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SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

B-ISDN equipment aspects – ATM equipment

Functional characteristics of ATM equipment

ITU-T Recommendation I.732

(Formerly CCITT Recommendation)

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ITU-T Recommendation I.732

Functional Characteristics of ATM equipment

Summary

ITU-T I.731 and I.732 describe the functional requirements to enable the interoperability between ATM network elements. The detailed characteristics of ATM equipment, or equipment containing ATM aspects, are contained in this Recommendation. The companion Recommendation, ITU-T I.731, provides introductions and covering terms and concepts that did not easily fit into the structure of this Recommendation. ITU-T I.731 introduces the functional model used in this Recommendation.

The functional model approach used in this Recommendation is derived from ITU-T G.805. It is also used by other technologies such as SDH equipment, PDH equipment and optical networking. This allows for equipment with multiple technologies to be easily defined by selecting the appropriate functional blocks.

Annex D defines the atomic functions used in the TP Convergence, ATM VP and VC Layer Networks and their associated adaptation functions.

Source

ITU-T Recommendation I.732 was revised by ITU-T Study Group 15 (1997-2000) and approved by the World Telecommunication Standardization Assembly (Montreal, 27 September – 6 October 2000).

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Introduction

The B-ISDN Protocol Reference Model described in ITU-T I.321 partitions ATM equipment into a user (transfer) plane, a layer management plane, a plane management and a control plane.

The user and control planes are decomposed into a Physical Layer, ATM Layer, ATM Adaptation Layer and higher level functions. The plane management may not be layered.

Further decomposition of the layers is possible in order to define additional functions which can be grouped to provide a logical description of any ATM equipment. The ATM layer may be decomposed into the Virtual Path and Virtual Channel layers. The physical layer may be decomposed into a number of path and section layers depending on the transport technology employed.

Within each layer of the Transfer and Layer Management Planes, the management and processing of user information may be described in terms of three functions. These support the termination of layer specific information, adaptation of information between layers, and connection. This methodology provides a logical description of equipment which is aligned with the network level view of ATM transport contained in ITU-T I.326 and G.805.

ITU-T Recommendation I.732

Functional characteristics of ATM equipment

1 Scope

The purpose of this Recommendation is to describe the functional requirements to enable interoperability between ATM Network Elements (NEs). The description must be precise enough to enable interoperability, but be generic so as to not constrain implementation.

This Recommendation provides a detailed description of the functional requirements identified in ITU-T I.731.

This Recommendation makes references to other existing Recommendations where they contain detailed descriptions or specifications for a function to avoid duplication of work. This Recommendation provides the basis for defining in detail an ATM NE.

2 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 G.703 (1998), *Physical/electrical characteristics of hierarchical digital interfaces*.

[2] ITU-T G.707/Y.1322 (2000), *Network node interface for the synchronous digital hierarchy (SDH)*.

[3] ITU-T G.783 (2000), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks*.

[4] ITU-T G.784 (1999), *Synchronous digital hierarchy (SDH) management*.

[5] ITU-T G.804 (1998), *ATM cell mapping into plesiochronous digital hierarchy (PDH)*.

[6] ITU-T G.805 (2000), *Generic functional architecture of transport networks*.

[7] ITU-T I.326 (1995), *Functional architecture of transport networks based on ATM*.

[8] ITU-T G.832 (1998), *Transport of SDH elements on PDH networks – Framing and multiplexing structures*.

[9] ITU-T G.957 (1999), *Optical interfaces for equipments and systems relating to the synchronous digital hierarchy*.

[10] ITU-T I.731 (2000), *Types and general characteristics of ATM equipment*.

[11] ITU-T I.211 (1993), *B-ISDN service aspects*.

[12] ITU-T I.311 (1996), *B-ISDN general network aspects*.

[13] ITU-T I.321 (1991), *B-ISDN protocol reference model and its application*.

[14] ITU-T I.353 (1996), *Reference events for defining ISDN and B-ISDN performance parameters*.

[15] ITU-T I.356 (2000), *B-ISDN ATM layer cell transfer performance*.

[16] ITU-T I.361 (1999), *B-ISDN ATM layer specification*.

[17] ITU-T I.363.1 (1996), *B-ISDN ATM Adaptation Layer specification: Type 1 AAL*.

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[22] ITU-T I.432.1 (1999), *B-ISDN user-network interface – Physical layer specification: General characteristics*.

[23] ITU-T I.432.2 (1999), *B-ISDN user-network interface – Physical layer specification: 155 520 kbit/s and 622 080 kbit/s operation*.

[24] ITU-T I.432.3 (1999), *B-ISDN user-network interface – Physical layer specification: 1544 kbit/s and 2048 kbit/s operation*.

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[26] ITU-T I.432.5 (1997), *B-ISDN User-network interface – Physical layer specification: 25 600 kbit/s operation*.

[27] ITU-T I.610 (1999), *B-ISDN operation and maintenance principles and functions*.

[28] ITU-T Q.2931 (1995), *Digital Subscriber Signalling System No. 2 (DSS 2) – User-Network Interface (UNI) layer 3 specification for basic call/connection control*.

[29] ITU-T Q.2761 (1999), *Functional description of the B-ISDN user part (B-ISUP) of signalling system No. 7*.

[30] ITU-T Q.2762 (1999), *General functions of messages and signals of the B-ISDN user part (B-ISUP) of Signalling System No. 7*.

[31] ITU-T Q.2763 (1999), *Signalling System No. 7 B-ISDN User Part (B-ISUP) – Formats and codes*.

[32] ITU-T Q.2764 (1995), *Signalling System No. 7 B-ISDN User part (B-ISUP) – Basic call procedures*.

[33] ITU-T Q.2120 (1995), *B-ISDN metasignalling protocol*.

[34] ITU-T O.191 (1997), *Equipment to assess ATM layer cell transfer performance*.

[35] ITU-T G.992.1 (1999), *Asymmetrical digital subscriber line (ADSL) transceivers*.

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[37] ITU-T I.761 (2000), *Inverse multiplexing for ATM (IMA)*.

[38] ITU-T G.806 (2000), *Characteristics of Transport Equipment – Description Methodology and Generic Functionality.*

[39] ITU-T I.365.1 (1993), *B-ISDN ATM adaptation layer sublayers: Frame relaying service specific convergence sublayer (FR-SSCS)*.

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[42] ITU-T I.365.4 (1996), *B-ISDN ATM adaptation layer sublayers: Service-specific convergence sublayer for HDLC applications*.

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[45] ITU-T G.995.1 (1999), *Overview of digital subscriber line (DSL) Recommendations*.

[46] ITU-T G.991.1 (1998), *High bit rate digital subscriber line (HDSL) transceivers*.

[47] ITU-T G.994.1 (1999), *Handshake procedures for digital subscriber line (DSL) transceivers*.

[48] ITU-T G.996.1 (1999), *Test procedures for digital subscriber line (DSL) transceivers*.

[49] ITU-T G.997.1 (1999), *Physical layer management for digital subscriber line (DSL) transceivers*.

3 Abbreviations, Terms and Definitions

3.1 Abbreviations

The main body of this Recommendation and Annex D have their own abbreviation lists. For expansion of abbreviations used in Annex D see abbreviation list in Annex D. For the purposes of this Recommendation, the following abbreviations are used:

AAL ATM Adaptation Layer

AD Activation/Deactivation

ADSL Asymmetrical Digital Subscriber Loop

AEMF ATM Element Management Function

AESF ATM Equipment Signalling Function

AIS Alarm Indication Signal

ATM Asynchronous Transfer Mode

B-ISDN Broadband Integrated Services Digital Network

CAC Connection Admission Control

CC Continuity Check

CDV Cell Delay Variation

CLR Cell Loss Ratio

CoF Coordination Function

CPCS Common Part Convergence Sublayer

CT Correlation Tag

CTD Cell Transfer Delay

DBR Deterministic Bit Rate

DSS2 Digital Subscriber Signalling System No. 2

EAC Equipment Admission Control

EPD Early Packet Discard

FM	Fault Management
FMBS	Frame Mode Bearer Service
HEC	Header Error Control
IMA	Inverse Multiplexed ATM
IWF	InterWorking Function
LB	Loopback
LCD	Loss of Cell Delineation
LM	Layer Management
LMI	Layer Management Indication
LOC	Loss of Continuity
LOP	Loss of Pointer
LOS	Loss of Signal
MCF	Message Communications Function
NE	Network Element
NNI	Network Node Interface
NPC	Network Parameter Control
OAM	Operation, Administration and Maintenance
OCD	Out of Cell Delineation
PDH	Plesiochronous Digital Hierarchy
PLCP	Physical Layer Convergence Protocol
PM	Performance Management/Performance Monitoring
POH	Path OverHead
PPD	Partial Packet Discard
PVC	Permanent Virtual Connection
QoS	Quality of Service
RM	Resource Management
SAAL	B-ISDN Signalling ATM Adaptation Layer
SAC	Service Acceptance Control
SAP	Service Access Point
SAR	Segmentation and Reassembly
SDH	Synchronous Digital Hierarchy
SLAD	Service Level Admission
SOH	Section OverHead
SSCF	Service Specific Coordination Function
SSCS	Service Specific Convergence Sublayer
SSF	Server Signal Fail
SVC	Switched Virtual Connection

TIM	Trace Identifier Mismatch
TM	Transmission Media
TMN	Telecommunication Management Network
TP_T	Transmission Path Termination
TP/VP_A	Transmission Path to Virtual Path Adaptation
UNEQ	Unequipped signal
UNI	User Network Interface
UPC	Usage Parameter Control
VC	Virtual Channel (ATM) or Virtual Container (SDH)
VCCT	VC Connection Termination
VCI	VC Identifier
VCL	VC Link
VoD	Video on Demand
VP	Virtual Path
VP_TT	VP Trail Termination
VPCT	VP Connection Termination
VPI	VP Identifier
VP/VC_A	Virtual Path to Virtual Channel Adaptation

3.2 Definitions

This Recommendation uses terms defined in other referenced ITU-T Recommendations.

Additionally, the following terms are used:

3.2.1 functional block: The ATM NE functional model is described by means of transport functions, or logical groups of these functions called functional blocks. ATM Layer functions and related requirements are associated with multiplexing/demultiplexing and cross-connecting or switching of ATM cells. They are subdivided into two functional blocks respectively processing Virtual Paths and Virtual Channels.

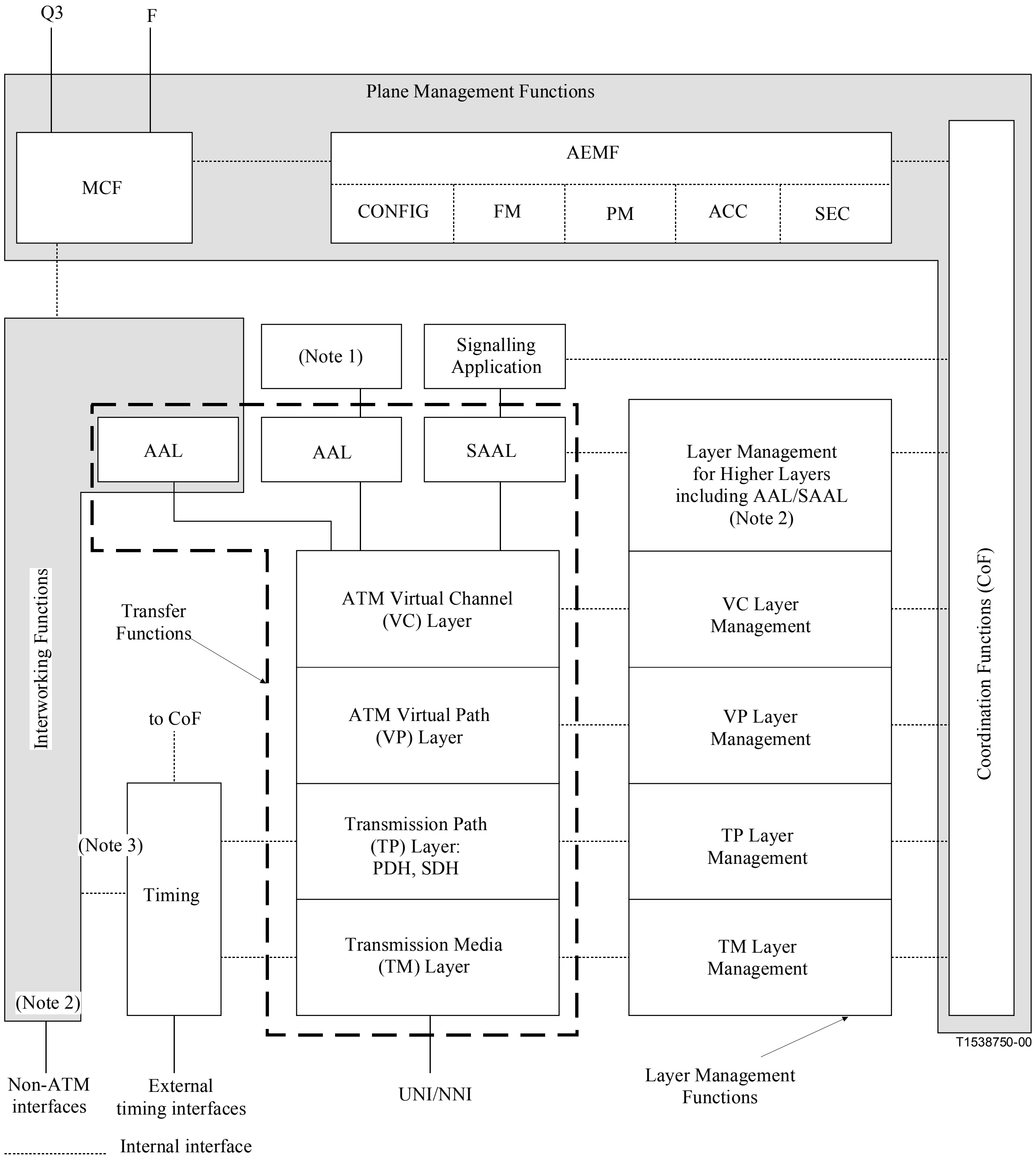
3.2.2 function: Each functional block is decomposed into several functions (e.g. VP Trail Termination function, Loopback function, Traffic Management function, ...) using the atomic function modelling (termination function, adaptation function, connection function).

3.3.3 process: Each function consists of several individual processes (setting or extracting of several fields, inserting or extracting of OAM cells, ...).

4 General functional description of the ATM equipment

For the purposes of this Recommendation, ATM equipment is described in terms of the functions of the user plane/transfer plane, control plane, layer management plane, plane management and timing functions as illustrated in Figure 4-1. To avoid complication, the control plane is not explicitly shown in Figure 4-1. The control plane comprises of the signalling applications and the associated AAL (SAAL). The ATM equipment may also include interworking function. The transfer functions can be configured by the management plane (PVC) and control plane (SVC). In the case of S-PVCs, which are a combination of PVC accesses connected by network signalled SVC links, the transfer functions are configured by a combination of both management plane and control plane.

The user plane/transfer plane is composed of the TM, TP, VP, VC, AAL transfer functions.



NOTE 1 – Service Specific and higher layers are not addressed in this Recommendation.
NOTE 2 – Not addressed in this Recommendation.
NOTE 3 – Some interworking functions may require an input from the timing functional block.
NOTE 4 – The CAC function is not shown in Figure 4-1. Please refer to Figure 4-3.
NOTE 5 – For reasons of space the following names had to be shortened. These are not adopted acronyms. Accounting was shortened to "ACC", Configuration was shortened to "Config" and Security was shortened to "SEC".

Figure 4-1/I.732 – General functional architecture of an ATM NE

4.1 Transfer functions

Transfer functions include all functions required for the transport of user, signalling, OAM, and RM information. In accordance with the B-ISDN Protocol Reference Model described in ITU-T I.321, the User Plane functions are layered into those for Physical Layer processing and those for ATM Layer processing.

The transfer functions are common for all higher layer services in B-ISDN. The service specific requirements for user information transfer only manifest themselves in the ATM Adaptation Layer (AAL) and higher layers. Descriptions of the higher layers are outside the scope of this Recommendation.

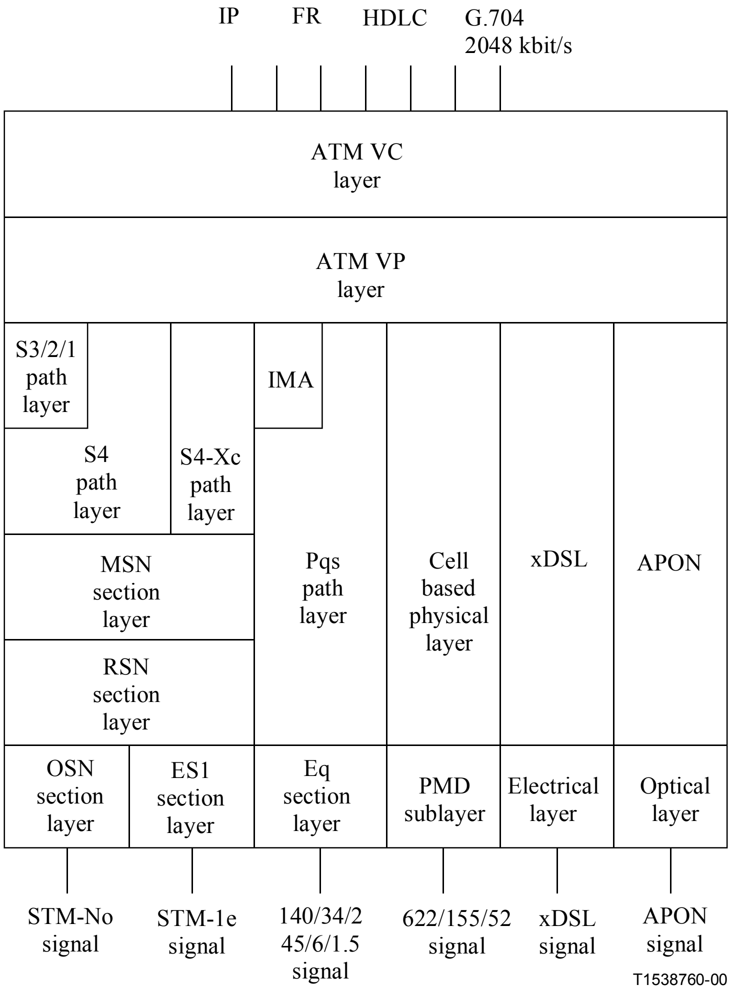
The transfer functions are also common for network related information such as signalling and management communications. The B-ISDN Protocol Reference Model makes a clear separation between User Plane, Control Plane and Management Plane functions. Consequently, the information flows between peer entities of the User Plane, Control Plane and Management Plane should be distinguished by the ATM NE in accordance with the procedures described in ITU-T I.361 [16].

4.1.1 Physical layer

The functions and related requirements associated with the Physical Layer include electro-optical conversion, line coding, timing recovery, frame generation, synchronization, and transmission overheads processing. Some physical layers (e.g. SDH) can be subdivided into Transmission Media Layer (including the digital or multiplex section, the regenerator section and the transmission media) and Transmission Path layers.

Some example physical interfaces for ATM NEs are shown in Figure 4-2.

4.1.1.1 Transmission media and path layers for user and network interfaces



NOTE 1 – The AALs are not shown in Figure 4-2 as AAL is not strictly a layer in the sense of Annex D.

NOTE 2 – Pqs is intended to represent synchronous PDH path options in the style of G.705. One example would be P31s.

NOTE 3 – Eq is intended to represent the synchronous PDH path options in the style of G.705. One example would be E31.

Figure 4-2/I.732 – Examples of transmission layers and interface signals

4.1.1.2 Other interfaces

1) TMN interface (e.g. Q interface in accordance with ITU-T G.773, Q.811 and Q.812).

2) Local craft interface (e.g. F interface).

3) External Timing interfaces (see clause 12/I.731 [10]).

Non-ATM interfaces (e.g. 64 kbit/s, FMBS, ITU-T X.25, etc. Not described in this Recommendation).

4.1.2 ATM Layer

ATM Layer functions and related requirements are associated with multiplexing/demultiplexing and cross-connecting or switching of ATM cells. They are subdivided into two functional blocks respectively processing Virtual Paths and Virtual Channels. The VP layer consists of: TP/VP adaptation, VP Traffic management; VP Loopback; Segment VP Termination; end-to-end VP Monitoring; Segment VP Monitoring; VP Connection, and VP Termination. The VC layer consists of: VP/VC adaptation, VC Traffic management; VC Loopback; Segment VC Termination; end-to-end VC Monitoring; Segment VC Monitoring; VC Connection, and VC Termination. Figure 4-3 depicts these functions in relation with the general functional architecture of Figure 4-1. The detailed ATM NE functional model is described by a set of transport functions: a connection function, a termination function, and an adaptation function. These transport functions and their relationships are defined in ITU-T G.806 [38]. The ATM NE functional model is thus described by means of these transport functions, or logical groups of these functions called functional blocks.

In Figure 4-3, reference points A and B are defined to indicate information flow directionality. In Table 4-1 transport functions are further distinguished by this directionality indication (e.g. TP/VP_A (A to B) and TP/VP_A (B to A)). In addition, the transport functions involved when considering two interfaces of an ATM NE are shown in Figure 4-4.

4.1.2.1 TP/VP_A, VP/VC_A

The *TP/VP Adaptation functions* (TP/VP_A) include processes that are common to all VP links and are not associated with just a single VP (e.g. cell rate decoupling, HEC processing, cell delineation, scrambling/descrambling, multiplexing/demultiplexing of VPs). The *VP/VC Adaptation functions* (VP/VC_A) include processes that are common to all VC links (multiplexing/demultiplexing of VCs).

4.1.2.2 VPTM, VCTM

The *VP and VC Traffic Management functions* (VPTM and VCTM) include processes that are performed per individual VP and VC trail. These include e.g. Resource Management cells handling, VP/VC traffic shaping, UPC/NPC, EFCI setting.

4.1.2.3 VPLB, VCLB

The *VP and VC Loopback Functions* (VPLB and VCLB) include processes that are performed per individual VP and VC trail. These include handling of Loopback cells on both end-to-end and segment level. Reduced functionality loopback options (VPLBR and VCLBR) have also been defined which may be used in certain reduced functionality equipment.

4.1.2.4 VPS, VCS

The *Segment VP and VC Termination Functions* (VPS and VCS) include processes that are performed per individual VP and VC trail (i.e. processing of segment F4 and F5 OAM flows).

4.1.2.5 VPM, VCM, VPSM, VCSM

The *end-to-end and Segment VP and VC Monitoring Functions* (VPM, VCM, VPSM, VCSM) include the monitoring of functions that are performed per individual VP and VC trail in the functions VP_TT, VC_TT, VPS and VCS.

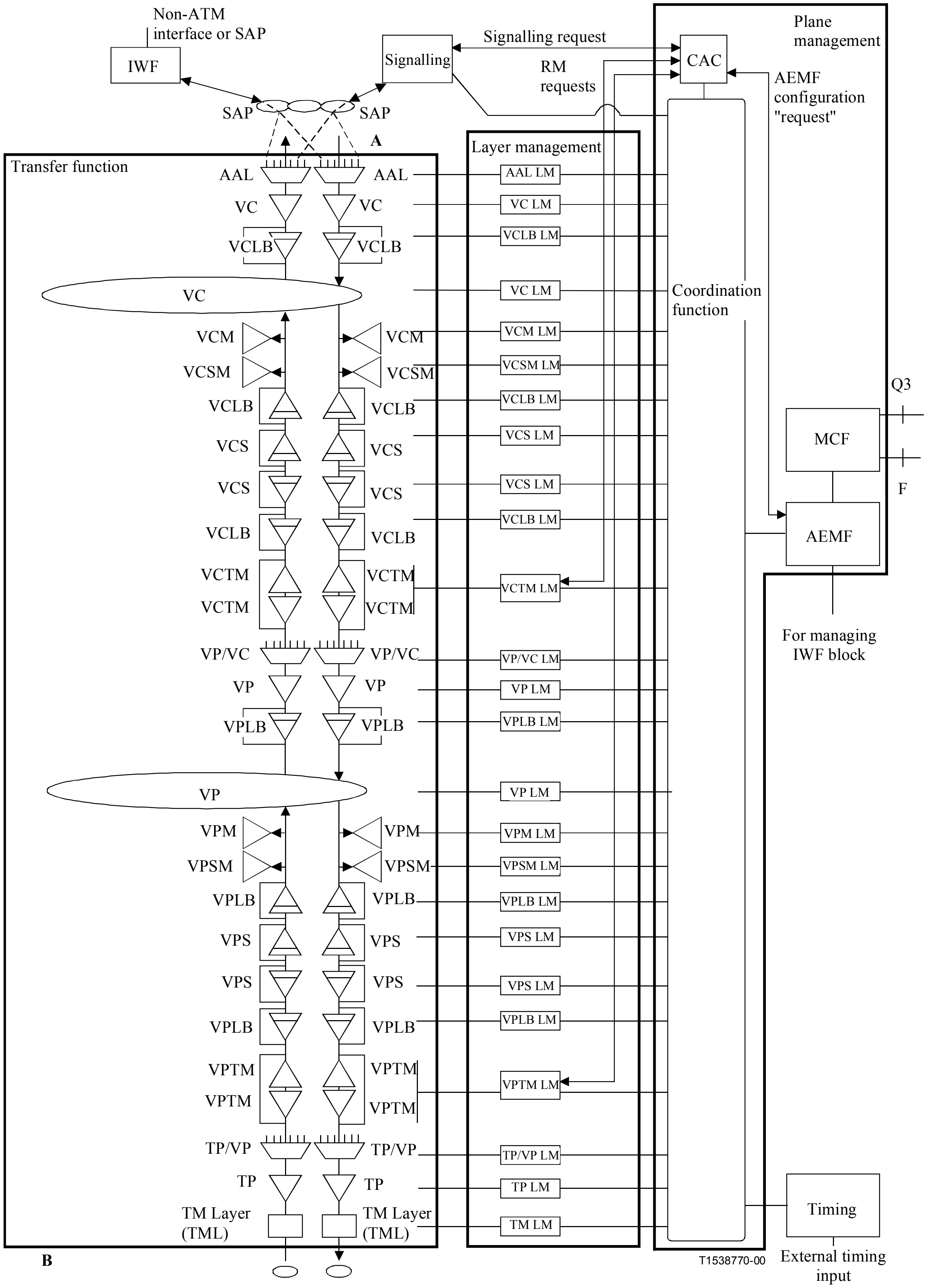
4.1.2.6 VP_C, VC_C

The *VP and VC Connection Functions* (VP_C, VC_C) perform matrix connections at the VP and/or VC layer within the ATM NE according to established ATM connections. The VC connection function (VC_C) performs connections of VC links between VC link End Points within the same NE according to established ATM connections. According to ITU-T I.150, cell sequence integrity shall be maintained between endpoints of a VP Connection for all cells belonging to this VP and between endpoints of a VC Connection for all cells belonging to this VC.

The number of connections that can be supported per TP/VP adaptation, per interface card, per NE (generalized switch/mux/concentrator) is for further study. The impact of the different connection types on the number of connections that can be supported is for further study.

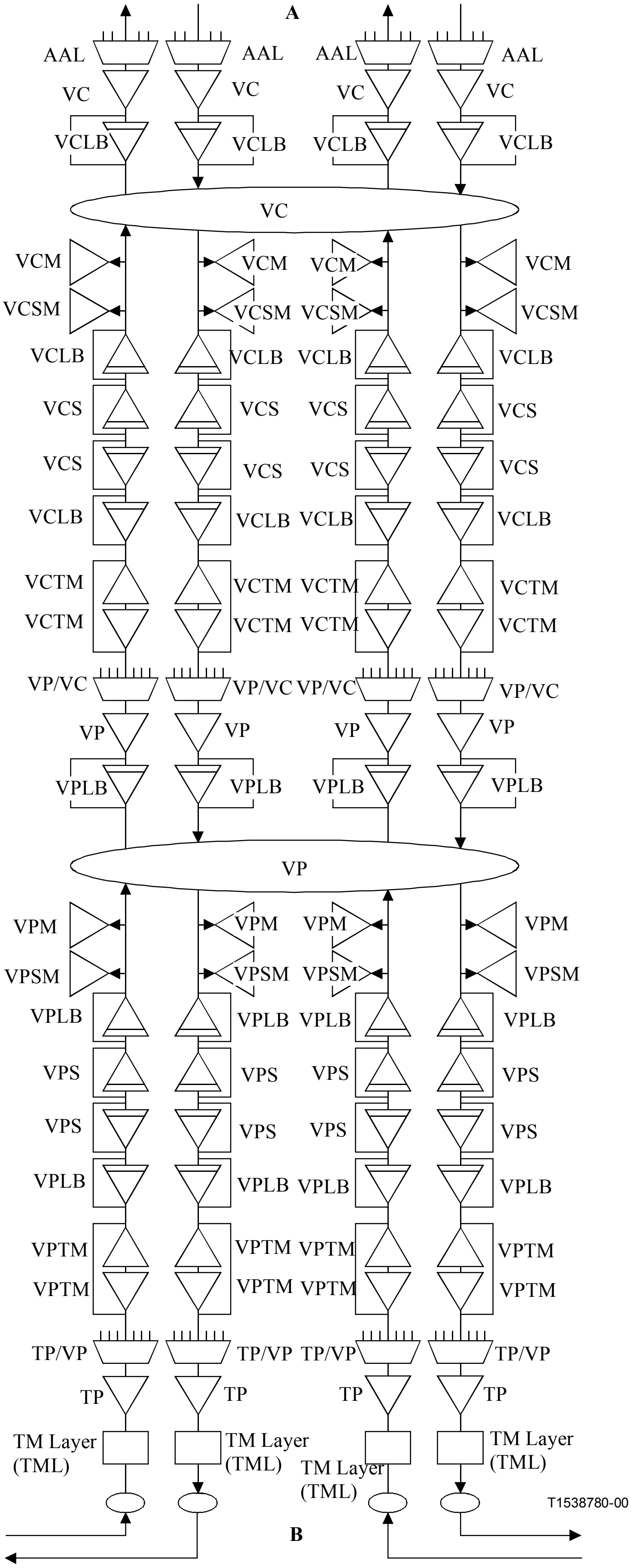
4.1.2.7 VP_TT, VC_TT

VP and VC Termination Functions (VP_TT, VC_TT) perform functions devoted to ATM Connection Endpoints (e.g. processing of end-to-end F4/F5 OAM flows); there is one instance of these functions per terminated VP and VC link.



NOTE – The OAM and traffic management functions may not be present in all ATM Equipments. If present, they may be activated or bypassed. This is represented by the bypass line in Figure 4-3.

Figure 4-3/I.732 – Detailed functional architecture of an ATM NE



NOTE – The OAM and traffic management functions may not be present in all ATM Equipments. If present, they may be activated or bypassed. This is represented by the bypass line in Figure 4-4.

Figure 4-4/I.732 – Information flows when considering two interfaces of an ATM NE

4.1.3 ATM Adaptation Layer (AAL)

The 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.

When AAL processing is required in the ATM NE, the AAL functional requirements should be in accordance with the AAL protocols described in ITU-T I.363x.

The AAL types described in ITU-T I.363x are:

1) AAL Type 1 in ITU-T I.363.1 [17];
2) AAL Type 2 in ITU-T I.363.2 [18];
3) AAL Type 3/4 in ITU-T I.363.3 [19];
4) AAL Type 5 in ITU-T I.363.5 [20].

Typical AAL functions include:

1) Segmentation and Reassembly (SAR).
2) Error detection/correction.
3) Length indication.
4) Timing Recovery.
5) Other service specific functions.

These protocols are service specific and are consequently Network/Service Provider Option(s). In general AAL protocols are end-to-end protocols and therefore not processed by intermediate ATM NEs. However, network providers may choose to offer specific services which may require AAL processing in ATM NEs.

4.1.4 Signalling ATM Adaptation Layer (SAAL)

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 Q.2100, B-ISDN signalling ATM adaptation layer (SAAL). ITU-T Q.2100 also serves as a guide to all other Recommendations required by a user for the implementation of an AAL for the purpose of signalling.

4.2 Layer Management functions

Management information associated with a given transfer layer function is passed to (or received from) the corresponding Layer Management function, e.g. for processing of configuration, fault management, and performance monitoring.

Layer Management functions correspond one-to-one with transfer functions.

Physical layer management functions are provided in ITU-T G.705 (PDH TPs), G.783 [3] (SDH TPs) and G.806 [38] (generic processes).

ATM layer management functions are provided in clause 5 and Annex D.

4.3 Coordination functions

The coordination functions allow management information to flow between the layers for the purposes of communication. The coordination functions have some filtering capabilities. The coordination functions are described in more detail in clause 6.

4.4 Guidelines for using the Table structure and corresponding functional descriptions

An overview of the functional blocks decomposition of the Transfer and Layer Management functional blocks is provided in Table 4-1. This functional model is generic and no particular physical partitioning of functions or implementation is implied. However, the logical ordering of the functions given in Table 4-1 must be maintained. For direction B to A, the functions in Table 4-1 need to be read in the order from the bottom of the table to the top of the table. Also, the processes within each function are to be read in the order from bottom of the function to the top of the function. For direction A to B, the functions in Table 4-1 need to be read in the order from the top of the table to the bottom of the table.

Table 4-1/I.732 – Functional partitioning

Level	Function	B to A		A to B	
		Function description		Function description	
		Transfer	Layer management	Transfer	Layer management
VC/ client_A	AAL – SAR – CPCS – SSCS	– AAL1 – AAL2 – AAL3/4 – AAL5 – SAAL		– AAL1 – AAL2 – AAL3/4 – AAL5 – SAAL	
	Discard of e-t-e and segment F5 OAM cells	Discard of e-t-e and segment F5 OAM cells	–	–	–
VC_TT	VC Termination function	Extraction of e-t-e F5 OAM cells	e-t-e F5 OAM cells processing	Insertion of e-t-e F5 OAM cells	F5 OAM cells processing
VCLB	VC connection endpoint loopback point and/or loopback source point	VCLB sink See D.5.6.2 or reduced functionality VCLBR Sink refer to D.5.6.4		VCLB source See D.5.6.1 or reduced functionality VCLBR Source refer to D.5.6.3	
VC_C	VC Connection Function	Interconnection of VC links	Association of VC links	Interconnection of VC links	Association of VC links
		Multicasting	FFS	Multicasting	FFS
		VC Protection functions	FFS	VC protection functions	FFS
VCM	e-t-e F5 OAM non-intrusive monitoring	Read e-t-e F5 OAM cell	e-t-e F5 OAM cell processing	Read e-t-e F5 OAM cell	e-t-e F5 OAM cell processing
VCSM	Seg F5 OAM non-intrusive monitoring	Read segment F5 OAM cell	Segment F5 OAM cell processing	Read segment F5 OAM cell	Segment F5 OAM cell processing
VCLB	VC Loopback (e-t-e and/or segment) source point and/or segment loopback point	VCLB source See D.5.6.1 or reduced functionality VCLBR Source refer to D.5.6.3		VCLB sink See D.5.6.2 or reduced functionality VCLBR Sink refer to D.5.6.4	
VCS	Segment VC OAM	Segment VC OAM endpoint Source. Refer to D.5.4.1		Segment VC OAM endpoint Sink. Includes e-t-e VC-AIS insertion Refer to D.5.4.2	
VCS	Segment VC OAM	Segment VC OAM endpoint Sink. Includes e-t-e VC-AIS insertion Refer to D.5.4.2		Segment VC OAM endpoint Source. See D.5.4.1	

Table 4-1/I.732 – Functional partitioning *(continued)*

Level	Function	B to A		A to B	
		Function description		**Function description**	
		Transfer	**Layer management**	**Transfer**	**Layer management**
VCLB	VC Loopback (e-t-e and/or segment) source point and/or segment loopback point	VCLB sink refer to D.5.6.2 or reduced functionality VCLBR Sink refer to D.5.6.4		VCLB source refer to D.5.6.1 or reduced functionality VCLBR Source refer to D.5.6.3	
VCTM	Resource management	For further study	For further study	For further study	For further study
	Shaping (Note 1)	VC traffic shaping	Traffic descriptors	VC traffic shaping	Traffic descriptors
	VC usage measurement	–	–	Detection of cell arrival	Count outgoing cells per VC for CLP = 0+1 and CLP = 0
	EPD/PPD functionality (Note 2)	For further study	For further study	For further study	For further study
	VC UPC/NPC	VC compliance checking and corrective action if activated	Traffic descriptors, discarded cells and tagged cells counters	–	–
	VC usage measurement	Detection of cell arrival	Count incoming cells per VC for CLP = 0+1 and CLP = 0	–	–
	EFCI setting	Setting of the EFCI bit of PTI field for user congestion indication	EFCI generation	Setting of the EFCI bit of PTI field for user congestion indication	EFCI generation
VP/ VC_A	VCI setting	–	–	VCI field setting	VCI assignment
	VC multiplexing	Demultiplexing of the VCs according to the VCI values	–	VC Multiplexing into VP	–
	VC-AIS	VC-AIS insertion (Note 5)	Generation of VC-AIS for each configured VC	–	–
	Metasignalling Sink (Note 3)	Extraction of metasignalling cells	Metasignalling cells processing	–	–

Table 4-1/I.732 – Functional partitioning *(continued)*

Level	Function	B to A		A to B	
		Function description		Function description	
		Transfer	Layer management	Transfer	Layer management
VP/ VC_A (continued)	Congestion Control (Notes 3, 4)	Selective Cell discard (CLP based)	Act./deact. of cell discard based on congestion detection	Detects congestion	Indicates congestion to EPD/PPD, RM and EFCI processing functions
		Detects congestion	Indicates congestion to EPD/PPD (Note 6), RM and EFCI processing functions	Selective Cell discard (CLP based)	Act./deact. of cell discard based on congestion detection
	Metasignalling Source (Note 3)			Insertion of metasignalling cells	Metasignalling cells processing
	VCI processing	Reading of VCI; discarding of cells with invalid VCI	Count of cells with invalid VCI cells (Note 7)	–	–
	Discard of e-t-e and segment F4 OAM cells	Discard of e-t-e and segment F4 OAM cells	–	–	–
VP_TT	F4 OAM cells insertion/ extraction	Extraction of F4 OAM cells	F4 OAM cells processing	Insertion of F4 OAM cells	F4 OAM cells processing
VPLB	VP connection endpoint loopback point and/or loopback source point	VPLB Sink refer to D.3.6.2 or reduced functionality VPLBR Sink refer to D.3.6.4		VPLB Source refer to D.3.6.1 or reduced functionality VPLBR Source refer to D.3.6.3	
VP_C	VP connection function	Interconnection of VP links	Association of VP links	Interconnection of VP links	Association of VP links
		Multicasting	FFS	Multicasting	FFS
		VP Protection functions	FFS	VP protection functions	FFS
VPM	e-t-e F4 OAM non-intrusive monitoring	Read e-t-e F4 OAM cell	e-t-e F4 OAM cell processing	Read e-t-e F4 OAM cell	e-t-e F4 OAM cell processing
VPSM	Seg F4 OAM non-intrusive monitoring	Read segment F4 OAM cell	Segment F4 OAM cell processing	Read segment F4 OAM cell	Segment F4 OAM cell processing
VPLB	VP Loopback (e-t-e and/or segment) source point and/or segment loopback point	VPLB Source refer to D.3.6.1 or reduced functionality VPLBR Source refer to D.3.6.3		VPLB Sink refer to D.3.6.2 or reduced functionality VPLBR Sink refer to D.3.6.4	

Table 4-1/I.732 – Functional partitioning *(continued)*

Level	Function	B to A		A to B	
		Function description		Function description	
		Transfer	Layer management	Transfer	Layer management
VPS	Segment VP OAM	Segment VP OAM endpoint Source. See D.3.4.1		Segment VP OAM endpoint Sink. Includes e-t-e VP-AIS insertion See D.3.4.2	
VPS	Segment VP OAM	Segment VP OAM endpoint Sink. Includes e-t-e VP-AIS insertion Refer to D.3.4.2		Segment VP OAM endpoint Source. Refer to D.3.4.1	
VPLB	VP Loopback (e-t-e and/or segment) source point and/or segment loopback point	VPLB Sink refer to D.3.6.2 or reduced functionality VPLBR Sink refer to D.3.6.4		VPLB Source refer to D.3.6.1 or reduced functionality VPLBR Source refer to D.3.6.3	
VPTM	Resource management	For further study	For further study	For further study	For further study
	Shaping (Note 1)	VP traffic shaping	Traffic descriptors	VP traffic shaping	Traffic descriptors
	VP UPC/NPC	VP compliance checking and corrective action if activated	Traffic descriptors, discarded cells and tagged cell counters		
	VP usage measurement	Detection of cell arrival	Incoming cells count per VP for CLP = 0+1 and CLP = 0		Outgoing cells count per VP
	EFCI setting	Setting of the EFCI bit of PTI field for user congestion signalling	EFCI generation	Setting of the EFCI bit of PTI field for user congestion signalling	EFCI generation
TP/VP_A (Note 8)	VPI setting	–	–	VPI field setting	VPI assignment
	VP mux	Demultiplexing of the VPs according to the VPI values		Multiplexing of VPs onto TP	
	VP-AIS insertion	VP-AIS insertion (Note 5)	Generation of VP-AIS for each configured VC	–	–
	Congestion Control (Note 4)	Selective Cell discard (CLP based)	Act./deact. of cell discard based on congestion detection	Congestion detection	Indicates congestion to EPD/PPD, RM and EFCI processing functions if present elsewhere in stack. (Note 9)

Table 4-1/I.732 – Functional partitioning *(continued)*

Level	Function	B to A		A to B	
		Function description		**Function description**	
		Transfer	**Layer management**	**Transfer**	**Layer management**
TP/VP_A (Note 8) (continued)		Congestion detection	Indicates congestion which may be used by EPD/PPD, RM and EFCI processing functions if present elsewhere in stack. (Note 9)	Selective Cell discard (CLP based)	Act./deact. Of cell discard based on congestion detection
	VPI verification	Reading of VPI; and discarding of unassigned cells and cells with invalid VPI	Count of cells with invalid VPI (Note 7)	–	–
	GFC	Read GFC field (if applicable) (Note 10)	GFC processing	Setting of GFC field in an assigned cell or insertion of unassigned cells (Note 10)	GFC processing
TP/VP_A	Header verification	Read header and discard cells with invalid header pattern (e.g. F3 OAM on SDH or PDH TPs)	Count of cells with invalid header pattern. (Note 11)	–	–
	TP usage measurement	Detection of cell arrival	Incoming cells count per TP Act./deact. of cell counting	detection of cell arrival	Outgoing cells count per TP Act./deact. of cell counting
	Cell rate decoupling	Idle cell discard (Note 11)	–	Idle cell insertion (Note 11)	–
	HEC processing	Header verification, correction (if applicable) and discarding of invalid HEC cells (see Note 12)	Invalid HEC event. Invalid HEC cell discarded event. Act./deact. of correction mode	HEC generation	–
	Scrambling/ Descrambling	Cell information field descrambling	–	Cell information field scrambling	–

Table 4-1/I.732 – Functional partitioning *(concluded)*

Level	Function	B to A		A to B	
		Function description		Function description	
		Transfer	Layer management	Transfer	Layer management
TP/VP_A (continued)	Cell delineation	Cell delineation (T3 PLCP uses PLCP frame and not the cell headers)	LCD defect detection (except with the T3 PLCP format)	–	–
			OCD anomaly event counter and consequent actions	–	–
	Mapping/ Demapping	Cell stream extraction	–	Cell stream mapping	–
	TP payload specific functions	TP payload specific fields extraction. E.g. for SDH & PDH TPs the trail signal label is processed	TP payload specific fields processing	TP payload specific fields insertion. E.g. for SDH & PDH TPs the trail signal label is set	–
TP_TT	Transmission Path Trail Termination Function	Transmission path overhead extraction	Transmission path overhead processing	Transmission path overhead insertion	Transmission path overhead processing
TML	Transmission Media Layer				

NOTE 1 – Shaping is optional.

NOTE 2 – The modelling of the EPD/PPD and Resource Management functions is for further study. Until the modelling is completed their relative positions could change.

NOTE 3 – The relative location of the Metasignalling (source and sink) functions with respect to Congestion Control is still an open issue.

NOTE 4 – Congestion detection can occur in other functions than VP/VC_A and TP/VP_A. Moreover other mechanisms to react to a congestion detection are possible.

NOTE 5 – This should be end-to-end AIS and optionally segment AIS. See Annex D for options.

NOTE 6 – EPD and PPD are not yet modelled in this Recommendation.

NOTE 7 – The counter is common for invalid header, invalid VPI and invalid VCI.

NOTE 8 – The TP/VP_A currently defined in this Recommendation applies only for SDH and PDH path. For other TP/VP_As reference should be made to TP-specific Recommendations.

NOTE 9 – EPD/PPD is not available at the VP layer.

NOTE 10 – UNI only.

NOTE 11 – For IMA, cell rate decoupling is achieved using IMA Control Protocol cells (ICP) and IMA filler cells.

NOTE 12 – The TP/VP_A shall pass all cells to the IMA sublayer (this includes HEC errored cells); discarding of invalid HEC cells and idle cells insertion/extraction prevents IMA operation.

5 Transfer functions and Layer Management functions

This clause describes in detail the transfer functions and layer management functions of an ATM NE. The structure of the text is intended to follow the ordering of Figure 4-3.

5.1 Section/Path Adaptation, Section Termination and Lower Layer Functions

The section/path adaptation, section termination and lower physical layer functions applicable to ATM NEs are independent of the processing of the ATM cells. These functions are directly associated with the physical layer. They include:

1) electro-optical conversion;
2) line coding;
3) transmission frame generation and recovery;
4) transmission overheads processing.

They provide for input/output termination of the physical medium path, of the physical medium multiplex section, and lower level layers (e.g. photonic layer). The following interfaces have been specified: SDH interfaces according to ITU-T G.707 [2] and G.783 [3], PDH interfaces according to ITU-T G.703 [1], G.705 and G.832 [8], cell-based interfaces (e.g. ATM 155.52 Mbit/s in ITU-T I.432.2 [23], ATM 622 Mbit/s in ITU-T I.432.2 and ATM 25 Mbit/s in ITU-T I.432.5), interfaces that have inverse multiplexing capability (e.g. n * 2.048 Mbit/s IMA and n * 1.544 Mbit/s IMA in ITU-T I.761 [37]) and interfaces that are xDSL based (e.g. ADSL based interface in ITU-T G.992.1 [35] and splitterless ADSL interfaces in ITU-T G.992.2 [36]).

The physical layer specifications for ATM NEs shall comply with ITU-T I.432 for B-ISDN User-Network Interface (UNI) types. ITU-T G.707, G.783, G.957, and G.703 apply for SDH-based B-ISDN Network Node Interface (NNI) types. ITU-T G.832, G.804, G.705 and G.703 apply for PDH based B-ISDN Network Node Interface (NNI) types. ITU-T I.432 applies for cell based UNIs. ITU-T I.761 applies for IMA interfaces.

Support of additional interface types is not specified here, but is not precluded as National or Network Provider options.

5.1.1 SDH 155.52 Mbit/s Interface

The interface rate and format shall conform to the SDH STM-1 level given in ITU-T G.707 and ITU-T I.432.2. These functions are defined in ITU-T G.783.

5.1.2 SDH 622.08 Mbit/s Interface

The interface rate and format shall conform to the SDH STM-4 level/given in ITU-T G.707 and I.432.2. These functions are defined in ITU-T G.783.

5.1.3 SDH 2488.32 Mbit/s Interface

The interface rate and format shall conform to the SDH STM-16 level given in ITU-T G.707. These functions are defined in ITU-T G.783.

5.1.4 SDH 9953.28 Mbit/s Interface

The interface rate and format shall conform to the SDH STM-64 level given in ITU-T G.707.

5.1.5 PDH based interfaces

The interfaces rates and formats shall conform to the PDH levels given in ITU-T G.703 and G.705.

5.1.6 Cell-based UNI

For cell-based interfaces, functionality shall be in accordance with ITU-T I.432.2.

5.1.7 ATM 25 Mbit/s interface

The interface rate and format shall be in accordance with ITU-T I.432.5 [26].

5.1.8 IMA interface

The interface rate and format shall be in accordance with ITU-T I.761 and G.703.

5.1.9 xDSL interfaces

An overview of DSL standardization is given in ITU-T G.995.1 [45]. The interface rates and formats shall conform to the ADSL standard given in ITU-T G.992.1 and ADSL Lite standard given in ITU-T G.992.2. Work is in progress in ITU-T SG 15 on Recommendations for VDSL and SHDSL.

5.2 Transmission Path Trail Termination function (TP_TT)

The TP_TT function terminates a transmission path by extraction and insertion of the appropriate overhead. Both SDH paths and PDH paths apply here.

Specifications for the appropriate SDH overhead shall be in accordance with ITU-T G.707. The SDH TP_TT is further defined in ITU-T G.783. Generic functions are in ITU-T G.806.

Specifications for the appropriate PDH overhead shall be in accordance with ITU-T G.804 and G.832 [8]. The PDH TP_TT function is further defined in ITU-T G.705.

Specifications for the appropriate cell-based and ATM 25 overhead shall be in accordance with ITU-T I.432 and I.432.5.

Specifications for the appropriate IMA overhead shall be in accordance with ITU-T I.761. The IMA TP_TT function is further defined in ITU-T G.705 since they use PDH frames.

Specifications for the appropriate ADSL overhead shall be in accordance with ITU-T G.992.1.

Specifications for the appropriate ADSL Lite overhead shall be in accordance with ITU-T G.992.2.

Work is in progress in ITU-T SG 15 on Recommendations for VDSL and SHDSL. The information derived from/provided to plane management is defined in ITU-T G.783 for SDH interfaces.

5.3 Transmission Path/Virtual Path Adaptation function (TP/VP_A)

This function adapts an ATM cell structure to a transmission path signal structure.

Clauses 5.3.1 and 5.3.2 mainly address SDH and PDH interfaces but some of the information is valid for other interfaces. These clauses will be updated in the future to improve the validity of these clauses for cell-based, ATM 25, IMA, and xDSL interfaces.

5.3.1 TP/VP_A (B to A)

See D.2.:

S3/VP_A_Sk

S4/VP_A_Sk

S4-nc/VP_A_Sk

P12s/VP_A_Sk

P31s/VP_A_Sk

5.3.1.1 TP Payload specific functions

Certain TP information fields (e.g. signal label) are payload specific and hence have to be set for ATM equipment use.

NOTE – The payload position indicator (e.g. H4 in C4-POH) is not used for ATM equipment.

Transfer function: Extract the payload specific information from the TP overhead: signal label and path status information. Other fields are not yet defined for use with ATM.

For SDH the trail signal label is defined in ITU-T G.707 and its usage is defined in ITU-T G.783. The defect payload mismatch and consequent actions are defined in ITU-T G.783.

For SDH higher order paths the signal label is contained in the C2 byte. The value for ATM is 13 hex.

For SDH lower order paths, the signal label was defined in ITU-T G.707 to be contained in byte V5 and K4. Since there was an extended period between a mapping being defined and a code-point being assigned, interworking between new and old equipment has been defined in Table 5-1.

– New equipment shall be configured to expect an ATM signal of V5 = 101 binary and a signal label of 0000 1001 carried in bit 1 of the K4 byte. New equipment shall also accept an equipped, non specific code of V5 = 001 binary for backwards compatibility.

– Old equipment shall be reprogrammed to accept V5 = 001 binary and V5 = 101 binary (and expected to ignore K4).

– For old equipment that cannot be reprogrammed, old-new interworking is only possible if:

    a) payload mismatch detection can be disabled on the old equipment; or

    b) if payload mismatch is not supported on the old equipment.

There is a risk with this scheme that old equipment will accept a non-ATM payload (such as IP). This risk will decline as old equipment is retired.

Table 5-1/I.732 – Interworking solution for V5/K4 lower order signal label assignment for ATM

	Equipment "1"		Equipment "2"	
	Transmitter settings	**Receiver settings**	**Transmitter settings**	**Receiver settings**
Old-Old interworking	V5 = 001	Accepts V5 = 001 and V5 = 101. Ignores K4. May alarm on other values received	V5 = 001	Accepts V5 = 001 and V5 = 101. Ignores K4. May alarm on other values received
Old-New interworking	V5 = 001	Accepts V5 = 001 and V5 = 101. Ignores K4. May alarm on other values received	V5 = 101 and ATM signal label in K4 bit 1.	Payload mismatch function is negated by receiving V5 = 001.
New-New interworking	V5 = 101 and K4 = 00000010	Expects V5 = 101 and ATM signal label in K4 bit 1. Will not alarm on V5 = 001	V5 = 101 and ATM signal label in K4 bit 1.	Expects V5 = 101 and ATM signal label in K4 bit 1. Will not alarm on V5 = 001

For PDH the trail signal label (payload type) is defined in ITU-T G.832 and its usage is defined in ITU-T G.705. The defect payload mismatch and consequent actions are defined in G.705.

Layer Management functions:

In the event of payload mismatch as defined by ITU-T G.783, downstream transport is stopped and an internal Server Signal Fail is sent to the end-to-end VP-AIS generation process and segment VP-AIS generation function (if present). The Server Signal Fail is also forwarded to all associated VP/VC_A process. When the payload mismatch state has been cleared, user transport is allowed to continue and SSF is no longer sent to the end-to-end and segment VP-AIS generation process.

There are two notes covering exclusions for segment AIS in ITU-T I.610 that are applicable.

5.3.1.2 Demapping

Transfer function:

The cell stream shall be extracted from the transmission path payload which shall be in accordance with ITU-T G.707 for SDH, ITU-T G.804 for PDH, ITU-T I.761 for IMA, ITU-T I.432.5 for ATM 25, ITU-T G.992.1 for ADSL, and ITU-T G.992.2 for ADSL Lite. Work is in progress in ITU-T SG 15 on Recommendations for VDSL and SHDSL.

5.3.1.3 Cell delineation

Transfer function:

Cell delineation is performed on the continuous cell stream extracted from the TP frames. The cell delineation algorithm should be in accordance with ITU-T I.432.2 [23] for SDH, ITU-T I.432.1 [21] and I.432.3 [24] for PDH.

Indications of OCD anomaly event is to be provided by the transfer function to layer management.

Layer Management function:

The detection of LCD defect shall be in accordance with ITU-T I.432.2 for SDH, ITU-T I.432.1 and I.432.3 for PDH.

NOTE – The PLCP mapping for T3 (DS3) interfaces does not use the ATM headers for cell delineation.

5.3.1.4 Descrambling

Transfer function:

For SDH and PDH the information field of each cell is descrambled with a self-synchronizing scrambler polynomial $X^{43} + 1$. Operation of the descrambler shall be in accordance with ITU-T I.432.2 for SDH and ITU-T I.432.1 and ITU-T I.432.3 for PDH.

For details of whether scramblers are required for other TPs, the TP-specific Recommendation should be consulted, e.g. to determine whether scrambling is required for ATM 25, the ATM 25 interface description, ITU-T I.432.5 [26] should be consulted.

5.3.1.5 HEC Processing

Transfer function:

HEC verification and correction shall be in accordance with ITU-T I.432.2 for SDH, ITU-T I.432.1 and I.432.3 for PDH. Cells determined to have an invalid and uncorrectable HEC pattern shall be discarded. If this function is a TP/VP_A_Sk for IMA, cells determined to have an invalid and uncorrectable HEC pattern are not discarded.

Indications of invalid HEC event and invalid HEC cell discard event are to be provided by the transfer function to layer management.

Layer Management function:

A count of invalid HEC events and a count of invalid HEC cell discard events are maintained with threshold crossings checked. HEC correction mode may be activated/deactivated by the AEMF. The

HEC correction mode should be activated by default.

5.3.1.6 Cell rate decoupling

Transfer function:

Idle cells are extracted from the cell stream for SDH and PDH TPs. For IMA TPs the multiple links are more akin to TDM or TDMA and there are no idle cells. Instead the IMA processing will process the IMA control cells and remove the IMA filler cells. The description for other TPs will be found in the TP-specific Recommendations.

5.3.1.7 TP usage measurement

Transfer function:

Cell reception is indicated to layer management.

Layer Management function:

Received cells are counted for TP usage measurement purposes. Measurement results are maintained and reported to the AEMF periodically. This cell counting is activated/deactivated by the AEMF.

5.3.1.8 Cell Header verification

Transfer function:

The receiving ATM NE shall verify that the first four octets of the ATM cell header are recognizable as being a valid header pattern. Cells with unrecognized header patterns shall be discarded. An example of invalid header pattern occurs when cell-based OAM cells are detected on SDH or PDH based physical layers. An indication of an invalid header cell discard event is provided to layer management.

Layer Management function:

Specific values of the cell header have been defined in ITU-T I.361 [16] for use by the Physical Layer, e.g. idle cells and Physical Layer OAM cells. The ATM NE shall process these cells in accordance with the procedures defined in ITU-T I.361.

Invalid header patterns for SDH/PDH-based TP-TTs are as follows (Table 5-2) (except idle cell) (p = any value):

Table 5-2/I.732 – Invalid header patterns as defined by I.361

Interface type	GFC	VPI	VCI	PTI	CLP
UNI	pppp	0000 0000	0000 0000 0000 0000	ppp	1
NNI	not applicable	0000 0000 0000	0000 0000 0000 0000	ppp	1

These invalid header discard events are counted. A common invalid header/VPI/VCI cell discard count is maintained with setable threshold crossing checked.

5.3.1.9 GFC

Transfer function:

The GFC function is an option at UNIs. If present, the GFC function should be in accordance with ITU-T I.150 and I.361.

Layer Management function:

If present, GFC layer management function shall be in accordance with ITU-T I.150 and I.361. More detail is contained in D.2 for each physical layer (e.g. for S4 physical layer see S4/VP_A_Sk).

5.3.1.10 VPI verification

Transfer function:

The ATM NE shall verify that the received cell VPI is valid. If the VPI is determined to be invalid (i.e. out-of-range VPI or not assigned), the cell shall be discarded. An indication of an invalid VPI cell discard event is provided to layer management.

Layer Management function:

The invalid VPI cell discard events are counted. A common invalid header/VPI/VCI cell discard count is maintained with setable threshold crossing checked.

5.3.1.11 Congestion Control

Transfer function:

Selective cell discard according to CLP value.

If a selective cell discard function is present, in the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 [21] for further details about the use of the CLP.

Layer Management function:

If enabled, this process shall perform selective cell discard according to the CLP value.

5.3.1.12 End-to-end VP AIS insertion

See D.2 for details on end-to-end VP-AIS insertion.

