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SERIES I: INTEGRATED SERVICES DIGITAL
NETWORK

Overall network aspects and functions – Protocol layer
requirements

**B-ISDN ATM Adaptation Layer specification:
Type 2 AAL**

ITU-T Recommendation I.363.2

(Formerly CCITT Recommendation)

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INTEGRATED SERVICES DIGITAL NETWORK

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B-ISDN ATM Adaptation Layer specification: Type 2 AAL

Summary

This Recommendation specifies the AAL type 2 that provides for the bandwidth-efficient transmission of low-rate, short, and variable length packets in delay sensitive applications. More than one AAL type 2 user information stream can be supported on a single ATM connection. This Recommendation covers the specification of the frame structure of the short and variable length packets, the packing of short length packets into one (or more) ATM cells, and the mechanisms to recover from transmission errors.

This Recommendation describes the interactions between AAL type 2 and the next higher layer, between AAL type 2 and the ATM layer, and between AAL type 2 and Layer Management, as well as AAL type 2 peer-to-peer operations.

Source

ITU-T Recommendation I.363.2 was revised by ITU-T Study Group 13 (2001-2004) and approved under the WTSA Resolution 1 procedure on 24 November 2000.

FOREWORD

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ITU-T Recommendation I.363.2

B-ISDN ATM Adaptation Layer specification: Type 2 AAL

1 Scope

This Recommendation specifies the AAL type 2 that provides for the bandwidth-efficient transmission of low-rate, short, and variable length packets in delay sensitive applications. More than one AAL type 2 user information stream can be supported on a single ATM connection. This Recommendation covers the specification of the frame structure of the short and variable length packets, the packing of short length packets into one (or more) ATM cells, and the mechanisms to recover from transmission errors.

This Recommendation describes the interactions between AAL type 2 and the next higher layer, between AAL type 2 and the ATM layer, and between AAL type 2 and Layer Management, as well as AAL type 2 peer-to-peer operations.

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 I.361 (1999), *B-ISDN ATM layer specification*.
- [2] ITU-T X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The basic model*.
- [3] ITU-T X.210 (1993), *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services*.
- [4] ITU-T I.371 (2000), *Traffic control and congestion control in B-ISDN*.

3 Definitions

This Recommendation is based upon the concepts developed in ITU-T 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-CEP | AAL Connection End Point |
| AAL-SDU | AAL Service Data Unit |
| ANP | AAL type 2 Negotiation Procedures |
| ATC | ATM Transfer Capability |
| ATM | Asynchronous Transfer Mode |

| | |
|----------|--|
| ATM-CEP | ATM Connection End Point |
| ATM-SDU | ATM Service Data Unit |
| AUU | ATM-User-to-ATM-User Indication |
| CEP | Connection End Point |
| CI | Congestion Indication |
| CID | Channel Identifier |
| CLP | Cell Loss Priority |
| CPS | Common Part Sublayer |
| CPS-INFO | CPS Interface Data |
| CPS-PDU | CPS Protocol Data Unit |
| CPS-PH | CPS Packet Header |
| CPS-PP | CPS Packet Payload |
| CPS-SDU | CPS Service Data Unit |
| CPS-UUI | CPS User-to-User Indication |
| HEC | Header Error Control |
| LI | Length Indication |
| LM | Layer Management |
| LSB | Least Significant Bit |
| MSB | Most Significant Bit |
| OAM | Operation and Maintenance |
| OSF | Offset Field |
| PAD | Padding |
| PCI | Protocol Control Information |
| PDU | Protocol Data Unit |
| QoS | Quality of Service |
| RLP | Received (Cell) Loss Priority |
| SAP | Service Access Point |
| SDL | Specification and Description Language |
| SDU | Service Data Unit |
| SLP | Submitted (Cell) Loss Priority |
| SN | Sequence Number |
| SSCS | Service Specific Convergence Sublayer |
| SSCS-PDU | SSCS Protocol Data Unit |
| STF | Start Field |
| UUI | User-to-User Indication |
| VCC | Virtual Channel Connection |

5 Conventions

The AAL type 2 receives from the ATM layer the information in the form of a 48-octet ATM Service Data Unit (ATM-SDU). The AAL type 2 passes to the ATM layer information in the form of a 48-octet ATM-SDU.

6 General framework of AAL type 2

6.1 Structure of AAL type 2

The AAL type 2 is subdivided into the Common Part Sublayer (CPS) and the Service Specific Convergence Sublayer (SSCS) as shown in Figure 1. For more detail, see Annex B.

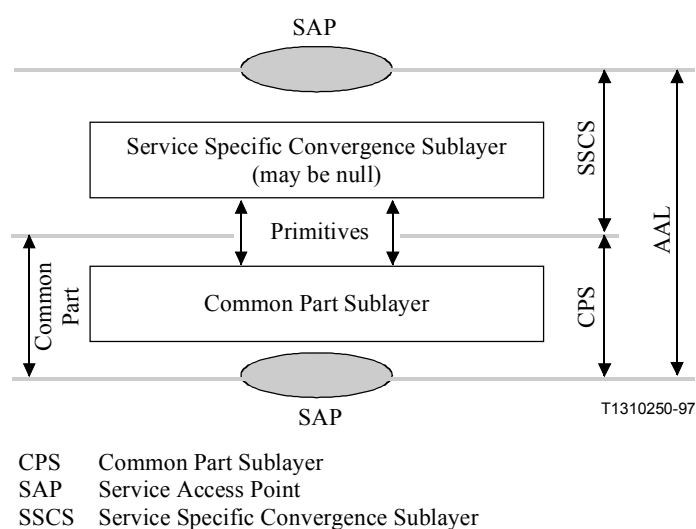


Figure 1/I.363.2 – Structure of the AAL type 2

Different SSCS protocols may be defined to support specific AAL type 2 user services, or groups of services. The SSCS may also be null, merely providing for the mapping of the equivalent AAL primitives to the AAL type 2 CPS primitives and vice versa. SSCS protocols are defined in separate Recommendations.

The AAL type 2 provides the capabilities to transfer AAL-SDUs from one AAL-SAP to one other AAL-SAP through the ATM network (see Figure 2 a)). The AAL type 2 in non-assured operation provides the capability to transfer the AAL-SDUs from one AAL-SAP to more than one AAL-SAP through the point-to-multipoint ATM layer capability (see Figure 2 b)).

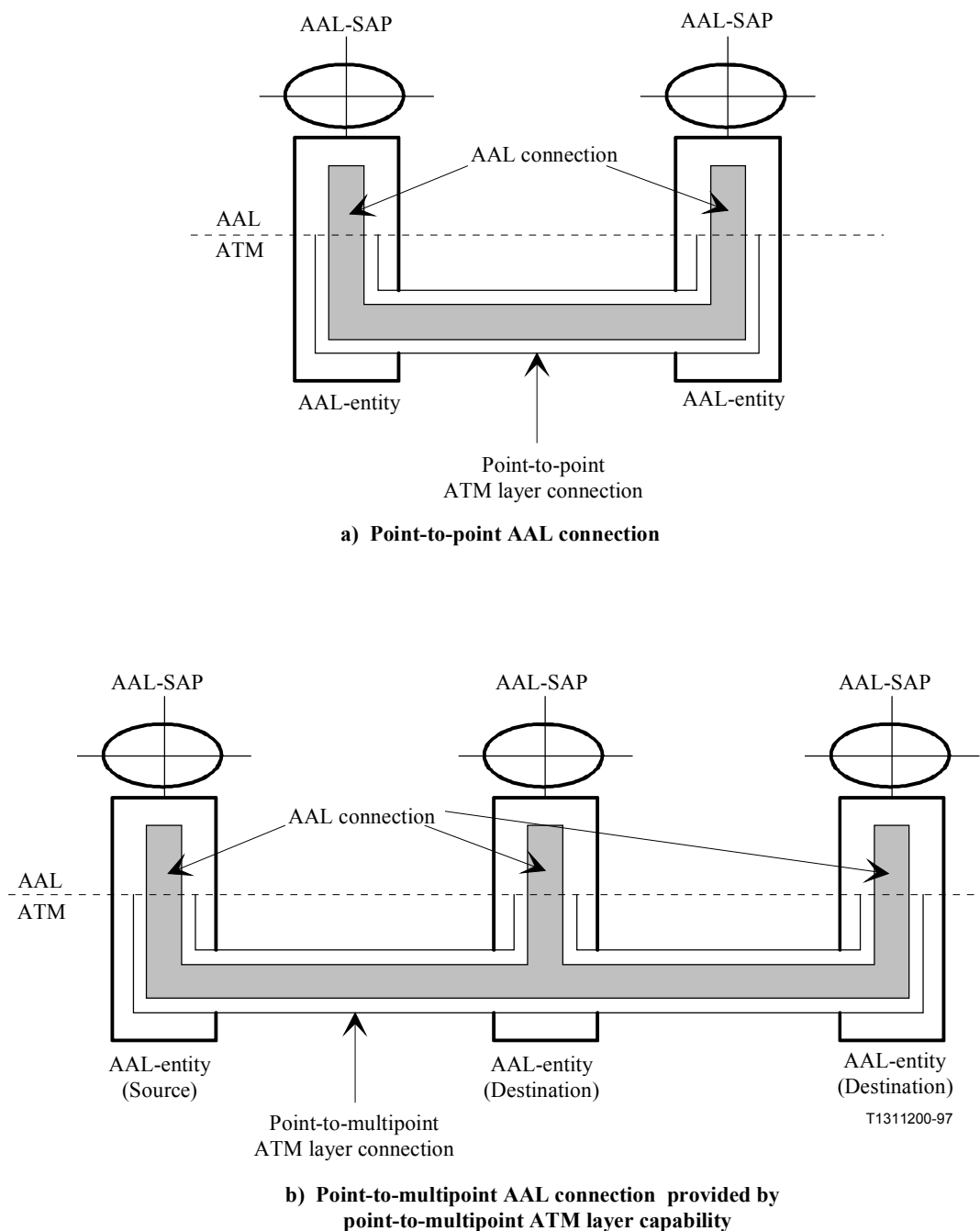
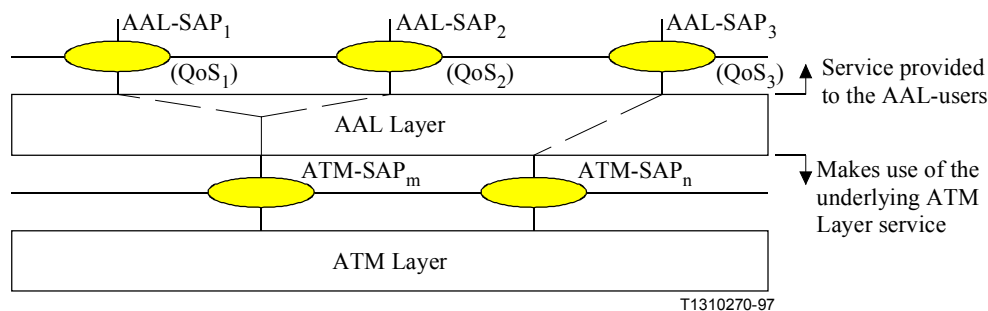


Figure 2/I.363.2

The AAL type 2 users have the capability to select a given AAL-SAP associated with the QoS (for example, delay and loss sensitivity) required to transport that AAL-SDU (see Figure 3). The AAL type 2 makes use of the service provided by the underlying ATM layer. Multiple AAL connections may be associated with a single ATM layer connection, allowing multiplexing at the AAL; multiplexing in the AAL type 2 occurs in the Common Part Sublayer (CPS). The AAL user selects the QoS provided by the AAL through the choice of the AAL-SAP used for data transfer. In this version of the Recommendation, Quality of Service (QoS_x in Figure 3) is provided by the ATM layer and there exists no standardized means to provide QoS at the AAL type 2 layer.



NOTE – How QoS at the AAL-SAP is mapped into the ATM-SAP QoS in the event of multiplexing in the AAL is for further study.

Figure 3/I.363-2 – Relation between AAL-SAP and ATM-SAP

The switching aspects of AAL type 2 connections are specified in Annex C.

6.2 Primitives provided by AAL type 2 for higher layer

The primitives that cross the AAL type 2 SAP are service-specific and contained in Recommendations that specify SSCS protocols.

The SSCS may be null, merely providing for the mapping of the equivalent AAL primitives to CPS and vice versa. In this case, the primitives for the AAL are equivalent to the AAL type 2 CPS primitives (see 7.2) but identified as AAL-UNITDATA.request and AAL-UNITDATA.indication consistent with the primitive naming convention at a SAP.

6.3 Information flow across the AAL-ATM boundary

The AAL type 2 makes use of the ATM layer services as defined in ITU-T I.361 [1]. The primitives that cross the ATM-SAP are defined in ITU-T I.361 [1]. They are summarized in Table 1. In the event of any difference between the following summary and the definitions in ITU-T I.361, the definitions in ITU-T I.361 take precedence.

Table 1/I.363.2 – Primitives and parameters of the ATM layer

| Parameter | ATM- DATA request | ATM- DATA indication | Comments |
|--|----------------------------------|-------------------------------------|---|
| ATM-SDU (INFO) | m | m | 48 octets of ATM user data |
| ATM-User-to-ATM-User Indication (AUU) (Note) | m | m | 1 bit of ATM user information |
| Submitted Loss Priority (SLP) (Note) | m | – | CLP = 1 increases the probability that the ATM network may discard the cell |
| Received Loss Priority (RLP) | – | m | The CLP may have been modified by ATM network from "0" to "1" |
| Congestion Indication (CI) (Note) | o | m | CI = "1" indicates that congestion has been encountered either before transmission or during transfer |
| m Parameter mandatory o Parameter optional – Parameter not present NOTE – AUU, SLP and CI of ATM-DATA.request are set to "0" (see clause 10). | | | |

7 General framework of AAL type 2 Common Part Sublayer (CPS)

7.1 Service provided by AAL type 2 CPS

The AAL type 2 CPS provides the capabilities to transfer CPS-SDUs from one CPS user to one other CPS user through an ATM network. Two types of CPS users are supported:

- SS-CS entities; and
- Layer Management.

The service offers peer-to-peer operation:

- data transfer of CPS-SDUs of up to 45 (default) or 64 octets [see 9.1 b)];
- multiplexing and demultiplexing of multiple AAL type 2 channels;
- CPS-SDU sequence integrity is maintained on each AAL type 2 channel.

The above service is non-assured, i.e.:

- integral CPS-SDU may be delivered or lost; and
- lost CPS-SDUs will not be corrected by retransmission.

The AAL type 2 CPS possesses the following characteristics:

- The AAL type 2 CPS connection is defined on an end-to-end basis as a concatenation of AAL type 2 channels.

NOTE – The concatenation of AAL type 2 channels requires a relay function within the Common Part Sublayer; details are for further study.

- The AAL type 2 channel is a bidirectional virtual channel. The same value of channel identifier value shall be used for both directions.
- The AAL type 2 channels are established over an ATM layer Permanent Virtual Circuit (PVC) or Switched Virtual Circuit (SVC).

7.2 Primitives between AAL type 2 CPS and SSCS entities

The primitives provided by the AAL type 2 CPS for communication with SSCS entities are CPS-UNITDATA.request and CPS-UNITDATA.indication. They are used for the data transfer.

The following parameters are defined.

CPS Interface Data (CPS-INFO)

This parameter specifies the interface data unit exchanged between the CPS and the SSCS entity. The interface data is an integral multiple of one octet. The CPS Interface Data represents a complete CPS-SDU.

CPS User-to-User Indication (CPS-UUI)

This parameter is transparently transported by the CPS between peer CPS users.

The usage of parameters is summarized in Table 2.

8 Interaction with Management and Control Plane

8.1 Management Plane

8.1.1 Management Plane interaction with AAL type 2 CPS User Plane

Layer Management provides the primitive MAAL-SEND.request to signal to the AAL type 2 CPS that the ATM Transfer Capability [4] (ATC) in force for the ATM connection allows the submission of a CPS-PDU for transmission; this primitive has no parameters. The AAL type 2 CPS also reports detected transmission errors to Layer Management by means of the MAAL-ERROR.indication primitive that has a single parameter indicating the error number (type of error, see Table 6).

To enable peer-to-peer AAL type 2 management communication via AAL type 2 channels, the primitive MAAL-UNITDATA.request is used to deliver data from the Management Plane to the CPS transmitter. The primitive MAAL-UNITDATA.indication is used to deliver data from the CPS receiver to the Management Plane. The following parameters are defined:

CPS Interface Data (CPS-INFO)

This parameter specifies the interface data unit exchanged between the CPS and Layer Management. The interface data is an integral multiple of one octet.

CPS User-to-User Indication (CPS-UUI)

This parameter is transparently transported by the CPS between peer Layer Management entities.

CPS Channel Identifier (CPS-CID)

This parameter contains a Channel Identifier (CID), it identifies the CPS connection for which this management information is exchanged.

