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Transmission and Multiplexing (TM); Generic requirements of Asynchronous Transfer Mode (ATM) transport functionality within equipment; Part 1-1: Functional characteristics and equipment performance

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European Standard (Telecommunications series)

**Transmission and Multiplexing (TM);
Generic requirements of Asynchronous Transfer Mode (ATM)
transport functionality within equipment;
Part 1-1: Functional characteristics
and equipment performance**

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

The present document is part 1 of a multi-part EN covering the generic requirements of Asynchronous Transfer Mode (ATM) transport functionality within equipment, as identified below:

Part 1: "Functional characteristics and equipment performance";

Part 2: "Functional model for the transfer and layer management plane".

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1 Scope

The purpose of the present document is to provide specifications for ATM equipment to be used in the ETSI region. These specifications seek to define the processes associated with ATM rather than specific equipment types. Such specifications will ensure compatibility between equipment by identifying which functions within a process are mandatory for interworking and which can be considered as truly optional. It is not the intention to prevent manufacturers or procurers from following an alternative specification, but the consequences should become clear from the present document.

The ETSI ATM Equipment specification will be in two parts. The first part (the present document) being more conceptual, producing a list of functions and processes and some guidance to the ITU model and the ETSI functional model. The second part (EN 301 163-2-1 [18]) is a formal representation of transfer and layer management functions in the form of a library of atomic functions. This will provide flexibility since many equipment types may be defined by using these atomic functions in different combinations.

The specification will take advantage of the work done in ITU but will take the work further with an ETSI view. This means: the identification of ITU options that has to be mandatory in the ETSI region, deletion of options not required for the ETSI region, creation of new or revised descriptions where necessary, identification of guideline or benchmark performance parameters for classes of equipment.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] ATMF TM v4.0: "Integrated Local Management Interface (ILMI) Specification v4.0".
- [2] ETS 300 019-1-0: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".
- [3] ETS 300 119-1: "Equipment Engineering (EE); European telecommunication standard for equipment practice; Part 1: Introduction and terminology".
- [4] ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources".
- [5] ETS 300 132-2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [6] ETS 300 150: "Transmission and Multiplexing (TM); Protocol suites for Q interfaces for management of transmission systems".
- [7] ETS 300 253: "Equipment Engineering (EE); Earthing and bonding of telecommunication equipment in telecommunication centres".
- [8] ETS 300 301: "Broadband Integrated Services Digital Network (B-ISDN); Traffic control and congestion control in B-ISDN".

- [9] ETS 300 304: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); SDH information model for the Network Element (NE) view".
- [10] ETS 300 386-1: "Equipment Engineering (EE); Telecommunication network equipment; Electro-Magnetic Compatibility (EMC) requirements; Part 1: Product family overview, compliance criteria and test levels".
- [11] EN 300 386-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements; Part 2: Product family standard".
- [12] ETS 300 404: "Broadband Integrated Services Digital Network (B-ISDN); B-ISDN Operation And Maintenance (OAM) principles and functions".
- [13] EN 300 417: "Transmission and Multiplexing (TM)".
- [14] EN 300 417-1-1: "Transmission and Multiplexing (TM); Generic functional requirements for Synchronous Digital Hierarchy (SDH) equipment; Part 1–1: Generic processes and performance".
- [15] EN 300 417-6-1: "Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 6–1: Synchronous layer functions".
- [16] EN 300 462-1: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 1: Definitions and terminology for synchronization networks".
- [17] ETS 300 469: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Management of the network element view [ITU–T Recommendation I.751 (1996)]"
- [18] EN 301 163–2–1: "Transmission and Multiplexing (TM); Generic requirements of Asynchronous Transfer Mode (ATM) transport functionality within equipment; Part 2–1: Functional model for the transfer and layer management plane".
- [19] ITU-T handbook: "Handbook on Quality of Service and Network Performance".
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- [20] ITU-T Recommendation E.862: "Dependability planning of telecommunication networks".
- [21] ITU Recommendation I.150: "B-ISDN asynchronous transfer mode functional characteristics".
- [22] ITU-T Recommendation I.321: "B-ISDN protocol reference model and its application".
- [23] ITU-T Recommendation I.326: "Functional architecture of transport networks based on ATM".
- [24] ITU-T Recommendation I.353: "Reference events for defining ISDN and B-ISDN performance parameters".
- [25] ITU-T Recommendation I.356: "B-ISDN ATM layer cell transfer performance".
- [26] ITU-T Recommendation I.357: "B-ISDN semi-permanent connection availability".
- [27] ITU-T Recommendation I.358: "Call processing performance for switched Virtual Channel Connections (VCCs) in B-ISDN".
- [28] ITU-T Recommendation I.371: "Traffic control and congestion control in B-ISDN".
- [29] ITU-T Recommendation I.432: "B-ISDN user-network interface - Physical layer specification".
- [30] ITU-T Recommendation I.432.1: "B-ISDN user-network interface - Physical layer specification: General characteristics".
- [31] ITU-T Recommendation I.610: "B-ISDN operation and maintenance principles and functions".
- [32] ITU-T Recommendation I.731: "Types and general characteristics of ATM equipment".
- [33] ITU-T Recommendation I.732: "Functional characteristics of ATM equipment".

