end of the SAR-SDU.

   If the More parameter is set to M=1, the interface data parameter must contain an integral multiple of 44 octets.

3) **Reception Status (RS)**: This parameter indicates that the interface data delivered may be corrupted. This parameter is only utilized if the corrupted data delivery option is used.

7.3.2 Primitives for the abort service

a) *SAR-U-Abort invoke and SAR-U-Abort signal*

   These primitives are used by the sending SAR user to invoke the abort service and by the receiving SAR entity to signal to the receiving SAR user that a partially delivered SAR-SDU is to be discarded by instruction from its peer entity. No parameters are defined.

b) *SAR-P-Abort signal*

   This primitive is used by the SAR entity to signal to its user that a partially delivered SAR-SDU is to be discarded due to the detection of some error. This primitive is only used if the corrupted data delivery option is not used. No parameters are defined.

8 Interaction with the management and control plane

8.1 Management plane

For further study.

8.2 Control plane

There are no interactions between the U-plane and the C-plane in the CPCS and the SAR sublayers. There may be interactions in the SSCS; however, if they exist, they are specified in separate Recommendations on SSCS protocols.

9 Functions, structure and coding of the AAL type 3/4

9.1 Segmentation and Reassembly (SAR) sublayer

9.1.1 Functions of the SAR sublayer

The SAR sublayer functions are performed on an SAR-PDU basis. The SAR sublayer accepts variable length SAR-SDUs from the Convergence Sublayer (CS) and generates SAR-PDUs containing up to 44 octets of SAR-SDU data.

The SAR sublayer functions provide the means for the transfer of multiple variable length SAR-SDUs concurrently over a single ATM layer connection between AAL entities.

a) *Preservation of SAR-SDU*

This function preserves the SAR-SDU by providing for a segment type indication and a SAR-PDU payload length indication. The SAR-PDU payload length indication identifies the number of octets of SAR-SDU information contained within the SAR-PDU payload. The segment type indication identifies a SAR-PDU as a Beginning of Message (BOM), Continuation of Message (COM), End of Message (EOM), or Single Segment Message (SSM).

b) *Error detection and handling*

This function provides the means to detect and handle:

– bit errors in the SAR-PDU;

– lost or gained SAR-PDUs.

SAR-PDUs with bit errors are discarded. An optional feature may be provided to allow corrupted SAR-PDUs to be delivered to the CPCS (corrupted data delivery option). However, if the optional multiplexing and demultiplexing of SAR connections is performed, such an optional corrupted data delivery service may deliver corrupted SAR-SDU to the wrong state machine. SAR-SDUs with lost or gained SAR-PDUs are discarded or are optionally delivered to the CPCS. When delivering corrupted data, an appropriate indication is associated with the information.

c) *SAR-SDU sequence integrity*

This function assures that the sequence of SAR-SDUs is maintained within one SAR connection.

d) *Multiplexing/demultiplexing*

This function provides for the optional multiplexing and demultiplexing of multiple SAR connections. The number of SAR connections supported over an ATM connection shall be negotiated at connection establishment. The default number of SAR connections shall be one. Within a given SAR connection, sequence integrity will be preserved.

e) *Abort*

This function provides for the means to abort a partially transmitted SAR-SDU.

f) *Mapping between SAR connections and ATM connections*

This function provides for the multiplexing/demultiplexing of several SAR connections to/from one ATM connection.

g) *Handling of congestion information*

This function is for further study; it is intended to provide for the passing of congestion information between the (sub)layers above the SAR and the ATM layer in both directions.

h) *Handling of loss priority information*

This function is for further study; it is intended to provide for the passing of cell loss priority information between the (sub)layers above the SAR and the ATM layer in both directions.

9.1.2 SAR-PDU structure and coding

The SAR sublayer require a 2-octet SAR-PDU header and a 2-octet SAR-PDU trailer. The SAR-PDU header and trailer together with the 44 octets of SAR-PDU payload comprise the 48-octet ATM-SDU (cell payload). The sizes and positions of fields for the SAR-PDU structure are given in Figure 5.

The coding of the SAR-PDU conforms to the coding conventions specified in 2.1/I.361. There are two types of SAR-PDU: Data-SAR-PDUs and Abort-SAR-PDUs.

9.1.2.1 Data-SAR-PDU coding

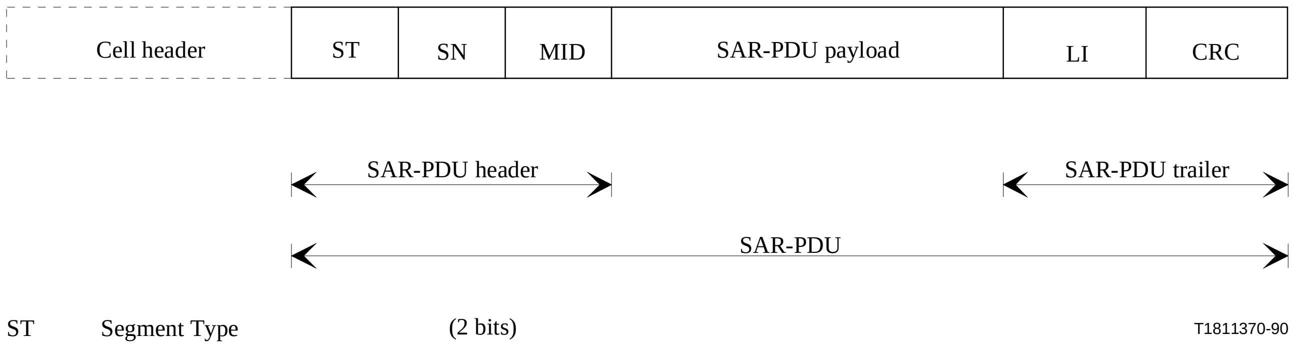
a) *Segment type (ST) field*

The segment type indication identifies a SAR-PDU as containing a Beginning of Message (BOM), a Continuation of Message (COM), an End of Message (EOM), or a Single Segment Message (SSM). The association between the encoding and the meaning of the segment type field is shown in Table 2.

b) *Sequence Number (SN) field*

Four bits are allocated to the sequence Number field allowing the stream of SAR-PDUs of a CPCS-PDU to be numbered modulo 16.

Each SAR-PDU belonging to a SAR-SDU (and hence associated with a given MID value) will have its sequence number incremented by one relative to its previous sequence number. The receiver checks the sequence of the sequence number field of SAR-PDUs derived from one SAR-SDU and does not check the sequence of the sequence number field of the SAR-PDUs derived from successive SAR-SDUs. As the receiver does not check the sequence number continuity between SAR-SDUs, the sender may set the sequence number field to any value from 0 to 15 at the beginning of each SAR-SDU.



ST	Segment Type	(2 bits)
SN	Sequence Number	(4 bits)
MID	Multiplexing Identification	(10 bits)
LI	Length Indication	(6 bits)
CRC	Cyclic Redundancy Check Code	(10 bits)

Figure 5/I.363.3 – SAR-PDU format for AAL type 3/4

Table 2/I.363.3 – Coding of segment type field

Segment type	Encoding	Usage
BOM	10	Beginning of message
COM	00	Continuation of message
EOM	01	End of message
SSM	11	Single segment message

c) *Multiplexing Identification (MID) field*

This field is used for multiplexing. If no multiplexing is used, this field shall be set to zero.

In connection-oriented applications, it may be used to multiplex multiple SAR connections on a single ATM connection. The following restrictions may apply:

– Multiplexing/demultiplexing on a single ATM connection using the MID field will be on a user-to-user basis.
– A single ATM connection containing multiplexed AAL type 3/4 traffic will be administered as a single entity.

In connectionless and connection-oriented applications, all SAR-PDUs of a SAR-SDU will have the same MID field value. The MID field is used to identify SAR-PDUs belonging to a particular SAR-SDU. The MID field assists in the interleaving of SAR-PDUs from different SAR-SDUs and reassembly of these SAR-SDUs.

An implementation of AAL type 3/4 is not obliged to support the full range of MID field values. The mechanism for restricting the range of MID field values is for further study. Examples of possible mechanisms would include those based on dynamic negotiation or on signalling.

Further information on the multiplexing of the AAL type 3/4 connections on an ATM connection using the MID field is given in Appendix I.

d) *SAR-PDU payload field*

The SAR-SDU information is left justified within the SAR-PDU payload field. The remaining octets of the SAR-PDU payload field may be set to "0" and are ignored at the receiving end.

e) *Length Indication (LI) field*

The length indication field is binary encoded with the number of octets of SAR-SDU information that are included in the SAR-PDU payload field. Permissible values of this field, depending on the coding of the segment type field are shown in Table 3. See also Figure B.3 (Combined SAR and CPCS-PDU format).

Table 3/I.363.3 – Permissible values of the length indication field

Segment type	Permissible value
BOM	44
COM	44
EOM	4 ... 44, 63 (Note)
SSM	8 ... 44
NOTE – The value "63" is used in the Abort-SAR-PDU (see 9.1.2.2).	

f) *CRC field*

The CRC field shall be a 10-bit sequence. It shall be the remainder of the division (modulo 2) by the generator polynomial of the product of x^{10} and the content of the SAR-PDU, including the SAR-PDU header, SAR-PDU payload, and length indication field of the SAR-PDU trailer. Each bit of the concatenated fields mentioned above are considered as coefficients (modulo 2) of a polynomial of degree 373. The CRC-10 generator polynomial is:

$$G(x) = 1 + x + x^4 + x^5 + x^9 + x^{10}$$

The result of the CRC calculation is placed with the least significant bit right justified in the CRC field. The CRC-10 is used to detect bit errors in the SAR-PDU.

9.1.2.2 Abort-SAR-PDU coding

The coding of the Abort-SAR-PDU conforms to the structure and coding specified above with the exception that:

1) the segment type field shall be coded as EOM;

2) the payload field may be set to zero and is ignored at the receiving end;

3) the length indication field shall be set to 63.

9.2 Convergence Sublayer (CS)

9.2.1 Functions, structure and coding for the CPCS

9.2.1.1 Functions of the CPCS

The CPCS functions are performed per CPCS-PDU. The CPCS provides several functions in support of the CPCS service user. Some of the functions provided depend on whether the CPCS service user is operating in message or streaming mode:

i) *Message mode service*

The CPCS-SDU is passed across the CPCS interface in exactly one CPCS-IDU. This service provides the transport of a single CPCS-SDU in one CPCS-PDU.

ii) *Streaming mode service*

The CPCS-SDU is passed across the CPCS interface in one or more CPCS-IDUs. The transfer of these CPCS-IDUs across the CPCS interface may occur separated in time. This service provides the transport of all the CPCS-IDUs belonging to a single CPCS-SDU in one CPCS-PDU. An internal pipelining function in the CPCS may be applied which provides the means by which the sending CPCS entity initiates the transfer to the receiving CPCS entity before it has the complete CPCS-SDU available. The Streaming Mode service includes an abort service by which the discarding of a CPCS-SDU partially transferred across the interface can be requested.

The functions implemented by the CPCS include:

a) *Preservation of CPCS-SDU*

This function provides for the delineation and transparency of CPCS-SDUs.

b) *Error detection and handling*

This function provides for the detection and handling of CPCS-PDU corruption. Corrupted CPCS-SDUs are either discarded or are optionally delivered to the SSCS. The procedures for delivery of corrupted CPCS-SDUs are for further study. When delivering corrupted data to the CPCS user, an error indication is associated with the delivery.

Examples of detected errors would include: Btag/Etag mismatch, received length and CPCS-PDU length field mismatch, buffer overflow, improperly formatted CPCS-PDU, and errors indicated by the SAR sublayer.

c) *Buffer allocation size*

This function provides for the indication to the receiving peer entity of the maximum buffering requirements to receive the CPCS-PDU.

d) *Abort*

This function provides for the means to abort a partially transmitted CPCS-SDU.

e) *CPCS-SDU sequence integrity*

This function assures that the sequence of CPCS-SDUs is maintained within one CPCS connection.

f) *Mapping between CPCS connections and SAR connections*

This function provides for the one-to-one mapping between CPCS connections and SAR connections. Neither CPCS connection multiplexing nor splitting is provided.

g) *Handling of congestion information*

This function is for further study; it is intended to provide for the passing of congestion information between the (sub)layers above the CPCS and the SAR in both directions.

h) *Handling of loss priority information*

This function is for further study; it is intended to provide for the passing of cell loss priority information between the (sub)layers above the CPCS and the SAR in both directions.

Other functions are for further study.

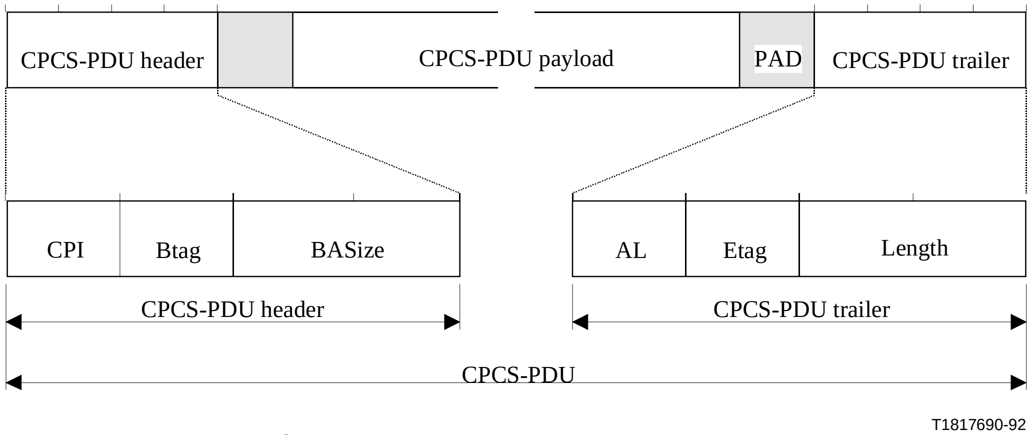
9.2.1.2 CPCS-PDU structure and coding

The CPCS functions require a 4-octet CPCS-PDU header and a 4-octet CPCS-PDU trailer. In addition, a padding field provides for a 32-bit alignment of the CPCS-PDU payload. The CPCS-PDU header and trailer together with the padding field and the CPCS-PDU payload comprise the CPCS-PDU. The sizes and positions of fields for the CPCS-PDU structure are given in Figure 6.

The coding of the CPCS-PDU conforms to the coding conventions specified in 2.1/I.361:

a) *Common Part Indicator (CPI) field*

The CPI field is used to interpret subsequent fields for the CPCS functions in the CPCS-PDU header and trailer. The counting units for the values specified in the BAsize and length fields may be indicated; other uses are for further study. These uses shall be restricted to the CPCS and SAR sublayer functions including the means to identify related AAL layer management messages. These messages in the future could be used to perform layer management functions which may include: performance and fault monitoring, MID allocation, and transfer of OAM messages.



CPI	Common Part Indicator	(1 octet)
Btag	Beginning tag	(1 octet)
BASize	Buffer Allocation Size	(2 octets)
PAD	Padding	(0 ... 3 octets)
AL	Alignment	(1 octet)
Etag	End tag	(1 octet)
Length	Length of CPCS-PDU payload	(2 octets)

Figure 6/I.363.3 – CPCS-PDU format for AAL type 3/4

Table 4 shows the agreed coding of the CPI field and indicates the related semantics of the BAsize and length fields. Additional encodings and uses of the CPI field are for further study.

Table 4/I.363.3 – CPI field encoding

CPI encoding	BAsize field semantics	Length field semantics
00000000	Buffer allocation requirements in octets	Equals length of CPCS-PDU payload in octets
Other values are reserved and are for future standardization.	For further study	For further study

b) *Beginning Tag (Btag) field*

This field allows the association of the CPCS-PDU header and trailer. The sender inserts the same value in the Btag and the Etag in the trailer for a given CPCS-PDU and changes the value for each successive CPCS-PDU. The receiver checks the value of the Btag in the CPCS header with the value of the Etag in the CPCS trailer. It does not check the sequence of the Btag/Etags in successive CPCS-PDUs.

As an example, a suitable mechanism is as follows: The sender increments the value placed in the Btag and Etag fields for each successive CPCS-PDU sent over a given MID value. Btag values are cycled up to modulo 256.

c) *Buffer Allocation Size (BAsize) indication field*

The BAsize field indicates to the receiving peer entity the maximum buffering requirements to receive the CPCS-SDU. In message mode, the BAsize value is encoded equal to the CPCS-PDU payload length. In streaming mode, the BAsize value is encoded equal to or greater than the CPCS-PDU payload length.

The buffer allocation size is binary encoded as number of counting units. The size of the counting units is identified by the CPI field.

NOTE 1 – The length of the CPCS-PDU payload is limited to the maximum value of the BAsize field multiplied by the value of the counting unit.

d) *Padding (PAD) field*

Between the end of the CPCS-PDU payload and the 32-bit aligned CPCS-PDU trailer, there will be from 0 to 3 unused octets. These unused octets are called the Padding (PAD) field; they are strictly used as filler octets and do not convey any information. It may be set to "0" and its value is ignored at the receiving end. This padding field complements the CPCS-PDU payload to an integral multiple of 4 octets.