5.3.1.13 Segment VP AIS insertion

See D.2 for details on segment VP-AIS insertion.

5.3.1.14 VP demultiplexing

This function enables the flow of cells to be logically separated into individual flows according to the VPI values.

5.3.2 TP/VP_A (A to B) for SDH and PDH

See D.2:

S3/VP_A_So

S4/VP_A_So

S4-nc/VP_A_So

P12s/VP_A_So

P31s/VP_A_So

5.3.2.1 VPI setting

This function provides the possibility to map an internal connection tag to the VPI. The VPI setting is located in the TP/VP_A. It is needs to be associated with a TP since the VPIs may be reused across TPs.

Transfer function:

The VPI value is processed in accordance with the assigned values.

Layer Management function:

At the UNI a total of up to 8 bits are available for VPI as defined in ITU-T I.361. At the NNI a total of up to 12 bits are available for VPI as defined in ITU-T I.361. The actual number of active VPI bits may be reduced by negotiation, e.g. in order to reduce interface costs.

The ATM NE associates a unique VPI value for each VP link per transmission path. The rules for allocation of the VPI/VCI bits and the pre-assigned values are specified in ITU-T I.361. The VPI/VCI values are to be assigned bidirectionally.

All ATM NE shall comply with the allocation rules and pre-assigned values.

The need to standardize a minimum number of VPI/VCI values per interface rate is for further study.

5.3.2.2 VP multiplexing

This function enables individual cell flows to be logically combined into a single cell flow according to the VPI values.

5.3.2.3 Congestion Control

Transfer function:

Selective cell discard according to CLP value.

If a selective cell discard function is present, in the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

Layer Management function:

For further study.

5.3.2.4 GFC

Transfer function:

The GFC function is an option at UNIs. If present, the GFC function should be in accordance with ITU-T I.150 and I.361.

Layer Management function:

If present, GFC layer management function shall be in accordance with ITU-T I.150 and I.361.

5.3.2.5 TP Usage Measurement

Transfer function:

Cell transmission is indicated to layer management.

Layer Management function:

Transmitted cells are counted for cell measurement purposes. Measurement results are maintained and reported to the AEMF periodically. This cell counting is activated/deactivated by the AEMF.

5.3.2.6 Cell rate decoupling

Transfer function:

Idle cells are inserted into the cell stream to match the rate of the TP payload in accordance with ITU-T I.432.2 [23] for SDH, I.432.1.1 [22] and I.432.3 [24] for PDH. The format of the idle cell should be in accordance with ITU-T I.432.

5.3.2.7 HEC Processing

Transfer function:

The HEC value for each cell is calculated and inserted into the HEC field. The method of HEC value calculation shall be in accordance with ITU-T I.432.2 for SDH, ITU-T I.432.1 and I.432.3 for PDH.

5.3.2.8 Scrambling

Transfer function:

The information field of each cell is scrambled with a self-synchronizing scrambler polynomial $X^{43} + 1$. Operation of the scrambler shall be in accordance with ITU-T I.432.2 for SDH, ITU-T I.432.1 and I.432.3 for PDH.

5.3.2.9 Mapping

Transfer function:

The cell stream shall be inserted into the transmission path payload which shall be in accordance with ITU-T G.707 [2] for SDH, ITU-T G.804 for PDH and ITU-T I.761 for IMA. The cell boundaries are aligned with the TP octet boundaries. The cell stream shall be inserted into the transmission path payload which shall be in accordance with ITU-T I.432.5 [26] for ATM 25, ITU-T G.992.1 [35] for ADSL, and ITU-T G.992.2 [36] for ADSL Lite. Work is in progress in ITU-T SG 15 on Recommendations for VDSL and SHDSL.

5.3.2.10 TP Payload specific functions

Certain TP information fields (e.g. signal label and path status) are payload specific and hence have to be set for ATM equipment use.

NOTE 1 – The payload position indicator (e.g. H4 in C4-POH) is not used for ATM equipment.

Transfer function:

For SDH the trail signal label is defined in ITU-T G.707 [2] and its usage is defined in ITU-T G.783 [3] and G.806 [38]. Codepoints exist for ATM for the higher order paths in the C2 byte and the correct value should be used. A specific codepoint has been defined for ATM mapped into lower order paths in the 2000 version of ITU-T G.707 using an escape code V5 = 101 and the signal label of 0000 1001 carried in bit 1 of the K4 byte.

NOTE 2 – Old equipment which predates the allocation of a codepoint for ATM in the lower order VC is expected to transmit V5 = 001.

Layer Management functions:

For SDH paths, the trail signal label shall be set for ATM equipment. For higher order SDH paths, the layer management should instruct that the G1 byte is set to ATM.

For lower order SDH paths the V5 byte shall be set to 101 and the signal label of 0000 1001 carried in bit 1 of the K4 byte. Old equipment may have V5 set to 001.

For PDH paths, the trail signal label (payload type) shall be set in accordance with ITU-T G.832 [8].

5.4 VP Traffic Management function (VPTM)

The VP traffic management functions are modelled as a set of functions which if activated are always present as a set. The set consists of the following functions of Annex D: VPTM_TT_Sk, and VPTM_TT_So. The functionality is currently modelled as being the same for ingress and egress to the equipment with the exception that UPC/NPC does not occur for egress ports. Modelling of new traffic classes and functionality to support IP is for further study.

A detailed description of the VPTM_TT functions can be found in D.3.5.

5.4.1 VP usage measurement

Transfer function:

For B to A direction cell reception is indicated to layer management. For A to B direction cell transmission is indicated to layer management.

Layer Management function:

Cells are counted for usage measurement purposes. The following counts shall be maintained:

1) Count of total VPC cells with CLP = 0 + 1.
2) Count of total VPC cells with CLP = 0. This count is only maintained when the CLP option is used. See 5.4.2 on UPC/NPC.

Measurement results are maintained and reported to the AEMF periodically. Cell counting is activated/deactivated per VPC by the AEMF.

5.4.2 VP UPC/NPC (B to A only)

UPC/NPC may be performed on each VP connection to detect violations of negotiated traffic parameters for the purpose of protecting the QOS of other VPCs. The use of UPC may be required for VPTM_TT_Sk associated with a TP_TT configured as a UNI. The use of NPC is optional for a VPTM_TT_Sk associated with a TP_TT configured as an NNI. Actions and requirements of UPC/NPC are described in ITU-T I.371.

NOTE – The use of UPC in ATM equipment on the user side of S_B and T_B reference point is optional.

The VP UPC/NPC function is activated/deactivated by the AEMF.

Transfer function:

VPC cell may be passed, discarded, or tagged (if used), depending on ATM Traffic Class (ATC) and indication from layer management.

Layer Management function:

Traffic descriptions are used by the layer management function to determine if connections are in violation of the negotiated traffic parameters. Plane Management is responsible for the setup and modification of the traffic parameters.

The cell loss priority function explicitly identifies the relative loss priority level in the handling of a cell (i.e. its discard eligibility depending on network conditions).

Cells with CLP = 0 are handled by an ATM NE as having higher priority than cells with CLP = 1.

The use of the CLP for Resource Management is described in ITU-T I.371 and I.150. The coding of CLP values is defined in ITU-T I.361. The ATM NE should be capable of interpreting the CLP value for the case of relative discard eligibility of a cell in the event of congestion. However, ATM NEs may not interpret the CLP value in some network applications.

The use of the CLP for the tagging function by the UPC is a network option, and is described in ITU-T I.371. Note that since the same bit is used both for the tagging function by the UPC and explicit CLP indication, the discard eligibility of the UPC tagged cells is the same as that of user set CLP = 1 cells from the equipment perspective.

When the UPC/NPC is activated, the following counts shall be maintained and reported to the AEMF periodically:

1) *Count of discarded cells with CLP = 0 + 1*

   A count of cells discarded due to UPC/NPC of combined CLP = 0 and CLP = 1 traffic.

2) *Count of discarded cells with CLP = 0*

A count of CLP = 0 cells discarded due to UPC/NPC of CLP = 0 only traffic. This count is maintained only when the CLP option is used.

3) *Count of cells tagged by the UPC/NPC function*

A count of cells with CLP = 0 that were tagged (i.e. CLP reset to 1) by the UPC/NPC. This count is maintained only when the CLP tagging option is used.

5.4.3 Traffic shaping

Transfer function:

If present, the use of the traffic shaper should be in accordance with ITU-T I.371. The shaping function can be activated/deactivated at this point in the model per connection.

Traffic shaping should be incorporated as a mechanism that alters the traffic characteristics of a stream of cells on a specific VPC while maintaining cell sequence integrity on the ATM connection. In general, shaping modifies the traffic characteristics with the consequence of increasing the mean cell transfer delay. Examples of traffic shaping are peak cell rate reduction, burst length limiting, reduction of CDV by spacing cells in time and queue service schemes.

Layer Management function:

If present, the function can be activated/deactivated per connection.

The traffic shaping function should not be activated simultaneously on both B to A and A to B sides on the same connection.

NOTE – This does not preclude shaping at two layers i.e. VP shaping on the B to A side and VC shaping on the A to B side, simultaneously. As a consequence, a VC connection can be shaped twice.

5.4.4 EFCI setting

The modelling of EFCI setting is for further study.

5.4.5 Resource management

For further study. Some material can be found in Appendix I, Functional requirements for ABR.

5.5 VP OAM functions

NOTE – This clause deals with the OAM functions between the VPTM and VP_C. OAM functions are also associated with the TP/VP_A (one of the locations for AIS insertion – see 5.3), and the VPLB (connection end-point associated loopback functions – see 5.7) and the VP_TT (connection end-point associated OAM functions – see 5.8).

5.5.1 F4 OAM functions (B to A) between VPTM and VP_C

Between the VP Traffic management function and the VP connection function are the following OAM functions:

VPLB_Sk compound function	see D.3.6
VPS_Sk compound function	see D.3.4.2 (VPS_TT_Sk) and D.3.4.4 (VPS/VP_A_Sk)
VPS_So compound function	see D.3.4.1 (VPS_TT_So) and D.3.4.3 (VPS/VP_A_So)
VPLB_So compound function	see D.3.6
VPSM_Sk	see D.3.3.2
VPM_Sk	see D.3.3.1

All ATM equipment supporting loopback functionality will implement source point function and loopback point function as described above. For some specific terminal equipment (e.g. PABX, XDSL modem, …) only loopback point function could be implemented to reduce their complexity. These reduced loopback functions are called VPLBR_TT in Annex D.

NOTE 1 – There are no VPSM_So or VPM_So functions corresponding to the VPSM_Sk and VPM_Sk non-intrusive monitors by definition of it being a non-intrusive function.

NOTE 2 – As artefacts of the functional modelling, the Loopback termination points are accompanied by adaptation functions that are actually null functions.

NOTE 3 – An option exists to replace the Loopback functions VPLB_Sk and VPLB_So with reduced functionality loopback functions VPLBR_Sk and VPLBR_So. These are also described in D.3.6.

5.5.2 F4 OAM functions (A to B) between VPTM and VP_C

Between the VP Traffic management function and the VP connection function are the following OAM functions:

VPM_Sk	see D.3.3.1
VPSM_Sk	see D.3.3.2
VPLB_Sk compound function	see D.3.6
VPS_Sk compound function	see D.3.4.2 (VPS_TT_Sk) and D.3.4.4 (VPS/VP_A_Sk)
VPS_So compound function	see D.3.4.1 (VPS_TT_So) and 3.4.3 (VPS/VP_A_So)
VPLB_So compound function	see D.3.6

NOTE 1 – There are no VPSM_So and VPM_So functions corresponding to the VPSM_Sk and VPM_Sk non-intrusive monitors by definition.

NOTE 2 – As artefacts of the functional modelling, the Loopback termination points are accompanied by adaptation functions that are forsooth null functions.

NOTE 3 – An option exists to replace the Loopback functions VPLB_Sk and VPLB_So with reduced functionality loopback functions VPLBR_Sk and VPLBR_So. These are also described in D.3.6.

5.6 VP Connection function (VP_C)

See VP_C in D.3.1. The model includes VP layer Subnetwork Protection functions as part of the VP_C.

5.7 VP Connection End point Loopback function (VPLB_TT)

The specific functions for the VPLB_TT can be found in D.3.6. An artifact of the model is that the loopback termination functions are accompanied by adaptation functions although these are actually null functions.

5.8 VP Trail Termination function (VP_TT)

The specific functions for the VP Termination point can be found in D.3.2.

5.9 Virtual Path/Virtual Channel Adaptation function (VP/VC_A)

5.9.1 VP/VC_A (B to A)

See VP/VC_A_Sk, D.4.2.

5.9.1.1 Discard of end-to-end and segment F4 OAM cells

This function removes any end-to-end and segment F4 OAM cells that failed to get extracted by the termination point or any trail protection functionality.

5.9.1.2 VCI verification and invalid VCI cell discard

Transfer function:

The ATM NE shall verify that the received cell VCI is valid. If the VCI is determined to be invalid (i.e. out-of-range VCI or not assigned), the cell shall be discarded. An indication of an invalid VCI cell discard event is provided to layer management.

Layer Management function:

The invalid VCI cell discard events are counted. A common invalid header/VPI/VCI cell discard count is maintained with setable threshold crossing checked.

5.9.1.3 Congestion Control

Transfer function:

Selective cell discard according to CLP value.

If a selective cell discard function is present, in the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP.

Layer Management function:

If enabled, this process shall perform selective cell discard according to the CLP value.

5.9.1.4 Metasignalling

Transfer function:

Extraction of metasignalling cell. This function is optional. The modelling of metasignalling functionality is for further study. (Format of the metasignalling cell should be in accordance with ITU-T I.361.)

Layer Management function:

Metasignalling processing is not addressed in this Recommendation (see ITU-T Q.2120).

5.9.1.5 End-to-end VC AIS insertion

See D.4.2 of for detail on end-to-end VC-AIS insertion.

5.9.1.6 Segment VC AIS insertion

See D.4.2 for detail on segment VC-AIS insertion.

5.9.1.7 VC demultiplexing

Transfer function:

This function enables the separation of the individual Virtual Channels from their Virtual Paths according to the VCI values.

5.9.2 VP/VC_A (A to B)

See VP/VC_A_So, D.4.1.

5.9.2.1 VCI setting

Transfer function:

The VCI value is processed in accordance with the assigned values.

Layer Management function:

At the UNI/NNI a total of up to 16 bits are available for VCI as defined in ITU-T I.361. The actual number of active VCI bits may be reduced by negotiation, e.g. in order to reduce interface costs. The ATM NE associates a unique VCI value for each VC link per VP.

The rules for allocation of the VPI/VCI bits and the pre-assigned values are specified in ITU-T I.361. The VPI/VCI values are to be assigned bidirectionally.

All ATM NE shall comply with the allocation rules and pre-assigned values.

The need to standardize a minimum number of VPI/VCI values per interface rate is for further study.

5.9.2.2 VC multiplexing

Transfer function:

This function enables the individual Virtual Channels to be logically combined into their respective Virtual Paths according to the VCI values.

NOTE – When the VCCs are multiplexed into a VPC, the multiplexing function should respect the traffic characteristics of the VP level.

5.9.2.3 Congestion Control

Transfer function:

Selective cell discard according to CLP value.

If a selective cell discard function is present, in the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

Layer Management function:

For further study.

5.9.2.4 Metasignalling

Transfer function:

Insertion of metasignalling cell. This function is optional. The modelling of metasignalling functionality is for further study. (Format of the metasignalling cell should be in accordance with ITU-T I.361.)

Layer Management function:

Metasignalling processing is not addressed in this Recommendation (see ITU-T Q.2120).

5.10 VC Traffic Management function (VCTM)

The VC traffic management functions are modelled as a set of functions which if activated are always present as a set. The set consists of the following functions of Annex D: VCTM_TT_Sk, and VCTM_TT_So. The functionality is currently modelled as being the same for ingress and egress to the equipment with the exception that UPC/NPC does not occur for egress ports. Modelling of new traffic classes and functionality to support IP is for further study.

A detailed description of the VCTM_TT functions can be found in D.5.5.

5.10.1 VC usage measurement

Transfer function:

For B to A direction cell reception is indicated to layer management. For A to B direction cell transmission is indicated to layer management.

Layer Management function:

VCC cells are counted for usage measurement purposes. The following counts shall be maintained:

1) Count of total VCC cells with CLP = 0 + 1.

2) Count of total VCC cells with CLP = 0. This count is only maintained when the CLP option is used. See 5.10.2 on UPC/NPC.

Measurement results are maintained and reported to the AEMF periodically. Cell counting is activated/deactivated on a per VCC basis by the AEMF.

5.10.2 VC UPC/NPC (B to A only)

UPC/NPC may be performed on each VC connection to detect violations of negotiated traffic parameters for the purpose of protecting the QOS of other VCCs. The use of UPC may be required for a VCTM_TT_Sk associated with a VP_TT configured as a UNI. The use of NPC is optional for a VCTM_TT_Sk associated with a VP_TT configured as an NNI. Actions and requirements of UPC/NPC are described in ITU-T I.371.

NOTE – The use of UPC in ATM equipment on the user side of S_B and T_B reference point is optional.

The VC UPC/NPC function is activated/deactivated by the AEMF.

Transfer function:

VCC cell may be passed, discarded, or tagged (if used), depending on ATM Traffic Class (ATC) and indication from layer management.

Layer management function:

Traffic descriptions are used by the layer management function to determine if connections are in violation of the negotiated traffic parameters. Plane Management is responsible for the setup and modification of the traffic parameters.

The cell loss priority function explicitly identifies the relative loss priority level in the handling of a cell (i.e. its discard eligibility depending on network conditions).

Cells with CLP = 0 are handled by an ATM NE as having higher priority than cells with CLP = 1.

The use of the CLP for Resource Management is described in ITU-T I.371 and I.150. The coding of CLP values is defined in ITU-T I.361. The ATM NE should be capable of interpreting the CLP value for the case of relative discard eligibility of a cell in the event of congestion. However, ATM NEs may not interpret the CLP value in some network applications.

The use of the CLP for the tagging function by the UPC is a network option, and is described in ITU-T I.371. Note that since the same bit is used both for the tagging function by the UPC and explicit CLP indication, the discard eligibility of the UPC tagged cells is the same as that of user set CLP = 1 cells from the equipment perspective.

When the UPC/NPC is activated, the following counts shall be maintained and reported to the AEMF periodically:

1) *Count of discarded cells with CLP = 0 + 1*

   A count of cells discarded due to UPC/NPC policing of combined CLP = 0 and CLP = 1 traffic.

2) *Count of discarded cells with CLP = 0*

A count of CLP = 0 cells discarded due to UPC/NPC policing of CLP = 0 only traffic. This count is maintained only when the CLP option is used.

3) *Count of cells tagged by the UPC/NPC function*

A count of cells with CLP = 0 that were tagged (i.e. CLP reset to 1) by the UPC/NPC. This count is maintained only when the CLP tagging option is used.

5.10.3 Traffic shaping

Transfer function:

If present, the use of traffic shaping should be in accordance with ITU-T I.371. The shaping function can be activated/deactivated at this point in the model per connection.

Traffic shaping should be incorporated as a mechanism that alters the traffic characteristics of a stream of cells on a specific VCC while maintaining cell sequence integrity on the ATM connection. In general, shaping modifies the traffic characteristics with the consequence of increasing the mean cell transfer delay. Examples of traffic shaping are peak cell rate reduction, burst length limiting, reduction of CDV by spacing cells in time and queue service schemes.

Layer Management function:

If present, the function can be activated/deactivated per connection.

The traffic shaping function should not be activated simultaneously on both the B-to-A and A-to-B directions of the same connection.

NOTE – This does not preclude shaping at two layers i.e. VC shaping on the B to A side and VP shaping on the A to B side, simultaneously. As a consequence, a VC connection can be shaped twice.

5.10.4 EFCI setting

The modelling of EFCI setting is for further study.

5.10.5 Resource management

For further study. Some material can be found in Appendix I, Functional requirements for ABR.

5.11 VC OAM functions

NOTE – This clause deals with the OAM functions between the VCTM and VC_C. OAM functions are also associated with the VP/VC_A (one of the locations for AIS insertion – see 5.9), and the VCLB (connection end-point associated loopback functions – see 5.7) and the VC_TT (connection end-point associated OAM functions – see 5.14).

5.11.1 F5 OAM functions (B to A) between VCTM and VC_C

Between the VC Traffic management function and the VC connection function are the following OAM functions:

VCLB_Sk compound function	see D.5.6
VCS_Sk compound function	see D.5.4.2 (VCS_TT_Sk) and D.5.4.4 (VCS/VC_A_Sk)
VCS_So compound function	see D.5.4.1 (VCS_TT_So) and D.5.4.3 (VCS/VC_A_So)
VCLB_So compound function	see D.5.6
VCSM_Sk	see D.5.3.2
VCSM_Sk	see D.5.3.1

All ATM equipment supporting loopback functionality will implement source point function and loopback point function as described above. For some specific terminal equipment (e.g. PABX, XDSL modem, …) only loopback point function could be implemented to reduce their complexity. These reduced loopback functions are called VCLBR_TT in Annex D.

NOTE 1 – There are no VCSM_So or VCM_So functions corresponding to the VCSM_Sk or VCM_Sk non-intrusive monitors by definition of it being a non-intrusive function.

NOTE 2 – As artefacts of the functional modelling, the Loopback termination points are accompanied by adaptation functions that are actually null functions.

NOTE 3 – An option exists to replace the Loopback functions VCLB_Sk and VCLB_So with reduced functionality loopback functions VCLBR_Sk and VCLBR_So. These are also described in D.5.6.

5.11.2 F5 OAM functions (A to B) between VCTM and VC_C

VC OAM functions occur in three locations in the model: the first two sets are between the VC traffic management functions and the third set is associated with the VC connection end-point.

Between the VC Traffic management function and the VC connection function are the following OAM functions:

VCM_Sk	see D.5.3.1
VCSM_Sk	see D.5.3.2
VCLB_Sk compound function	see D.5.6
VCS_Sk compound function	see D.5.4.2 (VCS_TT_Sk) and D.5.4.4 (VCS/VC_A_Sk)
VCS_So compound function	see D.5.4.1 (VCS_TT_So) and D.5.4.3 (VCS/VC_A_So)
VCLB_So compound function	see D.5.6

NOTE 1 – There are no VCSM_So and VCM_So functions corresponding to the VCSM_Sk and VCM_Sk non-intrusive monitors by definition.

NOTE 2 – As artefacts of the functional modelling, the Loopback termination points are accompanied by adaptation functions that are actually null functions.

NOTE 3 – An option exists to replace the Loopback functions VCLB_Sk and VCLB_So with reduced functionality loopback functions VCLBR_Sk and VCLBR_So. These are also described in D.5.6.

5.12 VC Connection function (VC_C)

See VC_C in D.5.1. The model includes VC layer Subnetwork Protection functions as part of the VC_C.

5.13 VC Connection End point Loopback function (VCLB_TT)

The specific functions for the VCLB_TT can be found in D.5.6. An artifact of the model is that the loopback termination functions are accompanied by adaptation functions although these are actually null functions. Reduced functionality loopback (VCLBR) functions have been defined which may be used in certain reduced functionality equipment.

5.14 VC Trail Termination function (VC_TT)

The specific functions for the VC Termination point can be found in D.5.2.

The issue of the processing of the PTI (mainly for AAL 5), CLP field needs to be clarified. These information involve exchange of information between the higher layers and the ATM layer.

5.15 ATM Adaptation Layer function (AAL)

5.15.1 Discard of end-to-end and segment F5 OAM cells

This function removes any end-to-end and segment F5 OAM cells that failed to get extracted by the termination point or any trail protection functionality.

5.15.2 AAL functional modelling

The functional modelling of AALs is partially covered in D.6. Enhancements are for further study.

5.15.3 Service Specific Coordination functions

Service dependent functions e.g. SSCF of ITU-T I.365x are for further study. Service dependent functions e.g. SSCS of ITU-T I.366x [43] and [44] are for further study. Signalling ATM Adaptation Layer (SAAL) is also for further study.

6 Coordination Function (CoF)

The Coordination Function (CoF) provides the following functions:

1) communications between:
   - Layer Management (LM) blocks;
   - the AEMF and LM blocks;
   - signalling applications and LM block;
   - the CAC and the LM block.

   to support:
   - a) configuration management;
   - b) fault management;
   - c) performance management;
   - d) accounting management;
   - e) security management.

The communications consist of Management Indication (MI) signals described in Annex D. Annex D covers fault management, performance, and configuration management.

2) Appropriate selection and distribution of timing information.

7 CAC and resource control functions

This clause aims at providing the modelling of the way in which an ATM resource request is handled in an equipment, but there are no requirements implied.

7.1 ATM resource requests to be processed by an ATM equipment

Two types of ATM resource requests can be considered from an equipment point of view:

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

7.1.1 Establishing or releasing a VP or VC connection

Establishing a connection means to create a new point-to-point VPC or VCC or to add a leaf in a tree of multipoint connections with leaf initiated join.

Releasing a connection means to delete any VPC or VCC.

A request to establish or release a given VP or VC connection may be initiated independently by:

– **management procedure**, for establishing cross-connected connections VPCs or VCCs. The equipment configuration management is controlled from either the Network equipment layer (e.g. via the Q3 interface) or directly from the local craft terminal through the F interface. The network equipment layer is controlled by the management layer. Request can be made to the management layer directly by the network operator or by customers or services communicating to the management layer via the service layer;

– **signalling procedure**, for establishing switched VCCs. The signalling messages are generally transported through a dedicated VCC. The protocols involved are DSS2, B-ISUP, Broadband Bearer Channel Control (BBCC) for VB5, Metasignalling, QSIG.

These ATM resource requests include (see Figure 7-1):

– some routing parameters;

– the traffic and QOS characteristics of the connection to be set.

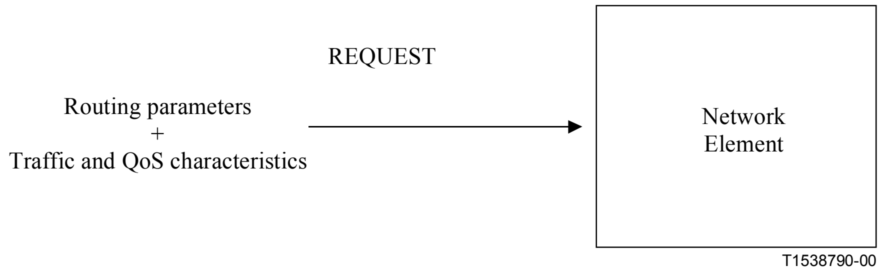


Figure 7-1/I.732 – Establishing or releasing a VP/VC connection

The routing parameters can be for example an input interface identification and e.g. an E.164 destination address.

The traffic and QOS characteristics of the connection are respectively defined in ITU-T I.371 [21] and I.356 [15]. These characteristics are summarized in Table 7-1.

Table 7-1/I.732 – Traffic characteristics associated with a connection

General traffic characteristics	ATM Transport Capability (ATC)
	STD and CDV tolerances associated with each cell rate included in the given ATC
ABR & ABT additional specific characteristics	ATC tuning parameters for ABT and ABR connections (e.g. RIF, RDF, etc.)
Quality of Service (QoS) required	QoS parameters (CTD, CDV 2 points, Cell Loss Ratio (CLR_0, CLR_{0+1}, CLR_1) (CLR))

7.1.2 Modification of the traffic characteristics of an established VP or VC connection

Modification of the traffic characteristics (see Table 7-1 and Figure 7-2) of an already established connection may be initiated by:

– management procedure via an equipment management interface;

– signalling procedure;

– RM procedure.

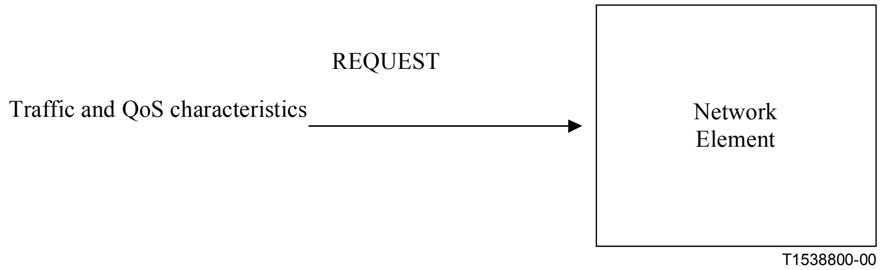


Figure 7-2/I.732 – Modification of the traffic characteristics of an existing VP/VC connection

These ATM resource requests only include the new re-negotiated parameters for the existing connection. That means that this kind of request does not include any routing parameters.

7.2 General ATM equipment features for processing an ATM resource request

The processing of an ATM resource request by the equipment involves two main functions described in Figure 7-3.

7.2.1 Processing of resource request messages

Resource request messages can be processed using different procedures (management, signalling or RM procedures). This processing is done by:

– the Management Applications for dealing with the Management Procedures;

– the Signalling Applications for dealing with the Signalling Procedures;

– the RM Applications for dealing with the RM procedures.

These functions allow for exchanging information following the protocol rules through the appropriate interface (Q3/F, User Network Interface (UNI)/Network Node Interface (NNI)). The applications are also strongly constrained by the specific time characteristics of the associated procedures (e.g. on the fly processing of RM cells in the case of ABR and ABT support). When an ATM resource request is identified, it is addressed to the Connection Admission Control (CAC) function for admission by the equipment. The timing scale to take into account the request originated by the Management, Signalling or RM procedures are very different.

7.2.2 CAC function

The equipment CAC function is part of the network level CAC function as defined in ITU-T I.371, but at an equipment level. The CAC function takes as input the ATM resource request as defined in 7.1, and accepts or rejects the request. An intermediate admission level (e.g. request "partially accepted") needs further studies.

NOTE – "Partially accepted" means for example that the request could be accepted with lower Peak Cell rates (PCRs). Another example involves a request for setting up a point-to-multipoint connection with n leaves: the connection could be accepted for only p leaves ($p < n$).

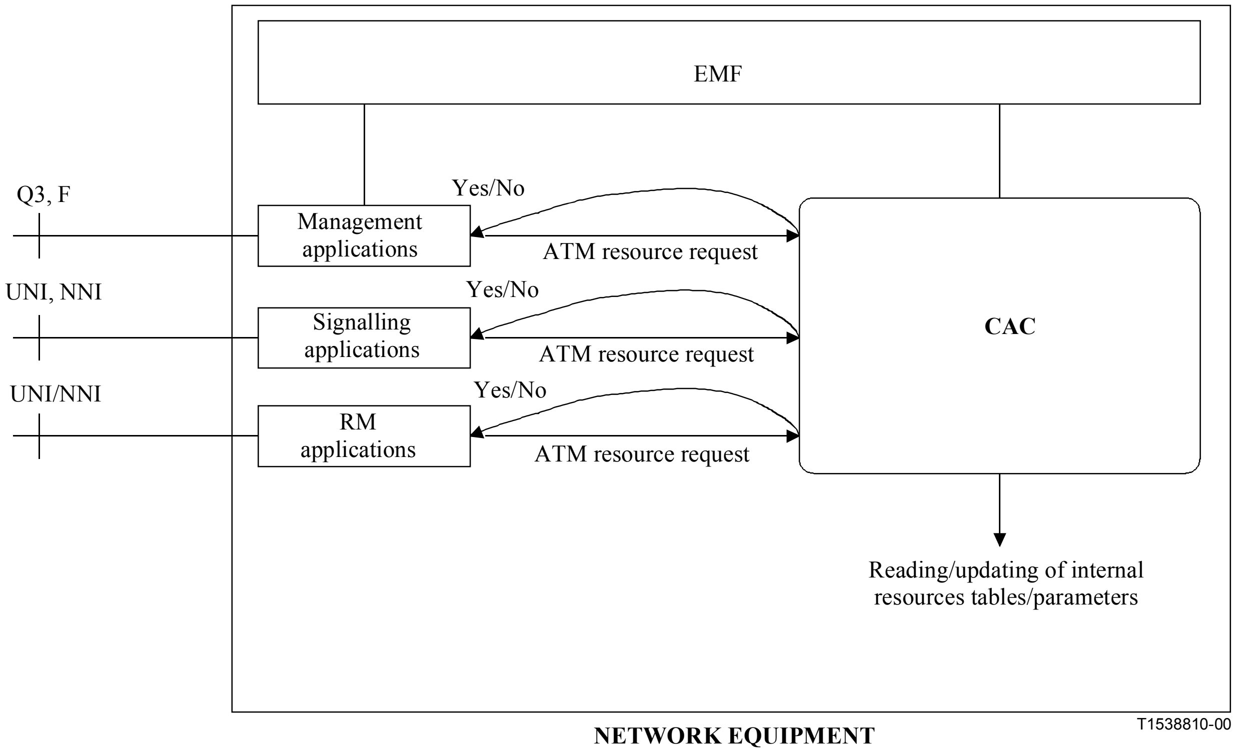


Figure 7-3/I.732 – Functions involved for processing an ATM resource request

7.3 Management, signalling, RM applications

For further study.

7.4 Detailed description of the CAC function

The **CAC** function can be considered as two processes named Service Admission Control (**SAC**) and Equipment Admission Control (**EAC**) (Figure 7-4).

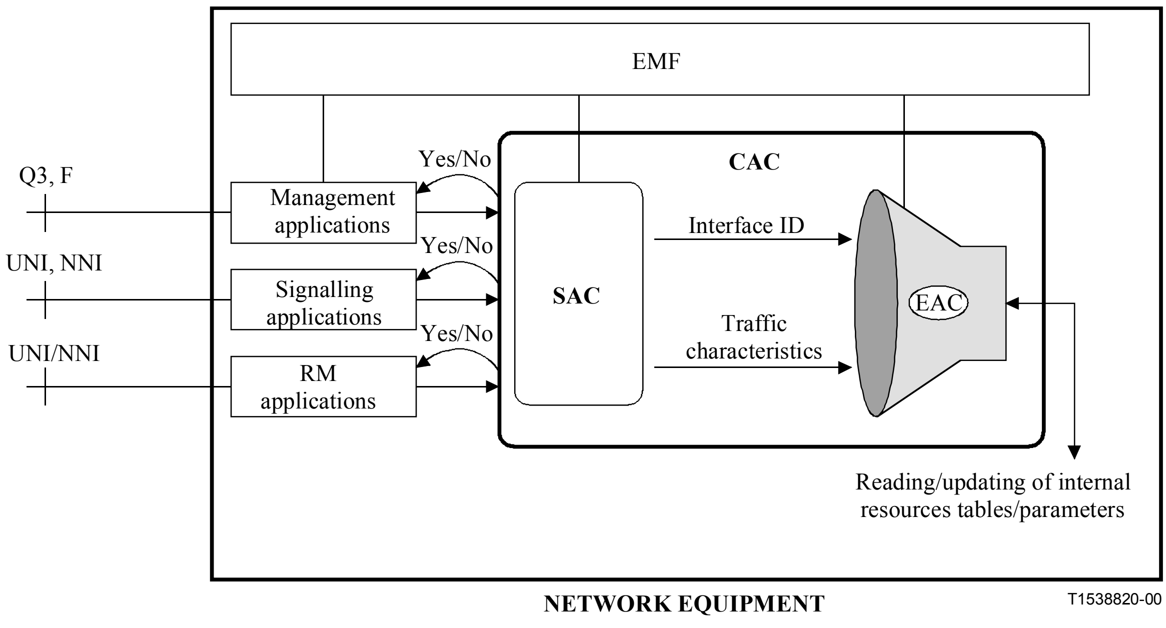


Figure 7-4/I.732 – Architecture of the CAC

– The **SAC**: this step corresponds to the part of the admission which **does not need the knowledge of the real time availability of the resources of the equipment**. The SAC function is divided into two subfunctions: the Service Level ADmission (SLAD) and the routing function. The admission of a connection on a statistical basis is done by the SAC function. This function, or parts of this function, can be centralized, partially centralized, or distributed, depending on operator/vendor policy. That means that this function may or may not be present within the equipment.

– The **EAC**: this step implies a more detailed process, which consists of **checking the current availability of the resources of the equipment**. This function can only be done at an equipment level, since the availability of the resources can change depending on the load of the equipment at a given moment. This function is implementation specific, considering that the load of the equipment depends on its implementation (e.g. presence of queues, blocking matrix), and works on a real time basis.

The YES/NO response between the CAC block and the different applications is the final response of the equipment to the ATM resource request. This final response results from the exchanges between the SAC and the EAC. These exchanges are illustrated in Figure 7-5.

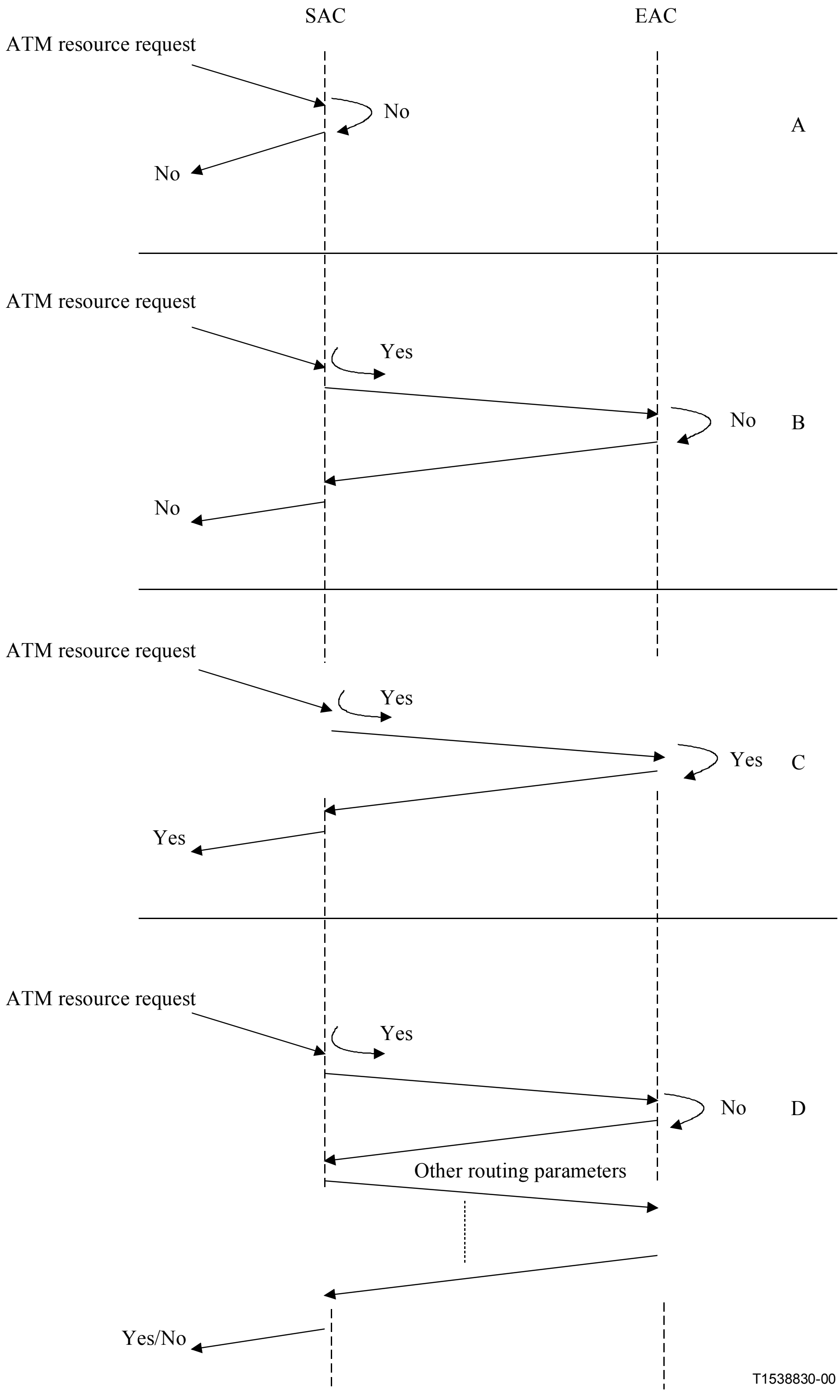


Figure 7-5/I.732 – Examples for exchanges between SAC and EAC

7.4.1 Service Acceptance Control SAC

See Figure 7-6.

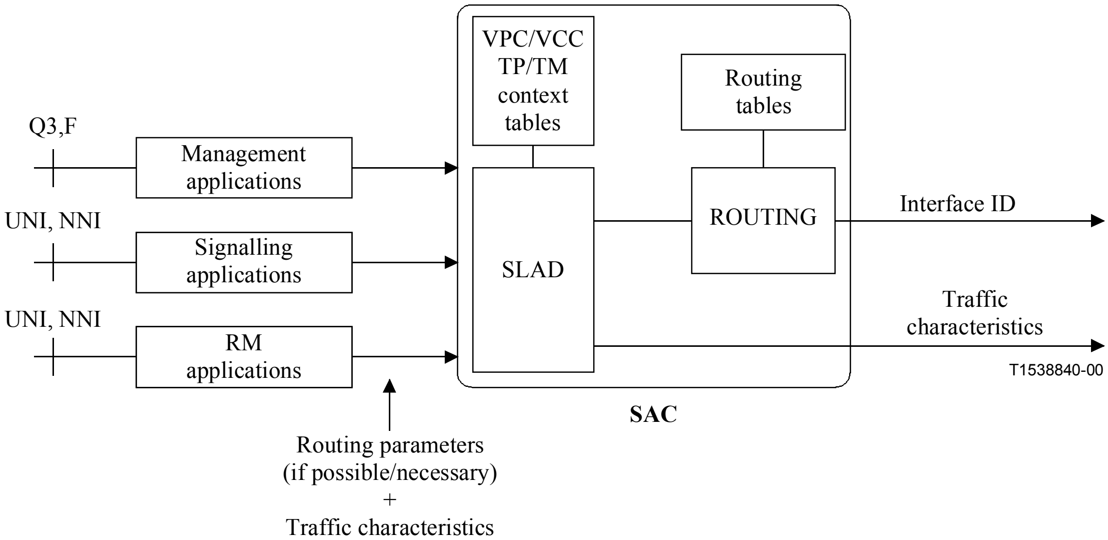


Figure 7-6/I.732 – Service Admission Control

SAC includes two functions (Figure 7-6):

– the SLAD checks whether the request can be accepted or not by considering the VPC/VCC, TP and Transmission Media (TM) context tables. For example, rejecting a Deterministic Bit Rate (DBR) VCC with a PCR larger than the PCR of the underlying DBR VPC does not imply any detailed equipment level verification, but only a theoretical checking of the traffic contract of the existing relevant VPC;

– the routing function is in charge of determining the appropriate interfaces for routing the connection. This function uses the information provided in the signalling or management messages (e.g. E.164 address, interface ID), and the routing tables. The routing function and/or the routing tables may be present, partially present, or may not be present in the equipment, depending on operator/vendor policy. If several solutions (i.e. interface ID) are acceptable, the routing function then evaluates which is the best one.

7.4.1.1 Service Level Admission (SLAD)

7.4.1.1.1 Description

The SLAD function receives the different requests coming with different formats (management, signalling, RM applications) and makes use of the VPC/VCC, TP and TM context tables to decide whether a request can be accepted or shall be rejected, mainly on ATM Transport Capability (ATC) and QoS class basis.

The VPC/VCC, TP and TM context tables contain the configuration parameters of the connections already set-up within the equipment. The configuration parameters are:

– the traffic characteristics of the connection (see Table 7-1);

– the OAM activated functions;

– the capacity of the TP and TM layers.

Other parameters are for further study. For example, these tables could also include:

– some lifetime parameters, for scheduling the use of some ATM connections at an equipment level (e.g. a VC connection could only be active between 1 a.m. and 7 a.m., and the associated bandwidth be available during the rest of the time for other connections);
– some statistical information, for allowing concentration. For example, consider the case of a bunch of DBR VCCs dedicated to Video on Demand (VoD) and carried by one single DBR VPC. The monitoring of the activity of the VCCs could show that only 80% of the users are active at the same time in the worst case. This information could be stored as one parameter of the VPC.

For each new connection, the context tables are updated by the SLAD.

The SLAD process is for further study. This process makes use of the configuration parameters of the connections, but should also take into account the statistical parameters.

Considering the example of concentration provided above, two approaches could be considered for optimizing the use of the resources by overbooking:

– either the DBR VP is accepted by the SLAD with a PCR larger than the underlying TP capacity. The VPC will carry a bunch of VCCs which are not all active at the same time, and as such, will never overload the TP;
– or the underlying DBR VPC is chosen with a PCR equal to 80% of the sum of the PCRs of all the VCCs. In that case, the SLAD should be able to accept a bunch of VCCs whose PCR sum is larger than the PCR of the VPC.

7.4.1.1.2 Configuration of the SLAD

The Service Level Admission (SLAD) function may be configured via the management interfaces. The configuration of the SLAD involves all the layers: TM, TP, VP and VC.

For example, the SLAD may be configured to logically partition the TP bandwidth based on some criteria, depending on vendor/operator policy. A part of the TP bandwidth could be reserved for cross-connected ATM connections, and another part for switched connections. More generally, partitioning of the TP could be envisaged based on one or a combination of the following parameters:

– traffic/QoS description;
– service classes;
– connection types (see example above: permanent, soft, switched connections ...);
– others.

A VP level configuration example is the activity rate of the VCCs carried within the VPCs.

7.4.1.2 Routing function

7.4.1.2.1 Definitions

The routing process can be centralized, partially centralized, or distributed, depending on operator/vendor policy. This function makes use of the routing tables. The routing tables can be centralized, partially centralized, or distributed, depending on operator/vendor policy. This clause deals with the routing at an equipment level.

When present within an equipment, the routing process allows for selecting the appropriate interfaces to connect. This function translates a network wide input information (e.g. IP or E.164 address) into an equipment level information (interface identification), by using the routing tables. This process generally leads to several appropriate solutions, since in many cases, different network routes can reach the same destination. In that case, the routing has to select the adequate solution, based on various criteria (e.g. network policy). These criteria need further study.

An interface identification includes all the levels involved in the connection (see Figure 7-10). For example, an interface for a VC connection is defined by a set of {TM Identifier, TP Identifier, VPI, VCI}.

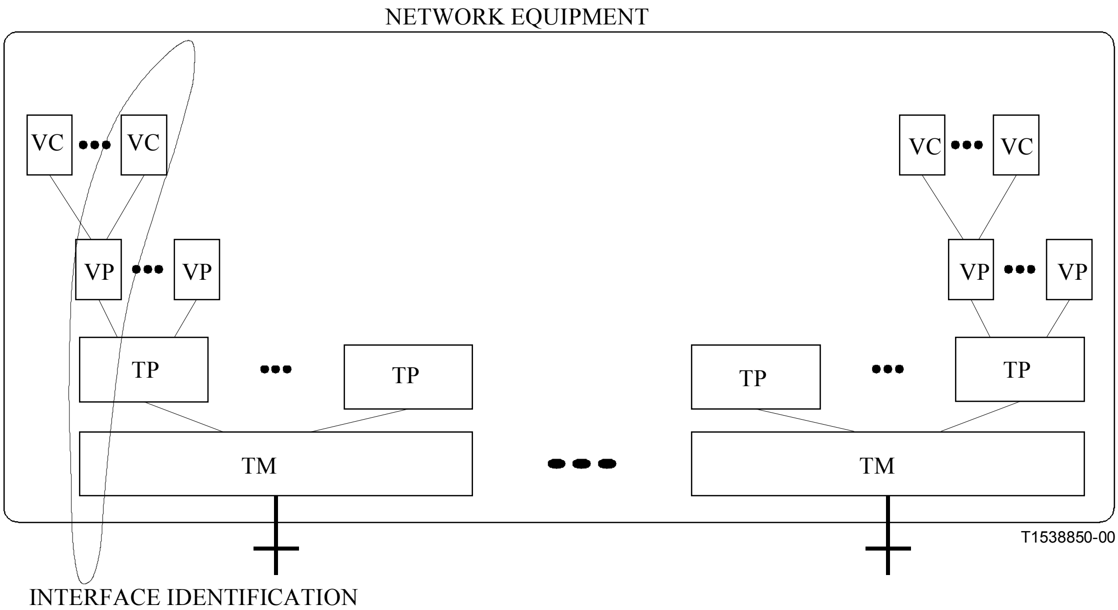


Figure 7-7/I.732 – Interface to be considered for a VC connection

In the case of point-to-point connections (see Figure 7-8), the routing consists of determining zero, one or several couples of {input interface, output interface}, and to select the adequate one.

In the case of multiway N-to-P connection, the routing consists of determining zero, one or several sets of {N input interfaces, P output interfaces} and to select the adequate one.

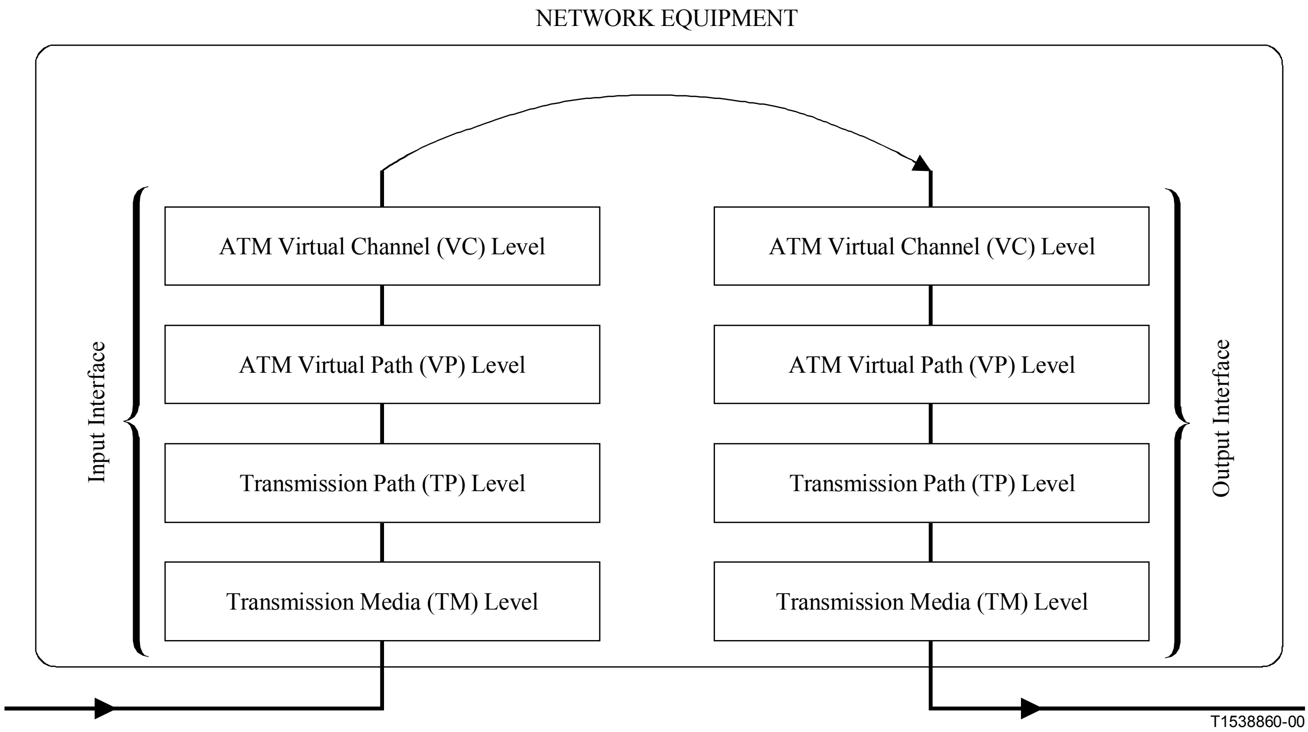


Figure 7-8/I.732 – Selecting two interfaces in the case of a point-to-point connection

7.4.1.2.2 Input parameters of the routing process

The input parameters of the routing process can be:

– the input interface(s) and the address(/addresses) of the destination(s). In that case, the routing function has only to find out the appropriate output interface(s). For example, a point-to-point routing request can include the {TM Identifier, TP Identifier, VPI, VCI} for defining the input interface, and e.g. an E.164 address for defining a destination. The role of the routing function in that case is to provide the output interface identification corresponding to the given address;

– the addresses of the source(s) and of the destination(s). For example, a point-to-point routing request can include e.g. one E.164 address for the source, and e.g. another E.164 address for defining the destination. In that case, the routing function provides the appropriate input and output interfaces.

7.4.1.2.3 Output parameters of the routing process

The output of the routing function for a point-to-point connection is a couple of interface identifiers.

The output of the routing function for an N-to-P multiway connection is a couple of {N input interface identifications, P output interface identifications}.

7.4.1.2.4 Configuration of the routing function

The configuration of the routing function via the management interfaces is for further study.

7.4.2 Equipment Admission Control (EAC) function

7.4.2.1 Resource of an ATM equipment

The resources of an ATM equipment up to an ATM level (VP/VC) include:

– a set of VP and VC identifiers (VPI and VCI) to identify connections;

– bandwidth available on the TPs;
– buffer space evaluated in number of cells.

It is not specified here where the buffer space is located. Indeed, an equipment may control internal resources which depend on the implementation. For example, an equipment built with a blocking matrix may control the allocation of switching capacity. This kind of internal resource can be considered as "buffer space". The buffer space can also be distributed within the equipment.

The way to manage the internal resources of an equipment depends on the implementation of the equipment and every manufacturer is free to choose how to allocate internal resources in order to satisfy the various requests in the adequate delays.

7.4.2.2 EAC process

The EAC algorithm used by the ATM NE is implementation specific.

Figure 7-9 shows the exchanges between the EAC function and the rest of the equipment.

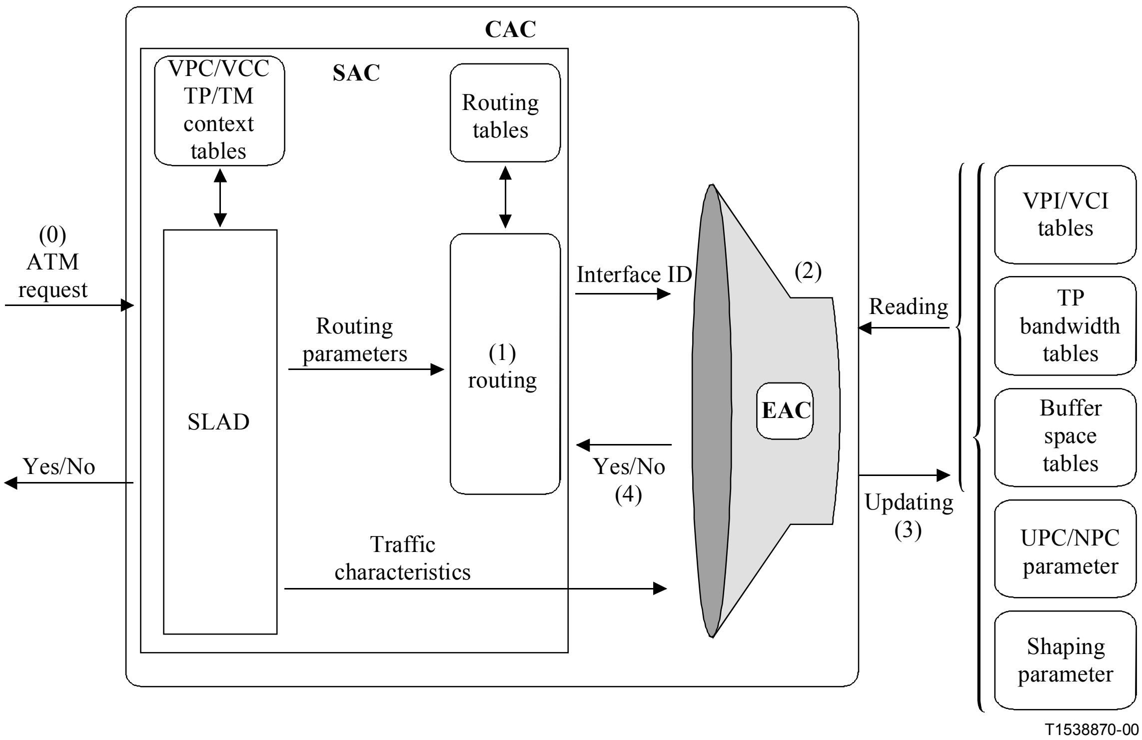


Figure 7-9/I.732 – Processing of an ATM resource request

The EAC consists of accepting or rejecting a request characterized by an interface ID and traffic characteristics:

– the EAC function *derives* from the traffic characteristics defined in Table 7-1 the appropriate bandwidth and/or buffer space to be assigned to the connection to meet the negotiated QoS objectives; the derivation is implementation dependent;
– the EAC checks whether the solution could be accepted or not. This process involves the reading of the real time resource tables, considering the interface ID and the derived traffic constraints (VPI/VCI, TP bandwidth/buffer space);
– if the appropriate VPI/VCI, TP bandwidth and/or buffer space is not available, the EAC function rejects the solution;

– if the appropriate VPI/VCI, TP bandwidth and/or buffer space is available, the EAC function updates the NE resource tables (VPI/VCI, TP bandwidth/buffer space derived from negotiated or re-negotiated traffic and QoS parameters).

On connection release, the EAC updates VPI/VCI, bandwidth/buffer space allocation tables.

7.4.2.3 Configuration of the EAC function

The configuration of the EAC function via the management interfaces is for further study.

7.5 Processing steps of an ATM resource request

This clause shows the processing of an ATM resource request, based on Figure 7-9.

When an ATM resource request is received by the Management, Signalling or RM Applications, this request is firstly addressed to the SAC function (see step (0) in Figure 7-9).

The SLAD function checks whether the ATM resource request is acceptable following the VPC/VCC, TP and TM context tables. For example, the request could be not compliant with the ATC parameters.

The rest of the admission process involving relations between the routing function and the EAC, depends on the nature of the ATM resource request:

7.5.1 Request to establish or release an ATM VP or VC connection

This involves 4 other steps (see numbers in Figure 7-9):

1) The routing function is in charge of determining the appropriate interfaces for routing the connection. This function uses the information provided in the signalling or management messages (e.g. address, interface ID, etc), and the routing tables. The routing function and/or the routing tables may be present, partially present, or may not be present in the equipment, depending on operator/vendor policy. If several solutions (i.e. interface ID) are acceptable, the routing function then evaluates which is the best one. The selection of the best solution is based on various criteria (e.g. network policy): these criteria and the configuration of the routing function need further studies.
2) The EAC function makes use of an interface ID and of traffic characteristics to determine whether a request can be accepted or not. The EAC derives the resources to be assigned to the connection according to an implementation dependant algorithm. The EAC can then reject or accept the solution depending on the resource tables: VPI/VCI, TP bandwidth, buffer space.
3) If the EAC accepts the connection, it then updates the different tables and parameters (VPC/VCI, TP bandwidth tables, buffer space tables, UPC/NPC parameters, shaping parameters).
4) If the EAC rejects the solution, then the routing function can propose an alternative interface ID, if available. In that case, the process loops to step (2).

