COVERING NOTE

GENERAL SECRETARIAT INTERNATIONAL TELECOMMUNICATION UNION

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Geneva, 6 April 1994

Recommendation ITU-T I.363 (03/93)

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

To insert in Recommendation ITU-T I.363 (03/93):

1) *at page 37*

New paragraph 6, *pages 37/1 to 37/15*

2) *at page 41*

FIGURE A-4/I.363, *page 41/1*

3) *after page 51*

Annex E, *pages 51/1 and 51/2*

Annex F, *pages 51/3 to 51/5*

4) *after page 68*

Appendices II and III, *pages 69 to 75*

The electronic document store of this Recommendation will be up dated.

6 AAL type 5

6.0 Framework of AAL type 5

The Convergence Sublayer (CS) has been subdivided into the Common Part CS (CPCS), and the Service Specific CS (SSCS) as shown in Figure 6-1. Different SSCS protocols, to support specific AAL user 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 CPCS and vice versa. SSCS protocols are specified in separate Recommendations.

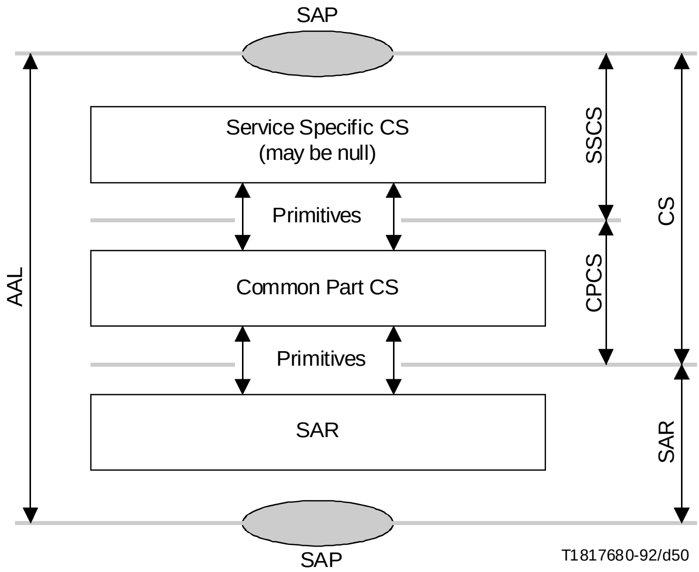


FIGURE 6-1/I.363

Structure of the AAL type 5

6.1 Service provided by the AAL type 5

The AAL type 5 provides the capabilities to transfer the AAL-SDU from one AAL user to another AAL user through the ATM network. The Message Mode service, Streaming Mode service, and assured and non-assured operations as defined below for AAL type 5 are identical to those defined for AAL type 3/4 in 4.1.

Two modes of service are defined: Message and Streaming.

a) *Message Mode service* – The AAL Service Data Unit is passed across the AAL interface in exactly one AAL Interface Data Unit (AAL-IDU). This service provides the transport of fixed size or variable length AAL-SDUs.

  i) In case of small fixed size AAL-SDUs, an internal blocking/deblocking function in the SSCS may be applied; it provides the transport of one or more fixed size AAL-SDUs in one SSCS-PDU.

  ii) In case of variable length AAL-SDUs, an internal AAL-SDU message segmentation/reassembling function in the SSCS may be applied. In this case a single AAL-SDU is transferred in *one or more* SSCS-PDUs.

  iii) Where the above options are not used, a single AAL-SDU is transferred in one SSCS-PDU. When the SSCS is null, the AAL-SDU is mapped to one CPCS-SDU.

b) *Streaming Mode service* – The AAL-SDU is passed across the AAL interface in one or more AAL-IDU. The transfer of these AAL-IDUs across the AAL interface may occur separated in time. This service provides the transport of variable length AAL-SDUs. The Streaming Mode service includes an abort service by which the discarding of an AAL-SDU partially transferred across the AAL interface can be requested.

   i) An internal AAL-SDU message segmentation/reassembling function in the SSCS may be applied. In this case all the AAL-IDUs belonging to a single AAL-SDU are transferred in *one or more* SSCS-PDU.

   ii) An internal pipelining function may be applied. It provides the means by which the sending AAL entity initiates the transfer to the receiving AAL entity before it has the complete AAL-SDU available.

   iii) Where option i) is not used, all the AAL-IDUs belonging to a single AAL-SDU are transferred in one SSCS-PDU. When the SSCS is null, the AAL-IDUs belonging to a single AAL-SDU are mapped to one CPCS-SDU.

Summaries of the service mode and feature options are provided in Table 6-1 and Table 6-2.

TABLE 6-1/I.363

Combination of service mode and internal functions

	AAL-SDU message segmentation/ reassembly in the SSCS	AAL-SDU blocking/deblocking in the SSCS	Pipelining
Message Option 1	O	N/A	N/A
Message Option 2	N/A	O	N/A
Streaming	O	N/A	O

Option 1 Long variable size SDUs
Option 2 Short fixed size SDUs
O Optional
N/A Not Applicable

TABLE 6-2/I.363

Combination of service mode at the sender and receiver side

Receiver	Sender		
	MM/Block	MM/Seg	SM
MM/Deblocking	A	N/A	N/A
MM/Reassembly	N/A	A	A
SM	N/A	A	A

MM Message Mode
SM Streaming Mode
A Applicable
N/A Not Applicable

NOTE – An end-to-end specification of the SDU length in Message Mode with Blocking/Deblocking is needed.

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

– *Assured operations*

  Every assured AAL-SDU is delivered with exactly the data content that the user sent. The assured service is provided by retransmission of missing or corrupted SSCS-PDUs. Flow control is provided as a mandatory feature. The assured operation may be restricted to point-to-point ATM Adaptation Layer connections.

– *Non-assured operations*

  Integral AAL-SDUs may be lost or corrupted. Lost and corrupted AAL-SDUs will not be corrected by retransmission. An optional feature may be provided to allow corrupted AAL-SDUs to be delivered to the user (i.e. optional error discard). Flow control may be provided as an option.

6.1.1 Description of AAL connections

The AAL type 5 provides the capabilities to transfer the AAL-SDU from one AAL-SAP to one other AAL-SAP through the ATM network [see Figure 6.2a)]. The AAL users will have the capability to select a given AAL-SAP associated with the QOS required to transport the AAL-SDU (for example, delay and loss sensitive QOS).

The AAL type 5 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 6.2b)].

The AAL type 5 makes use of the service provided by the underlying ATM layer [see Figure 6.3]. Multiple AAL connections may be associated with a single ATM layer connection, allowing multiplexing at the AAL; however, if multiplexing is used in the AAL, it occurs in the SSCS. The AAL user selects the QOS provided by the AAL through the choice of the AAL-SAP used for data transfer.

6.1.2 Primitives

The functional model for AAL type 5 as contained in Annex E shows the interrelation between the SAR, CPCS and SSCS and the SAR and CPCS primitives.

6.1.2.1 Primitives for the AAL

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 (see 6.1.2.2) 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 an SAP.

6.1.2.2 Primitives for the CPCS of the AAL

As there exists no Service Access Point (SAP) between the sublayers of the AAL type 5, the primitives are called “invoke” and “signal” instead of the conventional “request” and “indication” to highlight the absence of the SAP.

6.1.2.2.1 Primitives for the data transfer service

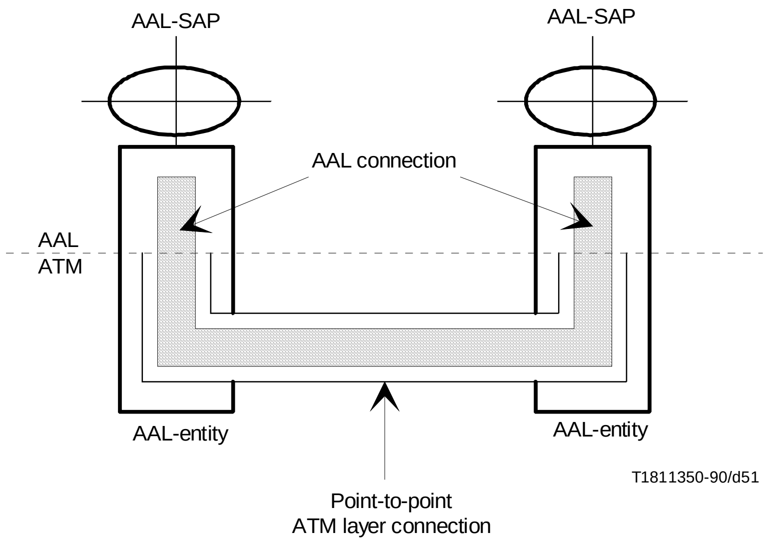
These primitives are CPCS-UNITDATA invoke and the CPCS-UNITDATA signal. They are used for the data transfer. The following parameters are defined:

– *Interface Data (ID)*

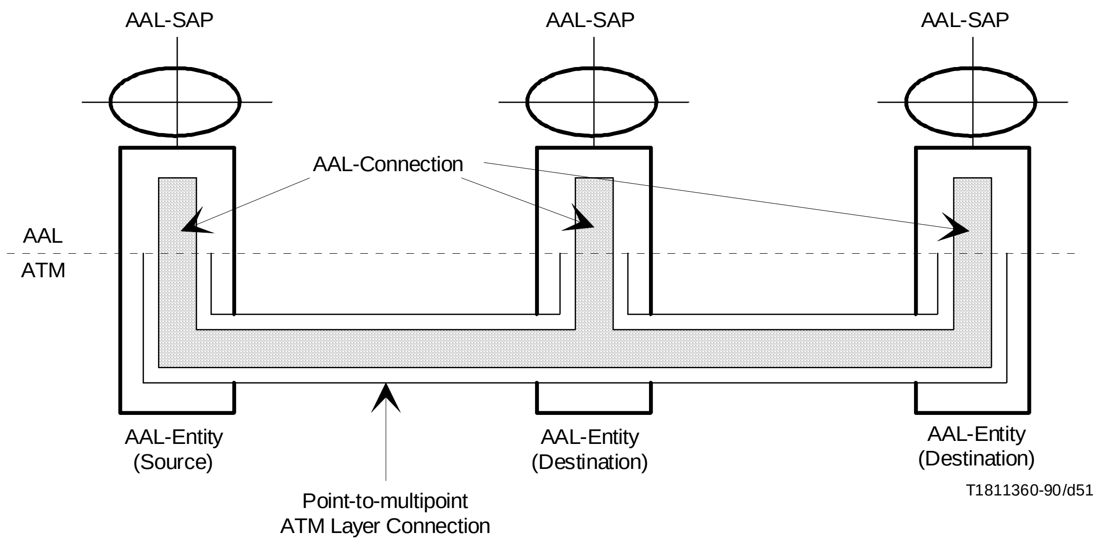
  This parameter specifies the interface data unit exchanged between the CPCS and the SSCS entity. The interface data is an integral multiple of one octet. If the CPCS entity is operating in the Message Mode service, the Interface Data represents a complete CPCS-SDU; when operating in the Streaming Mode 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.