The usage of parameters is summarized in Table 3.

Table 2/I.363.2 – Primitives and parameters between the CPS and the SSCS

| Parameter | CPS-UNITDATA request | CPS-UNITDATA indication | Comments |
|--|----------------------|-------------------------|---|
| CPS-Interface Data (CPS-INFO) | m | m | 1..45 (default) or 1..64 octets of CPS user data (see 9.1 b)) |
| CPS-User-to-User Indication (CPS-UUI) | m | m | 5 bits of CPS user information (Note) |
| m Parameter mandatory NOTE – Only values "0" .. "27" are permitted. | | | |

Table 3/I.363.2 – Primitives and parameters between the CPS and Layer Management

| Parameter | MAAL-UNITDATA request | MAAL-UNITDATA indication | Comments |
|---|-----------------------|--------------------------|--|
| CPS- Interface Data (CPS-INFO) | m | m | 1..45 (default) or 1..64 octets of Layer Management user data (see 9.1 b)) |
| CPS- User-to-User Indication (CPS-UUI) | m | m | 5 bits of Layer Management information (Note) |
| CPS-Channel Identifier (CPS-CID) | m | m | An 8 bit CPS Channel Identifier indicating the AAL type 2 channel on which the information will be or has been transmitted |
| m Parameter mandatory NOTE – Only values "30" .. "31" are permitted. | | | |

Other interactions with the Management Plane are for further study.

8.2 Control Plane

Interaction between the AAL type 2 and the Control Plane (C-plane) is outside the scope of this Recommendation. If the AAL type 2 is used on a Switched Virtual Circuit (SVC) that has been established via Control Plane functions (signalling), the SVC is established at the AAL type 2 level and not at the individual channel level contained within the AAL type 2. Switching at the individual channel level within the AAL type 2 is for further study.

9 Format and coding of AAL type 2 Common Part Sublayer (CPS)

This clause specifies the format and coding of the CPS-Packet and the packing of CPS-Packets into AAL type 2 CPS PDUs.

The coding conforms to the coding conventions specified in 2.1/I.361 [1].

9.1 Format and coding of the CPS-Packet

A CPS-Packet consists of a 3-octet CPS-Packet Header (CPS-PH) followed by a CPS-Packet Payload (CPS-PP). The size and positions of the fields of the CPS-Packet are shown in Figure 4.

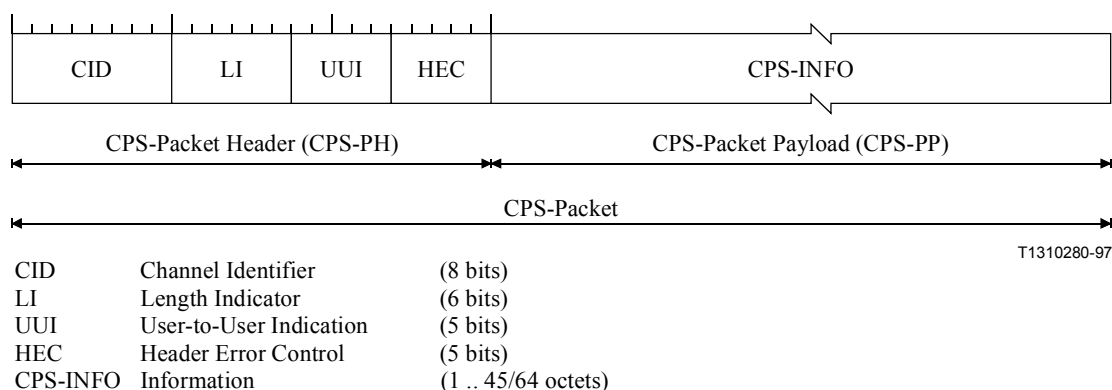


Figure 4/I.363.2 – Format of AAL type 2 CPS-Packet

The CPS-PH consists of four fields:

a) *Channel Identifier (CID)*

The CID value identifies the AAL type 2 CPS user of the channel. The AAL type 2 channel is a bidirectional channel. The same value of channel identification shall be used for both directions.

The value "0" is not used for channel identification because the all zero octet is used for the padding function (see 9.2.2). The values "1" .. "7" are reserved for use by the AAL type 2 and are specified in this Recommendation (see Table 4).

The values "8" .. "255" are used to identify the users of the AAL type 2 CPS; further discrimination between the two types of users, i.e. SSCS and Layer Management, is provided by the UUI field (see item c) below).

Table 4/I.363.2 – Coding of the CID Field

| CID value | Use |
|-----------|---|
| 0 | Not used |
| 1 | Reserved for Layer Management peer-to-peer procedures |
| 2 | Reserved for Signalling |
| 3 .. 7 | Reserved |
| 8 .. 255 | Identification of AAL type 2 CPS user entity |

b) *Length Indicator (LI)*

The LI field is binary encoded with a value that is one less than the number of octets in the CPS-Packet Payload. The default maximum length of the CPS-Packet Payload is 45 octets; otherwise, the maximum length can be set to 64 octets.

The maximum length is channel specific, i.e. its value need not be common to all AAL type 2 channels. However, for a given CID value, all CPS-Packet payloads must conform to a common maximum value. This maximum length is set by signalling or management procedures.

When the maximum length is 45 octets, LI values 45 ... 63 are not allowed.

c) *User-to-User Indication (UUI)*

The UUI field serves two purposes:

- to convey specific information transparently between the CPS users, i.e. between SSCS entities or between Layer Management; and
- to distinguish between the SSCS entities and Layer Management users of the CPS (see range of permissible values in Tables 2 and 3).

The 5-bit UUI field provides for 32 codepoints, "0" .. "31". Codepoints "0" .. "27" are available for SSCS entities, codepoints "30" .. "31" are available to Layer Management, and codepoints "28" .. "29" are reserved for future standardization.

The contents of the UUI field are used to transport the UUI parameters of the CPS-UNITDATA and MAAL-UNITDATA primitives.

d) *Header Error Control (HEC)*

The transmitter shall calculate the remainder of the division (modulo 2), by the generator polynomial $x^5 + x^2 + 1$, of the product of x^5 and the contents of the first 19 bits of the CPS-PH. The coefficients of the remainder polynomial shall be inserted in the HEC field with the coefficient of the x^4 term in the most significant bit of the HEC field.

The receiver uses the contents of the HEC field to detect errors in the CPS-PH.

9.2 Format and coding of the CPS-PDU

The CPS-PDU consists of a one octet start field and a 47-octet payload. The 48-octet CPS-PDU is the ATM-SDU. The size and positions of the fields of the CPS-PDU are shown in Figure 5.

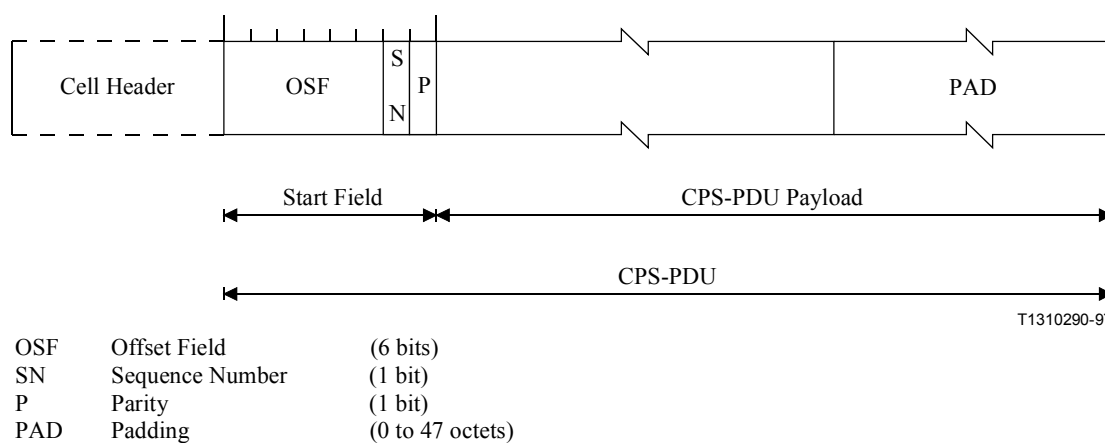


Figure 5/I.363.2 – Format of CPS-PDU

9.2.1 CPS-PDU start field (STF)

The CPS-PDU header also is referred to as the Start Field (STF). The STF consists of the following subfields:

a) *Offset Field (OSF)*

This field carries the binary value of the offset, measured in number of octets, between the end of the STF and the first start of a CPS-Packet or, in the absence of a first start, to the start of the PAD field. The value 47 indicates that there is no start boundary in the CPS-PDU payload. Values greater than 47 are not allowed.

b) *Sequence Number (SN)*

This bit is used to number (modulo 2) the stream of CPS-PDUs.

c) *Parity (P)*

This bit is used by the receiver to detect errors in the STF. The transmitter sets this bit value such that the parity over the 8-bit STF is odd.

9.2.2 CPS-PDU payload

The CPS-PDU payload may carry zero, one or more (complete or partial) CPS-Packets. Unused payload is filled with padding octets coded with the value zero. A CPS-Packet may overlap one or two ATM cell boundaries. The overlap point where the CPS-Packet becomes partitioned may occur anywhere in the CPS-Packet, including the CPS-Packet header.

NOTE – Example uses of the CPS-PDU payload are shown in Appendix I.

10 Procedure of AAL type 2 Common Part Sublayer (CPS)

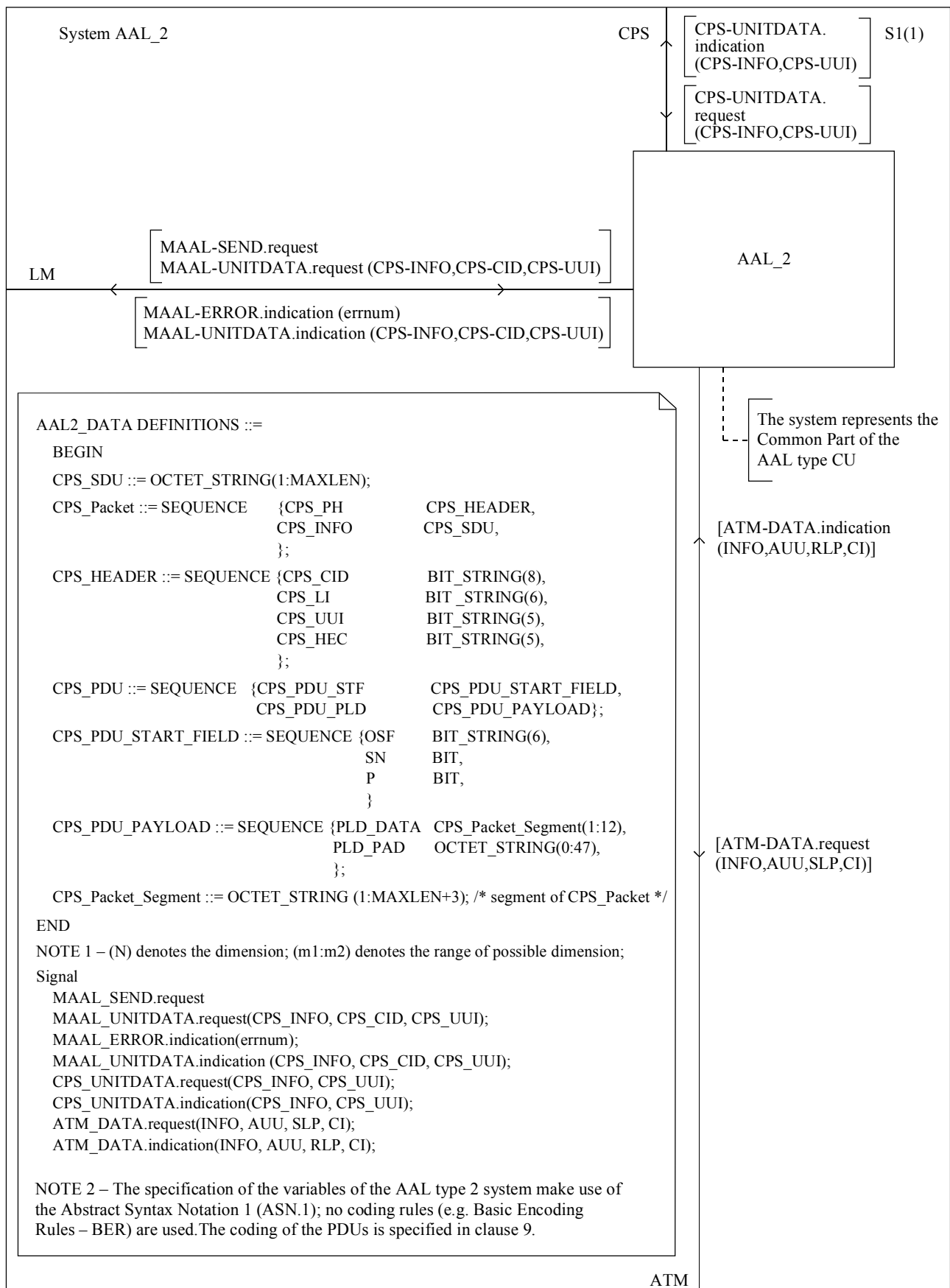
The multiplexing function in the Common Part Sublayer merges several streams of CPS-Packets onto a single ATM connection. The method of scheduling the different streams and the possible use of priorities is not specified in this Recommendation.

The SDL system diagram is shown in Figure 6 and the SDL block structure in Figure 7. SDL symbol repertoire is given in Figure 8.

The Common Part Sublayer receives CPS-SDUs from one or more SSCS transmitter processes. It multiplexes and packs CPS-Packets constructed from these into CPS-PDUs. At the CPS receiver, the CPS-Packets are unpacked and demultiplexed and passed to one of the SSCS receivers.

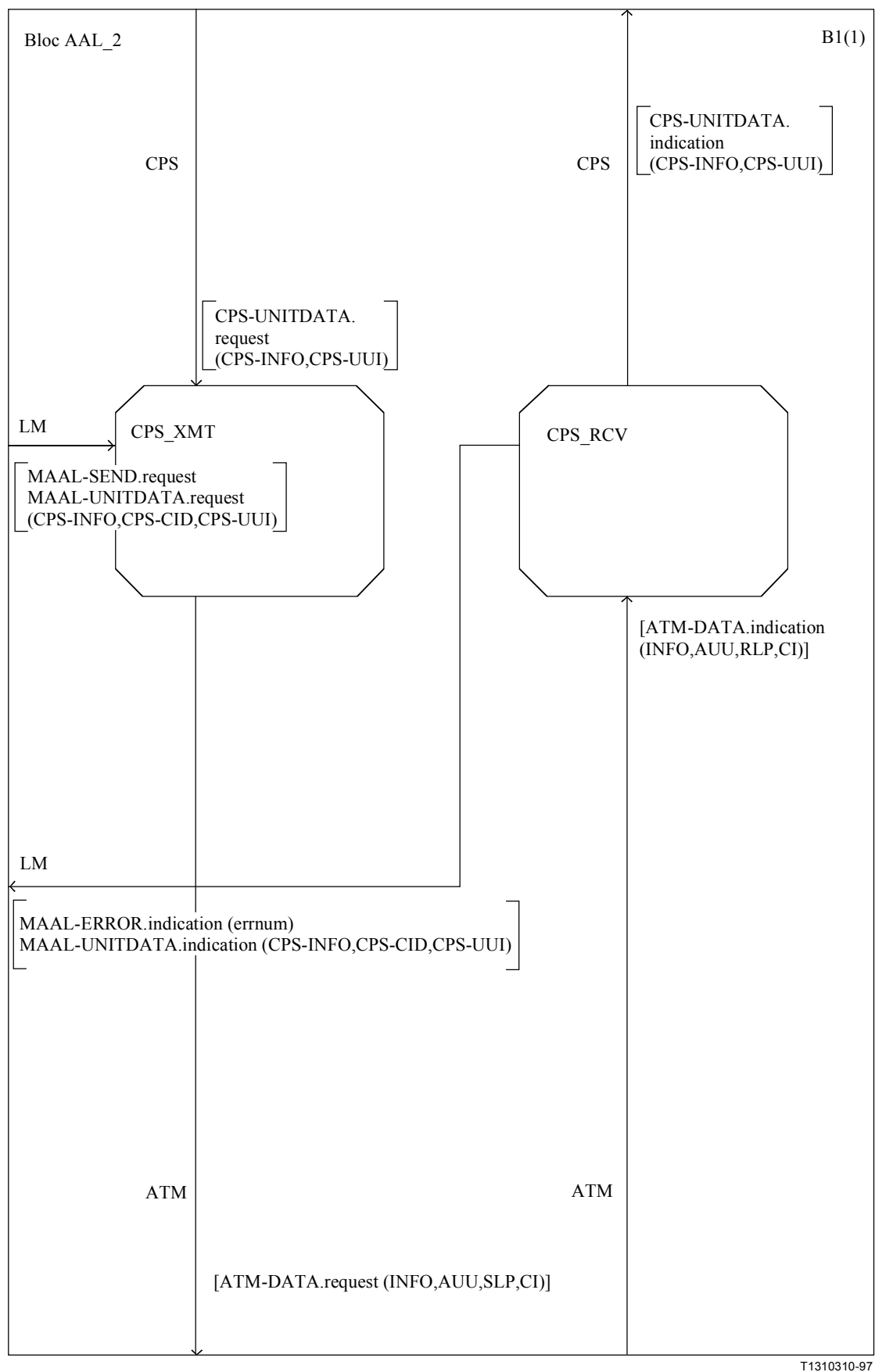
The SDL diagrams of the procedures of the Common Part Sublayer are given in this clause. If there exists any difference between the prose description also given in this clause and the SDL diagrams, the SDL diagrams take precedence.

