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Contents

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Foreword

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

Asynchronous Transfer Mode (ATM) is the transfer mode solution for implementing a Broadband Integrated Services Digital Network (B-ISDN). It influences the standardization of digital hierarchies, multiplexing structures, switching and interfaces for broadband signals.

This ETS consists of 2 parts as follows:

Part 1: "B-ISDN ATM functional specification".

Part 2: "B-ISDN ATM layer specification".

Transposition dates	
Date of latest announcement of this ETS (doa):	30 June 1995
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1 Scope

This European Telecommunication Standard (ETS) is a 2 Part ETS which gives the basic characteristics and functional specification of Asynchronous Transfer Mode (ATM).

This part specifically addresses, from CCITT Recommendation I.361 [1]:

a) the cell structure and the ATM cell coding;

b) the ATM protocol procedures.

2 Normative references

This ETS incorporates by dated or 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 ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] CCITT Recommendation I.361: "B-ISDN ATM layer specification".

[2] CCITT Recommendation I.432: "B-ISDN user-network interface - Physical layer specification".

[3] CCITT Recommendation I.311: "B-ISDN general network aspects".

[4] CCITT Recommendation I.610: "B-ISDN Operation and Maintenance principles and functions".

[5] CCITT Recommendation I.371: "Traffic control & congestion control in B-ISDN".

[6] ETS 300 298-1: "Network Aspects (NA); Basic characteristics and functional specification of Asynchronous Transfer Mode (ATM) Part 1: B-ISDN ATM functional specification".

3 Abbreviations

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

ATM	Asynchronous Transfer Mode
CLP	Cell Loss Priority
GFC	Generic Flow Control
HEC	Header Error Control
MSB	Most Significant Bit
NNI	Network Node Interface
OAM	Operation And Maintenance
PT	Payload Type
PTI	Payload Type Identifier
UNI	User-Network Interface
VCI	Virtual Channel Identifier
VPI	Virtual Path Identifier

4 Cell structure coding

Two different coding schemes have been adopted; the User-Network Interface (UNI) format, and the Network Node Interface (NNI) format. They are described in subclauses 4.2 and 4.3.

4.1 Cell structure

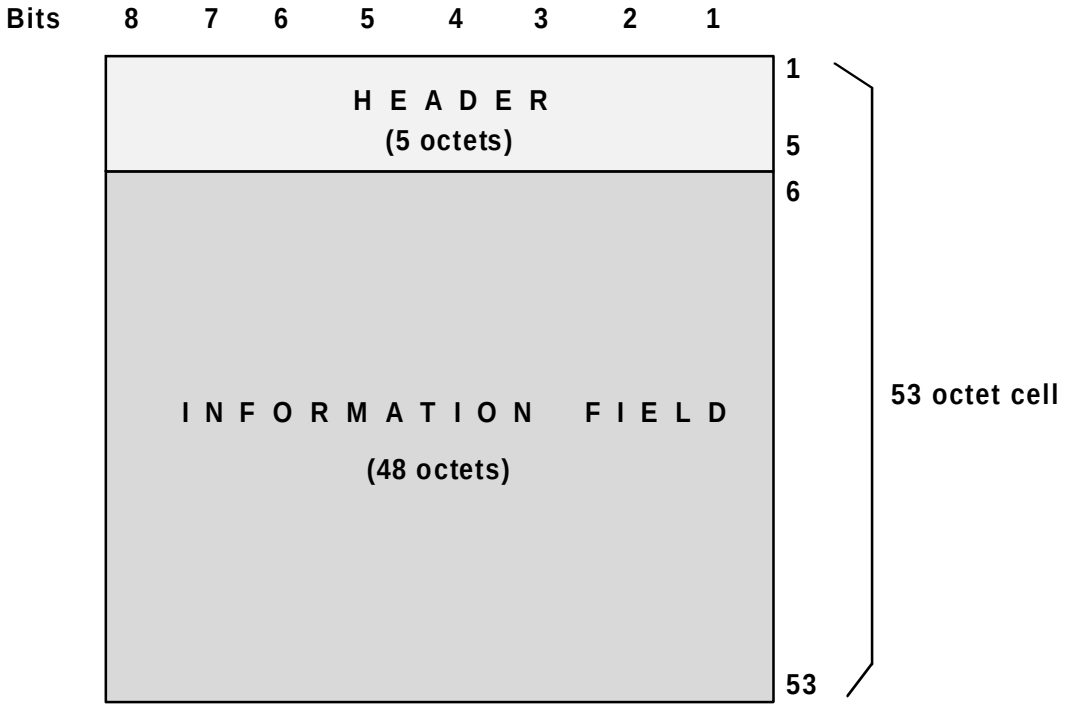
The cell consists of a 5 octet header and a 48 octet information field as shown in figure 1.