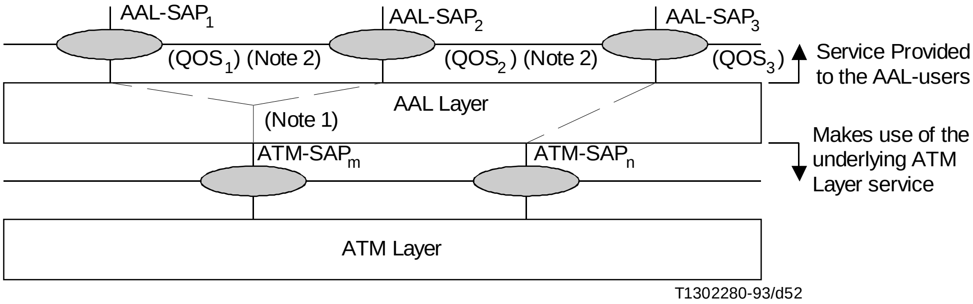


a) Point-to-point AAL connection



b) Point-to-multipoint AAL connection

FIGURE 6-2/I.363



NOTES

1 If multiplexing is present at the AAL, it occurs in the SSCS.

2 How QOS at the AAL-SAP is mapped to the ATM-SAP QOS in the event of multiplexing in the AAL is for further study.

FIGURE 6-3/I.363

Relation between AAL-SAP and ATM-SAP

– *CPCS-Loss Priority (CPCS-LP)*

This parameter indicates the loss priority for the associated CPCS-SDU. It can take only two values, one for high priority and the other for low priority. The use of this parameter in Streaming Mode is for further study. This parameter is mapped to and from the SAR-LP parameter.

– *CPCS Congestion Indication (CPCS-CI)*

This parameter indicates whether the associated CPCS-SDU has experienced congestion. The use of this parameter in Streaming Mode is for further study. This parameter is mapped to and from the SAR-CI parameter.

– *CPCS User-to-User indication (CPCS-UU)*

This parameter is transparently transported by the CPCS between peer CPCS users. The use of this parameter in Streaming Mode is for further study.

– *Reception Status (RS)*

This parameter indicates that the associated CPCS-SDU delivered may be corrupted. This parameter is only utilized if the corrupted data delivery option is used. The use of this parameter in Streaming Mode is for further study.

Depending on the service mode (Message or Streaming Mode service, discarding or delivery of errored information), not all parameters are required. This is summarized in Table 6-3.

6.1.2.2.2 Primitives for the abort service

These primitives are used in the Streaming Mode service.

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

This primitive is used by the CPCS user to invoke the abort service. It is also used to signal to the 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.

TABLE 6-3/I.363

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
CPCS – Loss Priority (CPCS-LP)	Invoke Signal	m m	FFS FFS	Mapped to and from the ATM layer's CLP field CPCS-LP=1: Low Priority CPCS-LP=0: High Priority
CPCS – Congestion Indication (CPCS-CI)	Invoke Signal	m m	FFS FFS	Mapped to and from the ATM layer's congestion indication parameter, CPCS-CI=1: congestion experienced; CPCS-CI=0: no congestion experienced
CPCS – User-to-User Indication (CPCS-UU)	Invoke Signal	m m	FFS FFS	Transparently transported by the CPCS
Reception status (RS) (Note 1)	Invoke Signal	– m	– FFS	Indication of corrupted data

MM Message Mode service
SM Streaming Mode service
FFS The use of these parameters in Streaming Mode is for further study
m Mandatory
– Not présent

NOTE – Not present if the corrupted data delivery option is not supported.

6.1.2.3 Primitives for the SAR sublayer of the AAL

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 5, the primitives are called "invoke" and "signal" instead of the conventional "request" and "indication" to highlight the absence of the SAP.

6.1.2.3.1 Primitives for the data transfer service

These primitives are SAR-UNITDATA-invoke and the SAR-UNITDATA signal**.** They are used for the data transfer. The following parameters are defined:

– *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. The Interface Data does not necessarily represent a complete SAR-SDU.

– *More (M)*

This parameter specifies whether the Interface Data communicated contains the end of the SAR-SDU.

– *SAR-Loss Priority (SAR-LP)*

This parameter indicates the loss priority for the associated SAR Interface Data. It can take only two values, one for high priority, and the other for low priority. This parameter is mapped to the ATM layer's Submitted Loss Priority parameter and from the ATM layer's Received Loss Priority parameter.

– *SAR-Congestion Indication (SAR-CI)*

This parameter indicates whether the associated SAR Interface Data has experienced congestion. This parameter is mapped to and from the ATM layer's Congestion Indication parameter.

6.2 Interaction with the management and control plane

6.2.1 Management plane

For further study.

6.2.2 Control plane

For further study.

6.3 Functions, structure and coding of AAL type 5

6.3.1 Segmentation and Reassembly (SAR) sublayer

6.3.1.1 Functions of the SAR sublayer

The SAR sublayer functions are performed on an SAR-PDU basis. The SAR sublayer accepts variable length SAR-SDUs which are integral multiples of 48 octets from the CPCS and generates SAR-PDUs containing 48 octets of SAR-SDU data.

a) *Preservation of SAR-SDU*

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

b) *Handling of congestion information*

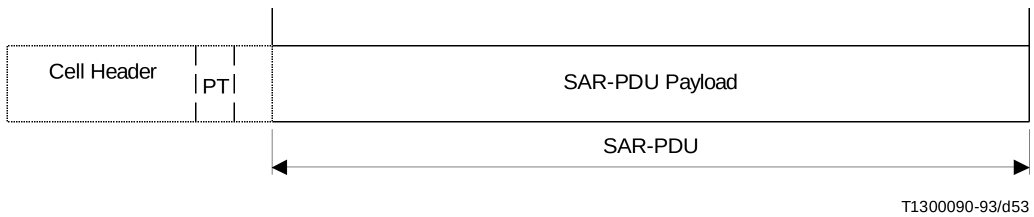
This function provides for the passing of congestion information between the layers above the SAR sublayer and the one below in both directions.

c) *Handling of loss priority information*

This function provides for the passing of cell loss priority information between the layers above the SAR sublayer and the one below in both directions.

6.3.1.2 SAR-PDU structure and coding

The SAR sublayer function utilizes the ATM-layer-user to ATM-layer-user (AUU) parameter of the ATM layer primitives (the relationship between the AUU parameter and the ATM layer PTI encoding is defined in 2.2.4/I.361) to indicate that an SAR-PDU contains the end of an SAR-SDU. An SAR-PDU where the value of the AUU parameter is "1" indicates the end of an SAR-SDU; the value of "0" indicates the beginning or continuation of an SAR-SDU. The structure of the SAR-PDU is illustrated in Figure 6-4.



PT = Payload Type

NOTE – The Payload Type field belongs to the ATM header. It conveys the value of the AUU parameter end-to-end.

FIGURE 6-4/I.363

SAR-PDU format for the AAL type 5

6.3.2 Convergence Sublayer (CS)

6.3.2.1 Functions, structure and coding for the CPCS

The CPCS has the following service characteristics.

- Non-assured data transfer of user data frames with any length measured in octets from 1 to 65 535 octets. In addition, an independent octet of user-to-user information per frame is transferred.
- The CPCS connection will be established by management or by the control plane.
- Error detection and indication (bit error or cell loss or gain).
- CPCS-SDU sequence integrity on each CPCS connection.

6.3.2.1.1 Functions of the CPCS

The CPCS functions are performed per CPCS-PDU. The CPCS provides several functions in support of the CPCS service user. 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 into 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.

NOTE – At the sending side, parts of the CPCS-PDU may have to be buffered if the restriction ("Interface Data are a multiple of 48 octets", see 6.3.1.1) cannot be satisfied.

The functions implemented by the CPCS include:

a) *Preservation of CPCS-SDU*

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

b) *Preservation of CPCS user-to-user information*

This function provides for the transparent transfer of CPCS user-to-user information.

c) *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 errored information to the CPCS user, an error indication is associated with the delivery.

Examples of detected errors would include: received length and CPCS-PDU Length field mismatch including buffer overflow, and improperly formatted CPCS-PDU and CPCS CRC errors.

d) *Abort*

This function provides for the means to abort a partially transmitted CPCS-SDU. This function is indicated in the Length field.

e) *Padding*

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

f) *Handling of congestion information*

This function provides for the passing of congestion information between the layers above the CPCS and the one below in both directions.