7.5.2 Request to modify the traffic characteristics of an existing ATM VP or VC connection

The processing of such a request includes the second and third steps of the establishing/releasing request previously described. The main difference is that if the bandwidth is available, no routing is implied for this type of request, because the connection already exists. The EAC only accepts or rejects the request, depending on real-time resource availability. The fourth step, in the case of a re-negotiation (when it is not possible to simply increase the bandwidth on the existing route), needs further study: one could envisage a new routing process to try to cope with the request when the current working interface is not able to support it, by trying to find another interface within the equipment able to route the connection. This aspect is for further study.

The admission of the connection is then indicated to the Management/Signalling/RM Applications by the SLAD function.

7.6 Method for reducing outages on resource modification

For further study: There is a problem with a request for resource increase if the current TP cannot provide the extra capacity. Although the existing connection could be taken down and a new connection created in another TP, there will be a delay due to CAC process, equipment configuration time and at least one e-to-e cell propagation delay. These delays will be perceived as a break in service by the user. Even worse, there is a risk that the new connection request will fail and the connection falls back to the original connection on the original TP causing a longer outage.

It would be advantageous if a technique could be developed to establish an alternate path with the requested higher capacity, fill it with cells and then force the network to switch over. This sounds similar to the techniques used in 1 + 1 ATM protection where there is a second path with identical traffic that can be switched to in the event of the working link failing.

The concept proposed is to create a "protection path" with higher bandwidth, wait until the protection path has filled with traffic then command a switchover to the "protection path". This would then be followed by a cessation of the original path so that just the new higher bandwidth path remains.

ANNEX A

Relationship between B-ISDN PRM and I.326 representations of an ATM NE

The relationship between the generic B-ISDN Protocol Reference Model (PRM) and the generic equipment modelling methodology derived from ITU-T G.805 and I.326 is used to establish the equivalence between the two representations.

For the modelling of an ATM NE, the important result of the B-ISDN PRM is the relationship between the User (Transfer) Plane, Layer Management, AEMF and Control Plane functions in the support of all B-ISDN services.

However, the B-ISDN PRM, although necessary for the overall description of an ATM NE, is not sufficient for the detailed functional description required to enable interoperability between ATM equipment, since each layer in the PRM may consist of numerous processes. In this Recommendation and I.731 [10] we have not been strict and have often interchangeably used the words "functions" and "processes".

To represent the detailed function model, the equipment modelling methodology used in ITU-T G.805 and I.326 [7] is employed for the functions within each layer of the PRM. Consequently, each layer of the PRM is further decomposed into the Termination, Adaptation, and Connection functions described in ITU-T I.326.

In addition, each of these functions needs to be further decomposed into the individual processes required for the operation of the ATM equipment. The relationship between the individual elements must also be defined within the context of the overall PRM. This is illustrated in Figure A.1.

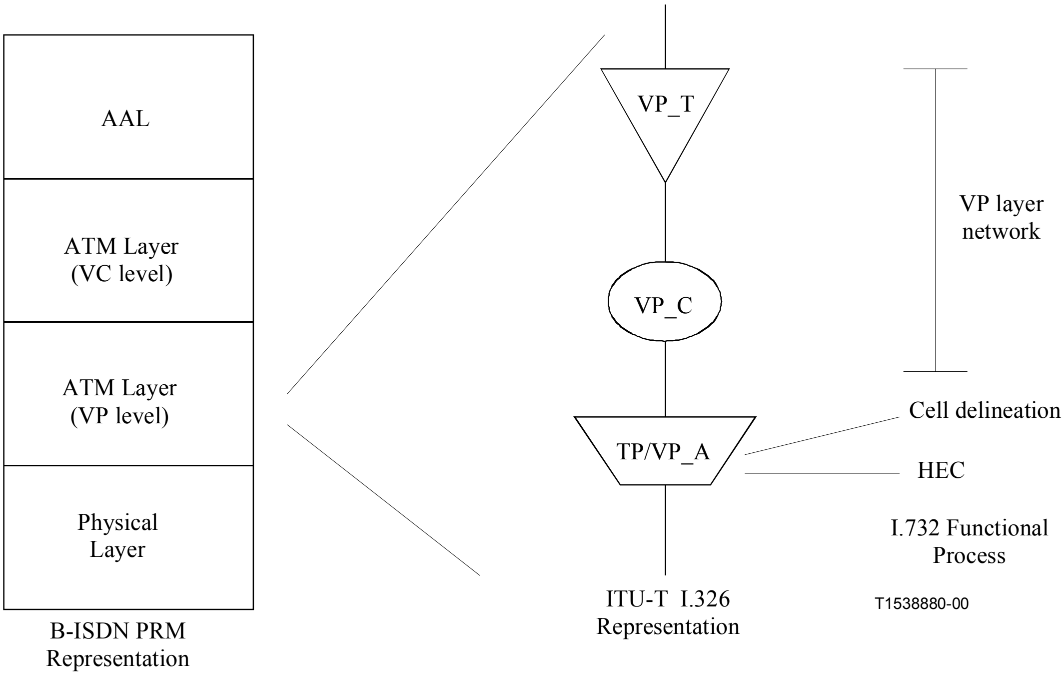


Figure A.1/I.732 – Relationship between PRM and I.326 Model

ANNEX B

Examples of ATM equipment

This annex intends to provide examples of ATM equipment. This annex is not aimed to be exhaustive. Other combinations of blocks may be possible (see clause 6/I.731).

Classification of ATM equipment

The basic criteria used for classification of equipment types are:

1) signalling capability, which refers to the presence of signalling applications inside the equipment;

2) connectivity.

Restricted connectivity implies that:

a) the equipment has multiple transfer interfaces towards user side and only one transfer interface towards the network;

b) there is no connectivity between the user side interfaces.

Unrestricted connectivity implies that a) and/or b) above may not apply.

Those basic criteria lead to the following equipment types (see Table B.1):

Table B.1/I.732 – ATM equipment types

Basic equipment types	Signalling Capability	
	No	Yes
Unrestricted connectivity	Cross-connect	Switch
Restricted connectivity	Multiplexer	On-demand multiplexer

Additional distinguishing characteristics are:

1) VPI based connectivity or (VPI, VCI) based connectivity;

2) presence of Interworking functions for support of non-ATM interfaces.

Those additional distinguishing characteristics lead to the following derived equipment types (see Tables B.2 to B.5).

Table B.2/I.732 – Cross-connect types

Cross-connect types		VPI based connectivity	(VPI, VCI) based connectivity
Interworking function	No	VP Cross-connect	VC Cross-connect
for support of non-ATM interfaces	Yes	Interworking VP Cross-connect	Interworking VC Cross-connect

Table B.3/I.732 – Switch types

Switch types		VPI based connectivity	(VPI, VCI) based connectivity
Interworking function	No	VP Switch	VC Switch
for support of non-ATM interfaces	Yes	Interworking VP Switch	Interworking VC Switch

Table B.4/I.732 – Multiplexer types

Multiplexer types		VPI based connectivity	(VPI, VCI) based connectivity
Interworking function	No	VP multiplexer	VC multiplexer
for support of non-ATM interfaces	Yes	Interworking VP multiplexer (Note)	Interworking VC multiplexer (Note)
NOTE – Interworking multiplexer is sometimes called a "Services Multiplexer".			

Table B.5/I.732 – On-demand multiplexer types

On-demand multiplexer types		VPI based connectivity	(VPI, VCI) based connectivity
Interworking function	No	VP On-demand multiplexer	VC On-demand multiplexer
for support of non-ATM interfaces	Yes	Interworking On-demand VP multiplexer (Note)	Interworking On-demand VC multiplexer (Note)
NOTE – Interworking multiplexer is sometimes called a "Services Multiplexer".			

ANNEX C

Correspondence between I.732 and I.751 models

Introduction

The following provides a correspondence between the I.751 managed object classes and the I.732 functions. Moreover it provides a definition of the terms "ingress" and "egress" which are specified in ITU-T I.751 for description of the attributes.

Definition of ingress and egress concept in ITU-T I.751

ITU-T I.751 uses concepts of "Egress" and "Ingress" parameters.

Figure C.1 shows how to understand the terms Ingress and Egress, by giving the example of a bidirectional communication composed by two connections (X→Y and Y→X) between two users X and Y. One can of course extend this concept to other object classes of I.751 than VPCTPbid.

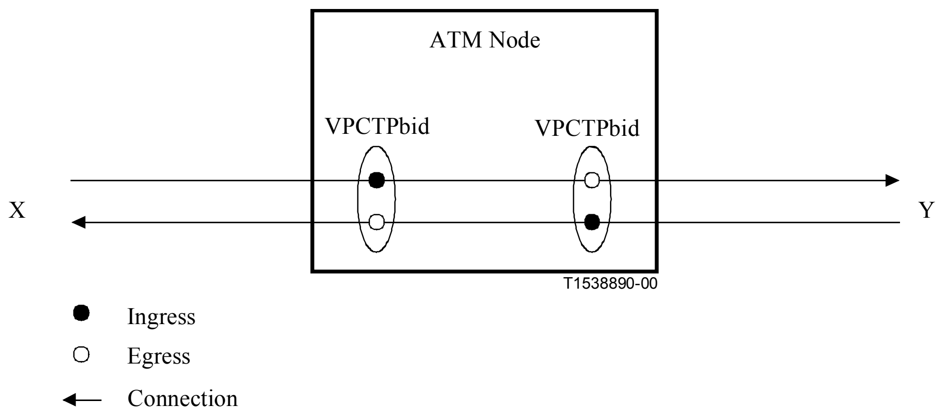


Figure C.1/I.732 – Usage of Ingress and Egress terms in I.751

Correspondence between I.732 functions and I.751 managed object classes is for further study.

ANNEX D

Library of Atomic Functions

D.1 Definitions, abbreviations and symbols

D.1.1 Definitions

The functional definitions are described in ITU-T G.806, G.805, I.326 and G.783.

D.1.2 Abbreviations

A Adaptation function

a Consequent Action

ACS ATM Cell Start

AD Activation/Deactivation

AEMF ATM Element Management Function

AI Adapted Information

AIS	Alarm Indication Signal
AP	Access Point
APId	Access Point Identifier
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
BRPM	Backward Report Performance Monitoring
C	Connection function
c	fault cause
CBDS	Connectionless Broadband Data Service
CCAD	Continuity Check Activation/Deactivation
CEP	Connection End Point
CI	Characteristic Information
CK	Clock
CLP	Cell Loss Priority
CNGI	Congestion Indication
CP	Connection Point
D	Data
d	defect correlation
DTDL	Defect Type and Defect Location
EDC	Error Detection Code
EFCI	Explicit Forward Congestion Indicator
F4E	F4 End-to-end Flow
F4S	F4 Segment Flow
F_DS	Far-end Defect Second
FA	Frame Alignment
FS	Frame Start signal
GFC	Generic Flow Control
HDLC	High-level Data Link Control procedure
HEC	Header Error Check
Hex	Hexadecimal
ISF	Incoming Signal Fail
ITU	International Telecommunication Union
LAN	Local Area Network
LB	Loopback
LCD	Loss of Cell Delineation
LLID	Loopback Location IDentifier
LM	Layer Management

LOC	Loss of Continuity
MA	Maintenance and Adaptation
MI	Management Information
N_DS	Near-end Defect Second
NE	Network Element
N-ISDN	Narrow-band Integrated Services Digital Network
NNI	Network Node Interface
NPC	Network Parameter Control
OAM	Operation, Administration and Maintenance
OCD	Out of Cell Delineation
P12s	2048 kbit/s PDH path layer with synchronous 125 μs frame structure
P31s	34 368 kbit/s PDH path layer with synchronous 125 μs frame structure
PDH	Plesiochronous Digital Hierarchy
PLM	Payload Mismatch
PM	Performance Monitoring
PM	Physical Media
PMAD	Performance Monitoring Activation/Deactivation
POH	Path OverHead
PRM	Protocol Reference Model
PT	Payload Type
PTI	Payload Type Identifier
QoS	Quality Of Service
RDI	Remote Defect Indicator
REI	Remote Error Indicator
RI	Remote Information
S	Segment
S4	VC-4 path layer
SDH	Synchronous Digital Hierarchy
SEP	Segment End Point
Sk	Sink
SLOC	Segment Loss of Continuity
So	Source
SSF	Server Signal Fail
T	Traffic Management
TCP	Termination Connection Point
TI	Timing Information
TP	Timing Point

TP	Transmission Path
TSF	Trail Signal Fail
TT	Trail Termination function
UNI	User Network Interface
UPC	Usage Parameter Control
VC	Virtual Channel
VC	Virtual Container
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VCLB	Virtual Channel LoopBack function
VCLBR	Virtual Channel LoopBack function (Reduced functionality)
VCM	Virtual Channel non-intrusive Monitoring function
VCS	Virtual Channel Segment function
VCSM	Virtual Channel Segment non-intrusive Monitoring function
VCTM	Virtual Channel Traffic Management function
VP	Virtual Path
VPC	Virtual Path Connection
VPI	Virtual Path Identifier
VPLB	Virtual Path LoopBack function
VPLBR	Virtual Path LoopBack function (Reduced functionality)
VPM	Virtual Path non-intrusive Monitoring function
VPS	Virtual Path Segment function
VPSM	Virtual Path Segment non-intrusive Monitoring function
VPTM	Virtual Path Traffic Management function

D.1.3 Symbols and diagrammatic conventions

The symbols and diagrammatic conventions are based on ITU-T G.805 and I.326.

D.1.4 Introduction

The atomic functions used in the TP convergence, ATM VP and VC Layer Networks and their associated Adaptation functions are defined in this annex.

This annex is structured in the following manner:

- Transmission Path to VP Adaptation Functions:
  - SDH Adaptation Functions;
  - Cell Based Adaptation Functions;
  - PDH Adaptation Function.
- VP Layer Network, including Connection, Trail Termination, Segment, Traffic Management, Monitoring and Loopback Functions.
- VP to VC Adaptation Functions.

- VC Layer Network, including Connection, Trail Termination, Segment, Traffic Management, Monitoring and Loopback Functions.
- VC to ATM Client Layer Adaptation Functions.

The Layer Networks and Adaptation functions are defined for the purpose of the user to group them into a higher level grouping, if required. The decomposition of the atomic function sequence into Layer Networks and Adaptation functions corresponds to the view of ITU-T G.805. It also represents the common basis view from the SDH and ATM history perspective, since ITU-T G.803 (defining SDH networks) as well as ITU-T I.326 (defining ATM networks) are both based on ITU-T G.805.

For the SDH view, the grouping used in ITU-T G.803 is the Network Layer (or simply called Layer). It associates the Layer Network and the Adaptation function in Client Layer direction into the grouping called "Network Layer".

For the ATM view, the grouping used in ITU-T I.326 is the Transport Assembly, also called VP Level resp. VC Level. It associates the Layer Network and the Adaptation function in Server direction into the grouping called "VP Level", resp. "VC Level".

In the PRM view, the entity called ATM Layer comprises the VC layer network, the VP/VC Adaptation function, the VP layer network and some of the processes of the TP/VP Adaptation function.

Figure D.1 shows the grouping of Adaptation functions and Layer Networks according to the various views.

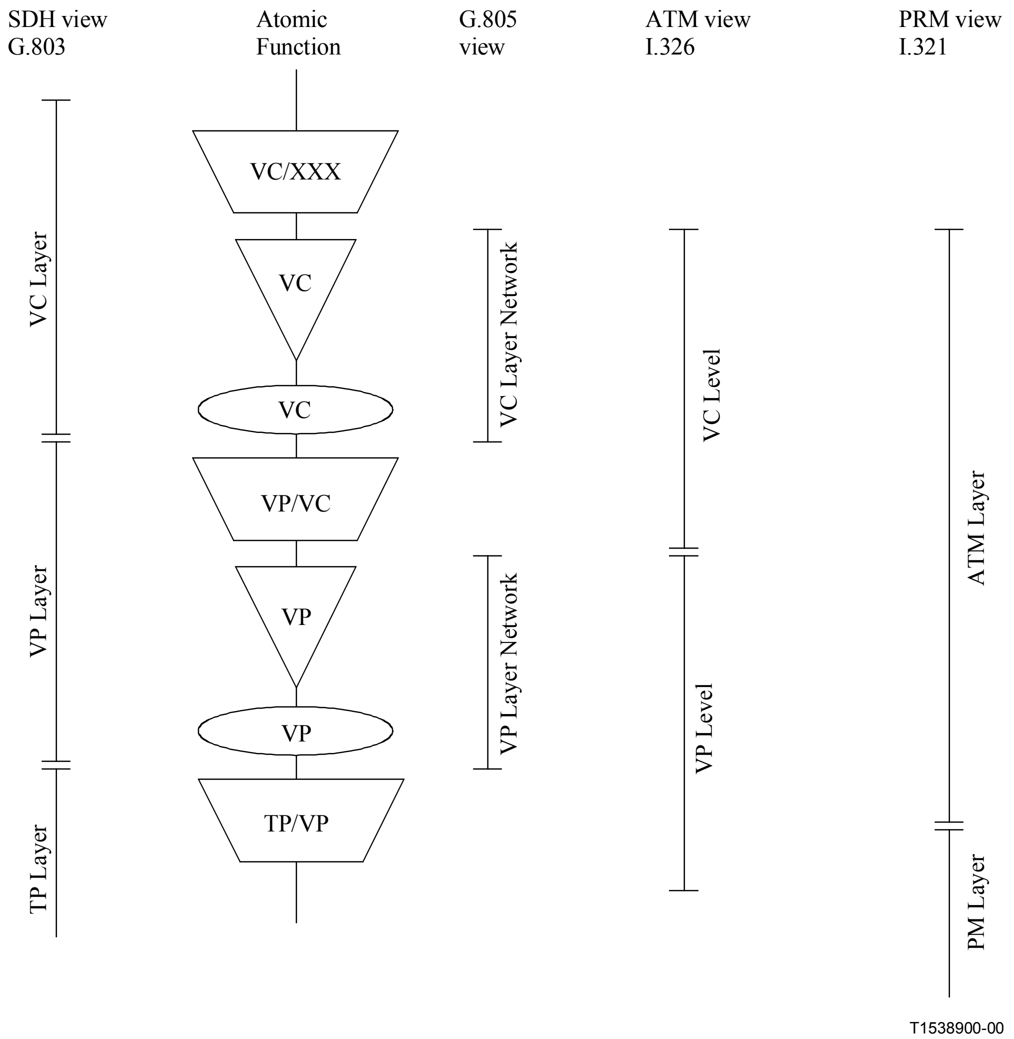


Figure D.1/I.732 – Different views for the grouping of the adaptation functions

In this annex, each Atomic Function is described by:

– A symbol, decomposed into a Transfer function and Layer Management part.

– A table, listing all input and output signals into and out of the Atomic Function.

– A list of processes, being listed in the order of the information flow. The names of the processes are written in *italics*. Where applicable, the process description is decomposed into a Transfer Function and Layer Management part.

– A Defects section, specifying the conditions for a defect to be declared/cleared. Forms part of the Layer Management.

– A Performance Management section, detailing the parameters to be evaluated and counted. Forms part of the Layer Management.

– A Coordination Functions section, consisting of a description of Consequent Actions and Defect Correlations.

D.2 Transmission Path to ATM Virtual Path Adaptation Functions

D.2.1 S3 Path Adaptation Functions

D.2.1.1 S3 Path to ATM Virtual Path Adaptation Source Function S3/VP_A_So

Symbol

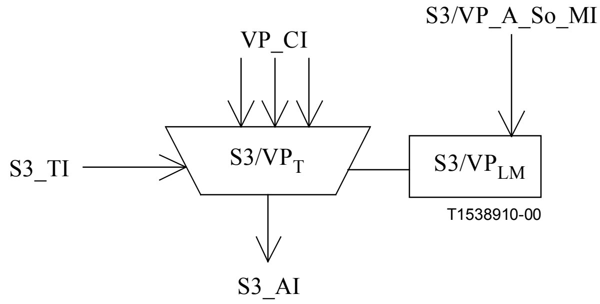


Figure D.2/I.732 – S3/VP_A_So symbol

Interfaces

Table D.1/I.732 – S3/VP_A_So input and output signals

Input(s)	Output(s)
per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF S3_TI_CK S3_TI_FS S3/VP_A_So_MI_Active S3/VP_A_So_MI_CellDiscardActive S3/VP_A_So_MI_TpusgActive S3/VP_A_So_MI_GFCActive S3/VP_A_So_MI_VPI-Kactive	S3_AI_D S3_AI_CK S3_AI_FS

Processes

The S3/VP_A_So function provides adaptation from the ATM Virtual Path to the VC-3 path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.3.

Activation:

– Layer Management function: The S3/VP_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

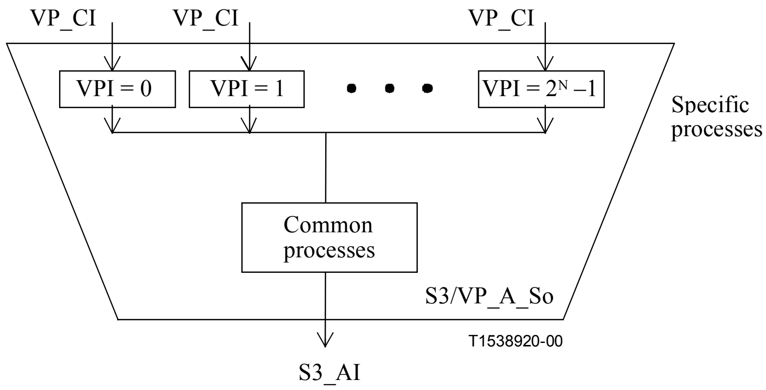


Figure D.3/I.732 – S3/VP_A_So atomic function decomposed into Specific and Common processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Specific Processes

These Processes include VPI setting as well as VP asynchronous multiplexing. Each of these Specific Processes is characterised by the Virtual Path Identifier number K, where $0 \le K \le 2^N - 1$.

NOTE 2 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true)

The format of the Characteristic Information (VP_CI) is given in Figure D.4.

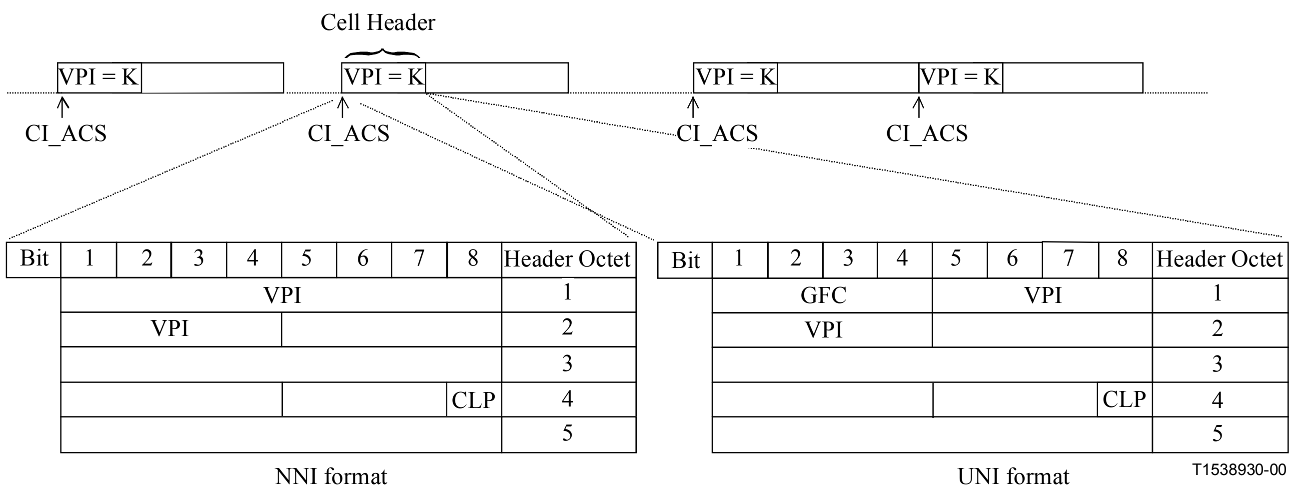


Figure D.4/I.732 – VP_CI (NNI format)

VPI setting:

– Transfer function: VPI setting inserts the value of "K" as VPI for each active Specific function.

– Layer Management function: VPI setting is based on the activation of the Specific function by MI_VPI-KActive.

VP multiplexing:

– Transfer function: Asynchronous multiplexing is performed for each active Specific function.

Common Processes

The Common Processes include: Congestion control (selective cell discard (CLP based)), GFC processing, TP usage measurement, cell rate decoupling, HEC processing, cell information field scrambling, cell stream mapping and processing of the payload specific bytes C2 and H4, to the VC-3 Path OverHead (POH). The logical ordering of the processes from input to output must be maintained.

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
									4
	HEC								5

UNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
									4
	HEC								5

NNI format

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Figure D.5/I.732 – Cell header information processed in S3/VP_A_So

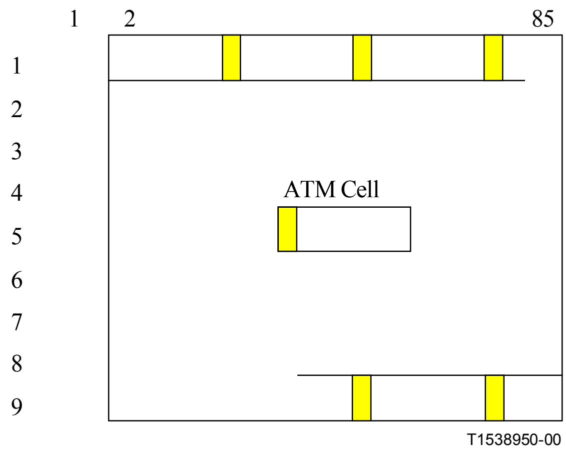

Figure D.6/I.732 – ATM cell stream mapping into Container-3 structure

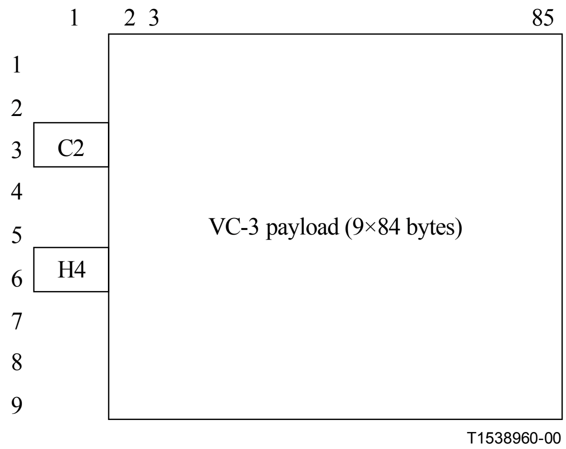

Figure D.7/I.732 – S3_AI_So_D

Congestion control:

– Transfer function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value. In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the Explicit Forward Congestion Indicator (EFCI) marking in the Payload Type Identifier (PTI) field is set according to ITU-T I.361.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process sets the GFC field. The GFC field processing is defined in ITU-T I.150 and ITU-T I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). If enabled by MI_GFCActive = true, this process shall insert the GFC protocol in the GFC field. If the GFC function is not supported or the GFC function disabled by MI_GFCActive = false, the binary contents of the GFC field shall be set to "0000". In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure.

TP usage measurement:

– Transfer function: Cell transmission is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Cell rate decoupling:

– Transfer function: This process takes the ATM cell stream present at its input and inserts it into the synchronous container having a capacity of 765 bytes adding fixed stuff idle cells. The idle cells format is specified in ITU-T I.361. The cell rate decoupling process makes use of the VC-3 timing clock, frame position (S3_TI), and idle cell generator.

HEC Processing:

– Transfer function: The HEC value for each cell is calculated and inserted into the HEC field. The method of HEC value calculation shall be according to ITU-T I.432.1.

Cell information field scrambling:

– Transfer function: The self synchronising scrambler polynomial $x^{43} + 1$ has been identified for the SDH-based transmission paths and minimises the error multiplication introduced by the self synchronising scrambling process. It scrambles the information field bits only. The operation of the scrambler shall be according to 4.3.4/I.432.1.

Cell stream mapping:

– Transfer function: The octet structure of ATM cells shall be aligned with the octet structure of Container-3 as shown in Figure D.6.

Processing of the payload specific bytes:

– Transfer function:

  H4: This payload dependent byte is not used for the mapping of ATM cells into VC-3. The contents of this byte shall be 00Hex.

  C2: In this byte the process shall insert code "0001 0011" (ATM mapping) as defined in ITU-T G.707.

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The parameters for the following processes need to be defined:

- TP usage measurement;
- Count of discarded cells from congestion control.

Coordination Functions

Consequent Actions

None.

Defect Correlation

None.

D.2.1.2 S3 Path to ATM Virtual Path Adaptation Sink Function S3/VP_A_Sk

Symbol

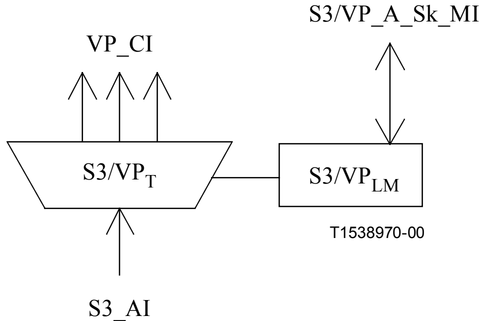

Figure D.8/I.732 – S3/VP_A_Sk symbol

Interfaces

Table D.2/I.732 – S3/VP_A_Sk input and output signals

Input(s)	Output(s)
S3_AI_D S3_AI_CK S3_AI_FS S3_AI_TSF S3/VP_A_Sk_MI_Active S3/VP_A_Sk_MI_CellDiscardActive S3/VP_A_Sk_MI_TpusgActive S3/VP_A_Sk_MI_VPIrange S3/VP_A_Sk_MI_HECactive S3/VP_A_Sk_MI_GFCactive S3/VP_A_Sk_MI_DTDLuseEnabled S3/VP_A_Sk_MI_VPI-Kactive S3/VP_A_Sk_MI_VPI-K_SAISactive	per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF VP_CI_CNGI S3/VP_A_Sk_MI_cPLM S3/VP_A_Sk_MI_cLCD

Processes

The S3/VP_A_Sk function provides adaptation from the VC-3 Path to the ATM Virtual Path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.9.

Activation:

– Layer Management function: The S3/VP_A_Sk function shall perform the Common and Specific Processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF) and not report its status via the management point.

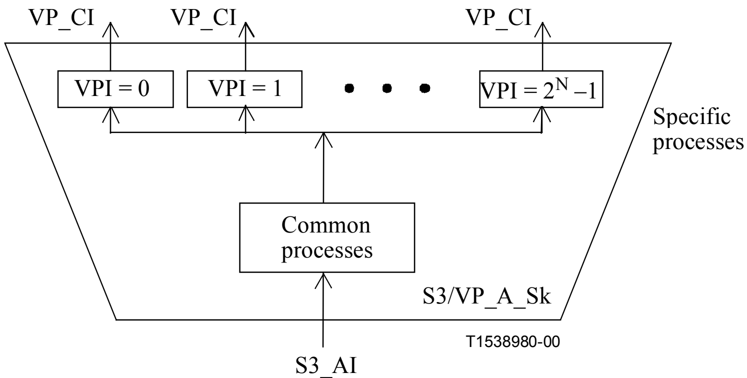

Figure D.9/I.732 – S3/VP_A_Sk atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Common Processes

These Common Processes include: Handling of the payload specific bytes (C2 and H4), demapping, cell delineation, cell information field descrambling, HEC processing, cell rate decoupling, TP usage measurement, header verification, GFC processing, VPI verification and congestion control (selective cell discard (CLP based)). The logical ordering of these processes from input to output must be maintained.

Handling of payload specific bytes:

– Transfer function:

  C2: The process extracts the C2 byte to the Layer Management function.

  H4: This payload dependent byte is not used for this mapping and the receiver shall ignore its contents.

– Layer Management:

  C2: The process shall compare the contents of the accepted C2 byte with the expected value code "0001 0011" (ATM mapping) as a check on consistency between the provisioning operation at each end. The application, acceptance and mismatch detection processes are described in the defects section below.

Demapping:

– Transfer function: The cell stream shall be extracted from C-3 container in the S3_AI in accordance with ITU-T G.707.

Cell Delineation:

– Transfer function: Cell delineation is performed on the continuous cell stream. The cell delineation algorithm should be in accordance with ITU-T I.432.1. The OCD events are indicated to the Layer Management function.

– Layer Management function: Loss of Cell Delineation defect (dLCD) shall be declared as in the defects section below.

Cell information field descrambling:

– Transfer function: The self synchronising descrambler polynomial $x^{43} + 1$ has been identified for the SDH-based transmission paths and minimises the error multiplication introduced by the self synchronising scrambling process (factor 2). It descrambles the information field bits only. The operation of the descrambler in relation to the HEC cell delineation state diagram shall be according to 4.3.4/I.432.1.

HEC Processing:

– Transfer function: HEC verification and correction shall be according to ITU-T I.432.1. Cells determined to have an invalid and incorrectible HEC pattern shall be discarded.

– Layer Management function: A count of invalid HEC events and a count of invalid HEC cell discard events are maintained with threshold crossings checked. HEC correction mode may be activated/deactivated by MI_HECactive. The HEC correction mode should be activated by default.

Cell rate decoupling:

– Transfer function: The process shall extract the idle cells used as fixed stuff in the far-end S3/VP adaptation source function.

TP usage measurement:

– Transfer function: The cell reception is indicated to the Layer Management function.

– Layer Management function: The process shall count the received cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Header verification:

– Transfer function: The receiving ATM NE shall verify that the first four octets of the ATM cell header are recognizable as being a valid header pattern. Cells with unrecognized header patterns shall be discarded. An indication of an invalid header cell discard event is provided to layer management.

 Invalid header patterns from paths based on SDH/PDH transmission systems are as follows (except idle cell)(x = any value):

	GFC	VPI	VCI	PTI	CLP
UNI	Xxxx	all 0s	All 0s	Xxx	1

	VPI		VCI	PTI	CLP
NNI	all 0s		All 0s	xxx	1

– Layer Management function: The process shall count the invalid header cell discard event.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process extracts the GFC field. The GFC field processing is defined in ITU-T I.150 and ITU-T I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall extract the GFC protocol from the GFC field.

 NOTE 2 – According to the Protocol Reference Model (ITU-T I.321), the unassigned cells should be processed in the ATM layer. Some of the ATM layer processes are adaptation processes belonging to the adaptation function between the TP and the VP layer network. The unassigned cells as well as idle cells are per physical connection (VPI = 0, VCI = 0). For this reason the idle and unassigned cells processing is allocated to the same atomic function.

VPI verification:

– Transfer function: The process shall verify that the received cell VPI is valid. If the VPI is determined to be invalid (i.e. out-of-range VPI or not assigned), the cell shall be discarded. An indication of the invalid VPI cell discard events is provided to the Layer Management function.

– Layer Management function: The range of valid VPIs is given by MI_VPIrange. The invalid VPI cell discard events are counted.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the indication VP_CI_CNGI is set for the traffic management function VPTM_TT_So to insert EFCI on all VPs.

– Layer Management function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

Specific Processes

The function performs end-to-end VP-AIS insertion, segment VP-AIS insertion and demultiplexing on a per VP basis.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true). Otherwise, it shall send no cells and SSF = false.

End-to-end VP-AIS insertion:

– Transfer function: This process inserts end-to-end VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: End-to-end VP-AIS cells (Figure D.10) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function.

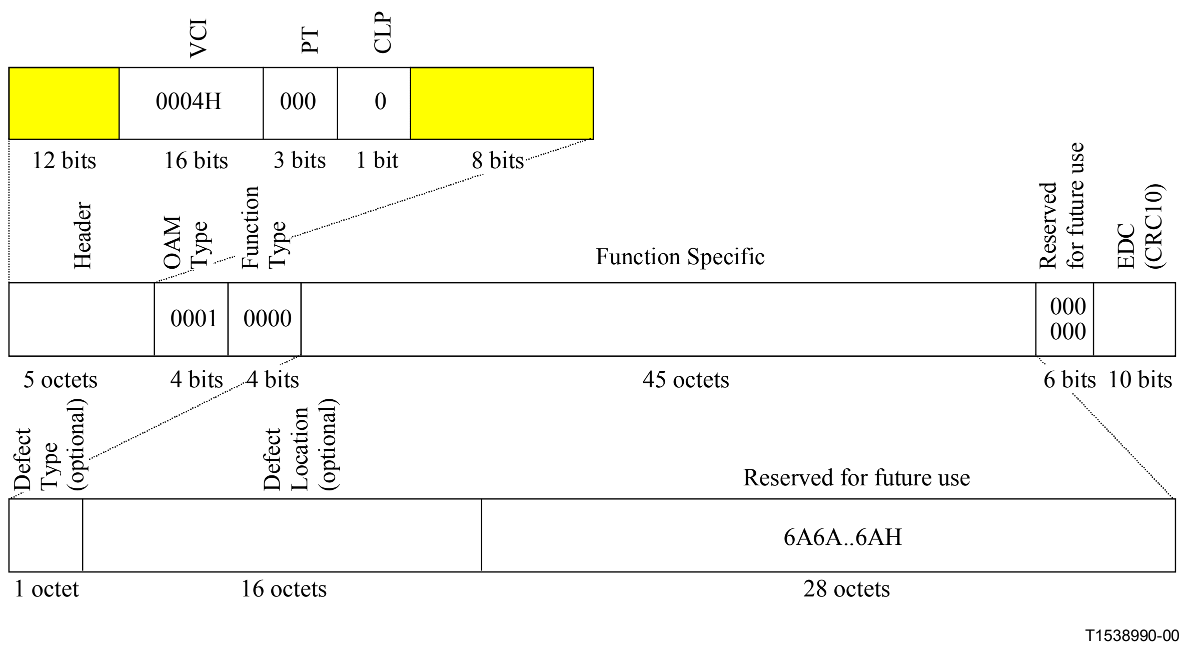

Figure D.10/I.732 – End-to-end VP-AIS OAM cell as part of the VP_CI

The value of the VCI, Payload Type (PT), CLP, OAM Type, Function Type, Defect Type, Defect Location, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Segment VP-AIS insertion:

– Transfer function: This process inserts segment VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: Segment VP-AIS cells (Figure D.11) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function and the segment VP-AIS cells insertion is also activated (MI_VPI-K_SAISactive is true).

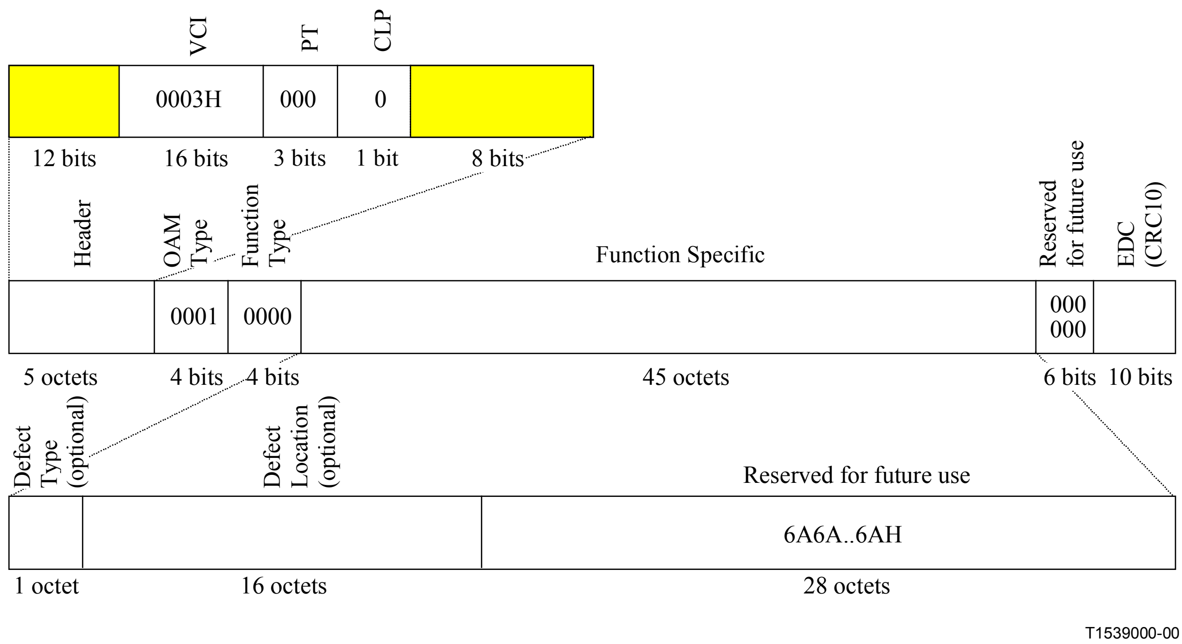

Figure D.11/I.732 – Segment VP-AIS OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Defect Type, Defect Location, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

VP demultiplexing:

– Transfer function: The adaptation sink function has access to a specific VP identified by the number K ($0 \le K \le 2^N - 1$). For each active Specific Function, only the cells of that specific VPI-K are passed in client direction.

NOTE 3 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

Defects

The function shall detect for the dPLM defect according to ITU-T G.783, and for the dLCD defect according to ITU-T I.432.2.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The parameters for the following processes need to be defined:

- TP usage measurement;
- Count of discarded cells from congestion control;
- Count of invalid HEC events;
- Count of invalid HEC discard events;
- Count of invalid header discard events (one common counter for invalid header/invalid VPI/invalid VCI is maintained);
- OCD event.

Coordination Functions

Consequent Actions:

aCNGI ← "Event of Congestion" and CellDiscardActive

aSSF ← dPLM or dLCD or AI_TSF

aAIS ← dPLM or dLCD or AI_TSF

On declaration of aAIS, the function shall output end-to-end VP-AIS cells (Figure D.10) on all active VPCs and segment VP-AIS cells (Figure D.13) on all active VPCs for which MI_SAISactive is true, according to 9.2.1.1.1.1/I.610. On clearing of aAIS, the generation of end-to-end and segment VP-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option, or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end and segment VP-AIS cell shall be coded as 6AH. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end and segment VP-AIS cells.

NOTE 4 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, the fields shall be encoded as 6AH.

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations:

cPLM ← dPLM and (not AI_TSF)

cLCD ← dLCD and (not dPLM) and (not AI_TSF)

D.2.2 S4 Path Adaptation Functions

D.2.2.1 S4 Path to ATM Virtual Path Adaptation Source Function S4/VP_A_So

Symbol

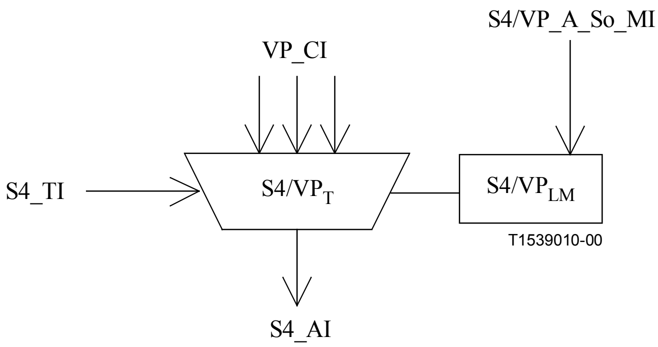

Figure D.12/I.732 – S4/VP_A_So symbol

Interfaces

Table D.3/I.732 – S4/VP_A_So input and output signals

Input(s)	Output(s)
per VP_CI, for each VP configured:VP_CI_D VP_CI_ACS VP_CI_SSF S4_TI_CK S4_TI_FS S4/VP_A_So_MI_Active S4/VP_A_So_MI_CellDiscardActive S4/VP_A_So_MI_TPusgActive S4/VP_A_So_MI_GFCActive S4/VP_A_So_MI_VPI-KActive	S4_AI_D S4_AI_CK S4_AI_FS

Processes

The S4/VP_A_So function provides adaptation from the ATM Virtual Path layer to the VC-4 path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.13.

Activation:

– Layer Management function: The S4/VP_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

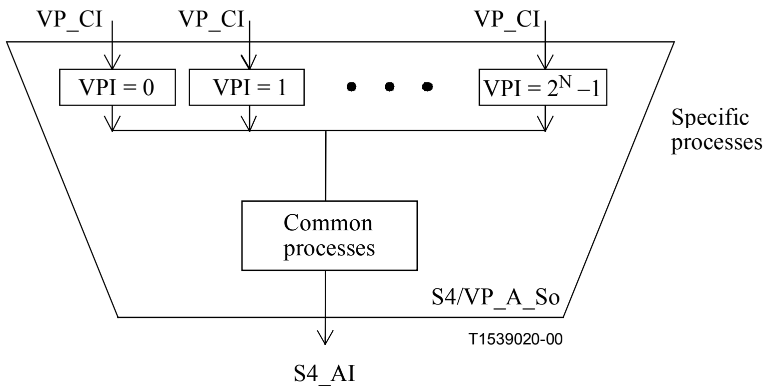

Figure D.13/I.732 – S4/VP_A_So atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Specific Processes

These Processes include VPI setting as well as VP asynchronous multiplexing. Each of these Specific Processes is characterised by the Virtual Path Identifier number K, where $0 \le K \le 2^N - 1$.

NOTE 2 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true).

The format of the Characteristic Information (VP_CI) is given in Figure D.14.

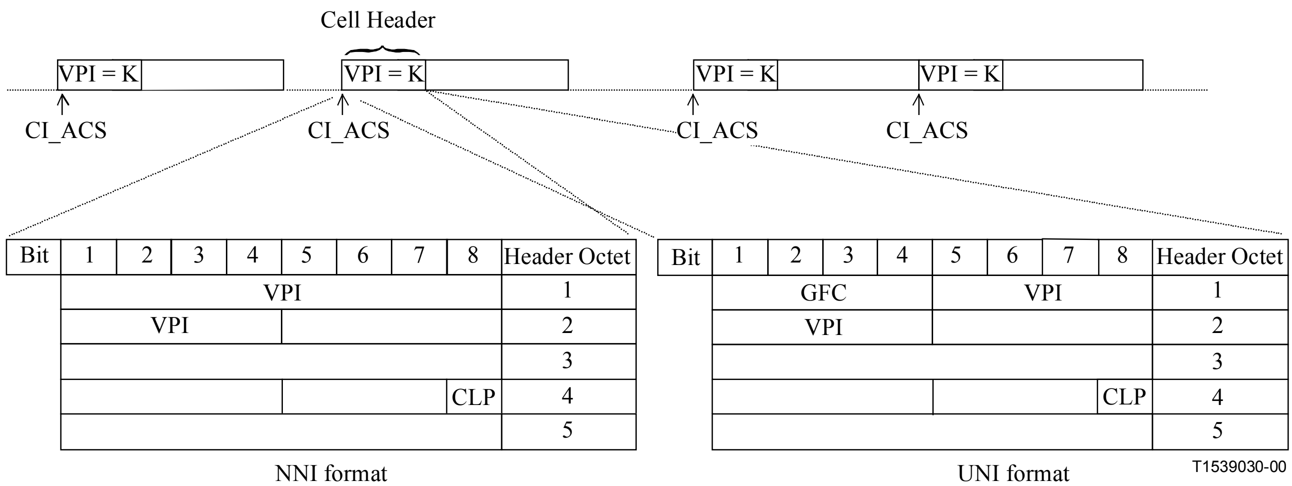

Figure D.14/I.732 – VP_CI (NNI format)

VPI setting

– Transfer function: VPI setting inserts the value of "K" as VPI for each active Specific Function.

– Layer Management function: VPI setting is based on the activation of the Specific function by MI_VPI-KActive.

VP multiplexing:

– Transfer function: Asynchronous multiplexing is performed for each active Specific function.

Common Processes

The Common Processes include: Congestion control (selective cell discard (CLP based)), GFC processing, TP usage measurement, cell rate decoupling, HEC processing, cell information field scrambling, cell stream mapping and processing of the payload specific bytes C2 and H4, to the VC-4 POH. The logical ordering of the processes from input to output must be maintained.

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
									4
	HEC								5

UNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
									4
	HEC								5

NNI format

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Figure D.15/I.732 – Cell header information processed in S4/VP_A_So

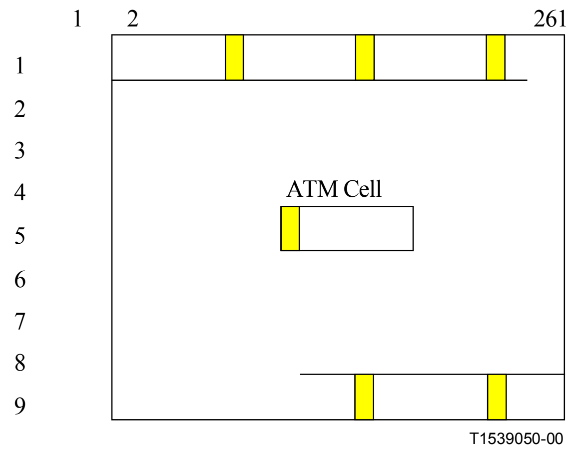


Figure D.16/I.732 – ATM cell stream mapping into Container-4 structure

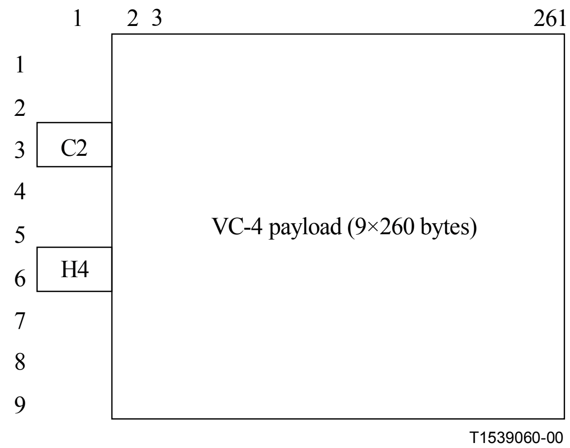


Figure D.17/I.732 – S4_AI_So_D

Congestion control:

– Transfer function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value. In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process sets the GFC field. The GFC field processing is defined in ITU-T I.150 and ITU-T I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall insert the GFC protocol in the GFC field. If the GFC function is not supported or the GFC function disabled by MI_GFCActive = false, the binary contents of the GFC field shall be set to "0000".

TP usage measurement:

– Transfer function: Cell transmission is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Cell rate decoupling:

– Transfer function: This process takes the ATM cell stream present at its input and inserts it into the synchronous container having a capacity of 2340 bytes adding fixed stuff idle cells. The idle cells format is specified in ITU-T I.361. The cell rate decoupling process makes use of the VC-4 timing clock, frame position (S4_TI), and idle cell generator.

HEC Processing:

– Transfer function: The HEC value for each cell is calculated and inserted into the HEC field. The method of HEC value calculation shall be according to ITU-T I.432.1.

Cell information field scrambling:

– Transfer function: The self synchronising scrambler polynomial $x^{43} + 1$ has been identified for the SDH-based transmission paths and minimises the error multiplication introduced by the self synchronising scrambling process. It scrambles the information field bits only. The operation of the scrambler shall be according to 4.3.4/I.432.1.

Cell stream mapping:

– Transfer function: The octet structure of ATM cells shall be aligned with the octet structure of Container-4 as shown in Figure D.16.

Processing of the payload specific bytes:

– Transfer function:

H4: This payload dependent byte is not used for the mapping of ATM cells into VC-4. The contents of this byte shall be 00Hex.

C2: In this byte the process shall insert code "0001 0011" (ATM mapping) as defined in ITU-T G.707.

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters are for further study. The parameters for the following processes need to be defined:

- TP usage measurement;
- Count of discarded cells from congestion control.

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.2.2.2 S4 Path to ATM Virtual Path Adaptation Sink Function S4/VP_A_Sk

Symbol

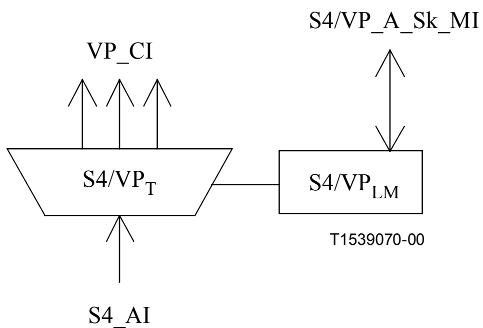


Figure D.18/I.732 – S4/VP_A_Sk symbol

Interfaces

Table D.4/I.732 – S4/VP_A_Sk input and output signals

Input(s)	Output(s)
S4_AI_D S4_AI_CK S4_AI_FS S4_AI_TSF S4/VP_A_Sk_MI_Active S4/VP_A_Sk_MI_CellDiscardActive S4/VP_A_Sk_MI_TPusgActive S4/VP_A_Sk_MI_VPIrange S4/VP_A_Sk_MI_HECactive S4/VP_A_Sk_MI_GFCactive S4/VP_A_Sk_MI_ DTDLuseEnabled S4/VP_A_Sk_MI_VPI-Kactive S4/VP_A_Sk_MI_VPI-K_SAISactive	per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF VP_CI_CNGI S4/VP_A_Sk_MI_cPLM S4/VP_A_Sk_MI_cLCD

Processes

The S4/VP_A_Sk function provides adaptation from the VC-4 Path to the ATM Virtual Path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.19.

Activation:

– Layer Management function: The S4/VP_A_Sk function shall perform the Common and Specific Processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF) and not report its status via the management point.

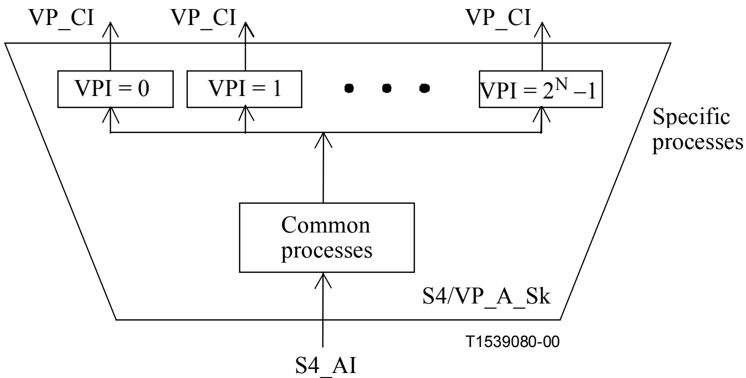


Figure D.19/I.732 – S4/VP_A_Sk atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Common Processes

These Common Processes include: Handling of the payload specific bytes (C2 and H4), demapping, cell delineation, cell information field descrambling, HEC processing, cell rate decoupling, TP usage measurement, header verification, GFC processing, VPI verification and congestion control (selective cell discard (CLP based)). The logical ordering of these processes from input to output must be maintained.

Handling of payload specific bytes:

– Transfer function:

  C2: The process extracts the C2 byte to the Layer Management function.

  H4: This payload dependent byte is not used for this mapping and the receiver shall ignore its contents.

– Layer Management:

  C2: The process shall compare the contents of the accepted C2 byte with the expected value code "0001 0011" (ATM mapping) as a check on consistency between the provisioning operation at each end. The application, acceptance and mismatch detection processes are described in the defects section below.

Demapping:

– Transfer function: The cell stream shall be extracted from C-4 container in the S4_AI in accordance with ITU-T G.707.

Cell Delineation:

– Transfer function: Cell delineation is performed on the continuous cell stream. The cell delineation algorithm should be in accordance with ITU-T I.432.1. The OCD events are indicated to the Layer Management function.

– Layer Management function: Loss of Cell Delineation defect (dLCD) shall be declared as in the defects section below.

Cell information field descrambling:

– Transfer function: The self synchronizing descrambler polynomial $x^{43} + 1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self synchronizing scrambling process (factor 2). It descrambles the information field bits only. The operation of the descrambler in relation to the HEC cell delineation state diagram shall be according to 4.3.4/I.432.1.

HEC Processing:

– Transfer function: HEC verification and correction shall be according to ITU-T I.432.1. Cells determined to have an invalid and incorrectible HEC pattern shall be discarded.

– Layer Management function: A count of invalid HEC events and a count of invalid HEC cell discard events are maintained with threshold crossings checked. HEC correction mode may be activated/deactivated by MI_HECactive. The HEC correction mode should be activated by default.

Cell rate decoupling:

– Transfer function: The process shall extract the idle cells used as fixed stuff in the far-end S4/VP adaptation source function.

TP usage measurement:

– Transfer function: The cell reception is indicated to the Layer Management function.

– Layer Management function: The process shall count the received cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Header verification:

– Transfer function: The receiving ATM NE shall verify that the first four octets of the ATM cell header are recognizable as being a valid header pattern. Cells with unrecognized header patterns shall be discarded. An indication of an invalid header cell discard event is provided to layer management.

Invalid header patterns from paths based on SDH/PDH transmission systems are as follows (except idle cell)(x = any value):

	GFC	VPI	VCI	PTI	CLP
UNI	xxxx	all 0s	all 0s	xxx	1

	VPI		VCI	PTI	CLP
NNI	all 0s		all 0s	xxx	1

– Layer Management function: The process shall count the invalid header cell discard event.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process extracts the GFC field. The GFC field processing is defined in ITU-T I.150 and ITU-T I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall extract the GFC protocol from the GFC field.

NOTE 2 – According to the Protocol Reference Model (ITU-T I.321), the unassigned cells should be processed in the ATM layer. Some of the ATM layer processes are adaptation processes belonging to the adaptation function between the TP and the VP layer network. The unassigned cells as well as idle cells are per physical connection (VPI = 0, VCI = 0). For this reason the idle and unassigned cells processing is allocated to the same atomic function.

VPI verification:

– Transfer function: The process shall verify that the received cell VPI is valid. If the VPI is determined to be invalid (i.e. out-of-range VPI or not assigned), the cell shall be discarded. An indication of the invalid VPI cell discard events is provided to the Layer Management function.

– Layer Management function: The range of valid VPIs is given by MI_VPIrange. The invalid VPI cell discard events are counted.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the indication VP_CI_CNGI is set for the traffic management function VPTM_TT_So to insert EFCI on all VPs.

– Layer Management function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

Specific Processes

The function performs end-to-end VP-AIS insertion, segment VP-AIS insertion and demultiplexing on a per VP basis.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true). Otherwise, it shall send no cells and SSF = false.

