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Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Adaptation Layer (AAL) specification - type 1

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Contents

Foreword

This Interim European Telecommunication Standard (I-ETS) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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Introduction

The content of this I-ETS is derived from ITU-T Recommendation I.363.1 [8]. This I-ETS is one of a set of I-ETSs describing different Asynchronous Transfer Mode (ATM) Adaptation Layer (AAL) types.

The AAL uses the ATM layer service and offers its layer service to the higher layers. The connection-oriented transmission methods which provide timing relation between sending and receiving AAL service users, are described in ITU-T Recommendation I.363.1 [8], clause 2. These methods form the AAL type 1. They check the validity of the cell sequence count, transmit and utilize time stamp information for source clock recovery at the receiver as a user option, optionally correct data by using Forward Error Correction (FEC) and offer utilities to transfer structured data. Subtypes are defined for "circuit transport", "video signal transport" and "voice-band signal transport".

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1 Scope

As ITU-T Recommendation I.363.1 [8] contains options and describes methods which can be used in different combinations, this Interim European Telecommunication Standard (I-ETS) minimizes the options and methods and describes a subset of the Asynchronous Transfer Mode (ATM) Adaptation Layer (AAL) type 1 to be used in Europe.

This I-ETS describes the interactions between the AAL and the next higher layer, and the AAL and the ATM layer, as well as AAL peer-to-peer operations.

2 Normative references

This I-ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this I-ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ITU-T Recommendation G.702: "Digital hierarchy bit rates".

[2] ITU-T Recommendation G.707: "Network node interface for the synchronous digital hierarchy (SDH)".

[3] ITU-T Recommendation G.711: "Pulse code modulation (PCM) of voice frequencies".

[4] ITU-T Recommendation G.823: "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy".

[5] ITU-T Recommendation G.824: "The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy".

[6] ITU-T Recommendation I.231: "Circuit-mode bearer service categories".

[7] ITU-T Recommendation I.361 (1993): "B-ISDN ATM layer specification".

[8] ITU-T Recommendation I.363.1 (1996): "B-ISDN ATM Adaptation: Type 1 AAL".

[9] ITU-T Recommendation J.82 (1995): "Transport of MPEG-2 constant bit rate television signals in B-ISDN".

[10] ITU-T Recommendation H.310 (1995): "Broadband audiovisual communication systems and terminals".

[11] ITU-T Recommendation H.320 (1993): "Narrow-band visual telephone systems and terminal equipment".

[12] ITU-T Recommendation H.321: "Adaptation of H.320 visual telephone terminals to B-ISDN environments".

[13] ITU-T Recommendation H.221 (1995): "Frame structure for a 64 to 1 920 kbit/s channel in audiovisual teleservices".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this I-ETS, the following definitions apply:

ATM Adaptation Layer (AAL): The AAL uses the ATM layer service and includes multiple protocols to fit the need of the different AAL service users. In AAL type 1 source timing recovery is provided at the receiver.

Convergence Sublayer Indication (CSI): The CSI is a part of the Protocol Control Information (PCI) in the SAR sublayer; it indicates a special event in the sending Convergence Sublayer (CS) entity in combination with the Sequence Count (SC) and depending on the AAL subtype used: it supports source clock timing recovery using the SRTS method, data structure indication using the SDT method and bit error and cell loss recovery using Forward Error Correction (FEC).

Forward Error Correction (FEC): The FEC method is adapted to the error conditions at the ATM layer.

non-P format: Format of the SAR-PDU (Protocol Data Unit) payload, which does not carry a pointer of the SDT method.

P format: Format of the SAR-PDU payload which carries a pointer of the SDT method.

Residual Time Stamp (RTS): The SRTS method uses the RTS value to measure and convey information about the frequency differences between a common reference clock (derived from the network) and a service clock. The same derived network clock is assumed to be available at both the transmitter and the receiver.

Sequence Count (SC): This 3-bit field counts the SAR-PDUs from 0 to 7 (modulo 8).

Sequence Number (SN): The SN field consists of the 1-bit indication called CSI and a 3-bit SC in the SAR-PDUs.

Sequence Number Protection (SNP): The SNP protects the SN by Cyclic Redundancy Check (CRC) and parity check.