The function of the PAD field is shown in Figure 7.

e) *Alignment (AL) field*

The function of the alignment field is to achieve 32-bit alignment in the CPCS-PDU trailer. The alignment field complements the CPCS-PDU trailer to 32 bits. This unused octet is strictly used as a filler octet and does not convey any information.

The alignment field shall be set to zero.

f) *End Tag (Etag) field*

For a given CPCS-PDU, the sender shall insert the same value in this field as was inserted in the Btag field in the CPCS-PDU header to allow the association of the CPCS-PDU trailer with its CPCS-PDU header.

g) *Length field*

The length field is used to encode the length of the CPCS-PDU payload field. This field is also used by the receiver to detect the loss or gain of information.

The length is binary encoded as number of counting units. The size of the counting units is identified by the CPI field.

NOTE 2 – The length of the CPCS-PDU payload is limited to the maximum value of the length field multiplied by the value of the counting unit.

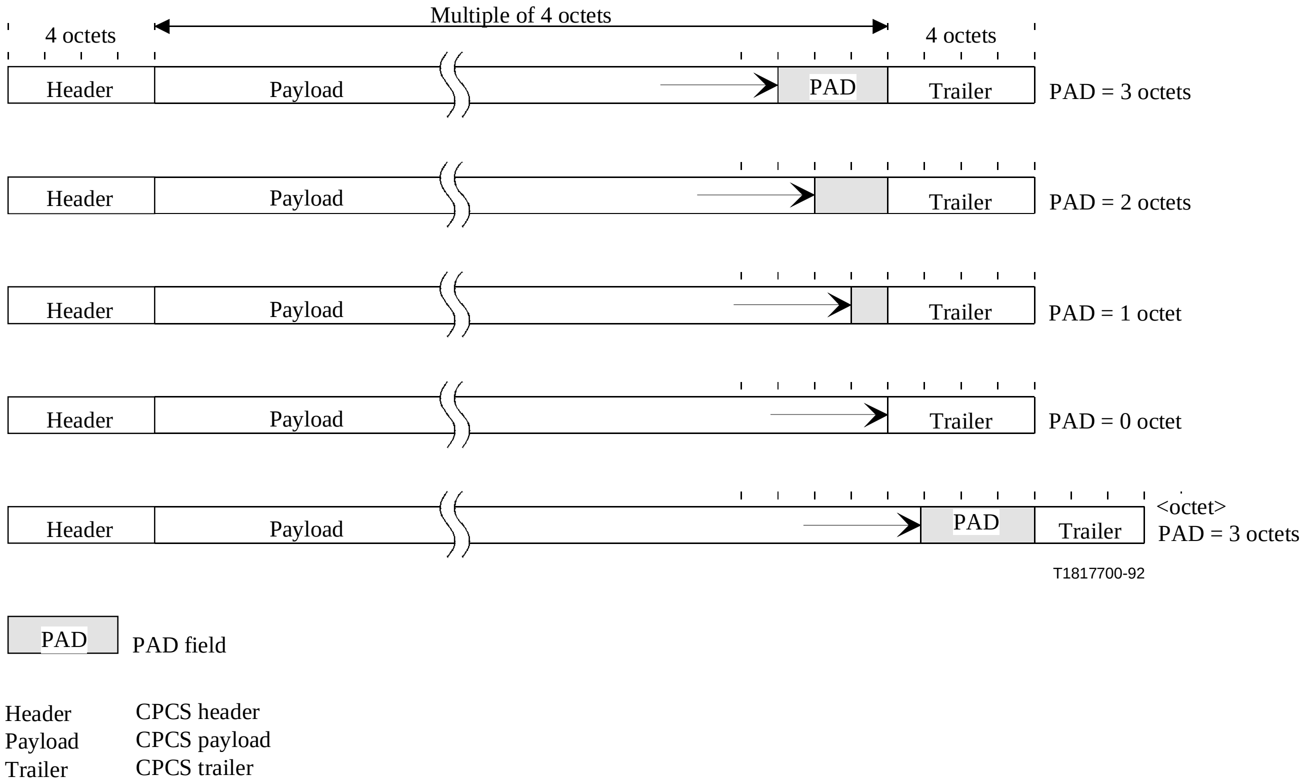


Figure 7/I.363.3 – Function of the PAD field

10 Procedures

There exists one segmentation and reassembly state machine per multiplexing identification (MID) field value. For each such state machine, the value of this field must be known by the protocol state machines. The SDL diagrams of the procedures are given in Annex D. If there exists any difference between the prose description in this clause and the SDL diagrams in Annex D, the SDL diagrams take precedence.

NOTE – Implementations may or may not make the boundary between the CPCS and the SAR sublayer visible and accessible.

10.1 Procedures of the SAR sublayer

The structure and coding of the SAR-PDU is defined in 9.1.2.

10.1.1 State variables of the SAR sublayer at the sender side

The SAR sender maintains the following state variable:

– *snd_SN*

This variable is used to set the sequence number field of the SAR-PDU header. It is incremented modulo 16 after each SAR-PDU of a SAR-SDU has been forwarded to the ATM layer for transmission.

10.1.2 Procedures of the SAR sublayer at the sender side

The state machine of the SAR sender is shown in Figure 8.

Table 5 defines the states for the SAR sender.

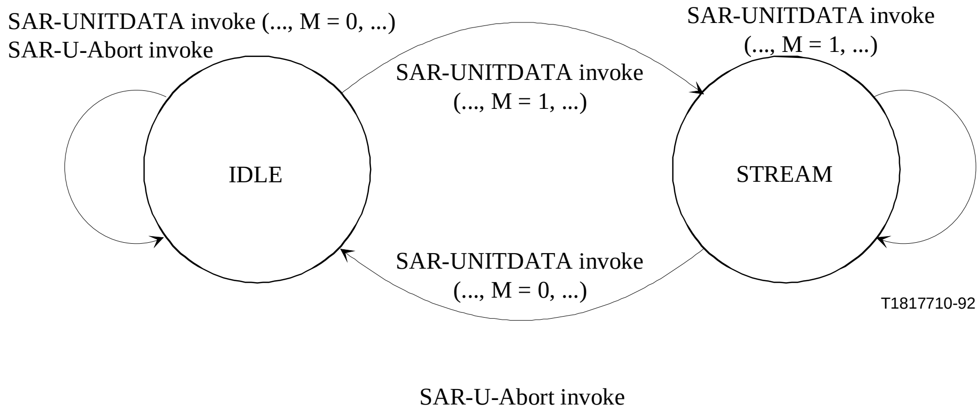


Figure 8/I.363.3 – State transition diagram for the SAR sender

Table 5/I.363.3 – State definitions for the SAR sender

State	Definition
IDLE	Waiting to begin to transmit a new SAR-SDU
STREAM	Transmitting a SAR-SDU in streaming mode

1) When the SAR connection is established, the SAR sender shall proceed to the IDLE state. Whenever entering the IDLE state, the SAR sender may change its state variable snd_SN to any value from 0 to 15.

2) For each SAR-PDU, the SAR sender shall set the MID field to the values governing this state machine. The sequence number field is set to the value of the state variable snd_SN and the state variable snd_SN is incremented by one (modulo 16).

3) Upon receiving a SAR-UNITDATA invoke primitive from the CPCS, the SAR sender shall start the segmenting process. If the Interface Data has a length of more than 44 octets, the SAR sender will generate more than one SAR-PDU. In all SAR-PDUs (except possibly the last one), the SAR-PDU payload field shall be filled with 44 octets of CPCS-PDU information.

4) In each SAR-PDU, the length indication field shall be set to the number of octets of SAR-SDU data carried in the payload and the CRC field shall be computed as specified in 9.1.2.

5) If the SAR sender is in the IDLE state, it shall set the most significant bit of the segment type field in the first SAR-PDU to "1" ("BOM" or "SSM"); in all subsequent SAR-PDUs, this bit shall be set to "0" ("COM" or "EOM"). If the SAR sender is in the STREAM state, the most significant bit of the ST field of all SAR-PDUs shall be set to "0".

6) If the M parameter in the SAR-UNITDATA invoke primitive has the value "0", the SAR sender shall set the least significant bit of the segment type field in the last SAR-PDU to "1" ("EOM" or "SSM"); in all other cases, this bit shall be set to "0" ("BOM" or "COM").

7) Upon completion of the segmenting process, the *resulting complete SAR-PDU's shall be forwarded to the ATM layer.* The SAR sender shall *then* proceed either to the IDLE state or the STREAM state. If the M parameter in the SAR-UNITDATA invoke parameter has the value "0", the SAR sender shall proceed to the IDLE state; otherwise, it shall proceed to the STREAM state.

NOTE 1 – The mechanism of setting parameters AUU, SLP and CI used in the ATM layer primitives is not specified because this is an implementation matter that does not impact interoperability; however, future enhancements may assign functionalities to these parameters.

8) The SAR sender shall ignore a SAR-U-Abort invoke primitive when it is in the IDLE state. When in the STREAM state, the SAR sender shall generate and transmit and Abort-SAR-PDU and proceed to the IDLE state.

NOTE 2 – This description of the SAR sender procedures is valid for all service modes of the CPCS. If the CPCS passes only complete CPCS-PDUs to the SAR sublayer, the state machine remains always in the IDLE state.

10.1.3 State variables of the SAR sublayer at the receiver side

The SAR receiver maintains the following state variable:

– *rcv_SN*

This variable is used to detect loss or gain of SAR-PDUs. After the receipt of an SAR-PDU with a segment type field that indicates "COM" or "EOM", the SAR receiver compares the value in the sequence number field with this state variable. If they are equal, the SAR-PDU is assumed to be in sequence and the rcv_SN is incremented by one (modulo 16).

If the segment type field of a SAR-PDU indicates "BOM" or "SSM", the sequence number field is not compared with rcv_SN; however, the state variable rcv_SN is set to one greater (modulo 16) than the value in the sequence number field.

10.1.4 Procedures of the SAR sublayer at the receiver side

The state machine of the SAR receiver is shown in Figure 9.

Table 6 defines the states for the SAR receiver.

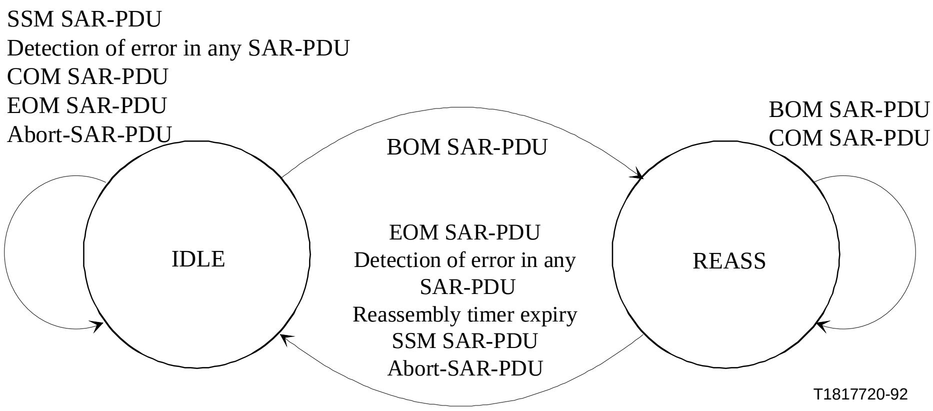


Figure 9/I.363.3 – State transition diagram for the SAR receiver

Table 6/I.363.3 – State definitions for the SAR receiver

State	Definition
IDLE	Waiting to begin to receive a new SAR-SDU
REASS	Receiving a SAR-SDU

The following procedures are specified for an SAR receiver that does not deliver corrupted data to the receiving CPCS. The procedures describing the delivery of corrupted data are for further study.

NOTE – The term "delivery to the CPCS" refers to the communication across the SAR-CPCS sublayer boundary via a SAR-UNITDATA-signal primitive.

1) All illegal SAR-PDUs are ignored. An illegal SAR-PDU is a SAR-PDU with either:
   - a CRC verification error; or
   - an unexpected MID field value.

   NOTE 1 – The discarding of illegal SAR-PDUs actually takes place prior to assigning the SAR-PDU to a reassembly process governed by a particular MID field value.

2) For every SAR-PDU received, the SAR receiver verifies that the value of the length indication field is permissible given the coding of the segment type field (see Table 3 "Permissible values of the Length Indication Field"). If the value is outside the allowed range, the SAR-PDU is discarded. If the SAR receiver is in the REASS state, it shall issue a SAR-P-Abort-signal primitive to the receiving CPCS. In all cases, it shall proceed to the IDLE state.

3) In the absence of errors and irrespective of the state in which the SAR receiver is, the number of octets indicated in the length indication field are sent from the SAR-PDU payload to the CPCS. If the segment type field indicates "EOM" or "SSM", the M parameter is set to "0" and the SAR receiver proceeds to the IDLE state; otherwise, if the segment type field indicates "BOM" or "COM", the M parameter is set to "1" and the SAR receiver proceeds to or remains in the REASS state.

The following error recovery procedures apply:

4) If the SAR receiver is in the IDLE state and receives a SAR-PDU whose segment type field indicates "COM" or "EOM", the SAR receiver shall ignore the SAR-PDU.

5) If the SAR receiver is in the REASS state and receives a SAR-PDU whose segment type field indicates "BOM" or "SSM", the SAR receiver shall issue a SAR-P-Abort-signal to the receiving CPCS; the SAR-PDU shall be processed normally as described in item 3) above.

6) If the SAR receiver is in the REASS state and it receives a SAR-PDU whose value in the sequence number field is not the same as the value of the state variable rcv_SN, it shall issue a SAR-P-Abort-signal to the receiving CPCS; in addition, if the segment type field indicates "COM" or "EOM", the SAR-PDU is discarded and the SAR receiver shall proceed to the IDLE state; otherwise, the SAR-PDU shall be processed normally as described in item 3) above.

7) If the SAR receiver receives an Abort-SAR-PDU and is in the IDLE state, this SAR-PDU shall be ignored; if in the REASS state, the SAR receiver shall issue a SAR-U-Abort-signal primitive and proceed to the IDLE state.

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

8) When after the processing of a SAR-PDU the SAR receiver reaches the REASS state, the reassembly timer shall be (re-) started.

9) If the timer is still running when the SAR receiver transitions from the REASS state to the IDLE state, the timer shall be stopped.

10) If the timer expires (the SAR receiver is in the REASS state), the SAR receiver shall issue a SAR-P-Abort-signal to the receiving CPCS and shall proceed to the IDLE state.

Other reassembly timer procedures are for further study.

NOTE 2 – The timer value may be dependent on the AAL connection but is not specified in this Recommendation.

10.2 Procedures of the CPCS for the message mode service

The structure and coding of the CPCS-PDU are defined in 9.2.1.2.

10.2.1 State variables of the CPCS at the sender side

The CPCS sender maintains the following state variable:

– *snd_BEtag*

This variable is used to set the Btag field in the CPCS-PDU header and the Etag field in the CPCS-PDU trailer.

10.2.2 Procedures of the CPCS at the sender side for the message mode service

The state machine of the CPCS sender is shown in Figure 10.

Table 7 defines the states for the CPCS sender.

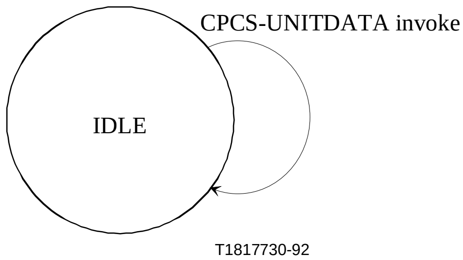


Figure 10/I.363.3 – State transition diagram for the CPCS sender

Table 7/I.363.3 – State definitions for the CPCS sender

State	Definition
IDLE	Waiting to transmit a new CPCS-SDU

1) When the CPCS connection is established, the CPCS sender shall set its state variable snd_BEtag to any value from 0 to 255.

2) Upon receiving an CPCS-UNITDATA invoke from the CPCS user, the CPCS sender shall construct the CPCS-PDU header, place the received CPCS-SDU into the CPCS-PDU payload, construct the PAD field and construct the CPCS-PDU trailer. The CPCS-PDU is then forwarded in its entirety (i.e. the M parameter is set to "0") to the SAR sublayer via the SAR-UNITDATA invoke primitive for segmentation and transmission.

3) After forwarding the CPCS-PDU to the SAR sublayer, the CPCS sender shall modify its state variable snd_BEtag. This modification must assure that the CPCS receiver can unambiguously associate the CPCS-PDU header and trailer of every CPCS-PDU even in the presence of loss of information (cell losses across CPCS-PDU boundaries). At the minimum, the snd_BEtag shall be set to any value different from the current one (modulo 256).

NOTE – A suitable mechanism is to increment the state variable snd_BEtag by one (modulo 256) after each CPCS-PDU.

10.2.3 State variables of the CPCS at the receiver side

The CPCS receiver maintains the following state variables:

1) *rcv_BEtag*

   This variable is used to assure that a received CPCS-PDU trailer belongs to the CPCS-PDU currently being reassembled. This is achieved by copying the Btag field value to this state variable when processing the CPCS-PDU header; when processing the associated CPCS-PDU trailer, the value in the Etag field is compared to the value in the state variable.