End-to-end VP-AIS insertion:

– Transfer function: This process inserts end-to-end VP-AIS cells from the Layer Management function for each active Specific Function.
– Layer Management function: End-to-end VP-AIS cells (Figure D.10) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function.

Segment VP-AIS insertion:

– Transfer function: This process inserts segment VP-AIS cells from the Layer Management function for each active Specific Function.
– Layer Management function: Segment VP-AIS cells (Figure D.11) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function and the segment VP-AIS cells insertion is also activated (MI_VPI-K_SAISactive is true).

VP demultiplexing:

– Transfer function: The adaptation sink function has access to a specific VP identified by the number K ($0 \le K \le 2^N - 1$). For each active Specific Function, only the cells of that specific VPI-K are passed in client direction.

NOTE 3 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

Defects

The function shall detect for the dPLM defect according ITU-T G.783 and for the dLCD defect according to ITU-T I.432.1.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The parameters for the following functions need to be defined:

- TP usage measurement;
- count of discarded cells from congestion control;
- count of invalid HEC events;
- count of invalid HEC discard events;
- count of invalid header discard events (one common counter for invalid header/invalid VPI/invalid VCI is maintained); and
- OCD event.

Coordination Functions

Consequent Actions

aCNGI ← "Event of Congestion" and CellDiscardActive

aSSF ← dPLM or dLCD or AI_TSF

aAIS ← dPLM or dLCD or AI_TSF

On declaration of aAIS, the function shall output end-to-end VP-AIS cells (Figure D.10) on all active VPCs and segment VP-AIS cells (Figure D.13) on all active VPCs for which MI_SAISactive is true, according to 9.2.1.1.1.1/I.610. On clearing of aAIS, the generation of end-to-end and segment VP-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option, or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end and segment VP-AIS cell shall be coded as 6AH. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end and segment VP-AIS cells.

NOTE 4 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, the fields shall be encoded as 6AH.

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations

cPLM ← dPLM and (not AI_TSF)

cLCD ← dLCD and (not dPLM) and (not AI_TSF)

D.2.3 S4-nc Path Adaptation Functions

NOTE – For S4-nc, values of "n" = 4, 16 and 64 are currently supported by the S4 layer network, i.e. the following three adaptation functions are defined by this clause:

– S4-4c/VP_A

– S4-16c/VP_A

– S4-64c/VP_A

Other values of "n" are for further study.

D.2.3.1 S4-nc Path to ATM Virtual Path Adaptation Source Function S4-nc/VP_A_So

Symbol

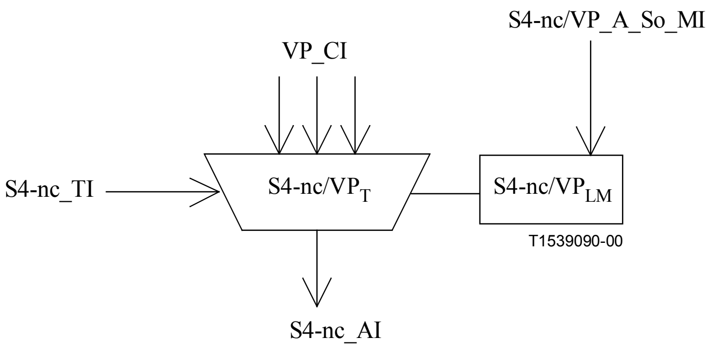


Figure D.20/I.732 – S4-nc/VP_A_So symbol

Interfaces

Table D.5/I.732 – S4-nc/VP_A_So input and output signals

Input(s)	Output(s)
per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF S4-nc_TI_CK S4-nc_TI_FS S4-nc/VP_A_So_MI_Active S4-nc/VP_A_So_MI_CellDiscardActive S4-nc/VP_A_So_MI_TpusgActive S4-nc/VP_A_So_MI_GFCActive S4-nc/VP_A_So_MI_VPI-KActive	S4-nc_AI_D S4-nc_AI_CK S4-nc_AI_FS

Processes

The S4-nc/VP_A_So function provides adaptation from the ATM Virtual Path layer to the VC-4-nc path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.21.

Activation:

– Layer Management function: The S4-nc/VP_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

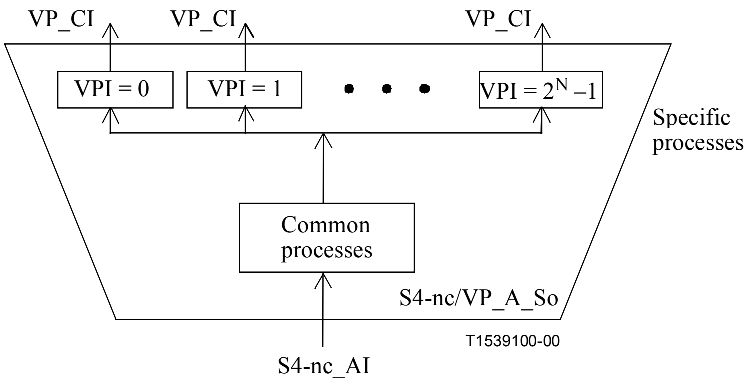


Figure D.21/I.732 – S4-nc/VP_A_So atomic function decomposed into Specific and Common processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Specific Processes

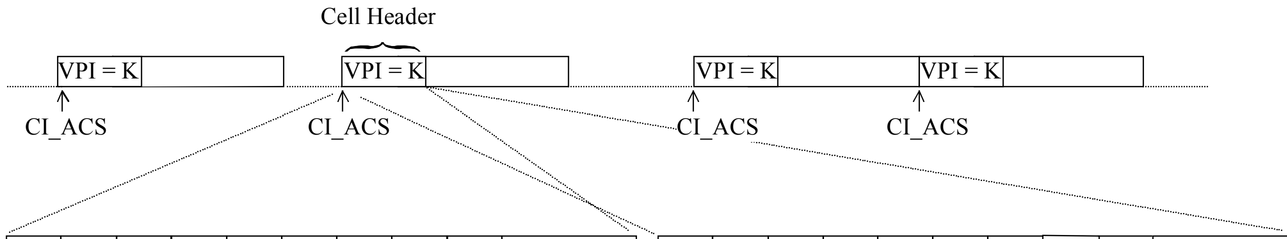
These Processes include VPI setting as well as VP asynchronous multiplexing. Each of these Specific Processes is characterized by the Virtual Path Identifier number K, where $0 \leq K \leq 2^N - 1$.

NOTE 2 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true).

The format of the Characteristic Information (VP_CI) is given in Figure D.22.



Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
								CLP	4
									5

NNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
								CLP	4
									5

UNI format

T1539110-00

Figure D.22/I.732 – VP_CI cell header format

VPI setting:

– Transfer function: VPI setting inserts the value of "K" as VPI for each active Specific function.

– Layer Management function: VPI setting is based on the activation of the Specific function by MI_VPI-KActive.

VP multiplexing:

– Transfer function: Asynchronous multiplexing is performed for each active Specific function.

Common Processes

The Common Processes include: Congestion control (selective cell discard (CLP-based)), GFC processing, TP usage measurement, cell rate decoupling, HEC processing, cell information field scrambling, cell stream mapping and processing of the payload specific bytes C2 and H4 to the VC-4-nc POH. The logical ordering of the processes from input to output must be maintained.

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
									4
	HEC								5

UNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
									4
	HEC								5

NNI format

T1539120-00

Figure D.23/I.732 – Cell header information processed in S4-nc/VP_A_So

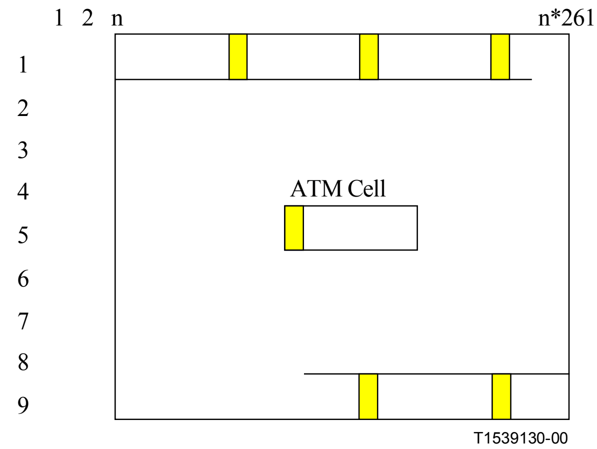


Figure D.24/I.732 – ATM cell stream mapping into Container-4-nc structure

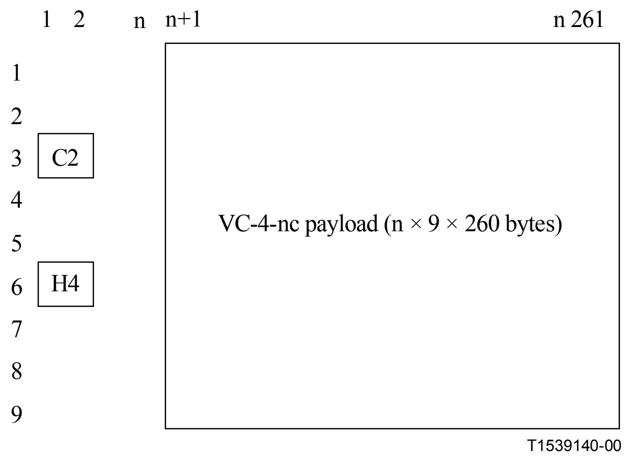


Figure D.25/I.732 – S4-nc_AI_So_D

Congestion control:

– Transfer function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value. In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process sets the GFC filed. The GFC field processing is defined in ITU-T I.150 and ITU-T I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall insert the GFC protocol in the GFC field. If the

GFC function is not supported or the GFC function disabled by MI_GFCActive = false, the binary contents of the GFC field shall be set to "0000".

TP usage measurement:

– Transfer function: Cell transmission is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Cell rate decoupling:

– Transfer function: This process takes the ATM cell stream present at its input and inserts it into the synchronous container having a capacity of "n × 2340" bytes adding fixed stuff idle cells. The idle cells format is specified in ITU-T I.361. The cell rate decoupling process makes use of the VC-4 timing clock, frame position (S4-nc_TI), and idle cell generator.

HEC Processing:

– Transfer function: The HEC value for each cell is calculated and inserted into the HEC field. The method of HEC value calculation shall be according to ITU-T I.432.1.

Cell information field scrambling:

– Transfer function: The self synchronizing scrambler polynomial $x^{43}+1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self synchronizing scrambling process. It scrambles the information field bits only. The operation of the scrambler shall be according to 4.3.4/I.432.1.

Cell stream mapping:

– Transfer function: The octet structure of ATM cells shall be aligned with the octet structure of Container-4-nc as shown in Figure D.24.

Processing of the payload specific bytes:

– Transfer function:

H4: These payload dependent bytes are not used for the mapping of ATM cells into VC-4-nc. The contents of this byte shall be 00H.

C2: In this byte the process shall insert code "0001 0011" (ATM mapping) as defined in ITU-T G.707.

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The parameters for the following processes need to be defined:

• TP usage measurement;

• Count of discarded cells from congestion control.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.2.3.2 S4-nc Path to ATM Virtual Path Adaptation Sink Function S4-nc/VP_A_Sk

Symbol

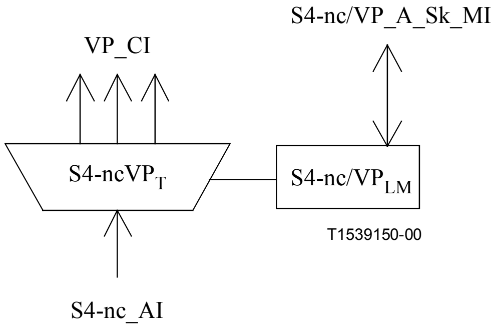


Figure D.26/I.732 – S4-nc/VP_A_Sk symbol

Interfaces

Table D.6/I.732 – S4-nc/VP_A_Sk input and output signals

Input(s)	Output(s)
S4-nc_AI_D S4-nc_AI_CK S4-nc_AI_FS S4-nc_AI_TSF S4-nc/VP_A_Sk_MI_Active S4-nc/VP_A_Sk_MI_CellDiscardActive S4-nc/VP_A_Sk_MI_TpusgActive S4-nc/VP_A_Sk_MI_VPIrange S4-nc/VP_A_Sk_MI_HECactive S4-nc/VP_A_Sk_MI_GFCactive S4-nc/VP_A_Sk_MI_ DTDLuseEnabled S4-nc/VP_A_Sk_MI_VPI-Kactive S4-nc/VP_A_Sk_MI_VPI-K_SAISactive	per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF VP_CI_CNGI S4-nc/VP_A_Sk_MI_Cplm S4-nc/VP_A_Sk_MI_cLCD

Processes

The S4-nc/VP_A_Sk function provides adaptation from the VC-4-nc Path to the ATM Virtual Path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.27.

Activation:

– Layer Management function: The S4-nc/VP_A_Sk function shall perform the Common and Specific Processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF) and not report its status via the management point.

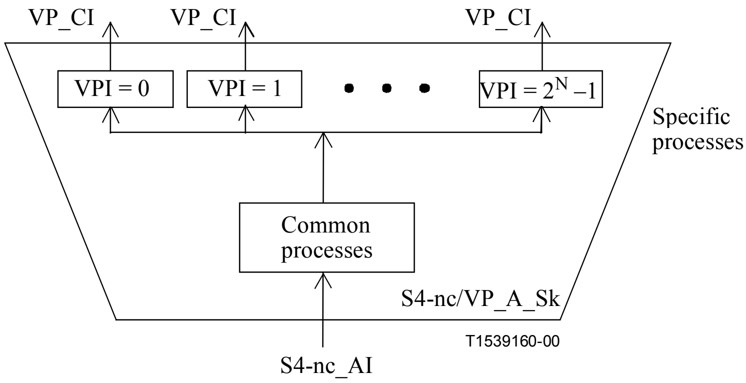


Figure D.27/I.732 – S4-nc/VP_A_Sk atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Common Processes

These Common Processes include: Handling of the payload specific bytes (C2 and H4), demapping, cell delineation, cell information field descrambling, HEC processing, cell rate decoupling, TP usage measurement, header verification, GFC processing, VPI verification and congestion control (selective cell discard (CLP-based)). The logical ordering of these processes from input to output must be maintained.

Handling of payload specific bytes:

– Transfer function:

  C2: The process extracts the C2 byte to the Layer Management function.

  H4: This payload dependent byte is not used for this mapping and the receiver shall ignore their contents.

– Layer Management:

  C2: The process shall compare the contents of the accepted C2 byte with the expected value code "0001 0011" (ATM mapping) as a check on consistency between the provisioning operation at each end. The application, acceptance and mismatch detection processes are described in the defects clause below.

Demapping:

– Transfer function: The cell stream shall be extracted from C-4-nc container in the S4-nc_AI in accordance with ITU-T G.707.

Cell Delineation:

– Transfer function: Cell delineation is performed on the continuous cell stream. The cell delineation algorithm should be in accordance with ITU-T I.432.1. The OCD events are indicated to the Layer Management function.

– Layer Management function: Loss of Cell Delineation defect (dLCD) shall be declared as in the defects clause below.

Cell information field descrambling:

– Transfer function: The self-synchronizing descrambler polynomial $x^{43} + 1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self-synchronizing scrambling process (factor 2). It descrambles the information field bits only. The operation of the descrambler in relation to the HEC cell delineation state diagram shall be according to 4.3.4/I.432.1.

HEC Processing:

– Transfer function: HEC verification and correction shall be according to ITU-T I.432.1. Cells determined to have an invalid and uncorrectable HEC pattern shall be discarded.

– Layer Management function: A count of invalid HEC events and a count of invalid HEC cell discard events are maintained with threshold crossings checked. HEC correction mode may be activated/deactivated by MI_HECactive. The HEC correction mode should be activated by default.

Cell rate decoupling:

– Transfer function: The process shall extract the idle cells used as fixed stuff in the far-end S4-nc/VP adaptation source function.

TP usage measurement:

– Transfer function: The cell reception is indicated to the Layer Management function.

– Layer Management function: The process shall count the received cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Header verification:

– Transfer function: The receiving ATM NE shall verify that the first four octets of the ATM cell header are recognizable as being a valid header pattern. Cells with unrecognized header patterns shall be discarded. An indication of an invalid header cell discard event is provided to layer management.

  Invalid header patterns from paths based on SDH/PDH transmission systems are as follows (except idle cell)(x = any value):

	GFC	VPI	VCI	PTI	CLP
UNI	xxxx	all 0s	all 0s	xxx	1

	VPI		VCI	PTI	CLP
NNI	all 0s		all 0s	xxx	1

– Layer Management function: The process shall count the invalid header cell discard event.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process extracts the GFC field. The GFC field processing is defined in ITU-T I.150 and I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall extract the GFC protocol from the GFC field.

NOTE 2 – According to the Protocol Reference Model (Recommendation I.321), the unassigned cells should be processed in the ATM layer. Some of the ATM layer processes are adaptation processes belonging to the adaptation function between the TP and the VP layer network. The unassigned cells as well as idle cells are per physical connection (VPI = 0, VCI = 0). For this reason the idle and unassigned cells processing is allocated to the same atomic function.

VPI verification:

– Transfer function: The process shall verify that the received cell VPI is valid. If the VPI is determined to be invalid (i.e. out-of-range VPI or not assigned), the cell shall be discarded. An indication of the invalid VPI cell discard events is provided to the Layer Management function.

– Layer Management function: The range of valid VPI is given by MI_VPIrange. The invalid VPI cell discard events are counted.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the indication VP_CI_CNGI is set for the traffic management function VPTM_TT_So to insert EFCI on all VPs.

– Layer Management function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

Specific Processes

The function performs end-to-end VP-AIS insertion, segment VP_AIS insertion and demultiplexing on a per VP basis.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true). Otherwise, it shall send no cells and Server Signal Fail (SSF) = false.

End-to-end VP-AIS insertion:

– Transfer function: This process inserts end-to-end VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: End-to-end VP-AIS cells (Figure D.10) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function.

Segment VP-AIS insertion:

– Transfer function: This process inserts segment VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: Segment VP-AIS cells (Figure D.11) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function and the segment VP-AIS cells insertion is also activated (MI_VPI-K_SAISactive is true).

VP demultiplexing:

– Transfer function: The adaptation sink function has access to a specific VP identified by the number K ($0 \leq K \leq 2^N - 1$). For each active Specific Function, only the cells of that specific VPI-K are passed in client direction.

NOTE 3 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

Defects

The function shall detect for the dPLM defect according to ITU-T G.783 and for the dLCD defect according to ITU-T I.432.2.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The parameters for the following processes need to be defined:

– TP usage measurement;
– Count of discarded cells from congestion control;
– Count of invalid HEC events;
– Count of invalid HEC discard events;
– Count of invalid header discard events (one common counter for invalid header/invalid VPI/invalid VCI is maintained);
– OCD event.

Coordination Functions

Consequent Actions

aCNGI ← "Event of Congestion" and CellDiscardActive

aSSF ← dPLM or dLCD or AI_TSF

aAIS ← dPLM or dLCD or AI_TSF

On declaration of aAIS, the function shall output end-to-end VP-AIS cells (Figure D.10) on all active VPCs and segment VP-AIS cells (Figure D.13) on all active VPCs for which MI_SAISactive is true, according to 9.2.1.1.1.1/I.610. On clearing of aAIS, the generation of end-to-end and segment VP-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option, or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end and segment VP-AIS cell shall be coded as 6AH. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end and segment VP-AIS cells.

NOTE 4 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, the fields shall be encoded as 6AH.

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations

cPLM ← dPLM and (not AI_TSF)

cLCD ← dLCD and (not dPLM) and (not AI_TSF)

D.2.4 Cell-Based Adaptation Functions

NOTE – This placeholder subclause is intended to incorporate in future the adaptation function for the Cell-based transmission layers.

D.2.5 P12s Path Adaptation Functions

D.2.5.1 P12s Path to ATM Virtual Path Adaptation Source Function P12s/VP_A_So

Symbol

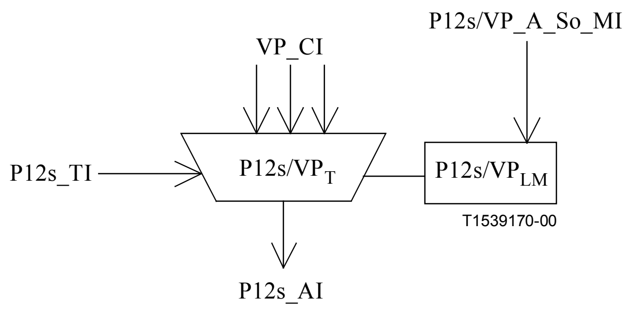


Figure D.28/I.732 – P12s/VP_A_So symbol

Interfaces

Table D.7/I.732 – P12s/VP_A_So input and output signals

Input(s)	Output(s)
per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF P12s_TI_CK P12s_TI_FS P12s/VP_A_So_MI_Active P12s/VP_A_So_MI_CellDiscardActive P12s/VP_A_So_MI_TPusgActive P12s/VP_A_So_MI_GFCActive P12s/VP_A_So_MI_VPI-KActive	P12s_AI_D P12s_AI_CK P12s_AI_FS

Processes

The P12s/VP_A_So function provides adaptation from the ATM Virtual Path to the P12s path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.29.

Activation:

– Layer Management function: The function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

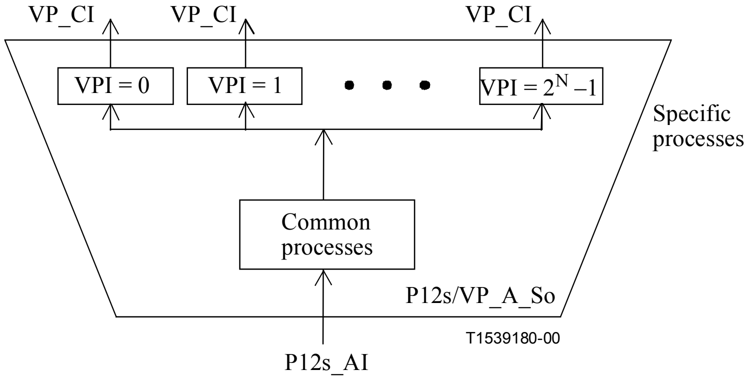


Figure D.29/I.732 – P12s/VP_A_So atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Specific Processes

These Processes include VPI setting as well as VP asynchronous multiplexing. Each of these Specific Processes is characterized by the Virtual Path Identifier number K, where $0 \le K \le 2^N - 1$.

NOTE 2 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true).

The format of the Characteristic Information (VP_CI) is given in Figure D.30.

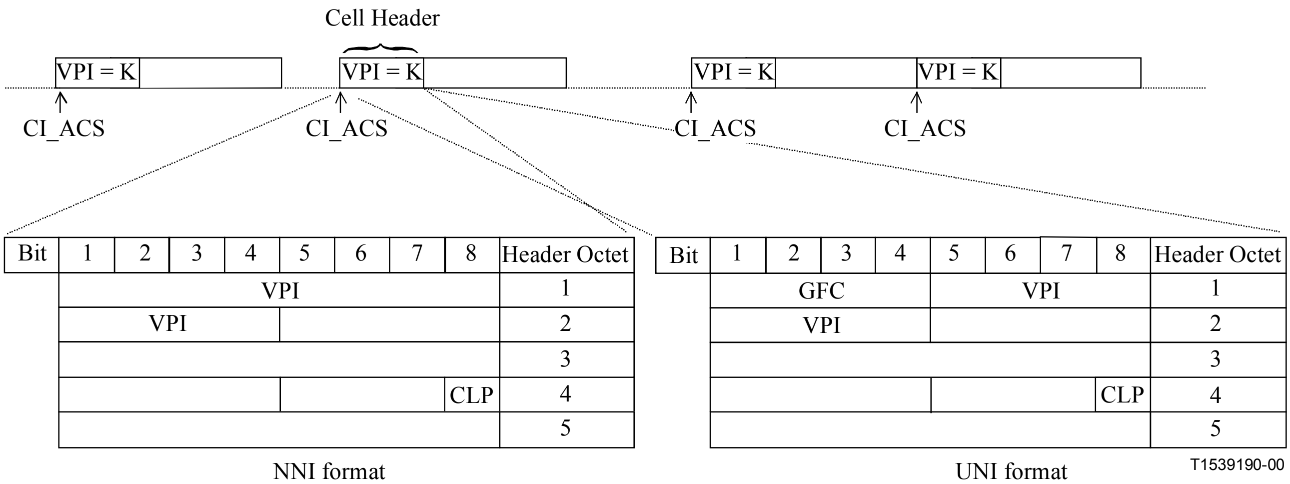


Figure D.30/I.732 – VP_CI (NNI format)

VPI setting:

– Transfer function: VPI setting inserts the value of "K" as VPI for each active Specific function.

– Layer Management function: VPI setting is based on the activation of the Specific function by MI_VPI-KActive.

VP multiplexing:

– Transfer function: Asynchronous multiplexing is performed for each active Specific function.

Common Processes

The Common Processes include: Congestion control (selective cell discard (CLP-based)), GFC processing, TP usage measurement, cell rate decoupling, HEC processing, cell information field scrambling, cell stream mapping and insertion into the synchronous payload having a capacity of 30 bytes adding fixed stuff idle cells. The logical ordering of the processes from input to output must be maintained.

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
									4
	HEC								5

UNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
									4
	HEC								5

NNI format

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Figure D.31/I.732 – Cell header information processed in P12s/VP_A_So

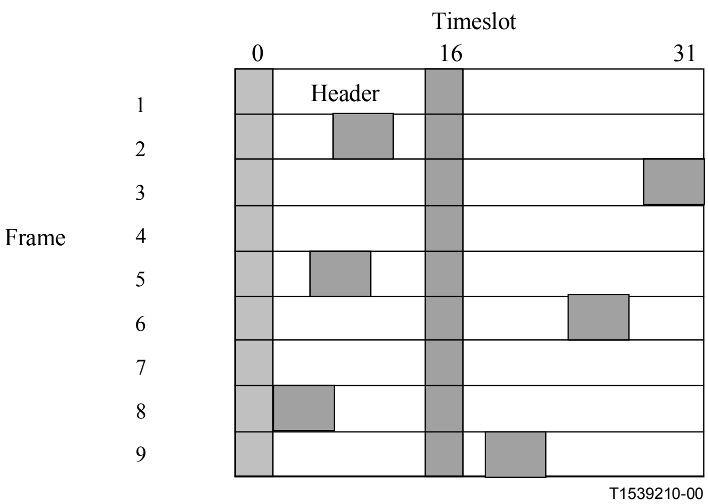


Figure D.32/I.732 – ATM cell stream mapping into P12s payload structure

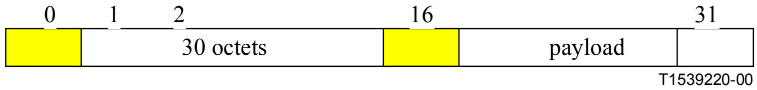


Figure D.33/I.732 – P12s_AI_So_D

Congestion control:

– Transfer function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value. In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process sets the GFC field. The GFC field processing is defined in ITU-T I.150 and I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). If enabled by MI_GFCActive = true, this process shall insert the GFC protocol in the GFC field. If the GFC function is not supported or the GFC function disabled by MI_GFCActive = false, the binary contents of the GFC field shall be set to "0000". In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure.

TP usage measurement:

– Transfer function: Cell transmission is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Cell rate decoupling:

– Transfer function: This process takes the ATM cell stream present at its input and inserts it into the synchronous container having a capacity of 30 bytes adding fixed stuff idle cells. The idle cells format is specified in ITU-T I.361. The cell rate decoupling process makes use of the P12s timing clock, frame position (P12s_TI), and idle cell generator.

HEC Processing:

– Transfer function: The HEC value for each cell is calculated and inserted into the HEC field. The method of HEC value calculation shall be according to ITU-T I.432.1.

Cell information field scrambling:

– Transfer function: The self synchronizing scrambler polynomial $x^{43}+1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self synchronizing scrambling process. It scrambles the information field bits only. The operation of the scrambler shall be according to 4.3.4/I.432.1.

NOTE 3 – I.432.1 only defines cell information field scrambling for SDH and cell-based interfaces. For P12s, the same parameters apply as for SDH interfaces.

Cell stream mapping:

– Transfer function: The octet structure of ATM cells shall be aligned with the octet structure of P12s as shown in Figure D.33.

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters are for further study. The parameters for the following functions need to be defined:

- TP usage measurement;
- Count of discarded cells from congestion control.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.2.5.2 P12s Path to ATM Virtual Path Adaptation Sink Function P12s/VP_A_Sk

Symbol

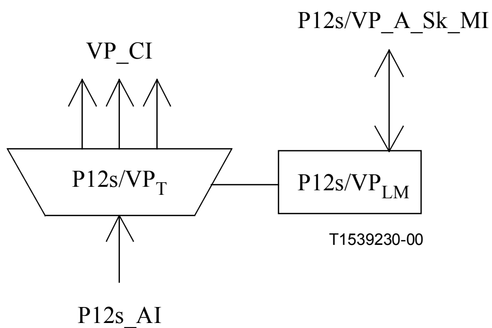


Figure D.34/I.732 – P12s/VP_A_Sk symbol

Interfaces

Table D.8/I.732 – P12s/VP_A_Sk input and output signals

Input(s)	Output(s)
P12s_AI_D P12s_AI_CK P12s_AI_FS P12s_AI_TSF P12s/VP_A_Sk_MI_Active P12s/VP_A_Sk_MI_CellDiscardActive P12s/VP_A_Sk_MI_TPusgActive P12s/VP_A_Sk_MI_VPIrange P12s/VP_A_Sk_MI_HECactive P12s/VP_A_Sk_MI_GFCactive P12s/VP_A_Sk_MI_ DTDLuseEnabled P12s/VP_A_Sk_MI_VPI-Kactive P12s/VP_A_Sk_MI_VPI-K_SAISactive	per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF VP_CI_CNGI P12s/VP_A_Sk_MI_cLCD

Processes

The P12s/VP_A_Sk function provides adaptation from the P12s Path to the ATM Virtual Path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.35.

Activation:

– Layer Management function: The P12s/VP_A_Sk function shall perform the Common and Specific Processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF) and not report its status via the management point.

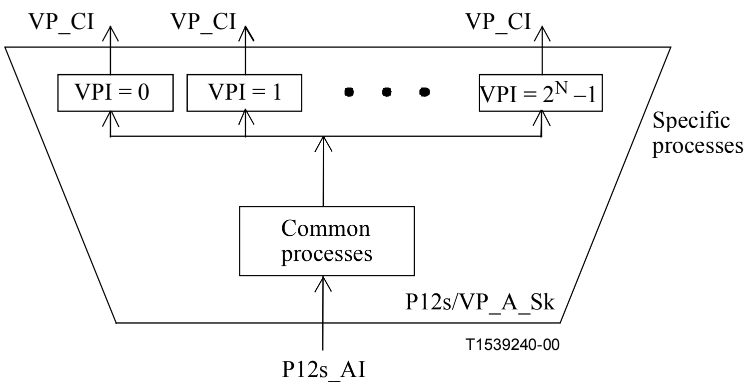


Figure D.35/I.732 – P12s/VP_A_Sk atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Common Processes

These Common Processes include: Demapping, cell delineation, cell information field descrambling, HEC processing, cell rate decoupling, TP usage measurement, header verification, GFC processing, VPI verification and congestion control (selective cell discard (CLP-based)). The logical ordering of these processes from input to output must be maintained.

Demapping:

– Transfer function: The cell stream shall be extracted from P12s payload in the P12s_AI in accordance with ITU-T G.804.

Cell Delineation:

– Transfer function: Cell delineation is performed on the continuous cell stream. The cell delineation algorithm should be in accordance with ITU-T I.432.1. The OCD events are indicated to the Layer Management function.

– Layer Management function: Loss of Cell Delineation defect (dLCD) shall be declared as in the defects section below.

Cell information field descrambling:

– Transfer function: The self synchronizing descrambler polynomial $x^{43}+ 1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self synchronizing scrambling process (factor 2). It descrambles the information field bits only. The operation of the descrambler in relation to the HEC cell delineation state diagram shall be according to 4.3.4/I.432.1.

NOTE 2 – ITU-T I.432.1 only defines cell information field descrambling for SDH and cell-based interfaces. For P12s, the same parameters apply as for SDH interfaces.

HEC Processing:

– Transfer function: HEC verification and correction shall be according to ITU-T I.432.1. Cells determined to have an invalid and uncorrectable HEC pattern shall be discarded.

– Layer Management function: A count of invalid HEC events and a count of invalid HEC cell discard events are maintained with threshold crossings checked. HEC correction mode may be activated/deactivated by MI_HECactive. The HEC correction mode should be activated by default.

NOTE 3 – ITU-T I.432.1 only defines HEC verification and correction for SDH and cell-based interfaces. For P12s, the same parameters apply as for SDH interfaces.

Cell rate decoupling:

– Layer Management function: The process shall extract the idle cells used as fixed stuff in the far-end P12s/VP adaptation source function.

TP usage measurement:

– Transfer function: The cell reception is indicated to the Layer Management function.

– Layer Management function: The process shall count the received cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Header verification:

– Transfer function: The receiving ATM NE shall verify that the first four octets of the ATM cell header are recognizable as being a valid header pattern. Cells with unrecognized header patterns shall be discarded. An indication of an invalid header cell discard event is provided to layer management.

Invalid header patterns from paths based on SDH/PDH transmission systems are as follows (except idle cell) (x = any value):

	GFC	VPI	VCI	PTI	CLP
UNI	xxxx	All 0s	all 0s	xxx	1

	VPI		VCI	PTI	CLP
NNI	all 0s		all 0s	xxx	1

– Layer Management function: The process shall count the invalid header cell discard event.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process extracts the GFC field. The GFC field processing is defined in ITU-T I.150 and I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall extract the GFC protocol from the GFC field.

NOTE 4 – According to the Protocol Reference Model (ITU-T I.321), the unassigned cells should be processed in the ATM layer. Some of the ATM layer processes are adaptation processes belonging to the adaptation function between the TP and the VP layer network. The unassigned cells as well as idle cells are per physical connection (VPI = 0, VCI = 0). For this reason the idle and unassigned cells processing is allocated to the same atomic function.

VPI verification:

– Transfer function: The process shall verify that the received cell VPI is valid. If the VPI is determined to be invalid (i.e. out-of-range VPI or not assigned), the cell shall be discarded. An indication of the invalid VPI cell discard events is provided to the Layer Management function.

– Layer Management function: The range of valid VPI is given by MI_VPIrange. The invalid VPI cell discard events are counted.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the indication VP_CI_CNGI is set for the traffic management function VPTM_TT_So to insert EFCI on all VPs.

– Layer Management function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

Specific Processes

The function performs end-to-end VP-AIS insertion, segment VP-AIS insertion and demultiplexing on a per VP basis.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true). Otherwise, it shall send no cells and SSF = false.

End-to-end VP-AIS insertion:

– Transfer function: This process inserts end-to-end VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: End-to-end VP-AIS cells (Figure D.10) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function.

Segment VP-AIS insertion:

– Transfer function: This process inserts segment VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: Segment VP-AIS cells (Figure D.11) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function and the segment VP-AIS cells insertion is also activated (MI_VPI-K_SAISactive is true).

VP demultiplexing:

– Transfer function: The adaptation sink function has access to a specific VP identified by the number K ($0 \leq K \leq 2^N - 1$). For each active Specific Function, only the cells of that specific VPI-K are passed in client direction.

  NOTE 5 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

Defects

The function shall detect for dLCD defect according to ITU-T I.432.2.

Performance Monitoring

The use of the Performance Monitoring parameters are for further study. The parameters for the following functions need to be defined:

• TP usage measurement;

• Count of discarded cells from congestion control;

• Count of invalid HEC events;

• Count of invalid HEC discard events;

• Count of invalid header discard events (one common counter for invalid header/invalid VPI/invalid VCI is maintained);

• OCD event.

Coordination Functions

Consequent Actions

aCNGI ← "Event of Congestion" and CellDiscardActive

aSSF ← dLCD or AI_TSF

aAIS ← dLCD or AI_TSF

On declaration of aAIS the function shall output end-to-end VP-AIS cells (Figure D.10) on all active VPCs and segment VP-AIS cells (Figure D.13) on all active VPCs for which MI_SAISactive is true, according to 9.2.1.1.1.1/I.610. On clearing of aAIS the generation of end-to-end and segment VP-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option, or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end and segment VP-AIS cell shall be coded as 6AH. If the function supports the DTDL option and if the

MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end and segment VP-AIS cells.

NOTE 6 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, the fields shall be encoded as 6AH.

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations

cLCD ← dLCD and (not AI_TSF)

D.2.6 P31s Path Adaptation Functions

D.2.6.1 P31s Path to ATM Virtual Path Adaptation Source Function P31s/VP_A_So

Symbol

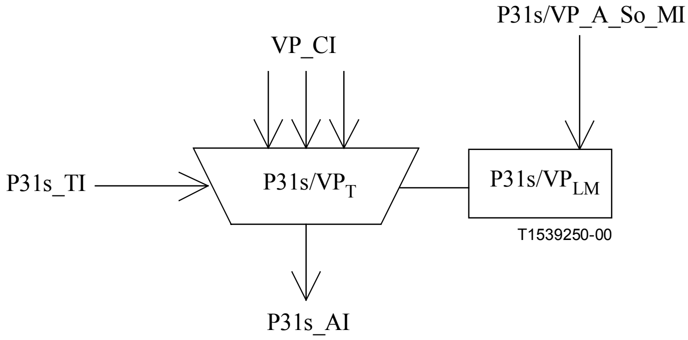


Figure D.36/I.732 – P31s/VP_A_So symbol

Interfaces

Table D.9/I.732 – P31s/VP_A_So input and output signals

Input(s)	Output(s)
per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF P31s_TI_CK P31s_TI_FS P31s/VP_A_So_MI_Active P31s/VP_A_So_MI_CellDiscardActive P31s/VP_A_So_MI_TPusgActive P31s/VP_A_So_MI_GFCActive P31s/VP_A_So_MI_VPI-KActive	P31s_AI_D P31s_AI_CK P31s_AI_FS

Processes

The P31s/VP_A_So function provides adaptation from the ATM Virtual Path to the P31s path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.37.

Activation:

– Layer Management function: The P31s/VP_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

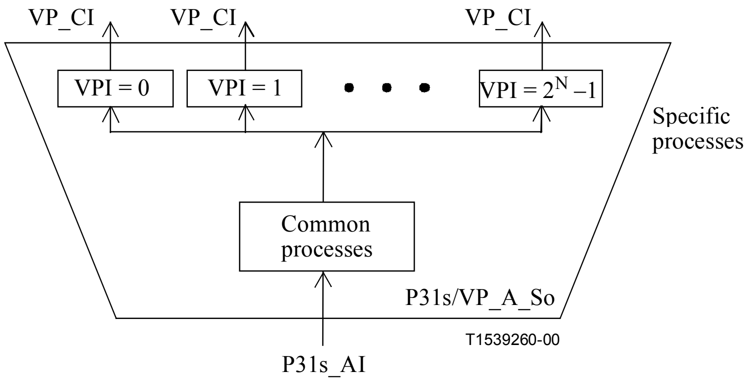


Figure D.37/I.732 – P31sVP_A_So atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Specific Processes

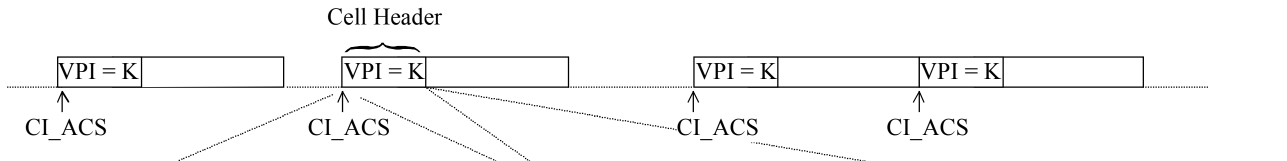
These Processes include VPI setting as well as VP asynchronous multiplexing . Each of these Specific Processes is characterized by the Virtual Path Identifier number K, where $0 \leq K \leq 2^N - 1$.

NOTE 2 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true).

The format of the Characteristic Information (VP_CI) is given in Figure D.38.



Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
								CLP	4
									5

NNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
								CLP	4
									5

UNI format

Figure D.38/I.732 – VP_CI (NNI format)

VPI setting:

– Transfer function: VPI setting inserts the value of "K" as VPI for each active Specific function.

– Layer Management function: VPI setting is based on the activation of the Specific function by MI_VPI-KActive.

VP multiplexing:

– Transfer function: Asynchronous multiplexing is performed for each active Specific function.

Common Processes

The Common Processes include: Congestion control (selective cell discard (CLP-based)), GFC processing, TP usage measurement, cell rate decoupling, HEC processing, cell information field scrambling, cell stream mapping and processing of the payload specific signals (bits MA[3-5] and MA[6-7]) to the P31s POH. The logical ordering of the processes from input to output must be maintained.

Bit	1	2	3	4	5	6	7	8	Header Octet
	GFC				VPI				1
	VPI								2
									3
									4
	HEC								5

NNI format

Bit	1	2	3	4	5	6	7	8	Header Octet
	VPI								1
	VPI								2
									3
									4
	HEC								5

UNI format

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Figure D.39/I.732 – Cell header information processed in P31s/VP_A_So

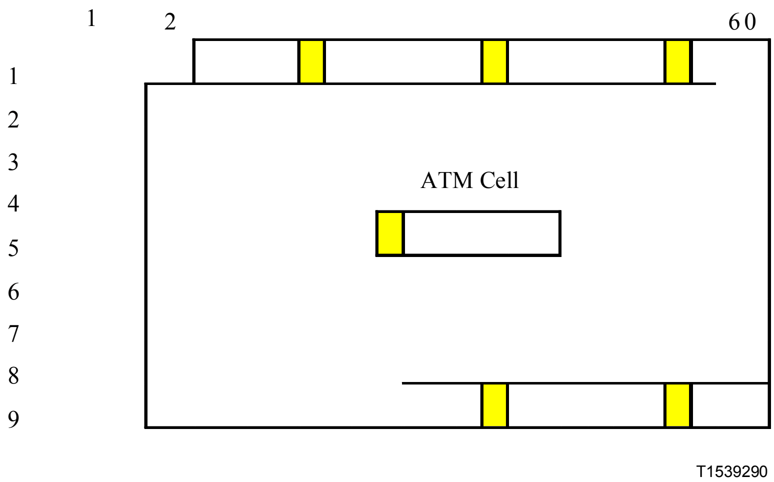


Figure D.40/I.732 – ATM cell stream mapping into P31s payload structure

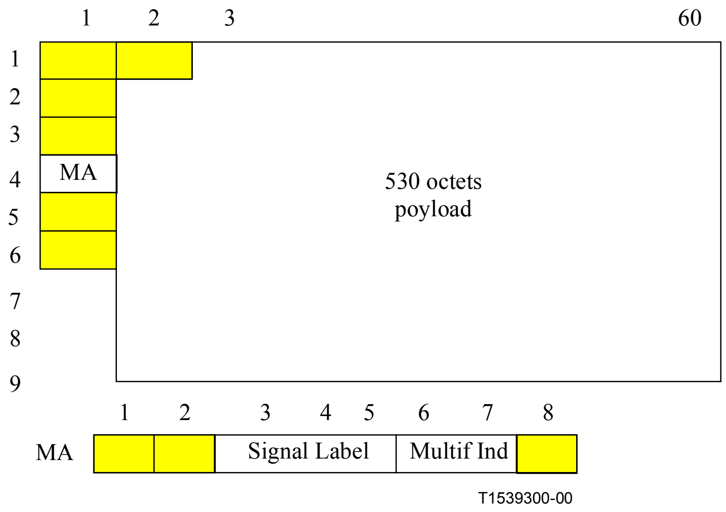


Figure D.41/I.732 – P31s_AI_So_D

Congestion control:

– Transfer function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value. In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process sets the GFC filed. The GFC field processing is defined in ITU-T I.150 and I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall insert the GFC protocol in the GFC field. If the GFC function is not supported or the GFC function disabled by MI_GFCActive = false, the binary contents of the GFC field shall be set to "0000".

TP usage measurement:

– Transfer function: Cell transmission is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Cell rate decoupling:

– Transfer function: This process takes the ATM cell stream present at its input and inserts it into the synchronous container having a capacity of 530 bytes adding fixed stuff idle cells. The idle cells format is specified in ITU-T I.361. The cell rate decoupling process makes use of the P31s timing clock, frame position (P31s_TI), and idle cell generator.

HEC Processing:

– Transfer function: The HEC value for each cell is calculated and inserted into the HEC field. The method of HEC value calculation shall be according to ITU-T I.432.1.

Cell information field scrambling:

– Transfer function: The self synchronizing scrambler polynomial $x^{43}+1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self synchronizing scrambling process. It scrambles the information field bits only. The operation of the scrambler shall be according to 4.3.4/I.432.1.

  NOTE 3 – ITU-T I.432.1 only defines cell information field scrambling for SDH and cell-based interfaces. For P31s, the same parameters apply as for SDH interfaces.

Cell stream mapping:

– Transfer function: The octet structure of ATM cells shall be aligned with the octet structure of P31s payload as shown in Figure D.40.

Processing of the payload specific bytes:

– Transfer function:

  MA[3-5]: In this byte the process shall insert code "010" (ATM payload) as defined in ITU-T G.832.

  MA[6-7]: The multiframe indicator bits are not used for the ATM mapping into P31s option. The contents of these bits shall be "00".

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters are for further study. The parameters for the following functions need to be defined:

- TP usage measurement;
- Count of discarded cells from congestion control.

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.2.6.2 P31s Path to ATM Virtual Path Adaptation Sink Function P31s/VP_A_Sk

Symbol

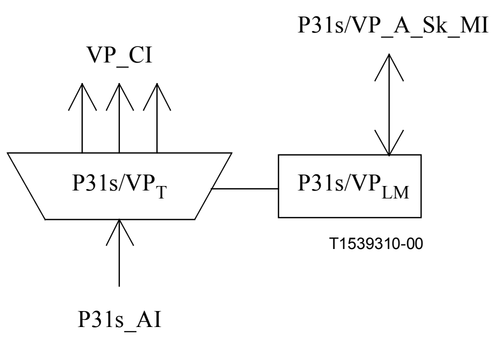


Figure D.42/I.732 – P31s/VP_A_Sk symbol

Interfaces

Table D.10/I.732 – P31s/VP_A_Sk input and output signals

Input(s)	Output(s)
P31s_AI_D P31s_AI_CK P31s_AI_FS P31s_AI_TSF P31s/VP_A_Sk_MI_Active P31s/VP_A_Sk_MI_CellDiscardActive P31s/VP_A_Sk_MI_TPusgActive P31s/VP_A_Sk_MI_VPIrange P31s/VP_A_Sk_MI_HECactive P31s/VP_A_Sk_MI_GFCactive P31s/VP_A_Sk_MI_ DTDLuseEnabled P31s/VP_A_Sk_MI_VPI-Kactive P31s/VP_A_Sk_MI_VPI-K_SAISactive	per VP_CI, for each VP configured: VP_CI_D VP_CI_ACS VP_CI_SSF VP_CI_CNGI P31s/VP_A_Sk_MI_cLCD P31s/VP_A_Sk_MI_cPLM

Processes

The P31s/VP_A_Sk function provides adaptation from the P31s Path to the ATM Virtual Path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.43.

Activation:

– Layer Management function: The P31s/VP_A_Sk function shall perform the Common and Specific Processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF) and not report its status via the management point.

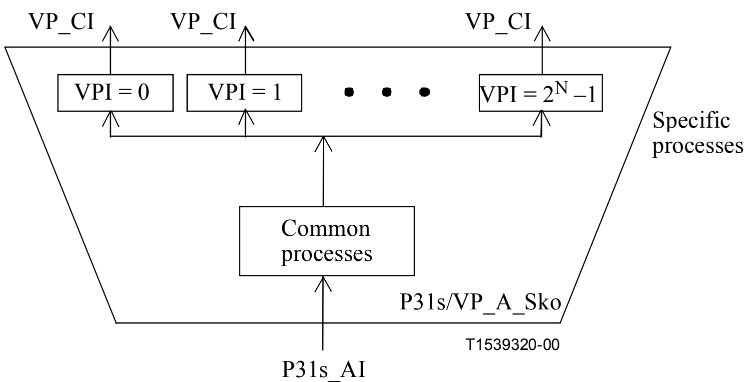


Figure D.43/I.732 – P31s/VP_A_Sk atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Common Processes

These Common Processes include: Handling of the payload specific bits (MA[3-5], MA[6-7]), demapping, cell delineation, cell information field descrambling, HEC processing, cell rate decoupling, TP usage measurement, header verification, GFC processing, VPI verification and congestion control (selective cell discard (CLP-based)). The logical ordering of these processes from input to output must be maintained.

Handling of payload specific bytes:

– Transfer function:

  MA[3-5]: The process extracts the MA[3-5] bits to the Layer Management function.

  MA[6-7]: Multiframe indicator. The contents of these bits shall be ignored by the receiver.

– Layer Management:

  The process shall compare the content of the accepted MA[3-5] bits with the expected value code "010" (ATM cell mapping) as a check on consistency between the provisioning operation at each end. The application, acceptance and mismatch detection process are described in the defects section below.

Demapping:

– Transfer function: The cell stream shall be extracted from P31s payload in the P31s_AI in accordance with ITU-T G.804.

Cell Delineation:

– Transfer function: Cell delineation is performed on the continuous cell stream. The cell delineation algorithm should be in accordance with ITU-T I.432.1. The OCD events are indicated to the Layer Management function.

– Layer Management function: Loss of Cell Delineation defect (dLCD) shall be declared as in the defects section below.

Cell information field descrambling:

– Transfer function: The self synchronizing descrambler polynomial $x^{43} + 1$ has been identified for the SDH-based transmission paths and minimizes the error multiplication introduced by the self synchronizing scrambling process (factor 2). It descrambles the information field bits only. The operation of the descrambler in relation to the HEC cell delineation state diagram shall be according to 4.3.4/I.432.1.

  NOTE 2 – ITU-T I.432.1 only defines cell information field descrambling for SDH and cell-based interfaces. For P31s, the same parameters apply as for SDH interfaces.

HEC Processing:

– Transfer function: HEC verification and correction shall be according to ITU-T I.432.1. Cells determined to have an invalid and uncorrectable HEC pattern shall be discarded.

– Layer Management function: A count of invalid HEC events and a count of invalid HEC cell discard events are maintained with threshold crossings checked. HEC correction mode may be activated/deactivated by MI_HECactive. The HEC correction mode should be activated by default.

  NOTE 3 – ITU-T I.432.1 only defines HEC verification and correction for SDH and cell-based interfaces. For P31s, the same parameters apply as for SDH interfaces.

Cell rate decoupling:

– Transfer function: The process shall extract the idle cells used as fixed stuff in the far-end P31s/VP adaptation source function.

TP usage measurement:

– Transfer function: The cell reception is indicated to the Layer Management function.

– Layer Management function: The process shall count the received cells for cell measurement purposes. This cell counting shall be activated/deactivated by MI_TPusgActive.

Header verification:

– Transfer function: The receiving ATM NE shall verify that the first four octets of the ATM cell header are recognizable as being a valid header pattern. Cells with unrecognized header patterns shall be discarded. An indication of an invalid header cell discard event is provided to layer management.

Invalid header patterns from paths based on SDH/PDH transmission systems are as follows (except idle cell) (x = any value):

	GFC	VPI	VCI	PTI	CLP
UNI	xxxx	all 0s	all 0s	xxx	1

	VPI		VCI	PTI	CLP
NNI	all 0s		all 0s	xxx	1

– Layer Management function: The process shall count the invalid header cell discard event.

GFC processing:

– Transfer function: The support of the GFC protocol applies to the UNI and in point-to-point configuration only and is an option. This process extracts the GFC field. The GFC field processing is defined in ITU-T I.150 and I.361.

– Layer Management function: The GFC function uses assigned and unassigned cells. Two modes of operation are available: Uncontrolled Transmission (MI_GFCActive = false) and Controlled Transmission (MI_GFCActive = true). In Uncontrolled Transmission mode, neither the controlling nor the controlled NE performs the GFC procedure. If enabled by MI_GFCActive = true, this process shall extract the GFC protocol from the GFC field.

NOTE 4 – According to the Protocol Reference Model (ITU-T I.321), the unassigned cells should be processed in the ATM layer. Some of the ATM layer processes are adaptation processes belonging to the adaptation function between the TP and the VP layer network. The unassigned cells as well as idle cells are per physical connection (VPI = 0, VCI = 0). For this reason the idle and unassigned cells processing is allocated to the same atomic function.

VPI verification:

– Transfer function: The process shall verify that the received cell VPI is valid. If the VPI is determined to be invalid (i.e. out-of-range VPI or not assigned), the cell shall be discarded. An indication of the invalid VPI cell discard events is provided to the Layer Management function.

– Layer Management function: The range of valid VPI is given by MI_VPIrange. The invalid VPI cell discard events are counted.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the indication VP_CI_CNGI is set for the traffic management function VPTM_TT_So to insert EFCI on all VPs.

– Layer Management function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

Specific Processes

The function performs end-to-end VP-AIS insertion, segment VP-AIS insertion and demultiplexing on a per VP basis.

VPI-K Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VPI-KActive is true). Otherwise, it shall send no cells and SSF = false.

End-to-end VP-AIS insertion:

– Transfer function: This process inserts end-to-end VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: End-to-end VP-AIS cells (Figure D.10) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function.

Segment VP-AIS insertion:

– Transfer function: This process inserts segment VP-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: Segment VP-AIS cells (Figure D.11) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function and the segment VP-AIS cells insertion is also activated (MI_VPI-K_SAISactive is true).

VP demultiplexing:

– Transfer function: The adaptation sink function has access to a specific VP identified by the number K ($0 \leq K \leq 2^N - 1$). For each active Specific Function, only the cells of that specific VPI-K are passed in client direction.

NOTE 5 – The value of N represents the number of bits in the VPI field and is an integer number. Its maximum value is equal to 12 for the ATM NNI. Its maximum value is equal to 8 for the ATM UNI.

Defects

The function shall detect for the dPLM defect according to ITU-T G.783 and for the dLCD defect according to ITU-T I.432.2.

NOTE 6 – For P31s, the same parameters apply as for SDH.

Performance Monitoring

The use of the Performance Monitoring parameters are for further study. The parameters for the following functions need to be defined:

- TP usage measurement;
- count of discarded cells from congestion control;
- count of invalid HEC events;
- count of invalid HEC discard events
- count of invalid header discard events (one common counter for invalid header/invalid VPI/invalid VCI is maintained);
- OCD event.

Coordination Functions

Consequent Actions

aCNGI ← "Event of Congestion" and CellDiscardActive

aSSF ← dPLM or dLCD or AI_TSF

aAIS ← dPLM or dLCD or AI_TSF

On declaration of aAIS the function shall output end-to-end VP-AIS cells (Figure D.10) on all active VPCs and segment VP-AIS cells (Figure D.13) on all active VPCs for which MI_SAISactive is true, according to 9.2.1.1.1.1/I.610. On clearing of aAIS the generation of end-to-end and segment VP-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option, or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end and segment VP-AIS cell shall be coded as 6AH. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end and segment VP-AIS cells.

NOTE 7 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, the fields shall be encoded as 6AH.

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

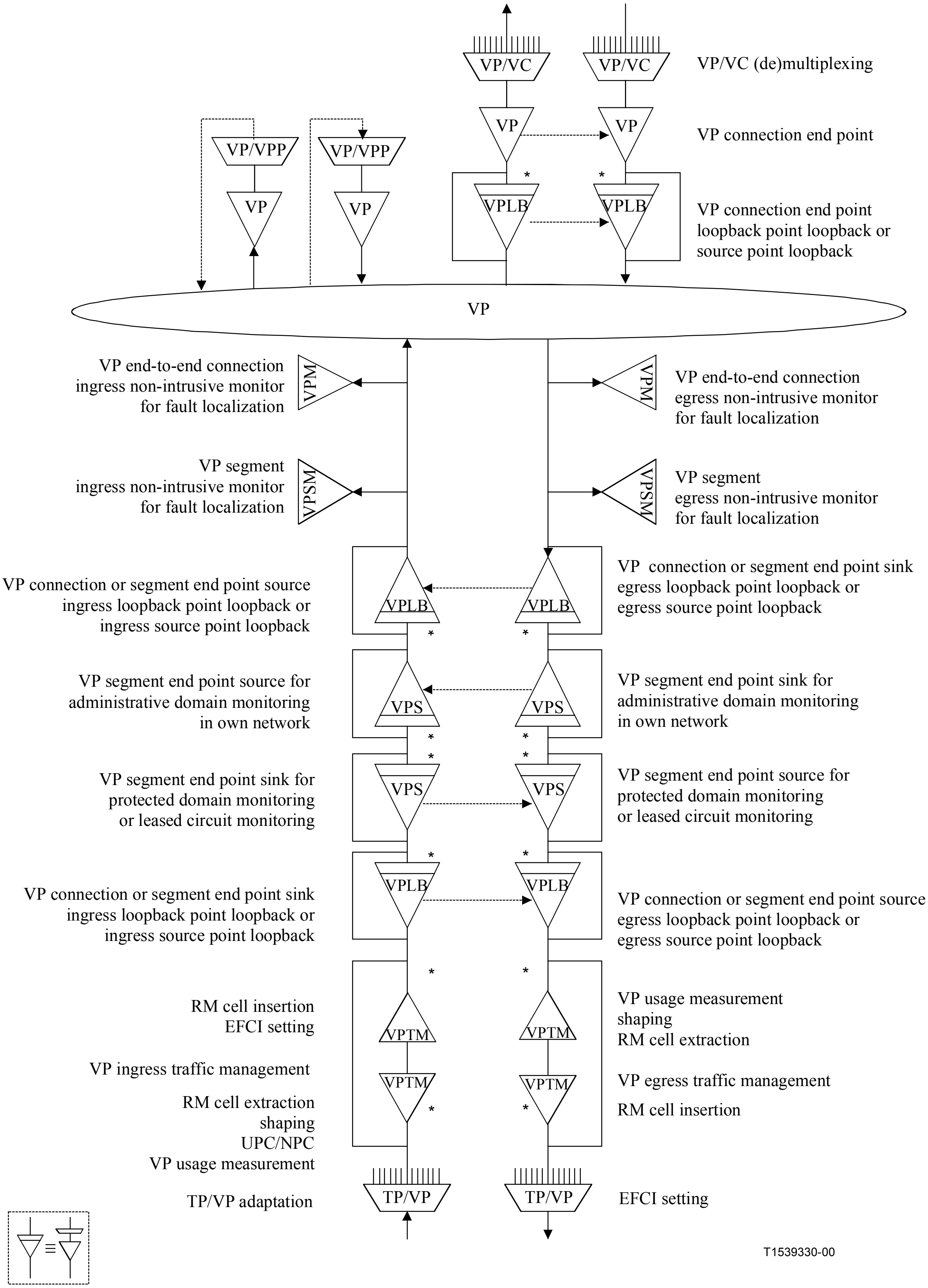
Defect Correlations

cPLM ← dPLM and (not AI_TSF)

cLCD ← dLCD and (not dPLM) and (not AI_TSF)

D.3 ATM Virtual Path Layer Network Functions

Figure D.44 shows the relative sequencing of the atomic functions of the Virtual Path (VP) layer network and its server and client layer adaptation functions that has to be maintained *if they are present*. The figure also presents the application that is supported by each atomic function and may vary with the location in the sequence.