When a field within the header is contained within a single octet, the lowest bit number of the field represents the lowest order value.

When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases. The lowest bit number associated with the field represents the lowest order value.

This leads to the following conventions:

- bits within an octet are sent in decreasing order, starting with bit 8;
- octets are sent in increasing order, starting with octet 1;
- for all fields, the first bit sent is the Most Significant Bit (MSB).

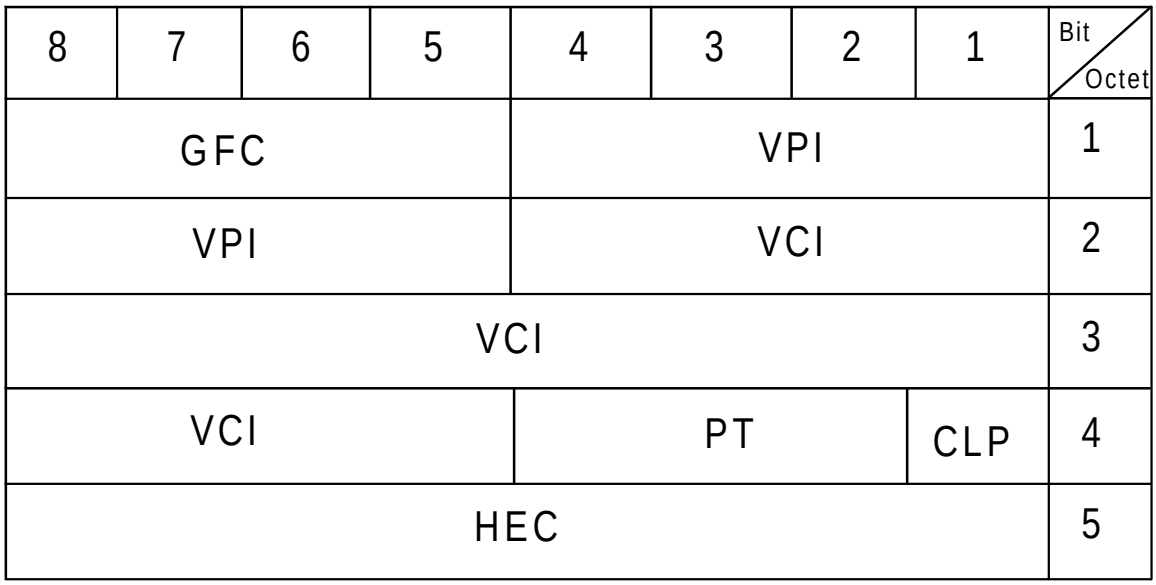


NOTE: The header will be sent first, followed by the information field.

Figure 1: Cell structure at the UNI/NNI

4.2 Cell header format and coding at UNI

The structure of the header is shown in figure 2. The fields contained in the header and their encoding are described in subclauses 4.2.1 to 4.2.6.



VCI: Virtual Channel Identifier.
VPI: Virtual Path Identifier.
GFC: Generic Flow Control.
PT: Payload Type.
CLP: Cell Loss Priority.
HEC: Header Error Control.

Figure 2: Header structure at UNI

4.2.1 Pre-assigned values of the cell header reserved for use by the physical layer

Pre-assigned values of the cell header (to differentiate cells for the use of the ATM layer from cells for the use of the physical layer) are given in table 1. All other values are for the use of the ATM layer.

Table 1: Pre-assigned cell header values at the UNI for the use by the physical layer (excluding the Header Error Control (HEC) field)

	Octet 1	Octet 2	Octet 3	Octet 4
Idle cell identification (notes 1 and 2)	00000000	00000000	00000000	00000001
Physical layer OAM F1 cell identification (note 2)	00000000	00000000	00000000	00000011
Physical layer OAM F3 cell identification (note 2)	00000000	00000000	00000000	00001001
Reserved for use of the physical layer (notes 1, 2 and 3)	PPPP0000	00000000	00000000	0000PPP1

P: Indicates the bit is available for use by the physical layer. Values assigned to these bits have no meaning with respect to the fields occupying the corresponding bit positions at the ATM layer.