2) *rcv_BAsize*

   This variable is used to assure that attempts to assemble CPCS-PDUs that are longer than the requested BAsize will fail.

10.2.4 Procedures of the CPCS at the receiver side

The state machine of the CPCS receiver is shown in Figure 11.

Table 8 defines the states for the CPCS receiver.

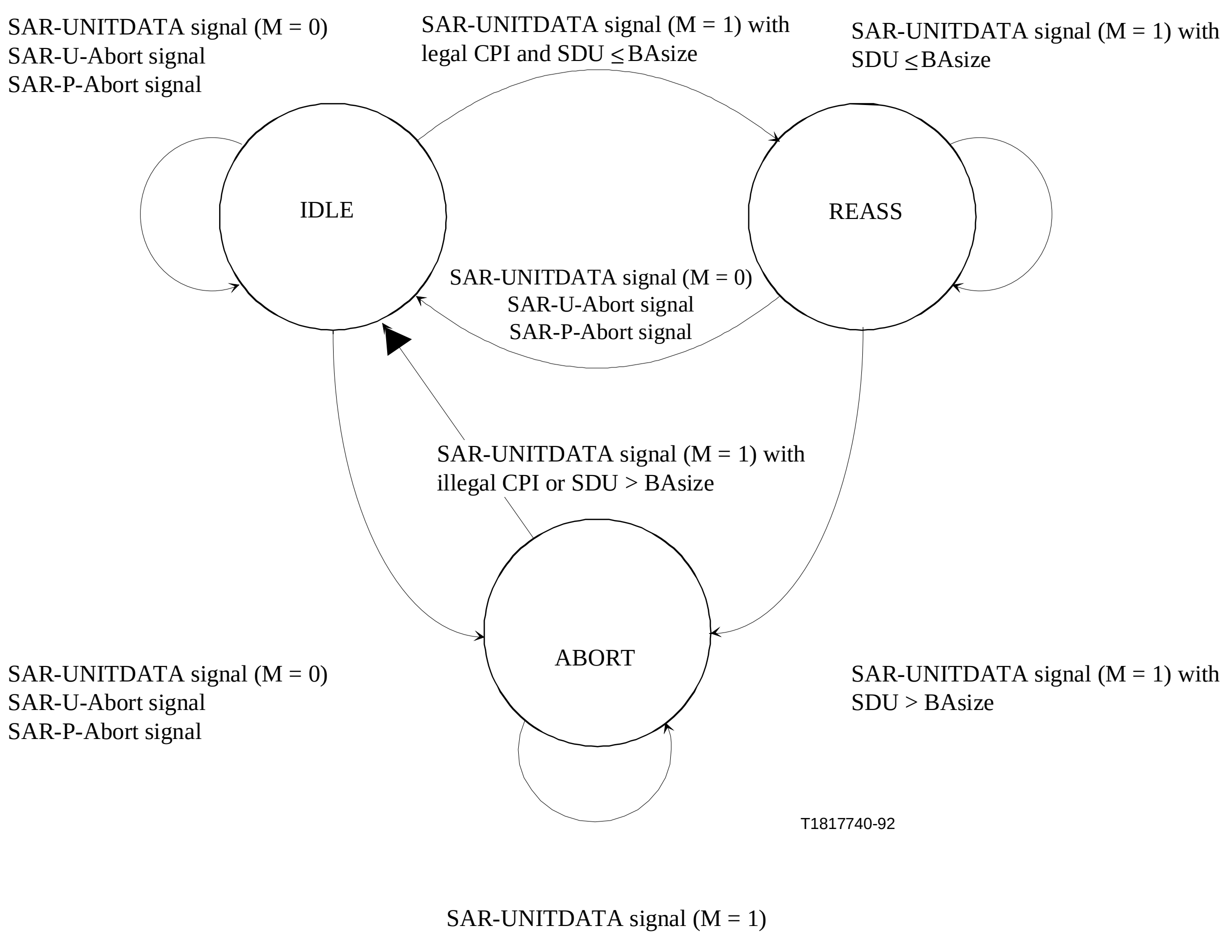


Figure 11/I.363.3 – State transition diagram for the CPCS receiver

Table 8/I.363.3 – State definitions for the CPCS receiver

State	Definition
IDLE	Waiting to begin to reassemble a new CPCS-PDU
REASS	Reassembling a CPCS-PDU
ABORT	Aborting an illegal CPCS-PDU

The following procedures are specified for a CPCS receiver that does not recognize CPI values other than "0" and does not deliver corrupted data to the receiving CPCS user. Procedures for the corrupted data delivery are for further study.

1) When the CPCS receiver is in the IDLE state and it receives a SAR-UNITDATA signal primitive from the SAR sublayer, the first four octets of the information represent the CPCS-PDU header.

   If the CPI field in the CPCS-PDU header is illegal, the CPCS receiver shall proceed to the ABORT state if the M parameter is set to "1" or to the IDLE state if the M parameter is set to "0". Otherwise, the CPCS receiver shall copy the value of the Btag field into the rcv_BEtag state variable. It also shall set the state variable rcv_BAsize to the value of the BAsize field. The allocation of a reassembly buffer with at least the size indicated in the state variable rcv_BAsize is implementation dependent.

   NOTE 1 – This procedure description may copy up to three octets of the PAD field into the reassembly buffer before processing the CPCS-PDU trailer.

   NOTE 2 – When the CPCS receiver is in the REASS state and it receives a SAR-UNITDATA signal primitive from the SAR sublayer, no CPCS-PDU header information is present.

2) When the CPCS receiver is in the IDLE state or the REASS state and it receives a SAR-UNITDATA signal primitive from the SAR sublayer with the M parameter set to "0", the last four octets of the information represents the CPCS-PDU trailer. If the alignment field in the CPCS-PDU trailer is not equal to zero, the CPCS receiver shall free the reassembly buffer and proceed to or remain in the IDLE state.

   The CPCS receiver shall verify that the value of the Etag field is equal to the value in the rcv_BEtag state variable. If they are not equal, the CPCS receiver shall free the reassembly buffer and proceed to or remain in the IDLE state.

   If the value of the length field in the CPCS-PDU trailer is greater than the already reassembled information in the reassembly buffer plus the information in the interface data of the primitive currently processed (without the CPCS-PDU trailer and the CPCS-PDU header), the CPCS receiver shall free the reassembly buffer and proceed to or remain in the IDLE state.

   If the value of the length field in the CPCS-PDU trailer is less than the already reassembled information in the reassembly buffer plus the information in the interface data of the primitive currently processed (without the CPCS-PDU trailer and the CPCS-PDU header) minus 3, the CPCS receiver shall free the reassembly buffer and proceed to or remain in the IDLE state.

   If the already reassembled information in the reassembly buffer plus the information in the interface data of the primitive currently processed (without the CPCS-PDU trailer and the CPCS-PDU header) is greater than the state variable rcv_BAsize plus the maximum pad field length, the CPCS receiver shall free the reassembly buffer and proceed to or remain in the IDLE state.

If no errors have been detected, the CPCS receiver shall copy the information in the interface data of the primitive currently processed (without the CPCS-PDU trailer and possibly the CPCS-PDU header) to the reassembly buffer. The CPCS receiver shall then send the reassembled CPCS-SDU to the CPCS user in the interface data of a CPCS-UNITDATA signal primitive; the amount of information in the interface data is equal to the value of the length field of the CPCS-PDU trailer. It shall also free the reassembly buffer, and proceed to or remain in the IDLE state.

3) When the CPCS receiver is in the IDLE state or the REASS state and it receives a SAR-UNITDATA signal primitive from the SAR sublayer with the M parameter set to "1", no CPCS-PDU trailer is present.

   If the already reassembled information in the reassembly buffer plus the information in the interface data of the primitive currently processed (without possibly the CPCS-PDU header) is greater than the state variable rcv_BAsize plus the maximum pad field length, the CPCS receiver shall free the reassembly buffer and proceed to the ABORT state. Otherwise, the CPCS receiver shall copy the information in the interface data of the primitive currently processed (without possibly the CPCS-PDU header) to the reassembly buffer and proceed to or remain in the REASS state.

4) If the CPCS receiver receives a SAR-U-Abort signal or a SAR-P-Abort signal primitive from the SAR sublayer while in the IDLE state, the primitive shall be ignored; when in the REASS state, the CPCS receiver shall free the reassembly buffer and proceed to the IDLE state.

5) If the CPCS receiver is in the ABORT state and it receives a SAR-UNITDATA signal primitive with the M parameter set to "1", the primitive shall be ignored and the CPCS receiver shall remain in the ABORT state.

   However, if in the ABORT state the CPCS receiver receives a SAR-U-Abort or SAR-P-Abort signal primitive or a SAR-UNITDATA signal primitive with the M parameter set to "0", the CPCS receiver shall proceed to the IDLE state.

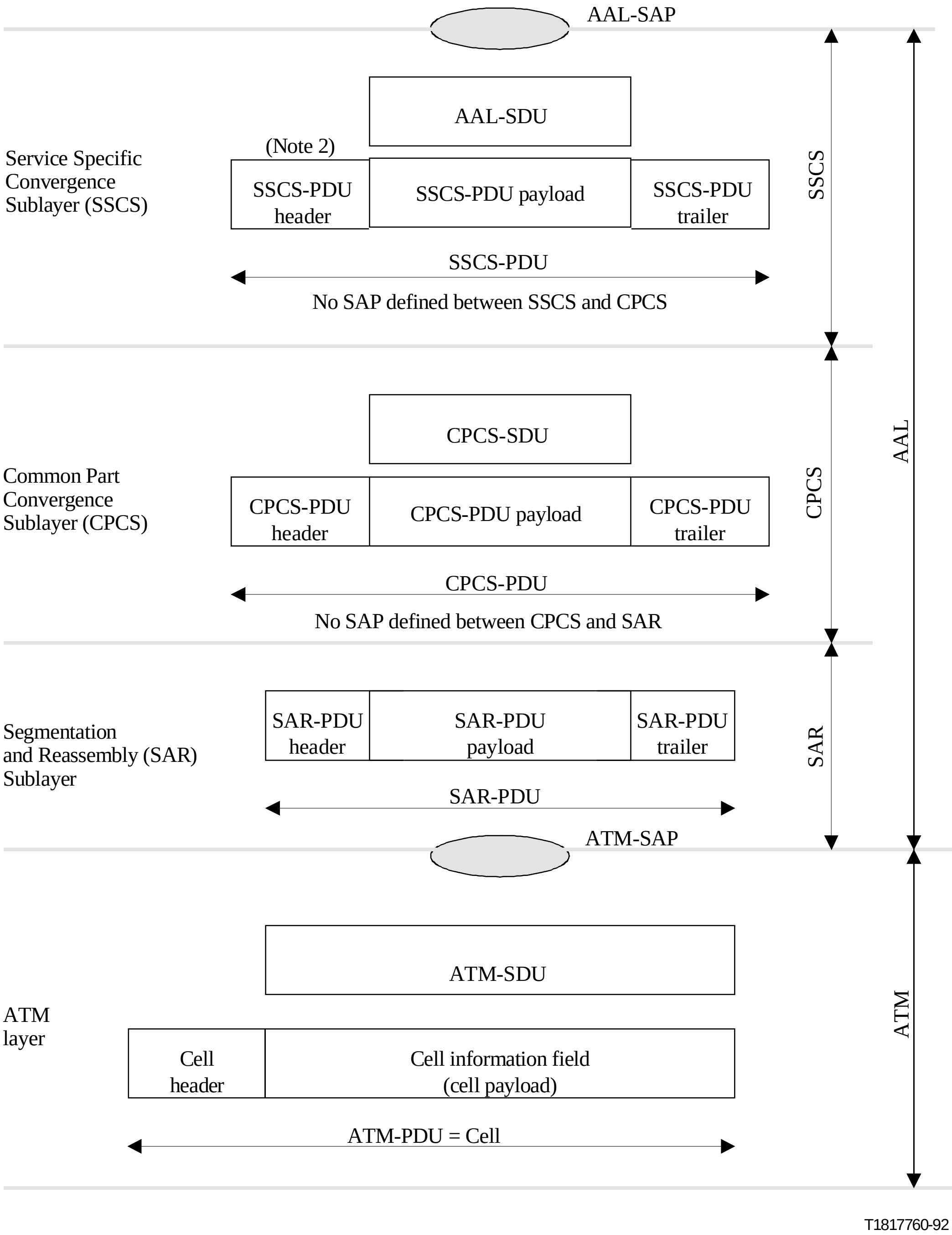
10.3 Procedures of the CPCS for the streaming mode service

These procedures are for further study.

ANNEX A

Details of the data unit naming convention

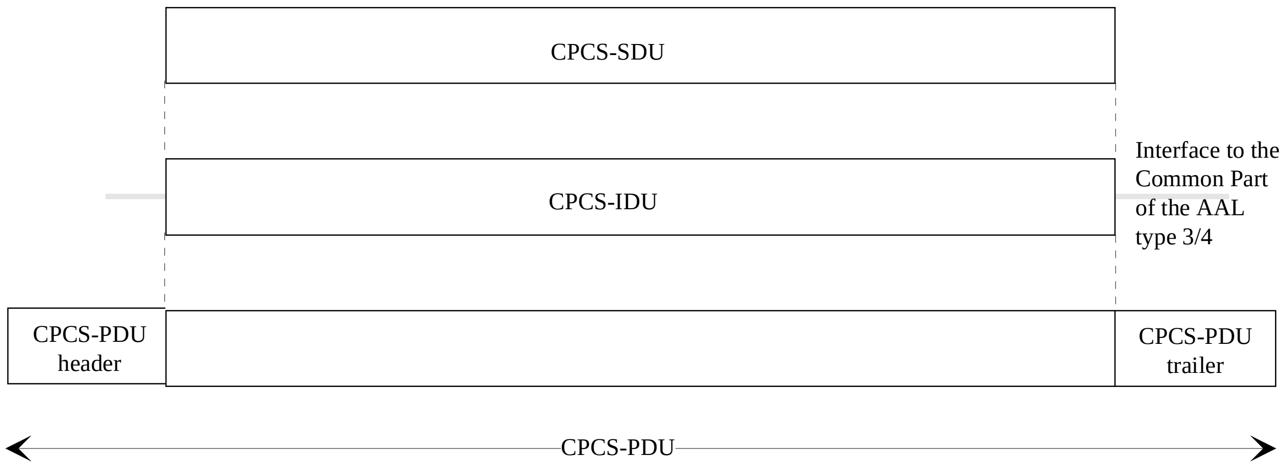
Details of the data unit naming convention are given in Figures A.1 and A.2.



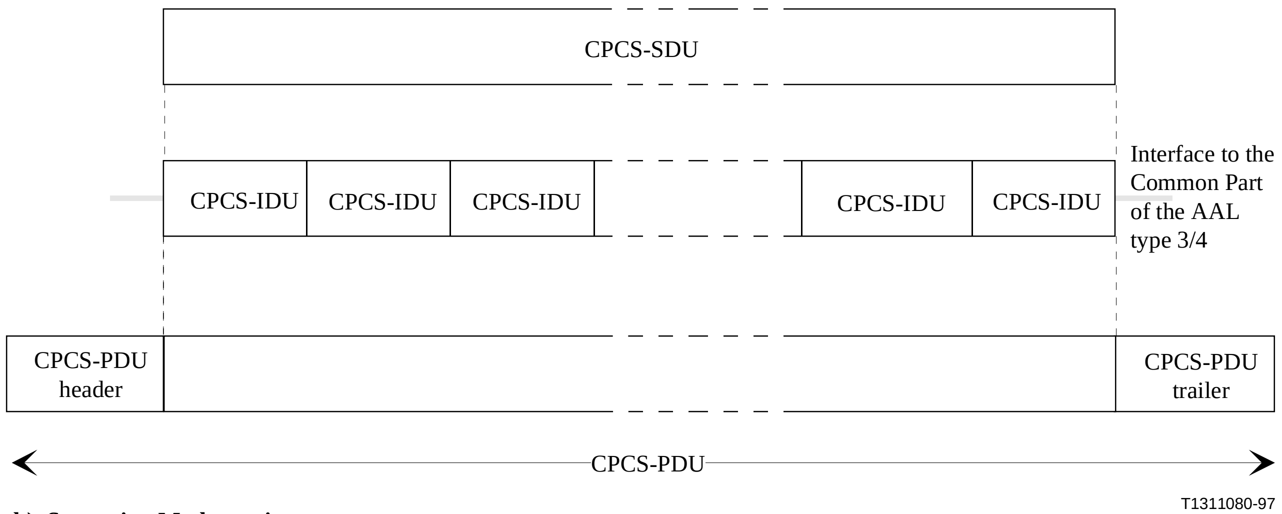
NOTE 1 – Figure A.1 indicates the naming of the AAL data units only. It is not implied that all fields are present in all cases. See Annex D for a list of abbreviations.

NOTE 2 – The exact structure of the SSCS-PDU is for further study.