NOTE – In the SDL diagrams of this clause, the octets in the CPS-PDU, i.e. the ATM cell payload, are numbered from "0" to "47".



T1313010-98

Figure 6/I.363.2 – SDL system of the AAL type 2



T1310310-97

Figure 7/I.363.2 – SDL block structure of the AAL type 2

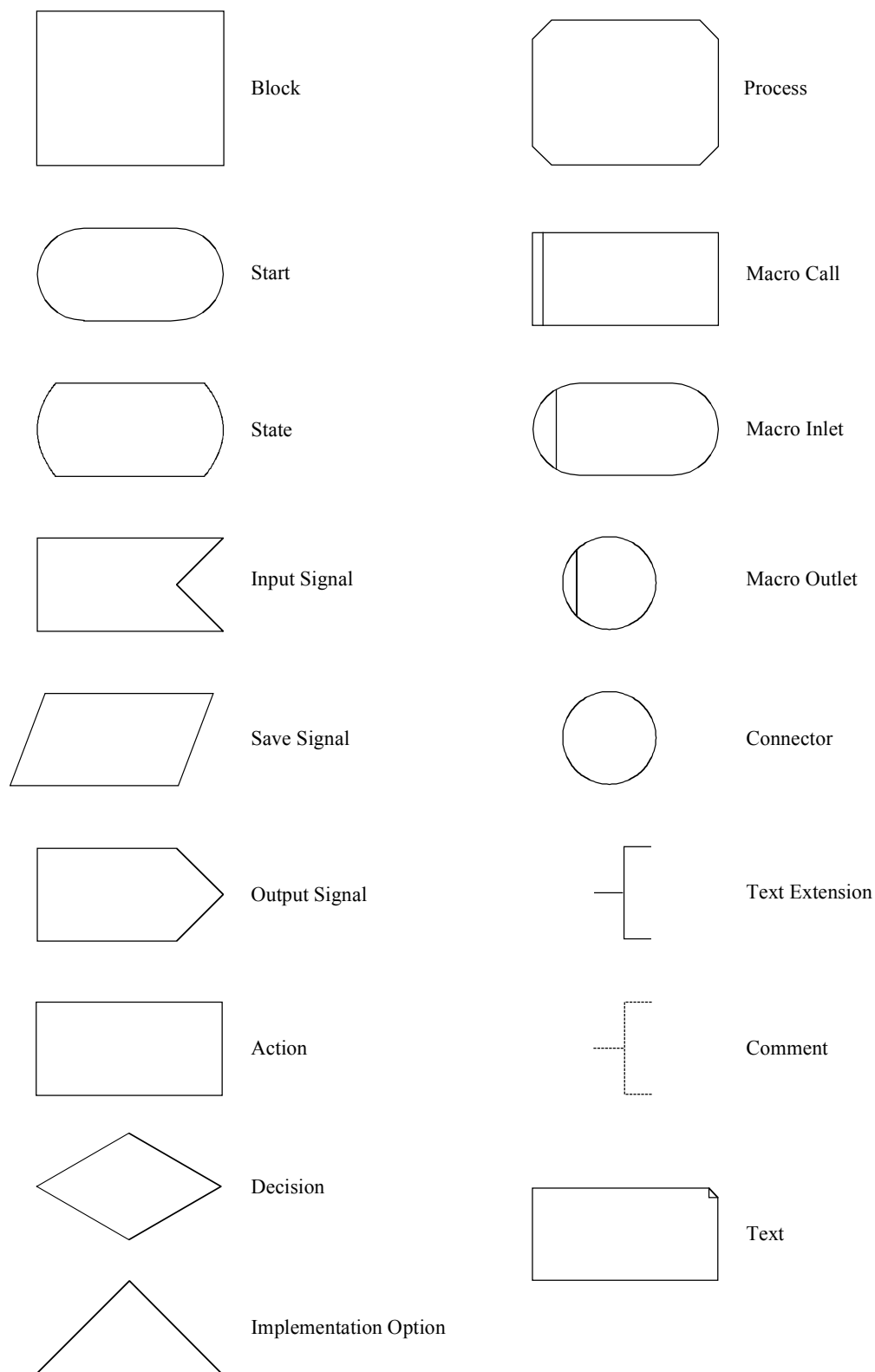


Figure 8/I.363.2 – SDL symbol repertoire

10.1 CPS transmitter

The operation of the CPS transmitter is modelled as a state machine consisting of the following states:

- IDLE** The CPS-PDU is empty and the OSF in octet 0 contains the value "0"; the "combined use" Timer_CU is not running.
- PART** Some CPS-Packet information is stored in the CPS-PDU and there is room for more; the "combined use" Timer_CU is running.
- FULL** The CPS-PDU is full; if the last CPS-Packet is overlapping into the next CPS-PDU, Timer_CU is running. The process is awaiting Layer Management's MAAL-SEND.request primitive to allow the dispatch of the CPS-PDU.
- SEND** Timer_CU expired but Layer Management has not yet sent the MAAL-SEND.request primitive to allow the dispatch of the CPS-PDU.

The state transition diagram for the CPS transmitter is shown in Figure 9.

The description of the operations of the CPS transmitter makes use of the following state variables:

- CPS-PDU** A buffer is maintained to fill a CPS-PDU before submitting it to the ATM layer.
- CPS-PH** A buffer is maintained to construct a CPS-Packet Header.
- ptrBUF** This state variable points to the next free octet in the CPS-PDU buffer. The next CPS-Packet or the PAD field starts here.
- rem** This state variable indicates the length of the current CPS-Packet remaining to be packed, i.e. the CPS-Packet payload being put into the CPS-PDU(s).
- part** This state variable indicates the number of octets of the CPS-PP to be placed in the following one or two CPS-PDUs.
- split** This state variable indicates the number of octets of the CPS-PH to be placed at the beginning of the next CPS-PDU to complete an overlapping CPS-Packet Header.
- seq** This state variable is used to set the SN field of the next CPS-PDU transmitted.
- permit** This state variable, when "TRUE", indicates that Layer Management has given permission to transmit a CPS-PDU.
- tmp** This state variable is used in an arithmetic calculation.

The description of the operations of the CPS transmitter makes use of the following timer:

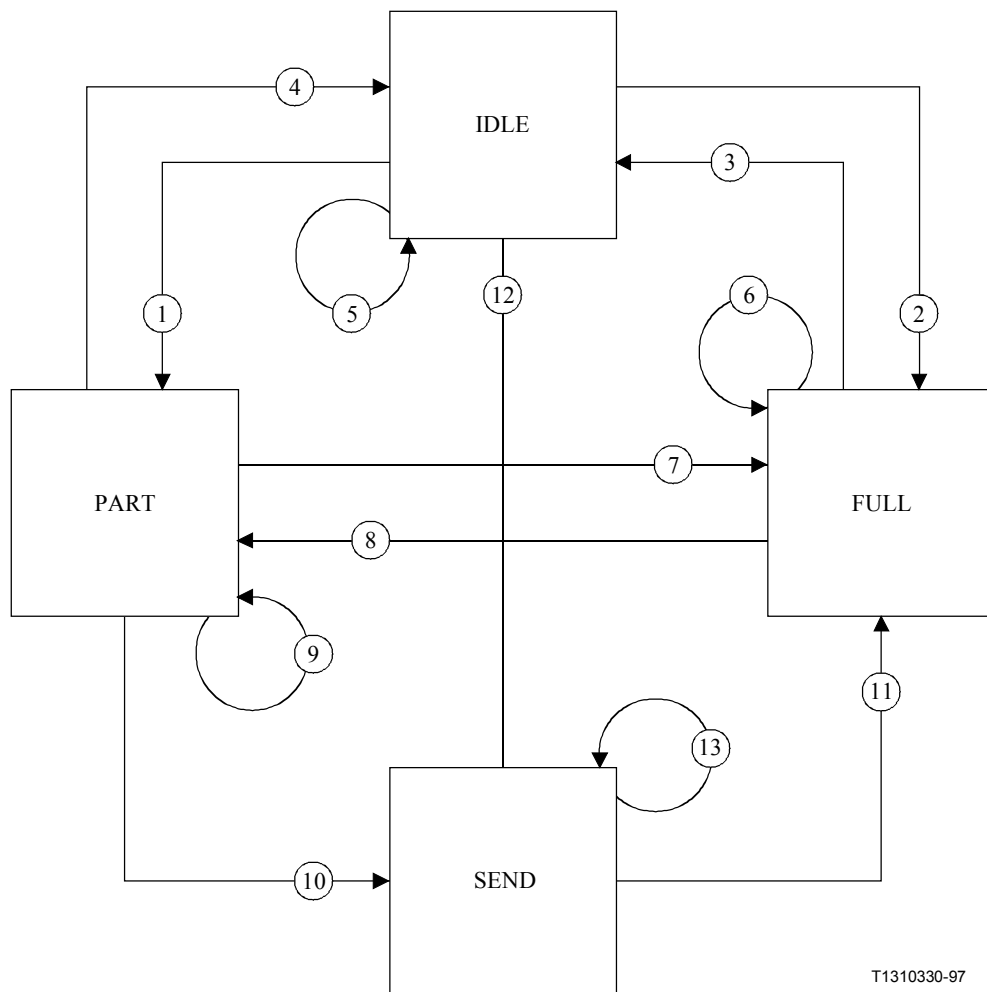
- Timer_CU** The "combined use" Timer_CU assures that CPS-Packets with one or more octets already packed wait at most the duration of Timer_CU before being scheduled for transmission (actual transmission takes place after receipt of a MAAL_SEND.request primitive from Layer Management).

NOTE 1 – If the underlying ATM connection requires the sending of a CPS-PDU every time that a MAAL-SEND.request is received (although no such requirement exists at this time), this timer might not be necessary; in this case, setting the timer to "infinite" or not setting the timer at all will give the desired results; however, this is not further defined in this Recommendation.

A CPS-Packet may overlap one or two CPS-PDU boundaries. When part of the CPS-Packet has filled a CPS-PDU completely, the state variables "split" and "part" indicate the amount of overlapping. The respective values are summarized in Table 5.

Table 5/I.363.2 – Values of state variables when CPS-Packets are overlapping CPS-PDU boundaries

| "split" | "part" | Comments |
|---------|--------|--|
| 0 | 0 | No overlapping |
| 0 | 1..64 | (Complete or partial) CPS-PP ("part" octets) is overlapping |
| 1..2 | 1..64 | "split" octets of CPS-PH and complete CPS-PP ("part" octets) are overlapping |



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- 1) CPS-UNITDATA.request or MAAL-UNITDATA.request received and "rem < 44".
- 2) CPS-UNITDATA.request or MAAL-UNITDATA.request received and "rem ≥ 44".
- 3) MAAL-SEND.request received and "split = part = 0".
- 4) {MAAL-SEND.request received and the underlying ATM connection requires the sending of a CPS-Packet or {MAAL-SEND.request received previously and CPS-UNITDATA.request or MAAL-UNITDATA.request received that exactly fills the remainder of the CPS-PDU} or {MAAL-SEND.request received previously and Timer_CU expiry}.
- 5) MAAL-SEND.request received.
- 6) MAAL-SEND.request received and "split + part ≥ 47".
- 7) CPS-UNITDATA.request or MAAL-UNITDATA.request received and "rem + ptrBUF ≥ 45".
- 8) MAAL-SEND.request received and "0 < split + part < 47".
- 9) CPS-UNITDATA.request or MAAL-UNITDATA.request received and "rem + ptrBUF < 45".
- 10) Timer_CU expiry.
- 11) CPS-UNITDATA.request or MAAL-UNITDATA.request received and "rem + ptrBUF ≥ 45".
- 12) MAAL-SEND.request received.
- 13) CPS-UNITDATA.request or MAAL-UNITDATA.request received and "rem + ptrBUF < 45".

Figure 9/I.363.2 – State transition diagram for the CPS transmitter

The SDL definition of the CPS-Packet transmitter process is shown in Figure 10.

- 1) When the CPS transmitter is in state IDLE and a CPS-SDU is passed:
- from a SSCS transmitter with the CPS-UNITDATA.request primitive; or
 - from Layer Management with the MAAL-UNITDATA.request primitive,
- the "combined use" Timer_CU is started and the CPS-Packet Header (CPS-PH) is constructed and copied into the CPS-PDU. The UUI field in the CPS-Packet Header is set to the value of the CPS-UUI parameter. If this CPS-Packet does not overlap into the next CPS-PDU, the complete CPS-SDU is copied into the CPS-PDU and the state variable "ptrBUF" is modified appropriately. Otherwise, the current CPS-PDU is filled with the beginning of this CPS-Packet and the state variable "part" is set as specified in Table 5.

When octets remain free for more CPS-Packets, the process progresses to state PART; otherwise, if Layer Management has not given permission to send CPS-PDU, the process enters state FULL.

NOTE 2 – When in state IDLE, the Start Field (OSF, SN, and P) are already set.

NOTE 3 – When a CPS-Packet carrying a CPS-SDU of more than 44 octets is to be packed when in state IDLE, this CPS-Packet will overlap into the next CPS-PDU.

- 2) When the CPS transmitter is in state PART and a further CPS-SDU is passed:
- from a SSCS transmitter with the CPS-UNITDATA.request primitive; or
 - from Layer Management with the MAAL-UNITDATA.request primitive,
- the CPS-Packet Header (CPS-PH) is constructed. The UUI field in the CPS-Packet header is set to the value of the CPS-UUI parameter. If this CPS-Packet does not overlap into the next CPS-PDU, the CPS-PH and the CPS-SDU are copied into the CPS-PDU and the state variable "ptrBUF" is modified appropriately. Otherwise, the current CPS-PDU is filled with the beginning of this CPS-Packet and the state variables "split" and "part" are set as specified in Table 5.

When more octets remain free in the current CPS-PDU for more CPS-Packets, the process remains in state PART; otherwise, if Layer Management has not given permission to send CPS-PDU, the process enters state FULL.

When this CPS-Packet overlaps into the next CPS-PDU, the current CPS-PDU is filled with the beginning of this CPS-Packet. The state variables "split" and "part" are set as specified in Table 5 and the "combined use" Timer_CU is re-started; if Layer Management has not given permission to send CPS-PDU, the process enters state FULL.

NOTE 4 – This procedure also handles the case where the CPS-Packet begins in the last one or two octets of the CPS-PDU.

- 3) When the CPS transmitter is in state FULL, the process is awaiting the permission to send the CPS-PDU; this is given by Layer Management with the MAAL-SEND.request primitive. Upon receipt of this primitive, the CPS-PDU is passed to the ATM layer with the ATM-DATA.request primitive.

The Start Field of the next CPS-PDU is constructed. If the sum "part + split" is greater than or equal 47, the OSF field is set to the value "47"; otherwise, the OSF field is set to "part + split". SN is assigned the value "seq" and "seq" is incremented by "1" (modulo 2) and Parity is computed. If no CPS-Packet is overlapping into the new CPS-PDU (state variables "part" and "split" are both "0"), the process enters state IDLE; otherwise, the remaining part of the overlapping CPS-Packet is copied to the CPS-PDU and the state variable "ptrBUF" is adjusted accordingly. The process then enters state PART or FULL depending on whether more than zero free octets remain in the CPS-PDU.

NOTE 5 – No primitives other than the MAAL-SEND.request is processed in state FULL. The fact that Timer_CU has expired is remembered by the CPS transmitter.