NOTE 1: In the case of physical layer cells, the bit in the location of the Cell Loss Priority (CLP) indication is not used for the CLP mechanism as specified in subclause 5.4.2.3.2 of ETS 300 298-1 [6].

NOTE 2: Cells having header values which are identified as idle, physical layer Operation And Maintenance (OAM), and reserved for use of the physical layer are not passed to the ATM layer from the physical layer.

NOTE 3: Specific pre-assigned physical layer cell header values are given in CCITT Recommendation I.432 [2].

4.2.2 Generic Flow Control (GFC) field

The GFC field contains 4 bits. When the GFC function is not used, the value of this field is 0000. When the GFC mechanism is standardized, all values of this field are available for coding. This coding is for further study. The coding shall take into account the relationship with the procedures described in subclause 6.1.

4.2.3 Routeing field Virtual Path Identifier / Virtual Channel Identifier (VPI/VCI)

24 bits are available for routeing: 8 bits for VPI and 16 bits for VCI. Pre-assigned combinations of VPI and VCI values are shown in table 2. Other pre-assigned values of VPI and VCI are for further study. The VCI value of zero is not available for user virtual channel identification.

Table 2: Combinations of pre-assigned VPI and VCI, PT, and CLP values at the UNI

	VPI	VCI	PT	CLP
Meta-signalling (refer to CCITT Recommendation I.311 [3])	XXXX XXXX (note 1)	00000000 00000001 (note 5)	0A0	C
General broadcast signalling (refer to CCITT Recommendation I.311 [3])	XXXX XXXX (note 1)	00000000 00000010 (note 5)	0AA	C
Segment OAM F4 flow cell (refer to CCITT Recommendation I.610 [4])	YYYY YYYY (note 2)	00000000 00000011 (note 4)	0A0	A
End-to-end OAM F4 flow cell; (refer to CCITT Recommendation I.610 [4])	YYYY YYYY (note 2)	00000000 00000100 (note 4)	0A0	A
Point-to-point signalling (refer to CCITT Recommendation I.311 [3])	XXXX XXXX (note 1)	00000000 00000101 (note 5)	0AA	C
Segment OAM F5 flow cell (refer to CCITT Recommendation I.610 [4])	YYYY YYYY (note 2)	ZZZZZZZZ ZZZZZZZZ (notes 3 and 4)	100	A
End-to-end OAM F5 flow cell (refer to CCITT Recommendation I.610 [4])	YYYY YYYY (note 2)	ZZZZZZZZ ZZZZZZZZ (notes 3 and 4)	101	A
Resource management cell (refer to CCITT Recommendation I.371 [5])	YYYY YYYY (note 2)	ZZZZZZZZ ZZZZZZZZ (note 3)	11A	A
Unassigned cell	0000 0000	00000000 00000000	BBB	0

The GFC field is available for use with all these combinations:

A: indicates that the bit may be 0 or 1 and is available for use by the appropriate ATM layer function;

B: indicates the bit is a "don't care" bit;

C: indicates the originating signalling entity shall set the CLP bit to 0. The value may be changed by the network.

NOTE 1: XXXX XXXX: any VPI value. For VPI value equal to 0, the specified VCI value is reserved for user signalling with the local exchange. For VPI values other than 0, the specified VCI value is reserved for signalling entities (e.g. other users or remote networks).

NOTE 2: YYYY YYYY: any VPI value.

NOTE 3: ZZZZZZZZ ZZZZZZZZ: any VCI value other than 0, 3 or 4.

NOTE 4: Transparency is not guaranteed for the OAM F4 (F5) flows in a user-to-user VPC (VCC).

NOTE 5: The VCI values are pre-assigned in every VPC at the UNI. The usage of these values depends on the actual signalling configurations (see CCITT Recommendation I.311 [3]).

The number of bits of the VPI and VCI fields used for routeing are established by negotiation between the user and the network as described in subclause 5.1.2.3 of ETS 300 298-1 [6]. The bits within the VPI and VCI fields used for routeing are allocated using the following rules:

- the allocated bits of the VPI field shall be contiguous;
- the allocated bits of the VPI field shall be the least significant bits of the VPI field (beginning at bit 5 of octet 2);
- the allocated bits of the VCI field shall be contiguous;
- the allocated bits of the VCI field shall be the least significant bits of the VCI field (beginning at bit 5 of octet 4).

In addition, unallocated bits, i.e. bits not utilized by the user or the network, within the 24 bit routeing field shall be set to zero.