Figure A.1/I.363.3 – Data unit naming conventions of the AAL type 3/4



a) Message Mode service



b) Streaming Mode service

Figure A.2/I.363.3 – Message and streaming mode of service at the Common Part AAL type 5 interface

ANNEX B

General framework of the AAL type 3/4

This annex provides a description of the general framework of the AAL type 3/4, including SAR and CPCS-PDU formats.

B.1 Message segmentation and reassembly

Figure B.1 provides a generic interpretation of the segmenting of a message into Beginning of Message (BOM), Continuation of Message (COM) and End of Message (EOM). Short messages are represented as a Single Segment Message (SSM).

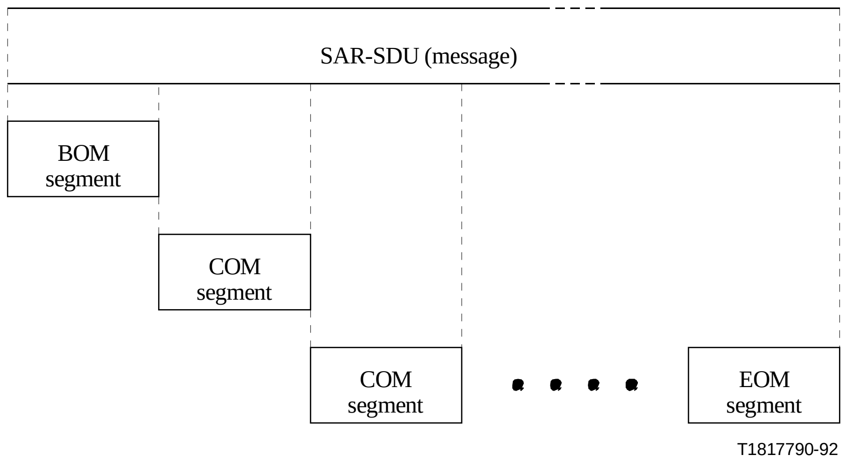


Figure B.1/I.363.3 – Message segmentation and reassembly

B.2 PDU headers, trailers and terminology

Figure B.2 builds on the generic view of message segmentation of Figure B.1 to incorporate the relevant PDU headers and trailers and appropriate terminology on the basis of BOM, COM and EOM which is of particular relevance to the combined SAR and CPCS-PDU formats of Figure B.3.

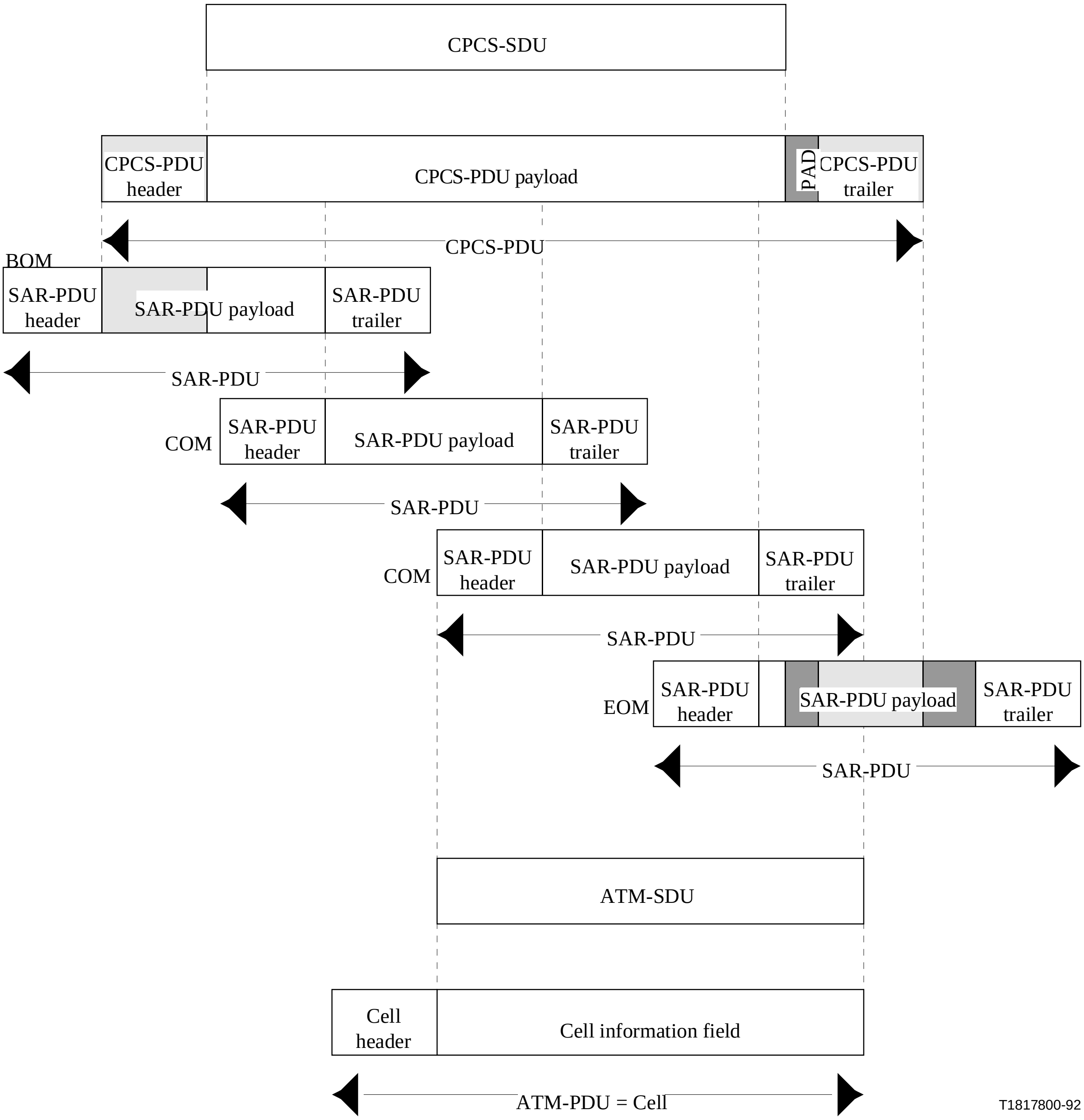
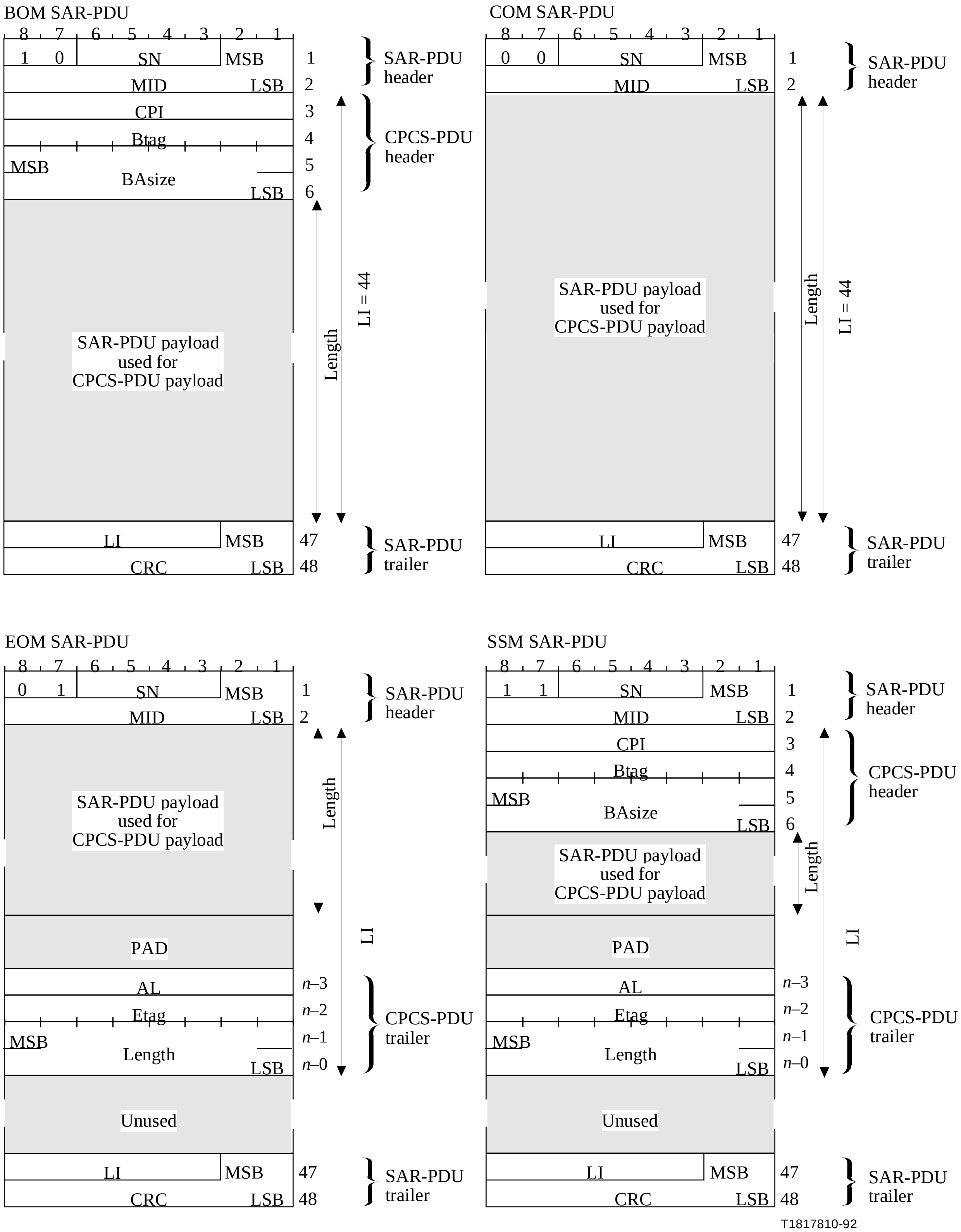


Figure B.2/I.363.3 – PDU headers, trailers, and terminology

B.3 SAR and CPCS format

Figure B.3 illustrates the combined SAR and CPCS-PDU format on a segment-by-segment basis.

The definition of the encoding and functions associated with the fields is described in 9.1.2 and 9.2.1.2.

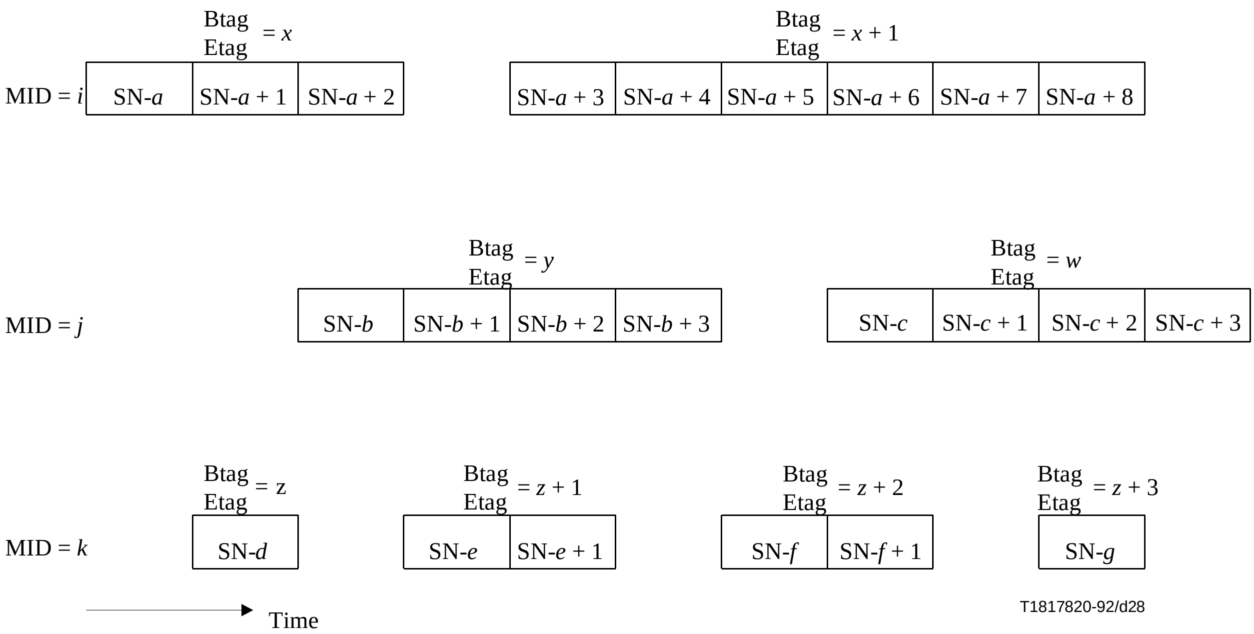


ST	Segment Type	Etag	End Tag
SN	Sequence Number	BAsize	Buffer Allocation size
MID	Multiplexing Identification	AL	Alignment
LI	Length Indicator	Length	CPCS-PDU payload length
CRC	Cyclic Redundancy Check	MSB	Most significant bit
CPI	Common Part Indicator	LSB	Least significant bit
Btag	Begin Tag		

Figure B.3/I.363.3 – Combined SAR and CPCS-PDU format

B.4 Relation of the MID field to the SN field and Btag/Etag fields

As an example, the following Figure B.4 illustrates the possible relation of the MID field values to the SN field and Btag/Etag field values for the AAL type 3/4.



NOTE – Modulo 16 and modulo 256 apply to determine the SN field and the Btag/Etag fields.

Figure B.4/I.363.3 – The relation of MID field values to the SN field and Btag/Etag field values for the AAL type 3/4

B.5 Examples of the segmentation and reassembly process

Figure B.5 shows schematically a successful segmentation and reassembly of a CPCS-SDU in message mode. In Figure B.6, a SAR-PDU is assumed lost due to a transmission error, hence, the reassembly cannot be completed.