(*) This function may or may not be present in equipment; if present, it may be active or bypassed.

Figure D.44/I.732 – Expanded view of the VP layer network and its server and client layer adaptation functions

Note that:

a) A network element need not support all depicted functions. A network element supporting the TP/VP_A function contains minimal ATM functionality. An example is the B-NT1 as defined in ITU-T G.966. A network element with TP/VP_A functions and a VP_C function is an ATM VP cross connect, etc.

b) The loopback point process in loopback sink functions operates in one of three process modes: CP, SEP or CEP. This depends on the position of the loopback process with respect to segment or end-to-end connection termination function. A loopback process co-located with a segment termination function that may be active or bypassed will change its loopback point sink process mode between CP and SEP depending on the active/bypass state of the segment function.

c) A VP loopback function (Figure D.45) can insert VP LB cells (end-to-end, segment), extract expected returned VP LB cells, and return (loopback) a received source loopback cell.

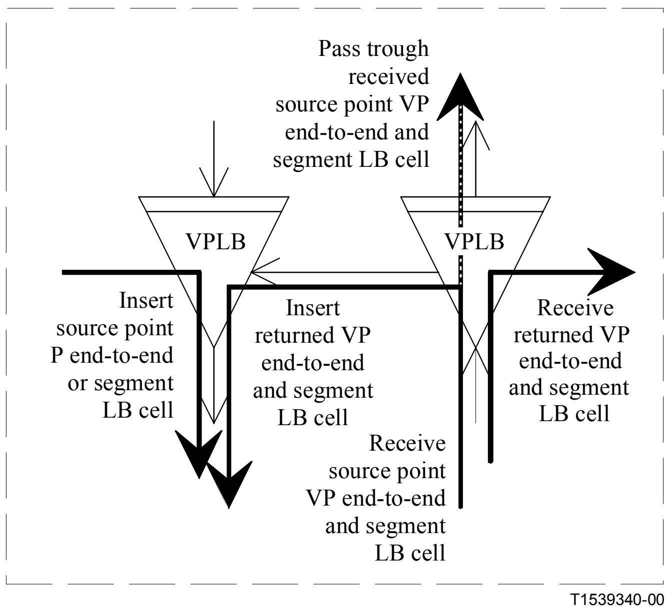


Figure D.45/I.732 – OAM cell insertion, extraction and looping in VP loopback function

d) A bidirectional VP segment endpoint function (Figure D.46) can insert VP segment CC, FPM, RDI, BR and AD cells, extract VP segment CC, FPM, RDI, BR, AD and AIS cells, and monitor end-to-end VP-AIS cells. A VP segment endpoint source function discards all incoming VP segment OAM cells. A VP segment endpoint sink function discards all VP segment OAM cells before the rest of the VP signal is output. A VP segment endpoint sink function inserts end-to-end VP-AIS OAM cells during signal fail conditions.

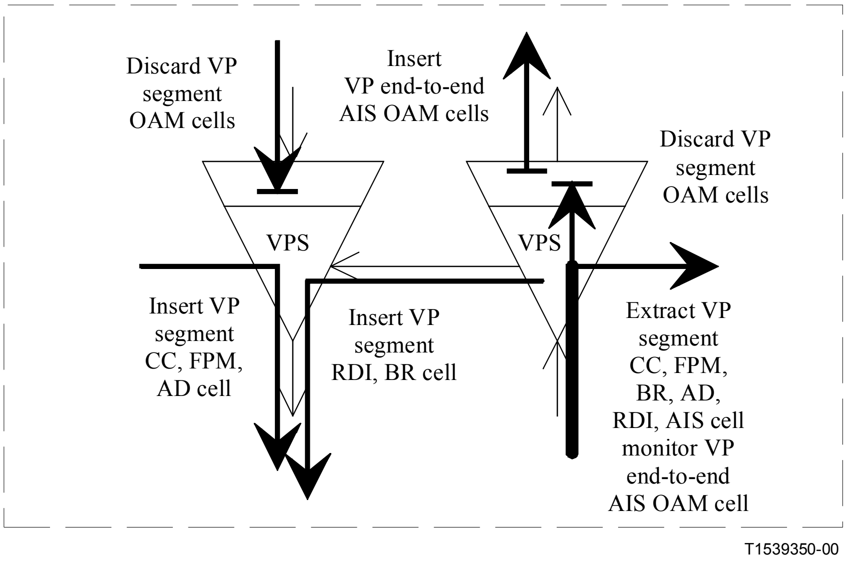


Figure D.46/I.732 – OAM cell insertion, extraction and discarding in VP segment endpoint functions

e) A bidirectional VP connection endpoint function (Figure D.47) can insert VP end-to-end CC, FPM, RDI, BR and AD cells and extract VP end-to-end CC, FPM, RDI, BR, AD and AIS cells. A VP connection endpoint sink function discards all VP end-to-end OAM cells and also all VP segment OAM cells[1] before the rest of the VP payload signal is output. A connection endpoint sink function inserts client layer AIS during signal fail conditions; a VP connection endpoint function inserts end-to-end and segment VC-AIS OAM cells.

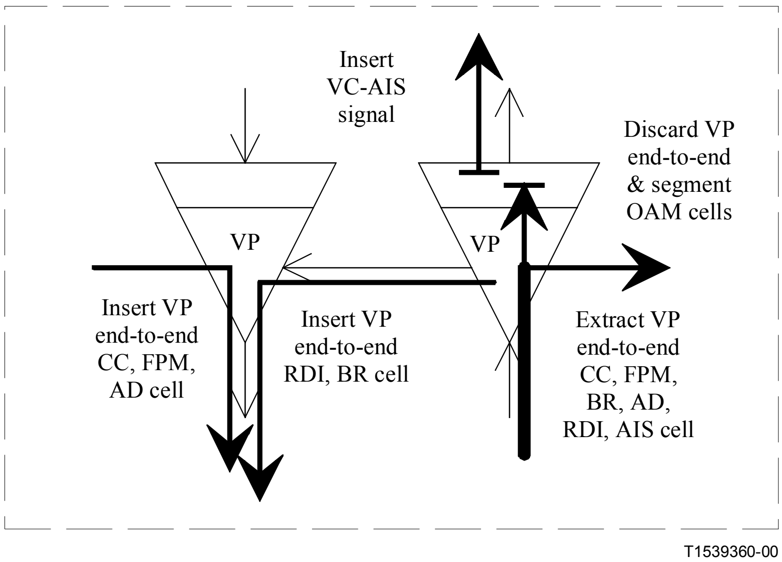


Figure D.47/I.732 – OAM cell insertion, extraction and discarding in VP connection endpoint functions

[1] Segment OAM cells might be present outside segments under certain fault conditions.

f) A VP end-to-end non-intrusive monitor function (Figure D.48) can monitor VP end-to-end CC, FPM, RDI, BR and AIS cells. A VP segment non-intrusive monitor function can monitor VP segment CC, FPM, RDI, BR and AIS cells and VP end-to-end AIS cells.

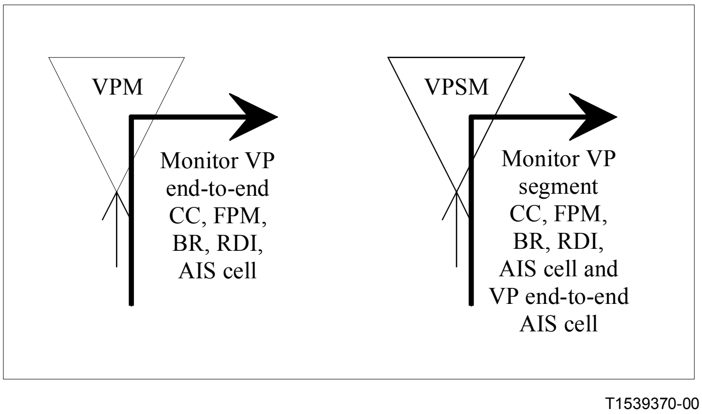


Figure D.48/I.732 – OAM cell extraction in VP end-to-end and VP segment non-intrusive monitor functions

g) Fault Management related signals in VP segment endpoint functions are depicted in Figure D.49. SSF and TSF signals communicate the signal fail condition detected in previous functions, help to suppress fault causes in equipment and are used to trigger protection switching. Fault causes (MI_cXXX) are determined and reported to the EMF. Remote Information (RI_XXX) is generated in the termination sink function and handed to the paired termination source function for insertion in the RDI and BR OAM cells. End-to-end VP-AIS cells are inserted under control of the aAIS signal.

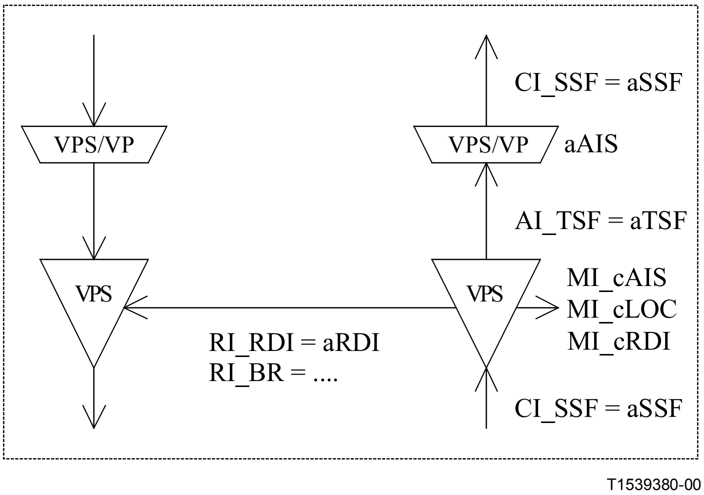


Figure D.49/I.732 – Fault Management in VP segment function

h) Fault Management related signals in VP connection endpoint functions are depicted in Figure D.50. SSF and TSF signals communicate the signal fail condition detected in previous functions, help to suppress fault causes in equipment and are used to trigger protection switching. Fault causes (MI_cXXX) are determined and reported to the EMF. Remote Information (RI_XXX) is generated in the termination sink function and handed to the paired termination source function for insertion in the RDI and BR OAM cells. End-to-end and segment VC-AIS is inserted under control of the aAIS signal.

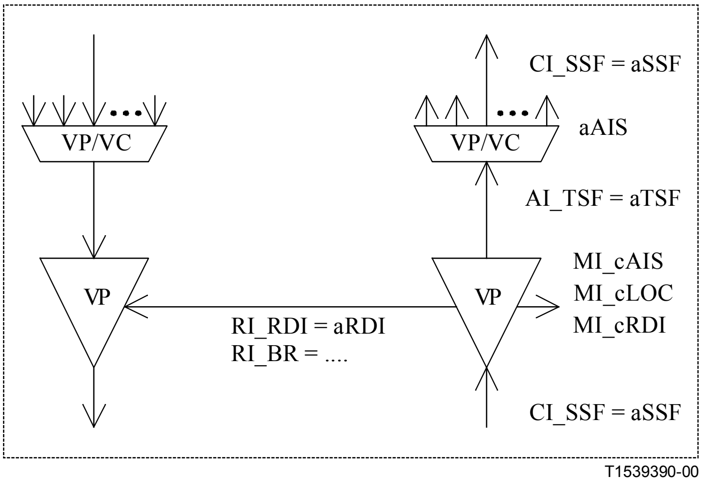


Figure D.50/I.732 – Fault Management in connection endpoint VP functions

i) Fault Management related signals in a VP non-intrusive monitor function are depicted in Figure D.51. SSF and TSF signals communicate the signal fail condition detected in previous functions, help to suppress fault causes in equipment and are used to trigger protection switching. Fault causes (MI_cXXX) are determined and reported to the EMF.

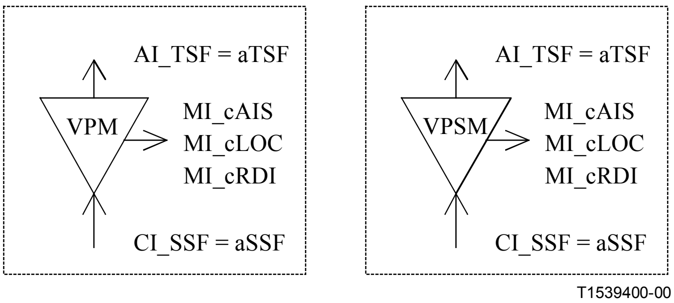


Figure D.51/I.732 – Fault Management and Performance Monitoring in end-to-end and segment non-intrusive monitor functions

j) The traffic management functions are modelled as back-to-back connected sink and source function. The functionality of traffic management is restricted to a single direction of transport. It differs as such from a normal sublayer functionality, which has sink and source processing performed in the two directions separately.

ATM Virtual Path layer Characteristic Information

The end-to-end VP CI is cell structured (Figure D.52). Its format is characterized as end-to-end VP_AI plus the end-to-end VP trail termination overhead in the end-to-end VP OAM cells (F4E) CC, FPM, BR, RDI and AD, as defined in ITU-T I.610. Downstream of a signal fail location, the end-to-end VP CI contains only the end-to-end VP AIS OAM cell and possibly the segment VP AIS OAM cell.

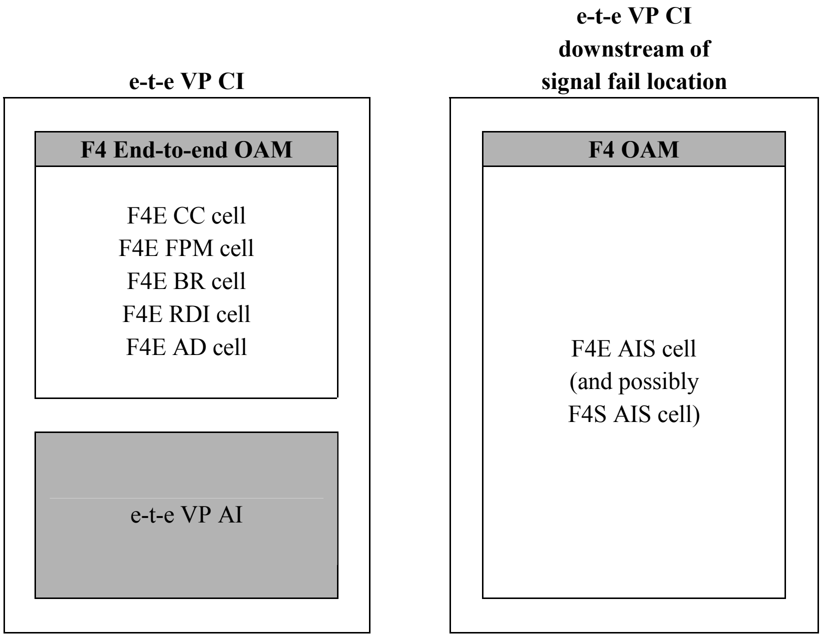


Figure D.52/I.732 – ATM VP Characteristic Information

The segment VP CI is cell structured (Figure D.53). Its format is characterized as segment VP_AI plus the segment VP trail termination overhead in the segment VP OAM cells (F4S) CC, FPM, BR, RDI and AD, as defined in ITU-T I.610. Downstream of a signal fail location, the segment VP CI contains only the end-to-end VP AIS OAM cell and possibly the segment VP AIS OAM cell.

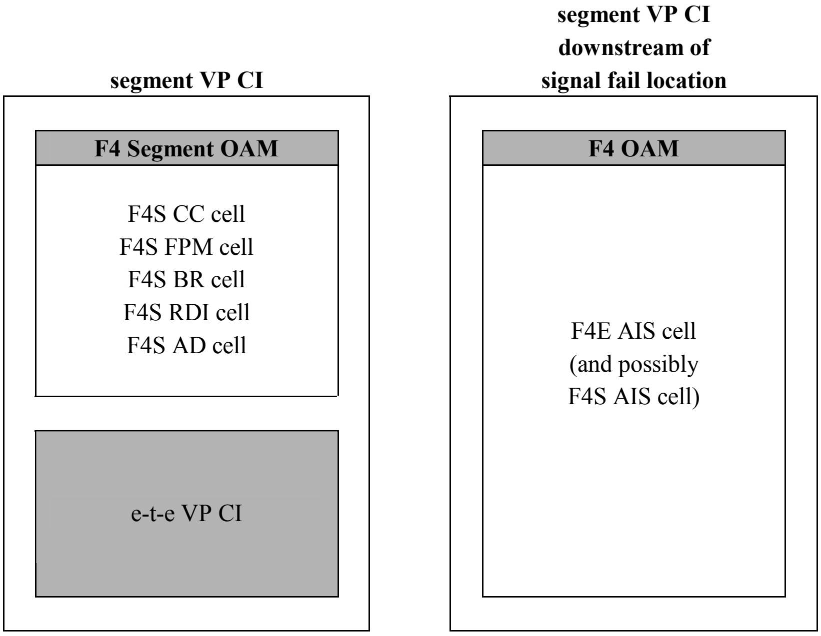


Figure D.53/I.732 – ATM VP Segment Characteristic Information

The loopback VP CI is cell structured (Figure D.54). Its format is characterized as the loopback VP trail termination overhead in the end-to-end VP OAM cell (F4E) LB, or segment VP OAM cell (F4S) LB, as defined in ITU-T I.610. Downstream of a signal fail location, the loopback VP CI is absent when it was inserted upstream of the signal fail location.

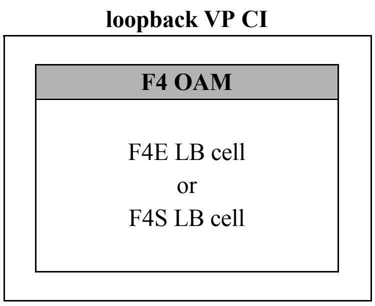


Figure D.54/I.732 – ATM VP Loopback Characteristic Information

The SNCP VP CI is cell structured (Figure D.55). Its format is characterized as the SNCP VP connection overhead in the end-to-end VP OAM cell (F4E) APS, as defined in ITU-T I.630. Downstream of a signal fail location, the SNCP VP CI is absent.

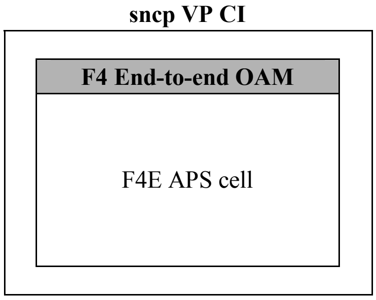


Figure D.55/I.732 – ATM VP SNCP Characteristic Information

ATM Virtual Path layer Adapted Information

The end-to-end VP AI is cell structured (Figure D.56). It represents (a multiplex of) adapted client layer information comprising end-to-end VP user cells as created in the VP/VC adaptation function performing the multiplexing of the VC signals. For the case the signal has passed the trail protection sublayer, end-to-end VP_AI may include the end-to-end VP trail protection overhead in the end-to-end OAM cell (F4E) APS, as defined in ITU-T I.630.

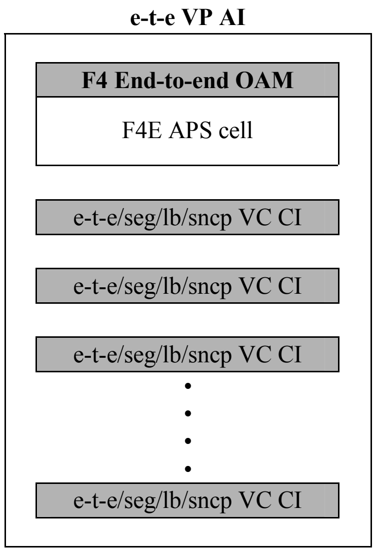


Figure D.56/I.732 – ATM VP Adapted Information

The segment VP AI is cell structured (Figure D.57). It represents end-to-end VP CI and VPSNC CI.

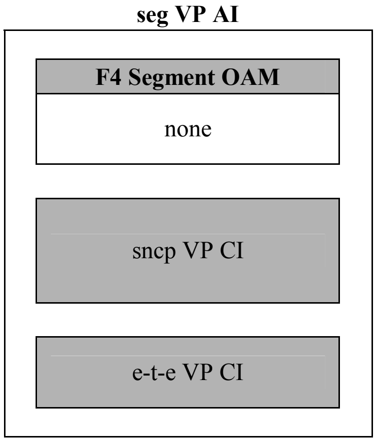


Figure D.57/I.732 – ATM VP Segment Adapted Information

D.3.1 ATM Virtual Path Connection Function VP_C

Symbol

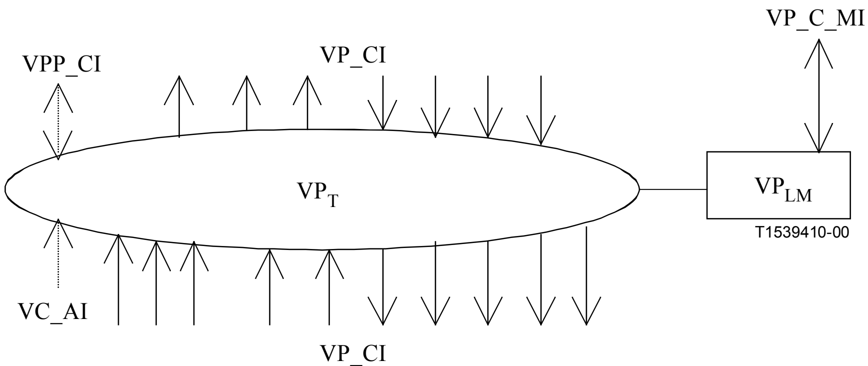


Figure D.58/I.732 – VP_C symbol

Interfaces

Table D.11/I.732 – VP_C input and output signals

Input(s)	Output(s)
Per VP_CI, n × for the function: VP_CI_D VP_CI_ACS for inputs from the server layer: VP_CI_SSF per SNC/N protection connection point: VP_AI_TSF VP_AI_TSD per SNC/T protection test termination point: VPP_CI_SSF VPP_CI_APS per input and output connection point: VP_C_MI_ConnectionPortIds per matrix connection: VP_C_MI_ConnectionType VP_C_MI_Directionality per SNC protection group: VP_C_MI_ProtType VP_C_MI_SwType VP_C_MI_GroupID VP_C_MI_OperType VP_C_MI_ WTRtime VP_C_MI_HOtime VP_C_MI_ExtCmd	per VP_CI, m × per function: VP_CI_D VP_CI_ACS VP_CI_SSF per SNC/T protection test termination point: VPP_CI_APS NOTE – Protection status reporting signals are for further study

Processes

In the VP_C function ATM Virtual Path Layer Characteristic Information is routed between input (termination) connection points ((T)CPs) and output (T)CPs by means of matrix connections. (T)CPs may be allocated within a protection group.

NOTE 1 – Neither the number of input/output signals to the connection function, nor the connectivity is specified in this Recommendation. That is a property of individual network elements.

NOTE 2 – If CI_SSF is not connected (when connected to the client layer TT_So), CI_SSF is assumed to be false.

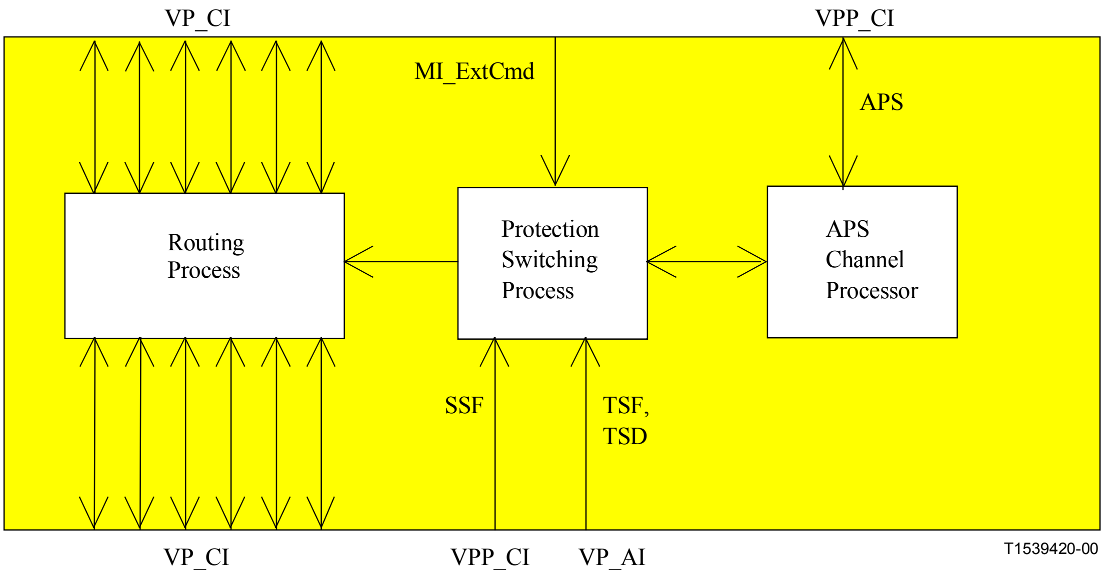


Figure D.59/I.732 – VP_C process block diagram

Routing process:

– Transfer function: This process passes all the cells received from a specific input to the corresponding output according to the matrix connection between the specified input and output established by the layer management function.

– Layer Management function: It configures, according to the information received from the AEMF and, in case of protected connections, from the protection switching control process, the associations between input and output ports of the VP_C block. It shall be able to remove an established matrix connection.

Each (matrix) connection in the VP_C function shall be characterized by the:

Type of connection (MI_ConnectionType):	unprotected, protected
Traffic direction (MI_Directionality):	unidirectional, bidirectional
Input and output connection points (MI_ConnectionPortIDs):	set of connection point identifiers
NOTE 1 – Multipoint connections are handled as separate connections from the same input CP and are for further study. NOTE 2 – It shall be possible to connect one or more Characteristic Information (CI) outputs to one input Connection Point (CP) of the VP_C function.	

Protection Switching process:

– Layer Management function: It controls the routing process in order to re-configure some protected (MI_ConnectionType="protected") matrix connections, when the switching criteria are matched. Refer to D.3.1.1 for more details.

In case of SNC/T, this process is responsible to require the switching from the working path to the protection path (or vice versa) for all the VP connections belonging to the VP group for which the switching criteria are met.

Each protected matrix connection in the VP_C function shall be characterized by the:

Type of protection (MI_ProtType):	1 + 1 SNC/N 1 + 1 SNC/T 1:1 SNC/T
Type of protection switching (MI_SwType):	unidirectional bidirectional
VP Group (MI_GroupID):	Identification of the VP group the matrix connection belongs to
NOTE – The MI_SwType and the MI_GroupID apply only to SNC/T protected matrix connections and are meaningless for SNC/N protected matrix connections.	

APS channel process:

– Layer Management function: It implements the APS communication protocol, according to Annex A/I.630. It is not used in case of SNC/N and unidirectional 1 + 1 SNC/T.

  The APS information from the far-end (i.e. the K1 and K2 fields) is received from the VP/VPP_A_So function of the test trail in the protection VP group through the CI_APS signal. The APS information to the far-end (i.e. the K1 and K2 fields) is sent to the VP/VPP_A_Sk function of the test trail in the protection VP group through the CI_APS signal.

Performance Monitoring

None.

Defects

None.

Coordination Functions

Consequent Actions

If an output of this function is not connected to one of its inputs, the connection function shall send no cells and SSF = false to the output.

Defect Correlations

None.

D.3.1.1 ATM Virtual Path Subnetwork Connection Protection Process

NOTE 1 – This process is active in the VP_C function as many times as there are SNC/N protected matrix connections or SNC/T protected group of matrix connections.

The VP_C function may provide protection for the connection against channel-associated defects within a subnetwork connection.

VP subnetwork connection protection mechanisms (i.e. SNC/N and SNC/T) are described in ITU-T I.630.

The SNC/N functions at both ends operated in the same way, by monitoring the subnetwork connection for defects, evaluating the system status taking into consideration the priorities of defect conditions and of external switch requests, and switching the appropriate channel to the protection subnetwork connection.

The SNC/T functions at both ends operated in the same way, by monitoring the test connections for defects, evaluating the system status taking into consideration the priorities of defect conditions and of external and remote switch requests, and switching the appropriate channel group to the protection subnetwork connection group. The two VP_C functions may communicate with each other via a bit-oriented protocol carried by the K1, K2 fields of APS cells. This protocol is described in ITU-T I.630.

The signal flow associated with the VP_C SNC protection process is described with reference to Figure D.60 (SNC/N) and to Figure D.61 (SNC/T). The VP_C protection process receives control parameters and external switch requests from the AEMF function and outputs status indications to the AEMF function, as a result of switch commands described in the ITU-T I.630.

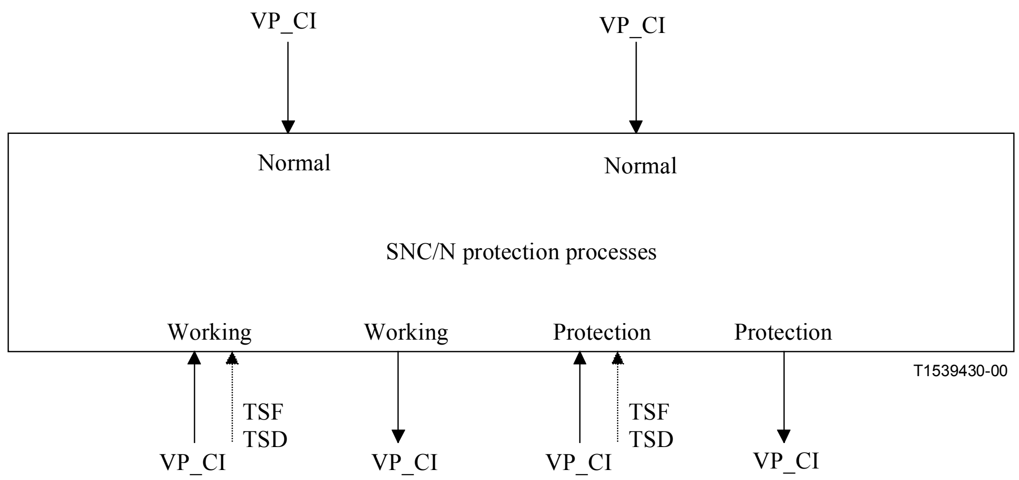


Figure D.60/I.732 – VP non-intrusive monitored subnetwork connection (SNC/N) protection process

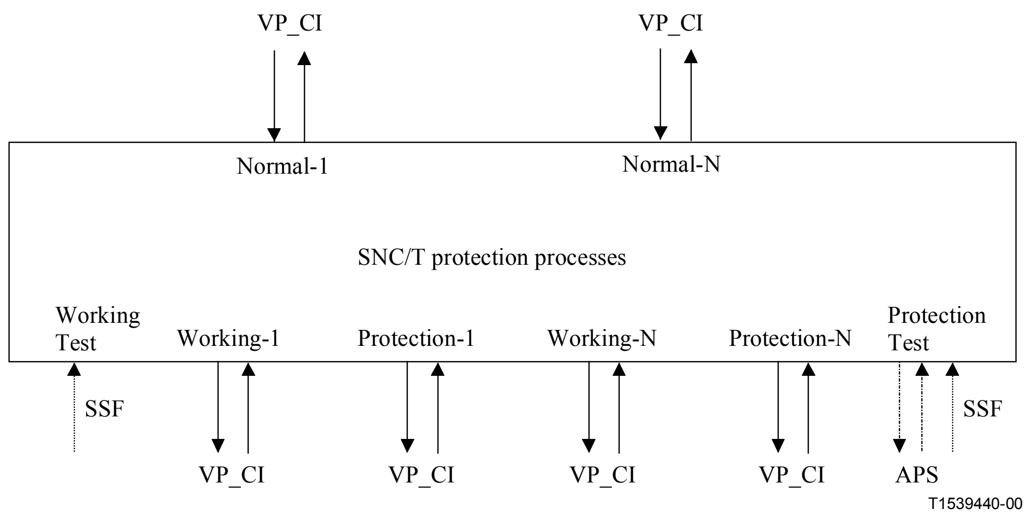


Figure D.61/I.732 – VP group subnetwork connection (SNC/T) protection process

NOTE 2 – The 1:1 SNC/T with extra-traffic is for further study.

Source Direction

For 1 + 1 architecture, the VP_CI signal received from the normal TP/VP_A (or VP_TT) function is bridged permanently to both the working and protection TP/VP_A functions.

For 1:1 architecture, under normal conditions the VP_CI signal received from the normal TP/VP_A (or VP_TT) function is passed to the corresponding working TP/VP_A function. When a switch has to be performed, the signal from the normal TP/VP_A (or VP_TT) function is passed to the corresponding protection TP/VP_A function.

NOTE 3 – The 1:1 SNC/T with extra-traffic is for further study.

When applicable (i.e. bidirectional 1 + 1 and 1:1 SNC/T protection), the APS information, generated according to the rules in ITU-T I.630, is forwarded to the VP/VPP_A_So function of the test VP trail in the protection group.

NOTE 4 – The atomic function connected to the VP_C is either a TP/VP_A or a VP_TT. When the trail signal is terminated in this network element, it will be connected to a VP_TT, otherwise it will be connected to a TP/VP_A (for further transport through the network).

Sink Direction

For SNC/N protection (Figure D.60) the VP_CI signals from the working and protection TP/VP_A functions are non-intrusively monitored by the VPM_TT_Sk functions before they access the VP_C function. The VP_C SNC/N protection process uses the resultant TSF and TSD signals.

For SNC/T protection (Figure D.61) the VP_CI signals from the TP/VP_A of the test trails in the working and protection groups are terminated to the VP_TT and the VP/VPP_A functions. The VP_C SNC/T protection process uses the resultant SSF and APS signals. The APS information received from the VP/VPP_A_Sk function of the test VP trail in the protection group is processed according to ITU-T I.630.

Under normal conditions, VP_C forwards the cells from the working TP/VP_A function to the corresponding TP/VP_A (or VP_TT) function. The cells from the protection subnetwork connection are discarded. The extra-traffic is for further study.

If a switch has to be performed, then the cells received from the protection TP/VP_A are forwarded to the corresponding TP/VP_A (or VP_TT) function. The cells received from the working TP/VP_A are discarded. The extra-traffic is for further study.

Switch Initiation Criteria

Automatic protection switching for the SNC/N is based on the defect conditions of the working and protection subnetwork connections. These conditions are the signal fail (AI_TSF) and signal degrade (AI_TSD). They are detected in the VPM_TT_Sk atomic function, as described in D.3.3.1.

Automatic protection switching for the SNC/T is based on the defect conditions of the working and protection test VP connections. These conditions are the signal fail (CI_SSF) and signal degrade (CI_SSF). They are detected in the VP/VPP_A_Sk atomic function, as described in D.3.7.2.

The automatic protection switching action is performed after a period of time after the detection of the SF/SD condition. This period called hold-off (HO) time should be set by the AEMF (MI_HOtime) within the range of 0 to 10 s with a granularity of 500 ms.

The protection switch can also be initiated by switch commands (MI_ExtCmd) received by the AEMF function. Refer to the switch initiation criteria described in ITU-T I.630.

Switching Time

Refer to ITU-T I.630.

Switch Restoration

In the revertive mode of operation (MI_OperType = "revertive"), the working channel shall be restored, i.e. the signal on the protection subnetwork connection shall be switched back to the working subnetwork connection, when the working subnetwork connection has recovered from the fault.

To prevent frequent operation of the protection switch due to an intermittent fault, a failed subnetwork connection must become fault-free. After the failed subnetwork connection meets this criterion, a fixed period of time shall elapse before being used again by a working channel. This period called wait-to-restore (WTR) time should be set by the AEMF (MI_WTRtime) within the range of one to 30 minutes with a granularity of one minute (default 12 minutes). An SSF, TSF or TSD condition shall override the WTR. Refer to the switch initiation criteria described in ITU-T I.630.

D.3.2 ATM Virtual Path Trail Termination Functions

D.3.2.1 ATM Virtual Path Trail Termination Source Function VP_TT_So

Symbol

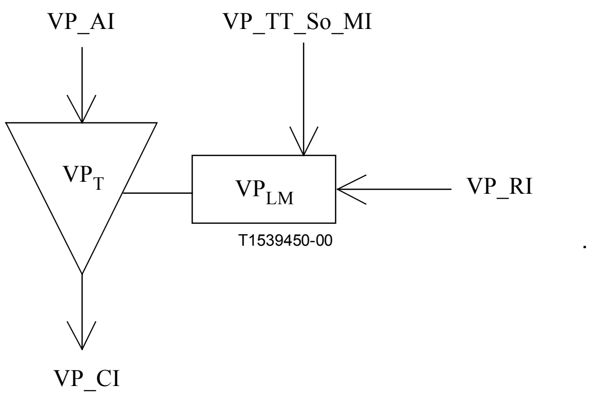


Figure D.62/I.732 – VP_TT_So symbol

Interfaces

Table D.12/I.732 – VP_TT_So input and output signals

Input(s)	Output(s)
VP_AI_D VP_AI_ACS VP_RI_RDI VP_RI_BRPMdata VP_TT_So_MI_CCOption VP_TT_So_MI_DTDLuseEnabled VP_TT_So_MI_CCActive VP_TT_So_MI_FPMActive VP_TT_So_MI_PMActive VP_TT_So_MI_TSTPuseEnabled VP_TT_So_MI_Time	VP_CI_D VP_CI_ACS

Processes

This function performs VP end-to-end RDI insertion, Continuity Check, FPM and BR cell generation as well as activation/deactivation of FPM, FPM&BR and CC on the VP end-to-end level.

End-to-end VP-RDI:

– Transfer function: This process inserts end-to-end VP-RDI cells from the Layer Management function.

– Layer Management function: End-to-end VP-RDI cells shall be generated according to the Consequent Actions section of the Coordination Function below.

End-to-end VP-Continuity Check:

– Transfer function: This process inserts end-to-end VP-CC cells from the Layer Management function.

– Layer Management function: End-to-end VP-CC activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the end-to-end VP-CC activation process (MI_CCActive), this process monitors the VP user cell stream activity at the input (VP_AI) and generates end-to-end VP-CC cells (Figure D.63). There are two options defined in ITU-T I.610 for end-to-end VP-CC. For the case option 1 is implemented or activated (MI_CCOption = 1), an end-to-end VP-CC cell shall be inserted if no user cell has been transmitted for a period of nominally 1-second. For the case option 2 is implemented or activated (MI_CCOption = 2), an end-to-end VP-CC cell shall be inserted with a periodicity of 1 cell/s independently of the VP user cell flow. The procedure of end-to-end VP-CC is described in 9.2.1.1.2/I.610.

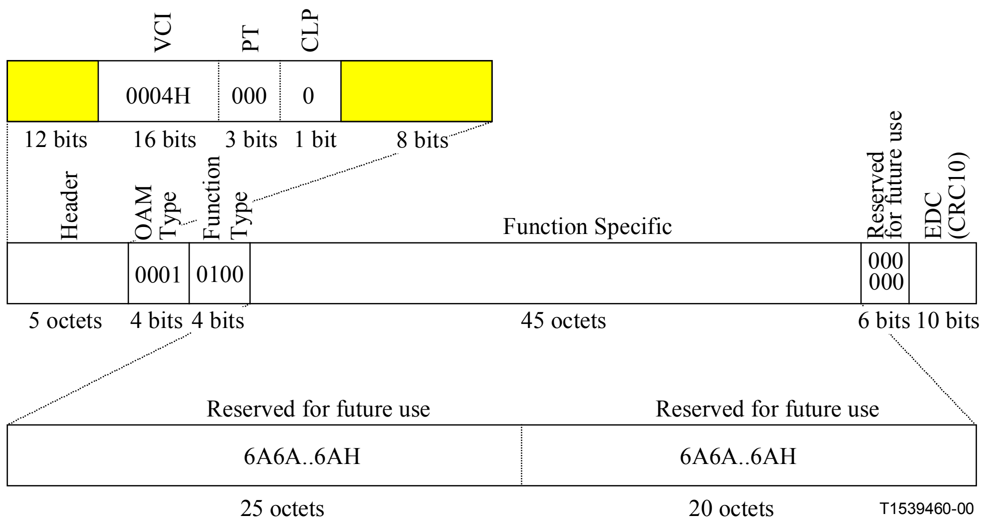


Figure D.63/I.732 – End-to-end VP-CC OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

NOTE – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the end-to-end VP-CC OAM cell as an ATM address field.

End-to-end VP-FPM cell generation:

– Transfer function: This process monitors the incoming cell flow and inserts end-to-end VP-FPM cells from the Layer Management function.

– Layer Management function: End-to-end VP-FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive for the end-to-end VP-FPM process or MI_PMActive for the end-to-end FPM&BR process. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), end-to-end VP-FPM cells shall be generated. Refer to 10.3/I.610.

The value of the VCI, PT, CLP, OAM Type, Function Type and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The value of the MSCN/FPM, TUC_{0+1}, $BEDC_{0+1}$ and TUC_0 shall be written with the information as specified in 10.3.1/I.610, which is functionally represented in Figure D.64.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

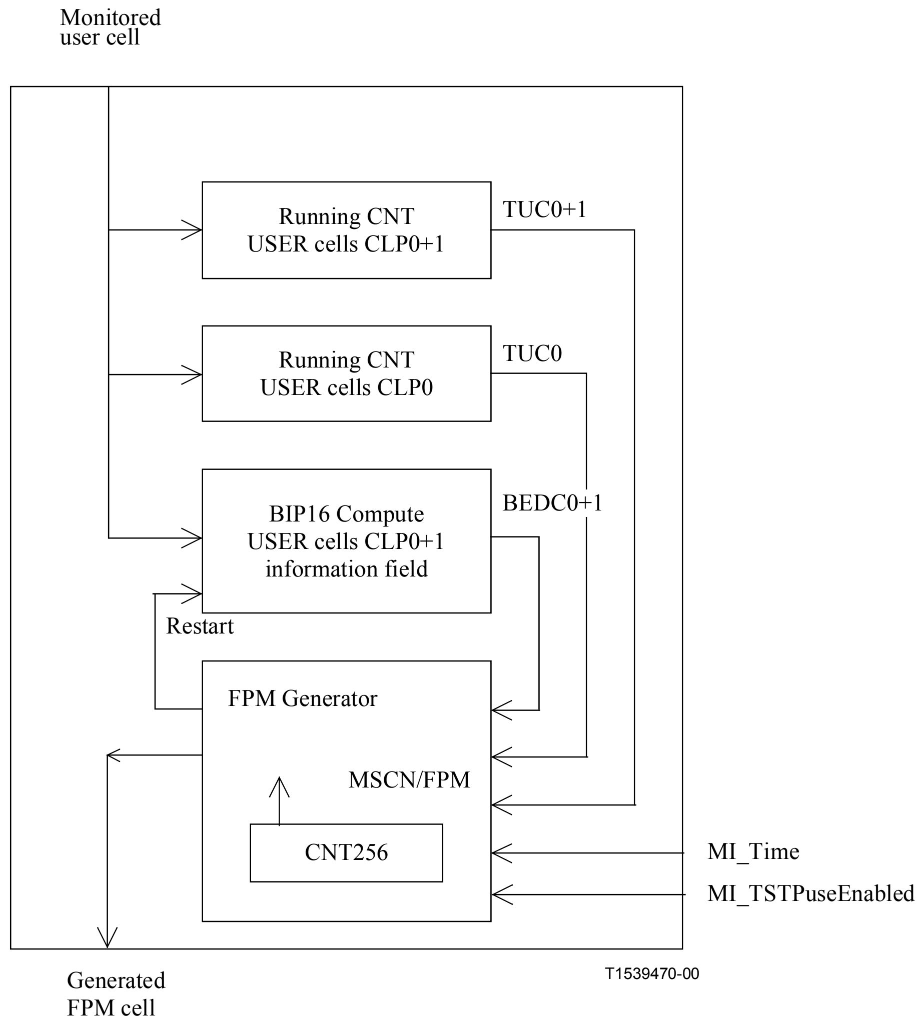


Figure D.64/I.732 – End-to-end VP-FPM generation process

End-to-end VP-BR cell generation:

– Transfer function: This process inserts end-to-end VP-BR cells from the Layer Management function.

– Layer Management function: VP end-to-end FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the FPM&BR activation process (MI_PMActive), the end-to-end VP-BR cells shall be generated using the PM data from RI_BRPMdata being collected by the VPS_TT_Sk. Refer to 10.3/I.610.

The value of the VCI, PT, CLP, OAM Type, Function Type, MSCN/BR and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The TUC_{0+1}, TUC_0, RMCSN, SECBS, $TRCC_0$, $BLER_{0+1}$ and $TRCC_{0+1}$ fields shall be written with the information received from the VPS_TT_Sk via RI_BRPMdata.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

End-to-end VP AD flow:

– Transfer function: This process inserts end-to-end VP-AD-FPM/BR, end-to-end VP-AD-CC and end-to-end VP-AD-FPM cells from the Layer Management function.

– Layer Management function: For further study.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

On reception of RI_RDI, the function shall output end-to-end VP-RDI cells according to 9.2.1.1.1.2/I.610. On clearing of RI_RDI, the generation of end-to-end VP-RDI cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option or the function supports the DTDL option and the MI_DTDLuseEnable is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end VP-RDI cell shall be coded as 6Ahex. If the function supports DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location fields of the end-to-end VP-RDI cell shall contain the value provided by the VP_TT_Sk via RI_RDI. The insertion of RDI cells should not interrupt any cell flows present on the connection.

Defect Correlations

None.

D.3.2.2 ATM Virtual Path Trail Termination Sink Function VP_TT_Sk

Symbol

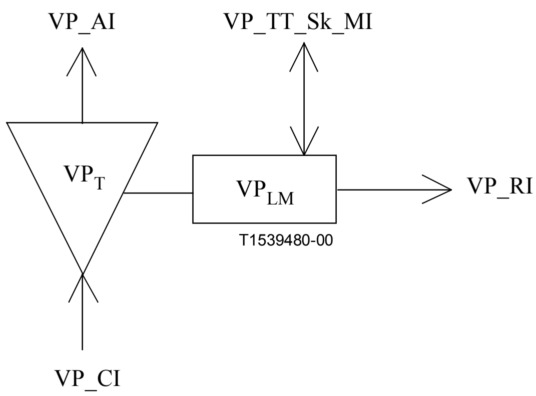


Figure D.65/I.732 – VP_TT_Sk symbol

Interfaces

Table D.13/I.732 – VP_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF	VP_AI_D VP_AI_ACS VP_AI_TSF
VP_TT_Sk_ MI_RDIreported VP_TT_Sk_ MI_AISreported VP_TT_Sk_ MI_LOCreported	VP_RI_RDI VP_RI_BRPMdata
VP_TT_Sk_ MI_CCActive VP_TT_Sk_ MI_FPMActive VP_TT_Sk_ MI_PMActive	VP_TT_Sk_MI_cRDI VP_TT_Sk_MI_RDIdata VP_TT_Sk_MI_cAIS VP_TT_Sk_MI_AISdata VP_TT_Sk_MI_cLOC VP_TT_Sk_MI_FPMdata VP_TT_Sk_MI_BRPMdata

Processes

This function performs VP end-to-end RDI, Continuity Check, FPM and BR cell extraction, end-to-end VP-AIS detection as well as activation/deactivation of FPM, FPM&BR and CC on the VP end-to-end level.

End-to-end VP-RDI:

– Transfer function: This process extracts end-to-end VP-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VP-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location The defect detection of the end-to-end VP-RDI cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_RDIdata. Refer to 9.2.1.1.1.2 and 10.2.1/I.610.

End-to-end VP Continuity Check:

– Transfer function: This process extracts end-to-end VP-CC cells and forwards them to the Layer Management function.

– Layer Management function: End-to-end VP CC activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the end-to-end VP CC activation process (MI_CCActive), the process shall report the end-to-end VP CC cells according to the Defects section below.

End-to-end VP FPM:

– Transfer function: This process monitors the incoming cell flow and extracts end-to-end VP-FPM cells and forwards them to the Layer Management function.

– Layer Management function: End-to-end VP FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct

TMN activation/deactivation is MI_FPMActive or MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the process shall monitor the performance derived from the comparison between received block of user cells and information in a received end-to-end VP-FPM cell, according to the Performance Monitoring section below.

End-to-end VP BR:

– Transfer function: This process extracts end-to-end VP-BR cells and forwards them to the Layer Management function.

– Layer Management function: VP end-to-end FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM&BR activation process (MI_PMActive), the process shall report the end-to-end VP-BR cells according to the Performance Monitoring section below.

End-to-end VP-AIS:

– Transfer function: This process extracts end-to-end VP-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VP-AIS cell provides information as to the status of the VP connection, as well as to the defect type and defect location. The defect detection of the end-to-end VP-AIS cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_AISdata and to the paired VP_TT_So according to the Consequent Actions section of the Coordination Function below. Refer to 9.2.1.1.1.1 and 10.2.1/I.610.

End-to-end VP-AD:

– Transfer function: This process extracts end-to-end VP-AD-FPM/BR, end-to-end VP-AD-CC and end-to-end VP-AD-FPM cells and forwards them to the Layer Management function.

– Layer Management function: For further study.

Defects

If enabled by the end-to-end VP-CC activation process (MI_CCActive = true), the function shall declare dLOC if no user cell or end-to-end VP continuity check cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dLOC shall be cleared when any user cell or end-to-end VP-CC cell is received. If disabled by the end-to-end VP-CC activation process (MI_CCActive = false), dLOC shall be cleared.

The function shall declare dRDI as soon as an end-to-end VP-RDI cell is received. The dRDI shall be cleared when no end-to-end VP-RDI is received during a nominally 2.5 s period, with a margin of ± 0.5 s. Refer to 9.2.1.1.1.2/I.610.

The function shall declare dAIS as soon as an end-to-end VP-AIS cell is received. The dAIS shall be cleared when a VP user cell or an end-to-end VP CC cell is received; if end-to-end VP CC is not activated, dAIS is cleared also if end-to-end VP-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between received block of user cells and information in a received end-to-end VP-FPM cell. The definition of user cells is given in Table 1/I.610.

If activated by the FPM activation process (MI_FPMActive), the result is reported to the AEMF via MI_FPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the result is backward reported via RI_BRPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the received end-to-end VP-BR cell on the near end contains the performance information regarding the unidirectional connection set up from the near end to the far end. This information is reported to the AEMF via MI_BRPMdata.

NOTE 1 – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Mis-insertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the EMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dLOC or dAIS

aRDI ← CI_SSF or dLOC or dAIS

The consequent action aRDI is conveyed through RI_RDI to the VP_TT_So together with the defect type and defect location (if implemented). In case of dAIS, defect type and location through RI_RDI are as in the received VP-AIS cell. In case of CI_SSF and dLOC, defect type and location are in respect to the equipment this function is built into.

The consequent action aTSF is conveyed by AI_TSF through the VP_AI.

NOTE 2 – VC-AIS insertion is performed in the VP/VC_A_Sk function under control of AI_TSF.

Defect Correlations

cRDI ← dRDI and (not dAIS) and (not CI_SSF) and RDIreported

cAIS ← dAIS and (not CI_SSF) and AISreported

cLOC ← dLOC and (not CI_SSF) and (not dAIS) and LOCreported

It shall be an option to report end-to-end VP-AIS as a fault cause. This is controlled by means of the parameter AISreported. The default shall be AISreported = false.

It shall be an option to report end-to-end VP-RDI as a fault cause. This is controlled by means of the parameter RDIreported. The default shall be RDIreported = false.

It shall be an option to report end-to-end VP-LOC as a fault cause. This is controlled by means of the parameter LOCreported. The default shall be LOCreported = false.

D.3.3 ATM Virtual Path Monitoring Functions

D.3.3.1 ATM Virtual Path Non-intrusive Monitoring Function VPM_TT_Sk

Symbol

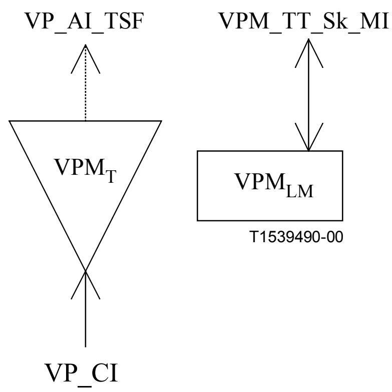


Figure D.66/I.732 – VPM_TT_Sk symbol

Interfaces

Table D.14/I.732 – VPM_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF VPM_TT_Sk_MI_AISreported VPM_TT_Sk_MI_RDIreported VPM_TT_Sk_MI_LOCreported VPM_TT_Sk_MI_CCActive VPM_TT_Sk_ MI_FPMActive VPM_TT_Sk_MI_PMActive	VP_AI_TSF VPM_TT_Sk_MI_cAIS VPM_TT_Sk_MI_AISdata VPM_TT_Sk_MI_cRDI VPM_TT_Sk_MI_RDIdata VPM_TT_Sk_MI_cLOC VPM_TT_Sk_MI_FPMdata VPM_TT_Sk_MI_BRPMdata

Processes

This function monitors VP end-to-end RDI, end-to-end Continuity Check, FPM and BR cells and end-to-end VP-AIS.

End-to-end VP-RDI:

– Transfer function: This process monitors end-to-end VP-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VP-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the end-to-end VP-RDI cells shall be according to the Defects section below. The information monitored from the defect type and defect location field is reported to the AEMF via MI_RDIdata. Refer to 9.2.1.1.1.2 and 10.2.1/I.610.

End-to-end VP Continuity Check:

– Transfer function: This process monitors end-to-end VP-CC cells and forwards them to the Layer Management function.

– Layer Management function: If enabled by TMN (MI_CCActive), the process shall report the end-to-end VP CC cells according to the Defects section below. End-to-end VP-CC activation (and associated deactivation) within a VP end-to-end non-intrusive monitoring point cannot be controlled using AD OAM flow.

End-to-end VP FPM:

– Transfer function: This process monitors the incoming cell flow and monitors end-to-end VP-FPM cells and forwards them to the Layer Management function.

– Layer Management function: If enabled by TMN (MI_FPMActive or by MI_PMActive), the process shall monitor the performance derived from the comparison between received block of user cells and information in a monitored end-to-end VP-FPM cell, according to the Performance Monitoring section below. End-to-end VP-FPM activation (and associated deactivation) within a VP end-to-end non-intrusive monitoring point cannot be controlled using AD OAM flow.

End-to-end VP BR:

– Transfer function: This process monitors end-to-end VP-BR cells and forwards them to the Layer Management function.

– Layer Management function: If enabled by TMN (MI_PMActive), the process shall process the end-to-end VP-BR cells according to the Performance Monitoring section below. End-to-end VP-BR activation (and associated deactivation) within a VP end-to-end non-intrusive monitoring point cannot be controlled using AD OAM flow.

End-to-end VP-AIS:

– Transfer function: This process monitors end-to-end VP-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VP-AIS cell provides information as to the status of the VP connection, as well as to the defect type and defect location The defect detection of the end-to-end VP-AIS cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_AISdata. Refer to 9.2.1.1.1.1 and 10.2.1/I.610.

Defects

If enabled by the end-to-end VP-CC activation process (MI_CCActive = true), the function shall declare dLOC if no user cell or end-to-end VP-CC cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dLOC shall be cleared when any user cell or end-to-end VP-CC cell is received. If disabled by the end-to-end VP-CC activation process (MI_CCActive = false), dLOC shall be cleared.

The function shall declare dRDI as soon as an end-to-end VP-RDI cell is received. The dRDI shall be cleared when no end-to-end VP-RDI is received during a nominally 2.5 s period, with a margin of ± 0.5 s. Refer to 9.2.1.1.1.2/I.610.

The function shall declare dAIS as soon as an end-to-end VP-AIS cell is received. The dAIS shall be cleared when a VP user cell or an end-to-end VP CC cell is received; if end-to-end VP CC is not activated, dAIS is cleared also if end-to-end VP-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between monitored block of user cells and information in a monitored end-to-end VP-FPM cell. The result is reported to the AEMF via MI_FPMdata. The definition of user cells is given in Table 1/I.610.

If activated by the FPM&BR activation process (MI_PMActive), the end-to-end VP-BR cell is monitored. The information is reported to the AEMF via MI_BRPMdata.

NOTE – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Mis-insertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the AEMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dLOC or dAIS

The consequent action aTSF is conveyed through the VP_AI_TSF.

Defect Correlations

cRDI ← dRDI and (not dAIS) and (not CI_SSF) and RDIreported

cAIS ← dAIS and (not CI_SSF) and AISreported

cLOC ← dLOC and (not CI_SSF) and (not dAIS) and LOCreported

It shall be an option to report end-to-end VP-AIS as a fault cause. This is controlled by means of the parameter AISreported. The default shall be AISreported = false.

It shall be an option to report end-to-end VP-RDI as a fault cause. This is controlled by means of the parameter RDIreported. The default shall be RDIreported = false.

It shall be an option to report end-to-end VP-LOC as a fault cause. This is controlled by means of the parameter LOCreported. The default shall be LOCreported = false.

D.3.3.2 ATM Virtual Path Segment Non-intrusive Monitoring function VPSM_TT_Sk

Symbol

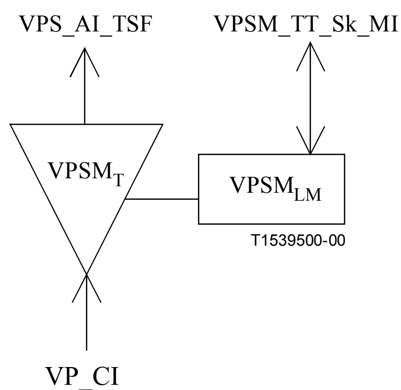


Figure D.67/I.732 – VPSM_TT_Sk symbol

Interfaces

Table D.15/I.732 – VPSM_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF VPSM_TT_Sk_MI_SLOCreported VPSM_TT_Sk_MI_SRDIreported VPSM_TT_Sk_MI_SAISreported VPSM_TT_Sk_MI_SAISuse VPSM_TT_Sk_MI_CCActive VPSM_TT_Sk_MI_FPMActive VPSM_TT_Sk_MI_PMActive	VPS_AI_TSF VPSM_TT_Sk_MI_cSLOC VPSM_TT_Sk_MI_cSRDI VPSM_TT_Sk_MI_cSAIS VPS_TT_Sk_MI_SRDIdata VPS_TT_Sk_MI_SAISdata VPS_TT_Sk_MI_AISdata VPS_TT_Sk_MI_FPMdata VPS_TT_Sk_MI_BRPMdata

Processes

This function performs VP segment AIS, RDI, CC, FPM, BR cell monitoring and processing.