See subclauses 5.1.3 and 5.1.4 of ETS 300 298-1 [6] for VPI/VCI assignment information.

4.2.4 PT field

Three bits are available for PT identification. Table 3 describes the Payload Type Identifier (PTI) field coding.

Table 3

PTI coding 432 (bits)	Interp3retation
000	User data cell, congestion not experienced ATM layer user-to-ATM layer user indication = 0
001	User data cell, congestion not experienced ATM layer user-to-ATM layer user indication = 1
010	User data cell, congestion experienced ATM layer user-to-ATM layer user indication = 0
011	User data cell, congestion experienced ATM layer user-to-ATM layer user indication = 1
100	OAM F5 segment associated cell
101	OAM F5 end-to-end associated cell
110	Fast resource management cell
111	Reserved for future functions

Any congested network element, upon receiving a user data cell, may modify the PTI as follows: cells received with PTI = 000 or PTI = 010 are transmitted with PTI = 010. Cells received with PTI = 001 or PTI = 011 are transmitted with PTI = 011. Non congested network elements should not change the PTI (see CCITT Recommendation I.371 [5], § 3.2.2).

The use of PTI = 110 is reserved for resource management use. See CCITT Recommendation I.371 [5].

The use of PTI = 100 is discussed in CCITT Recommendation I.610 [4].

The use of PTI = 101 is discussed in CCITT Recommendation I.610 [4].

4.2.5 CLP field

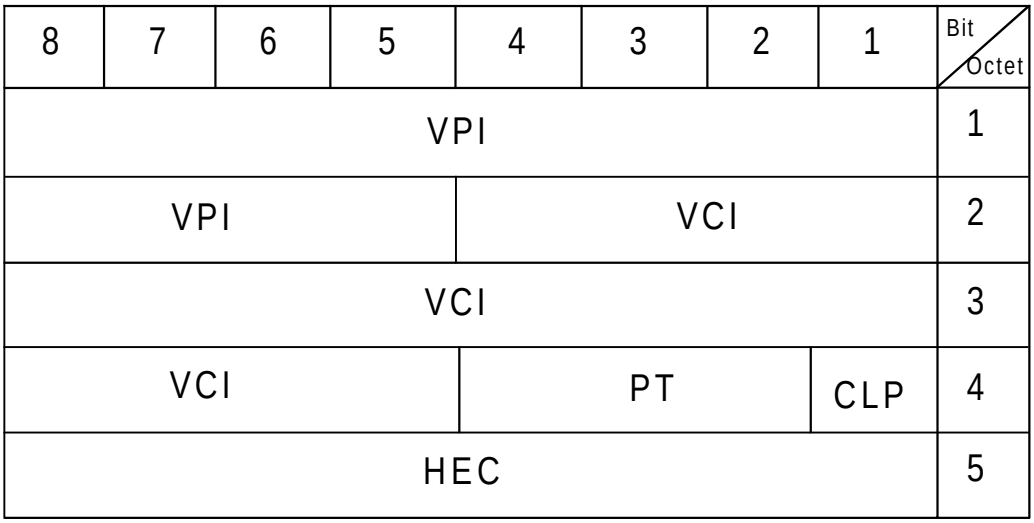
Depending on network conditions, cells where the CLP is set (CLP value is 1) are subject to discard prior to cells where the CLP is not set (CLP value is 0) (see CCITT Recommendation I.371 [5] for further details about the use of the CLP bit).

4.2.6 HEC field

The HEC field consists of 8 bits. Use of this field is described in CCITT Recommendation I.432 [2], § 4.3.

4.3 Cell header format and encoding at NNI

The structure of the header is shown in figure 3. The fields contained in the header and their encoding are described in subclauses 5.3.1 to 5.3.5.



VCI: Virtual Channel Identifier.
VPI: Virtual Path Identifier.
HEC: Header Error Control.
PT: Payload Type.
CLP: Cell Loss Priority.

Figure 3: Header structure at NNI

4.3.1 Pre-assigned values of the cell header

Pre-assigned values of the cell header (to differentiate cells for the use of the ATM layer from cells for the use of the physical layer) are given in table 4. All other values are for the use of the ATM layer.