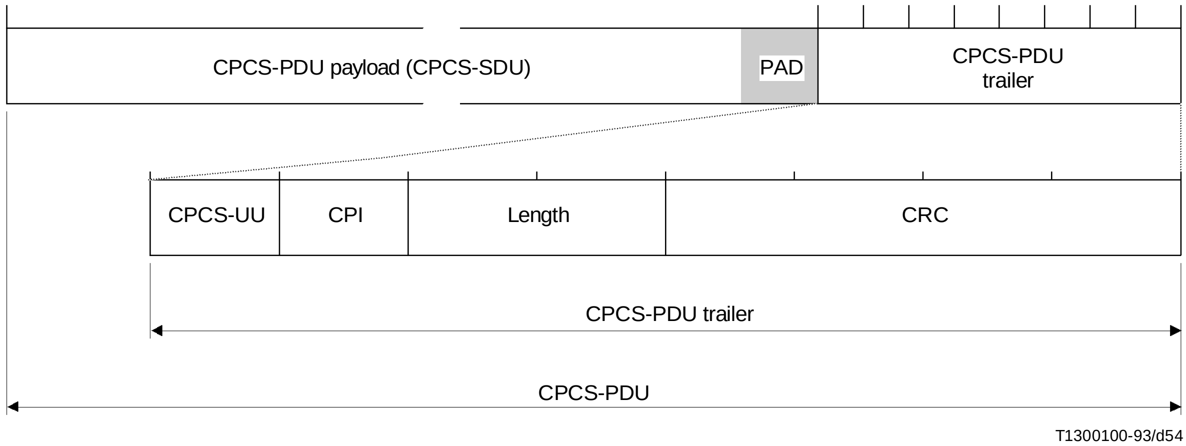
g) *Handling of loss priority information*

This function provides for the passing of cell loss priority information between the layers above the CPCS and the one below in both directions.

Other functions are for further study.

6.3.2.1.2 CPCS structure and coding

The CPCS functions require an 8 octet CPCS-PDU trailer. The CPCS-PDU trailer is always located in the last 8 octets of the last SAR-PDU of the CPCS-PDU. Therefore, a padding field provides for a 48-octet alignment of the CPCS-PDU. The CPCS-PDU 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 6-5.



PAD	Padding	(0 ... 47 octets)
CPCS-UU	CPCS User-to-User Indication	(1 octet)
CPI	Common Part Indicator	(1 octet)
Length	Length of CPCS-SDU	(2 octets)
CRC	Cyclic Redundancy Check	(4 octets)

FIGURE 6-5/I.363

CPCS-PDU Format for the AAL type 5

The coding of the CPCS-PDU conforms to the coding conventions specified in 2-1/I.361.

a) *CPCS-PDU payload*

The CPCS-PDU payload is used to carry the CPCS-SDU. This field is octet aligned and can range from 1 to 65 535 octets in length.

b) *Padding (PAD) field*

Between the end of the CPCS-PDU payload and the CPCS-PDU trailer, there will be from 0 to 47 unused octets. These unused octets are called the Padding (PAD) field; they are strictly used as filler octets and do not convey any information. Any coding is acceptable. This padding field complements the CPCS-PDU (including CPCS-PDU payload, padding field, and CPCS-PDU trailer) to an integral multiple of 48 octets.

The function of the PAD field is shown in Figure 6-6.

c) *CPCS User-to-User indication (CPCS-UU) field*

The CPCS-UU field is used to transparently transfer CPCS user-to-user information.

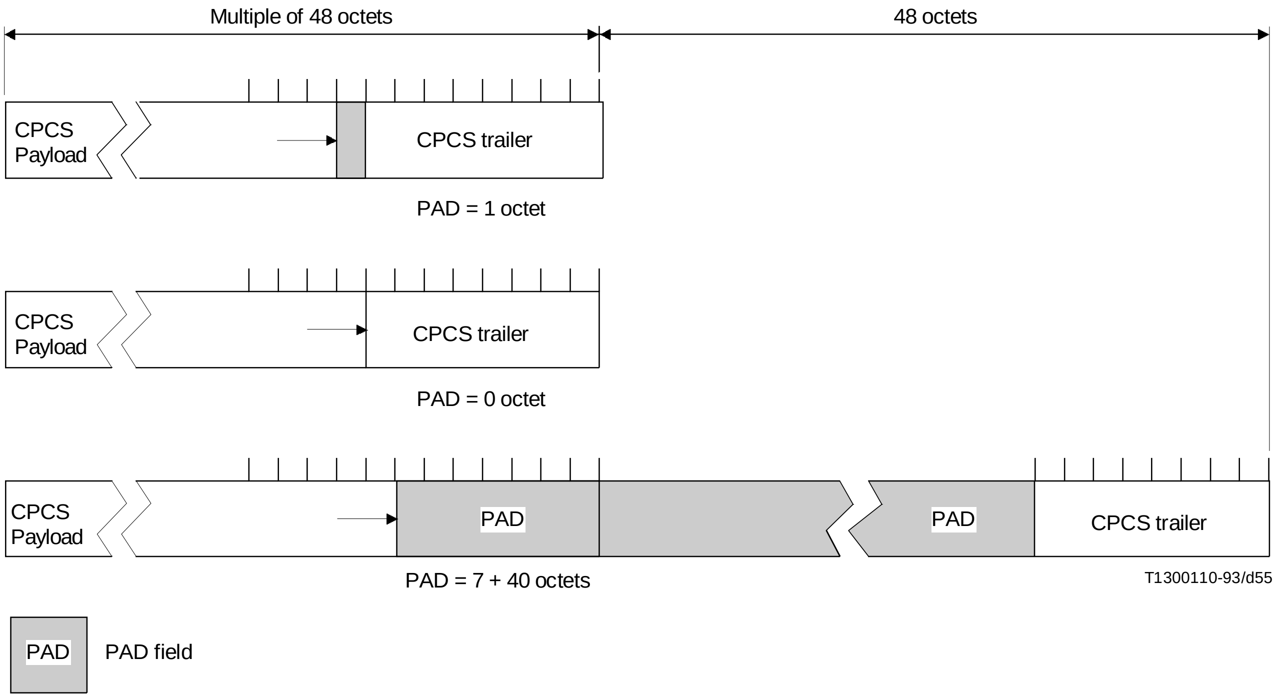


FIGURE 6-6/I.363

Examples of the PAD field function

d) *Common Part Indicator (CPI) field*

One of the functions of the CPI field is to align the CPCS-PDU trailer to 64 bits. Other functions are for further study. Possible additional functions may include identification of layer management messages. When only the 64-bit alignment function is used, this field shall be coded as zero. Other codings are for further study.

e) *Length field*

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

The length is binary encoded as number of octets.

A Length field coded as zero is used for the abort function.

f) *CRC field*

The CRC-32 is used to detect bit errors in the CPCS-PDU.

The CRC field is filled with the value of a CRC calculation which is performed over the entire contents of the CPCS-PDU, including the CPCS-PDU payload, the PAD field, and the first four octets of the CPCS-PDU trailer. The CRC field shall contain the ones complement of the sum (modulo 2) of:

1) the remainder of $x^k \cdot (x^{31} + x^{30} + ...x + 1)$ divided (modulo 2) by the generator polynomial, where k is the number of bits of the information over which the CRC is calculated; and

2) the remainder of the division (modulo 2) by the generator polynomial of the product of x^{32} by the information over which the CRC is calculated.

The CRC-32 generator polynomial is:

$$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$$

The result of the CRC calculation is placed with the least significant bit right justified in the CRC field.

As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all "1s" and is then modified by division by the generator polynomial (as described above) on the information over which the CRC is to be calculated; the ones complement of the resulting remainder is put into the CRC field.

As a typical implementation at the receiver, the initial content of the register of the device computing the remainder of the division is preset to all "1s". The final remainder, after multiplication by x^{32} and then division (modulo 2) by the generator polynomial of the serial incoming CPCS-PDU, will be (in the absence of errors):

$$C(x) = x^{31} + x^{30} + x^{26} + x^{25} + x^{24} + x^{18} + x^{15} + x^{14} + x^{12} + x^{11} + x^{10} + x^{8} + x^{6} + x^{5} + x^{4} + x^{3} + x + 1$$

An example of the CRC calculation is given in Appendix III.

6.4 Procedures

6.4.1 Procedures for the SAR sublayer

The structure and coding of the SAR-PDU is defined in 6.3.1.2.

6.4.1.1 State variables of the SAR sublayer at the sender side

The SAR sender maintains no state variables.

6.4.1.2 Procedures of the SAR sublayer at the sender side

The state machine of the SAR sender is shown in Figure 6-7.

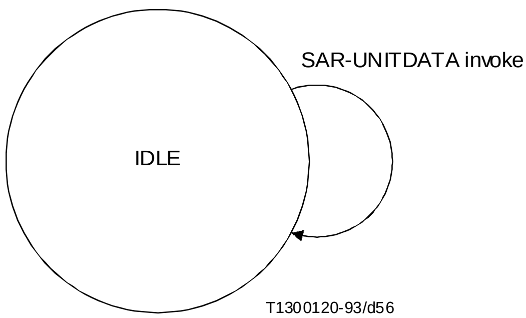


FIGURE 6-7/I.363

State transition diagram for the SAR sender

Table 6-4 defines the state for the SAR sender.

TABLE 6-4/I.363

State definition for the SAR sender

State	Definition
IDLE	Waiting to begin or continue to transmit a SAR-SDU

1) 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 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-PDU information.

2) If the More parameter in the SAR-UNITDATA invoke primitive has the value "0", the SAR sender shall set the AUU parameter in the ATM-DATA request primitive for the last SAR-PDU generated from the interface data to "1"; in all other cases (i.e. the More parameter has the value "1" or the ATM-DATA-request primitive does not contain the last data generated from the interface data), it shall set the AUU parameter to "0".