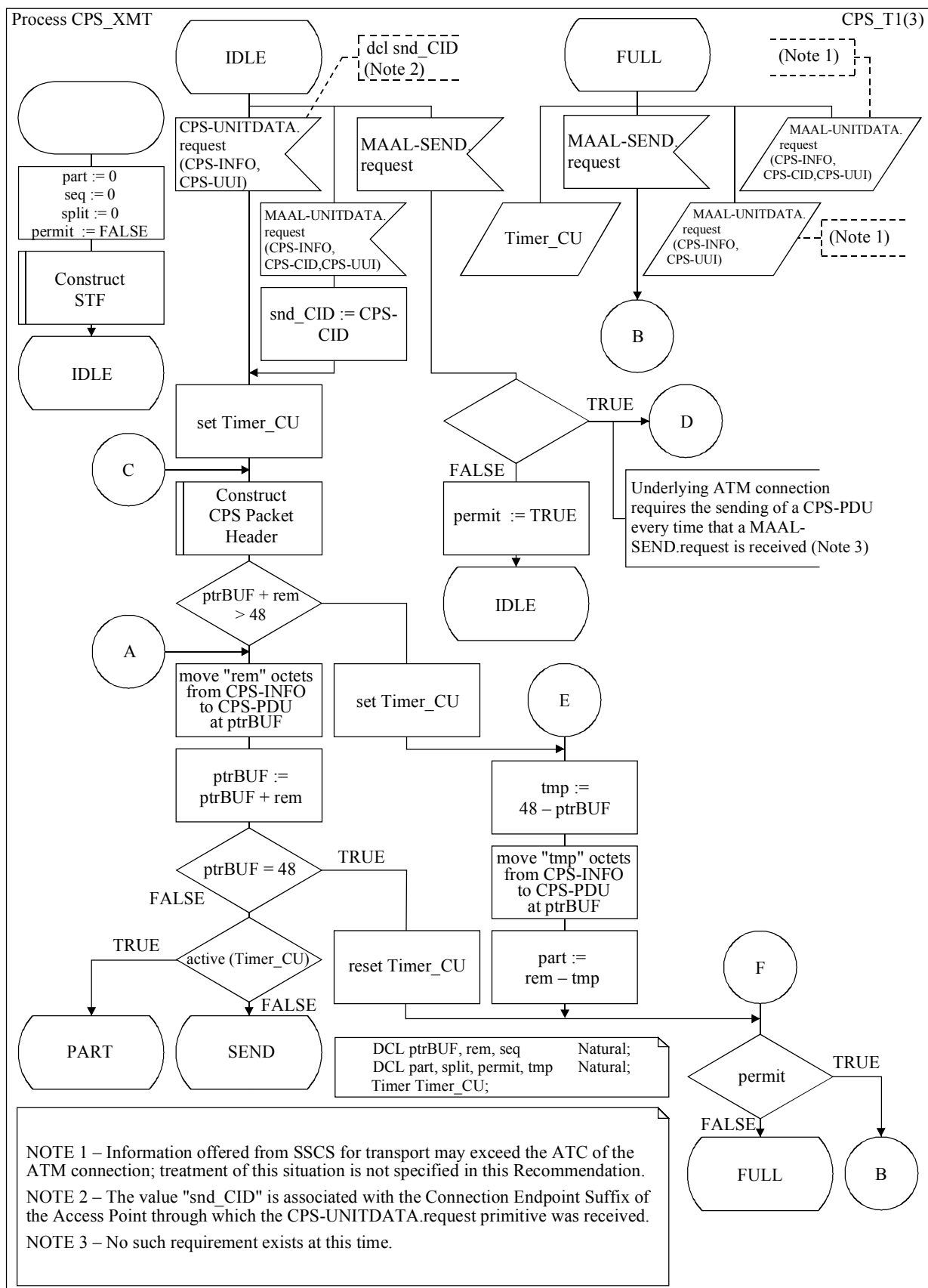
NOTE 6 – When a CPS-Packet is overlapping into the next CPS-PDU, Timer_CU continues to run in state FULL; otherwise, it is reset before entering state FULL.

- 4) When Timer_CU expires while the process is in state PART, the process enters state SEND. In state SEND, the process is awaiting the permission to send the CPS-PDU; this is given by Layer Management with the MAAL-SEND.request primitive. Upon receipt of this primitive, the remaining octets in the CPS-PDU are set to all zero (padding) and the CPS-PDU is passed to the ATM layer with the ATM-DATA.request primitive. Further processing takes place as described in 3) above.
- 5) In state SEND, the CPS-PDU is not completely filled. If a new CPS-SDU is passed:
 - from a SSCS transmitter with the CPS-UNITDATA.request primitive; or
 - from Layer Management with the MAAL-UNITDATA.request primitive,the CPS-Packet header (CPS-PH) is constructed. If this CPS-Packet does not overlap into the next CPS-PDU, the CPS-PH and the complete CPS-SDU is copied into the CPS-PDU and the state variable "ptrBUF" is modified appropriately.

When this CPS-Packet overlaps into the next CPS-PDU, the current CPS-PDU is filled with the beginning of this CPS-Packet. The state variables "part" and "split" are set as specified in Table 5.

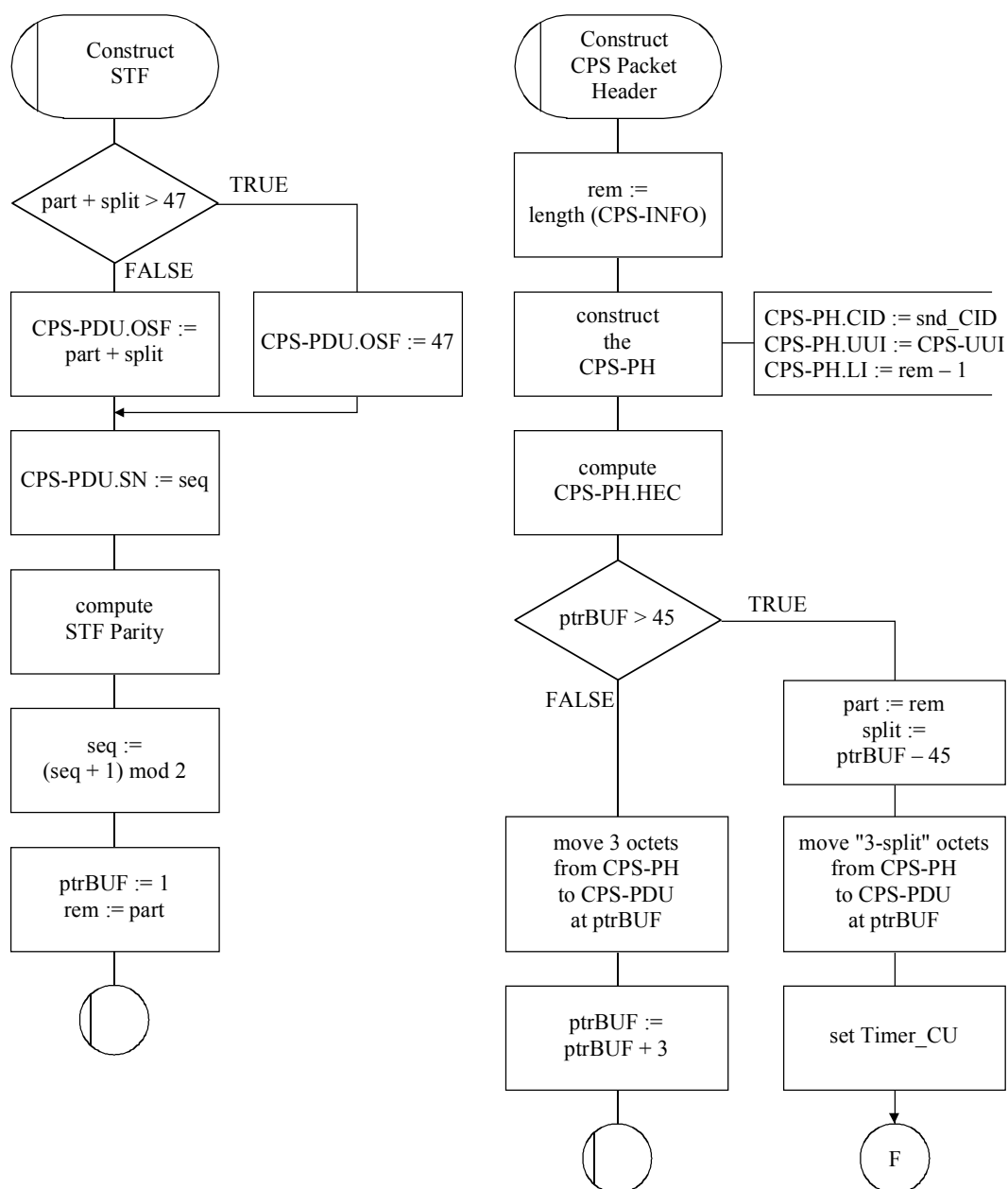
If there is still room for more CPS-Packets in the CPS-PDU, the process returns to state SEND; otherwise, the process enters state FULL and Timer_CU is started if the CPS-Packet just processed overlaps into the next CPS-PDU.
- 6) The receipt of a MAAL-SEND.request during states IDLE and PART is remembered by the CPS transmitter setting the "permit" state variable.

On the other hand, if the underlying ATM connection requires the sending of a CPS-PDU every time a MAAL-SEND.request is received, (although no such requirements exist at this time) then the empty or partially filled CPS-PDU is filled with padding information, Timer_CU is stopped and the CPS-PDU is submitted to the ATM layer as described in 3) above.



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Figure 10/I.363.2 – SDL diagram for the CPS transmitter (sheet 1 of 3)



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Figure 10/I.363.2 – SDL diagram for the CPS transmitter (sheet 3 of 3)

10.2 CPS receiver

The operation of the CPS receiver is modelled as a state machine consisting of the following single state:

IDLE There exists only one state; the process returns here after each transition.

The description of the operations of the CPS receiver makes use of the following state variables:

INFO_buffer The buffer is used to temporarily store or reassemble a split CPS-Packet payload.

PH_buffer A buffer is maintained to assist in the analysis of a CPS-Packet header.

expct This state variable indicates the amount expected at the beginning of the next CPS-PDU to complete an overlapping CPS-Packet payload.

len This state variable indicates the length of a CPS-Packet payload.

split This state variable indicates the number of octets of the CPS-PH still expected at the beginning of the next CPS-PDU to complete an overlapping CPS-Packet header.

ptrEXT This state variable is a pointer into the CPS-PDU where the information next to be processed is located.

seq This state variable is the next expected sequence number and assists in verifying the SN field of consecutive CPS-PDUs.

The CPS receiver maintains the following parameters:

Max_CPS-SDU_Length This parameter indicates the maximum size CPS-SDU, in octets, that is transported on any AAL type 2 channel of an ATM connection. This parameter can take on the values "45" or "64" and is set by the signalling or management procedures.

Max_SDU_Deliver_Length This parameter indicates the maximum size CPS-SDU, in octets, that is transported on a particular AAL type 2 channel. It also indicates the maximum size CPS-SDU that may be delivered to the corresponding CPS user. At a receiver, the value of this parameter is compared to the length of each CPS-SDU before it is delivered. Any CPS-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 the values "45" or "64" and is set by signalling or management procedures. The following inequality must be maintained:

$$\text{Max_SDU_Deliver_Length} \leq \text{Max_CPS-SDU_Length}.$$

The SDL definition of the CPS receiver process is shown in Figure 11.

- 1) Upon receipt of a CPS-PDU with the ATM-DATA.indication primitive, the Start Field is verified; if the Parity is incorrect, the error is signalled to Layer Management and the CPS-PDU is discarded. Any partially received CPS-Packet awaiting its overlapping second or third part is discarded as well.
- 2) If the SN field of the CPS-PDU indicates a sequence error, this is signalled to Layer Management. Any partially received CPS-Packet awaiting its overlapping second or third part is discarded. If the OSF of the CPS-PDU contains the value "47" no further information can be extracted from the CPS-PDU; otherwise, state variable "ptrEXT" is set according to the OSF field (i.e. OSF + 1).

- 3) If the CPS-PH is overlapping the CPS-PDU boundary (i.e. state variable split is non-zero), the verification of the OSF has to be deferred until the entire CPS-Packet header is processed. Therefore, one or two octets (depending on the state variable "split") are appended to the PH_buffer and the HEC is verified. If the verification fails, Layer Management is notified, the partially received CPS-Packet is discarded and extraction of further information continues at the octet indicated by the OSF field of the STF (i.e. ptrEXT is set to OSF + 1).

If the HEC verification did not detect any transmission errors, the LI field of the CPS-Packet Header is used to determine the length of the CPS-Packet payload. This is used to set the state variable "expct".

- 4) If payload octets for an overlapping CPS-Packet are expected (state variable "expct" is non-zero) and the length expected exceeds the remaining octets of the CPS-PDU, the OSF field is compared to the value "47". If equal, all remaining octets from the CPS-PDU payload are copied to the INFO_buffer and the state variable "expct" is set to the amount still outstanding. Processing of this CPS-PDU is complete.

If the OSF field is not equal to the value "47", Layer Management is notified and the partially received CPS-Packet is discarded. If the OSF field is less than the value "47", extraction of further information continues at the octet indicated by the OSF field of the STF (i.e. ptrEXT is set to OSF + 1).

- 5) If the length expected does not exceed the remaining octets of the CPS-PDU, the final part of an overlapping CPS-Packet is expected. If no CPS-Packet is being reassembled, the expected number of octets is "0". The OSF is compared with the expected number of octets. If they are not equal, Layer Management is notified, the partially received CPS-Packet is discarded and extraction of further information continues at the octet indicated by the OSF field of the STF (i.e. ptrEXT is set to OSF + 1).

- 6) If the final part of an overlapping CPS-Packet is expected, this part is appended to the information already in the INFO_buffer which now represents a complete CPS-SDU. If the length of this CPS-SDU exceeds the length indicated in Max_SDU_Deliver_Length, the CPS-SDU is discarded and Layer Management is notified. On the other hand, if the UII field is in the range "0" ... "27", this information is passed to the CPS user with the CPS-UNITDATA.indication primitive; otherwise, if the UII field is in the range "30" ... "31", this information is passed to the Layer Management with the MAAL-UNITDATA.indication primitive.

NOTE 1 – The information delivered consists of the CPS-SDU passed in the CPS-INFO parameter and the user-to-user information passed in the CPS-UII parameter of the respective primitives. The CPS-CID is delivered to Layer Management.

- 7) If there are still some octets left to be processed and the octet pointed to by "ptrEXT" is "0", this octet belongs to the PAD field; therefore, processing of the CPS-PDU is complete.
- 8) If there are still some octets left to be processed and the octet pointed to by "ptrEXT" is non-zero, the next three octets are assumed to be a CPS-Packet header. These are copied into the state variable "PH_buffer" and the HEC is verified. If this verification fails, Layer Management is notified and the rest of the CPS-PDU is discarded.

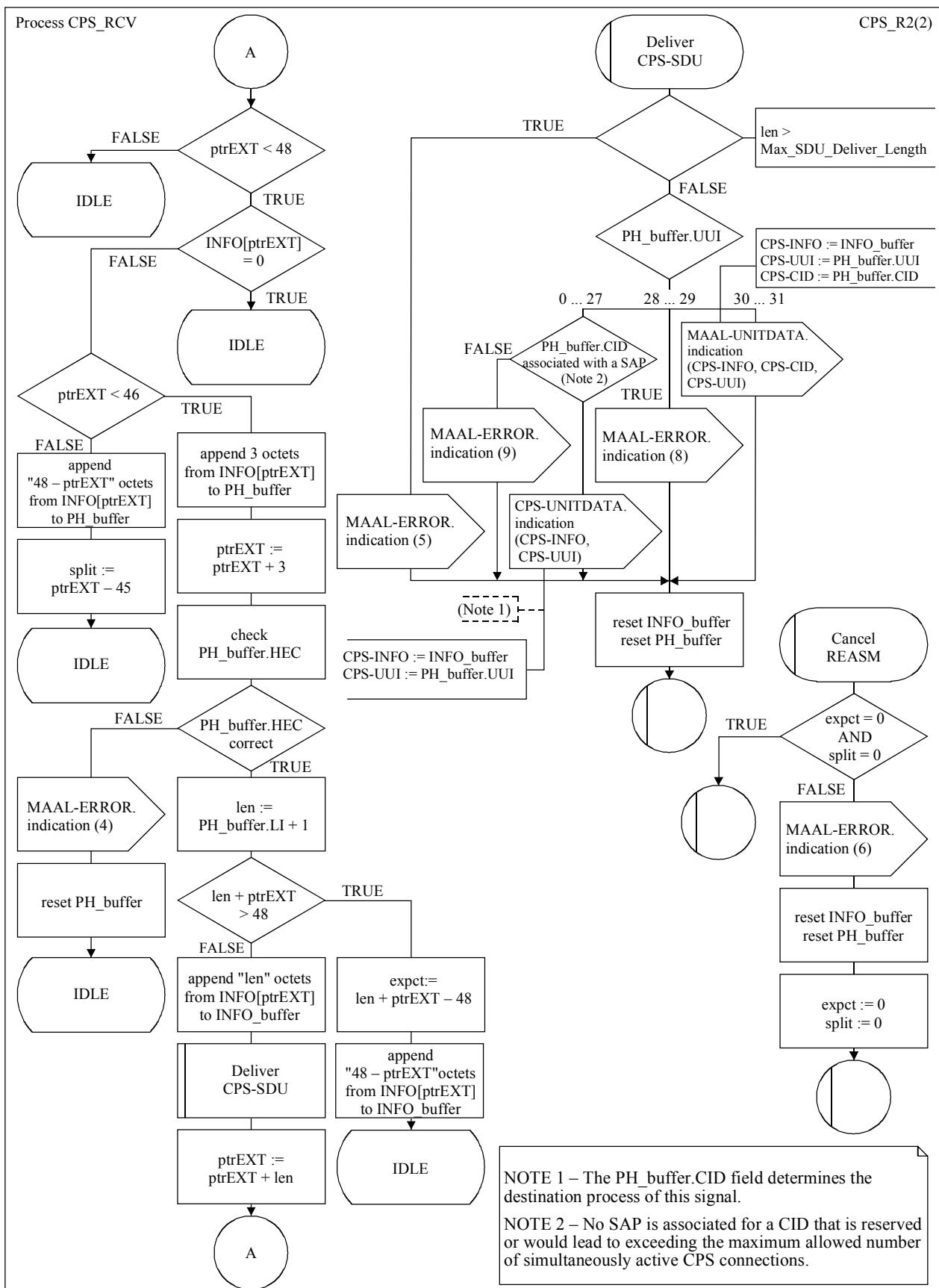
NOTE 2 – If the end of a CPS-PDU is discarded, any overlapping CPS-Packet is lost.