Table 4: Pre-assigned cell header values at NNI for use by the physical layer (excluding the HEC field)

	Octet 1	Octet 2	Octet 3	Octet 4
Idle cell identification (notes 1 and 2)	00000000	00000000	00000000	00000001
Physical layer OAM F1 cell identification (note 2)	00000000	00000000	00000000	00000011
Physical layer OAM F3 cell identification (note 2)	00000000	00000000	00000000	00001001
Reserved for use of the physical layer (notes 1, 2 and 3)	PPPP0000	00000000	00000000	0000PPP1

P: Indicates the bit is available for use by the physical layer. Values assigned to these bits have no meaning with respect to the fields occupying the corresponding bit positions at the ATM layer.

NOTE 1: In the case of physical layer cells, the bit in the location of the Cell Loss Priority (CLP) indication is not used for the CLP mechanism as specified in subclause 5.4.2.3.2 of ETS 300 298-1 [6].

NOTE 2: Cells having header values which are identified as idle, physical layer OAM, and reserved for use of the physical layer are not passed to the ATM layer from the physical layer.

NOTE 3: Specific pre-assigned physical layer cell header values are given in CCITT Recommendation I.432 [2].

4.3.2 Routeing field (VPI/VCI)

28 bits are available for routeing: 12 bits for VPI and 16 bits for VCI. The unassigned cell is identified by the following pre-assigned values: VPI = 0; VCI = 0; and CLP = 0. The PT field is unused.

Two pre-assigned VCI values are used to distinguish the F4 flow OAM flows:

- end-to-end associated flow (VCI = 4);
- segment associated flow (VCI = 3).

VCI value 5 is pre-assigned at NNI for signalling.

Other pre-assigned values of VPI and VCI are for further study. The VCI value of zero is not available for user virtual channel identification.

See subclauses 5.1.3 and 5.1.4 of ETS 300 298-1 [6] for VPI/VCI assignment information.

4.3.3 PT field

Three bits are available for PT identification. Table 5 describes PTI field coding.

Table 5

PTI coding 432 (bits)	Interpretation
000	User data cell, congestion not experienced ATM layer user-to-ATM layer user indication = 0
001	User data cell, congestion not experienced ATM layer user-to-ATM layer user indication = 1
010	User data cell, congestion experienced ATM layer user-to-ATM layer user indication = 0
011	User data cell, congestion experienced ATM layer user-to-ATM layer user indication = 1
100	OAM F5 segment associated cell
101	OAM F5 end-to-end associated cell
110	Fast resource management cell
111	Reserved for future functions

Any congested network element, upon receiving a user data cell may modify the PTI as follows:

- cells received with PTI = 000 or PTI = 010 are transmitted with PTI = 010;
- cells received with PTI = 001 or PTI = 011 are transmitted with PTI = 011;
- non congested network elements should not change the PTI.

See CCITT Recommendation I.371 [5], § 3.3.2.

The use of PTI = 110 is reserved for resource management use. See CCITT Recommendation I.371 [5], § 3.2.6.

The use of PTI = 100 is discussed in CCITT Recommendation I.610 [4].

The use of PTI = 101 is discussed in CCITT Recommendation I.610 [4].

4.3.4 CLP field

Depending on network conditions, cells where the CLP is set (CLP value is 1) are subject to discard prior to cells where the CLP is not set (CLP value is 0) (see CCITT Recommendation I.371 [5] for further details about the use of the CLP bit).

4.3.5 HEC field

The HEC field consists of 8 bits. The HEC mechanism of the NNI is identical to that at the UNI and is described in CCITT Recommendation I.432 [2], § 4.3.

4.4 Cell information field, pre-assigned values

The pre-assigned values of the information field of all unassigned cells are for further study.

5 Service primitives

See CCITT Recommendation I.361 [1].

6 ATM protocol procedures

This clause contains the procedures that describe the operation of the ATM protocol (including the peer-to-peer and inter-layer information flows).

6.1 GFC protocol

For equipment implementing the "uncontrolled transmission" set of procedures, the GFC function is not used. Therefore, no action is taken upon reception of any GFC field setting (except as described below) and the GFC field is always set to all zeros upon transmission. For equipment implementing the "controlled transmission" set of procedures, the actions taken upon reception of the GFC field and the settings of the GFC field upon transmission are for further study.

In order to minimize the interactions between these two sets of procedures, it is necessary to identify the procedures operating on a specific interface at any particular time. The mechanism to distinguish between procedures is as follows:

- any piece of equipment which receives ten or more non-zero GFC fields within 30 000 cell times, should consider the other ATM entity to be executing the "controlled transmission" set of procedures;

- any terminal equipment which implements the "uncontrolled transmission" set of procedures which detects that the peer ATM entity is executing the "controlled transmission" set of procedures shall notify layer management.