Structured Data Transfer (SDT): The SDT method supports the transmission of structured data (blocks of user data organized in octets) by using a pointer to the start of a block.

Synchronous Residual Time Stamp (method) (SRTS): This method uses the RTS values (transferred peer-to-peer) to recover the source service clock at the receiver side.

3.2 Abbreviations

For the purposes of this I-ETS, the following abbreviations apply:

AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
CRC	Cyclic Redundancy Check
CS	Convergence Sublayer
CSI	Convergence Sublayer Indication
FEC	Forward Error Correction
PCI	Protocol Control Information
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
RPOA	Recognized Private Operating Agency
RTS	Residual Time Stamp
SAP	Service Access Point
SAR	Segmentation And Reassembly (sublayer)
SC	Sequence Count
SDH	Synchronous Digital Hierarchy
SDL	Specification and Description Language
SDT	Structured Data Transfer
SDU	Service Data Unit
SN	Sequence Number
SNP	Sequence Number Protection
SRTS	Synchronous Residual Time Stamp (method)
STM-1	Synchronous Transport Module - 1

4 AAL type 1

The AAL enhances the service provided by the ATM layer to support functions required by the next higher layer. The AAL performs functions required by the user, control and management planes and supports the mapping between the ATM layer and the next higher layer. The functions performed in the AAL depend upon the higher layer requirements.

The AAL supports multiple protocols to fit the needs of the different AAL service users. The service provided by the AAL type 1 protocol to the higher layer and the functions performed are specified in this I-ETS.

Details of the data unit naming convention used in this I-ETS can be found in annex A.

This I-ETS describes the interactions between the AAL and the next higher layer, and the AAL and the ATM layer, as well as AAL peer-to-peer operations.

Different combinations of SAR sublayers and CS provide different Service Access Points (SAPs) to the layer above the AAL.

4.1 Service primitives provided by AAL type 1

The layer service capabilities provided by AAL type 1 to the AAL user are:

- transfer of service data units with a constant source bit rate and the delivery of them with the same bit rate;
- transfer of timing information between source and destination;
- transfer of structure information between source and destination;
- indication of lost or errored information which is not recovered by AAL type 1, if needed.

At the AAL-SAP, the following primitives are used between the AAL type 1 and the AAL user. They represent an abstract model of the interface and they are not intended to constrain implementations:

- from an AAL user to the AAL,
  AAL-UNITDATA-REQUEST;
- from the AAL to an AAL user,
  AAL-UNITDATA-INDICATION.

An AAL-UNITDATA-REQUEST primitive at the local AAL-SAP results in an AAL-UNITDATA-INDICATION primitive at its peer AAL-SAP.

4.1.1 AAL-UNITDATA-REQUEST

AAL-UNITDATA-REQUEST:

- (DATA [mandatory];
- STRUCTURE [optional]).

The AAL-UNITDATA-REQUEST primitive requests the transfer of the AAL-SDU, i.e. contents of the DATA parameter, from the local AAL entity to its peer entity. The length of the AAL-SDU is constant and the time interval between two consecutive primitives is constant. These two constants depend upon the specific AAL service provided to the AAL user.

4.1.2 AAL-UNITDATA-INDICATION

AAL-UNITDATA-INDICATION:

- (DATA [mandatory];
- STRUCTURE [optional];

- STATUS [optional]).

An AAL user is notified by the AAL that the AAL-SDU from its peer is available (i.e. via the contents of the DATA parameter). The length of the AAL-SDU shall be constant and the time interval between two consecutive primitives shall be constant. These two constants depend upon the specific AAL service provided to the AAL user.

4.1.3 Definition of parameters

4.1.3.1 DATA parameter

(Mandatory).

The DATA parameter carries the AAL-SDU to be sent or delivered. Its size depends on the specific AAL service used.

4.1.3.2 STRUCTURE parameter

(Optional use).

The STRUCTURE parameter can be used when the user data stream to be transferred to the peer AAL entity is organized into groups of octets. The length of the structured block is fixed for each instance of the AAL service. The length is an integer multiple of one octet. An example of the use of this parameter is to support circuit mode bearer services of the 64 kbit/s based ISDN. If the optional parameter is present, the two values of the STRUCTURE parameter are:

- START; and
- CONTINUATION.