If there are fewer than three octets left and the octet pointed to by "ptrEXT" is non-zero, the part available is copied to the PH_buffer and the state variable "split" is set to "1" or "2" depending on whether 1 or 2 octets are still missing. No HEC verification is possible at this time and processing of this CPS-PDU is complete.

- 9) If the HEC verification did not detect any transmission errors, the LI field of the CPS-Packet header is used to determine the length of the CPS-Packet payload. If the length does not exceed the remaining octets of the CPS-PDU, the CPS-Packet is copied to the INFO_buffer. If the length of this CPS-SDU exceeds the length indicated in Max_SDU_Deliver_Length, the CPS-SDU is discarded and Layer Management is notified. On the other hand, if the UUI field is in the range "0" ... "27", this information is passed to the CPS user with the CPS-UNITDATA.indication primitive; otherwise, if the UUI field is in the range "30" ... "31", this information is passed to the Layer Management with the MAAL-UNITDATA.indication primitive. After adjusting the state variable "ptrEXT" processing continues with 7) above.

NOTE 3 – The information delivered consists of the CPS-SDU passed in the CPS-INFO parameter and the user-to-user information passed in the CPS-UUI parameter of the respective primitives. The CPS-CID is delivered to Layer Management.

- 10) If the length of the CPS-Packet payload indicates more than the still available unprocessed octets in the current CPS-PDU, the remaining part of the CPS-PDU is copied to the INFO_buffer. State variable "expct" is set to the amount still outstanding. Processing of the CPS-PDU is complete.



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Figure 11/I.363-2 – SDL diagram for the CPS receiver (sheet 2 of 2)

10.3 Summary of error indications to Layer Management

The error indications to Layer Management are summarized in Table 6.

Table 6/I.363.2 – Error indications to Layer Management

| (errnum) | Error indicated |
|--|---|
| 0 | The parity of the STF indicates transmission errors; the complete CPS-PDU was discarded. |
| 1 | The sequence number of the STF is wrong; if the OSF is less than 47, processing starts at the octet pointed to by the OSF, otherwise the complete CPS-PDU is discarded. |
| 2 | The number of octets expected for a CPS-Packet overlapping into this CPS-PDU does not match the information contained in the STF; if the value of the OSF is less than 47, processing starts at the octet pointed to by the OSF. |
| 3 | The OSF of the STF contains a value 48 or greater; the complete CPS-PDU is discarded. |
| 4 | The Header Error Control (HEC) Code of a CPS-Packet header indicates transmission errors in the CPS-Packet header; the unprocessed information in the CPS-PDU is discarded. |
| 5 | The length of the received CPS-Packet Payload (CPS-SDU) exceeds the maximum length indicated in "Max_SDU_Deliver_Length". |
| 6 | A partial CPS-Packet has been received previously and must be discarded due to errors detected before the reassembly of the CPS-Packet could be completed. |
| 7 | The Header Error Control (HEC) Code of a CPS-Packet header that was overlapping a CPS-PDU boundary indicates transmission errors in the CPS-Packet header; if the value of the OSF is less than 47, processing starts at the octet pointed to by the OSF. |
| 8 | The UUI field in the received CPS-Packet header contains a value ("28" or "29") that is reserved for future standardization. |
| 9 | The CID value in the received CPS-Packet header is not associated with a SAP (Note). |
| NOTE – No SAP is associated for a CID value that is reserved or would lead to exceeding the maximum allowed number of simultaneously active CPS connections. | |

11 Summary of parameters and values for the AAL type 2

Determination of the values, the system resources listed in Table 7 must be made before individual AAL type 2 channels can be established. Such determination may be made via provisioning or signalling in a manner outside the scope of this Recommendation. In the absence of provisioning or signalling (ATM level control), the default values apply. The values of these AAL type 2 system parameters may differ from one ATM VCC to another.

Table 7/I.363.2 – Parameters for the AAL type 2 system

| Significance | Parameter | Permitted values | Default value |
|---|--|-------------------------|----------------------|
| Peer-to-peer | Maximum number of multiplexed channels (Note) | 255 | 255 |
| | Maximum length of a CPS-SDU (Max_CPS-SDU_Length) | 45 or 64 octets | 45 |
| Transmitter | Value of the "combined use" Timer_CU | For further study | For further study |
| NOTE – The maximum number of multiplexed channels includes all 7 reserved channels, i.e. the maximum number of user channels is the maximum number of multiplexed channels minus 7. | | | |

Determination of the values for the channel resources listed in Table 8 must be made before individual AAL type 2 channel is established (or during channel establishment). Such determination may be made via provisioning or signalling in a manner outside the scope of this Recommendation. In the absence of provisioning or signalling (ATM level control), the default values apply. The values of these AAL type 2 system parameters may differ from one channel to another.

Table 8/I.363.2 – Parameters for the AAL type 2 channel

| Significance | Parameter | Permitted values | Default value |
|---------------------|--|-------------------------|----------------------|
| Peer-to-peer | Maximum length of a CPS-SDU (Max_CPS_SDU_Deliver_Length) | 45 or 64 octets | 45 octets |

ANNEX A

Data unit naming convention

Details of the data unit naming convention are given in Figure A.1.

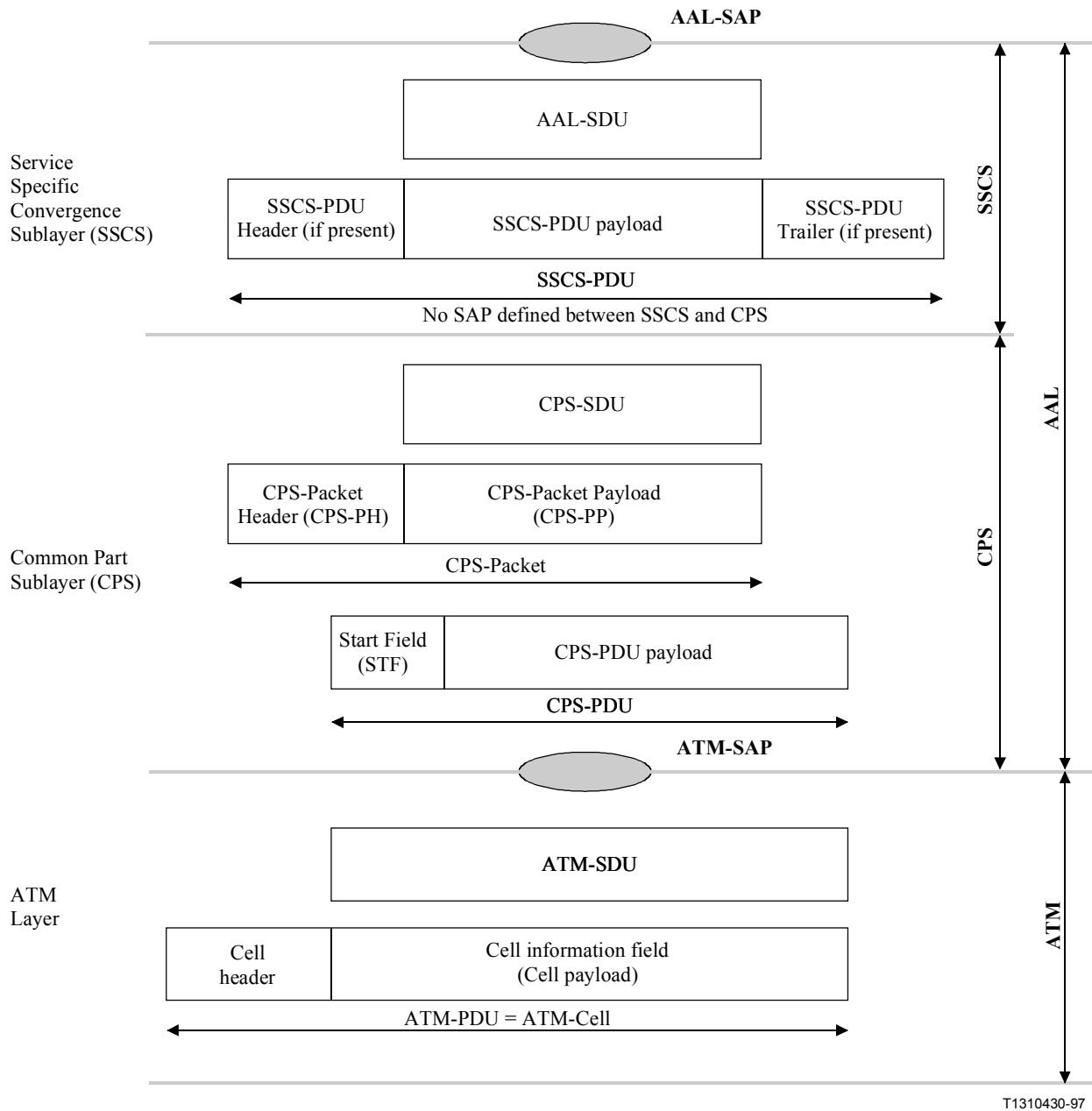


Figure A.1/I.363.2 – Data unit naming conventions for the AAL type 2

ANNEX B

Functional model for the AAL type 2

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

NOTE – Interactions with Layer Management are not shown in this model.

The functional model of the AAL type 2 at the transmitter side is shown in Figure B.1. The model consists of several blocks that cooperate to provide the AAL type 2 service.

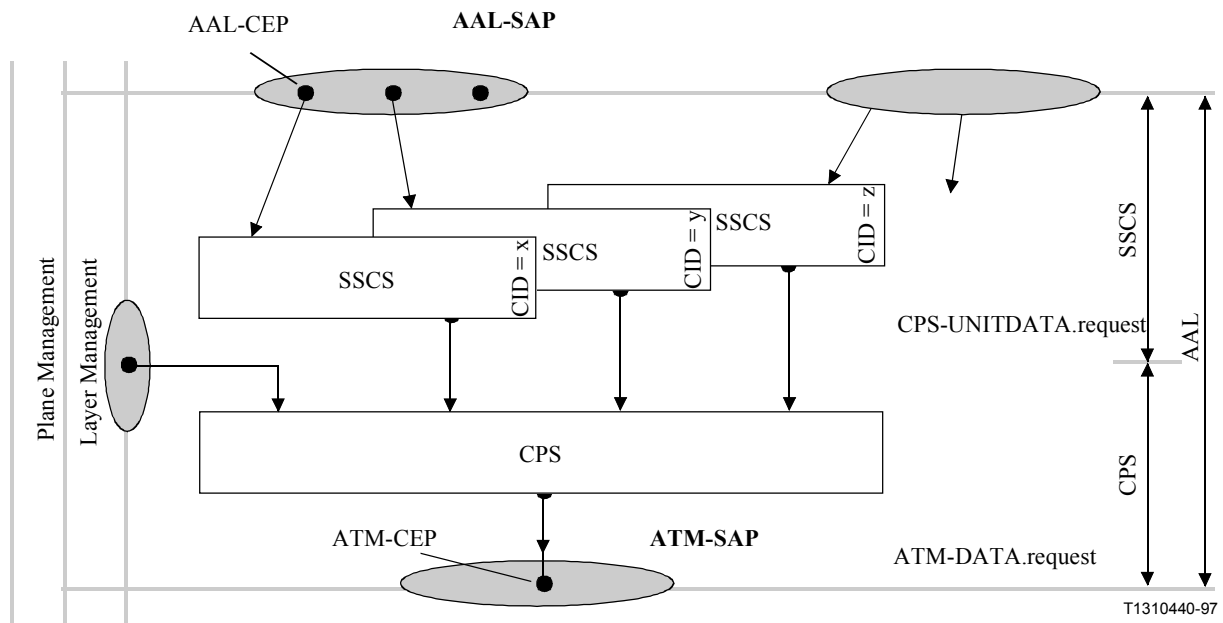


Figure B.1/I.363.2 – Functional model for the transmitter of the AAL type 2

The functional model of the AAL type 2 at the receiver side is shown in Figure B.2. The model consists of several blocks that cooperate to provide the AAL type 2 service.

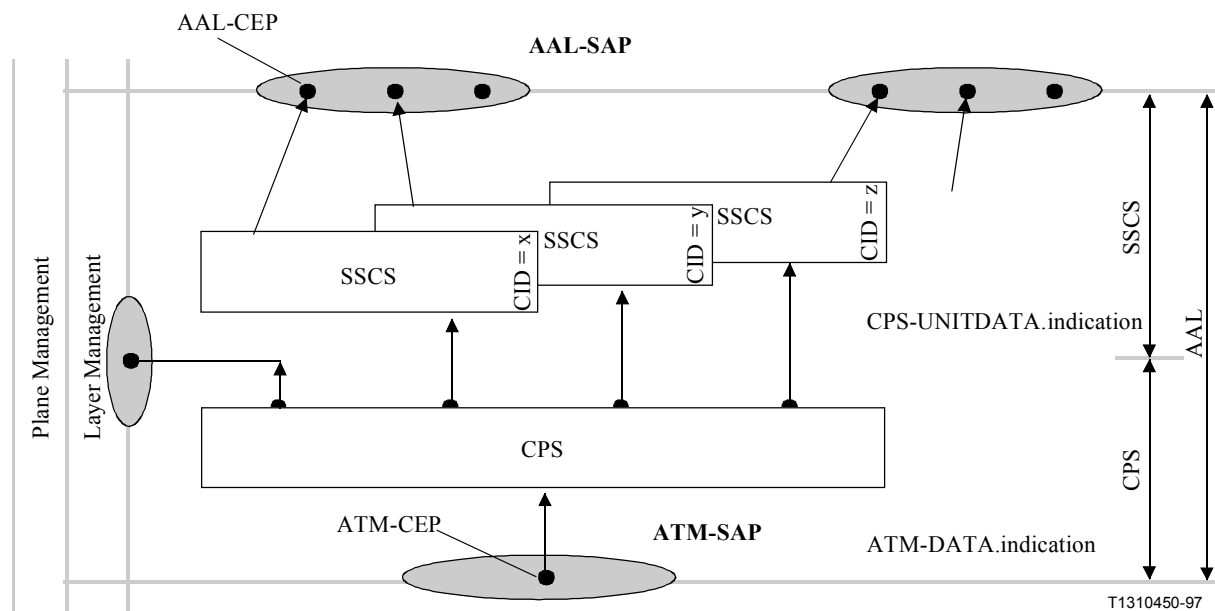


Figure B.2/I.363.2 – Functional model for the receiver of the AAL type 2

ANNEX C

Switching Aspects of AAL type 2 Connections

C.1 Introduction

This annex addresses specifically the functions related to switched AAL type 2 connections.

C.2 Definitions

For the purpose of this annex, the following definitions apply:

C.2.1 AAL type 2 Channel: A concept used in main part of this Recommendation to describe transport of CPS-Packets associated in a common unique identifier value called CID on an ATM VCC.

C.2.2 AAL type 2 Connection: The logical concatenation of one or more AAL type 2 links between two AAL type 2 service endpoints.

C.2.3 AAL type 2 Link: The logical user plane communication facility between two adjacent AAL type 2 switching entities or endpoint entities. An AAL type 2 link is designated by a single CID value. It designates the same concept as "AAL type 2 Channel" that is used in the main part of this Recommendation.

C.2.4 AAL type 2 Link Characteristics: Information that describes the attributes of the AAL type 2 link.

C.2.5 AAL type 2 Path: An ATM VCC between two AAL type 2 entities. This ATM VCC can either be an SVC, an SPVC, or a PVC.

C.2.6 AAL type 2 Path Identifier: The identifier of the AAL type 2 path.

C.2.7 AAL type 2 Switch Entity: A system capable of switching AAL type 2 connections.

C.2.8 ATM VCC: The logical concatenation of one or more ATM virtual channel links between two ATM service endpoints.