The procedures related to "controlled transmission" shall assure compatibility with the discrimination mechanism between "controlled transmission" procedures and "uncontrolled transmission" procedures.

6.2 Layer management communication

This ETS does not cover layer management communication aspects.

6.3 Layer management

6.3.1 Meta-signalling

Refer to CCITT Recommendation I.311 [3].

6.3.2 Fault management, functions

Refer to CCITT Recommendation I.610 [4].

6.3.3 Performance management, functions

Refer to CCITT Recommendation I.610 [4].

6.3.4 Configuration management, functions

Refer to CCITT Recommendation I.610 [4].

6.3.5 Resource management, functions

Refer to CCITT Recommendation I.371 [5].

Annex A (normative): Protocol Implementation Conformance Statement (PICS) proforma

A.1 Introduction

To evaluate conformance to the standard of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented for a given protocol. Such a statement is called a Protocol Implementation Conformance Statement (PICS).

This annex provides the PICS proforma for the ATM layer in compliance with the relevant requirements given in this ETS.

The first column in each table identifies the item. The second column describes the capability or parameter to be tested. The third column contains the reference to the subclause of the previous ETS referenced in which the capability or parameter is defined. The fourth column indicates the status of the feature:

m mandatory implementation;

o optional implementation;

c conditional;

n/a not applicable.

The complete notation for conditional features is:

c: <x>

to indicate that, under certain conditions, the status for the feature becomes <x>, where <x> belongs to {m, o, n/a}.

For conditional features, the fifth column states the condition under which the feature can become mandatory, optional or not applicable.

The sixth column contains the possible values for the feature:

xx .. yy indicates all the values from xx to yy;

xx/yy indicates either xx or yy.

The last column indicates whether the feature is supported or not in a specific implementation.

A.2 PICS

Table A.1

Item	Feature		Reference (note 1)	Status	Pred.	Value	Support
ATM.1	Cell Structure	UNI & NNI	4.1 (Part 2)	m			
ATM.2	Header format	UNI	4.2 (part 2)	m			
ATM.3	Preassigned values of cell header	UNI	4.2.1 (part 2) 5.1.5 (part 1)	m			
ATM.4	GFC field	UNI	5.4.4 (part 1) 4.2.2 (part 2)	c:m	controlled transmission	for futher study	
			6.1 (part 2)	c:n/a	uncontrolled transmission	0000	
ATM.5	Number of active connections	UNI	5.1.2.3 (part 1)	m			
ATM.6	VPI routeing fields (note 2)	UNI	4.2.3 (part 2)	m		0..255	
ATM.7	VCI routeing fields (note 2)	UNI	4.2.3 (part 2)	m		6..65535	
ATM.8	Reserved VCI	UNI	4.2.3 (part 2)	m		0..5	
ATM.9	Preassigned combination of VPI/VCI/PT/CLP	UNI	4.2.3 (part 2)	m			
ATM.10	Use of PT field	UNI	4.2.4 (part 2)	m			
ATM.11	Use of CLP	UNI	4.2.5 (part 2)	m			
ATM.12	Use of HEC (note 3)	UNI	4.2.6 (part 2)	n/a			
ATM.13	Header format	NNI	4.3 (part 2)	m			
ATM.14	Preassigned values of cell header	NNI	4.3.1 (part 2) 5.1.5 (part 1)	m			
ATM.15	Number of active connections	NNI	5.1.2.4 (part 1)	m			
ATM.16	VPI routeing field (note 2)	NNI	4.3.2 (part 2)	m		0..4095	
ATM.17	VCI routeing fields (note 2)	NNI	4.3.2 (part 2)	m		6..65535	
ATM.18	Reserved VCI	NNI	4.3.2 (part 2)	m		0..5	
ATM.19	Preassigned combination of VPI/VCI/PT/CLP	NNI	4.3.2 (part 2)	m			
ATM.20	Use of PT field	NNI	4.3.3 (part 2)	m			
ATM.21	Use of CLP	NNI	4.3.4 (part 2)	m			
ATM.22	Use of HEC (note 3)	NNI	4.3.5 (part 2)	n/a			

NOTE 1: References to the part of this ETS are indicated in the table as follows:
(part 1): ETS 300 298-1;
(part 2): ETS 300 298-2.

NOTE 2: This range of values is the maximum one. A smaller range is allowed.

NOTE 3: HEC functions are the responsibility of the physical layer.

The PICS for the ATM protocol procedures are not included, because the protocol procedures are not defined yet.

History

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