For interworking with equipment compliant to the 1995 version of ITU-T I.610 and for network operators that prefer to operate without the use of segment AIS, the function monitors also for end-to-end VP-AIS cells in conjunction with segment CC cells.

Segment VP-RDI:

– Transfer function: This process monitors segment VP-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The segment VP-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the segment VP-RDI cells shall be according to the Defects section below. The information monitored from the defect type and defect location field is reported to the AEMF via MI_SRDIdata. Refer to 9.2.1.1.1.2 and 10.2.1/I.610.

Segment VP-AIS:

– Transfer function: This process monitors segment VP-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The segment VP-AIS provides information as to the status of the VP segment up to this non-intrusive monitoring point, as well as to the defect type and defect location. The defect detection of the segment VP-AIS cells shall be according to the Defects section below. If enabled (MI_SAISuse = true), the information monitored from the defect type and defect location field is reported to the AEMF via MI_SAISdata.

End-to-end VP-AIS:

– Transfer function: This process monitors end-to-end VP-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VP-AIS provides information as to the status of the VP connection up to this non-intrusive monitoring point, as well as to the defect type and defect location. The defect detection of the end-to-end VP-AIS cells shall be according to the Defects section below. The information monitored from the defect type and defect location field is reported to the AEMF via MI_AISdata.

Segment VP-Continuity Check:

– Transfer function: This process monitors segment VP-CC cells and forwards them to the Layer Management function.

– Layer Management function: VP segment CC activation (and associated deactivation) can be initiated only by the TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. VP segment CC activation (and associated deactivation) within a VP segment non-intrusive monitoring point cannot be controlled using AD OAM flow.

  If enabled by the VP segment CC activation process (MI_CCActive), the process shall process the segment VP-CC cells according to the Defects section below.

NOTE 1 – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the segment VP-CC OAM cell as an ATM address field.

Segment VP-FPM:

– Transfer function: This process monitors the incoming cell flow and segment VP-FPM cells and forwards them to the Layer Management function.

– Layer Management function: VP segment FPM or FPM&BR activation (and associated deactivation) can be initiated only by the TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive or MI_PMActive. VP segment FPM activation (and associated deactivation) within a VP segment non-intrusive monitoring point can not be controlled using AD OAM flow.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the process shall report the segment VP-FPM cell according to the Performance Monitoring section below.

Segment VP-BR:

– Transfer function: This process monitors segment VP-BR cells and forwards them to the Layer Management function.

– Layer Management function: VP segment FPM&BR activation (and associated deactivation) can be initiated only by the TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. VP segment FPM&BR activation (and associated deactivation) within a VP segment non-intrusive monitoring point can not be controlled using AD OAM flow.

  If enabled by the FPM&BR activation process (MI_PMActive), the process shall report the segment VP-BR cells according to the Performance Monitoring section below.

Defects

If enabled by the VP segment CC activation process (MI_CCActive = true), the function shall declare dSLOC if no VP user cell or segment VP-CC cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dSLOC shall be cleared when any VP user cell or segment VP-CC cell is received. If disabled by the VP segment CC activation process (MI_CCActive = false), dSLOC shall be cleared.

If enabled (MI_SAISuse = true), the function shall declare dSAIS as soon as a segment VP-AIS cell is received. The dSAIS shall be cleared when a VP user cell or a segment VP-CC cell is received; if VP segment CC is not activated, dSAIS is cleared also if segment VP-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s. If disabled (MI_SAISuse = false), dSAIS shall be cleared.

For interworking with equipment that do not generate segment VP-AIS cells or when a network operator prefers not to use segment VP-AIS cells, the function shall declare dAIS as soon as a VP end to end AIS cell is received. The dAIS shall be cleared when a VP user cell or a segment VP-CC cell is received; if VP segment CC is not activated, dAIS defect is cleared also if end to end VP-AIS cells are absent for 2.5 ± 0.5 s.

The function shall declare dSRDI as soon as a segment VP-RDI cell is received. The dSRDI shall be cleared when no segment VP-RDI cell is received within a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between received block of user cells and information in a monitored segment VP-FPM cell. The result is reported to the AEMF via MI_FPMdata. The definition of user cells is given in Table 1/I.610.

If activated by the FPM&BR activation process (MI_PMActive), the segment VP-BR is monitored. This information is reported to the AEMF via MI_BRPMdata.

NOTE 2 – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Mis-insertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the EMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dSLOC or dSAIS

The consequent action aTSF is conveyed through the VPS_AI_TSF.

Defect Correlations

cSAIS ← dSAIS or (dSLOC and dAIS)] and (not CI_SSF) and SAISreported

cSRDI ← dSRDI and (not dSAIS) and (not CI_SSF) and SRDIreported

cSLOC ← dSLOC and (not dSAIS) and (not dAIS) and (not CI_SSF) and SLOCreported

It shall be an option to report segment AIS as a fault cause. This is controlled by means of the parameter SAISreported. The default shall be SAISreported = false.

It shall be an option to report segment RDI as a fault cause. This is controlled by means of the parameter SRDIreported. The default shall be SRDIreported = false.

It shall be an option to report segment LOC as a fault cause. This is controlled by means of the parameter SLOCreported. The default shall be SLOCreported = false.

D.3.4 ATM Virtual Path Segment Functions

D.3.4.1 ATM Virtual Path Segment Trail Termination Source function VPS_TT_So

Symbol

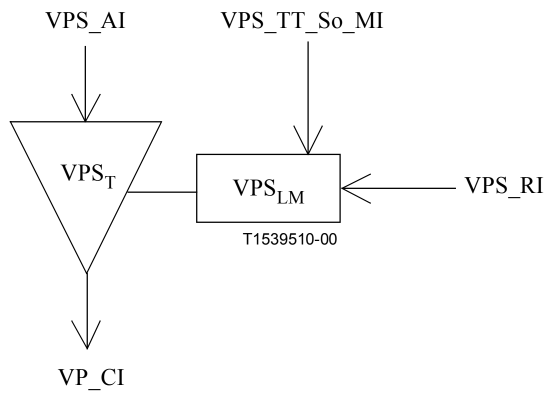


Figure D.68/I.732 – VPS_TT_So symbol

Interfaces

Table D.16/I.732 – VPS_TT_So input and output signals

Input(s)	Output(s)
VPS_AI_D VPS_AI_ACS VPS_RI_BRPMdata VPS_RI_RDI VPS_TT_So_MI_CCOption VPS_TT_So_MI_DTDLuseEnabled VPS_TT_So_MI_CCActive VPS_TT_So_MI_FPMActive VPS_TT_So_MI_PMActive VPS_TT_So_MI_TSTPuseEnabled VPS_TT_So_MI_Time	VP_CI_D VP_CI_ACS

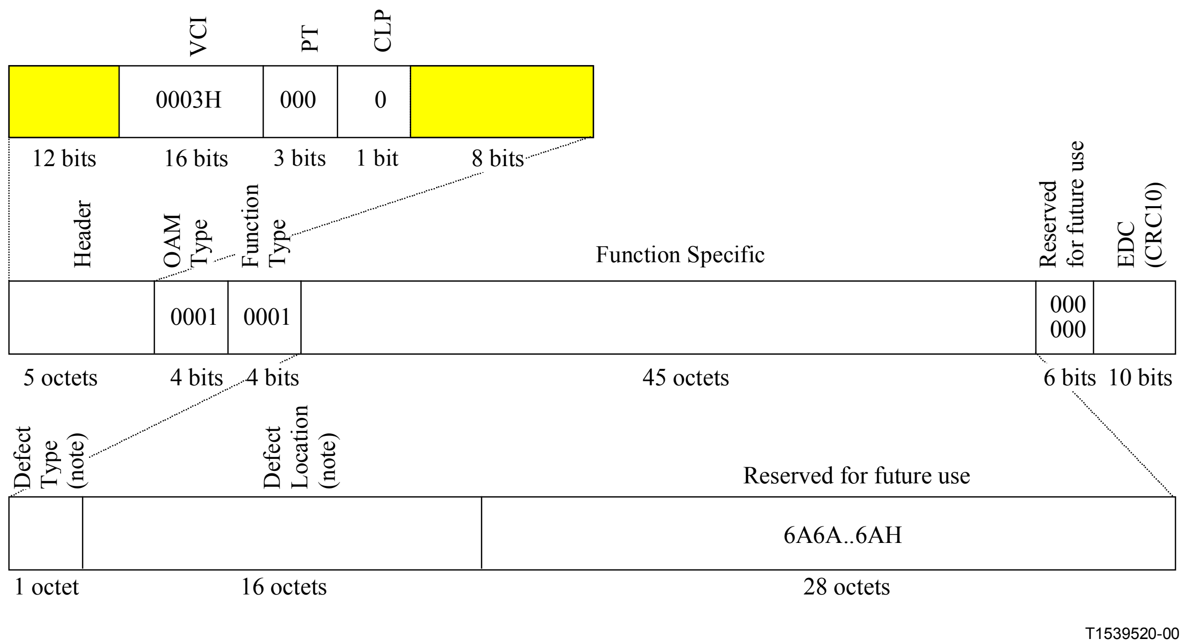
Processes

This function performs VP segment RDI, CC, FPM and BR cell generation as well as activation/deactivation of FPM, FPM&BR and CC on the VP segment level.

Segment VP-RDI:

– Transfer function: This process inserts segment VP-RDI cells from the Layer Management function.

– Layer Management function: Segment VP-RDI cells (Figure D.69) shall be generated according to the Consequent Actions section of the Coordination Function below.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.69/I.732 – Segment VP-RDI OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Defect Type, Defect Location, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Segment VP-Continuity Check:

– Transfer function: This process inserts segment VP-CC cells from the Layer Management function.

– Layer Management function: segment VP-CC activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the segment VP-CC activation process (MI_CCActive), this process monitors the VP user cell stream activity at the input (VPS_AI) and generates segment VP-CC cells (Figure D.70). There are two options defined in ITU-T I.610 for segment VP-CC. For the case option 1 is implemented or activated (MI_CCOption = 1), a segment VP-CC cell shall be inserted if no user cell has been transmitted for a period of nominally 1-second. For the case option 2 is implemented or activated (MI_CCOption = 2), a segment VP-CC cell shall be inserted with a periodicity of 1 cell/s independently of the VP user cell flow. The procedure of segment VP-CC is described in 9.2.1.1.2/I.610.

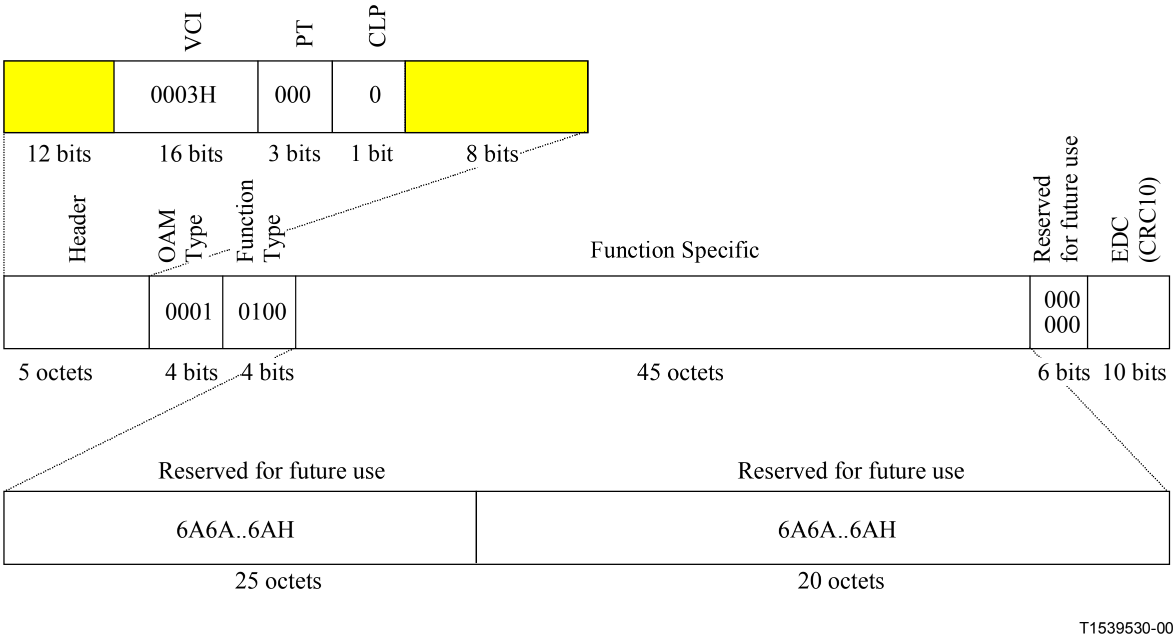


Figure D.70/I.732 – Segment VP-CC OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

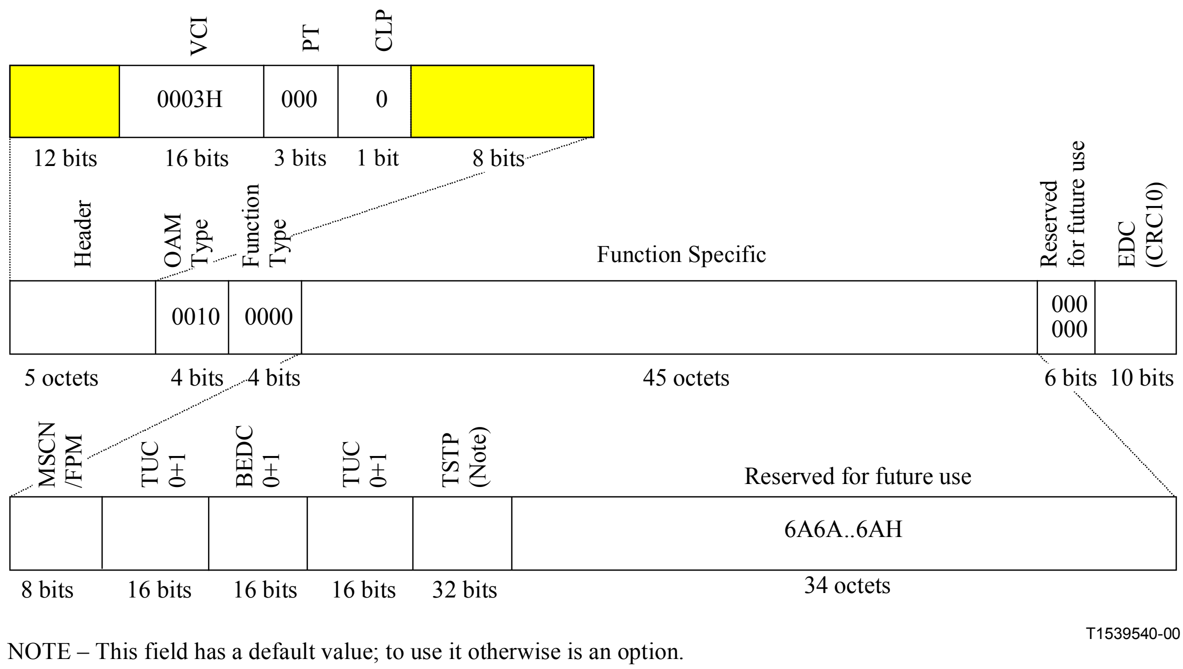
NOTE – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the segment VP-CC OAM cell as an ATM address field.

Segment VP-FPM:

– Transfer function: This process monitors the incoming cell flow and inserts segment VP-FPM cells from the Layer Management function.

– Layer Management function: VP segment FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive for the segment FPM process or MI_PMActive for the segment FPM&BR process. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), segment VP-FPM cells (Figure D.71) shall be generated. Refer to 10.3/I.610.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.71/I.732 – Segment VP-FPM OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The value of the MSCN/FPM, TUC_{0+1}, $BEDC_{0+1}$ and TUC_0 shall be written with the information as specified in 10.3.1/I.610, which is functionally represented in Figure D.72.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

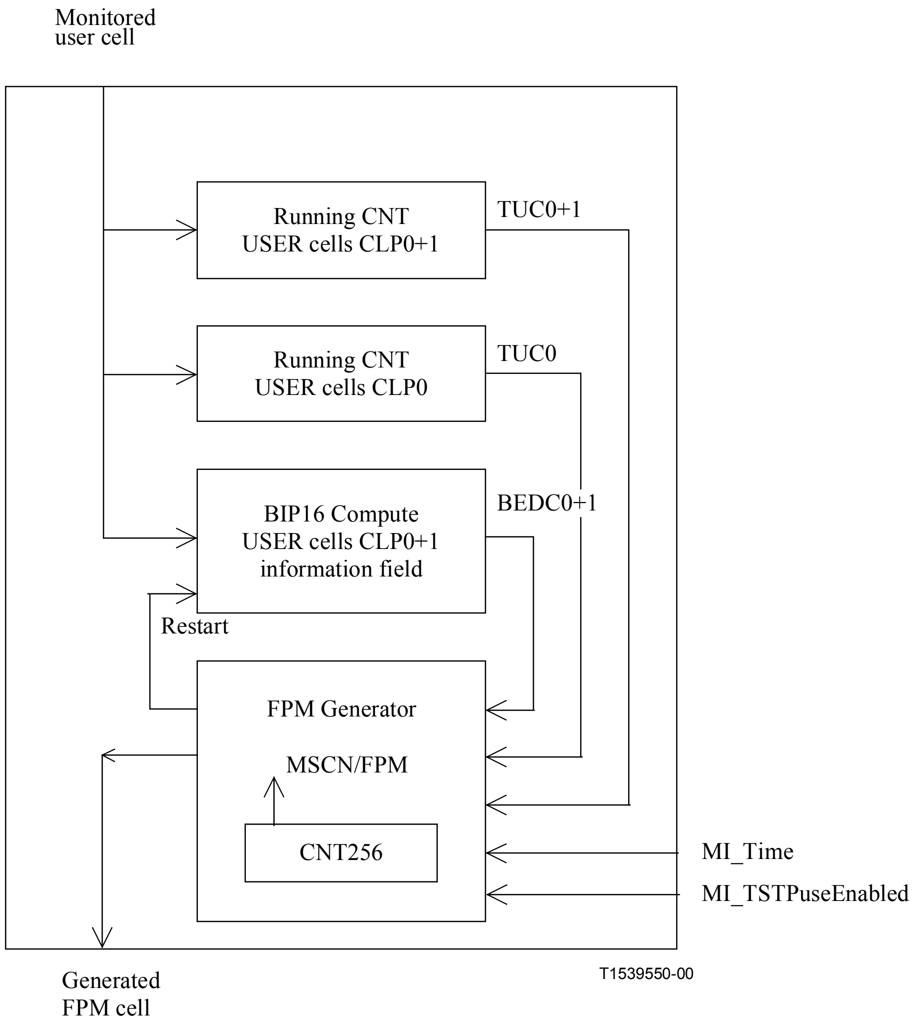


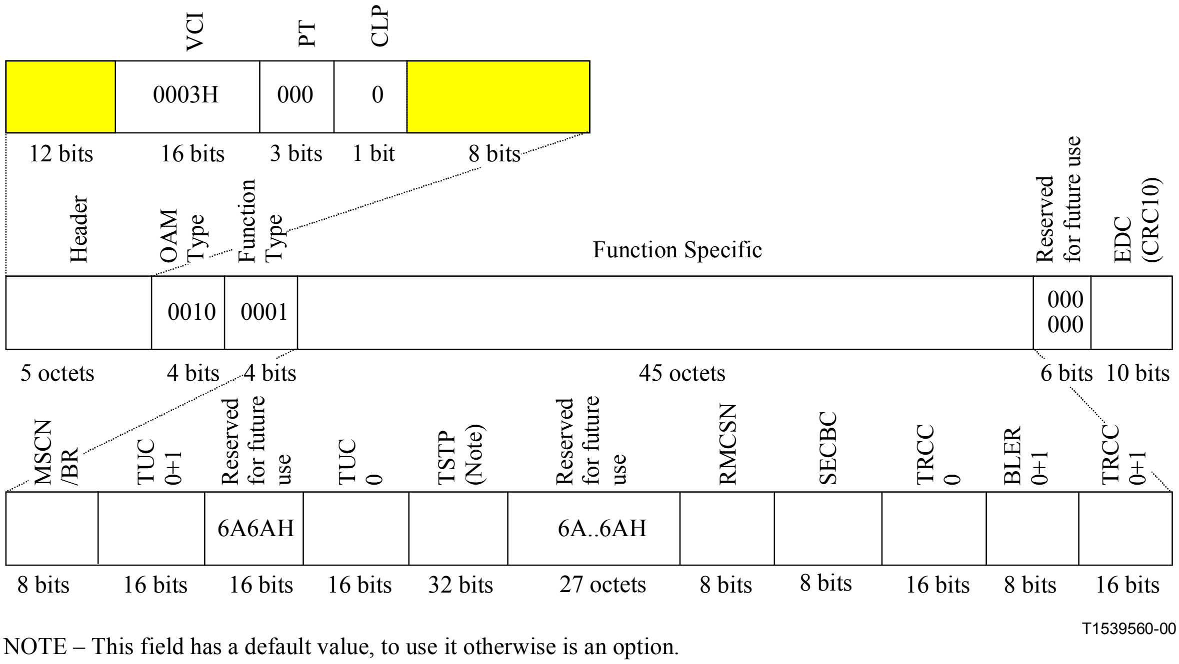
Figure D.72/I.732 – VP segment FPM generation process

Segment VP-BR:

– Transfer function: This process inserts segment VP-BR cells from the Layer Management function.

– Layer Management function: VP segment FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

If enabled by the FPM&BR activation process (MI_PMActive), the segment VP-BR cell (Figure D.73) shall be generated using the PM data from RI_BRPMdata being collected by the VPS_TT_Sk. Refer to 10.3/I.610.



NOTE – This field has a default value, to use it otherwise is an option.

Figure D.73/I.732 – Segment VP-BR OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, MSCN/BR and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The TUC_{0+1}, TUC_0, RMCSN, SECBS, $TRCC_0$, $BLER_{0+1}$ and $TRCC_{0+1}$ fields shall be written with the information received from the VPS_TT_Sk via RI_BRPMdata.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

Segment VP AD flows:

– Transfer function: This process inserts segment VP-AD-FPM/BR, segment VP-AD-CC and segment VP-AD-FPM cells from the Layer Management function.

– Layer Management function: For further study.

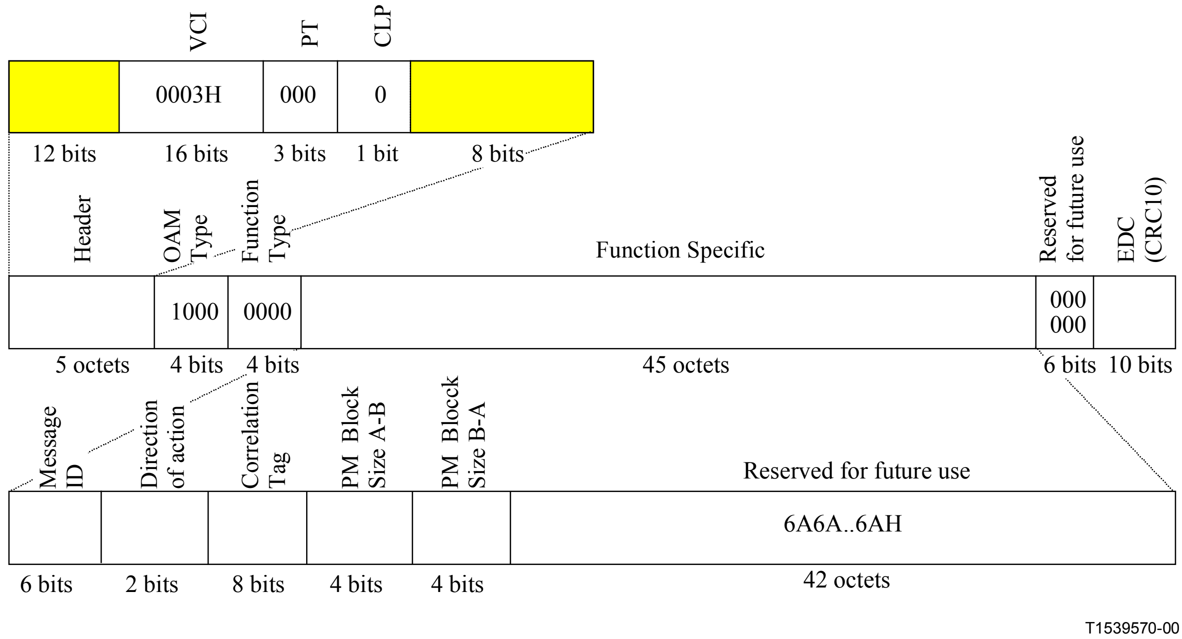


Figure D.74/I.732 – Segment VP-AD-FPM/BR OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Message ID, Direction of action, Correlation Tag, PM Block Size A-B, PM Block Size B-A, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

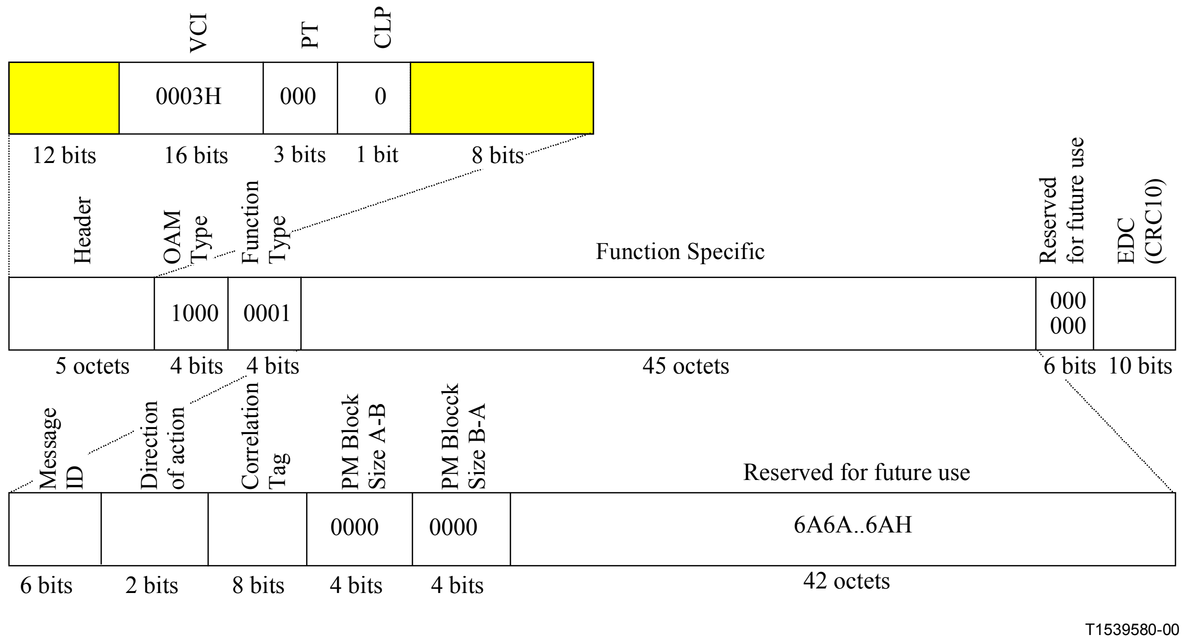


Figure D.75/I.732 – Segment VP-AD-CC OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Message ID, Direction of action, Correlation Tag, PM Block Size A-B, PM Block Size B-A, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

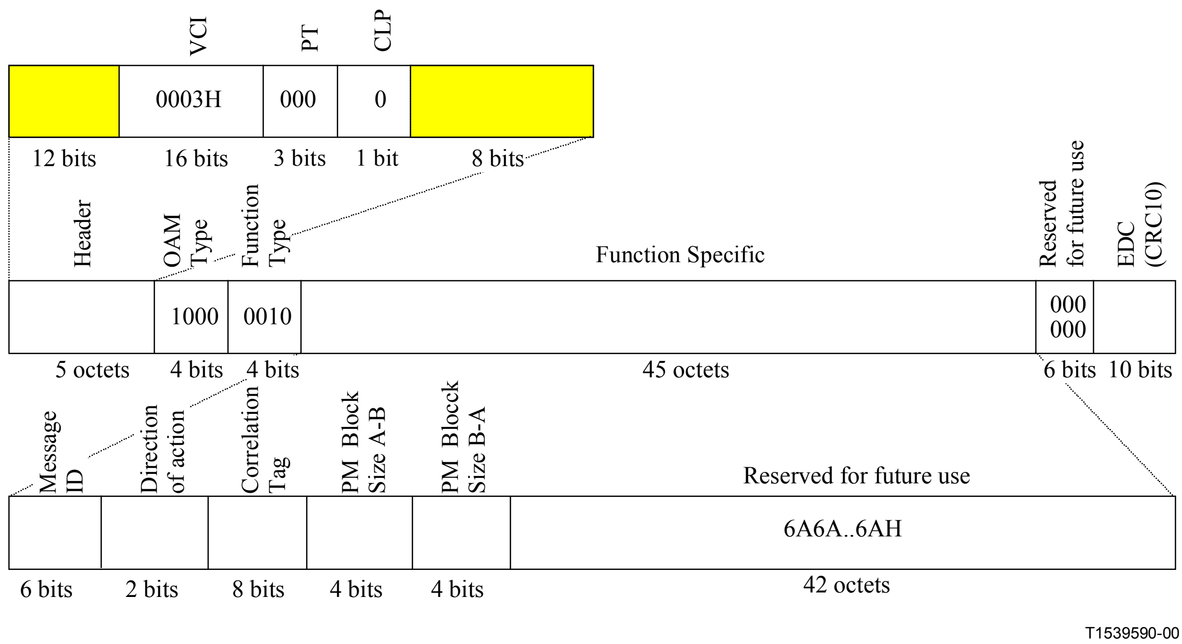


Figure D.76/I.732 – Segment VP-AD-FPM OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Message ID, Direction of action, Correlation Tag, PM Block Size A-B, PM Block Size B-A, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

On reception of RI_RDI, the function shall output segment VP-RDI cells (Figure D.69) according to 9.2.1.1.1.2/I.610; on clearing of RI_RDI, the generation of segment VP-RDI cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the segment VP-RDI cell shall be coded as 6Ahex. If the function supports DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location fields of the segment VP-RDI cell shall contain the value provided by the VPS_TT_Sk via RI_RDI. The insertion of RDI cells should not interrupt any cell flows present on the connection.

Defect Correlations

None.

D.3.4.2 ATM Virtual Path Segment Trail Termination Sink function VPS_TT_Sk

Symbol

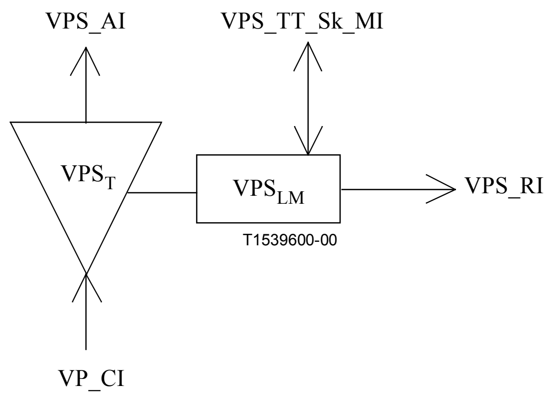


Figure D.77/I.732 – VPS_TT_Sk symbol

Interfaces

Table D.17/I.732 – VPS_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF VPS_TT_Sk_MI_SRDIreported VPS_TT_Sk_MI_SAISreported VPS_TT_Sk_MI_SLOCreported VPS_TT_Sk_MI_SAISuse VPS_TT_Sk_MI_CCActive VPS_TT_Sk_MI_FPMActive VPS_TT_Sk_MI_PMActive	VPS_AI_D VPS_AI_ACS VPS_AI_TSF VPS_AI_AIS VPS_RI_BRPMdata VPS_RI_RDI VPS_TT_Sk_MI_cSLOC VPS_TT_Sk_MI_cSRDI VPS_TT_Sk_MI_cSAIS VPS_TT_Sk_MI_SRDIdata VPS_TT_Sk_MI_SAISdata VPS_TT_Sk_MI_AISdata VPS_TT_Sk_MI_FPMdata VPS_TT_Sk_MI_BRPMdata

Processes

This function performs VP segment RDI, Continuity Check, FPM, BR and AIS cell extraction, end-to-end VP-AIS monitoring (in conjunction with segment CC cells) and processing as well as activation/deactivation of FPM, FPM&BR and CC on the VP segment level.

For interworking with equipment compliant to the 1995 version of ITU-T I.610 and for network operators that prefer to operate without the use of segment AIS, the function monitors also for end-to-end VP-AIS cells.

Segment VP-RDI:

– Transfer function: This process extracts segment VP-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The segment VP-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the segment VP-RDI cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_SRDIdata. Refer to 9.2.1.1.1.2 and 10.2.1/I.610

Segment VP Continuity Check:

– Transfer function: This process extracts segment VP-CC cells and forwards them to the Layer Management function.

– Layer Management function: VP segment CC activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the VP segment CC activation process (MI_CCActive), the process shall report the segment VP-CC cells according to the Defects section below.

  NOTE 1 – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the segment VP-CC OAM cell as an ATM address field.

Segment VP-FPM:

– Transfer function: This process monitors the incoming cell flow and extracts segment VP-FPM cells and forwards them to the Layer Management function.

– Layer Management function: VP segment FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive or MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the process shall monitor the performance derived from the comparison between received block of user cells and information in a received segment VP-FPM cell, according to the Performance Monitoring section of the Coordination Function below.

Segment VP-BR:

– Transfer function: This process extracts segment VP-BR cells and forwards them to the Layer Management function.

– Layer Management function: VP segment FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM&BR activation process (MI_PMActive), the process shall process the segment VP-BR cells according to the Performance Monitoring section of the Coordination Function below.

Segment VP-AIS:

– Transfer function: This process extracts segment VP-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The segment VP-AIS cell provides information as to the status of the VP segment, as well as to the defect type and defect location. The defect detection of the segment VP-AIS cells shall be according to the Defects section below. If enabled (MI_SAISuse = true), the information extracted from the defect type and defect location field is reported to the AEMF via MI_SAISdata and to the paired VPS_TT_So according to the Consequent Actions section of the Coordination Function below.

End-to-end VP-AIS:

– Transfer function: This process monitors end-to-end VP-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VP-AIS provides information as to the status of the VP connection up to this VP segment end-point, as well as to the defect type and defect location. The defect detection of the end-to-end VP-AIS cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_AISdata.

Segment VP-AD OAM flows:

– Transfer function: This process extracts segment VP-AD-FPM/BR, segment VP-AD-CC and segment VP-AD-FPM cells and forwards them to the Layer Management function.

– Layer Management function: For further study.

Defects

If enabled by the VP segment CC activation process (MI_CCActive = true), the function shall declare dSLOC if no VP user cell or segment VP-CC cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dSLOC shall be cleared when any VP user cell or segment VP-CC cell is received. If disabled by the VP segment CC activation process (MI_CCActive = false), dSLOC shall be cleared.

If enabled (MI_SAISuse = true), the function shall declare dSAIS as soon as a segment VP-AIS cell is received. The dSAIS shall be cleared when a VP user cell or a segment VP-CC cell is received; if VP segment CC is not activated, dSAIS is cleared also if segment VP-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s. If disabled (MI_SAISuse = false), dSAIS shall be cleared.

For interworking with equipment that do not generate segment VP-AIS cells or when a network operator prefers not to use segment VP-AIS cells, the function shall declare dAIS as soon as a VP end to end AIS cell is received. The dAIS shall be cleared when a VP user cell or a segment VP-CC cell is received; if VP segment CC is not activated, dAIS defect is cleared also if end to end VP-AIS cells are absent for 2.5 ± 0.5 s.

The function shall declare dSRDI as soon as a segment VP-RDI cell is received. The dSRDI shall be cleared when no segment VP-RDI cell is received within a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between received block of user cells and information in a received segment VP-FPM cell. The definition of user cells is given in Table 1/I.610.

If activated by the FPM activation process (MI_FPMActive), the result is reported to the AEMF via MI_FPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the result is backward reported via RI_BRPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the received segment VP-BR cell on the near end contains the performance information regarding the unidirectional connection set up from the near end to the far end. This information is reported to the AEMF via MI_BRPMdata.

NOTE 2 – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Mis-insertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the EMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dSLOC or dSAIS

aSRDI ← CI_SSF or dSLOC or dSAIS

The consequent action aSRDI is conveyed through RI_RDI to the VPS_TT_So together with the defect type and defect location (if implemented). In case of dSAIS, defect type and location through RI_RDI are as in the received segment VP-AIS cell. In case of CI_SSF and dSLOC, defect type and location are in respect to the equipment this function is built into.

NOTE 3 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, they shall be encoded as 6Ahex.

The consequent action aTSF is conveyed by AI_TSF through the VPS_AI.

aAIS ← dSLOC and not dSAIS and not dAIS

NOTE 4 – VP-AIS insertion is performed in the VPS/VP_A_Sk function under control of AI_AIS.

Defect Correlations

cSAIS ← [dSAIS or (dSLOC and dAIS)] and (not CI_SSF) and SAISreported

cSRDI ← dSRDI and (not dSAIS) and (not CI_SSF) and SRDIreported

cSLOC ← dSLOC and (not dSAIS) and (not dAIS) and (not CI_SSF) and SLOCreported

It shall be an option to report segment AIS as a fault cause. This is controlled by means of the parameter SAISreported. The default shall be SAISreported = false.

It shall be an option to report segment RDI as a fault cause. This is controlled by means of the parameter SRDIreported. The default shall be SRDIreported = false.

It shall be an option to report segment LOC as a fault cause. This is controlled by means of the parameter SLOCreported. The default shall be SLOCreported = false.

D.3.4.3 ATM Virtual Path Segment to ATM Virtual Path Adaptation Source Function VPS/VP_A_So

Symbol

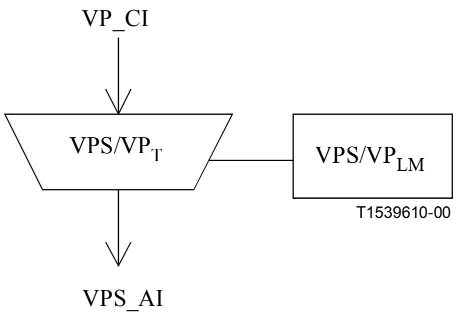


Figure D.78/I.732 – VPS/VP_A_So symbol

Interfaces

Table D.18/I.732 – VPS/VP_A_So input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS	VPS_AI_D VPS_AI_ACS

Processes

This function performs VP segment OAM cell discarding.

Segment VP-OAM cell discarding:

– Transfer function: This process discards any incoming VP segment OAM cell.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.3.4.4 ATM Virtual Path Segment to ATM Virtual Path Adaptation Sink function VPS/VP_A_Sk

Symbol

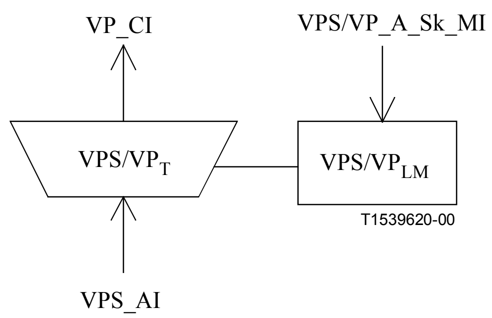


Figure D.79/I.732 – VPS/VP_A_Sk symbol

Interfaces

Table D.19/I.732 – VPS/VP_A_Sk input and output signals

Input(s)	Output(s)
VPS_AI_D VPS_AI_ACS VPS_AI_TSF VPS_AI_AIS VPS/VP_A_Sk_MI_DTDLuseEnabled	VP_CI_D VP_CI_ACS VP_CI_SSF

Processes

This function performs VP segment OAM cell discarding.

Segment VP-OAM cell discarding:

– Transfer function: This process discards any incoming VP segment OAM cell.

End-to-end VP-AIS:

– Transfer function: This process inserts end-to-end VP-AIS cells from the Layer Management function.

– Layer Management function: End-to-end VP-AIS cells (Figure D.80) shall be generated according to the Consequent Actions section of the Coordination Function below.

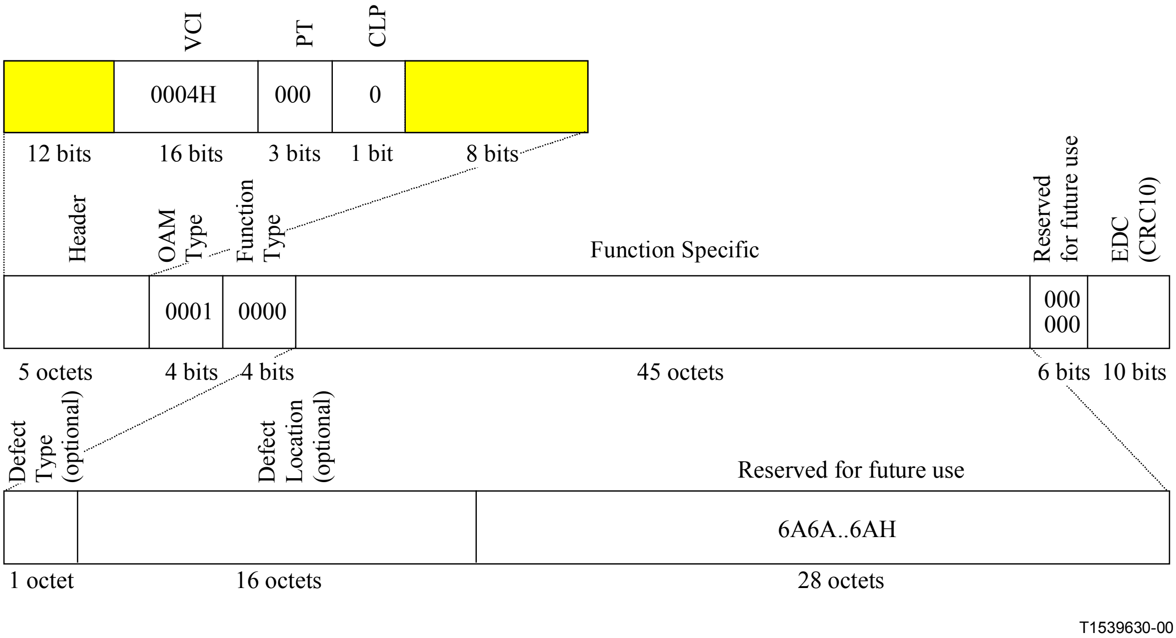


Figure D.80/I.732 – End-to-end VP-AIS OAM cell as part of the VP_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Defect Type, Defect Location, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Defects

None.

Performance Monitoring

None.

Coordination Functions:

Consequent Actions

aSSF ← AI_TSF

aAIS ← AI_AIS

On declaration of aAIS, the function shall output end-to-end VP-AIS cells (Figure D.80), according to 9.2.1.1.1.1/I.610. On clearing of aAIS, the generation of VP-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option or the function support the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end VP-AIS cell shall be coded as 6A. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end VP-AIS cell.

NOTE – As long as the coding scheme of Defect Type and Defect Location fields is not defined, they shall be encoded as 6A. The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations

None.

D.3.5 ATM Virtual Path Traffic Management Functions

NOTE – The ATM Virtual Path Traffic Management Functions are, if activated, always present as a set. If active, the VP_AI output of the VPTM_TT_Sk is always connected to the VP_AI input of the VPTM_TT_So as shown in Figure D.81 below. This model allows the insertion of additional traffic management functions by not inserting an additional sub-layer in the network architecture view.

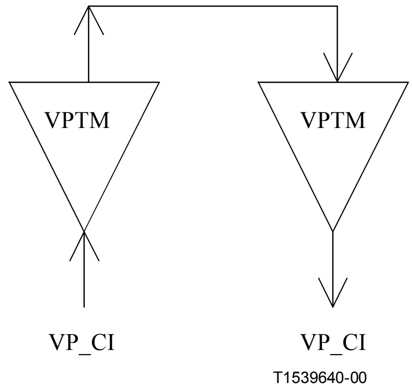


Figure D.81/I.732 – Model of active VPTM Traffic Management functions

D.3.5.1 ATM Virtual Path Traffic Management Trail Termination Source function VPTM_TT_So

Symbol

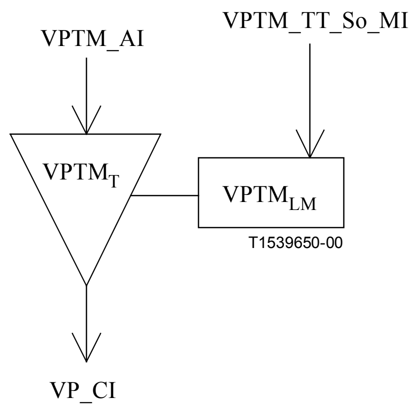


Figure D.82/I.732 – VPTM_TT_So symbol

Interfaces

Table D.20/I.732 – VPTM_TT_So input and output signals

Input(s)	Output(s)
VPTM_AI_D VPTM_AI_ACS VPTM_AI_TSF VPTM_AI_CNGI	VP_CI_D VP_CI_ACS VP_CI_SSF

Processes

This function performs EFCI setting and RM cells insertion.

EFCI setting:

– Transfer function: This process is optional. It applies in ingress direction only. It inserts the EFCI field under control of the Layer Management function.

– Layer Management function: The insertion of EFCI is driven by the input VPTM_AI_CNGI from the S4/VP_A_Sk. The EFCI setting is done in the PTI field of the cell header on all cells within the CI. For the coding, refer to ITU-T I.361. The PTI field shall not be changed if the NE is not congested.

RM cells insertion: This process is for further study.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

aSSF ← AI_TSF

On reception of AI_CNGI, any congested NE, 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. For the use of EFCI, refer to ITU-T I.371.

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations

None.

D.3.5.2 ATM Virtual Path Traffic Management Trail Termination Sink function VPTM_TT_Sk

Symbol

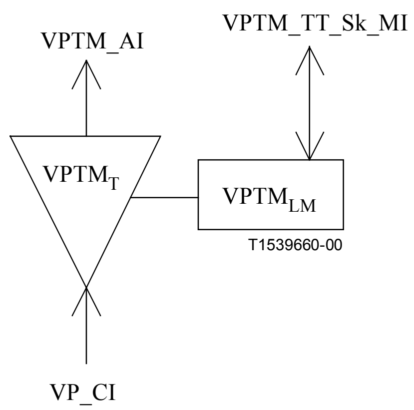


Figure D.83/I.732 – VPTM_TT_Sk symbol

Interfaces

Table D.21/I.732 – VPTM_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF VP_CI_CNGI VPTM_TT_Sk _MI_ShapingActive VPTM_TT_Sk _MI_UPC/NPCActive VPTM_TT_Sk _MI_VPusgActive	VPTM_AI_D VPTM_AI_ACS VPTM_AI_TSF VPTM_AI_CNGI

Processes

This function performs the VP usage measurement, UPC/NPC, VP traffic shaping and RM cells extraction per Virtual Path Connection (VPC).

VP usage measurement:

– Transfer function: This process is optional. Cell reception is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. If enabled by VPusgActive, this process shall count the incoming cells on the VPC.

UPC/NPC:

– Transfer function: This process is optional and can only be present at the ingress direction of the Network Element. VPC cells may be passed, discarded or tagged (if used), depending on indication from layer management.

– Layer Management function: If implemented, the UPC/NPC process can be activated/deactivated by UPC/NPCactive. If activated, it shall detect violations of negotiated traffic parameters for purpose of protecting the QoS of other VPCs. The use of UPC may be required, whereas the use of NPC is optional. Processes and requirements of UPC/NPC are described in ITU-T I.371.

NOTE 1 – The use of UPC in ATM equipment on the user side of S_B and T_B reference point is optional.

VP traffic shaping:

– Transfer function: This process is optional. If activated, it shall perform traffic shaping according to ITU-T I.371.

– Layer Management function: If implemented, the shaping process can be activated/deactivated by MI_ShapingActive.

NOTE 2 – The VP traffic shaping process should not be simultaneously activated on both ingress and egress directions of the same VPC.

RM cells extraction: This process is for further study.

Defects

None.

Performance Monitoring

The Performance Monitoring parameters are for further study. The following parameters need to be defined:

- VP usage measurement: Count for CLP = 0+1; Count for CLP = 0 Separate counters for ingress and egress direction shall be maintained.
- UPC/NPC (tagged cell count): Count for CLP = 0+1; Count for CLP = 0.

Coordination Functions

Consequent Actions

aCNGI ← CI_CNGI

aTSF ← CI_SSF

The consequent action aTSF is conveyed by AI_TSF through the VPTM_AI.

The consequent action aCNGI is conveyed by AI_CNGI through the VPTM_AI.

Defect Correlations

None.

D.3.6 ATM Virtual Path Loopback Functions

D.3.6.1 ATM virtual path loopback trail termination source function VPLB_TT_So

Symbol

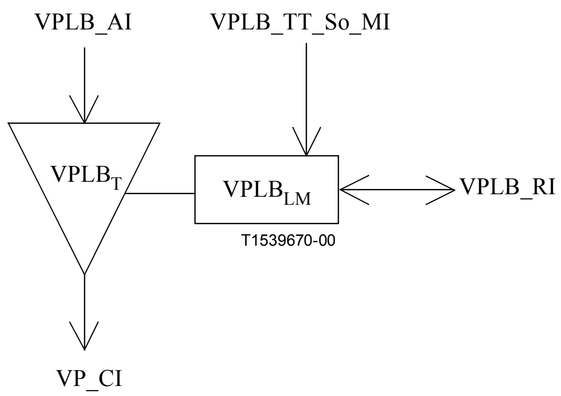


Figure D.84/I.732 – VPLB_TT_So symbol

Interfaces

Table D.22/I.732 – VPLB_TT_So input and output signals

Input(s)	Output(s)
VPLB_AI_D VPLB_AI_ACS	VP_CI_D VP_CI_ACS
VPLB_RI_LBresponse	VPLB_RI_LBeteTimer VPLB_RI_LBsegTimer
VPLB_TT_So_MI_LBeteRequest VPLB_TT_So_MI_LBsegRequest VPLB_TT_So_MI_LBlocID VPLB_TT_So_MI_LOCALlocID VPLB_TT_So_MI_SIDuseEnabled	VPLB_RI_LBeteCorrTag VPLB_RI_LBsegCorrTag

Processes

This function can operate as a loopback source point source and as a loopback point source at VP connection points, VP termination connection points (ITU-T I.610: connection end points) and VP segment termination connection points (ITU-T I.610: segment end points). It adds F4 loopback OAM cells to the passing through signal.

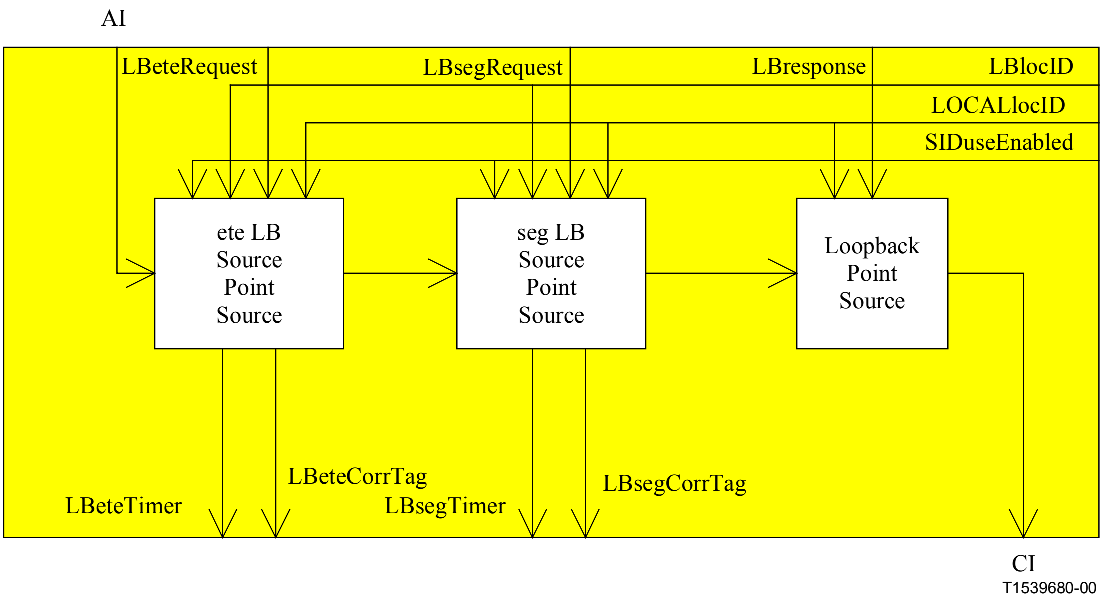


Figure D.85/I.732 – VPLB_TT_So process block diagram

Loopback process types:

The function shall be able to operate as:

1) end-to-end loopback source point source (for end-to-end loopback cells);

2) segment loopback source point source (for segment loopback cells);

3) loopback point source (for both end-to-end and segment loopback cells).

The function shall be able to operate any combination of the above three types simultaneously.

End-to-end Loopback Source Point (ELSP) Source process:

– Transfer function: This process inserts end-to-end VP-LB cells on request of the Layer Management function.

– Layer Management function: On MI_LBeteRequest, an F4 VP end-to-end loopback source OAM cell (Figure D.86) shall be generated.

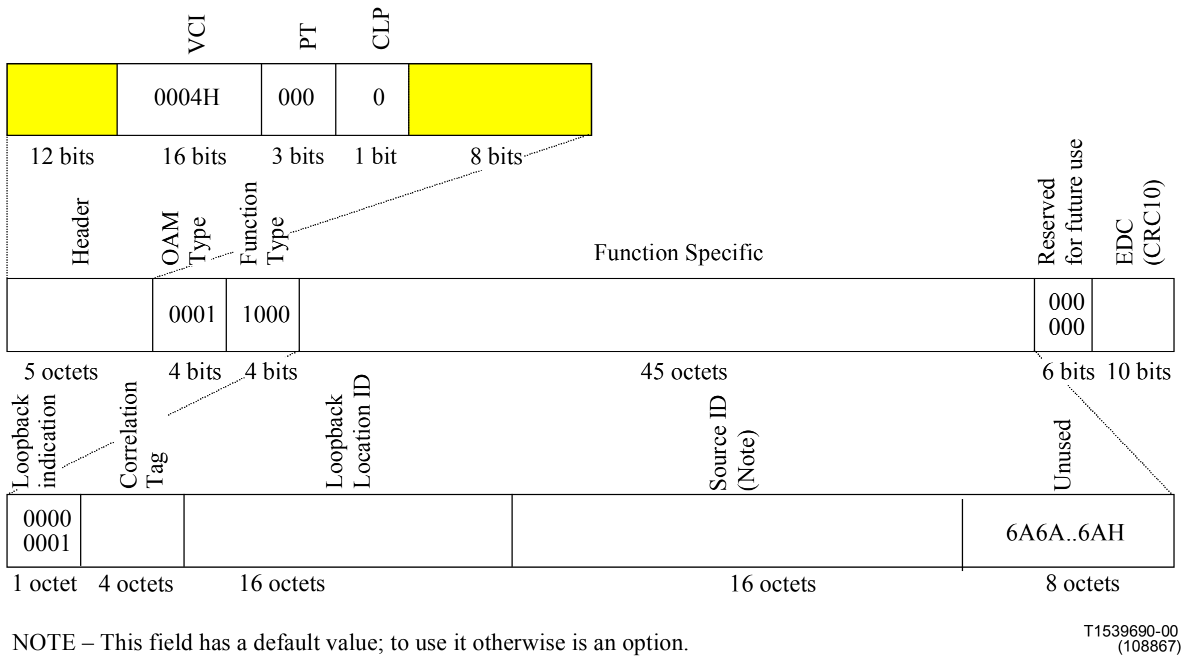


Figure D.86/I.732 – End-to-end VP-LB source OAM cell as part of VPLB_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Reserved, Loopback Indication fields shall be as specified in ITU-T I.361 and I.610.

The Loopback Location ID (LLID) field shall be written with the content of the MI_LBlocID.

If either the function does not support the Source ID (SID) or the function supports the SID and the MI_SIDuseEnabled is false, the SID field shall be set to all-ONEs. If the function supports the SID and if the MI_SIDuseEnabled is true, the SID field shall be written with the content of MI_LOCALlocID.

NOTE 1 – The LLID and SID contain the addresses of the loopback point (single loopback technique), resp. of the source point. The default value of the SID field is the all Ones pattern. If the LLID field contains an all Ones pattern, it indicates the connection end point that receive this loopback cell and support loopback processing should send back the received loopback cell.