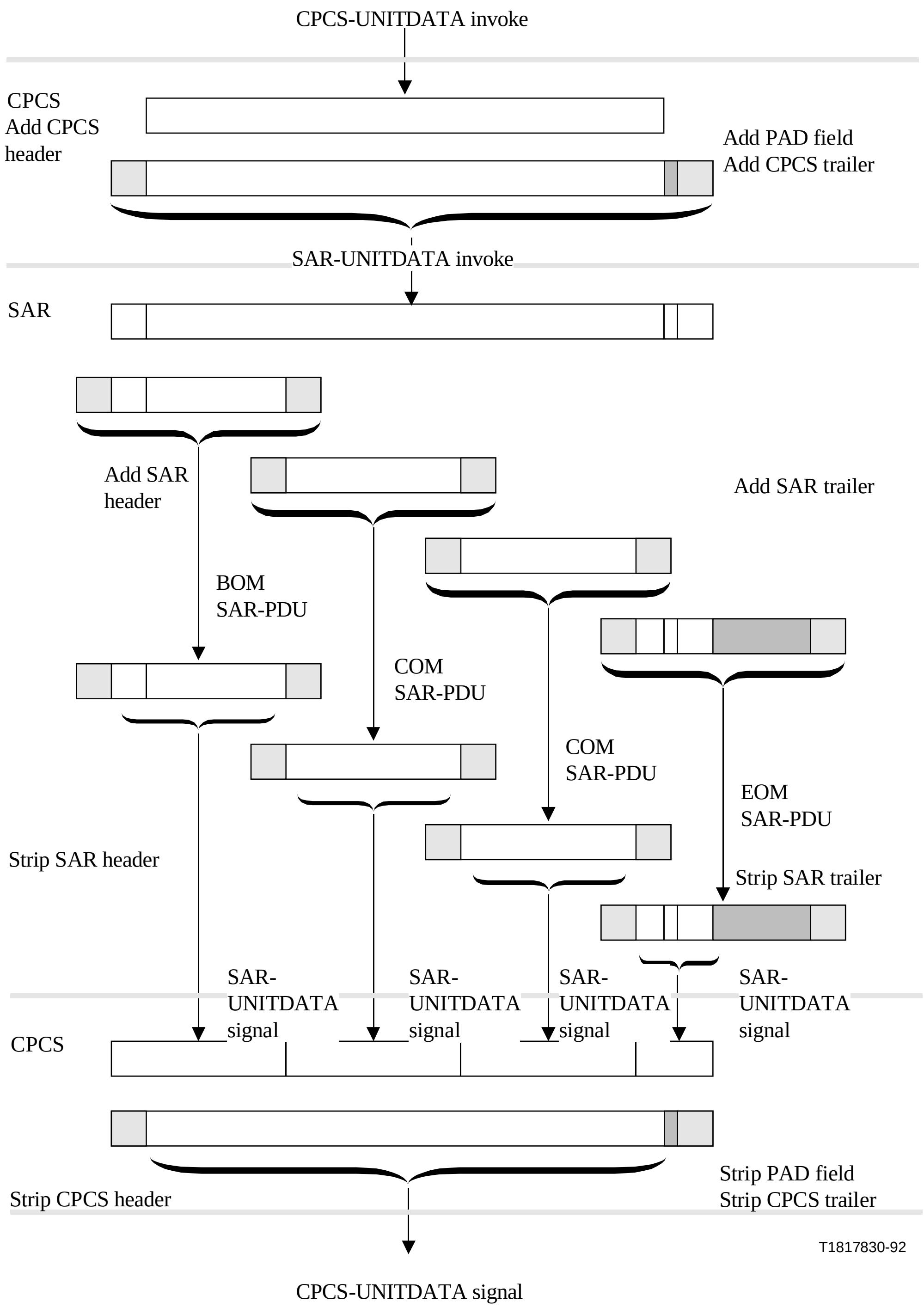


Figure B.5/I.363.3 – Successful segmentation and reassembly of a CPCS-SDU

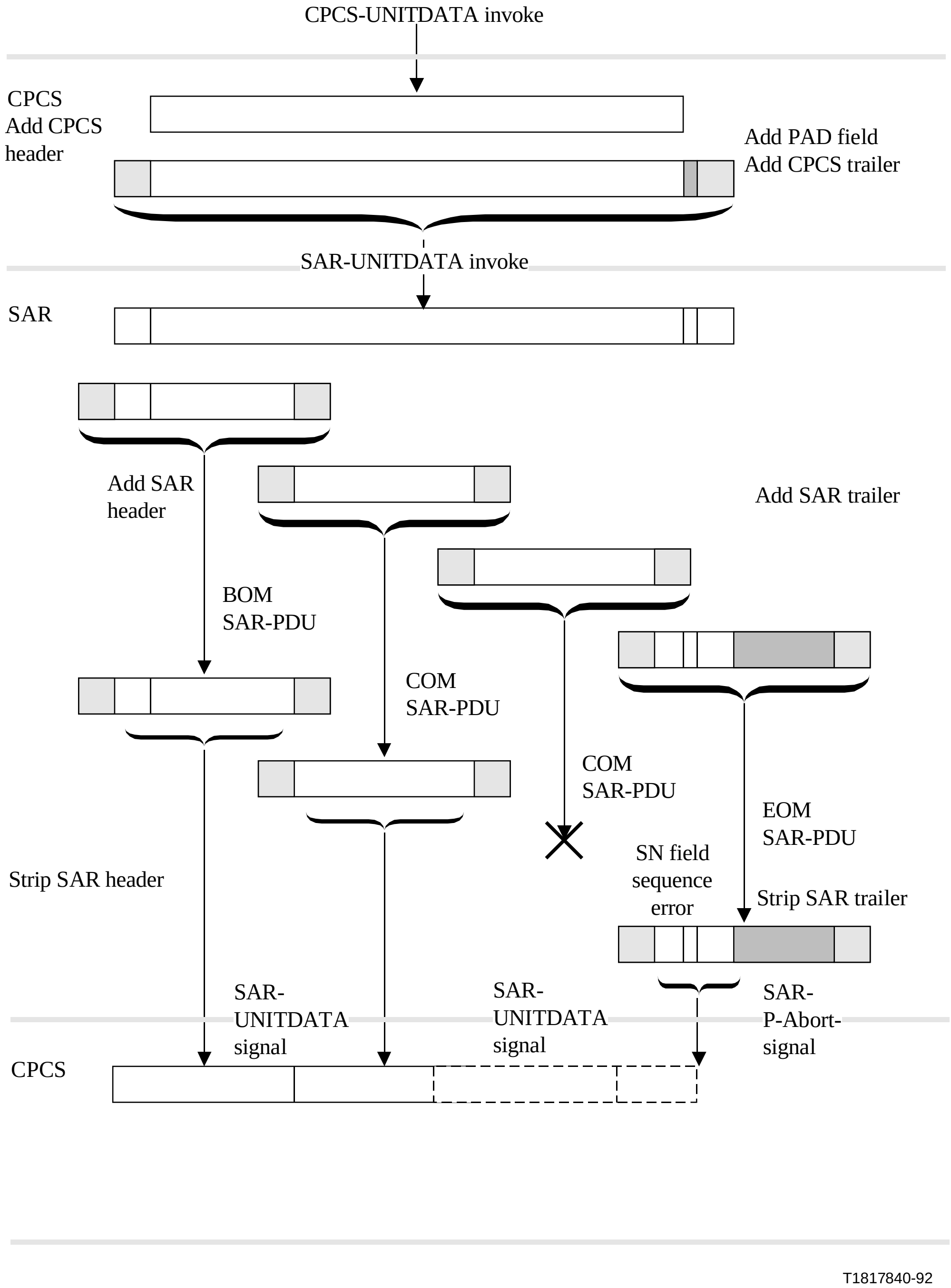


Figure B.6/I.363.3 – Segmentation and unsuccessful reassembly of a CPCS-SDU

ANNEX C

Functional model for the AAL type 3/4

For the AAL type 3/4, the functionality of the SSCS may provide only for the mapping of the equivalent primitives of the AAL to the CPCS and vice versa. The SSCS may also implement functions such as assured data transfer, etc. Such functions, however, are not shown in the following figures.

The functional model of the AAL type 3/4 at the sender side is shown in Figure C.1. The model consists of several blocks that cooperate to provide the AAL type 3/4 services. Each SAR and CPCS block that are paired represent one segmentation state machine.

The interleaver allocates the available bit rate of the ATM connection to the SAR-PDUs generated by the segmentation state machines according to some internal policy.

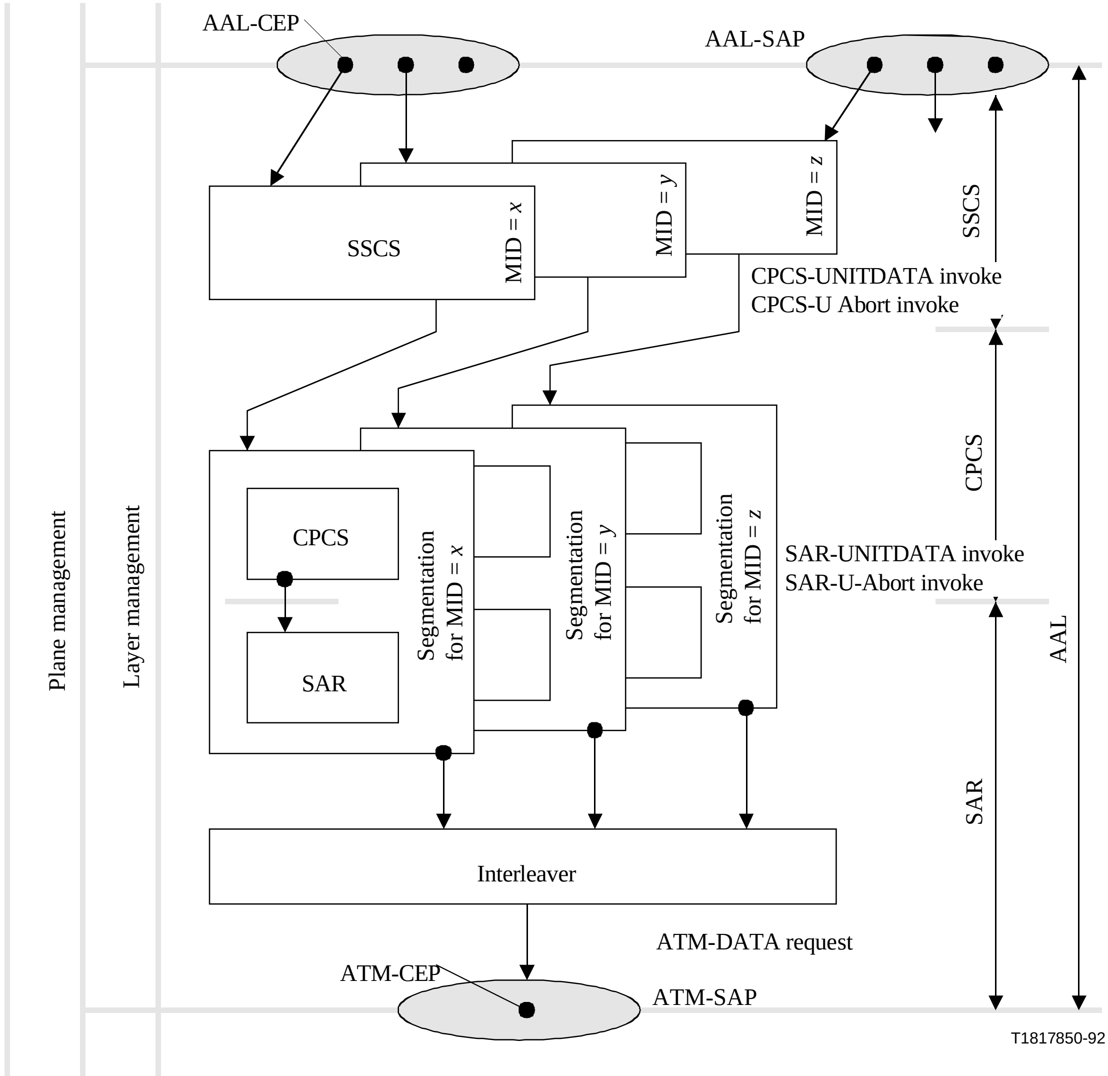


Figure C.1/I.363.3 – Functional model for the AAL type 3/4 (Sender side)

The functional model of the AAL type 3/4 at the receiver side is shown in Figure C.2. The model consists of several blocks that cooperate to provide the AAL type 3/4 services. Each SAR and CPCS block that are paired represent one reassembly state machine. The dispatcher routes the primitives from the ATM layer to the appropriate reassembly state machine based on the value of the MID field within the SAR-PDU.

NOTE – Layer management interactions require further study.

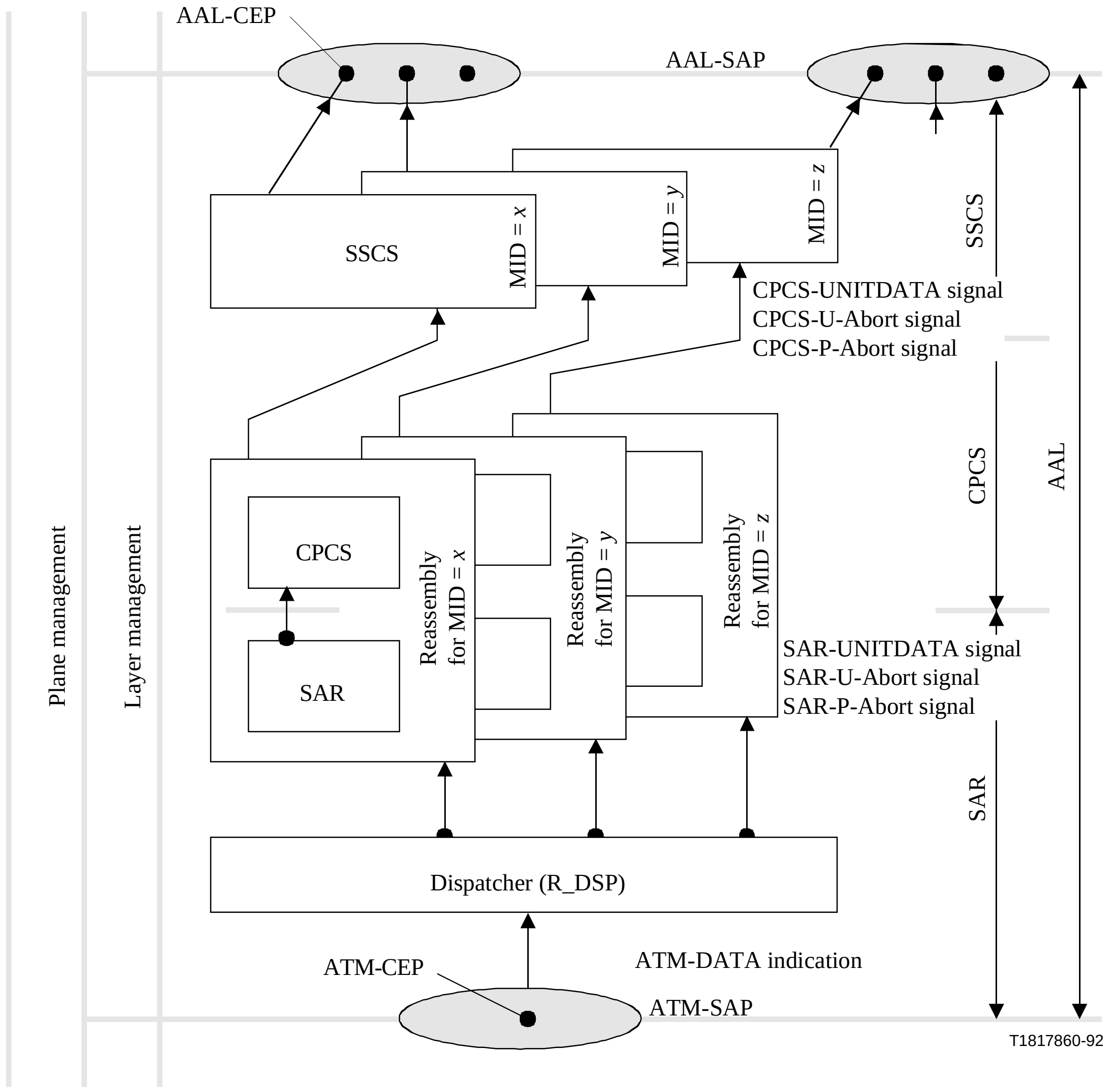


Figure C.2/I.363.3 – Functional model for the AAL type 3/4 (Receiver side)

ANNEX D

SDL diagrams for the SAR and the CPCS of the AAL type 3/4

Procedures for delivery of corrupted data are not included in this annex; CPCS procedures for streaming mode are not included in this annex.

NOTE – Implementations may or may not make the boundary between the CPCS and the SAR sublayer visible and accessible.

D.1 SDL for the SAR sublayer

NOTE – The SDL diagrams in Figures D.1 and D.2 represent the SAR for one MID field value.

D.1.1 The SAR sender

The SAR sender makes use of the state variable snd_SN (as defined in 10.1.1). In addition, it utilizes five further variables:

a) *ptrPDU*

This is a temporary variable that points into the (partial) CPCS-PDU received via the SAR-UNITDATA invoke primitive. As successive parts of the CPCS-PDU are filled into SAR-PDU payloads, this pointer keeps pointing at the first octet within the CPCS-PDU that has not yet been sent within a SAR-PDU.

b) *len*

This temporary variable is set to the length of the (partial) CPCS-PDU received via the SAR-UNITDATA invoke primitive.

c) *count*

This temporary variable keeps track of the number of octets still awaiting segmentation and transmission within a SAR-PDU.

d) *snd_ST*

This temporary variable is used to set the ST field of the SAR-PDU header. It can take the values: "BOM", "COM", "EOM" or "SSM".

e) *snd_MID*

This variable contains the value of the MID field that is put into every SAR-PDU.

The primitive MAAL-ID is used in the SAR sender. Its only parameter communicates a MID field value from layer management to the SAR sender. The details of this primitive and all other interactions with layer management are for further study.

D.1.2 The SAR receiver

The SAR receiver makes use of the state variable rcv_SN (as defined in 10.1.3). It utilizes no further variables.

All illegal SAR-PDUs are ignored. An illegal SAR-PDU is a SAR-PDU with either:

– a CRC verification error; or

– an unexpected MID field value.

NOTE 1 – The discarding of illegal SAR-PDUs actually takes place prior to assigning the SAR-PDU to a reassembly process governed by a particular MID field value; hence, this is not shown in the SDL diagrams.

NOTE 2 – No interactions with layer management are shown; these interactions require further study.