- [34] ITU-T Recommendation G.803: "Architecture of transport networks based on the synchronous digital hierarchy (SDH)".
- [35] ITU-T Recommendation G.805: "Generic functional architecture of transport networks".
- [36] ITU-T Recommendation G.911: "Parameters and calculation methodologies for reliability and availability of fibre optic systems".
- [37] ITU-T Recommendation O.191: "Equipment to assess ATM layer cell transfer performance".
- [38] ITU-T Recommendation Q.2100: "B-ISDN signalling ATM adaptation layer (SAAL) overview description".
- [39] ITU-T Recommendation X.721: "Information technology - Open Systems Interconnection - Structure of management information: definition of management information".
- [40] IEC 825-2: "Safety of laser products - Part 2: Safety of optical fibre communications systems".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

ATM resource request:

- request to establish or release a given VP or VC connection;
- request for modifying the traffic characteristics of an already established VP or VC connection

Hard PVC: traditional ATM Permanent Virtual Connection that is established/released upon a request initiated by a management request procedure (i.e. all nodes supporting the connections need to be instructed by the network management)

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Soft PVC: soft PVC is a Permanent Virtual Connection where the establishment within the network is done by signalling. By configuration, the switching system at one end of the soft PVC (VPC or VCC) initiates the signalling for this

Additional functional definitions are described in EN 300 417-1-1 [14].

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ABT	ATM Block Transfer
AD	Activation/Deactivation
AEMF	ATM Equipment Management Function
AI	Adapted Information
AIS	Alarm Indication Signal
ATC	ATM Transport Capability
ATM	Asynchronous Transfer Mode
BBCC	Broadband Bearer Channel Control
B-ISUP	Broadband ISDN Users Part
CAC	Connection Admission Control
CC	Continuity Check
CDV	Cell Delay Variation
CER	Cell Error Ratio
CI	Characteristic Information
CLP	Cell Loss Priority
CLR	Cell Loss Ratio (CLR ₀ , CLR ₀₊₁ , CLR ₁)

CMR	Cell Misinsertion Rate
DBR	Deterministic Bit Rate
DSS2	Digital Subscriber Signalling No. 2
EAC	Equipment Admission Control
EFCI	Explicit Forward Congestion Indication
EFS	Equipment Functional Specification
EMF	Equipment Management Function
e-to-e	End-to-End
F4E OAM	F4 End-to-End OAM
F4S OAM	F4 Segment OAM
F5E OAM	F5 End-to-End OAM
F5S OAM	F5 Segment OAM
FIT	Failure In Time
FM	Fault Management
GFC	Generic Flow Control
HEC	Header Error Control
IAM	Initial Address Message (signalling)
IWF	InterWorking Function
LB	Loopback
LCD	Loss of Cell Delineation
LOC	Loss Of Continuity
MCF	Message Communication Function
MCTD	Mean Cell Transfer Delay
MDT	Mean Down Time
MTBF	Mean Time Between Failures
MTBO	Mean Time Between Outages
MTTF	Mean Time To Failure
NE	Network Element
NMS	Network Management System
NNI	Network Node Interface
NPC	Network Parameter Control
OAM	Operations, Administration and Maintenance
OI	Outage Intensity
OS	Operations System
PCR	Peak Cell Rate
PDU	Protocol Data Unit
PM	Performance Management/Performance Monitoring
POH	Path Overhead
PTI	Payload Type Identifier
PVC	Permanent Virtual Connection
QoS	Quality of Service
RDI	Receive Defect Indication
RDF	Rate Decrease Factor
RIF	Rate Increase Factor
RM	Resource Management
SAC	Service Admission Control
SAAL	Signalling AAL
SECBR	Severely Errored Cell Block Ratio
Seg.	Segment
SLAD	Service Level ADmission
SP	Specific Process
SSF	Server Signal Fail
SSU	Synchronization Supply Unit
STD	Source Traffic Descriptor
SVC	Switched Virtual Connection
TBD	To Be Determined
TP	Transmission Path
TM	Transmission Media
UNI	User Network Interface
UPC	Usage Parameter Control