The value START is used when the DATA is the first part of a structured block which can be composed of consecutive DATA. In other cases, the STRUCTURE parameter is set to CONTINUATION. The use of the STRUCTURE parameter depends upon the specific AAL service provided. The use of this parameter is agreed prior to or at the connection establishment between the AAL user and the AAL.

4.1.3.3 STATUS parameter

(Local optional use).

The STATUS parameter identifies that the DATA is judged to be non-errored or errored. The STATUS parameter has two values:

- VALID; and
- INVALID.

The INVALID status can also indicate that the DATA is a dummy value. The use of the STATUS parameter and the choice of dummy value depend upon the specific AAL service provided. The use of this parameter is agreed prior to or at the connection establishment between the AAL user and the AAL.

4.2 Information flow across the ATM-AAL boundary

ITU-T Recommendation I.361 [7] describes the primitives exchanged between the ATM layer and the AAL. This subclause describes the usage of these primitives for AAL type 1.

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

The submitted CLP (Cell Loss Priority) in the request primitive is set to the high priority by the AAL transmitter. The value of the receive loss priority in the indication primitive is ignored by the AAL receiver.

The AUU (ATM-user-to-ATM-user) parameter is set to "0" in the request primitive. Future procedures may require that the AUU parameter can be set to "0" or "1". Such usage is reserved for future standardization.

The congestion indication is ignored by the AAL receiver.

The encoding principles for mapping information between the ATM layer and AAL type 1 are given in annex B.

4.3 Primitives between the SAR sublayer and the CS

4.3.1 General

These primitives model the exchange of information between the SAR sublayer and the Convergence Sublayer (CS). As there exists no Service Access Point (SAP) between the sublayers of the AAL type 1, the primitives are called "invoke" and "signal" instead of the conventional "request" and "indication" to highlight the absence of the SAP. Functional model and SDL is given in annex C.

4.3.1.1 SAR-UNITDATA-INVOKE

SAR-UNITDATA-INVOKE at the AAL type 1 transmitter has the following parameters:

- Interface data: This parameter specifies the interface data unit passed from the CS to the SAR entity. The interface data is 47 octets, and represents a SAR-PDU payload;

- CSI: The Convergence Sublayer Indication (CSI), either "0" or "1", is passed from the CS to the SAR entity;

- Sequence count: The sequence count value is passed from the CS to the SAR entity. The value of sequence count starts with 0, is incremented sequentially and is numbered modulo 8.

4.3.1.2 SAR-UNITDATA-SIGNAL

SAR-UNITDATA-SIGNAL at the AAL type 1 receiver has the following parameters:

- Interface data: This parameter specifies the interface data unit passed from the SAR to the CS entity. The interface data is 47 octets, and represents a SAR-PDU payload;

- CSI: The CSI is passed from the SAR to CS entity, regardless of the check status (valid or invalid);

- Sequence count: The sequence count value is passed from the SAR to CS entity, regardless of the check status (valid or invalid);

- Check status: This parameter specifies the status of the sequence count and CSI, and has the value of either valid or invalid.

4.4 Interaction with the management and control planes

Currently no interactions are standardized.

4.4.1 Management plane

For example, the following indications may be passed from the user plane to the management plane:

- errors in the transmission of user information;

- lost and misinserted cells;

- cells with errored AAL-PCI;

- loss of timing and synchronization;

- buffer underflow and overflow.

4.4.2 Control plane

Currently no interactions are standardized.

4.5 Functions of AAL type 1

The following functions may be performed in the AAL type 1 in order to enhance the ATM layer service:

a) segmentation and reassembly of user information;

b) blocking and deblocking of user information;

c) handling of cell delay variation;

d) handling of cell payload assembly delay;

e) handling of lost and misinserted cells;

f) source clock frequency recovery at the receiver;

g) recovery of the source data structure at the receiver;

h) monitoring of AAL-PCI for bit errors;

i) handling of AAL-PCI bit errors;

j) monitoring of user information field for bit errors and possible corrective action.

NOTE: For some AAL users, the end-to-end QoS may be monitored. This may be achieved by calculating a CRC for the CS-PDU payload, carried in one or more cells, and transmitting the CRC results in the CS-PDU or by the use of OAM cells.