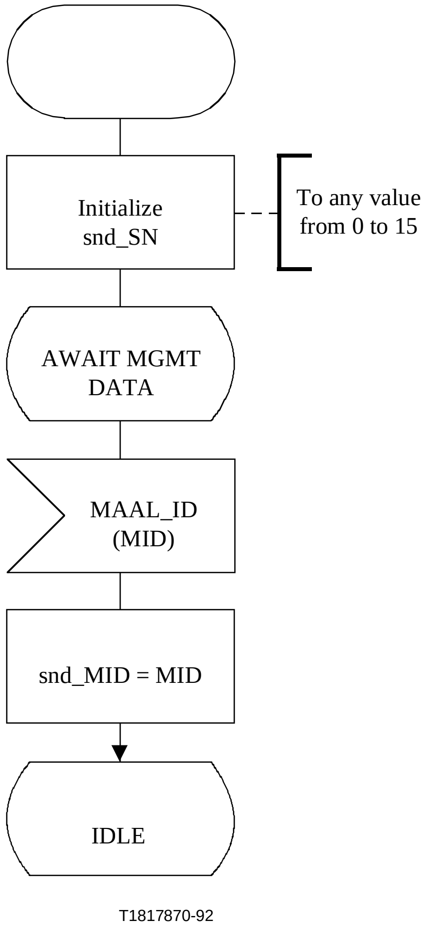


Figure D.1/I.363.3 (sheet 1 of 5) – SAR sender

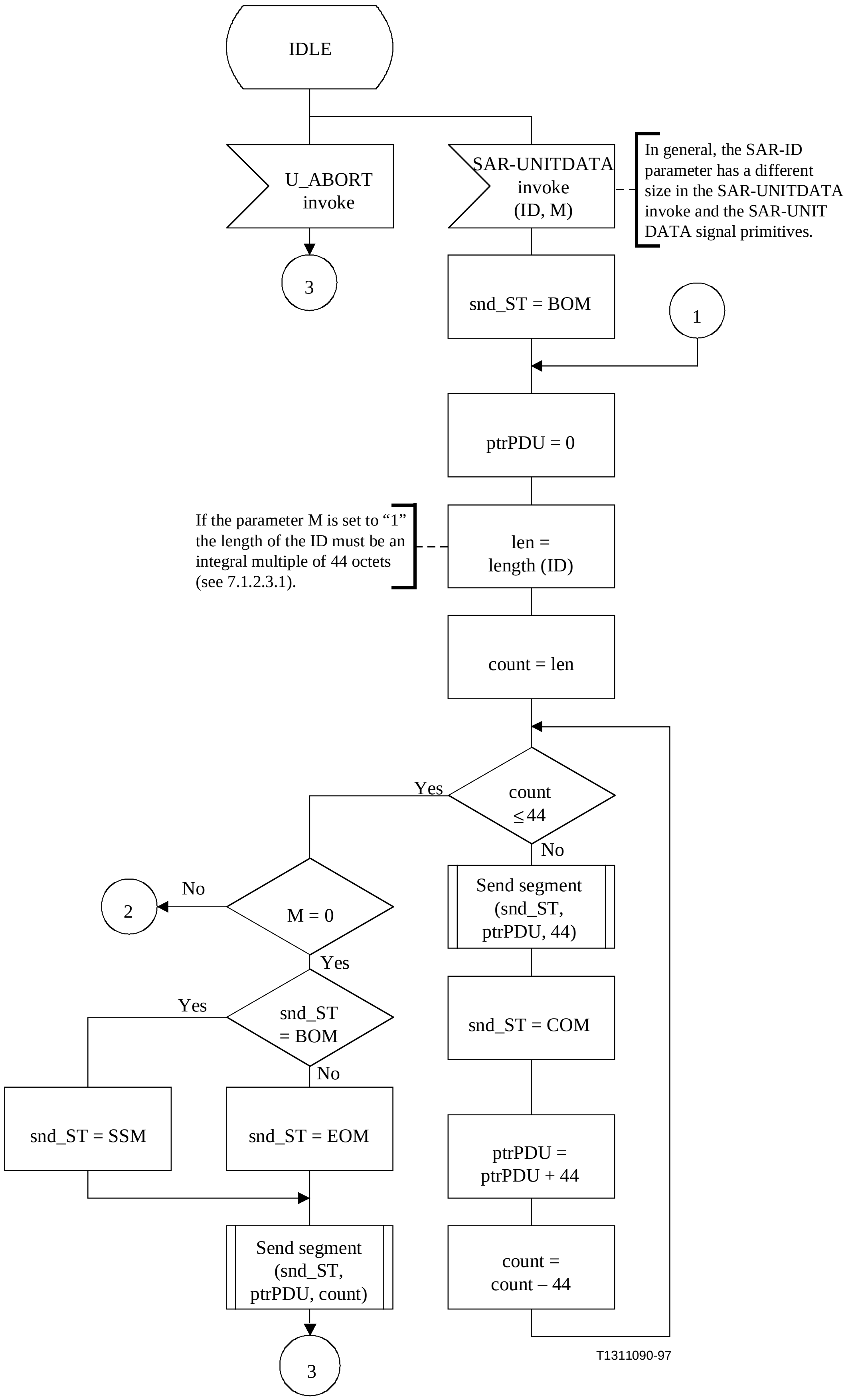


Figure D.1/I.363.3 (sheet 2 of 5) – SAR sender

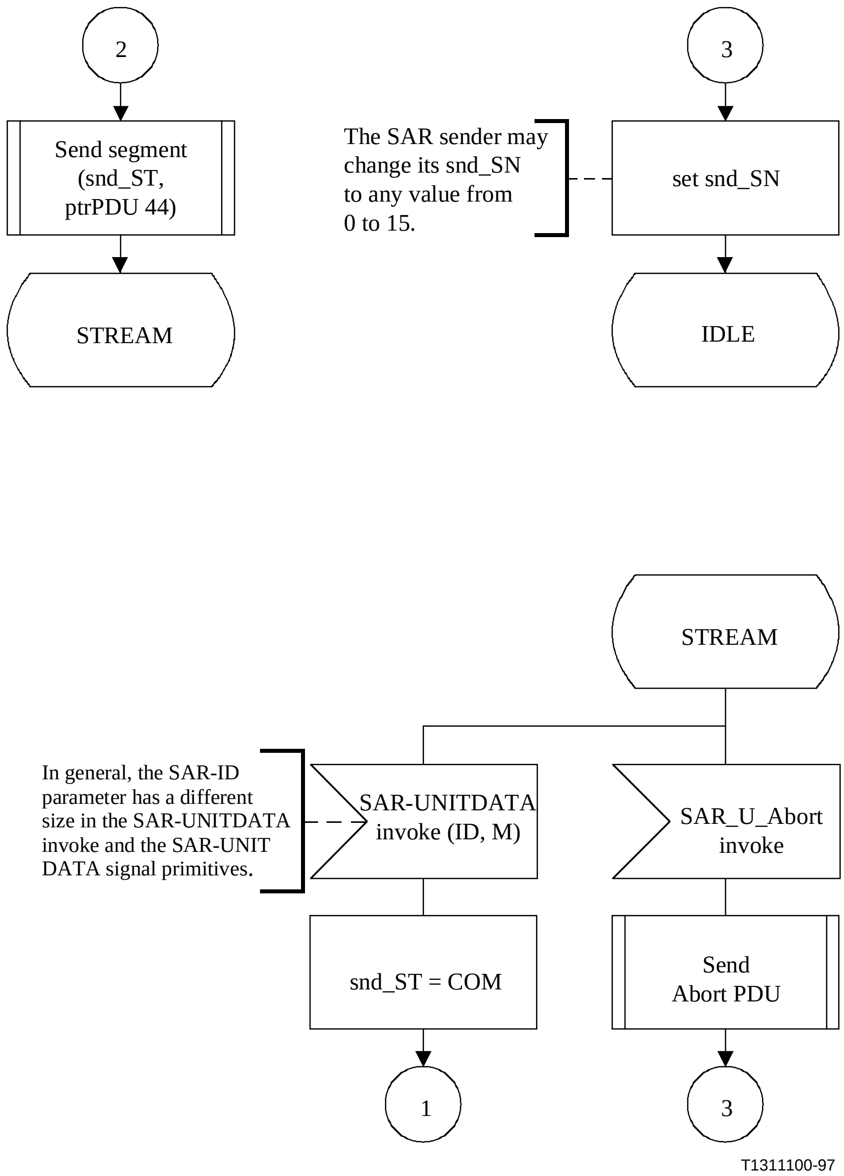
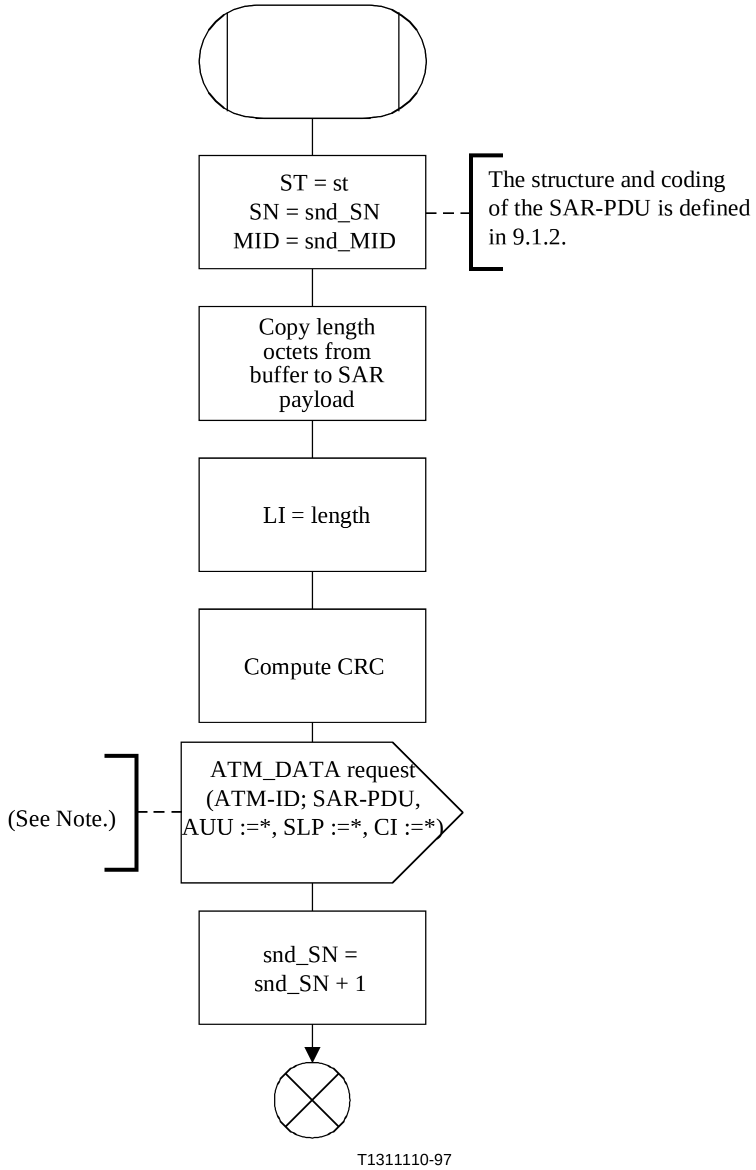
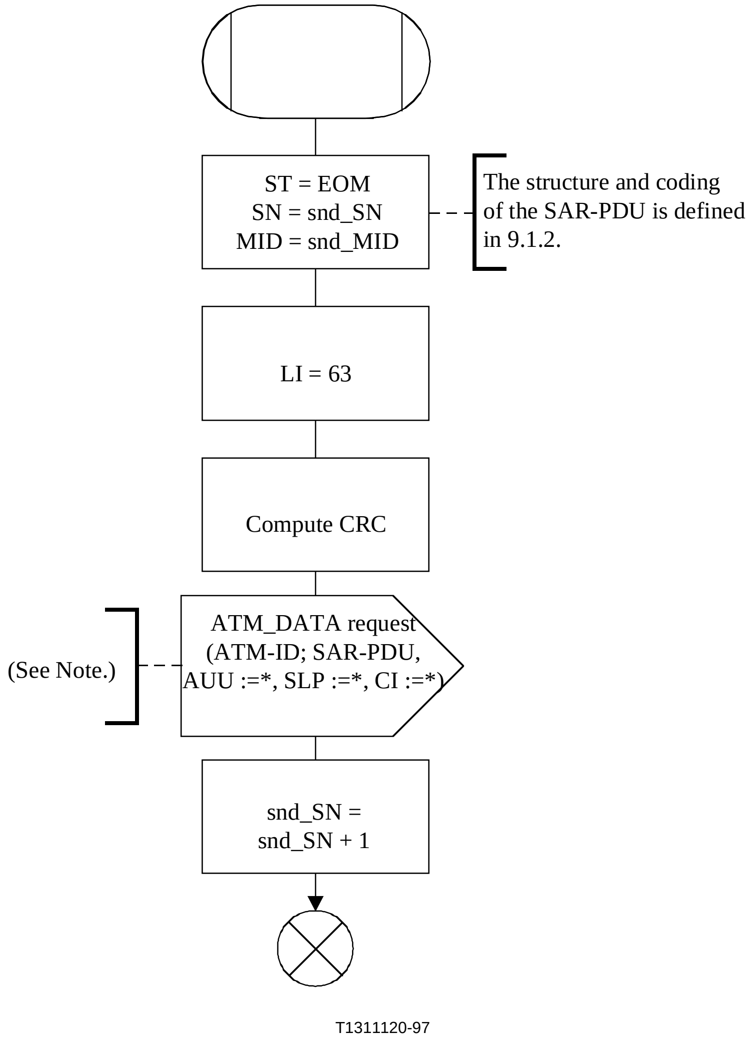


Figure D.1/I.363.3 (sheet 3 of 5) – SAR sender



NOTE – The mechanism for setting parameters AUU, SLP and CI used in the ATM layer primitives is not specified because this is an implementation matter that does not impact interoperatibility; however, future enhancements may assign functionalities to these parameters.

Figure D.1/I.363.3 (sheet 4 of 5) – SAR sender



NOTE – The mechanism for setting parameters AUU, SLP and CI used in the ATM layer primitives is not specified because this is an implementation matter that does not impact interoperability; however, future enhancements may assign functionalities to these parameters.