3) In all ATM-DATA request primitives, the "Submitted CLP" and "Congestion Indication" parameters shall be set to the same value as the SAR-LP and SAR-CI parameters, respectively, in the received SAR-UNITDATA invoke primitive.

6.4.1.3 State variables for the SAR sublayer at the receiver side

The SAR receiver maintains no state variables.

6.4.1.4 Procedures of the SAR sublayer at the receiver side

The state machine of the SAR receiver is shown in Figure 6-8.

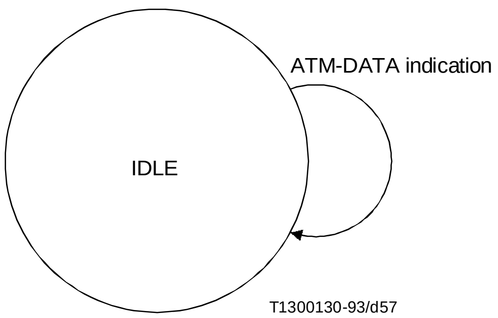


FIGURE 6-8/I.363

State transition diagram for the SAR receiver

Table 6-5 defines the state for the SAR receiver.

TABLE 6-5/I.363

State definition for the SAR receiver

State	Definition
IDLE	Waiting to begin or continue to receive a SAR-SDU

1) Upon receipt of an ATM-DATA indication primitive, the 48 octet SAR-PDU payload is sent to the CPCS. If the AUU parameter in the ATM-DATA indication primitive is set to "1", the More parameter is set to "0"; otherwise, the More parameter is set to "1".

2) In all SAR-UNITDATA signal primitives, the SAR-CI and the SAR-LP parameters shall be set to the same value as the "Congestion Indication" and the "Received Loss Priority" parameters, respectively, in the received ATM-DATA indication primitive.

6.4.2 Procedures of the CPCS for the message mode service

The structure and coding of the CPCS-PDU is defined in 6.3.2.1.2.

6.4.2.1 State variables of the CPCS at the sender side

The CPCS-sender maintains no state variables.

6.4.2.2 Procedures of the CPCS at the sender side

The state machine of the CPCS sender is shown in Figure 6-9.

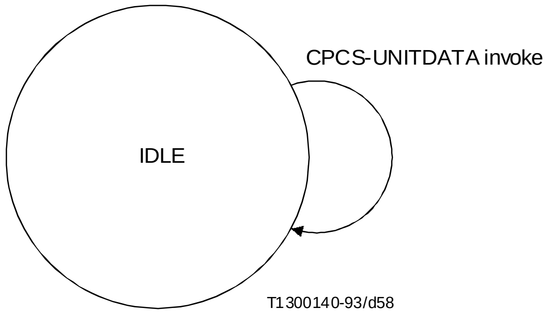


FIGURE 6-9/I.363

State transition diagram for the CPCS sender

Table 6-6 defines the state for the CPCS sender.

TABLE 6-6/I.363

State definition for the CPCS sender

State	Definition
IDLE	Waiting to transmit a new CPCS-SDU

Upon reception of a CPCS-UNITDATA invoke primitive, the CPCS-PDU is constructed as described in 6.3.2.1.2, and the CPCS-PDU is passed to the SAR sublayer in a SAR-UNITDATA invoke primitive with the More parameter set to "0". The SAR-LP and the SAR-CI parameters are set to the value of the CPCS-LP and the CPCS-CI parameters, respectively, of the CPCS-UNITDATA invoke primitive. The CPCS-UU field is assigned the value of the CPCS-UU parameter.

6.4.2.3 State variables of the CPCS at the receiver side

The CPCS receiver maintains the following state variable:

– rcv_LP
  The rcv_LP variable is initially set to zero. If any SAR-LP parameter is set to one, this variable is set to one. It is used to set the CPCS-LP parameter in the CPCS-UNITDATA signal primitive.

6.4.2.4 Procedures of the CPCS at the receiver side

The following procedures are specified for a CPCS receiver that does not deliver errored data to the receiving CPCS user. Optional delivery of errored information is for further study.

The CPCS receiver maintains the following parameter:

– Max_SDU_Deliver_Length

  This parameter indicates the maximum size SDU, in octets that may be delivered to a CPCS user. At a receiver, the value of this parameter is compared to the length of each CPCS-SDU before it is delivered. Any CPCS-SDUs that have a length greater than Max_SDU_Deliver_Length are discarded and the event is reported to Layer Management. This parameter can take on any integer value from 1 to 65 535 and is set by the management plane.

The state machine of the CPCS receiver is shown in Figure 6-10.

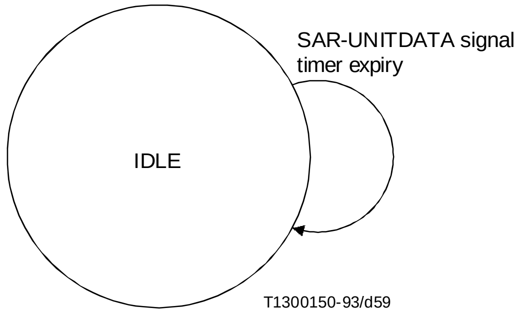


FIGURE 6-10/I.363

State transition diagram for the CPCS receiver

Table 6-7 defines the state of the CPCS receiver.

TABLE 6-7/I.363

State definition for the CPCS receiver

State	Definition
IDLE	Waiting to begin or continue to receive a CPCS-SDU

NOTE – This procedure description may copy up to 47 octets of the PAD field into the reassembly buffer before processing the CPCS-PDU trailer.

1) When the CPCS receiver receives a SAR-UNITDATA signal primitive from the SAR sublayer, it shall copy the interface data to the reassembly buffer. If the SAR-LP parameter is set to one, the variable rcv_LP is also set to one.

2) If the More parameter of the SAR-UNITDATA signal primitive is “1” and the received number of octets in the reassembly buffer of the CPCS-SDU is greater than the value of the parameter “Max_SDU_Deliver_Length” plus 7, the CPCS receiver shall discard any information in the reassembly buffer.

3) If the More parameter of the SAR-UNITDATA signal primitive is “0”, the last eight octets of the interface data represent the CPCS-PDU trailer. If the CRC calculation performed on the complete CPCS-PDU as specified in 6.3.2.1.2 and the value in the CRC field indicate the presence of errors, any information in the reassembly buffer shall be discarded.

4) If the value in the CPI field is not valid, any information in the reassembly buffer shall be discarded.

5) If the Length field of the CPCS-PDU trailer is coded as zero, any information in the reassembly buffer shall be discarded.

6) The Length field of the CPCS-PDU trailer is used to determine the length of the PAD field (length of received CPCS-PDU minus eight and minus the content of the Length field). If the PAD field is longer than 47 octets or not enough data has been received, any information in the reassembly buffer shall be discarded.

7) After the receipt of a SAR-UNITDATA signal primitive with the More parameter set to “0” and the data has not been discarded, any CPCS-SDU data in the reassembly buffer shall be delivered to the CPCS user via a CPCS-UNITDATA signal primitive. The CPCS-LP parameter shall be set to the value of the variable rcv_LP. The CPCS-CI parameter shall be set to the value of the SAR-CI parameter received with the last SAR-UNITDATA signal primitive. The CPCS-UU parameter shall be set to the value of the CPCS-UU field of the CPCS-PDU trailer. Data that is delivered is removed from the reassembly buffer.

8) Whenever information from the reassembly buffer is delivered or discarded, the variable rcv_LP is reset to zero.

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

9) When the CPCS receiver receives a SAR-UNITDATA signal primitive from the SAR sublayer with the More parameter set to “1”, the reassembly timer shall be (re)started.

10) When the CPCS receiver receives a SAR-UNITDATA signal primitive from the SAR sublayer with the More parameter set to “0”, the reassembly timer shall be stopped.

11) If the timer expires, the CPCS receiver shall discard any information in the reassembly buffer.

   Other reassembly timer procedures are for further study.

NOTE – The timer value is not specified in this Recommendation.

6.4.3 Procedures for the CPCS for the Streaming Mode service

For further study.

6.4.4 Summary of parameters and values for an AAL type 5 connection

The information in Table 6-8 must be known at AAL type 5 connection establishment.

TABLE 6-8/I.363

Parameters and options for the AAL type 5

Significance	Option/parameter	Value/Range
Peer-to-peer	Max_SDU_Deliver_Length	1 to 65 535 octets
Local	Corrupted SDU delivery	No/yes
(receiver)	Use and value of reassembly timer	No/yes-and value