C.2.9 link characteristics: (see AAL type 2 Link Characteristics)

C.3 Basic principles of switched AAL type 2 connections

The AAL type 2 is used in this annex for addressing a specific packet-oriented transfer mode which uses asynchronous time division multiplexing techniques. The multiplexed information flow is organized into blocks of variable size called CPS-Packets. A CPS-Packet consists of a CPS-Packet payload and a CPS-Packet header. The primary role of the header is to identify CPS-Packets belonging to the same AAL type 2 connection within the asynchronous time division multiplex.

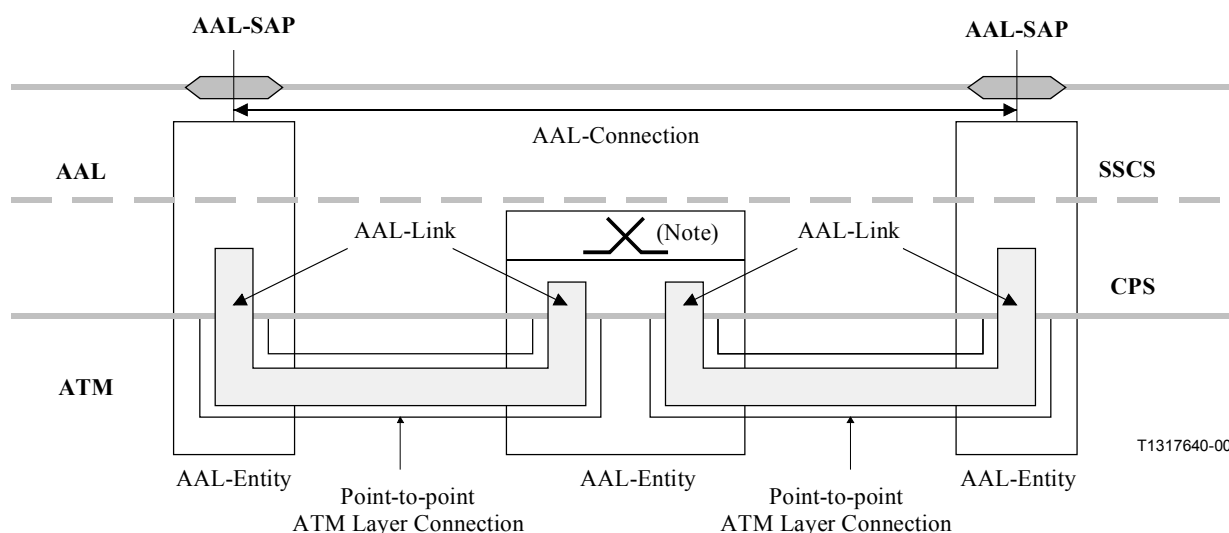
AAL type 2 is a connection-oriented technique. Connection identifiers are assigned to each link of an AAL type 2 connection when required and released when no longer needed.

AAL type 2 offers a flexible transfer capability common to several services. Additional functionalities on top of the Common Part sublayer of the AAL type 2, e.g. in the Service Specific Convergence Sublayer (SSCS), are provided to accommodate various services. The boundary between the Common Part sublayer of the AAL type 2 and the Service Specific Convergence Sublayer corresponds to the boundary between functions supported by the contents of the CPS-Packet header and functions supported by service-specific information. The service-specific information is contained in the CPS-Packet payload.

NOTE – Service-specific information is also transported in the User-to-User Indication (UUI field in the CPS-Packet header).

The CPS-Packet payload is transported transparently by the Common Part sublayer of the AAL type 2; no processing, e.g. error control, is performed on the CPS-Packet payload at the Common Part sublayer of the AAL type 2 (see Figure C.1).

The maximum size of the CPS-Packet payload is 45 octets.



NOTE – This entity represents a switch, a relay, a cross-connect, etc.

Figure C.1/I.363.2 – Switched AAL type 2 connection

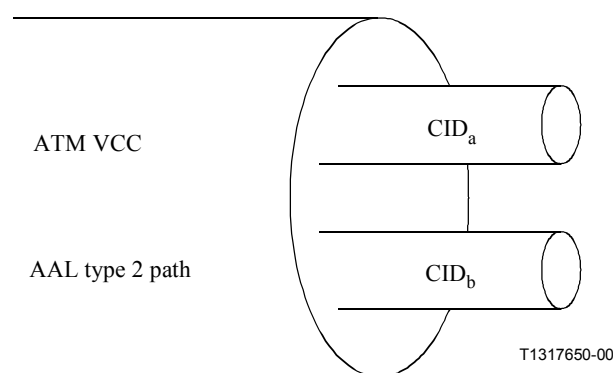
C.4 AAL type 2 connections

C.4.1 Connection-definition

An AAL type 2 connection consists of the concatenation of AAL type 2 CPS links in order to provide an end-to-end transfer capability.

C.4.2 Connection identifiers

At a given interface, in a given direction, the different AAL type 2 links multiplexed at the Common Part sublayer of the AAL type 2 into the same AAL type 2 path are distinguished by the CID. The different AAL type 2 links in an AAL type 2 path are distinguished by the CID as indicated in Figure C.2.



NOTE – CID_a and CID_b represent two of the possible values of CID in the AAL type 2 path (ATM VCC).

Figure C.2/I.363.2 – Switched AAL type 2 connection

C.4.3 AAL type 2 connection/AAL type 2 path relation

A specific value of CID has no end-to-end significance if the AAL type 2 connection is switched. CIDs may be changed wherever AAL type 2 paths (ATM VCCs) are terminated (e.g. cross-connects, concentrators, switches, etc.). CIDs may only be changed where AAL type 2 paths are terminated. As a consequence, CID values are preserved within an AAL type 2 path.

C.5 Aspects of AAL type 2 connections

C.5.1 General characteristics of AAL type 2 connections

The definition of an AAL type 2 connection is given in C.4.1. This subclause provides additional explanations to facilitate the understanding of the following topics:

- a) **Quality of Service** – Quality of Service (QoS) is provided by the ATM layer and there exists no standardized means to provide QoS at the AAL type 2 layer.
- b) **Switched and (semi-) permanent AAL type 2 connections** – Switched and (semi-) permanent AAL type 2 connections can be provided on a switched or (semi-) permanent basis.
- c) **CPS-Packet sequence integrity** – CPS-Packet sequence integrity is preserved within an AAL type 2 connection.
- d) **AAL type 2 link characteristics** – When the establishment of an AAL type 2 connection is requested, AAL type 2 link characteristics may be provided for each AAL type 2 connection and may be subsequently modified.

- e) **Service Specific Convergence Sublayer (SSCS)** – An AAL type 2 connection includes a specific SSCS (see C.6).

C.5.2 Establishment and release of an AAL type 2 connection

AAL type 2 connections may be established/released using one or more of the following methods:

- a) by using management procedures to establish/release provisioned AAL type 2 connections;
- b) by using signalling procedures to establish/release on-demand AAL type 2 connections (see C.6/Q.2630.1 [C1]); and
- c) without using signalling procedures, e.g. by subscription – (semi-) permanent connections.

The value assigned to a CID for an AAL type 2 using the methods listed above could be assigned by one of the following:

- i) the provisioning procedures;
- ii) the network using signalling procedures; and
- iii) standardization.

The specific value assigned to a CID is, in general, independent of the service provided over that AAL type 2 connection. For terminal interchangeability and initialization it is desirable to use the same value for certain functions on all AAL type 2 connections. For example, the same CID value for the signalling AAL type 2 connection will be used in order to simplify initialization of the terminal equipment.

During the establishment of an AAL type 2 connection, connection admission procedures for each AAL type 2 link and each AAL type 2 switch may need to be performed. Such connection admission procedures typically take into account the requested Quality of Service, the indicated AAL type 2 characteristics, and the specified SSCS.

C.6 Bibliography

The Recommendations listed in this clause provide informative background information for the reader and are not normative within this Recommendation.

- [C1] ITU-T Q.2630.1 (1999), *AAL type 2 signalling protocol – Capability Set 1*.
- [C2] ITU-T I.366.1 (1998), *Segmentation and Reassembly Service Specific Convergence Sublayer for the AAL type 2*.
- [C3] ITU-T I.366.2 (2000), *AAL type 2 service specific convergence sublayer for narrow-band services*.

APPENDIX I

Example of packing CPS-Packets into ATM cells

I.1 Multiplexing and packing of equal length CPS-Packets

Figure I.1 shows a case where equal length CPS-Packets are submitted to the Common Part Sublayer for multiplexing and packing. Whether the CPS-Packets originate from a single CPS user (e.g. an SSCS entity) or from several is not discernible in the figure; for the discussion of the packing rules, this is irrelevant.

The chosen lengths of the CPS-SDUs allow the following observations:

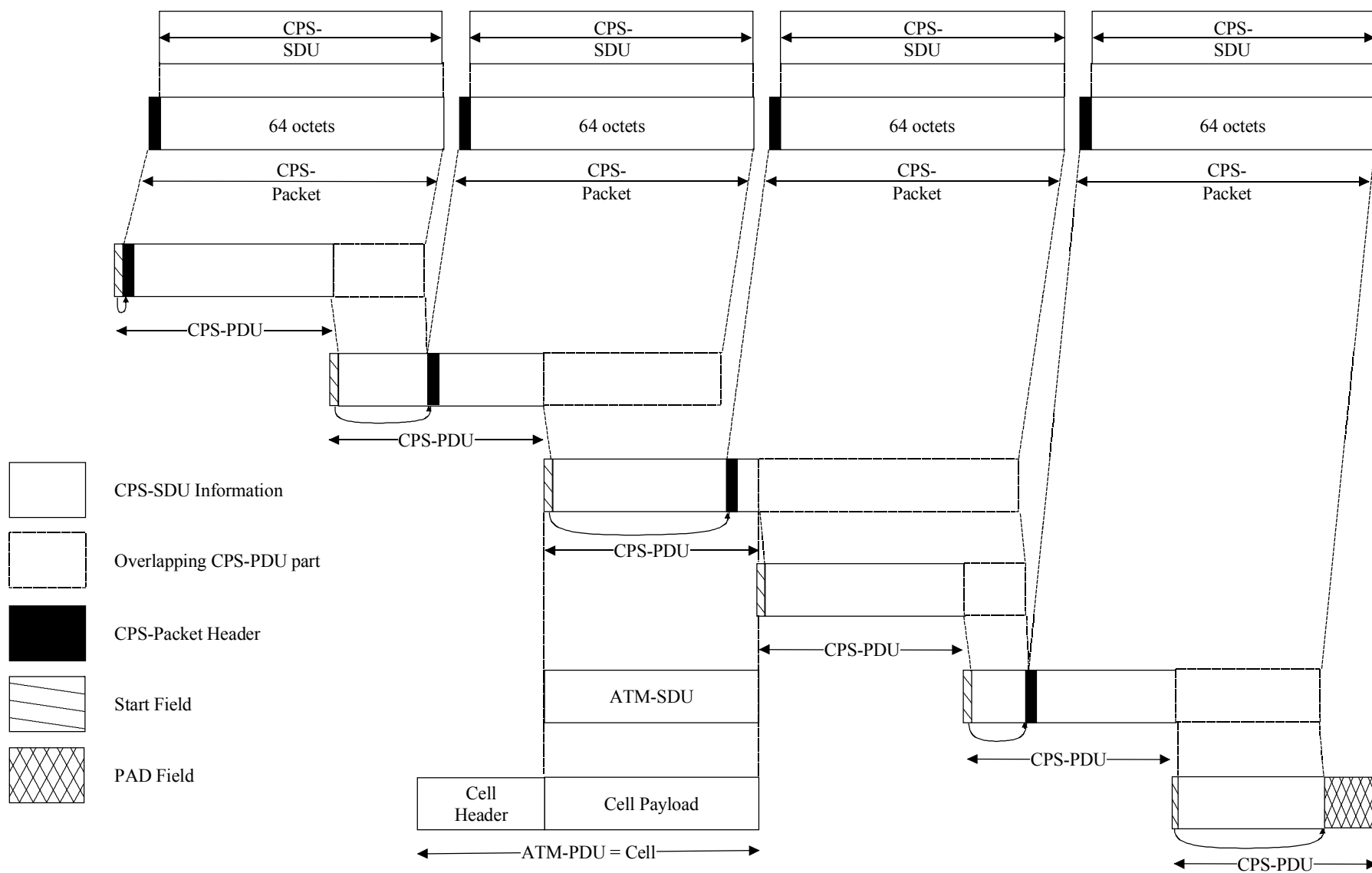
- a) The first two CPS-SDUs (i.e. SSCS-PDUs) are placed into CPS-Packets that fit entirely into the first CPS-PDU (ATM cell payload).

- b) The third CPS-SDU placed in its CPS-Packet does not fit in the remaining part of the first CPS-PDU; therefore, it has to be split between the first and the second CPS-PDUs. The full length of the CPS-Packet is indicated in the CPS-Packet header in the first cell; the STF of the following CPS-PDU points to the next CPS-Packet header and, thus, can be used to verify the length of the remaining part of the third CPS-Packet.
- c) Only a single octet of the 5th CPS-Packet overlaps into the 6th CPS-PDU.

NOTE – The amount CPS-Packet payload that overlaps can be of any size between 1 to 45 or 64 octets; also 1 or 2 octets of the CPS-Packet header can overlap into the next CPS-PDU.

Table I.1/I.363.2 – Start and End Octets for equal length CPS-Packets

| | | CPS-Packet | | | | | | | | | | | | | |
|-----------------|-----------|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Length of SDU | Octet | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Start of CPS-PH | PDU/Octet | 1/01 | 1/20 | 1/39 | 2/11 | 2/30 | 3/02 | 3/21 | 3/40 | 4/12 | 4/31 | 5/03 | 5/22 | 5/41 | 6/13 |
| Start of CPS-PP | PDU/Octet | 1/04 | 1/23 | 1/42 | 2/14 | 2/33 | 3/05 | 3/24 | 3/43 | 4/15 | 4/34 | 5/06 | 5/25 | 5/44 | 6/16 |
| End of CPS-PP | PDU/Octet | 1/19 | 1/38 | 2/10 | 2/29 | 3/01 | 3/20 | 3/39 | 4/11 | 4/30 | 5/02 | 5/21 | 5/40 | 6/12 | 6/31 |



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Figure I.3/I.363.2 – Multiplexing and packing of maximum size CPS-Packets into CPS-PDUs (ATM cells)

I.2 Multiplexing and packing of different length CPS-Packets

Figure I.2 shows the situation where various length CPS-Packets are submitted to the Common Part Sublayer for multiplexing and packing. Whether the CPS-Packets originate from a single CPS user (e.g. an SSCS entity) or from several is not discernible in the figure; for the discussion of the packing rules, this is irrelevant.