Figure D.1/I.363.3 (sheet 5 of 5) – SAR sender

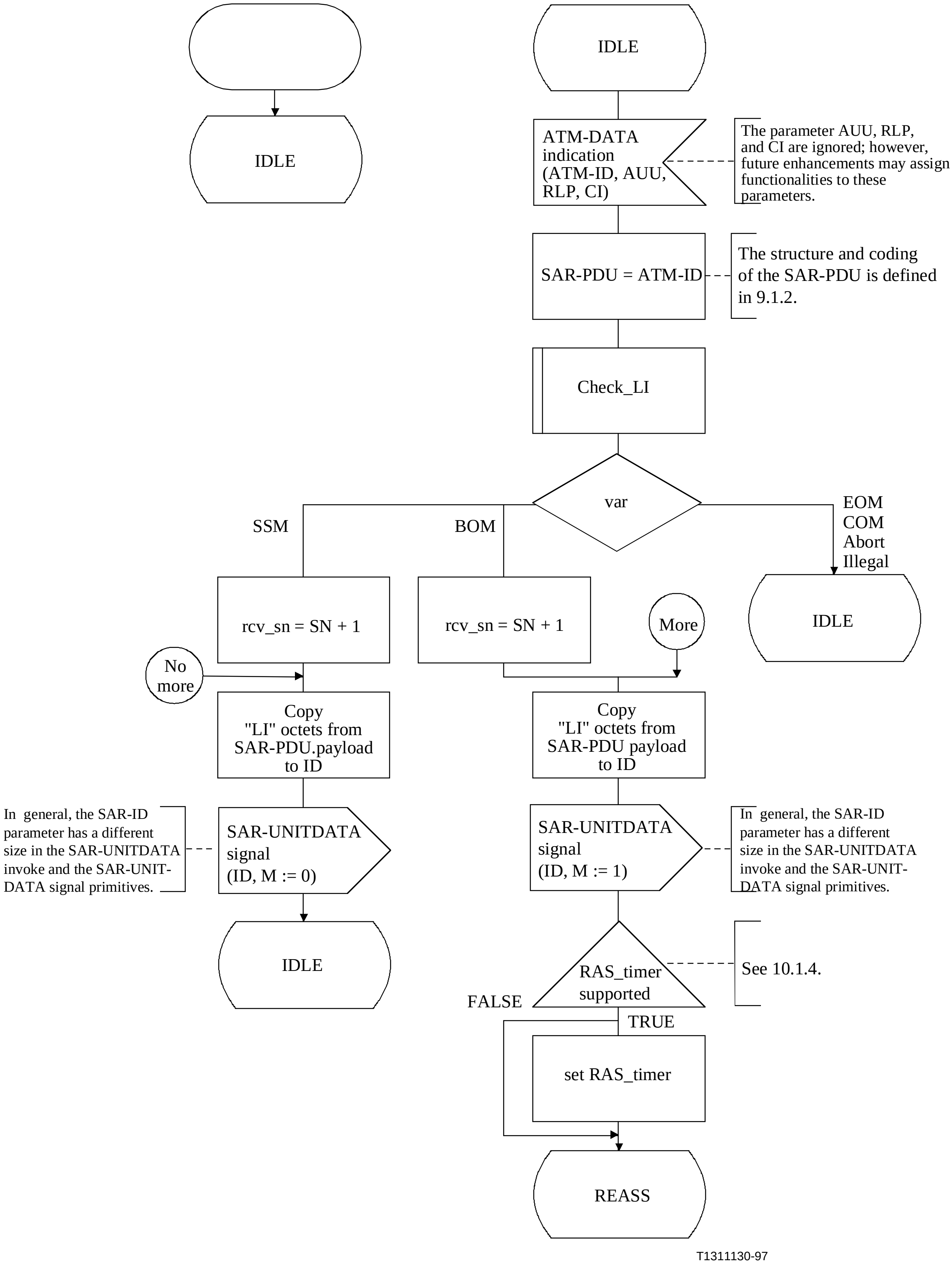


Figure D.2/I.363.3 (sheet 1 of 3) – SAR receiver

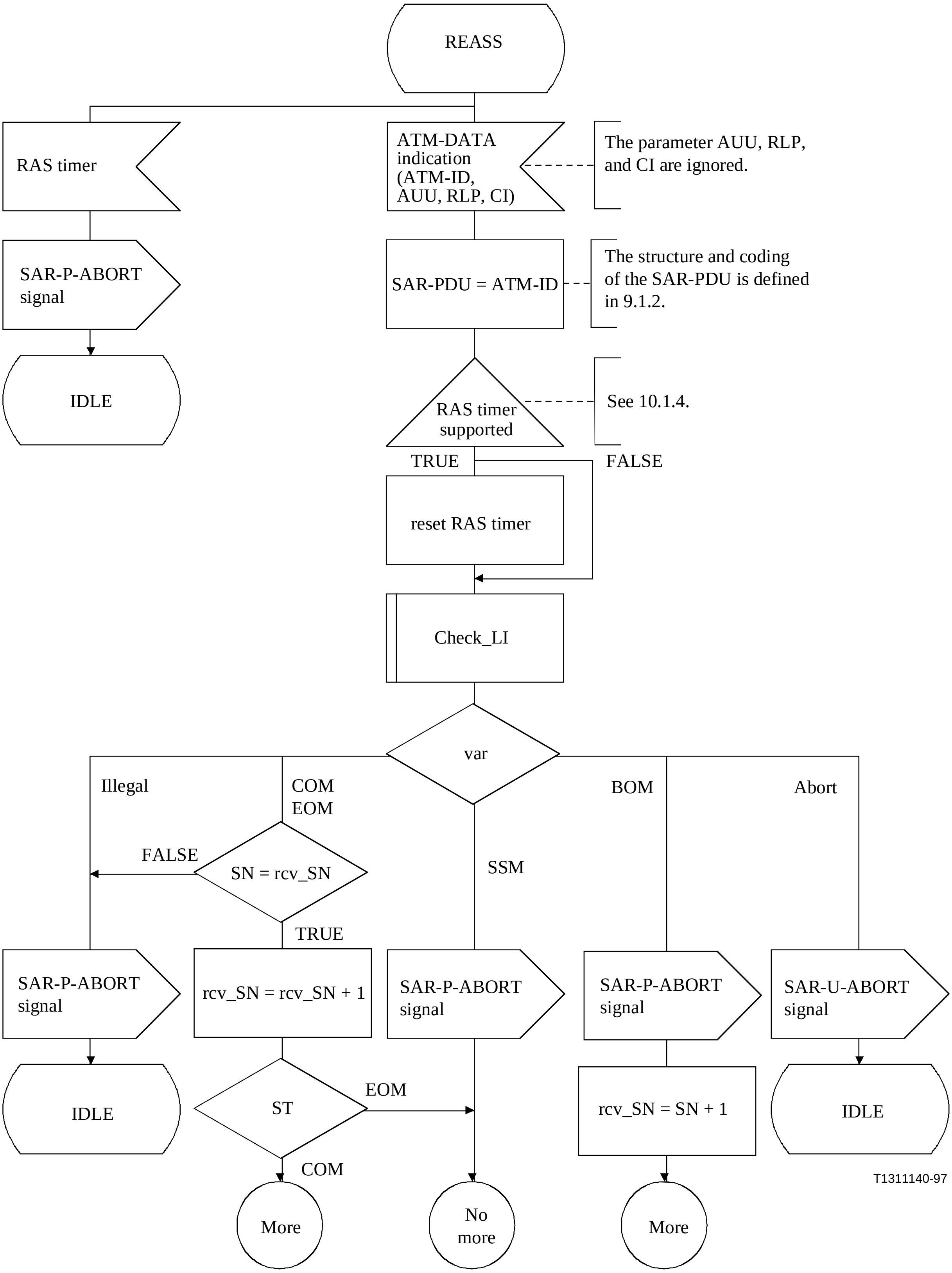


Figure D.2/I.363.3 (sheet 2 of 3) – SAR receiver

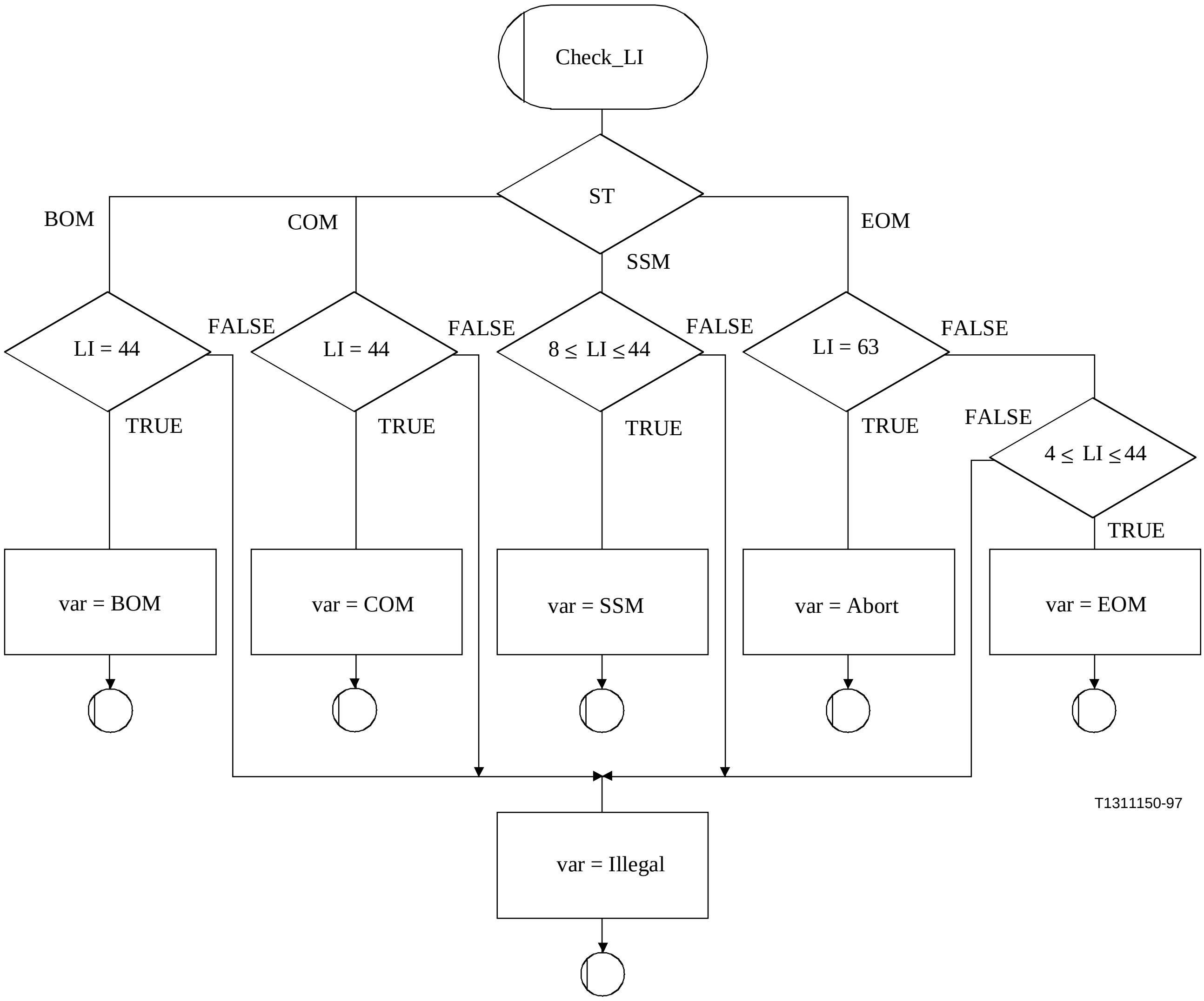


Figure D.2/I.363.3 (sheet 3 of 3) – SAR receiver

D.2 SDL for CPCS procedures

This subclause contains the SDL specifications for the CPCS procedures of the AAL type 3/4.

NOTE – The SDL diagrams of Figures D.4 and D.5 represent the CPCS for one MID field value.

D.2.1 The CPCS sender

The CPCS sender makes use of the state variable snd_BEtag (as defined in 10.2.1). In addition, it utilizes one further variable:

– *len*

This temporary variable is set to the length of the interface data parameter received via the CPCS-UNITDATA-invoke primitive. It is used to set the BAsize field, the Length field, and to calculate the length of the PAD field.

NOTE – No interactions with layer management are shown; these interactions require further study.

D.2.2 The CPCS receiver

The CPCS receiver makes use of the state variable rcv_BEtag and rcv_BAsize (as defined in 10.2.3). In addition, it utilizes three further variables:

a) *len*

This temporary variable is set to the length of the CPCS-PDU information received from the SAR sublayer for reassembly.

b) *reassembly buffer*

The reassembly buffer is allocated while processing the CPCS-PDU header and freed once the reassembly of a CPCS-PDU is complete (or abandoned due to errors).

c) *ptrRAB*

This variable points into the reassembly buffer to the octet where the next information received from the SAR sublayer is to be stored.

NOTE – No interactions with layer management are shown; these interactions require further study.

Figure D.3 illustrates the use of the reassembly buffer during the reassembly of a CPCS-SDU.