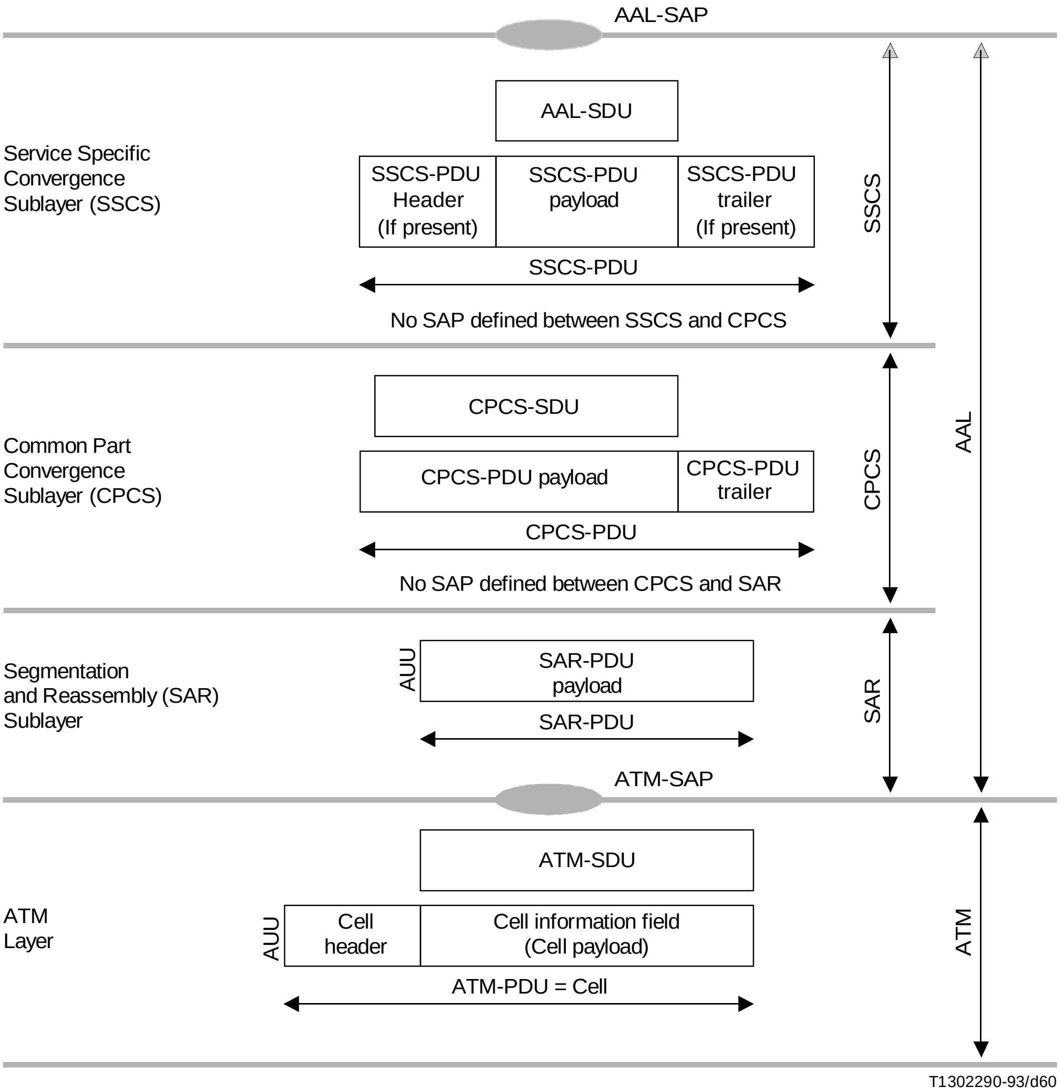


FIGURE A.4/I.363

Data unit naming conventions for the AAL type 5

Annex E

Functional model for the AAL type 5

(This annex forms an integral part of this Recommendation)

For the AAL type 5, the functionality of the SSCS may provide only for the mapping of the equivalent primitives of the AAL to the CPCS and vice versa. On the other hand, the SSCS may implement functions such as assured data transfer. Such functions, however, are not shown in the Figures E.1 and E.2.

The functional model of the AAL type 5 at the sender side is shown in Figure E.1. The model consists of several blocks that cooperate to provide the AAL type 5 service. The SAR and CPCS blocks that are paired represent the segmentation state machine.

The functional model of the AAL type 5 at the receiver side is shown in Figure E.2. The model consists of several blocks that cooperate to provide the AAL type 5 service. The SAR and CPCS blocks that are paired represent the reassembly state machine.

NOTE – Layer management interactions require further study.

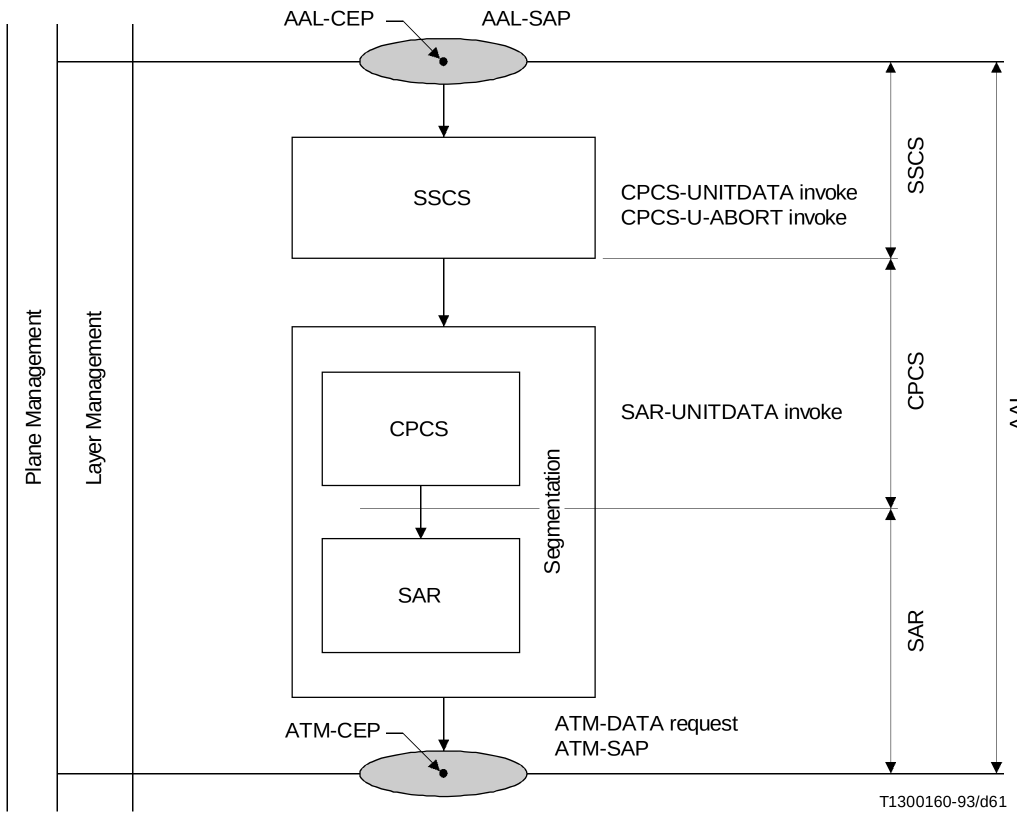
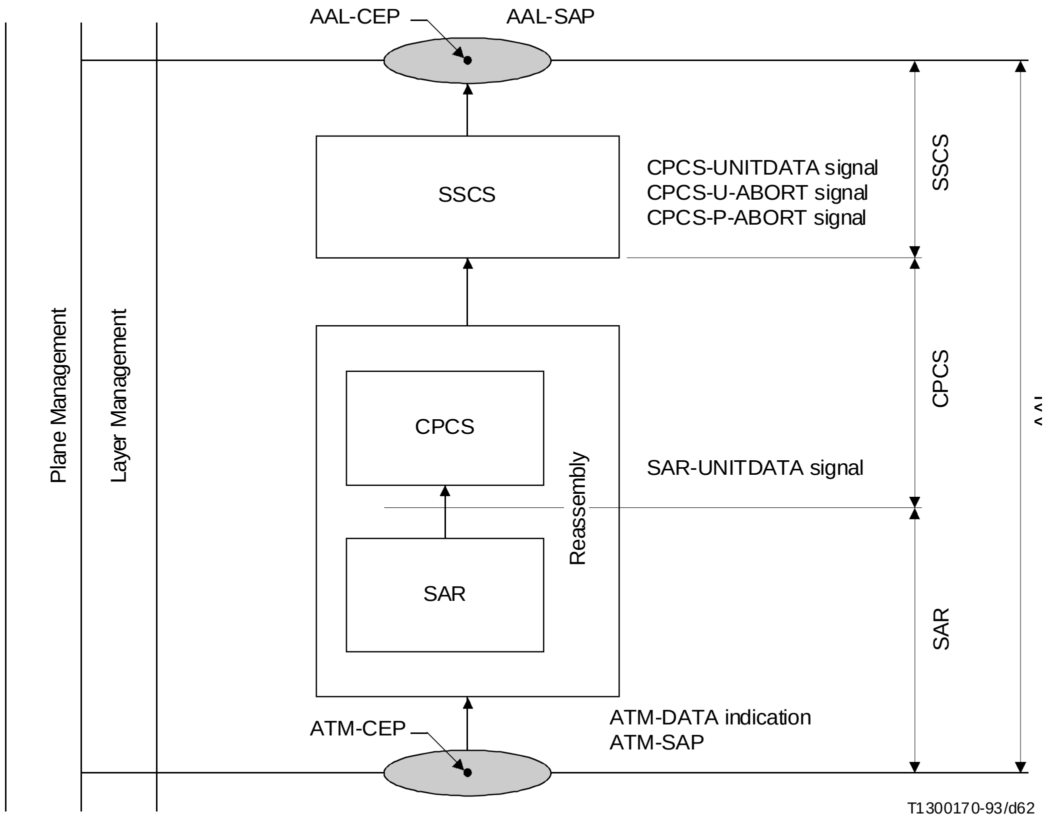


FIGURE E-1/I.363

Functional model for the AAL type 5 (sender side)



NOTE – Concerning the SSCS, the functional model is an example only. Possible functions in the SSCS (i.e. multiplexing) are not shown. The SSCS is specified in other Recommendations.

FIGURE E-2/I.363

Functional model for the AAL type 5 (receiver side)

Annex F

General framework of the AAL type 5

(This annex forms an integral part of this Recommendation)

This annex provides a description of the general framework of the AAL type 5 including SAR and CPCS PDU formats.

F.1 Message segmentation and reassembly

Figure F.1 provides a generic interpretation of the segmenting of a SAR-SDU (message) into SAR-PDUs where the AUU bit in the header of the associated ATM-SDU is set to “0” and the last SAR-PDU where the AUU bit is set to “1”.