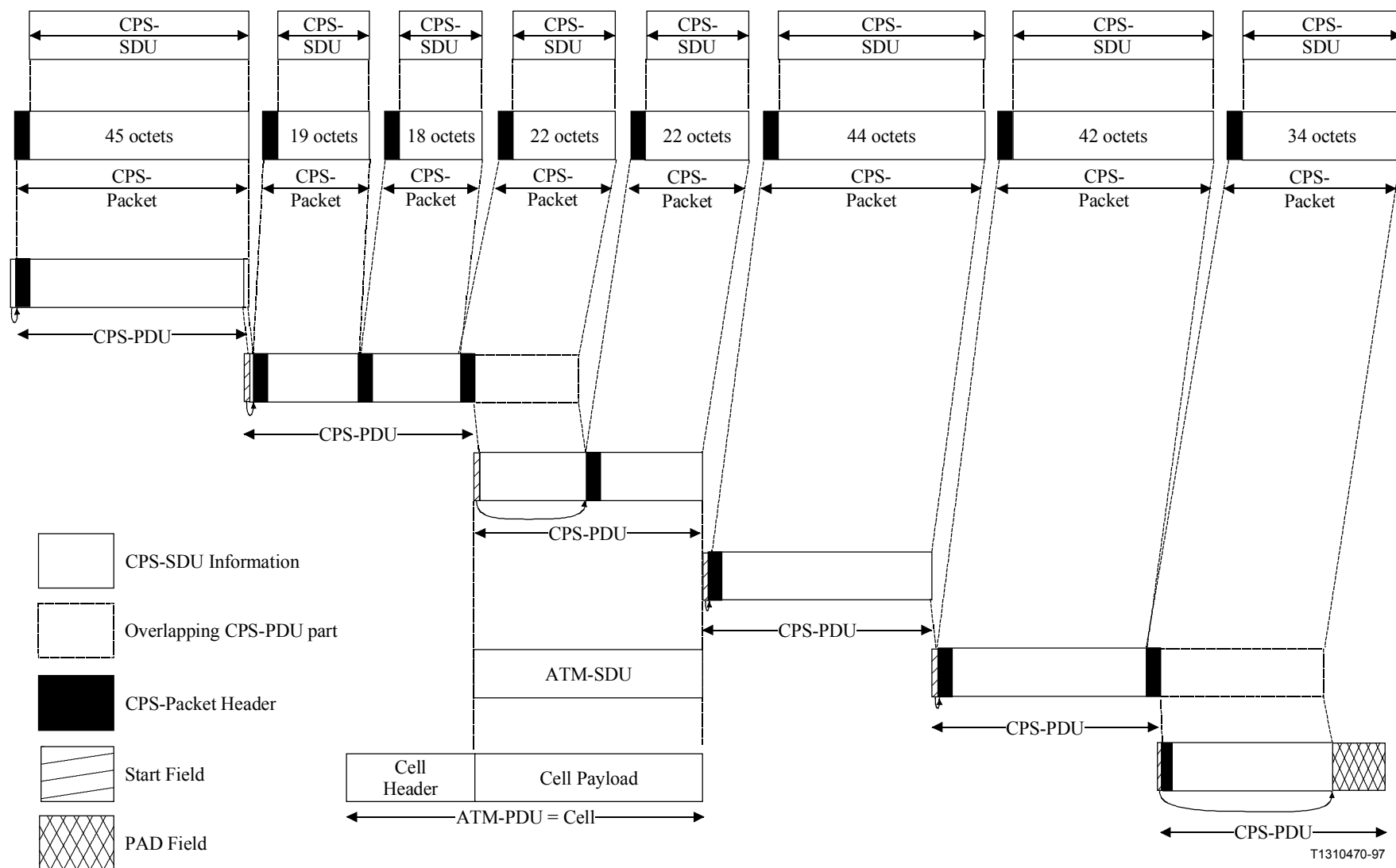
Under the assumption that the maximum CPS-SDU length is 45 octets, chosen lengths of the CPS-SDUs allow the following observations:

- a) The first two CPS-SDUs are derived from segmenting larger SSCS-SDUs. The first maximum size CPS-SDU does not fit into a single CPS-PDU; even when the CPS-Packet header is at the beginning of the CPS-PDU payload, the last octet overlaps into the second CPS-PDU.
- b) Only the CPS-Packet header of the 4th CPS-Packet can be placed in the second CPS-PDU. The complete CPS-Packet payload (CPS-SDU) is transmitted after the STF of the third CPS-PDU.
- c) The 6th CPS-Packet is of such a length and happens to be packed at such an opportunity that it fills a CPS-PDU completely.
- d) After the 7th CPS-Packet is filled into a CPS-PDU, two octets remain. These two octets are used to transmit part of the 8th CPS-Packet header, the remaining octet of the CPS-Packet header as well as the 34 octets of CPS-Packet payload are carried in the next CPS-PDU.
- e) Assuming that no further CPS-SDUs arrive after the eight CPS-Packets shown in the figure, the 6th CPS-PDU needs to be filled with PAD octets before it can be transmitted within the assumed time constraints.
- f) The STF in the header of the last CPS-PDU points to the location of the first PAD octet because there is no start of a CPS-Packet (CPS-Packet header) in this CPS-PDU.

NOTE – With the maximum CPS-SDU length restricted to 45 octets, at least either the beginning or the end of a CPS-Packet is always present in a CPS-PDU.

Table I.2/I.363.2 – Start and End Octets for different length CPS-Packets

| | | CPS-Packet | | | | | | | |
|-----------------|-----------|------------|------|------|------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Length of SDU | Octet | 45 | 19 | 18 | 22 | 22 | 44 | 42 | 34 |
| Start of CPS-PH | PDU/Octet | 1/01 | 2/02 | 2/24 | 2/45 | 3/23 | 4/01 | 5/01 | 5/46 |
| Start of CPS-PP | PDU/Octet | 1/04 | 2/05 | 2/27 | 3/01 | 3/26 | 4/04 | 5/04 | 6/02 |
| End of CPS-PP | PDU/Octet | 2/01 | 2/23 | 2/44 | 3/22 | 3/47 | 4/47 | 5/45 | 6/35 |



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Figure I.2/I.363.2 – Multiplexing and packing of special case CPS-Packets into CPS-PDUs (ATM cells)

I.3 Multiplexing and packing of maximum length CPS-Packets

Figure I.3 shows the situation where maximum length CPS-Packets (64 octets CPS-SDU) are submitted to the Common Part Sublayer for multiplexing and packing. Whether the CPS-Packets originate from a single CPS user (e.g. an SSCS entity) or from several is not discernible in the figure; for the discussion of the packing rules, this is irrelevant.

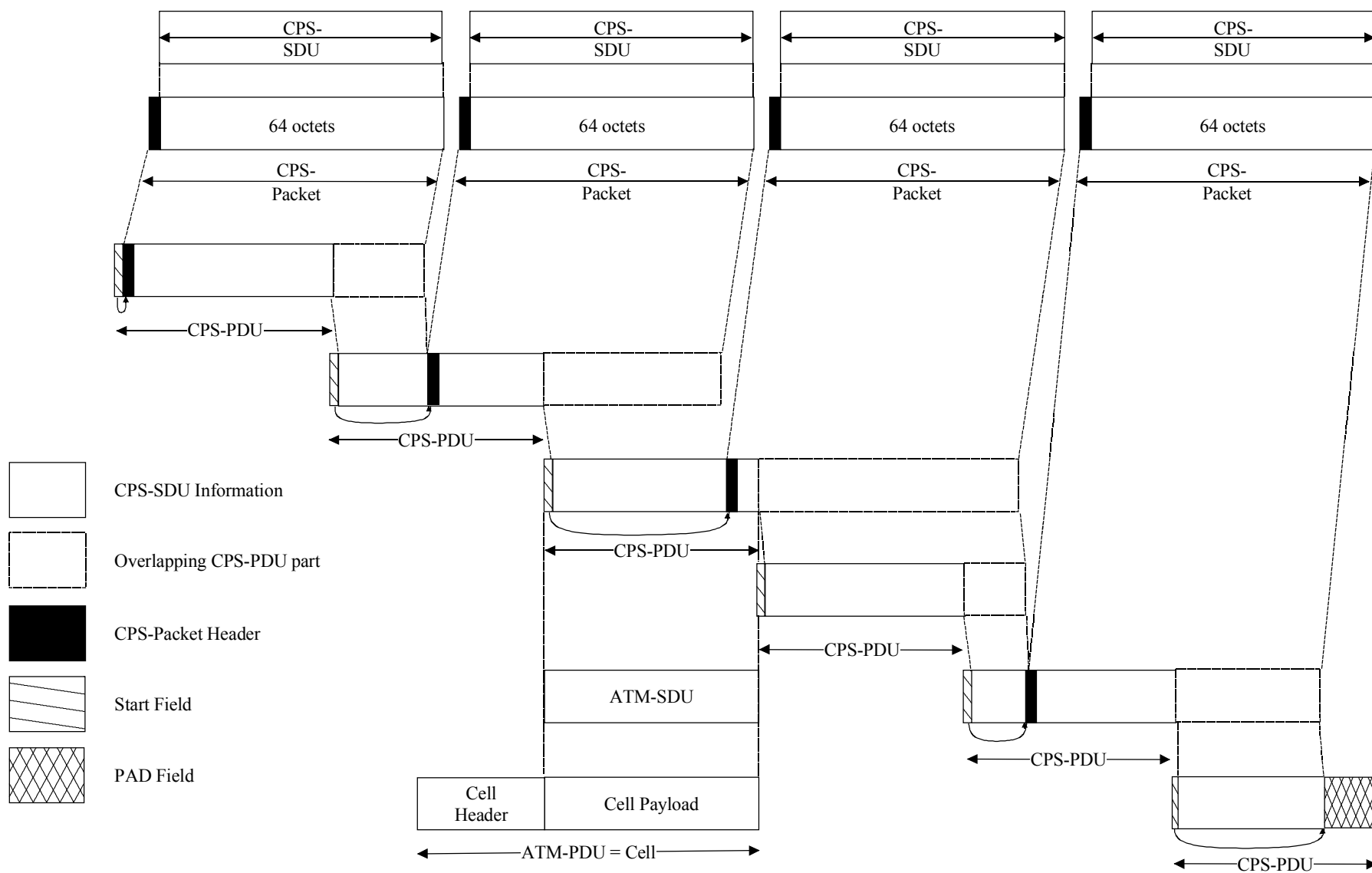
The chosen length of the CPS-SDUs allows the following observations:

- a) The first maximum size CPS-SDU does not fit into a single CPS-PDU; even when the CPS-Packet header is at the beginning of the CPS-PDU payload, 20 octets overlap into the second CPS-PDU.
- b) The third maximum size CPS-SDU starts towards the end of the third CPS-PDU; the fourth CPS-PDU contains only the STF and 47 octets of CPS-SDU data. The fifth CPS-PDU carries the final part of the third CPS-SDU.

**Table I.3/I.363.2 – Start and End Octets
for maximum length CPS-Packets**

| | | CPS-Packet | | | |
|-----------------|-----------|------------|------|------|------|
| | | 1 | 2 | 3 | 4 |
| Length of SDU | Octet | 64 | 64 | 64 | 64 |
| Start of CPS-PH | PDU/Octet | 1/01 | 2/21 | 3/41 | 5/14 |
| Start of CPS-PP | PDU/Octet | 1/04 | 2/24 | 3/44 | 5/17 |
| End of CPS-PP | PDU/Octet | 2/20 | 3/40 | 5/13 | 6/33 |

NOTE – Even in the absence of arriving CPS-SDUs it might be required to transmit a CPS-PDU (e.g. when the ATC is set to DBR). In such a situation, a CPS-PDU whose 47-octet payload consists entirely of PAD octets after the STF (which has the OSF set to zero) is transmitted; this is however not illustrated in this appendix.



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Figure I.3/I.363.2 – Multiplexing and packing of maximum size CPS-Packets into CPS-PDUs (ATM cells)

APPENDIX II

Protocol Implementation Conformance Statement (PICS) Proforma

(This appendix does not form an integral part of this Recommendation. It is only normative in the sense that if a Protocol Implementation Conformance Statement is made, this proforma shall be used.)¹

II.1 Introduction

Prior to the conformance testing and the interoperability testing of Implementations Under Tests (IUTs), it is necessary to have the PICS (Protocol Implementation Conformance Statement) document for an implementation.

This particular PICS deals with the implementation of the B-ISDN ATM Adaptation Layer Type 2 Specification.

II.1.1 Scope

This appendix provides the PICS proforma for the B-ISDN ATM Adaptation Layer Type 2, in compliance with the relevant requirements, and in accordance with the relevant guidelines, given in ITU-T X.296 [2].

II.1.2 Normative references

- [1] ITU-T X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts*.
- [2] ITU-T X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Implementation conformance statements*.

II.1.3 Abbreviations

This Appendix uses the following abbreviations.

| | |
|-----|-------------------------------------|
| ATM | Asynchronous Transfer Mode |
| CID | Channel Identifier |
| CPS | Common Part Sublayer |
| FCP | Format and Coding for CPS-Packet |
| FCU | Format and Coding for CPS-PDU |
| HEC | Header Error Control |
| IUT | Implementation Under Test |
| LI | Length Indicator |
| M | Mandatory |
| N/A | Not applicable |
| NOT | item not supported; absence of item |

¹ **Copyright release for PICS proforma**

Users of this Recommendation may freely reproduce the PICS proforma in this appendix so that it can be used for its intended purpose, and may further publish the completed PICS.

| | |
|-------|--|
| O | Optional |
| O.<n> | Optional, but, if chosen, support is required for either at least one or only one of the options in the group labelled by the same numeral <n> |
| OSF | Offset field |
| PDU | Protocol Data Unit |
| PH | Packet Header |
| RC | Receiver |
| S.<i> | Supplementary information number i |
| SAR | Segmentation and Reassembly (Sublayer) |
| SDU | Service Data Unit |
| SN | Sequence Number |
| SSCS | Service Specific Convergence Sublayer |
| STF | Start Field |
| SUT | System Under Test |
| TX | Transmitter |
| UII | User-to-User Indication |
| X.<i> | Exceptional information number i |

II.1.4 Conformance statement

The supplier of a protocol implementation which is claimed to conform to the B-ISDN ATM Adaptation Layer Type 2 Specification is required to complete a copy of the PICS proforma provided in II.2 and is required to provide the information necessary to identify both the supplier and the implementation.

II.2 PICS Proforma

II.2.1 Identification of the PICS Proforma Corrigenda

| | |
|--|---------------------------------------|
| Identification of corrigenda applied to this PICS proforma | Rec. I.363.2 (1997) Cor.: Cor.: |
|--|---------------------------------------|

II.2.2 Instructions for completing the PICS Proforma

The PICS Proforma is a fixed-format questionnaire. Answers to the questionnaire should be provided in the rightmost columns, either by simply indicating a restricted choice (such as Yes or No), or by entering a value or a set of range of values.

A supplier may also provide additional information, categorized as exceptional or supplementary information. This additional information should be provided as items labelled X.<i> for exceptional information, or S.<i> for supplemental information, respectively, for cross-reference purposes, where <i> is any unambiguous identification for the item. An exception item should contain the appropriate rationale.

The supplementary information is not mandatory and the PICS is complete without such information. The presence of optional supplementary or exception information should not affect test execution, and will in no way affect interoperability verification.

NOTE – Where an implementation is capable of being configured in more than one way, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, in case this makes for easier or clearer presentation of the information.

II.2.3 Identification of the implementation

Implementation Under Test (IUT)

Identification

IUT Name: _____

IUT Version: _____

System Under Test

SUT Name: _____

Hardware Configuration: _____

Operating System: _____

Product Supplier

Name: _____

Address: _____

Telephone Number: _____

Facsimile Number: _____

Email Address (optional): _____

Additional Information: _____

Client

Name: _____

Address: _____

Telephone Number: _____

Facsimile Number: _____

Email Address (optional): _____

Additional Information: _____

PICS Contact Person

Name: _____

Address: _____

Telephone Number: _____

Facsimile Number: _____

Email Address (optional): _____

Additional Information: _____

Identification of the protocol

This PICS proforma applies to the following Appendix:

- ITU-T I.363.2, *B-ISDN ATM Adaptation Layer Specification: Type 2 AAL*.

II.2.4 Global Statement of Conformance

The implementation described in this PICS meets all of the mandatory requirements of the reference protocol.

☐ Yes

☐ No

NOTE – Answering "No" indicates non-conformance to the specified protocol. Non-supported mandatory capabilities are to be identified in the following tables, with an explanation in the comments section of each table of why the implementation is non-conforming.