The Correlation Tag field shall be written with the value of the correlation tag included in MI_LBeteRequest, and this correlation tag value shall be output to the paired VPLB_TT_Sk via RI_LBeteCorrTag.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

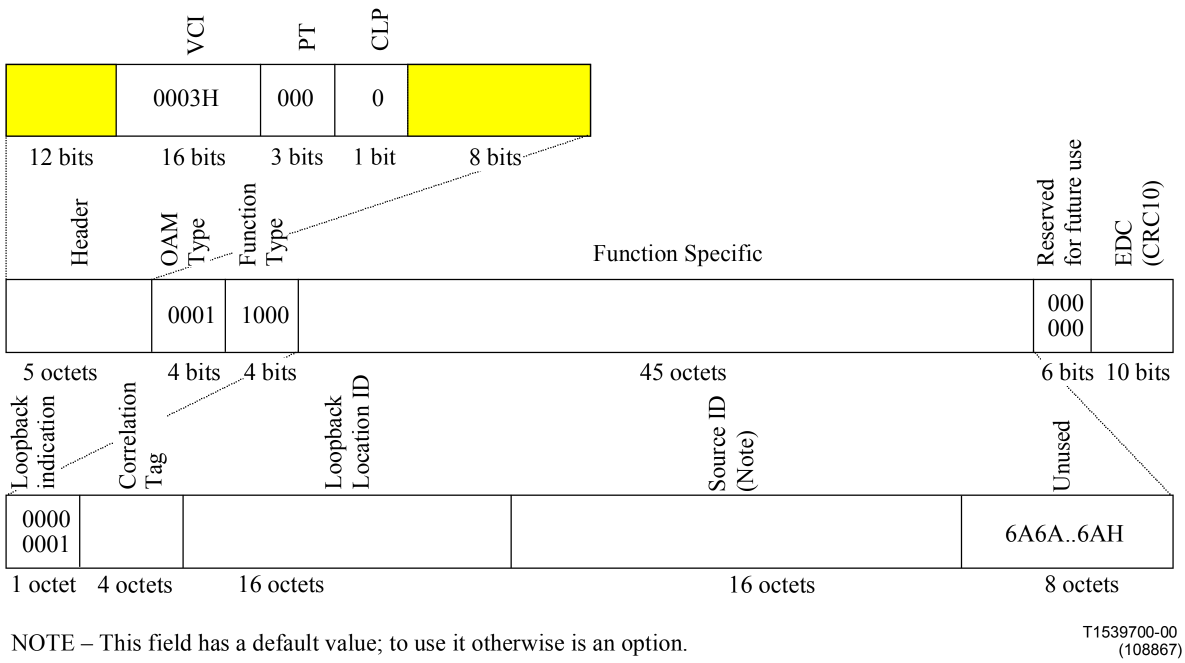
The time interval of sending consecutive end-to-end Loopback cells shall be longer than 5 s. A MI_LBeteRequest received within a period of 5 s after the previous request shall be rejected.

An indication VPLB_RI_LBeteTimer shall be generated to start the timer at the paired VPLB_TT_Sk when the end-to-end loopback cell is generated. Refer to 9.2.1.1.3/I.610.

Segment Loopback Source Point Source process:

– Transfer function: This process inserts segment VP-LB cells on request of the Layer Management function.

– Layer Management function: On MI_LBsegRequest, an F4 VP segment loopback source OAM cell (Figure D.87) shall be generated.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.87/I.732 – VP segment LB source OAM cell as part of VPLB_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, Reserved, Loopback Indication fields shall be as specified in ITU-T I.361 and I.610.

The Loopback Location ID (LLID) field shall be written with the content of the MI_LBlocID.

If either the function does not support the Source ID (SID) or the function supports the SID and the MI_SIDuseEnabled is false, the SID field shall be set to all-ONEs. If the function supports the SID and if the MI_SIDuseEnabled is true, the SID field shall be written with the content of MI_LOCALlocID.

NOTE 2 – The LLID and SID contain the addresses of the loopback point (single loopback technique), resp. of the source point. The default value of the SID field is the all Ones pattern. If the LLID field contains an all Ones pattern, it indicates that the segment end point (that support loopback processing) that receive this loopback cell should send back the received loopback cell. If the LLID field contains an all ZEROs pattern, it indicates that all connection points (that support loopback processing, for which the LLID option is enabled and are compliant with the 1999 version of ITU-T I.610) and the segment end point (that support loopback processing and are compliant with the 1999 version of ITU-T I.610) that receive this loopback cell should send back the received loopback cell (multiple loopback technique). Connection points outside a segment for which the LLID option is enabled, will also loopback segment loopback cells incoming due to e.g. a misconnection in the path.

The Correlation Tag field shall be written with the value of the correlation tag included in MI_LBsegRequest, and this correlation tag value shall be output to the paired VPLB_TT_Sk via RI_LBsegCorrTag.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

The time interval of sending consecutive segment Loopback cells shall be longer than 5 s. An MI_LBsegRequest received within a period of 5 s after the previous request shall be rejected.

An indication VPLB_RI_LBsegTimer shall be generated to start the timer at the paired VPLB_TT_Sk when the segment loopback cell is generated. Refer to 9.2.1.1.3/I.610.

Loopback Point Source process:

– Transfer function: This process inserts end-to-end or segment VP-LB cells on request of the Layer Management function.

– Layer Management function: On VPLB_RI_LBresponse, an F4 VP end-to-end or segment loopback cell identical to the cell received through VPLB_RI_LBresponse shall be generated, but with modified LI bit 8 and LLID fields and recalculated EDC field (Figure D.88).

Bit 8 of the Loopback Indication (LI) field shall be set to "0".

LLID field shall be written with the content of MI_LOCALlocID.

NOTE 3 – The MI_LOCALlocID contains the CP, SEP or CEP ID of the loopback point. Refer to 9.2.1.1.3 and 10.2.3/I.610.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

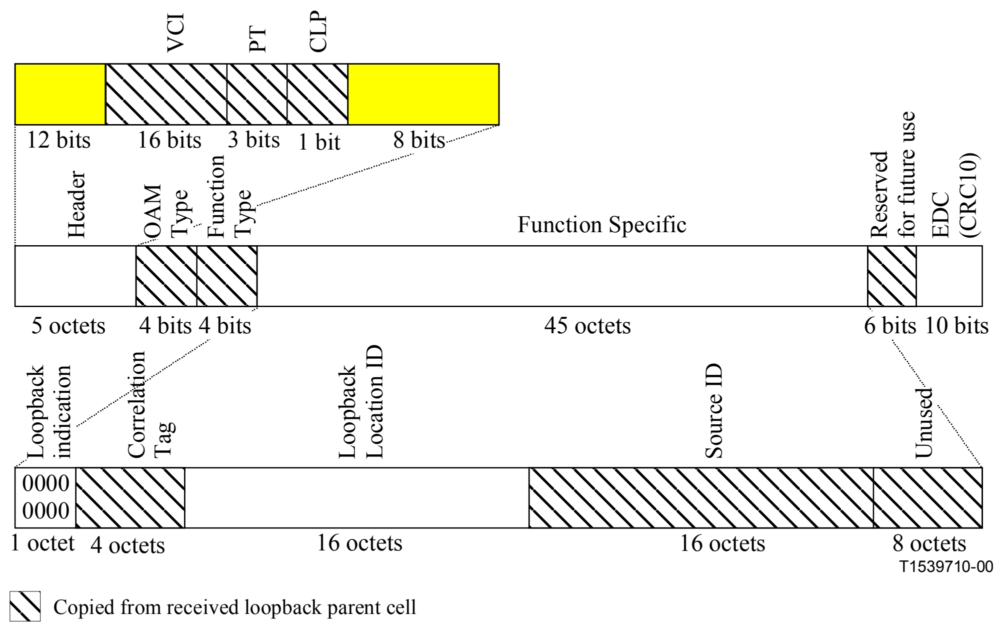


Figure D.88/I.732 – VP LB return OAM cell as part of VPLB_CI

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.3.6.2 ATM virtual path loopback trail termination sink function VPLB_TT_Sk

Symbol

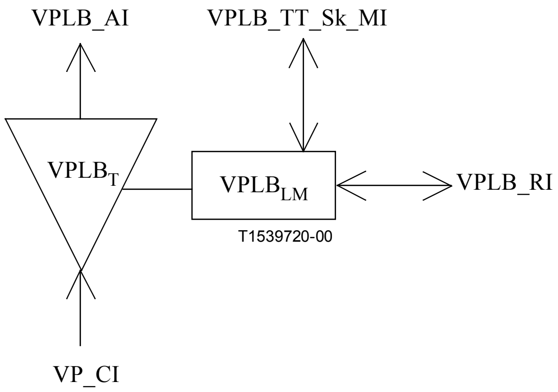


Figure D.89/I.732 – VPLB_TT_Sk symbol

Interfaces

Table D.23/I.732 – VPLB_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF VPLB_RI_LbeteTimer VPLB_RI_LbsegTimer VPLB_RI_LbeteCorrTag VPLB_RI_LbsegCorrTag VPLB_TT_Sk_MI_RefPointType VPLB_TT_Sk_MI_LLIDoption VPLB_TT_Sk_MI_LbeparDiscard VPLB_TT_Sk_MI_LbsparDiscard VPLB_TT_Sk_MI_LbretDiscard VPLB_TT_Sk_MI_LOCALlocID VPLB_TT_Sk_MI_SIDuseEnabled	VPLB_AI_D VPLB_AI_ACS VPLB_AI_TSF VPLB_RI_Lbresponse VPLB_TT_Sk_MI_eteLBdata VPLB_TT_Sk_MI_segLBdata VPLB_TT_Sk_MI_eteLBtestEnd VPLB_TT_Sk_MI_segLBtestEnd

Processes

This function can operate as a loopback source point sink as well as a loopback point sink at VP connection points, VP termination connection points (ITU-T I.610: connection end points) and VP segment termination connection points (ITU-T I.610: segment end points). It performs F4 OAM Loopback cells processing on the passing through signal.

Loopback process types:

The function shall be able to operate as:

1) end-to-end loopback source point sink (for end-to-end loopback cells);
2) segment loopback source point sink (for segment loopback cells);
3) loopback point sink, determined by the RefPointType:
   a) connection end point (for end-to-end loopback cells);
   b) segment end point (for segment loopback cells);
   c) connection point (for segment loopback cells).

The function shall be able to operate any combination of the above three types simultaneously.

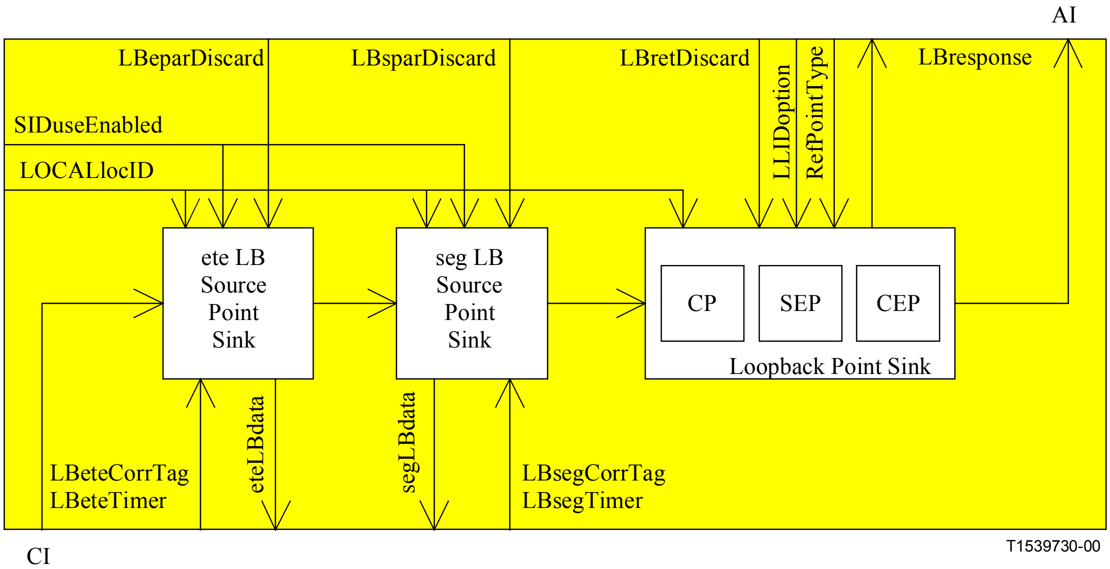


Figure D.90/I.732 – VPLB_TT_Sk function process block diagram

A cell within the incoming VP_CI shall be detected as a:

- End-to-end VP-LB cell if the VCI field is 4, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.
- Segment VP-LB cell if the VCI field is 3, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.

End-to-end Loopback Source Point (ELSP) Sink process:

– Transfer function: The end-to-end VP-LB cells shall be extracted and sent to the Layer Management function. The process shall insert end-to-end VP-LB cells on request of the Layer Management function.

– Layer Management function: On RI_LBeteTimer from the paired VPLB_TT_So, a 6 ± 1 s end-to-end LB timer shall be started and an end-to-end loopback (ELB) state shall be entered and the ELSP sink process shall be monitoring for incoming end to end LB OAM cells. At expiry of the end-to-end LB timer, the ELB state shall be cleared (entering the IDLE state), the ELSP sink process shall stop monitoring for incoming end to end LB OAM cells and report the expiry via MI_eteLBtestEnd. In the IDLE state LB OAM cells shall be passed through without further processing.

  The ELSP sink process shall perform the operation as specified in Figure D.91 (refer to 9.2.1.1.3, 10.2.3 and Annex C/I.610).

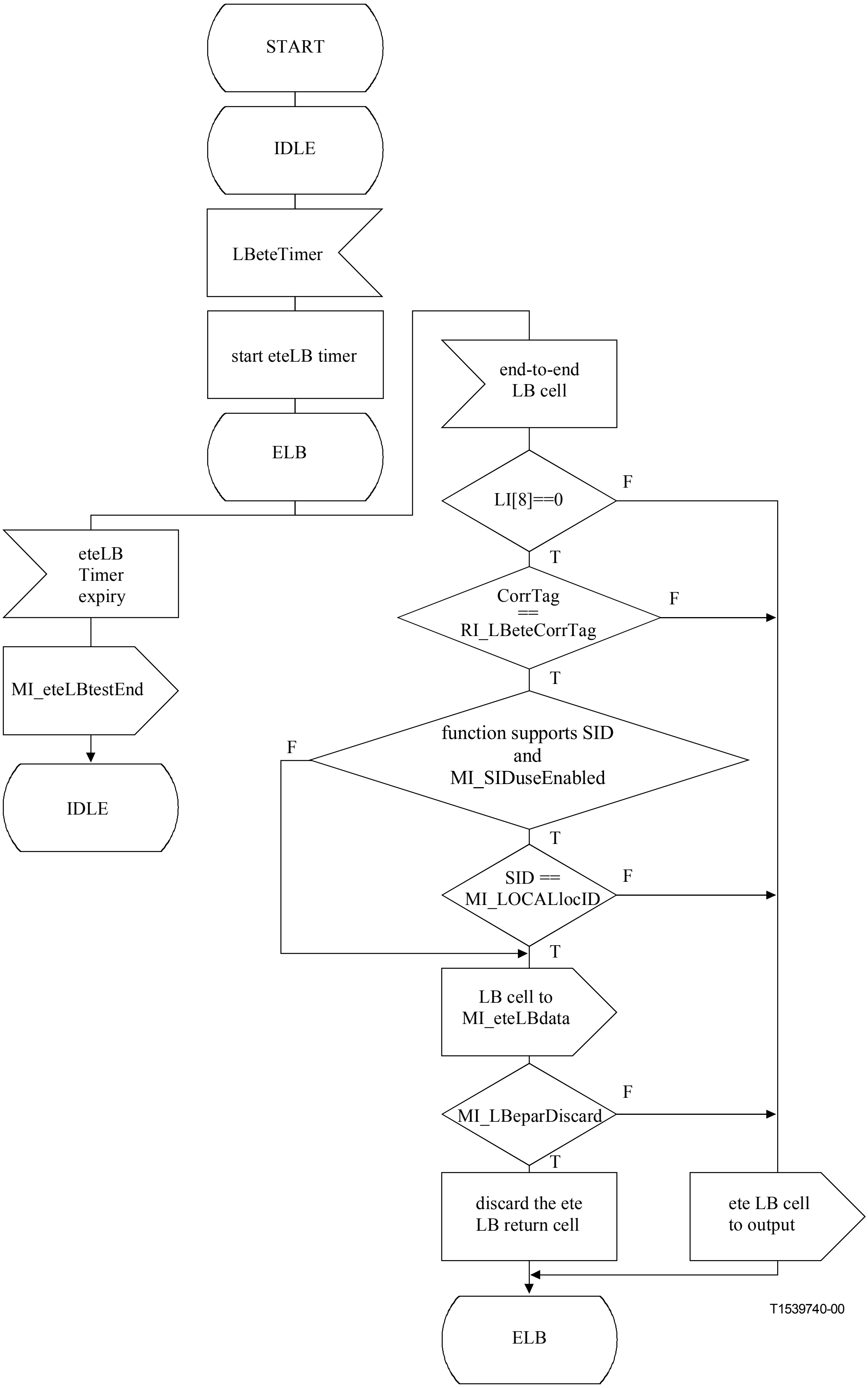


Figure D.91/I.732 – End-to-end Loopback Source Point Sink process

NOTE 1 – The requirement not to stop the end-to-end loopback timer in case of a single loopback is under study by Q.6/13.

Segment Loopback Source Point (SLSP) Sink process:

– Transfer function: The segment VP-LB cells shall be extracted and sent to the Layer Management function. The process shall insert segment VP-LB cells on request of the Layer Management function.

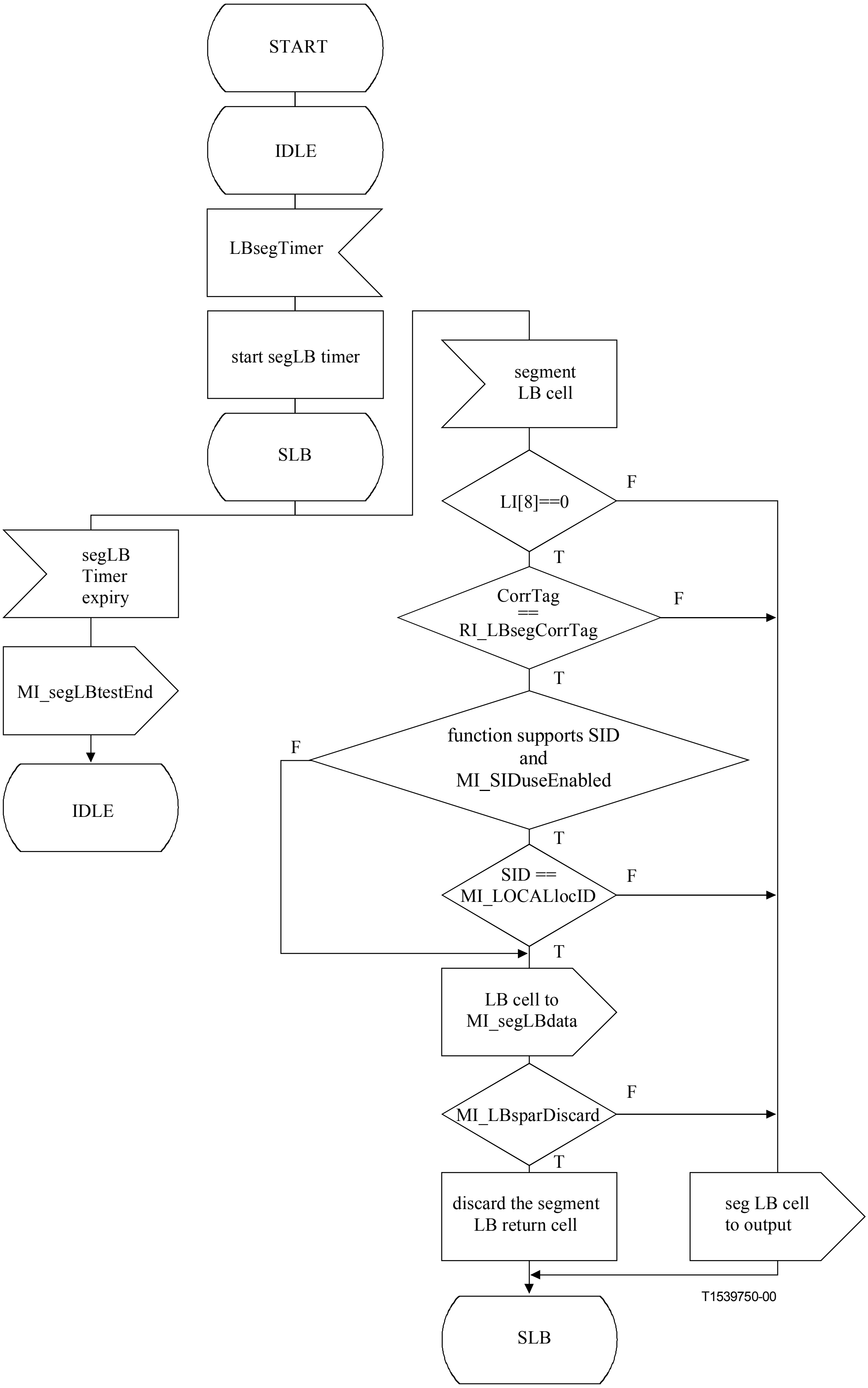


Figure D.92/I.732 – Segment Loopback Source Point Sink process

NOTE 2 – The requirement not to stop the segment loopback timer in case of a single loopback is under study by Q.6/13.

– Layer Management function: On RI_LBsegTimer from the paired VPLB_TT_So, a 6 ± 1 s segment VP-LB timer shall be started and a segment loopback (SLB) state shall be entered and the SLSP sink process shall be monitoring for incoming segment VP-LB OAM cells. At expiry of the segment VP-LB timer, the SLB state shall be cleared (entering the IDLE state), the SLSP sink process shall stop monitoring for incoming segment VP-LB OAM cells and report the expiry via MI_segLBtestEnd. In the IDLE state LB OAM cells shall be passed through without further processing.

  The SLSP sink process shall perform the operation as specified in Figure D.92 (refer to 9.2.1.1.3, 10.2.3 and Annex C/I.610).

Loopback Point (LP) Sink process:

– Transfer function: The end-to-end and segment VP-LB cells shall be extracted and sent to the Layer Management function. The process shall insert end-to-end and segment VP-LB cells on request of the Layer Management function.

– Layer Management function: The behavior of the LP_Sk process depends on the reference point (CEP, SEP, CP) it is associated with.

  If MI_RefPointType = CEP (connection end-point), the process shall process the cell flow of end-to-end VP-LB cells inserted by remote VPLB_TT_So functions. If an end-to-end VP-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s is received, the end-to-end VP-LB cell is copied and forwarded via RI_LBresponse to the VPLB_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefPointType = SEP (segment end-point), the process shall process the cell flow of segment VP-LB cells inserted by remote VPLB_TT_So functions. If a segment VP-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s or an LLID = all "0"s is received, this process copies and forwards the cell via RI_LBresponse to the VPLB_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefType = CP (connection point), the process shall process the cell flow of segment VP-LB cells inserted by remote VPLB_TT_So functions. If a segment VP-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID is received, this process copies and forwards the cell via RI_LBresponse to the VPLB_TT_So function for insertion of the Loopback cell in reverse direction and, if the MI_LBretDiscard = true, discards it. If a segment VP-LB cell with Loopback Indication set to "1" and an LLID = all "0"s is received and the LLID option is activated (MI_LLIDoption), this process copies and forwards the cell via RI_LBresponse to the VPLB_TT_So function for insertion of the Loopback cell in reverse direction.

  The LP_Sk process shall perform the operation as specified in Figure D.93 (refer to 9.2.1.1.3, 10.2.3 and Annex C/I.610).

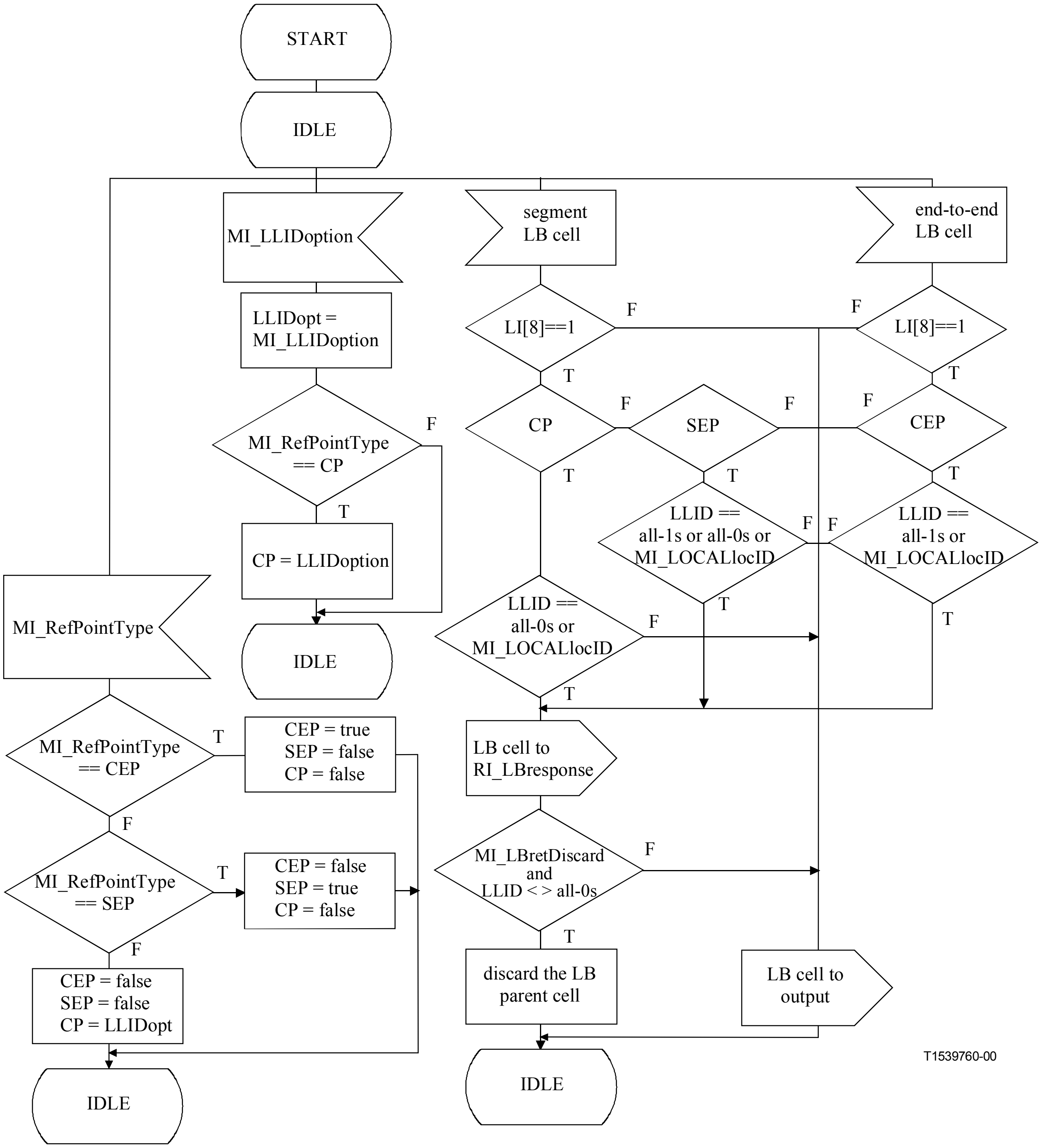


Figure D.93/I.732 – Loopback Point Sink process

Defects

None.

Performance Monitoring

None.

Coordination function

Consequent Actions

aTSF ← CI_SSF

The consequent action aTSF is conveyed by AI_TSF through the VPLB_AI.

Defect Correlations

None.

D.3.6.3 ATM virtual path loopback point trail termination source function VPLBR_TT_So

Symbol

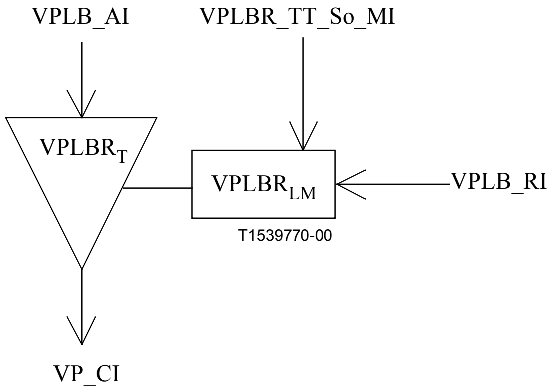


Figure D.94/I.732 – VPLBR_TT_So symbol

Interfaces

Table D.24/I.732 – VPLBR_TT_So input and output signals

Input(s)	Output(s)
VPLB_AI_D VPLB_AI_ACS VPLB_RI_Lbresponse VPLBR_TT_So_MI_LOCALlocID	VP_CI_D VP_CI_ACS

Processes

This function can operate as a loopback point source at VP connection points, VP termination connection points (I.610: connection end points) and VP segment termination connection points (I.610: segment end points). It adds F4 loopback OAM cells to the passing through signal.

NOTE 1 – VPLBR_TT_So has reduced functionality compared to VPLB_TT_So since it contains functionality for the loopback point only. It can be used to reduce complexity of implementation.

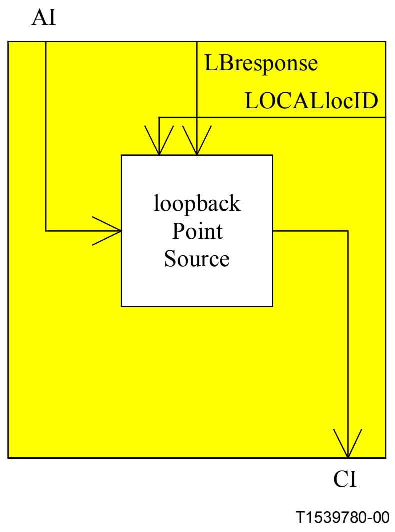


Figure D.95/I.732 – VPLBR_TT_So process block diagram

Loopback Point Source process:

– Transfer function: This process inserts end-to-end or segment VP-LB cells on request of the Layer Management function.

– Layer Management function: On VPLB_RI_LBresponse, an F4 VP end-to-end or segment loopback cell identical to the cell received through VPLB_RI_LBresponse shall be generated, but with modified LI bit 8 and LLID fields and recalculated EDC field (Figure D.95).

Bit 8 of the Loopback Indication (LI) field shall be set to "0".

LLID field shall be written with the content of MI_LOCALlocID.

NOTE 2 – The MI_LOCALlocID contains the CP, SEP or CEP ID of the loopback point. Refer to 9.2.1.1.3 and 10.2.3/I.610.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.3.6.4 ATM virtual path loopback point trail termination sink function VPLBR_TT_Sk

Symbol

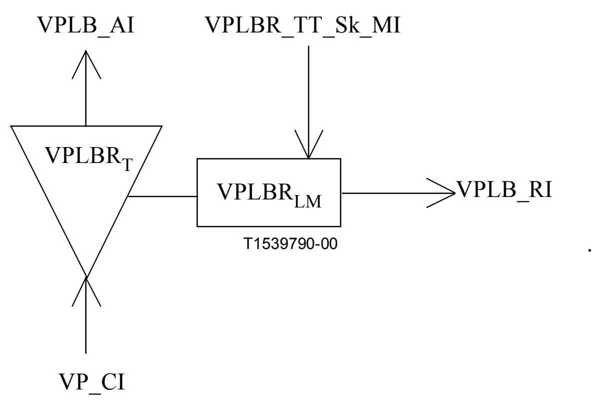


Figure D.96/I.732 – VPLBR_TT_Sk symbol

Interfaces

Table D.25/I.732 – VPLBR_TT_Sk input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS VP_CI_SSF VPLBR_TT_Sk_MI_RefPointType VPLBR_TT_Sk_MI_LLIDoption VPLBR_TT_Sk_MI_LbretDiscard VPLBR_TT_Sk_MI_LOCALlocID	VPLB_AI_D VPLB_AI_ACS VPLB_AI_TSF VPLB_RI_Lbresponse

Processes

This function can operate as a loopback point sink at VP connection points, VP termination connection points (I.610: connection end points) and VP segment termination connection points (I.610: segment end points). It performs F4 OAM Loopback cells processing on the passing through signal.

NOTE – VPLBR_TT_Sk has reduced functionality compared to VPLB_TT_Sk since it contains functionality for the loopback point only. It can be used to reduce complexity of implementation.

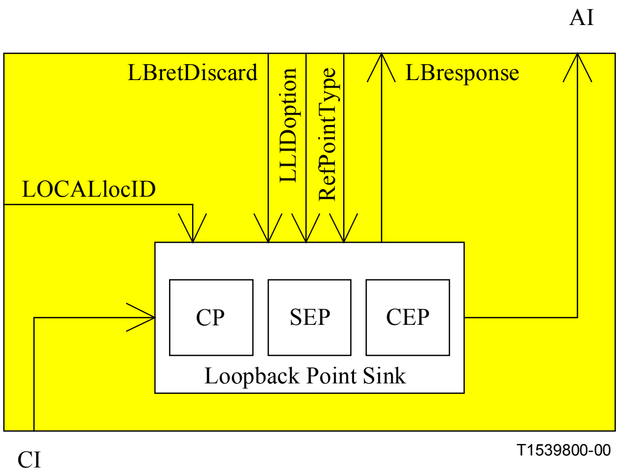


Figure D.97/I.732 – VPLBR_TT_Sk function process block diagram

Loopback process types:

The function shall be able to operate as loopback point sink, determined by the RefPointType:

a) connection end point;

b) segment end point;

c) connection point.

A cell within the incoming VP_CI shall be detected as a:

- End-to-end VP-LB cell if the VCI field is 4, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.
- Segment VP-LB cell if the VCI field is 3, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.

Loopback Point (LP) Sink process:

– Transfer function: The end-to-end and segment VP-LB cells shall be extracted and sent to the Layer Management function. The process shall insert end-to-end and segment VP-LB cells on request of the Layer Management function.

– Layer Management function: The behavior of the LP_Sk process depends on the reference point (CEP, SEP, CP) it is associated with.

  If MI_RefPointType = CEP (connection end-point), the process shall process the cell flow of end-to-end VP-LB cells inserted by remote VPLB_TT_So functions. If an end-to-end VP-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s is received, the end-to-end VP-LB cell is copied and forwarded via RI_LBresponse to the VPLBR_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefPointType = SEP (segment end-point), the process shall process the cell flow of segment VP-LB cells inserted by remote VPLB_TT_So functions. If a segment VP-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s or an LLID = all "0"s is received, this process copies and forwards the cell via RI_LBresponse to the VPLBR_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefType = CP (connection point), the process shall process the cell flow of segment VP-LB cells inserted by remote VPLB_TT_So functions. If a segment VP-LB cell with

Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID is received, this process copies and forwards the cell via RI_LBresponse to the VPLBR_TT_So function for insertion of the Loopback cell in reverse direction and, if the MI_LBretDiscard = true, discards it. If a segment VP-LB cell with Loopback Indication set to "1" and an LLID = all "0"s is received and the LLID option is activated (MI_LLIDoption), this process copies and forwards the cell via RI_LBresponse to the VPLBR_TT_So function for insertion of the Loopback cell in reverse direction.

The LP_Sk process shall perform the operation as specified in Figure D.97 (refer to 9.2.1.1.3, 10.2.3 and Annex C/I.610).

Defects

None.

Performance Monitoring

None.

Coordination function

Consequent Actions

aTSF ← CI_SSF

The consequent action aTSF is conveyed by AI_SSF through the VPLB_AI.

Defect Correlations

None.

D.3.6.5 ATM virtual path loopback to ATM VP adaptation source function VPLB/VP_A_So

Symbol

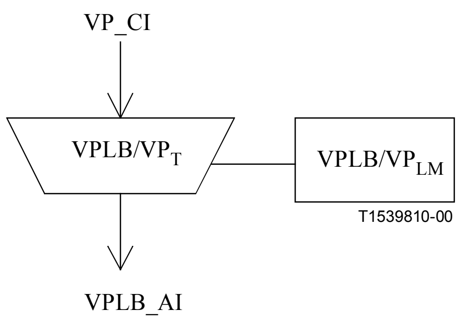


Figure D.98/I.732 – VPLB/VP_A_So symbol

Interfaces

Table D.26/I.732 – VPLB/VP_A_So input and output signals

Input(s)	Output(s)
VP_CI_D VP_CI_ACS	VPLB_AI_D VPLB_AI_ACS

Processes

None.

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.3.6.6 ATM virtual path loopback to ATM VP adaptation sink function VPLB/VP_A_Sk

Symbol

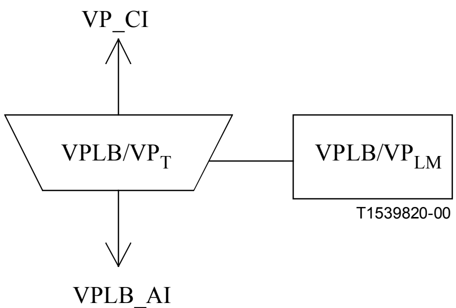


Figure D.99/I.732 – VPLB/VP_A_Sk symbol

Interfaces

Table D.27/I.732 – VPLB/VP_A_Sk input and output signals

Input(s)	Output(s)
VPLB_AI_D VPLB_AI_ACS VPLB_AI_TSF	VP_CI_D VP_CI_ACS VP_CI_SSF

Processes

None.

Defects

None.

Performance Monitoring

None.

Coordination function

Consequent Actions

aSSF ← AI_TSF

The consequent action aSSF is conveyed by CI_SSF through the VP_CI.

Defect Correlations

None.

D.3.7 ATM Virtual Path Linear Trail Protection Functions

D.3.7.1 ATM Virtual Path Linear Trail Protection Adaptation Source Function VP/VPP_A_So

Symbol

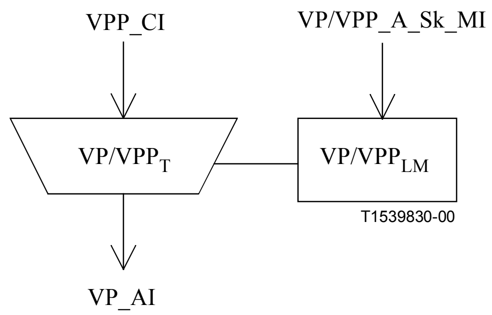


Figure D.100/I.732 – VP/VPP_A_So symbol

Interfaces

Table D.28/I.732 – VP/VPP_A_So input and output signals

Input(s)	Output(s)
for protection signal only: VPP_CI_APS VP/VPP_A_So_MI_APSenabled	VP_AI_D VP_AI_ACS

Processes

This function performs end-to-end VP-APS cell generation for 1+1 bidirectional and 1:1 protection switching functions.

End-to-end VP-APS cell generation:

– Transfer function: This function inserts end-to-end VP-APS cells from the Layer Management function.

– Layer Management function: If activated by the MI_APSenabled, for protection section in 1:1 and bidirectional 1+1 protection schemes, end-to-end VP-APS cells shall be generated. Refer to 5.8/I.630.

The value of the VCI, PT, CLP, OAM Type, Function Type and Reserved Fields shall be as specified in ITU-T I.630, I.610 and I.361.

The value of the K1 and K2 fields shall be written with the information received from the CI_APS.

The EDC field shall be written with the CRC-10 value of the 48-payload octets of the OAM cell as specified in 5.8/I.630.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.3.7.2 ATM Virtual Path Linear Trail Protection Adaptation Sink Function VP/VPP_A_Sk

Symbol

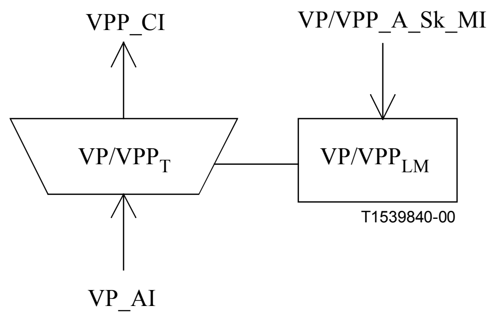


Figure D.101/I.732 – VP/VPP_A_Sk symbol

Interfaces

Table D.29/I.732 – VP/VPP_A_Sk input and output signals

Input(s)	Output(s)
VP_AI_D VP_AI_ACS VP_AI_TSF VP_AI_TSD VP/VPP_A_Sk_MI_APSenabled	VPP_CI_SSF for protection signal only: VPP_CI_APS

Processes

This function performs end-to-end VP-APS cell extraction for 1+1 bidirectional and 1:1 protection switching functions.

End-to-end VP-APS cell extraction:

– Transfer function: This function extracts end-to-end VP-APS cells to the Layer Management function.

– Layer Management function: If activated by the MI_APSenabled, for protection section in 1:1 and bidirectional 1+1 protection schemes, the information extracted from the K1 and K2 field is reported through the VPP_CI_APS. Refer to 5.8/I.630.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

aSSF ← AI_TSF

Defect Correlations

None.

D.4 ATM Virtual Path to ATM Virtual Channel Adaptation Functions

D.4.1 ATM Virtual Path to ATM Virtual Channel Adaptation Source Function VP/VC_A_So

Symbol

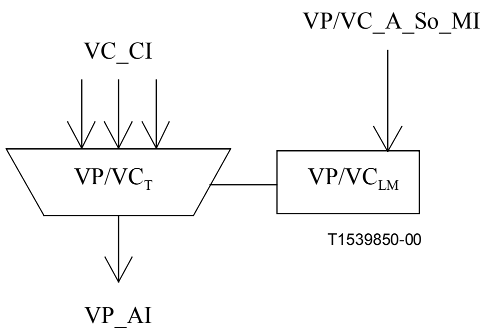


Figure D.102/I.732 – VP/VC_A_So symbol

Interfaces

Table D.30/I.732 – VP/VC_A_So input and output signals

Input(s)	Output(s)
per VC_CI for each VC configured: VC_CI_D VC_CI_ACS VC_CI_SSF VP/VC_A_So_MI_CellDiscardActive VP/VC_A_So_MI_VCI-LActive VP/VC_A_So_MI_Active	VP_AI_D VP_AI_ACS

The VP/VC_A_So function provides adaptation from the ATM Virtual Channel to the ATM Virtual Path. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.103.

Activation: The VP/VC_A_So function shall access the access point when it is activated (MI_Active is true). Otherwise, it shall not access the access point.

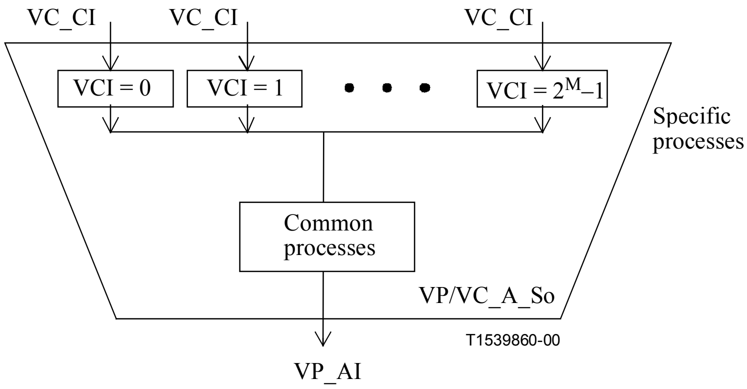


Figure D.103/I.732 – VP/VC_A_So atomic function decomposed into Specific and Common processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Specific Processes

These Processes include VCI setting as well as VC asynchronous multiplexing. Each of these Specific Processes is characterized by the Virtual Channel Identifier number L, where $0 \le L \le 2^M - 1$.

NOTE 2 – The value of M represents the number of bits in the VCI field and is an integer number. Its maximum value is equal to 16.

VCI-L Activation:

– Layer Management function: The Specific Processes perform the operation specified below when it is activated (MI_VCI-LActive is true).

VCI setting:

– Transfer function: VCI setting inserts the value of "L" as VCI.

– Layer Management function: VCI setting is based on the activation of the Specific function by MI_VCI-LActive. This process and the associated VC matrix connection perform the VCI translation.

VC multiplexing:

– Transfer function: Asynchronous multiplexing is performed for each active Specific function.

Common Processes

The Common Processes include: Congestion control and Metasignalling.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. See ITU-T I.371 for further details about the use of the CLP. In the event of congestion, the EFCI marking in the PTI field is set according to ITU-T I.361.

– Layer Management: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

Metasignalling:

– Transfer function: The metasignalling cells (refer to ITU-T I.361) are inserted with VCI = 1 (activation of VP/VC_A_So function with Specific Process L = 1). This process is optional.

– Layer Management: The processing of these cells is for further study.

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The following parameters need to be defined:

• Count of discarded cells from congestion control

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.4.2 ATM Virtual Path to ATM Virtual Channel Adaptation Sink Function VP/VC_A_Sk

Symbol

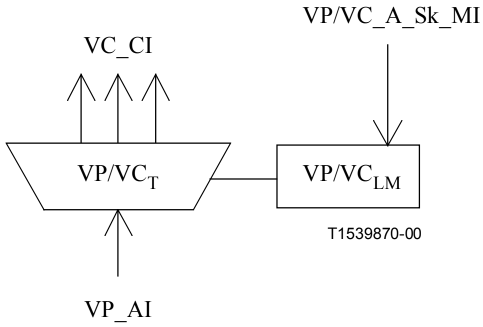


Figure D.104/I.732 – VP/VC_A_Sk symbol

Interfaces

Table D.31/I.732 – VP/VC_A_Sk input and output signals

Input(s)	Output(s)
VP_AI_D VP_AI_ACS VP_AI_TSF VP/VC_A_Sk_MI_VCIrange VP/VC_A_Sk_MI_CellDiscardActive VP/VC_A_Sk_MI_VCI-LActive VP/VC_A_Sk_MI_DTDLuseEnabled VP/VC_A_Sk_MI_Active VP/VC_A_Sk_MI_VCI-K_SAISactive	Per VC_CI for each VC configured: VC_CI_D VC_CI_ACS VC_CI_SSF VC_CI_CNGI

Processes

The VP/VC_A_Sk function provides adaptation from the ATM Virtual Path to the ATM Virtual Channel. This is performed by a grouping of Specific Processes and Common Processes as shown in Figure D.105. The function further discards all the F4 end-to-end and segment OAM cells from the Characteristic Information.

Activation:

– Layer Management function: The VP/VC_A_Sk function shall perform the Common and Specific Processes operation specified below when it is activated (MI_Active is true). Otherwise, it shall activate the SSF signals at its output (CI_SSF) and not report its status via the management point.

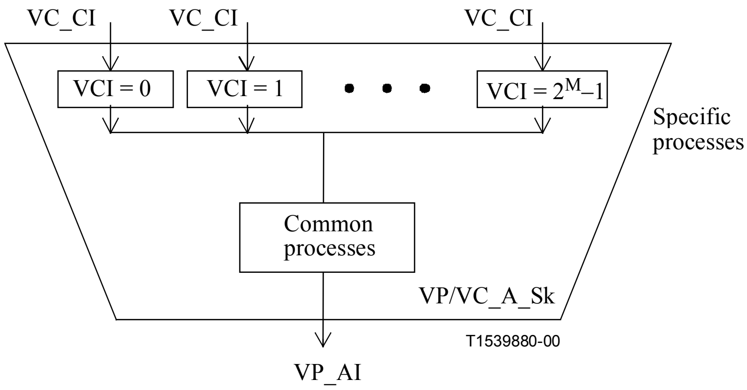


Figure D.105/I.732 – VP/VC_A_Sk atomic function decomposed into Specific and Common Processes parts

NOTE 1 – The sequential order of the processes within the atomic functions is important. For the correct order, refer to the ordering of the processes given below.

Common Processes

These Common Processes include: F4 OAM cell discarding, VCI verification, Congestion control and Metasignalling.

F4 OAM cell discarding:

– Transfer function: In case this function detects F4 end-to-end or segment OAM cells that were not extracted by the termination functions, this process shall discard these cells at this point.

VCI verification:

– Transfer function: This process shall verify that the received cell VCI is valid. If the VCI is determined to be invalid (i.e. out-of-range VCI or not assigned), the cell shall be discarded. The range of valid VCI values is given by MI_VCIrange.

– Layer Management function: The invalid VCI cell discard events are counted.

Congestion control:

– Transfer function: In the event of congestion, cells with CLP = 1 are subject to be discarded prior to cells with CLP = 0. In the event of congestion, the indication VC_CI_CNGI is set for the traffic management function VCTM_TT_So to insert EFCI on all VCs.

– Layer Management function: If enabled by MI_CellDiscardActive, this process shall perform selective cell discard according to CLP value.

See ITU-T I.371 for further details about the use of the CLP.

Metasignalling:

– Transfer function: The metasignalling cells (refer to ITU-T I.361) are extracted with VCI = 1 (activation of VP/VC_A_Sk function with Specific Process L = 1). This process is optional. The modelling of this process is for further study.

Specific Processes

The function performs VC-AIS insertion and VC demultiplexing on a per VC basis.

NOTE 2 – L is the VCI number, where $0 \leq L \leq 2^M-1$. This parameter defines the VC value within the AI stream the function has access to. The value of M provided by VCIrange represents the number of bits in the VCI fields and is an integer number; its maximum value is equal to 16.

VCI-L Activation:

– Layer Management function: The Specific Processes perform the operation specified above when it is activated (MI_VCI-LActive is true). Otherwise, it shall send no cells and SSF = false.

End-to-end VC-AIS insertion:

– Transfer function: This process inserts end-to-end VC-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: End-to-end VC-AIS cells (Figure D.10) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function.

Segment VC-AIS insertion:

– Transfer function: This process inserts segment VC-AIS cells from the Layer Management function for each active Specific Function.

– Layer Management function: Segment VC-AIS cells (Figure D.11) shall be generated according to the Consequent Actions section of the Coordination Function below for each active Specific Function and the segment VC-AIS cells insertion is also activated (MI_VCI-K_SAISactive is true).

VC demultiplexing:

– Transfer function: The adaptation sink function has access to a specific VC identified by the number L ($0 \leq L \leq 2^M-1$). When the function is activated only the cells of that specific VC-L are passed towards the Connection Point.

Defects

None.

Performance Monitoring

The use of the Performance Monitoring parameters is for further study. The parameters for the following functions need to be defined:

- Count of discarded cells from congestion control;
- Count of cells with invalid VCI (one common counter for invalid header/invalid VPI/invalid VCI is maintained).

Coordination Functions

Consequent Actions

aCNGI ← "Event of Congestion" and CellDiscardActive

aSSF ← AI_TSF

aAIS ← AI_TSF

On declaration of aAIS, the function shall output end-to-end VC-AIS cells (Figure D.10) on all active VCCs and segment VC-AIS cells (Figure D.13) on all active VCCs for which MI_SAISactive is true, according to 9.2.2.1.1.1/I.610. On clearing of aAIS, the generation of end-to-end and segment VC-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option, or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end and segment VC-AIS cell shall be coded as 6AH. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end and segment VC-AIS cells.

NOTE 3 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, the fields shall be encoded as 6AH.

The consequent action aSSF is conveyed by CI_SSF through the VC_CI.

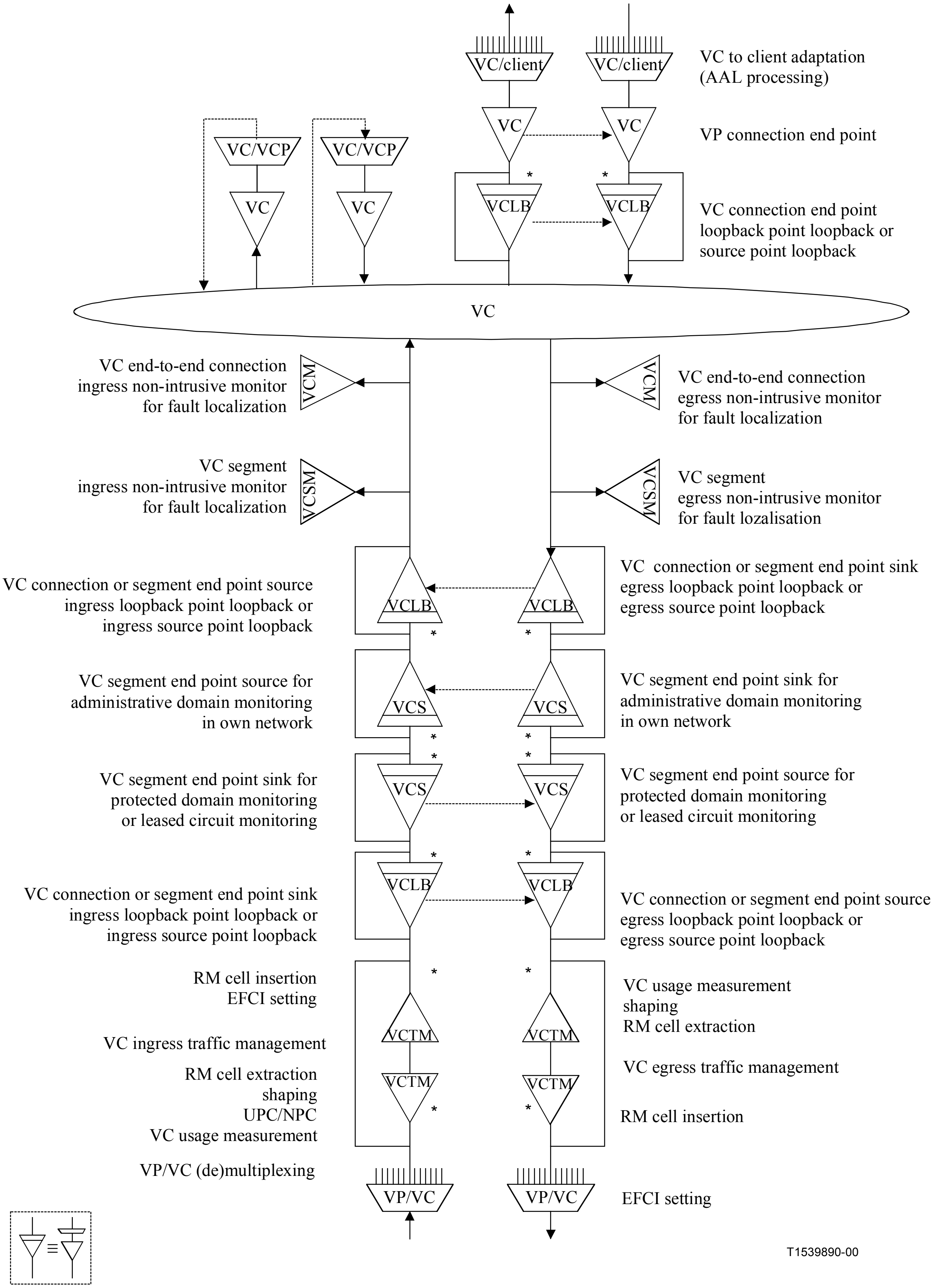
The consequent action aCNGI is conveyed by CI_CNGI through the VC_CI.

Defect Correlations

None.

D.5 ATM Virtual Channel Layer Network Functions

Figure D.106 shows the relative sequencing of the atomic functions of the Virtual Channel (VC) layer network and its server and client layer adaptation functions that has to be maintained *if they are present*. The figure also presents the application that is supported by each atomic function and may vary with the location in the sequence.



(*) This function may or may not be present in equipment; if present, it may be active or bypassed.

Figure D.106/I.732 – Expanded view of the VC layer network and its server and client layer adaptation functions

Note that:

a) A network element need not support all depicted functions. A network element supporting the TP/VP_A function contains minimal ATM functionality. An example is the B-NT1 as defined in ITU-T G.966. A network element with TP/VP_A, VP_TT, VP/VC_A functions and a VC_C function is an ATM VC switch equipment, etc.

b) The loopback point process in loopback sink functions operates in one of 3 process modes: CP, SEP or CEP. This depends on the position of the loopback process with respect to segment or end-to-end connection termination function. A loopback process co-located with a segment termination function that may be active or bypassed will change its loopback point sink process mode between CP and SEP depending on the active/bypass state of the segment function.

c) A VC loopback process (Figure D.107) can insert VC LB cells (end-to-end, segment), extract expected returned VC LB cells, and return (loopback) a received source loopback cell.

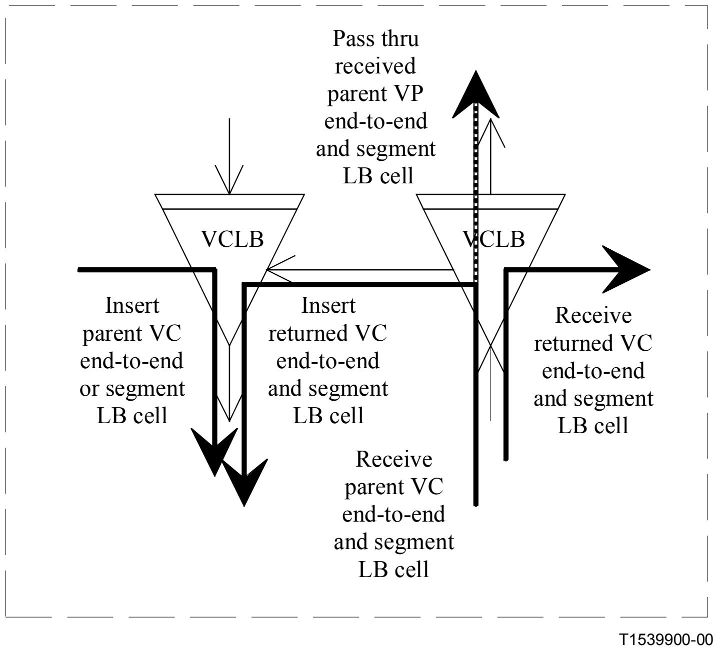


Figure D.107/I.732 – OAM cell insertion, extraction and looping in VC loopback function

d) A bidirectional VC segment endpoint function (Figure D.108) can insert VC segment CC, FPM, RDI, BR and AD cells, extract VC segment CC, FPM, RDI, BR, AD and AIS cells, and monitor end-to-end VC-AIS cells. A VC segment endpoint source function discards all incoming VC segment OAM cells. A VC segment endpoint sink function discards all VC segment OAM cells before the rest of the VC signal is output. A VC segment endpoint sink function inserts end-to-end VC-AIS OAM cells during signal fail conditions.

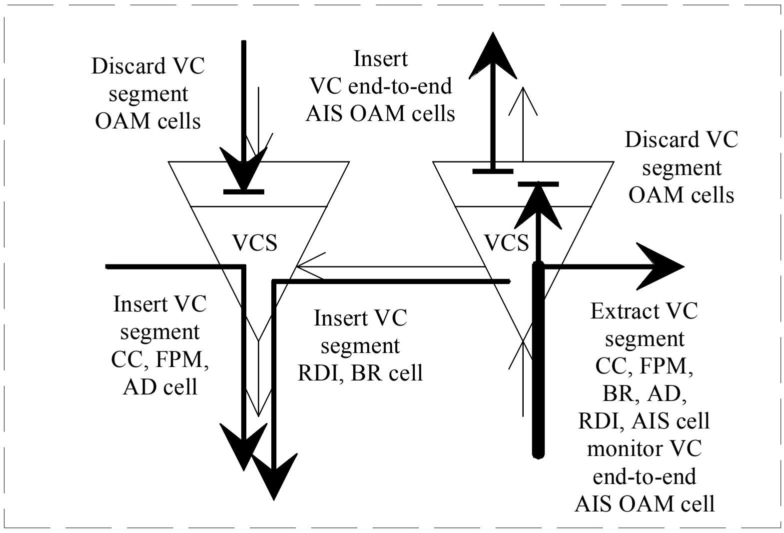


Figure D.108/I.732 – OAM cell insertion, extraction and discarding in VC segment endpoint functions

e) A bidirectional VC connection endpoint function (Figure D.109) can insert VC end-to-end CC, FPM, RDI, BR and AD cells and extract VC end-to-end CC, FPM, RDI, BR, AD and AIS cells. A VC connection endpoint sink function discards all VC end-to-end OAM cells and also all VC segment OAM cells[2] before the rest of the VC payload signal is output. A connection endpoint sink function inserts client layer AIS during signal fail conditions; a VC connection endpoint function inserts e.g. AAL 2-AIS OAM cells for case of I.366.2 AAL 2 client signal or 2 Mbit/s AIS for case of 2 Mbit/s client signal.