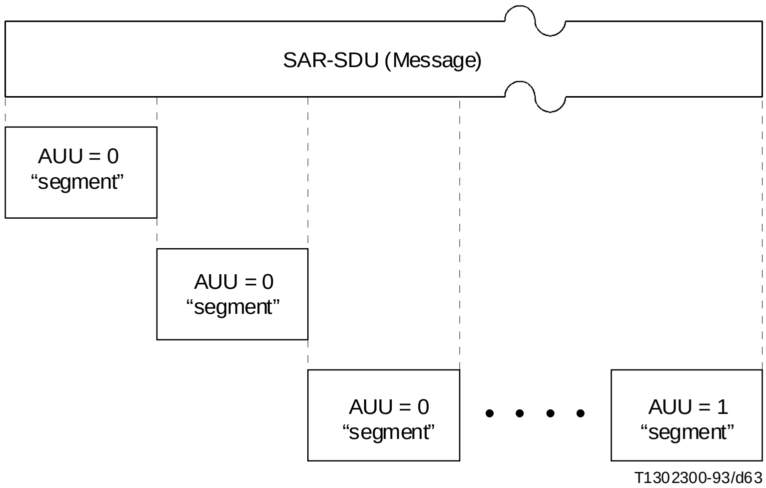


FIGURE F-1/I.363

Message segmentation and reassembly

F.2 PDU headers, trailers and terminology

Figure F.2 builds on the generic view of message segmentation of Figure A.1 to incorporate the relevant PDU headers and trailers and appropriate terminology on the basis of the AUU bit being set to “0” or “1”.

F.3 Examples of the segmentation and reassembly process

Figure F.3 shows schematically a successful segmentation and reassembly of a CPCS user PDU in message mode.

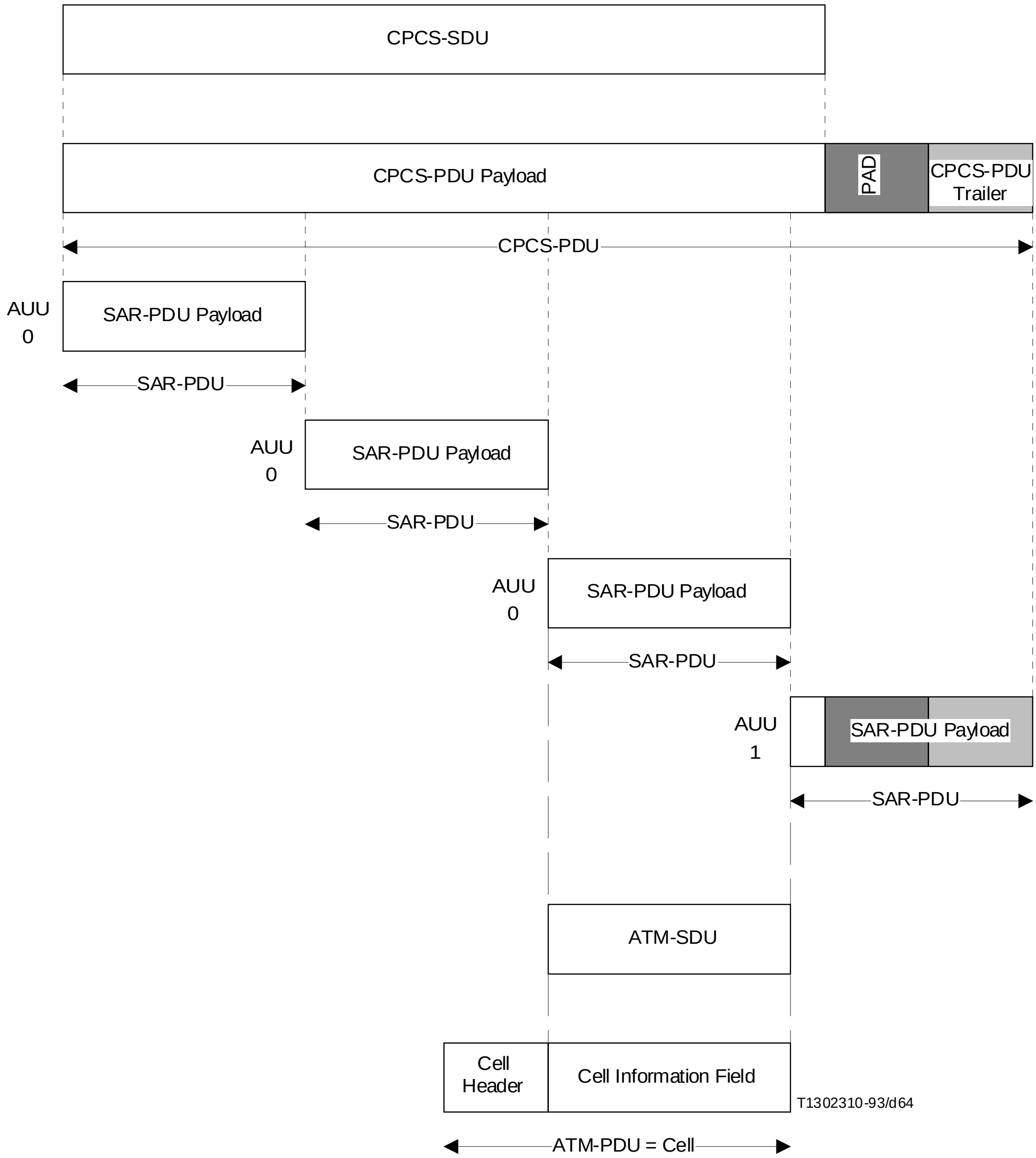


FIGURE F.2/I.363

PDU Headers, trailers and terminology

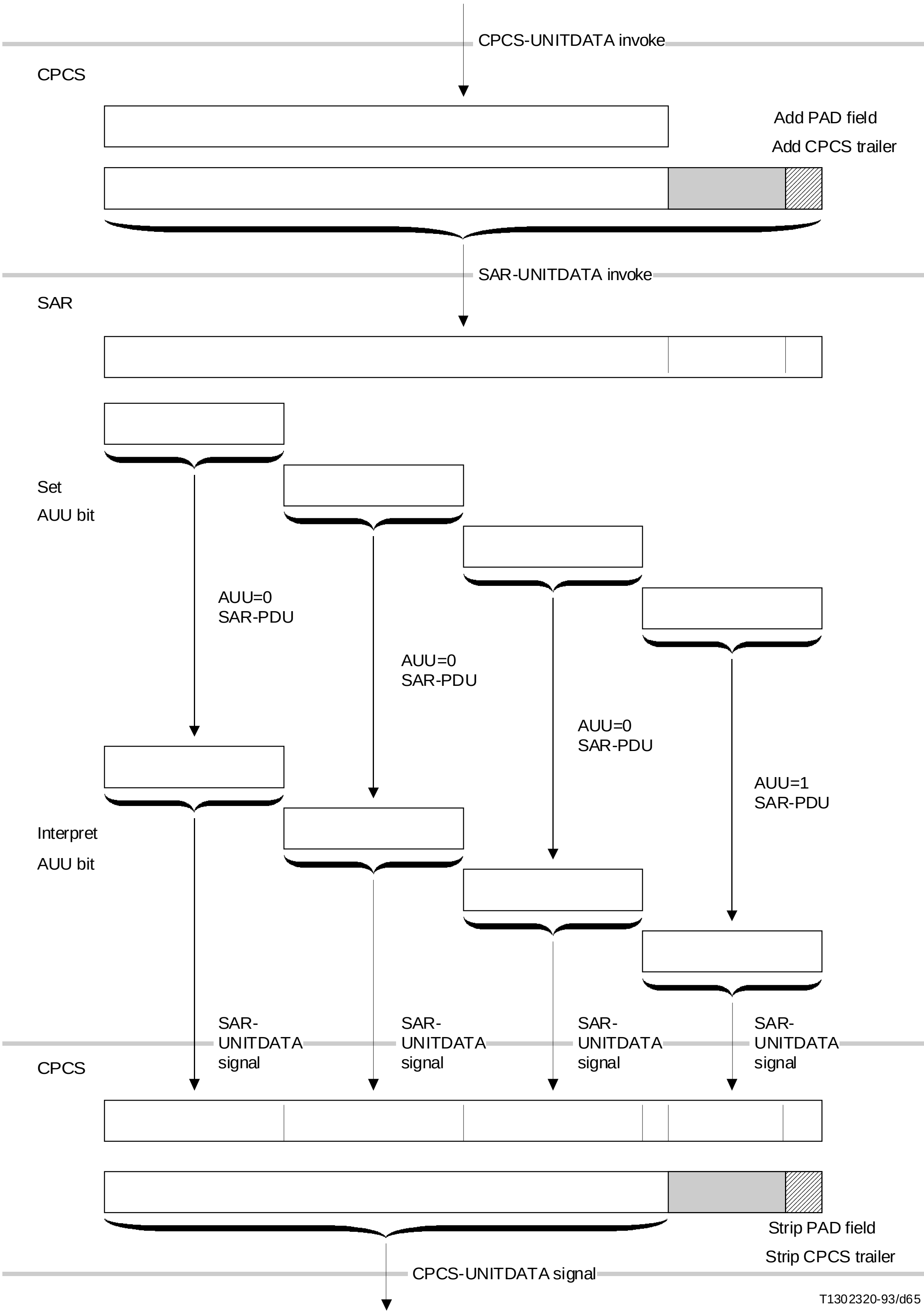


FIGURE F.3/I.363

Successful segmentation and reassembly of a CPCS user PDU

Appendix II

SDL diagram for the SAR and the CPCS of the AAL type 5

(This appendix does not form an integral part of this Recommendation)

II.1 SDL for the SAR sublayer

The purpose of this subclause is to provide one example of an SDL representation of the SAR procedures, to assist in the understanding of this Recommendation. The SDL representation does not constrain implementations from exploiting the full potential inherent in this highly parallel and fast environment. The text description of the procedures in the main body of this Recommendation is definitive.