4.6 SAR sublayer

4.6.1 Functions of the SAR sublayer

The SAR sublayer functions are performed on an ATM-SDU basis:

a) mapping between CS-PDU and SAR-PDU:

- the SAR sublayer at the transmitting end accepts a 47 octet block of interface data from the CS, and then prepends a one octet SAR-PDU header to each block to form the SAR-PDU;

- the SAR sublayer at the receiving end receives the 48 octet block of data from the ATM layer, and then separates the SAR-PDU header. The 47 octet block of SAR-PDU payload (interface data) is passed to the CS;

b) indication of existence of CS function:

- the SAR sublayer has the capability to indicate the existence of a CS function. Associated with each 47 octet SAR-PDU payload, it receives this indication (CSI) from the CS and conveys it to the peer CS entity;

c) sequence numbering:

- associated with each SAR-PDU payload, the SAR sublayer receives a sequence count value from the CS. At the receiving end, it passes the SC value to the CS. The CS may use these SC values to detect lost or misinserted SAR-PDU payloads (corresponding to lost or misinserted ATM cells);

d) error protection:

- the SAR sublayer protects the SC value and the CS indication against bit errors. It informs the receiving CS by the value of check status whether the SC value and/or the CS indication are errored.

4.6.2 SAR protocol

The SAR-PDU header together with the 47 octets of the SAR-PDU payload comprises the 48 octet ATM-SDU (cell information field). The size and positions of the fields in the SAR-PDU are given in figure 1.

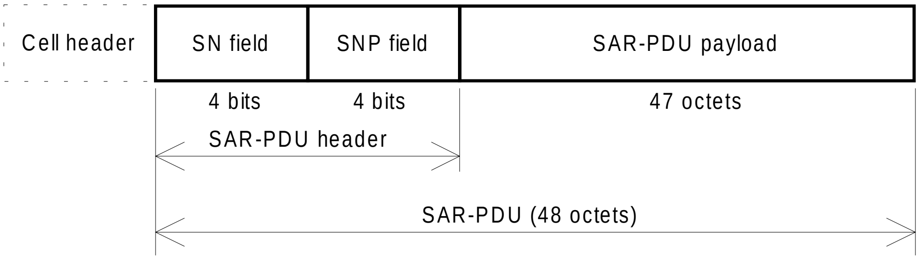

Figure 1: SAR-PDU format of AAL type 1

4.6.2.1 SN field

The SN field is divided into two subfields as shown in figure 2. The SC field carries the SC value provided by the CS. The CSI bit carries the CS indication provided by the CS. The default value of the CSI bit is "0".

The least significant bit of the SC value is right justified in the SC field.

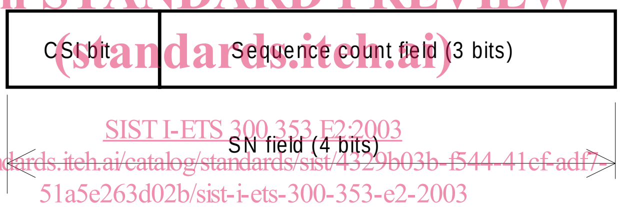

Figure 2: SN field format

4.6.2.2 SNP field

The SNP field provides error detection and correction capabilities over the SAR-PDU header. The format of this field is given in figure 3. A two step approach is used for the protection:

1) the SN field is protected by a 3 bit CRC code;

2) the resulting 7 bit code word is protected by an even parity bit, i.e. the parity bit is set such that the 8 bit SAR-PDU header has an even parity.

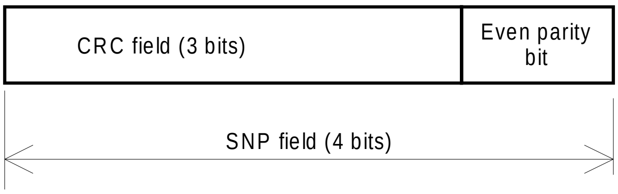

Figure 3: SNP field format

The receiver is capable of either single-bit error correction or multiple-bit error detection:

a) operations at transmitting end:

- the transmitter computes the CRC value across the first 4 bits of the SAR-PDU header and inserts the result in the CRC field.