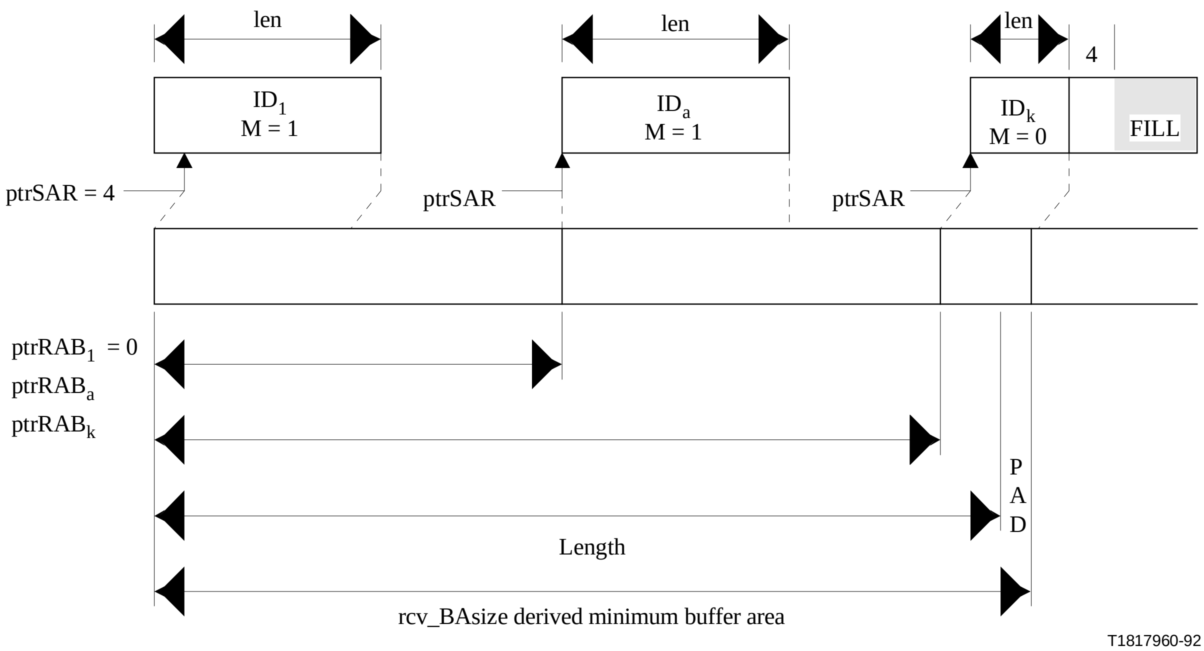


Figure D.3/I.363.3 – The mechanism of the reassembly buffer

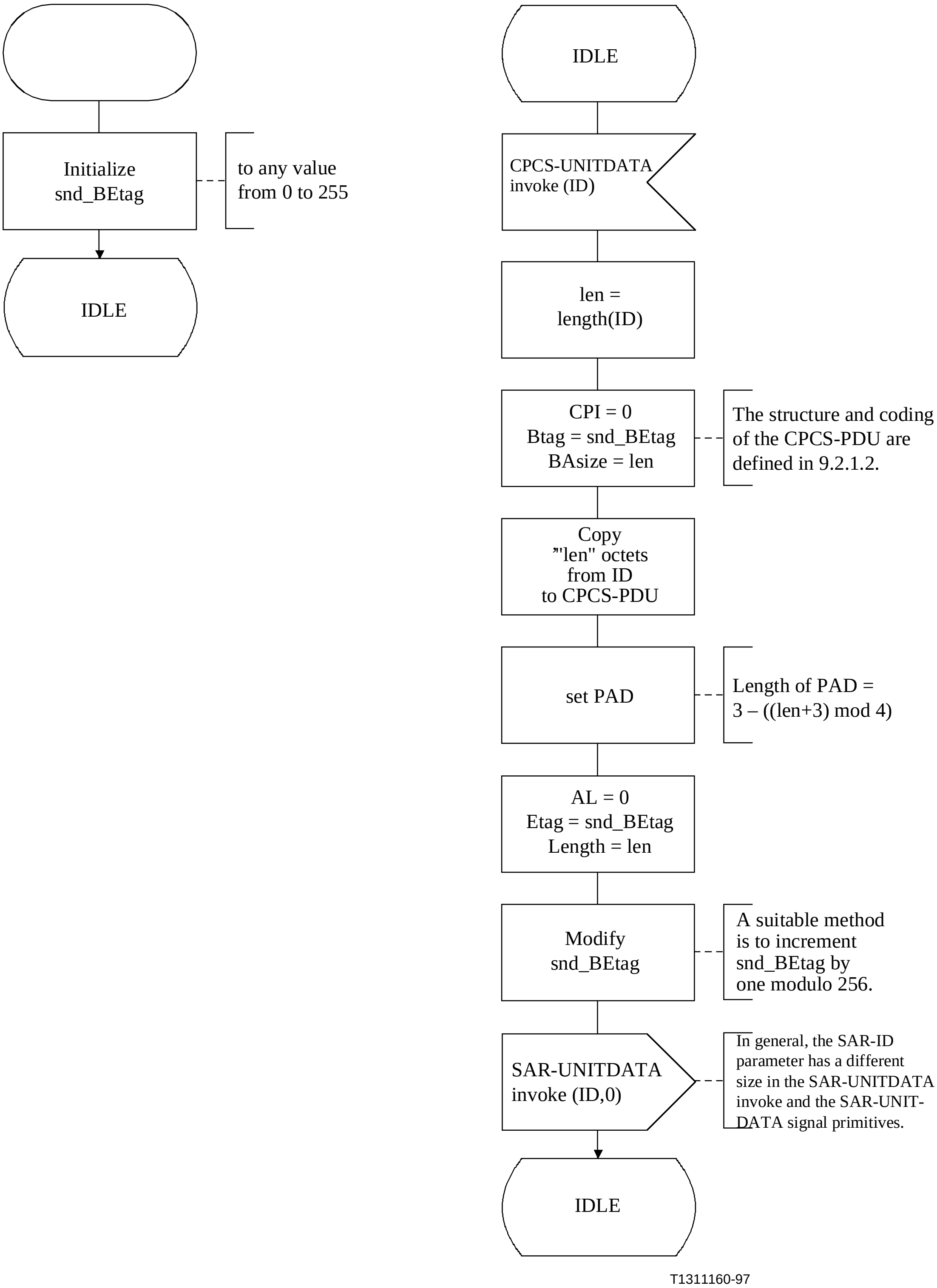


Figure D.4/I.363.3 – CPCS sender

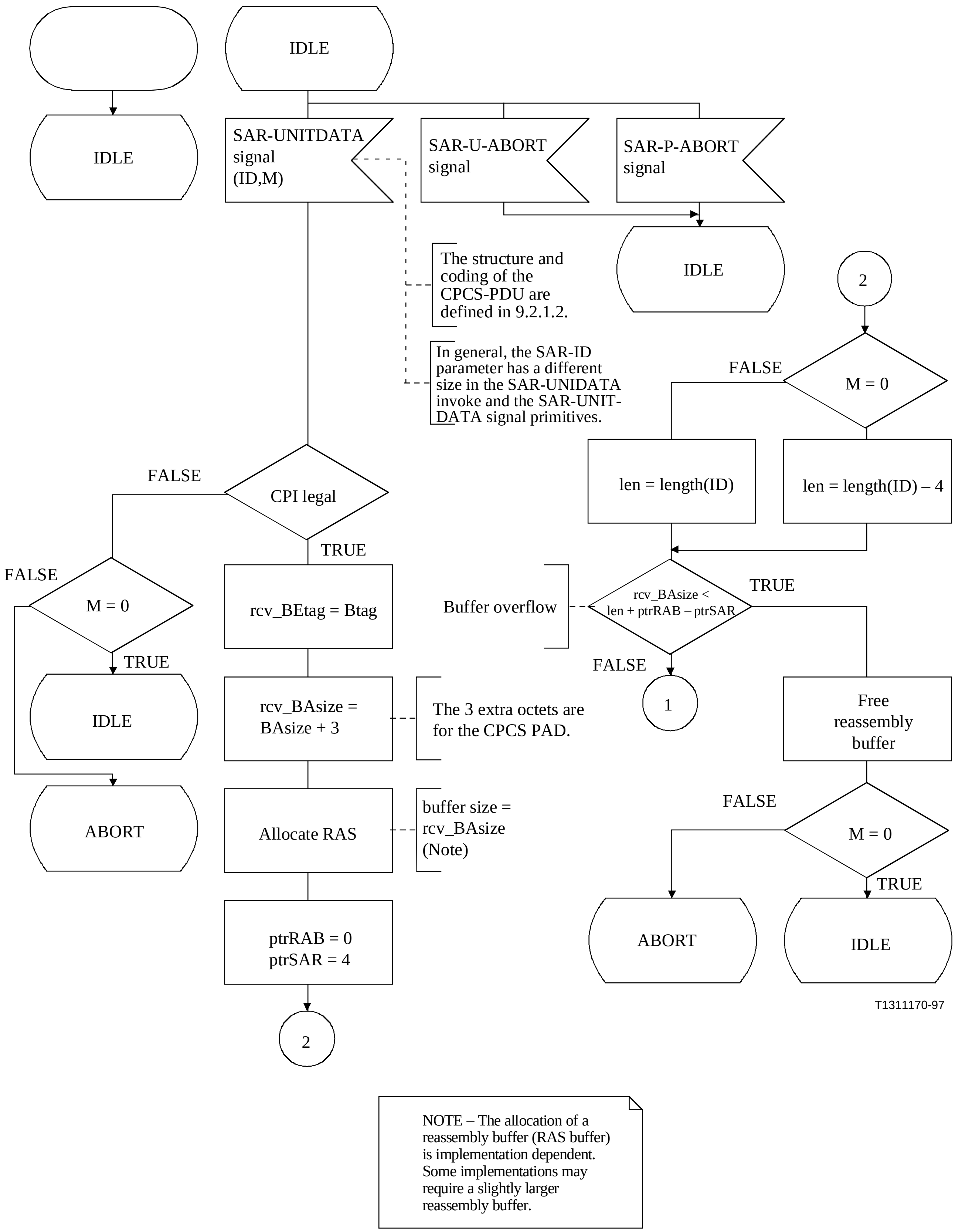


Figure D.5/I.363.3 (sheet 1 of 3) – CPCS receiver

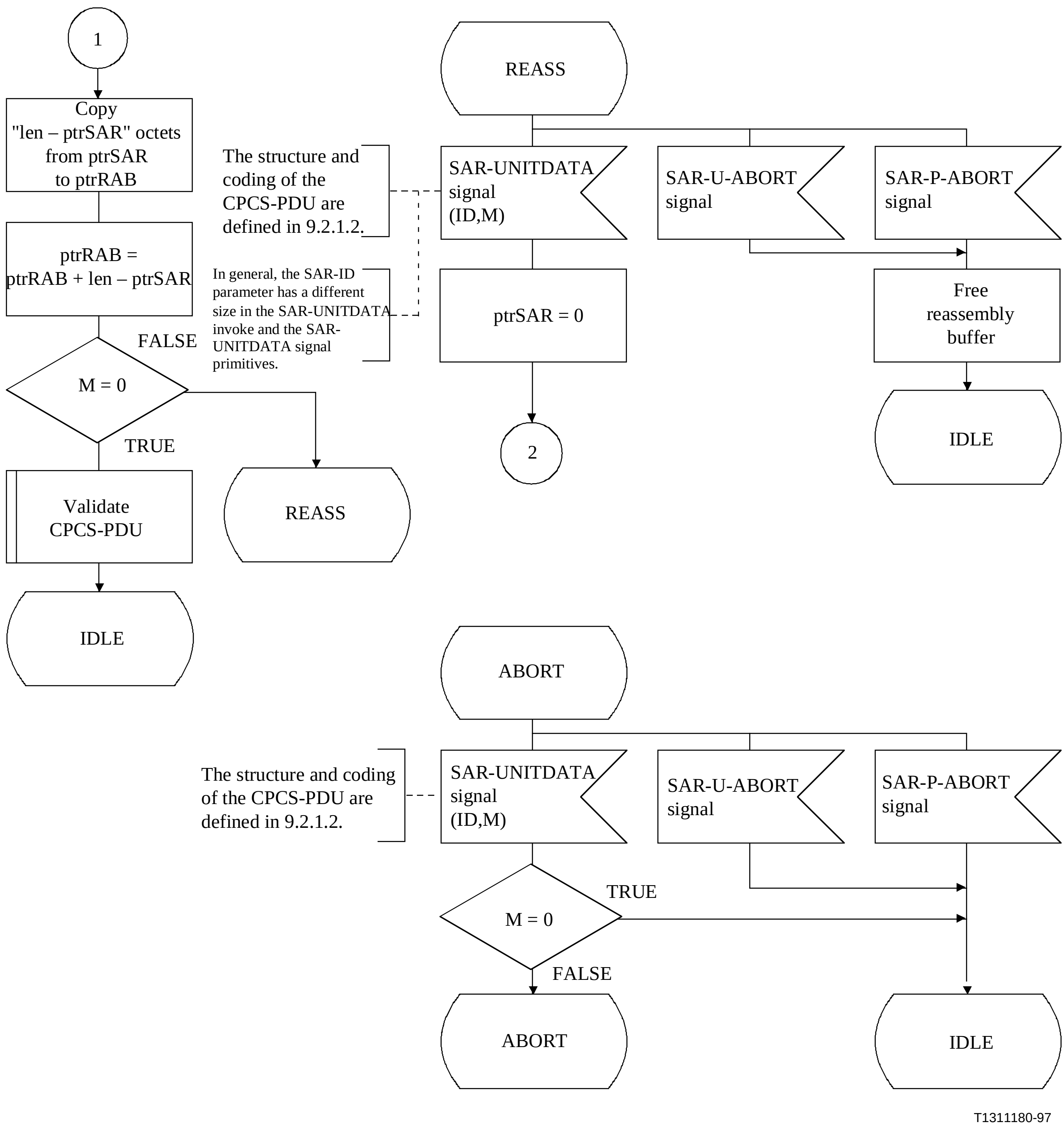


Figure D.5/I.363.3 (sheet 2 of 3) – CPCS receiver

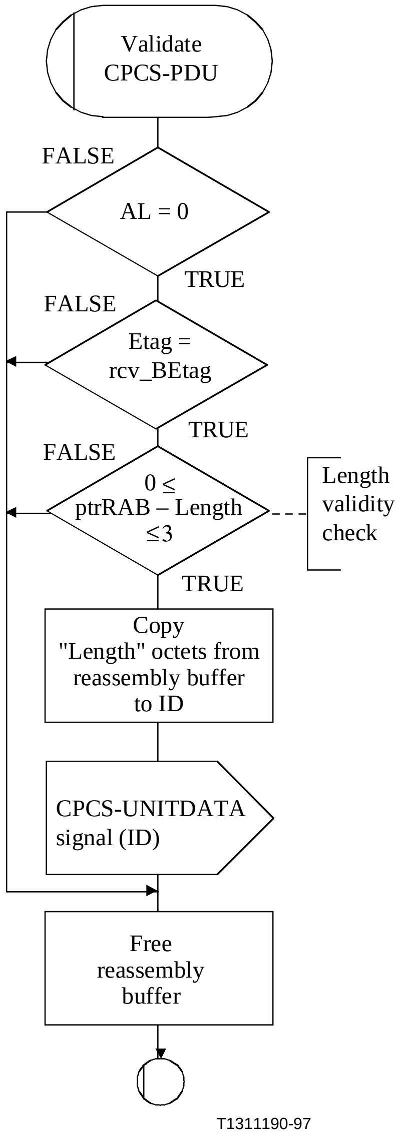


Figure D.5/I.363.3 (sheet 3 of 3) – CPCS receiver

APPENDIX I

Multiplexing AAL type 3/4 connections on an ATM connection using the MID field

I.1 Introduction

This appendix illustrates the multiplexing of AAL connections on an ATM connection using the MID field within the Common Part of the AAL type 3/4. It also identifies some of the requirements on the MID value allocation scheme.

AAL-connections can be:

a) unidirectional point-to-point;

b) bidirectional point-to-point;

c) unidirectional point-to-multipoint;

d) multipoint-to-multipoint;

e) multipoint-to-point.

The ATM-connection can either be a point-to-point, a point-to-multipoint, or a multipoint-to-multipoint connection.

Both for connection-oriented and connectionless services, the AAL protocol will use the MID field to identify an AAL connection. The correlation between CEP and MID values is defined by control or management plane functions.

An AAL Connection Endpoint Identifier (CEP) is defined according to the OSI model and is represented in the AAL protocol by a single MID value. For every AAL connection, the Common Part of AAL type 3/4 will maintain the sequence integrity.

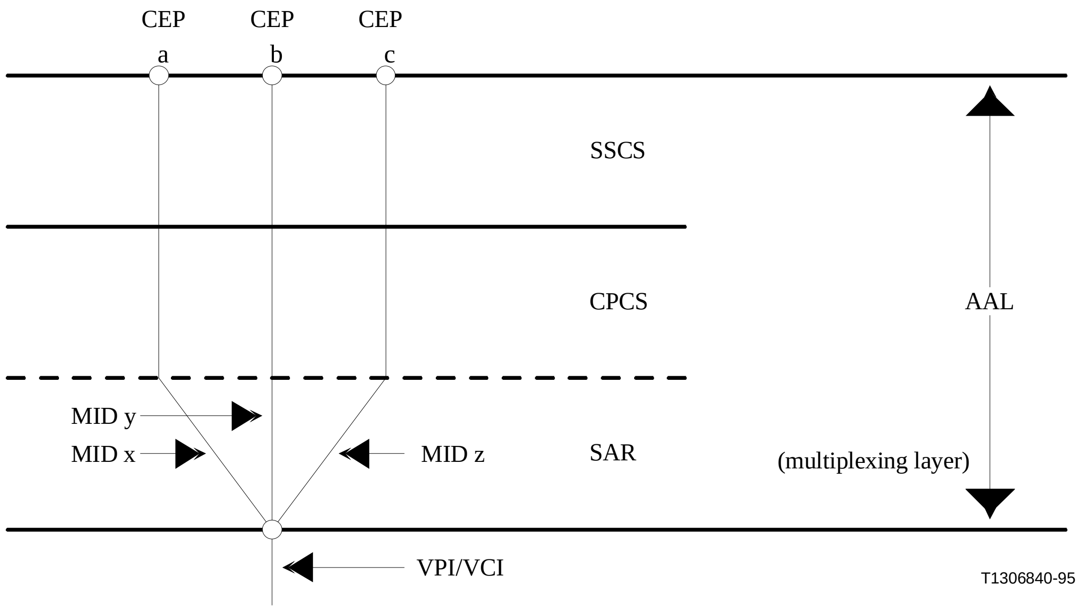


Figure I.1/I.363.3 – Simplified model of the AAL to illustrate the multiplexing

I.2 Multiplexing configurations

I.2.1 Point-to-point AAL connection on a point-to-point ATM connection

This subclause applies to both unidirectional and bidirectional point-to-point AAL connections.

Figure I.2 shows the case of point-to-point AAL connections on a point-to-point ATM connection. Only two AAL entities are involved in the negotiation of the MID value to be used for each AAL connection.

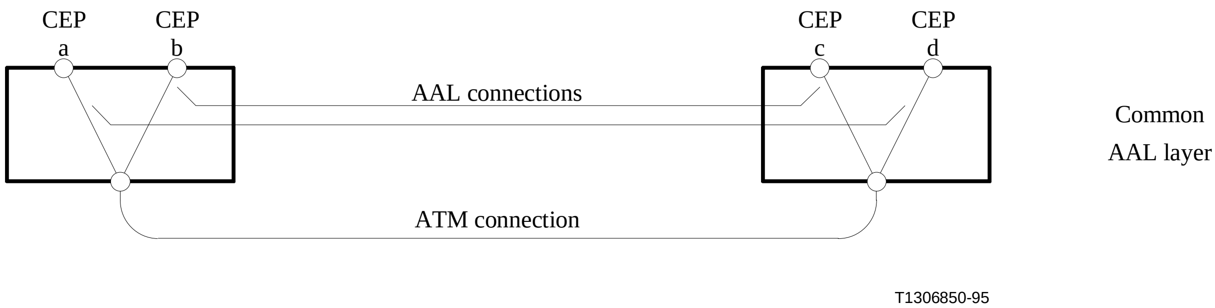


Figure I.2/I.363.3 – Point-to-point AAL connection on a point-to-point ATM-connection

The initial range of MID value to be used can be either default or negotiated in the call establishment phase. Additional MID values (thus the establishment of additional AAL connections on the same ATM connection) can be negotiated via the M-plane. The re-negotiation of the MID values during the data transfer phase via the C-plane is beyond the scope of this Recommendation. As an example, since only two AAL entities are involved, the AAL entity at either end can take a free MID value (e.g. SAR entity A starting from the low end of the range, SAR entity B from the high end of the range).

All received SAR-PDUs with an unknown MID value shall be discarded and the occurrence shall be reported to the layer management.

For every AAL connection, the Common Part of the AAL type 3/4 will maintain the sequence integrity.

I.2.2 Point-to-point AAL connection on a point-to-multipoint ATM connection

This subclause applies to both unidirectional and bidirectional point-to-point AAL connections.

Figure I.3 shows the configuration of a point-to-point AAL connection on a point-to-multipoint ATM connection.

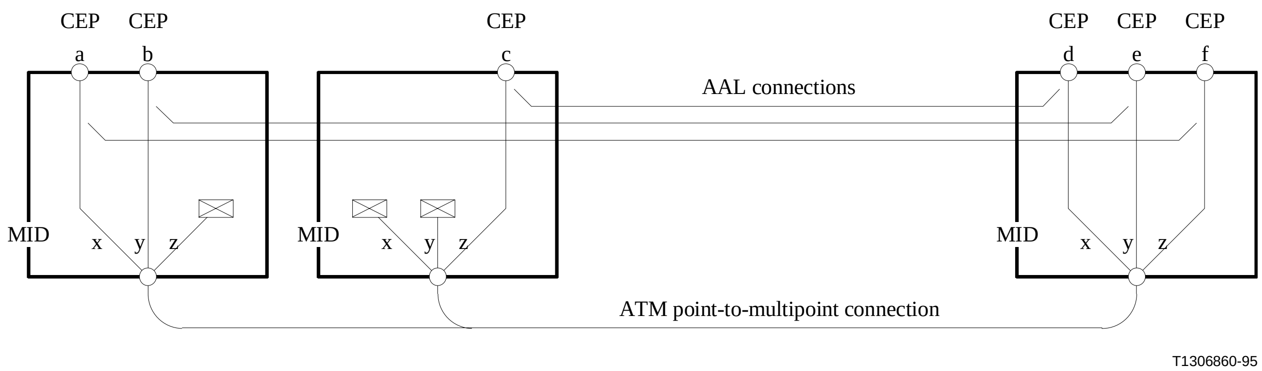


Figure I.3/I.363.3 – Point-to-point AAL connection on a point-to-multipoint ATM connection

In this case, the range of possible MID values needs to be distributed among all the AAL entities on the point-to-multipoint ATM connection. No MID value shall be allocated to two or more distinct AAL entities (on the multipoint side of the ATM connection).

An SAR entity at the multipoint side need not be aware of all MID values allocated to other AAL entities.

The demultiplexing will be handled the following way: the SAR entities at the multipoint side, on receiving a SAR-PDU with an unknown MID value, shall discard this SAR-PDU (this is represented with a crossed box in Figure I.3), but need not necessarily send an error indication to Layer Management.

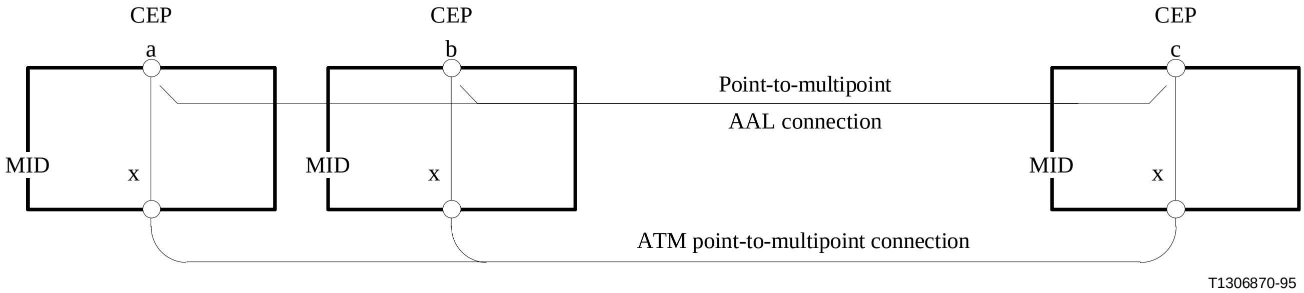


Figure I.4/I.363.3 – Point-to-multipoint AAL connection on a point-to-multipoint ATM connection

For every AAL connection, the Common Part of the AAL type 3/4 will maintain the sequence integrity.

I.2.3 Point-to-point AAL connection on a multipoint-to-multipoint ATM-connection

For further study.

I.2.4 Point-to-multipoint AAL connection on a point-to-multipoint ATM-connection

Without changing the functionality within an end system, it will also be possible to define a point-to-multipoint AAL connection by assigning more than two CEPs in two different AAL entities to the same MID value. Both ATM and AAL point-to-multipoint connections are to be assigned unidirectionally (see Figure I.4).

I.2.5 Point-to-multipoint AAL connection on a multipoint-to-multipoint ATM-connection

For further study.

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	**Integrated services digital network**
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	Maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communication
Series Z	Programming languages