II.1.1 The SAR sender

The SAR sender makes use of two 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 an SAR-PDU.

b) count

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

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

II.1.2 The SAR receiver

The SAR receiver maintains no variables.

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

II.2 SDL for the Common Part CS (CPCS) procedures

The purpose of this subclause is to provide one example of an SDL representation of the CPCS procedures, to assist in the understanding of this Recommendation. Neither delivery of errored data nor Streaming Mode procedures are included. The SDL representation does not constrain implementations from exploiting the full potential inherent in this highly parallel and fast environment. The text description of the procedures in the main body of this Recommendation is definitive.

II.2.1 The CPCS sender

The CPCS sender maintains no variables.

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

II.2.2 The CPCS receiver

The CPCS receiver makes use of the state variable rcv_LP (as defined in 6.4.2.3). In addition the CPCS receiver utilizes one variable:

– *reassembly buffer*

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

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

Process SAR Sender

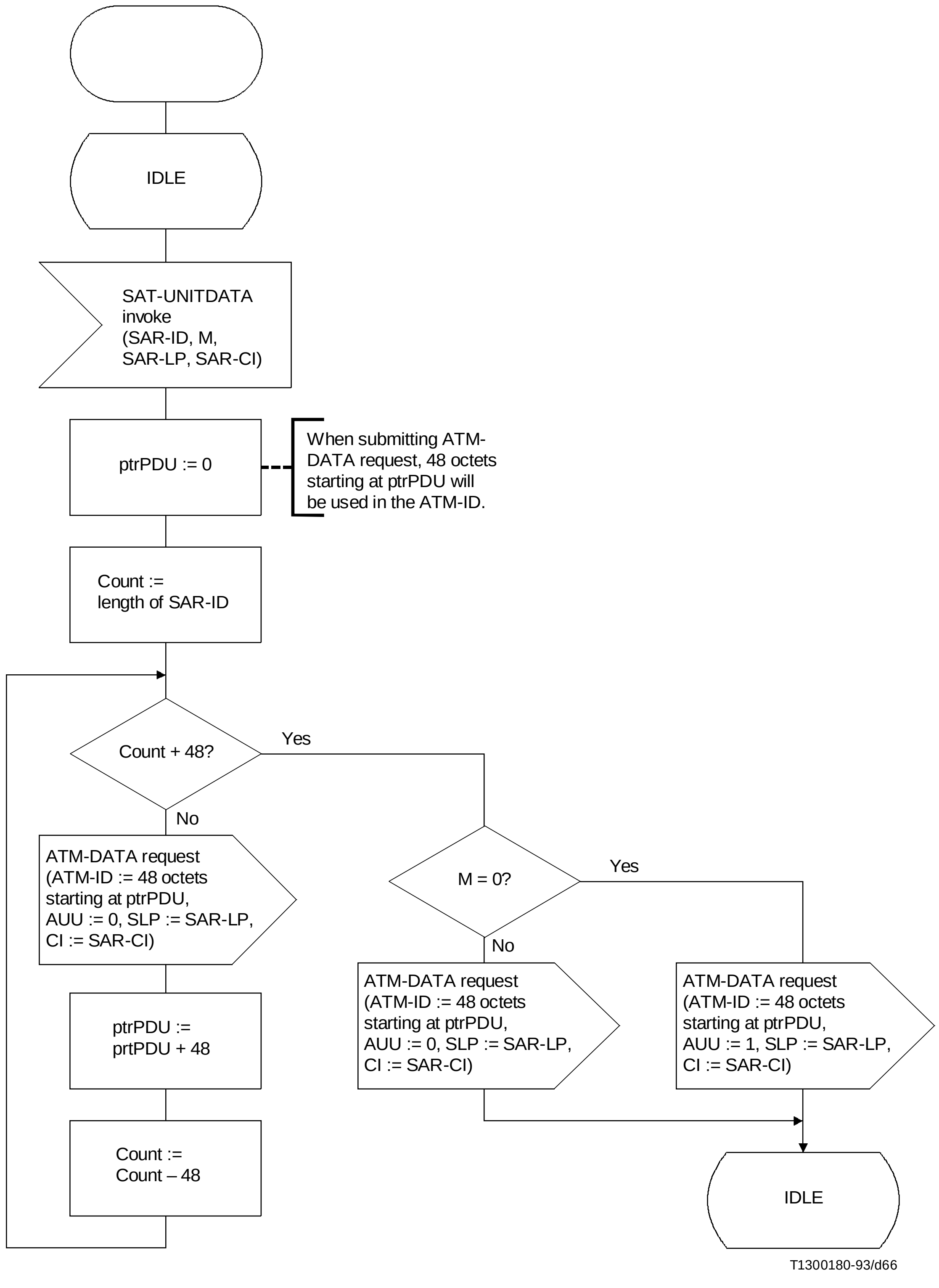


FIGURE II.1/I.363

Process SAR Receiver

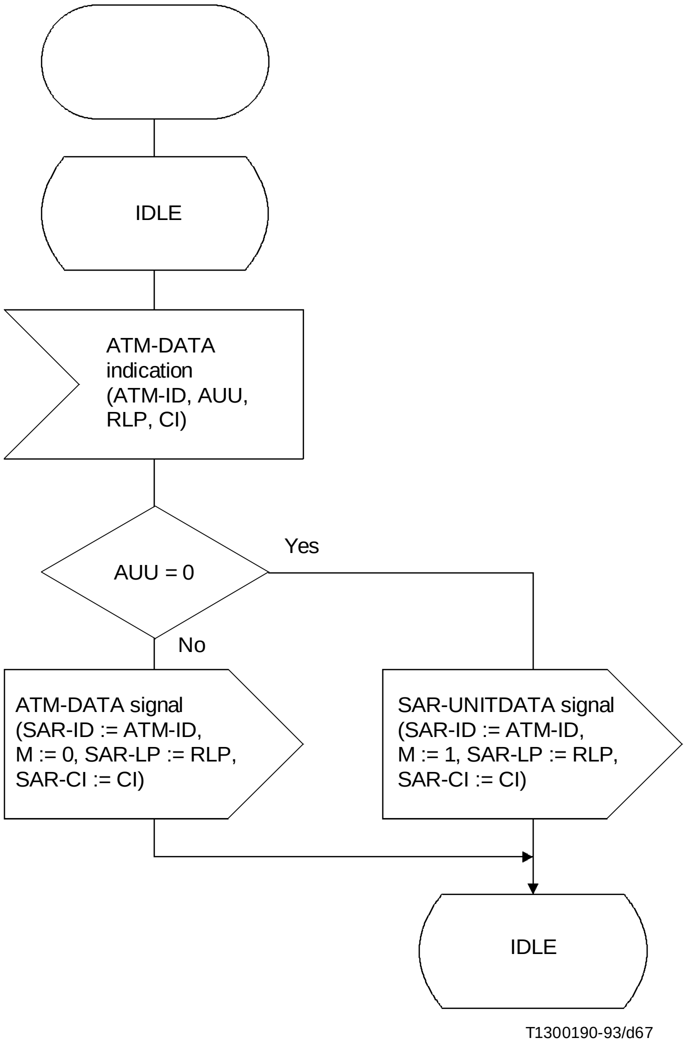


FIGURE II.2/I.363

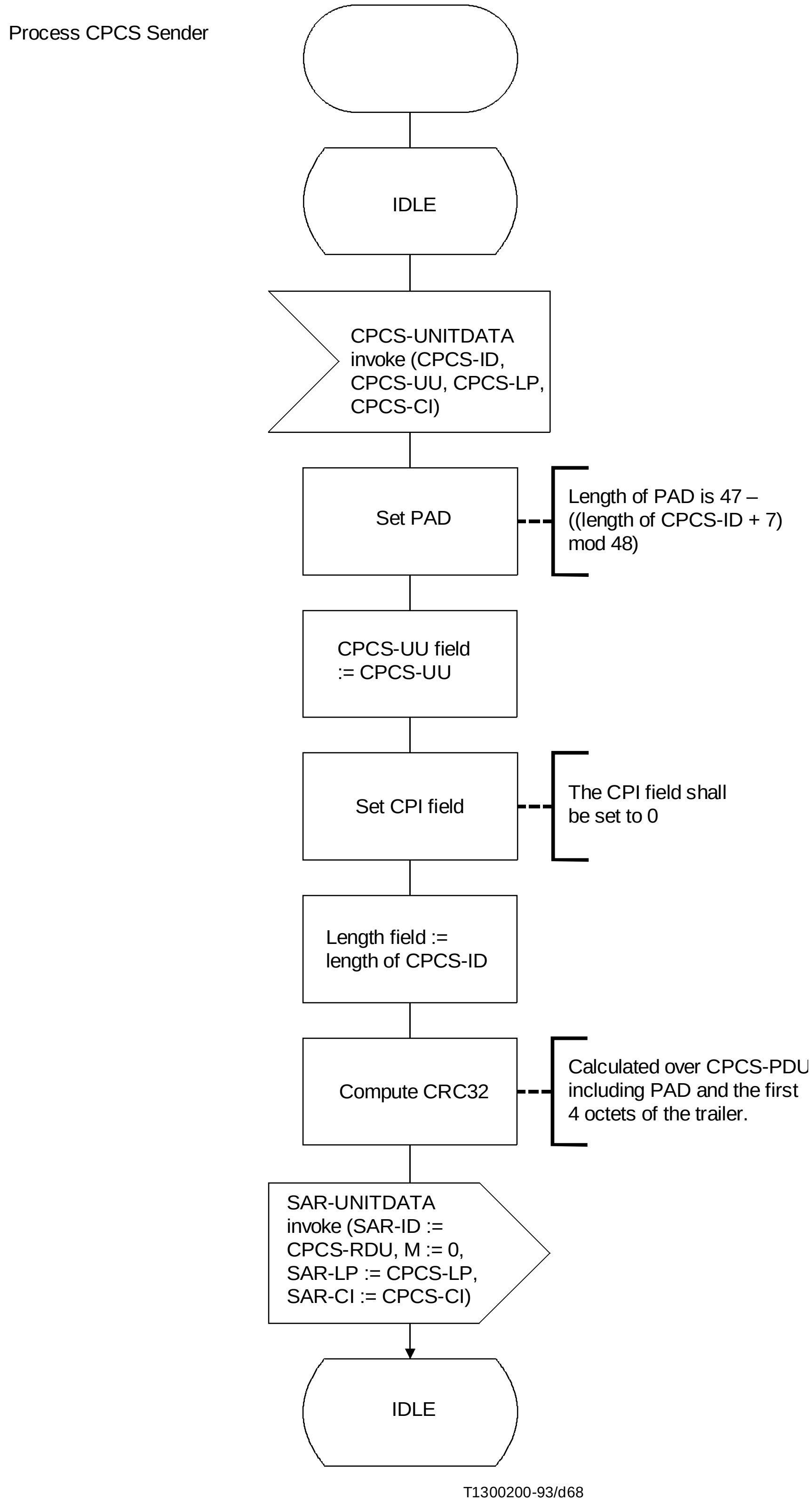


FIGURE II.3/I.363

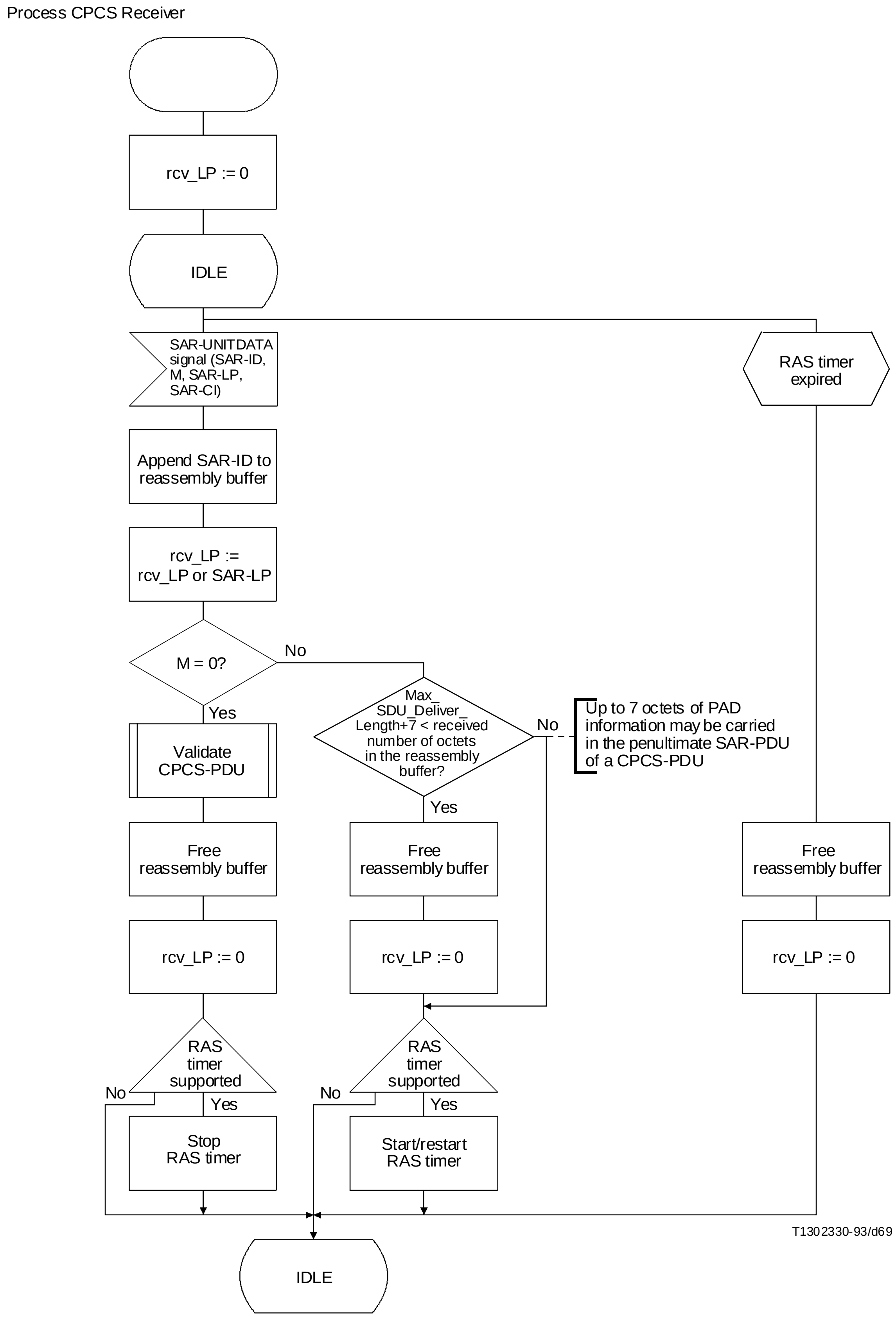


FIGURE II.4/I.363

SDL diagrams for the CPCS receiver

Procedure validate CPCS-PDU

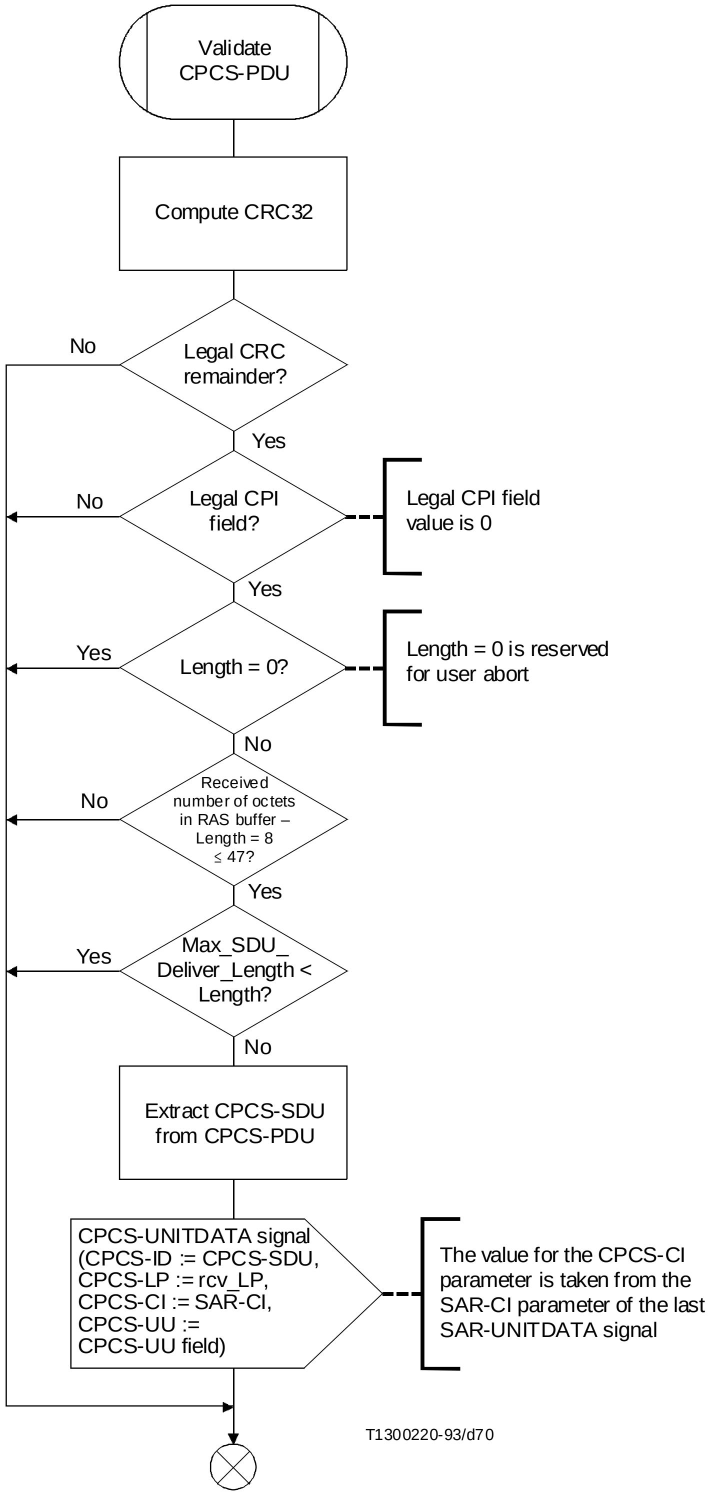


FIGURE II.5/I.363

Appendix III

Example CPCS-PDUs for the AAL type 5

(This appendix does not forms an integral part of this Recommendation)

The values in the examples are in hexadecimal notation.

a) *Example 1*

40 octets filled with “0”
CPCS-UU field=0
CPI Field=0
Length=40 octets
CRC-32=864d7f99

00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	28	86	4d	7f	99

b) *Example 2*

40 octets filled with “1”
CPCS-UU field=0
CPI Field=0
Length=40 octets
CRC-32=c55e457a

ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff
ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff
ff	ff	ff	ff	ff	ff	ff	ff	00	00	00	28	c5	5e	45	7a

c) *Example 3*

40 octets counting: 1 to 40
CPCS-UU field=0
CPI Field=0
Length=40 octets
CRC-32=bf671ed0

01	02	03	04	05	06	07	08	09	0a	0b	0c	0d	0e	0f	10
11	12	13	14	15	16	17	18	19	1a	1b	1c	1d	1e	1f	20
21	22	23	24	25	26	27	28	00	00	00	28	bf	67	1e	d0