VC	Virtual Channel
VC-4	Virtual Container level 4
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VoD	Video on Demand
VP	Virtual Path
VPC	Virtual Path Connection
VPI	Virtual Path Identifier

4 Introduction

The purpose of the present document is to provide specifications for Asynchronous Transfer Mode (ATM) equipment to be used in the ETSI region. It provides an overview of the functions and processes of ATM equipment. The approach of the present document is to have a library of functions and concepts that can be joined together as required to form many different equipment types for many different usages. Where possible, the present document will illustrate with examples how these functions and processes can be modelled using the atomic functions defined in EN 301 163-2-1 [18].

The document has the following themes with some themes relating to more than one clause (For a complete list of clause see the table of contents).

The themes are:

- Modelling techniques and a summary of the approaches in ITU-T Recommendation I.732 [33] and in ETSI TM1;
- Connectivity capabilities;
- OAM functions;
- Traffic management;
- Network Element (NE) performance;
- Equipment Management Function (EMF);
- Timing (the requirements for synchronization);
- General equipment characteristics (physical & environment requirements).

As the present document is very much linked to the state of the art for ATM technology and its philosophy, some of the clauses are more stable than others.

5 Functional model and processes

This clause describes the functional modelling technique used in ETSI TM1 (EN 300 417 [13], and the present document). In order to provide an introduction the clause provides information on the work done in ITU-T Recommendation I.732 [33]. The present document has a different treatment to ETSI TM1's model, but should be seen as complimentary rather than duplication since the level of detail in ITU-T Recommendation I.732 [33] is much less but it concentrates more on ordering and sequencing of the functions.

5.1 The ITU-T Recommendation I.732 functional model

This subclause provides a short description of the main broad functional areas of an ATM NE according to ITU-T Recommendation I.732 [33]. Detailed information is provided by ITU-T Recommendations I.731 [32] and I.732 [33].

The main broad functional areas of an ATM NE are:

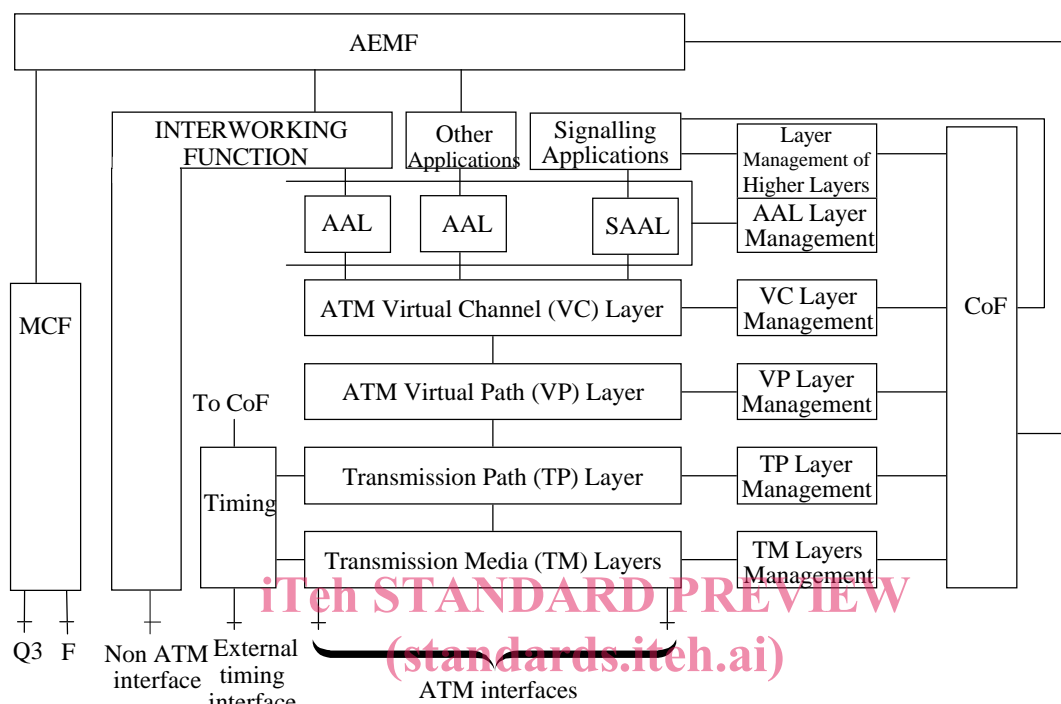
- the **transfer functions**, corresponding to the physical layers, ATM layer and adaptation to higher layers;
- the **layer management functions**, manages in real time the transfer functions (e.g. traffic enforcement), processes the information from the transfer functions (e.g. OAM processing) and Co-ordination Function; and sends information or instructions to the transfer functions or Co-ordination function;
- the **signalling applications**, responsible for the handling of the UNI and NNI signalling messages. The extent of this function is for further study (see clause 9);
- the **system management** which notably supports the Q3 interface towards the Network Management System (NMS). It includes the five classical management areas (configuration, fault, performance, accounting and security management). This entity is called the Asynchronous EMF;
- the **Co-ordination Function (CoF)** supplies:
 - a) the co-ordination between the relevant Layer Management functions at the different layers when required;
 - b) the processing of the requests for resources through the Signalling Applications, the EMF (Q3 interface), and the Resource Management (RM) procedure (Connection Admission Control (CAC)).
- the **InterWorking Function (IWF)**, which provides interworking between ATM based and other network services supported by the ATM equipment (e.g. Frame Relay, N-ISDN);
- the **Message Communication Function (MCF)**, which performs the exchange of EMF messages with the NMS, based on an ATM or X.25 transport stack;
- the **Timing** function, which deals with the actions required to synchronize the equipment interfaces to a clock source (internal or external) when required;
- **Protection Switching and restoration**. ATM layer based protection switching and restoration capabilities in ATM NEs is for further study in ITU-T Recommendations I.731 [32] and I.732 [33].

Application-specific functions may also exist in the equipment. The ATM Adaptation Layer (AAL) functions enhance the service provided by the ATM Layer functions to enable the service-specific higher layers to use the service-independent ATM layer. For example in the case of a MPEG-2 video server, specific stacks exist to carry a video signal on an AAL.

- One particular type of AAL service user is the signalling entity wishing to communicate with a peer entity. Each of these entities would require that functions are provided above the common part of the AAL specifically designed to facilitate this task. The AAL functions necessary to support signalling should be in accordance with ITU-T Recommendation Q.2100 [38], B-ISDN Signalling AAL (SAAL).

Figure 1 provides the overall organization of an ATM equipment, with respect to the previous description.

The following clauses provide tables containing a detailed description of the Transfer, the Layer Management and the Co-ordination functions for an ATM NE. Although the following clauses are limited to the ATM aspect, it should be kept in mind that other components exist in an ATM equipment (e.g. SDH-based interfaces and associated management functions).



NOTE: In ETSI environment, the block ATM Equipment Management Function (AEMF) is called EMF.

Figure 1: General Overview of ATM Equipment according to ITU-T Recommendation I.731 [32]

5.1.1 Allocation of process to ITU-T Recommendation I.732 functional blocks

The Table 1 and Table 2 mainly cover the transfer plane. Transfer functions are restricted to *insertion*, *extraction* of cells, *writing* or *reading* of fields and *other* operations concerning a set of cells (such as multiplexing and demultiplexing, control, shaping). The tables given below list and arrange these functions and their function types (I, E, W, R, Oth which represent respectively: Insertion, Extraction, Writing, Reading and Other) for B to A and A to B flows. The list is numbered for further identification purpose. The ITU-T Recommendation I.732 [33] blocks are indicated in the first column.