II.2.4.1 Roles

| Item number | Item description | Reference | Status | Support |
|-------------|--------------------------|-----------|--------|---------|
| R1 | Transmitter and Receiver | 7.1 | M | |

II.2.4.1.1 Procedures of the AAL type 2 Common Part Sublayer (Transmitter)

| Item number | Protocol feature | Reference | Status | Support |
|-----------------|--|---|--------|-------------------|
| TX1 | Is the sequence number in the Start Field incremented by "1" (modulo 2) when each PDU is transmitted? | 9.2.1 b) | M | Yes_ No_ X_ S_ |
| TX2 | Does the transmitter set the parity bit value such that the parity over the 8-bit Start Field is odd? | 9.2.1 c) | M | Yes_ No_ X_ S_ |
| TX3 | When IUT is in state IDLE and a CPS-UNITDATA.request is made, is a CPS Packet constructed? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX4 (Note 1) | When IUT is in state IDLE and a CPS-UNITDATA.request is made, is Timer_CU set? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX5 | When IUT is in state IDLE and a MAAL-UNITDATA.request is made, is a CPS Packet constructed? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX6 (Note 1) | When IUT is in state IDLE and a MAAL-UNITDATA.request is made, is Timer_CU set? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX7 | When IUT is in state IDLE and a CPS-UNITDATA.request is made, a CPS Packet is constructed, and more than zero octets remain free in the current CPS-PDU for more CPS-Packets, does the IUT progress to state PART? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |

| Item number | Protocol feature | Reference | Status | Support |
|-------------|---|--|--------|-------------------|
| TX8 | When IUT is in state IDLE and a MAAL-UNITDATA.request is made, a CPS Packet is constructed, and more than zero octets remain free in the current CPS-PDU for more CPS-Packets, does the IUT progress to state PART? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX9 | When IUT is in state IDLE and a CPS-UNITDATA.request is made, a CPS Packet is constructed, and the current CPS-PDU is filled exactly, does the IUT progress to state FULL and reset Timer_CU? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX10 | When IUT is in state IDLE and a MAAL-UNITDATA.request is made, a CPS Packet is constructed, and the current CPS-PDU is filled exactly, does the IUT progress to state FULL and reset Timer_CU? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX11 | When IUT is in state IDLE and a CPS-UNITDATA.request is made, a CPS Packet is constructed, and zero octets remain free for more CPS-Packets in the current CPS-PDU and there is overlap into the next CPS-PDU, does the IUT progress to state FULL and set Timer_CU? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX12 | When IUT is in state IDLE and a MAAL-UNITDATA.request is made, a CPS Packet is constructed, and zero octets remain free for more CPS-Packets in the current CPS-PDU and there is overlap into the next CPS-PDU, does the IUT progress to state FULL and set Timer_CU? | 10.1 1), Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX13 | When IUT is in state PART and a CPS-UNITDATA.request is made, is a CPS Packet constructed? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX14 | When IUT is in state PART and a MAAL-UNITDATA.request is made, is a CPS Packet constructed? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX15 | When IUT is in state PART and a CPS-UNITDATA.request is made, a CPS Packet constructed, and more than zero octets remain free for more CPS-Packets, does the IUT remain in state PART? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX16 | When IUT is in state PART and a MAAL-UNITDATA.request is made, a CPS Packet constructed, and more than zero octets remain free for more CPS-Packets, does the IUT remain in state PART? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |

| Item number | Protocol feature | Reference | Status | Support |
|------------------|--|--|--------|-------------------|
| TX17 | When IUT is in state PART and a CPS-UNITDATA.request is made, a CPS Packet constructed, zero octets remain free for more CPS-Packets and permit \diamond true, does the IUT progress to state FULL? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX18 | When IUT is in state PART and a MAAL-UNITDATA.request is made, a CPS Packet constructed, zero octets remain free for more CPS-Packets and permit \diamond true, does the IUT progress to state FULL? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX19 (Note 1) | When IUT is in state PART and a CPS-UNITDATA.request is made, a CPS Packet constructed, and the CPS-Packet overlaps into the next CPS-PDU is the Timer_CU set? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX20 (Note 1) | When IUT is in state PART and a MAAL-UNITDATA.request is made, a CPS Packet constructed, and the CPS-Packet overlaps into the next CPS-PDU is the Timer_CU set? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX21 | When IUT is in state PART and a CPS-UNITDATA.request is made, a CPS Packet constructed, and the CPS-Packet fits exactly, is the Timer_CU reset? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX22 | When IUT is in state PART and a MAAL-UNITDATA.request is made, a CPS Packet constructed, and the CPS-Packet fits exactly, is the Timer_CU reset? | 10.1 2), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX23 | When the IUT is in state FULL and a MAAL-SEND.request is received, does the IUT make an ATM-DATA.request? | 10.1 3), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX24 | When the IUT is in state FULL are no primitives other than the MAAL-SEND.request processed? | 10.1 3), Note 5; Figure 10 (sheet 1 of 3) | M | Yes_ No_ X_ S_ |
| TX25 (Note 1) | While in state PART, and permit = false, and Timer_CU expires, does the IUT enter state SEND? | 10.1 4), Figure 10 (sheet 2 of 3) | M | Yes_ No_ X_ S_ |
| TX26 (Note 1) | While in state PART, and permit = true, and Timer_CU expires, does the IUT pad the remaining octets, if any, and issue an ATM-DATA.request? | 10.1 4), Figure 10 (sheet 2 of 3) | M | Yes_ No_ X_ S_ |
| TX27 | While in state SEND and MAAL-SEND.request is received, does the IUT pad the remaining octets, if any, and issue an ATM-DATA.request? | 10.1 4), Figure 10 (sheet 2 of 3) | M | Yes_ No_ X_ S_ |
| TX28 | When IUT is in state SEND and a CPS-UNITDATA.request is made, is a CPS Packet constructed? | 10.1 4), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |

| Item number | Protocol feature | Reference | Status | Support |
|--|--|---|--------|-------------------|
| TX29 (Note 1) | When IUT is in state SEND and a CPS-UNITDATA.request is made and the data overlaps into the next CPS-PDU, is Timer_CU set and state FULL entered? | 10.1 4), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX30 | When IUT is in state SEND and a CPS-UNITDATA.request is made and the data fits exactly into the next CPS-PDU, is Timer_CU reset and state FULL entered? | 10.1 4), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX31 | When IUT is in state SEND and a CPS-UNITDATA.request is made and the data does not overlap nor fits exactly into the next CPS-PDU, is the new packet constructed and octets moved to CPS-PDU and the state returns to SEND? | 10.1 4), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX32 | When IUT is in state SEND and a MAAL-UNITDATA.request is made, is a CPS Packet constructed? | Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX33 (Note 1) | When IUT is in state SEND and a MAAL-UNITDATA.request is made and the data overlaps into the next CPS-PDU, is Timer_CU set and state FULL entered? | Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX34 | When IUT is in state SEND and a MAAL-UNITDATA.request is made and the data fits exactly into the next CPS-PDU, is Timer_CU reset and state FULL entered? | Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX35 | When IUT is in state SEND and a MAAL-UNITDATA.request is made and the data does not overlap nor fits exactly into the next CPS-PDU, is the new packet constructed and octets moved to CPS-PDU and the state returns to SEND? | Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX36 (Notes 1, 2) | In state IDLE or PART and the underlying ATM connection requires the sending of a CPS-PDU every time a MAAL-SEND.request is received, and a MAAL-SEND.request is received, does the IUT <ul style="list-style-type: none"> – reset (stop) Timer_CU(unless IDLE); – pad CPS-PDU, if necessary; and – make an ATM-DATA.request? | 10.1 5), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| TX37 (Note 2) | In state IDLE or PART and the underlying ATM connection does not require the sending of a CPS-PDU every time a MAAL-SEND.request is received, and a MAAL-SEND.request is received, does the IUT set permit = true? | 10.1 5), Figure 10 (sheets 1 & 2 of 3) | M | Yes_ No_ X_ S_ |
| NOTE 1 – The current specification specifies neither a default nor a range of values for Timer_CU. | | | | |
| NOTE 2 – At the current time, no such requirement of the underlying ATM connection exists. | | | | |

II.2.4.1.2 Procedures of the AAL type 2 Common Part Sublayer (Receiver)

| Item number | Protocol feature | Reference | Status | Support |
|-------------|--|---|--------|-------------------|
| RC1 | If the Parity of the Start Field in a received CPS-PDU is incorrect, is a MAAL-ERROR (0) reported and the CPS-PDU discarded? | 10.2 1), Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC2 | If the Parity of the Start Field in a received CPS-PDU is incorrect, is Cancel REASM procedures followed (i.e. PICS RC46)? | 10.2 1), Figure 11 | M | Yes_ No_ X_ S_ |
| RC3 | If the SN field of the Start Field in the CPS-PDU indicates a sequence error, is a MAAL-ERROR (1) reported? | 10.2 2), Figure 11 | M | Yes_ No_ X_ S_ |
| RC4 | If the SN field of the Start Field in the CPS-PDU indicates a sequence error, is Cancel REASM procedures followed (i.e. PICS RC46)? | 10.2 2), Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC5 | If the SN field of the Start Field in the CPS-PDU indicates a sequence error and the OSF contains a value greater than "47", is a MAAL-ERROR (3) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC6 | If the SN field of the Start Field in the CPS-PDU indicates a sequence error and the OSF contains a value less than or equal to "47", is the ptrEXT set to OSF + 1 and continue processing (A) (i.e. RC28-RC39)? | Figure 11 | M | Yes_ No_ X_ S_ |
| RC7 | If the Parity and the sequence number are correct in a received CPS-PDU and split $\neq 0$, then is "split" octets appended to PH_buffer? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC8 | If RC7 and PH_buffer.HEC is correct, is the ptrEXT set to split + 1 and split set to zero; and expct and len set to PH_buffer.LI + 1? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC9 | If RC7 and PH_buffer.HEC is incorrect, is a MAAL-ERROR (7) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC10 | If RC9, is split set to zero and PH_buffer reset? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC11 | If RC10 and the OSF contains a value less than or equal to "47", is the ptrEXT set to OSF + 1 and continue processing (A) (i.e. RC28-RC39)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC12 | If RC10 and the OSF contains a value greater than "47", is a MAAL-ERROR (3) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC13 | If the Parity and the sequence number are correct in a received CPS-PDU, split = 0, expct ≤ 47 , and expct \neq INFO.OSF, is a MAAL-ERROR (2) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC14 | If RC13, is Cancel REASM procedures followed (i.e. PICS RC46)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC15 | If RC14 and the OSF contains a value less than or equal to "47", is the ptrEXT set to OSF + 1 and continue processing (A) (i.e. RC28-RC39)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |

| Item number | Protocol feature | Reference | Status | Support |
|-----------------------|---|-----------------------------|--------|-------------------|
| RC16 | If RC14 and the INFO.OSF contains a value greater than "47", is a MAAL-ERROR (3) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC17 | If the Parity and the sequence number are correct in a received CPS-PDU, split = 0, expct ≤ 47, expct equals INFO.OSF, and expct equals zero, is ptrEXT set to 1 and processing continued (A) (i.e. RC28-RC39)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC18 | If the Parity and the sequence number are correct in a received CPS-PDU, split = 0, ptrEXT + expct ≤ 48, ptrEXT + expct – 1 equals INFO.OSF, and expct < zero, are the expected octets appended to the partially assembled CPS-Packet and the procedures of Deliver CPS-SDU followed (RC40-RC45)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC19 | If RC18, is expct set to zero and ptrEXT set to INFO.OSF + 1? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC20 | If RC19, does processing continue (A) (i.e. RC28-RC39)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC21 | If the Parity and the sequence number are correct in a received CPS-PDU, split = 0, ptrEXT + expct > 48, and INFO.OSF equals 47, are 48-ptrEXT octets appended to the INFO_buffer? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC22 | If RC21, is expct set to expct – 48 + ptrEXT? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC23 | If the Parity and the sequence number are correct in a received CPS-PDU, split = 0, ptrEXT + expct > 48, and INFO.OSF < 47, is a MAAL-ERROR (2) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC24 | If RC23, is Cancel REASM procedures followed (i.e. PICS RC46)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC25 | If RC24 and INFO.OSF > 47, is a MAAL-ERROR (3) reported? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC26 | If RC24 and INFO.OSF ≤ 47 is ptrEXT set to INFO.OSF + 1? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| RC27 | If RC26, does processing continue (A) (i.e. RC28-RC39)? | Figure 11 (sheet 1 of 2) | M | Yes_ No_ X_ S_ |
| Procedures (A) | | | | |
| RC28 | If ptrEXT ≥ 48, does processing of the CPS-PDU cease? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC29 | If ptrEXT < 48 and INFO[ptrEXT] equals zero, does processing of the CPS-PDU cease? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC30 | If ptrEXT < 48, INFO[ptrEXT] < zero, and ptrEXT ≥ 46, are 48-ptrEXT octets appended to PH_buffer and split set to ptrEXT – 45? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |

| Item number | Protocol feature | Reference | Status | Support |
|------------------------|--|--------------------------|--------|-------------------|
| RC31 | If ptrEXT < 48, INFO[ptrEXT] \neq zero, and ptrEXT < 46, are 3 octets appended to PH_buffer and ptrEXT set to ptrEXT + 3? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC32 | If RC31 and PH_buffer.HEC is incorrect, is a MAAL-ERROR (4) reported and PH_buffer reset? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC33 | If RC31 and PH_buffer.HEC is correct, is len set to PH_buffer.LI + 1? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC34 | If RC33 and len + ptrEXT > 48, is expct set to len + ptrEXT – 48? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC35 | If RC34, is 48 – ptrEXT octets appended to INFO_buffer? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC36 | If RC33 and len + ptrEXT \leq 48, are len octets appended to INFO_buffer? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC37 | If RC36, are the procedures of Deliver CPS-SDU followed (i.e. RC40-RC45)? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC38 | If RC37, is ptrEXT set to ptrEXT + len? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC39 | If RC38, are the procedures of (A) followed (i.e. RC28-RC39)? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| Deliver CPS-SDU | | | | |
| RC40 | If len > Max_SDU_Deliver_Length, is a MAAL-ERROR (5) reported? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC41 | If len \leq Max_SDU_Deliver_Length, PH_buffer.UUI equals any value 0-27, and CID is associated with a SAP, is CPS-INFO and CPS-UUI sent to user? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC42 | If len \leq Max_SDU_Deliver_Length, PH_buffer.UUI equals any value 0-27, and CID is not associated with a SAP, is a MAAL-ERROR (9) reported? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC43 | If len \leq Max_SDU_Deliver_Length and PH_buffer.UUI equals any value 30-31, is CPS-INFO, CPS-CID, and CPS-UUI sent to management? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC44 | If len \leq Max_SDU_Deliver_Length and PH_buffer.UUI equals either value 28 or 29, is a MAAL-ERROR (8) reported? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| RC45 | If RC40, RC41, RC42, RC43 or RC44, is the INFO_buffer and PH_buffer reset? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |
| Cancel REASM | | | | |
| RC46 | If expct \neq 0 or split \neq 0, is an MAAL-ERROR (6) reported and INFO_buffer and PH_buffer reset and expct and split set to zero? | Figure 11 (sheet 2 of 2) | M | Yes_ No_ X_ S_ |

II.2.4.1.3 Both Transmitter and Receiver

| Item number | Item description | Reference | Status | Support |
|-------------|--|-----------|--------|-------------------|
| TXRC1 | Is the same value of the Channel Identifier used in both directions? | 9.1 a) | M | Yes_ No_ X_ S_ |

II.2.4.2 Major capabilities

| Item number | Item description | Reference | Status | Support |
|---|-------------------------------------|-----------|--------|---------|
| MC1 | Support of 45-octet CPS-INFO fields | 7.1 | M | |
| MC2 | Support of 64-octet CPS-INFO fields | 7.1 | O | |
| NOTE – Answering "Yes" to MC2 does not imply that up to 64-octet CPS-INFO fields are used on all channels, but that the implementation is able to support this depending on the actual arrangement. | | | | |

II.2.4.3 PDUs

| Item number | Item description | Reference | Status | Support |
|-------------|------------------|-----------|--------|---------|
| P1 | CPS-packet | 9.1 | M | |
| P2 | CPS-PDU | 9.2 | M | |

II.2.4.3.1 CPS-Packet

| Item number | Format and coding | Reference | Status | Support | Values | |
|--------------------|--|---------------|--------|-------------------|----------------------|-----------|
| | | | | | Allowed | Supported |
| FCP1 | Does each CPS-Packet contain a header formatted as shown in Figure 4 | 9.1, Figure 4 | M | Yes_ No_ X_ S_ | | |
| FCP2 | CID field | 9.1 a) | M | Yes_ No_ X_ S_ | 1, 8-255 | |
| FCP3 | Length indicator field | 9.1 b) | M | Yes_ No_ X_ S_ | MC1:0-44 MC2:0-63 | |
| FCP4 (Note 1) | User-to-User Indication (UII) field | 9.1 c) | M | Yes_ No_ X_ S_ | 0-27,30-31 | |
| FCP4.1 | Serving SSCS entities | 9.1 c) | M | | 0-27 | |
| FCP4.2 (Note 2) | AAL Layer Management | 9.1 c) | M | | 30-31 | |
| FCP5 | Is the HEC calculated over the first 19 bits of the CPS-PH? | 9.1 d) | M | Yes_ No_ X_ S_ | | |
| FCP6 | Is the result of the HEC calculation the coefficient of the X^4 term as the most significant bit of the HEC field? | 9.1 d) | M | Yes_ No_ X_ S_ | | |

| Item number | Format and coding | Reference | Status | Support | Values | |
|--|--|-----------|--------|-------------------|---------|-----------|
| | | | | | Allowed | Supported |
| FCP7 | Do the order and significance of bits within a field adhere to the conventions specified in 2.1/I.361? | 9 | M | Yes_ No_ X_ S_ | | |
| NOTE 1 – The values of 28 and 29 are reserved for future functions. | | | | | | |
| NOTE 2 – The values of 30 and 31 are reserved for AAL type 2 layer management functions; the AAL type 2 layer management functions may be defined at a later date. | | | | | | |

II.2.4.3.2 CPS-PDU

| Item number | Format and coding | Reference | Status | Support | Values | |
|-------------|---|---------------|--------|-------------------|---------|-----------|
| | | | | | Allowed | Supported |
| FCU1 | Does each CPS-PDU consist of a one octet start field and a 47-octet payload formatted as shown in Figure 5? | 9.2, Figure 5 | M | Yes_ No_ X_ S_ | | |
| FCU2 | Offset field | 9.2.1 a) | M | Yes_ No_ X_ S_ | 0-47 | |
| FCU3 | Is all unused CPS-PDU payload filled with octets coded with the value of zero? | 9.2.2 | M | Yes_ No_ X_ S_ | | |

II.2.5 Timers

| Item number | Item description | Reference | Status | Support | Values | |
|-------------|------------------|-----------|--------|---------|---------|-----------|
| | | | | | Allowed | Supported |
| T1 | Timer_CU | 11 | M | | | |

SERIES OF ITU-T RECOMMENDATIONS

| | |
|-----------------|--|
| Series A | Organization of the work of 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 | TMN and network 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 |
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