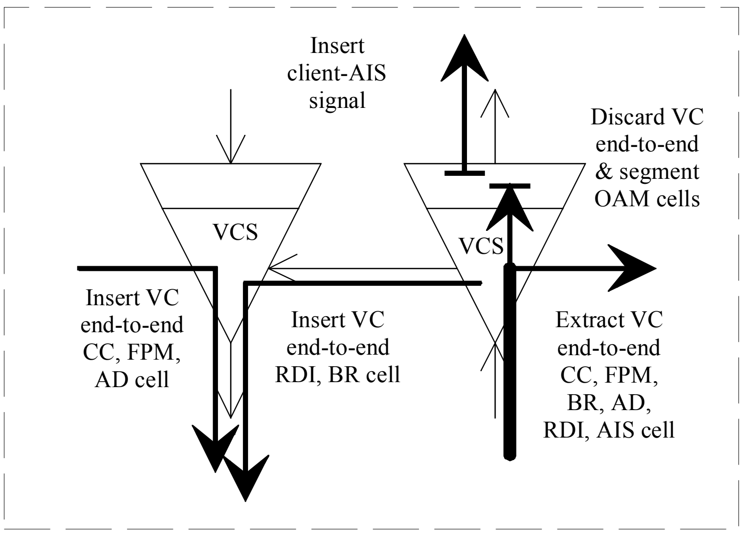


Figure D.109/I.732 – OAM cell insertion, extraction and discarding in VC connection endpoint functions

f) A VC end-to-end non-intrusive monitor function (Figure D.110) can monitor end-to-end VC-CC, FPM, RDI, BR and AIS cells. A VC segment non-intrusive monitor function can monitor VC segment CC, FPM, RDI, BR and AIS cells and end-to-end VC-AIS cells.

[2] Segment OAM cells might be present outside segments under certain fault conditions.

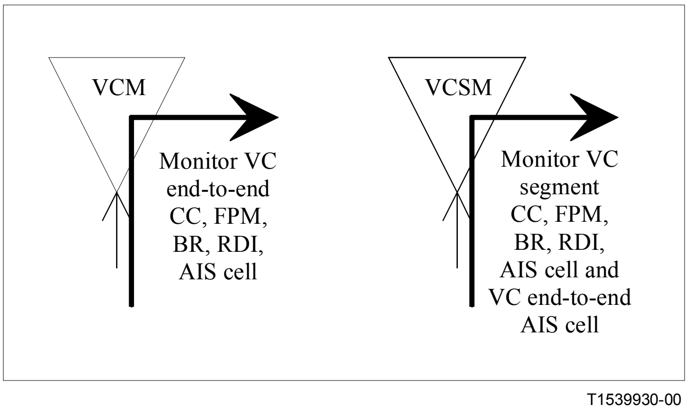


Figure D.110/I.732 – OAM cell extraction in VC end-to-end and VC segment non-intrusive monitor functions

g) Fault Management related signals in segment endpoint functions are depicted in Figure D.111. SSF and TSF signals communicate the signal fail condition detected in previous functions, help to suppress fault causes in equipment and are used to trigger protection switching. Fault causes (MI_cXXX) are determined and reported to the EMF. Remote Information (RI_XXX) is generated in the termination sink function and handed to the paired termination source function for insertion in the RDI and BR OAM cells. AIS is inserted under control of the aAIS signal.

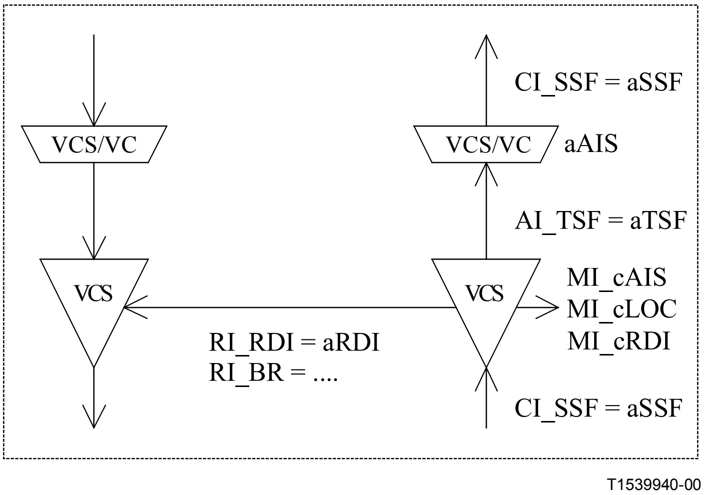


Figure D.111/I.732 – Fault Management in segment function

h) Fault Management related signals in connection endpoint functions are depicted in Figure D.112. SSF and TSF signals communicate the signal fail condition detected in previous functions, help to suppress fault causes in equipment and are used to trigger protection switching. Fault causes (MI_cXXX) are determined and reported to the EMF. Remote Information (RI_XXX) is generated in the termination sink function and handed to the paired termination source function for insertion in the RDI and BR OAM cells. AIS is inserted under control of the aAIS signal.

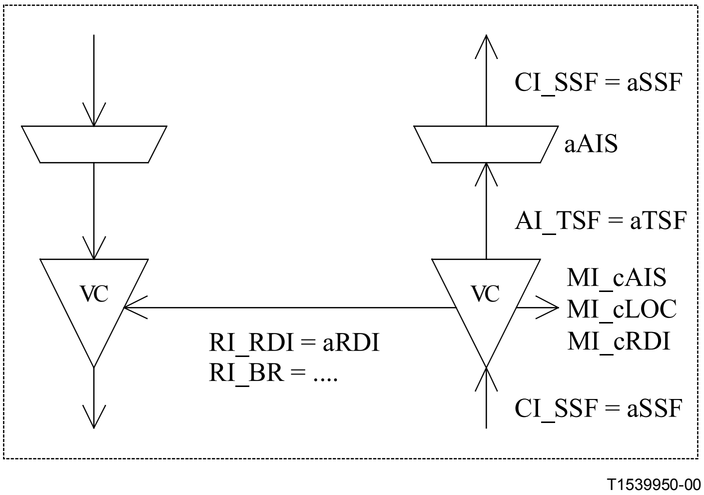


Figure D.112/I.732 – Fault Management in connection endpoint VC functions

i) Fault Management related signals in a VC non-intrusive monitor function are depicted in Figure D.113. SSF and TSF signals communicate the signal fail condition detected in previous functions, help to suppress fault causes in equipment and are used to trigger protection switching. Fault causes (MI_cXXX) are determined and reported to the EMF.

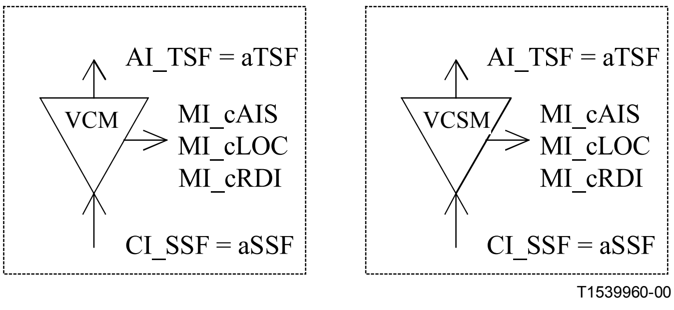


Figure D.113/I.732 – Fault Management and Performance Monitoring in VC end-to-end and VC segment non-intrusive monitor functions

j) The traffic management functions are modelled as back-to-back connected sink and source function. The functionality of traffic management is restricted to a single direction of transport. It differs as such from a normal sublayer functionality, which has sink and source processing performed in the two directions separately.

ATM Virtual Channel layer Characteristic Information

The end-to-end VC CI is cell structured (Figure D.114). Its format is characterized as end-to-end VC_AI plus the end-to-end VC trail termination overhead in the end-to-end VC OAM cells (F5E)

CC, FPM, BR, RDI and AD, as defined in ITU-T I.610. Downstream of a signal fail location, the end-to-end VC CI contains only the end-to-end VC AIS OAM cell and possibly the segment VC AIS OAM cell.

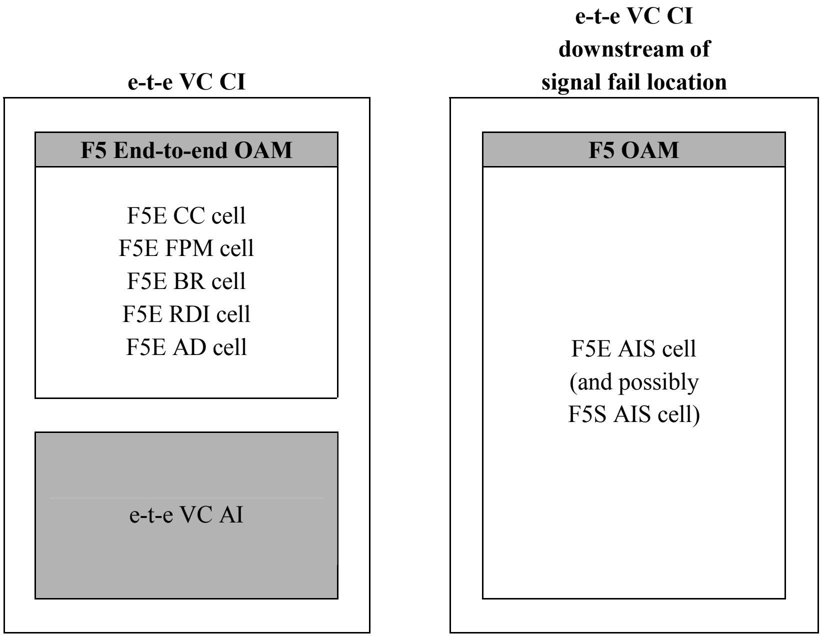


Figure D.114/I.732 – ATM VC Characteristic Information

The segment VC CI is cell structured (Figure D.115). Its format is characterized as segment VC_AI plus the segment VC trail termination overhead in the segment VC OAM cells (F5S) CC, FPM, BR, RDI and AD, as defined in ITU-T I.610. Downstream of a signal fail location, the segment VC CI contains only the end-to-end VC AIS OAM cell and possibly the segment VC AIS OAM cell.

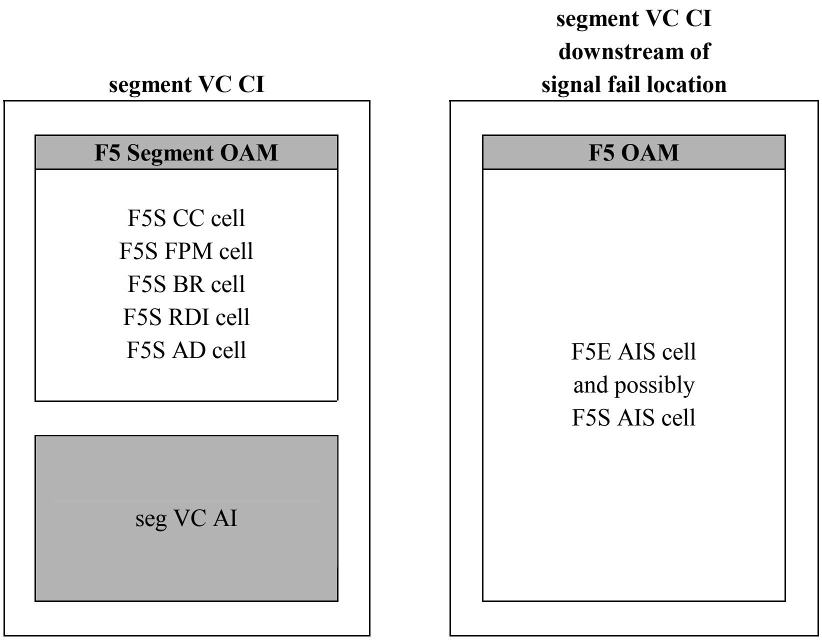


Figure D.115/I.732 – ATM VC Segment Characteristic Information

The loopback VC CI is cell structured (Figure D.116). Its format is characterized as the loopback VC trail termination overhead in the end-to-end VC OAM cell (F5E) LB, or segment VC OAM cell (F5S) LB, as defined in ITU-T I.610. Downstream of a signal fail location, the loopback VC CI is absent when it was inserted upstream of the signal fail location.

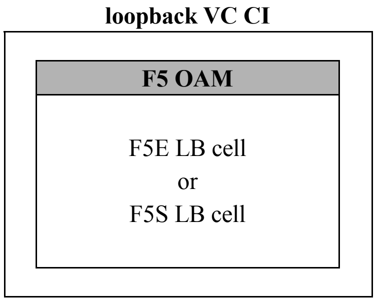


Figure D.116/I.732 – ATM VC Loopback Characteristic Information

The SNCP VC CI is cell structured (Figure D.117). Its format is characterized as the SNCP VC connection overhead in the end-to-end VC OAM cell (F5E) APS, as defined in ITU-T I.630. Downstream of a signal fail location, the SNCP VC CI is absent.

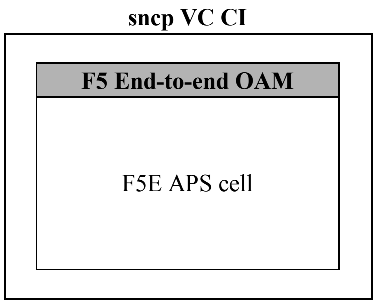


Figure D.117/I.732 – ATM VC SNCP Characteristic Information

ATM Virtual Channel layer Adapted Information

The end-to-end VC AI is cell structured (Figure D.118). It represents adapted client layer information comprising end-to-end VC user cells as created in the adaptation function performing the AAL 1, AAL 2, AAL 3/4, or AAL 5 process.

For the case the signal has passed the trail protection sublayer, end-to-end VC_AI may include the end-to-end VC trail protection overhead in the end-to-end VC OAM cell (F5E) APS, as defined in ITU-T I.630.

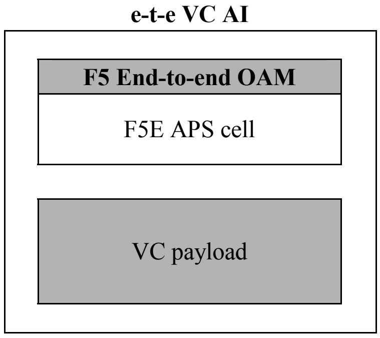


Figure D.118/I.732 – ATM VC Adapted Information

The segment VC AI is cell structured (Figure D.119). It represents end-to-end VC CI and VCSNC CI.

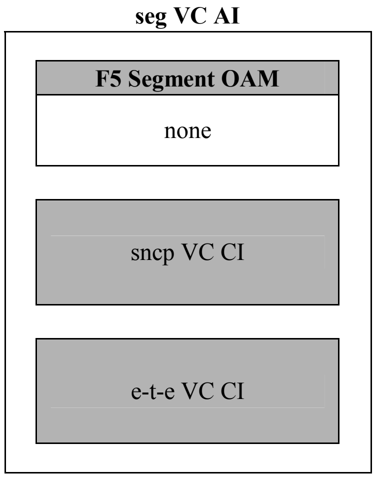


Figure D.119/I.732 – ATM VC Segment Adapted Information

D.5.1 ATM Virtual Channel Connection Function VC_C

Symbol

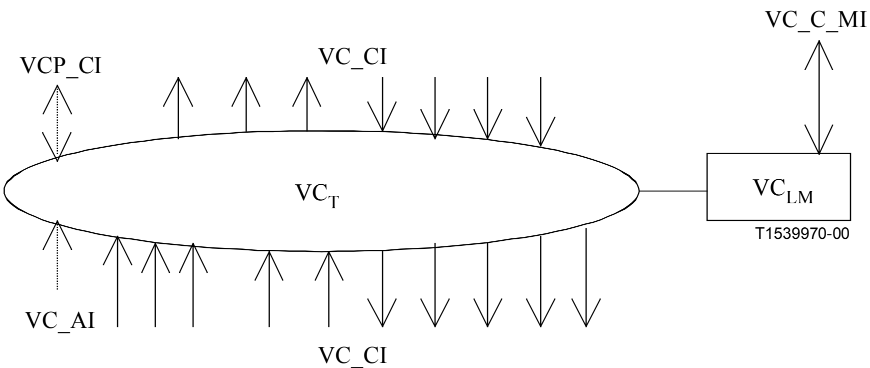


Figure D.120/I.732 – VC_C symbol

Interfaces

Table D.32/I.732 – VC_C input and output signals

Input(s)	Output(s)
Per VC_CI, n × for the function: VC_CI_D VC_CI_ACS for inputs from the server layer: VC_CI_SSF per SNC/N protection connection point: VC_AI_TSF VC_AI_TSD per SNC/T protection test termination point: VCP_CI_SSF VCP_CI_APS per input and output connection point: VC_C_MI_ConnectionPortIds per matrix connection: VC_C_MI_ConnectionType VC_C_MI_Directionality per SNC protection group: VC_C_MI_ProtType VC_C_MI_SwType VC_C_MI_GroupID VC_C_MI_OperType VC_C_MI_WTRtime VC_C_MI_HOtime VC_C_MI_ExtCmd	per VC_CI, m × per function: VC_CI_D VC_CI_ACS VC_CI_SSF per SNC/T protection test termination point: VCP_CI_APS NOTE – Protection status reporting signals are for further study.

Processes

In the VC_C function ATM Virtual Path Layer Characteristic Information is routed between input (termination) connection points ((T)CPs) and output (T)CPs by means of matrix connections. (T)CPs may be allocated within a protection group.

NOTE 1 – Neither the number of input/output signals to the connection function, nor the connectivity is specified in this Recommendation. That is a property of individual network elements.

NOTE 2 – If CI_SSF is not connected (when connected to the client layer TT_So), CI_SSF is assumed to be false.

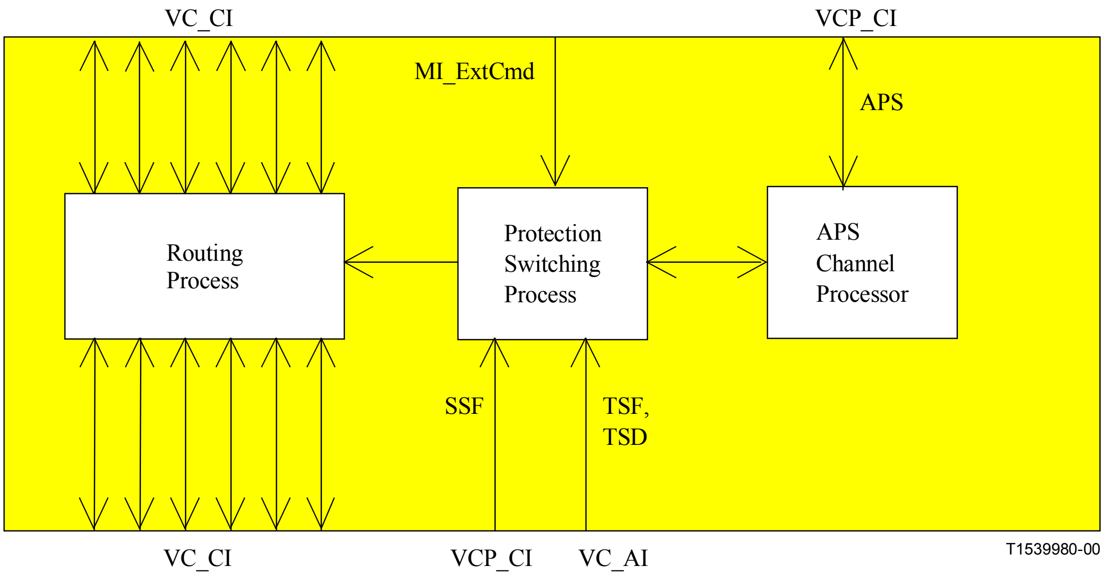


Figure D.121/I.732 – VC_C process block diagram

Routing process:

– Transfer function: This process passes all the cells received from a specific input to the corresponding output according to the matrix connection between the specified input and output established by the layer management function.

– Layer Management function: It configures, according to the information received from the AEMF and, in case of protected connections, from the protection switching control process, the associations between input and output ports of the VC_C block. It shall be able to remove an established matrix connection.

Each (matrix) connection in the VC_C function shall be characterized by the:

Type of connection (MI_ConnectionType):	unprotected, protected
Traffic direction (MI_Directionality):	unidirectional, bidirectional
Input and output connection points (MI_ConnectionPortIDs):	set of connection point identifiers
NOTE 1 – Multipoint connections are handled as separate connections from the same input CP and are for further study. NOTE 2 – It shall be possible to connect one or more Characteristic Information (CI) outputs to one input Connection Point (CP) of the VC_C function.	

Protection Switching process:

– Layer Management function: It controls the routing process in order to re-configure some protected (MI_ConnectionType = "protected") matrix connections, when the switching criteria are matched. Refer to D.3.1.1 for more details.

In case of SNC/T, this process is responsible to require the switching from the working path to the protection path (or vice versa) for all the VC connections belonging to the VC group for which the switching criteria are met.

Each protected matrix connection in the VC_C function shall be characterized by the:

Type of protection (MI_ProtType):	1+1 SNC/N 1+1 SNC/T 1:1 SNC/T
Type of protection switching (MI_SwType):	unidirectional bidirectional
VC Group (MI_GroupID):	identification of the VC group the matrix connection belongs to
NOTE – The MI_SwType and the MI_GroupID apply only to SNC/T protected matrix connections and are meaningless for SNC/N protected matrix connections.	

APS channel process:

– Layer Management function: It implements the APS communication protocol, according to Annex A/I.630. It is not used in case of SNC/N and unidirectional 1+1 SNC/T.

  The APS information from the far-end (i.e. the K1 and K2 fields) is received from the VC/VCP_A_So function of the test trail in the protection VC group through the CI_APS signal. The APS information to the far-end (i.e. the K1 and K2 fields) is sent to the VC/VCP_A_Sk function of the test trail in the protection VC group through the CI_APS signal.

Performance Monitoring

None.

Defects

None.

Coordination Functions

Consequent Actions

If an output of this function is not connected to one of its inputs, the connection function shall send no cells and SSF = false to the output.

Defect Correlations

None.

D.5.1.1 ATM Virtual Path SubNetwork Connection Protection Process

NOTE 1 – This process is active in the VC_C function as many times as there are SNC/N protected matrix connections or SNC/T protected group of matrix connections.

The VC_C function may provide protection for the connection against channel-associated defects within a subnetwork connection.

VC subnetwork connection protection mechanisms (i.e. SNC/N and SNC/T) are described in ITU-T I.630.

The SNC/N functions at both ends operated in the same way, by monitoring the subnetwork connection for defects, evaluating the system status taking into consideration the priorities of defect conditions and of external switch requests, and switching the appropriate channel to the protection subnetwork connection.

The SNC/T functions at both ends operated in the same way, by monitoring the test connections for defects, evaluating the system status taking into consideration the priorities of defect conditions and of external and remote switch requests, and switching the appropriate channel group to the protection subnetwork connection group. The two VC_C functions may communicate with each other via a bit-oriented protocol carried by the K1, K2 fields of APS cells. This protocol is described in ITU-T I.630.

The signal flow associated with the VC_C SNC protection process is described with reference to Figure D.122 (SNC/N) and to Figure D.123 (SNC/T). The VC_C protection process receives control parameters and external switch requests from the AEMF function and outputs status indications to the AEMF function, as a result of switch commands described in ITU-T I.630.

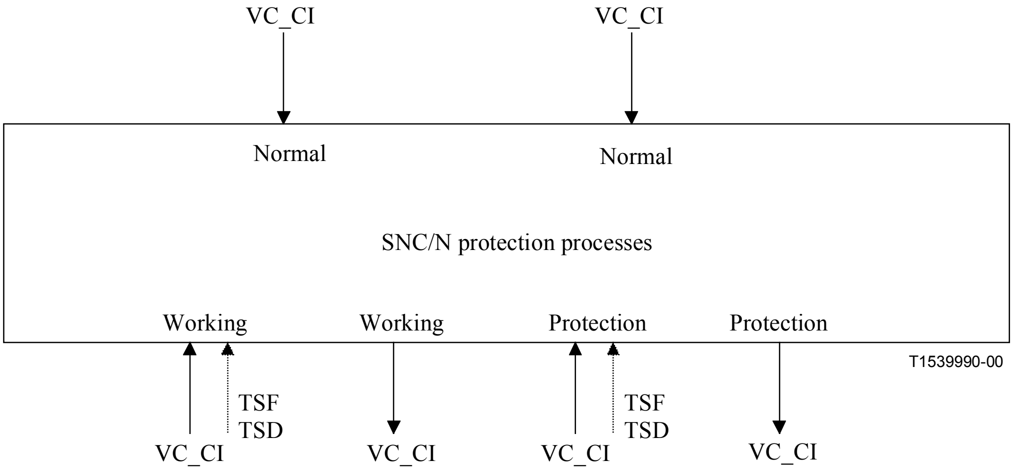


Figure D.122/I.732 – VC non-intrusive monitored subnetwork connection (SNC/N) protection process

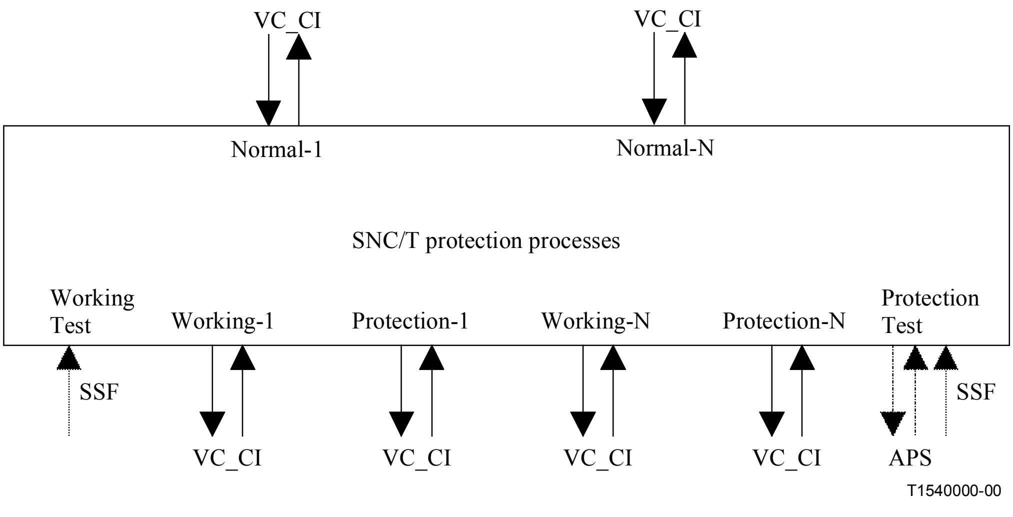


Figure D.123/I.732 – VC group subnetwork connection (SNC/T) protection process

NOTE 2 – The 1:1 SNC/T with extra-traffic is for further study.

Source Direction

For 1 + 1 architecture, the VC_CI signal received from the normal VP/VC_A (or VC_TT) function is bridged permanently to both the working and protection VP/VC_A functions.

For 1:1 architecture, under normal conditions the VC_CI signal received from the normal VP/VC_A (or VC_TT) function is passed to the corresponding working VP/VC_A function. When a switch has to be performed, the signal from the normal VP/VC_A (or VC_TT) function is passed to the corresponding protection VP/VC_A function.

NOTE 3 – The 1:1 SNC/T with extra-traffic is for further study.

When applicable (i.e. bidirectional 1+1 and 1:1 SNC/T protection), the APS information, generated according to the rules in the ITU-T I.630, is forwarded to the VC/VCP_A_So function of the test VC trail in the protection group.

NOTE 4 – The atomic function connected to the VC_C is either a VP/VC_A or a VC_TT. When the trail signal is terminated in this network element, it will be connected to a VC_TT, otherwise it will be connected to a VP/VC_A (for further transport through the network).

Sink Direction

For SNC/N protection (Figure D.122) the VC_CI signals from the working and protection VP/VC_A functions are non-intrusively monitored by the VCM_TT_Sk functions before they access the VC_C function. The VC_C SNC/N protection process uses the resultant TSF and TSD signals.

For SNC/T protection (Figure D.123) the VC_CI signals from the VP/VC_A of the test trails in the working and protection groups are terminated to the VC_TT and the VC/VCP_A functions. The VC_C SNC/T protection process uses the resultant SSF and APS signals. The APS information received from the VC/VCP_A_Sk function of the test VC trail in the protection group is processed according to ITU-T I.630.

Under normal conditions, VC_C forwards the cells from the working VP/VC_A function to the corresponding VP/VC_A (or VC_TT) function. The cells from the protection subnetwork connection are discarded. The extra-traffic is for further study.

If a switch has to be performed, then the cells received from the protection VP/VC_A are forwarded to the corresponding VP/VC_A (or VC_TT) function. The cells received from the working VP/VC_A are discarded. The extra-traffic is for further study.

Switch Initiation Criteria

Automatic protection switching for the SNC/N is based on the defect conditions of the working and protection subnetwork connections. These conditions are the signal fail (AI_TSF) and signal degrade (AI_TSD). They are detected in the VCM_TT_Sk atomic function, as described in D.3.3.1.

Automatic protection switching for the SNC/T is based on the defect conditions of the working and protection test VC connections. These conditions are the signal fail (CI_SSF) and signal degrade (CI_SSF). They are detected in the VC/VCP_A_Sk atomic function, as described in D.3.7.2.

The automatic protection switching action is performed after a period of time after the detection of the SF/SD condition. This period called hold-off (HO) time should be set by the AEMF (MI_HOtime) within the range of 0 to 10 s with a granularity of 500 ms.

The protection switch can also be initiated by switch commands (MI_ExtCmd) received by the AEMF function. Refer to the switch initiation criteria described in ITU-T I.630.

Switching Time

Refer to ITU-T I.630.

Switch Restoration

In the revertive mode of operation (MI_OperType = "revertive"), the working channel shall be restored, i.e. the signal on the protection subnetwork connection shall be switched back to the working subnetwork connection, when the working subnetwork connection has recovered from the fault.

To prevent frequent operation of the protection switch due to an intermittent fault, a failed subnetwork connection must become fault-free. After the failed subnetwork connection meets this criterion, a fixed period of time shall elapse before being used again by a working channel. This period called wait-to-restore (WTR) time should be set by the AEMF (MI_WTRtime) within the range of 1 to 30 minutes with a granularity of 1 minute (default 12 minutes). An SSF, TSF or TSD condition shall override the WTR. Refer to the switch initiation criteria described in ITU-T I.630.

D.5.2 ATM Virtual Channel Trail Termination Functions

D.5.2.1 ATM Virtual Channel Trail Termination Source VC_TT_So

Symbol

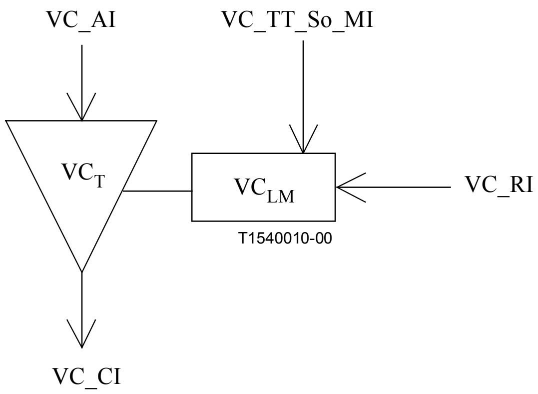


Figure D.124/I.732 – VC_TT_So symbol

Interfaces

Table D.33/I.732 – VC_TT_So input and output signals

Input(s)	Output(s)
VC_AI_D VC_AI_ACS VC_RI_RDI VC_RI_BRPMdata VC_TT_So_MI_CCOption VC_TT_So_MI_DTDLuseEnabled VC_TT_So_MI_PMActive VC_TT_So_MI_CCActive VC_TT_So_MI_FPMActive VC_TT_So_MI_PMActive VC_TT_So_MI_TSTPuseEnabled VC_TT_So_MI_Time	VC_CI_D VC_CI_ACS

Processes

This function performs VC end-to-end RDI insertion, Continuity Check, FPM and BR cell generation as well as activation/deactivation of FPM, FPM&BR and CC on the VC end-to-end level.

End-to-end VC-RDI:

– Transfer function: This process inserts end-to-end VC-RDI cells from the Layer Management function.

– Layer Management function: End-to-end VC-RDI cells shall be generated according to the Consequent Actions section of the Coordination Functions below.

End-to-end VC Continuity Check:

– Transfer function: This process inserts end-to-end VC-CC cells from the Layer Management function.

– Layer Management function: End-to-end VC-CC activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the end-to-end VC-CC activation process (MI_CCActive), this process monitors the VC user cell stream activity at the input (VC_AI) and generates CC cells. There are two options defined in ITU-T I.610 for end-to-end VC-CC. For the case option 1 is implemented or activated (MI_CCOption = 1), an end-to-end VC-CC cell shall be inserted if no user cell has been transmitted for a period of nominally 1-second. For the case option 2 is implemented or activated (MI_CCOption = 2), an end-to-end VC-CC cell shall be inserted with a periodicity of 1 cell/s independently of the VC user cell flow. The procedure of end-to-end VC-CC is described in 9.2.2.1.2/I.610.

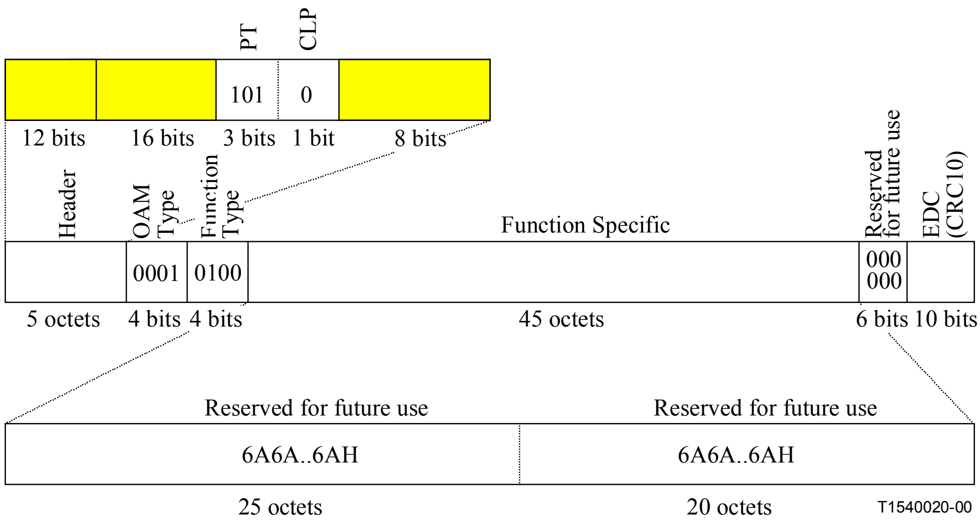


Figure D.125/I.732 – End-to-end VC-CC OAM cell as part of the VC_CI

The value of the VCI, PT, CLP, OAM Type, Function Type, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

NOTE – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the end-to-end VC-CC OAM cell as an ATM address field.

End-to-end VC-FPM:

– Transfer function: This process monitors the incoming cell flow and inserts end-to-end VC-FPM cells from the Layer Management function.

– Layer Management function: end-to-end VC-FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive for the end-to-end VC_FPM process or MI_PMActive for the end-to-end FPM&BR process. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), end-to-end VC-FPM cells shall be generated. Refer to 10.3/I.610.

The value of the VCI, PT, CLP, OAM Type, Function Type and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The value of the MSCN/FPM, TUC_{0+1}, $BEDC_{0+1}$ and TUC_0 shall be written with the information as specified in 10.3.1/I.610, which is functionally represented in Figure D.126.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

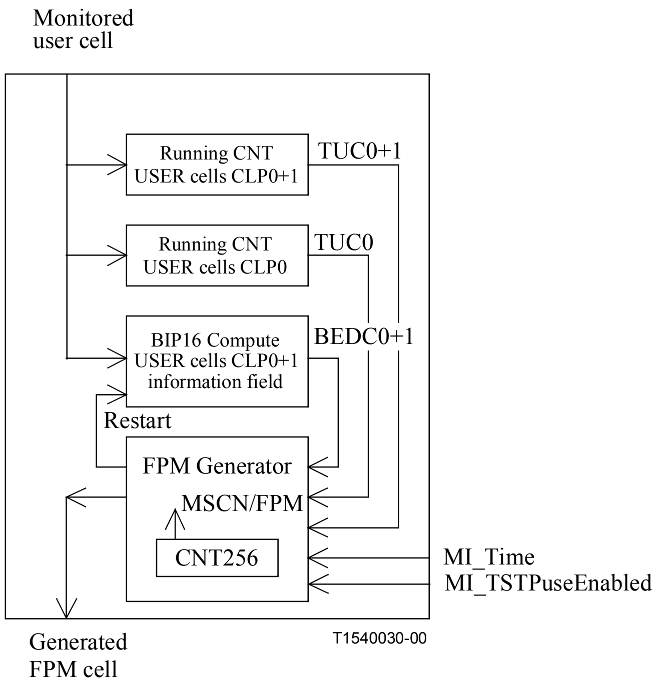


Figure D.126/I.732 – End-to-end VC-FPM generation process

End-to-end VC-BR:

– Transfer function: This process inserts end-to-end VC-BR cells from the Layer Management function.

– Layer Management function: VC end-to-end FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the FPM&BR activation process (MI_PMActive), the end-to-end VC-BR cells shall be generated using the PM data from RI_BRPMdata being collected by the VCS_TT_Sk. Refer to 10.3/I.610.

The value of the VCI, PT, CLP, OAM Type, Function Type, MSCN/BR and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The TUC_{0+1}, TUC_0, RMCSN, SECBS, $TRCC_0$, $BLER_{0+1}$ and $TRCC_{0+1}$ fields shall be written with the information received from the VCS_TT_Sk via RI_BRPMdata.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

End-to-end VC-AD:

– Transfer function: This process inserts end-to-end VC-AD-FPM/BR, end-to-end VC-AD-CC and end-to-end VC-AD-FPM cells from the Layer Management function.

– Layer Management function: For further study.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

On reception of RI_RDI, the function shall output end-to-end VC-RDI cells according to 9.2.2.1.1.2/I.610. On clearing of RI_RDI, the generation of end-to-end VC-RDI cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end VC-RDI cell shall be coded as 6Ahex. If the function supports DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location fields of the end-to-end VC-RDI cell shall contain the value provided by the VC_TT_Sk via RI_RDI. The insertion of RDI cells should not interrupt any cell flows present on the connection.

Defect Correlations

None.

D.5.2.2 ATM Virtual Channel Trail Termination Sink VC_TT_Sk

Symbol

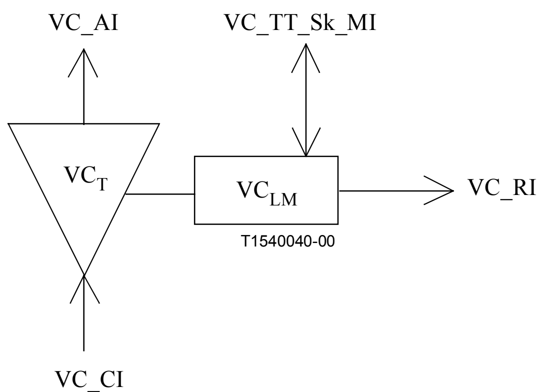


Figure D.127/I.732 – VC_TT_Sk symbol

Interfaces

Table D.34/I.732 – VC_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VC_TT_Sk_ MI_RDIreported VC_TT_Sk_ MI_AISreported VC_TT_Sk_ MI_LOCreported VC_TT_Sk_ MI_CCActive VC_TT_Sk_ MI_FPMActive VC_TT_Sk_ MI_PMActive	VC_AI_D VC_AI_ACS VC_AI_TSF VC_RI_RDI VC_RI_BRPMdata VC_TT_Sk_MI_cRDI VC_TT_Sk_MI_RDIdata VC_TT_Sk_MI_cAIS VC_TT_Sk_MI_AISdata VC_TT_Sk_MI_cLOC VC_TT_Sk_MI_FPMdata VC_TT_Sk_MI_BRPMdata

Processes

This function performs VC end-to-end RDI, Continuity Check, FPM and BR cell extraction, end-to-end VC-AIS as well as activation/deactivation of FPM, FPM&BR and CC on the VC end-to-end level.

End-to-end VC-RDI:

– Transfer function: This process extracts end-to-end VC-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VC-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the end-to-end VC-RDI cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_RDIdata. Refer to 9.2.2.1.1.2 and 10.2.1/I.610.

End-to-end VC Continuity Check:

– Transfer function: This process extracts end-to-end VC-CC cells and forwards them to the Layer Management function.

– Layer Management function: End-to-end VC CC activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the end-to-end VC CC activation process (MI_CCActive), the process shall report the end-to-end VC CC cells according to the Defects section process below.

End-to-end VC-FPM:

– Transfer function: This process monitors the incoming cell flow and extracts end-to-end VC-FPM cells and forwards them to the Layer Management function.

– Layer Management function: End-to-end VC FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive or MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the process shall monitor the performance derived from the comparison between received block of user cells and information in a received end-to-end VC-FPM cell, according to the Performance Monitoring section below.

End-to-end VC-BR:

– Transfer function: This process extracts end-to-end VC-BR cells and forwards them to the Layer Management function.

– Layer Management function: VC end-to-end FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one endpoint with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM&BR activation process (MI_PMActive), the process shall report the end-to-end VC-BR cells according to the Performance Monitoring section below.

End-to-end VC-AIS:

– Transfer function: This process extracts end-to-end VC-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VC-AIS cell provides information as to the status of the VC connection, as well as to the defect type and defect location. The defect detection of the end-to-end VC-AIS cells shall be according to the Defects section below.

  The information extracted from the defect type and defect location field is reported to the AEMF via MI_AISdata and to the paired VC_TT_So according to the Consequent Actions section of the Coordination Function below. Refer to 9.2.2.1.1.1 and 10.2.1/I.610.

End-to-end VC-AD:

– Transfer function: This process extracts end-to-end VC-AD-FPM/BR, end-to-end VC-AD-CC and end-to-end VC-AD-FPM cells and forwards them to the Layer Management function.

– Layer Management function: For further study.

Defects

If enabled by the end-to-end VC-CC activation process (MI_CCActive = true), the function shall declare dLOC if no user cell or continuity check cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dLOC shall be cleared when any user cell or end-to-end VC-CC cell is received. If disabled by the end-to-end VC-CC activation process (MI_CCActive = false), dLOC shall be cleared.

The function shall declare dRDI as soon as an end-to-end VC-RDI cell is received. The dRDI shall be cleared when no end-to-end VC-RDI is received during a nominally 2.5 s period, with a margin of ± 0.5 s. Refer to 9.2.2.1.1.2/I.610.

The function shall declare dAIS as soon as an end-to-end VC-AIS cell is received. The dAIS shall be cleared when a VC user cell or an end-to-end VC CC cell is received; if end-to-end VC CC is not activated, dAIS is cleared also if end-to-end VC-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between received block of user cells and information in a received end-to-end VC-FPM cell. The definition of user cells is given in Table 1/I.610.

If activated by the FPM activation process (MI_FPMActive), the result is reported to the AEMF via MI_FPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the result is backward reported via RI_BRPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the received end-to-end VC-BR cell on the near end contains the performance information regarding the unidirectional connection set up from the near end to the far end. This information is reported to the AEMF via MI_BRPMdata.

NOTE – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Mis-insertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the EMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dLOC or dAIS

aRDI ← CI_SSF or dLOC or dAIS

The consequent action aRDI is conveyed through RI_RDI to the VC_TT_So together with the defect type and defect location (if implemented). In case of dAIS, defect type and location through RI_RDI are as in the received VC-AIS cell. In case of CI_SSF and dLOC, defect type and location are in respect to the equipment this function is built into.

The consequent action aTSF is conveyed by AI_TSF through the VC_AI.

Defect Correlations

cRDI ← dRDI and (not dAIS) and (not CI_SSF) and RDIreported

cAIS ← dAIS and (not CI_SSF) and AISreported

cLOC ← dLOC and (not CI_SSF) and (not dAIS) and LOCreported

It shall be an option to report end-to-end VC-AIS as a fault cause. This is controlled by means of the parameter AISreported. The default shall be AISreported = false.

It shall be an option to report end-to-end VC-RDI as a fault cause. This is controlled by means of the parameter RDIreported. The default shall be RDIreported = false.

It shall be an option to report end-to-end VC-LOC as a fault cause. This is controlled by means of the parameter LOCreported. The default shall be LOCreported = false.

D.5.3 ATM Virtual Channel Monitoring Functions

D.5.3.1 ATM Virtual Channel Non-intrusive Monitoring Function VCM_TT_Sk

Symbol

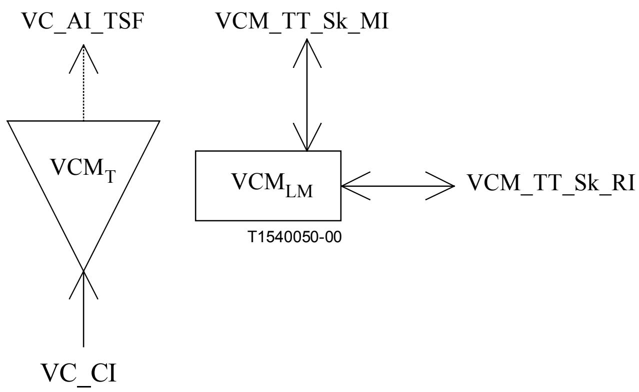


Figure D.128/I.732 – VCM_TT_Sk symbol

Interfaces

Table D.35/I.732 – VCM_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VCM_TT_Sk_MI_AISreported VCM_TT_Sk_MI_RDIreported VCM_TT_Sk_MI_LOCreported VCM_TT_Sk_MI_CCActive VCM_TT_Sk_MI_FPMActive VCM_TT_Sk_MI_PMActive	VC_AI_TSF VCM_TT_Sk_MI_cAIS VCM_TT_Sk_MI_AISdata VCM_TT_Sk_MI_cRDI VCM_TT_Sk_MI_RDIdata VCM_TT_Sk_MI_cLOC VCM_TT_Sk_MI_FPMdata VCM_TT_Sk_MI_BRPMdata VCM_TT_Sk_MI_FPMdata VCM_TT_Sk_MI_BRPMdata

Processes

This function monitors VC end-to-end RDI, end-to-end Continuity Check, FPM and BR cells and end-to-end VC-AIS.

End-to-end VC-RDI:

– Transfer function: This process monitors end-to-end VC-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VC-RDI provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the segment VC-RDI cells shall be according to the Defects section below. The information monitored from the defect type and defect location field is reported to the AEMF via MI_RDIdata. Refer to 9.2.2.1.1.2 and 10.2.1/I.610.

End-to-end VC-Continuity Check:

– Transfer function: This process monitors end-to-end VC-CC cells and forwards them to the Layer Management function.

– Layer Management function: If enabled by TMN (MI_CCActive), the process shall report the end-to-end VC CC cells according to the Defects section below. End-to-end VC-CC activation (and associated deactivation) within a VC end-to-end non-intrusive monitoring point can not be controlled using AD OAM flow.

End-to-end VC-FPM:

– Transfer function: This process monitors the incoming cell flow and monitors end-to-end VC-FPM cells and forwards them to the Layer Management function.

– Layer Management function: If enabled by TMN (MI_FPMActive or by MI_PMActive), the process shall monitor the performance derived from the comparison between received block of user cells and information in a monitored end-to-end VC-FPM cell, according to the Performance Monitoring section below. End-to-end VC-FPM activation (and associated deactivation) within a VC end-to-end non-intrusive monitoring point can not be controlled using AD OAM flow.

End-to-end VC-BR:

– Transfer function: This process monitors end-to-end VC-BR cells and forwards them to the Layer Management function.

– Layer Management function: If enabled by TMN (MI_PMActive), the process shall report the end-to-end VC-BR cells according to the Performance Monitoring section below. End-to-end VC-BR activation (and associated deactivation) within a VC end-to-end non-intrusive monitoring point can not be controlled using AD OAM flow.

End-to-end VC-AIS:

– Transfer function: This process monitors end-to-end VC-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VC-AIS provides information as to the status of the VC connection, as well as to the defect type and defect location. The defect detection of the segment VC-AIS cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_AISdata. Refer to 9.2.2.1.1.1 and 10.2.1/I.610.

Defects

If enabled by the end-to-end VC-CC activation process (MI_CCActive=true), the function shall declare dLOC if no user cell or end-to-end VC-CC cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.2.1.2/I.610. dLOC shall be cleared when any user cell or end-to-end VC-CC cell is received. If disabled by the end-to-end VC-CC activation process (MI_CCActive = false), dLOC shall be cleared.

The function shall declare dRDI as soon as an end-to-end VC-RDI cell is received. The dRDI shall be cleared when no end-to-end VC-RDI is received during a nominally 2.5 s period, with a margin of ± 0.5 s. Refer to 9.2.2.1.1.2/I.610.

The function shall declare dAIS as soon as an end-to-end VC-AIS cell is received. The dAIS shall be cleared when a VC user cell or an end-to-end VC CC cell is received; if end-to-end VC CC is not activated, dAIS is cleared also if end-to-end VC-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between monitored block of user cells and information in a monitored end-to-end VC-FPM cell. The result is reported to the AEMF via MI_FPMdata. The definition of user cells is given in Table 1/I.610.

If activated by the FPM&BR activation process (MI_PMActive), the end-to-end VC-BR cell is monitored. The information is reported to the AEMF via MI_BRPMdata.

NOTE – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Misinsertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the AEMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dLOC or dAIS

The consequent action aTSF is conveyed through the VC_AI_TSF.

Defect Correlations

cRDI ← dRDI and (not dAIS) and (not CI_SSF) and RDIreported

cAIS ← dAIS and (not CI_SSF) and AISreported

cLOC ← dLOC and (not CI_SSF) and (not dAIS) and LOCreported

It shall be an option to report AIS as a fault cause. This is controlled by means of the parameter AISreported. The default shall be AISreported = false.

It shall be an option to report RDI as a fault cause. This is controlled by means of the parameter RDIreported. The default shall be RDIreported = false.

It shall be an option to report LOC as a fault cause. This is controlled by means of the parameter LOCreported. The default shall be LOCreported = false.

D.5.3.2 ATM Virtual Channel Segment Non-intrusive Monitoring function VCSM_TT_Sk

Symbol

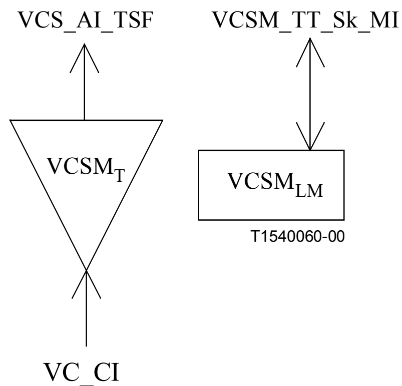


Figure D.129/I.732 – VCSM_TT_Sk symbol

Interfaces

Table D.36/I.732 – VCSM_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VCSM_TT_Sk_MI_SLOCreported VCSM_TT_Sk_MI_SRDIreported VCSM_TT_Sk_MI_SAISreported VCSM_TT_Sk_MI_SAISuse VCSM_TT_Sk_MI_CCActive VCSM_TT_Sk_MI_FPMActive VCSM_TT_Sk_MI_PMActive	VCS_AI_TSF VCSM_TT_Sk_MI_cSLOC VCSM_TT_Sk_MI_cSRDI VCSM_TT_Sk_MI_cSAIS VCS_TT_Sk_MI_SRDIdata VCS_TT_Sk_MI_SAISdata VCS_TT_Sk_MI_AISdata VCS_TT_Sk_MI_FPMdata VCS_TT_Sk_MI_BRPMdata

Processes

This function performs VC segment AIS, RDI, CC, FPM, BR cell monitoring and processing.

For interworking with equipment compliant to the 1995 version of ITU-T I.610 and for network operators that prefer to operate without the use of segment AIS, the function monitors also for end-to-end VC-AIS cells in conjunction with segment VC-CC cells.

Segment VC-RDI:

– Transfer function: This process monitors segment VC-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The segment VC-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the segment VC-RDI cells shall be according to the Defects section below. The information monitored from the defect type and defect location field is reported to the AEMF via MI_SRDIdata. Refer to 9.2.1.1.1.2 and 10.2.1/I.610.

Segment VC-AIS:

– Transfer function: This process monitors segment VC-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The segment VC-AIS provides information as to the status of the VC segment up to this non-intrusive monitoring point, as well as to the defect type and defect location. The defect detection of the segment VC-AIS cells shall be according to the Defects section below. If enabled (MI_SAISuse = true), the information monitored from the defect type and defect location field is reported to the AEMF via MI_SAISdata.

End-to-end VC-AIS:

– Transfer function: This process monitors end-to-end VC-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VC-AIS provides information as to the status of the VC connection up to this non-intrusive monitoring point, as well as to the defect type and defect location. The defect detection of the end-to-end VC-AIS cells shall be according to the Defects section below. The information monitored from the defect type and defect location field is reported to the AEMF via MI_AISdata.

Segment VC-Continuity Check:

– Transfer function: This process monitors segment VC-CC cells and forwards them to the Layer Management function.

– Layer Management function: VC segment CC activation (and associated deactivation) can be initiated only by the TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. VC segment CC activation (and associated deactivation) within a VC segment non-intrusive monitoring point cannot be controlled using AD OAM flow.

  If enabled by the VC segment CC activation process (MI_CCActive), the process shall process the segment VC-CC cells according to the Defects section below.

  NOTE 1 – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the segment VC-CC OAM cell as an ATM address field.

Segment VC-FPM:

– Transfer function: This process monitors the incoming cell flow and segment VC-FPM cells and forwards them to the Layer Management function.

– Layer Management function: VC segment FPM or FPM&BR activation (and associated deactivation) can be initiated only by the TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive or MI_PMActive. VC segment FPM activation (and associated deactivation) within a VC segment non-intrusive monitoring point can not be controlled using AD OAM flow.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the process shall report the segment VC-FPM cell according to the Performance Monitoring section below.

Segment VC-BR:

– Transfer function: This process monitors segment VC-BR cells and forwards them to the Layer Management function.

  Layer Management function: VC segment FPM&BR activation (and associated deactivation) can be initiated only by the TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. VC segment FPM&BR activation (and associated deactivation) within a VC segment non-intrusive monitoring point can not be controlled using AD OAM flow.

  If enabled by the FPM&BR activation process (MI_PMActive), the process shall report the segment VC-BR cells according to the Performance Monitoring section below.

Defects

If enabled by the VC segment CC activation process (MI_CCActive = true), the function shall declare dSLOC if no VC user cell or segment VC-CC cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dSLOC shall be cleared when any VC user cell or segment VC-CC cell is received. If disabled by the VC segment CC activation process (MI_CCActive = false), dSLOC shall be cleared.

If enabled (MI_SAISuse = true), the function shall declare dSAIS as soon as a segment VC-AIS cell is received. The dSAIS shall be cleared when a VC user cell or a segment VC-CC cell is received; if VC segment CC is not activated, dSAIS is cleared also if segment VC-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s. If disabled (MI_SAISuse = false), dSAIS shall be cleared.

For interworking with equipment that do not generate segment VC-AIS cells or when a network operator prefers not to use segment VC-AIS cells, the function shall declare dAIS as soon as a VC end to end AIS cell is received. The dAIS shall be cleared when a VC user cell or a segment VC-CC cell is received; if VC segment CC is not activated, dAIS defect is cleared also if end to end VC-AIS cells are absent for 2.5 ± 0.5 s.

The function shall declare dSRDI as soon as a segment VC-RDI cell is received. The dSRDI shall be cleared when no segment VC-RDI cell is received within a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between received block of user cells and information in a monitored segment VC-FPM cell. The result is reported to the AEMF via MI_FPMdata. The definition of user cells is given in Table 1/I.610.

If activated by the FPM&BR activation process (MI_PMActive), the segment VC-BR cell is monitored. The information is reported to the AEMF via MI_BRPMdata.

NOTE 2 – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Mis-insertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the EMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dSLOC or dSAIS

The consequent action aTSF is conveyed through the VCS_AI_TSF.

Defect Correlations

cSAIS ← [dSAIS or (dSLOC and dAIS)] and (not CI_SSF) and SAISreported

cSRDI ← dSRDI and (not dSAIS) and (not CI_SSF) and SRDIreported

cSLOC ← dSLOC and (not dSAIS) and (not dAIS) and (not CI_SSF) and SLOCreported

It shall be an option to report segment AIS as a fault cause. This is controlled by means of the parameter SAISreported. The default shall be SAISreported = false.

It shall be an option to report segment RDI as a fault cause. This is controlled by means of the parameter SRDIreported. The default shall be SRDIreported = false.

It shall be an option to report segment LOC as a fault cause. This is controlled by means of the parameter SLOCreported. The default shall be SLOCreported = false.

D.5.4 ATM Virtual Channel Segment Functions

D.5.4.1 ATM Virtual Channel Segment Trail Termination Source function VCS_TT_So

Symbol

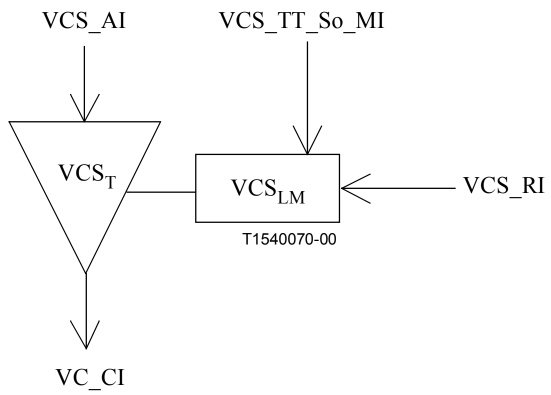


Figure D.130/I.732 – VCS_TT_So symbol

Interfaces

Table D.37/I.732 – VCS_TT_So input and output signals

Input(s)	Output(s)
VCS_AI_D VCS_AI_ACS VCS_RI_BRPMdata VCS_RI_RDI VCS_TT_So_MI_CCOption VCS_TT_So_MI_DTDLuseEnabled VCS_TT_So_MI_CCActive VCS_TT_So_MI_FPMActive VCS_TT_So_MI_PMActive VCS_TT_So_MI_TSTPuseEnabled	VC_CI_D VC_CI_ACS

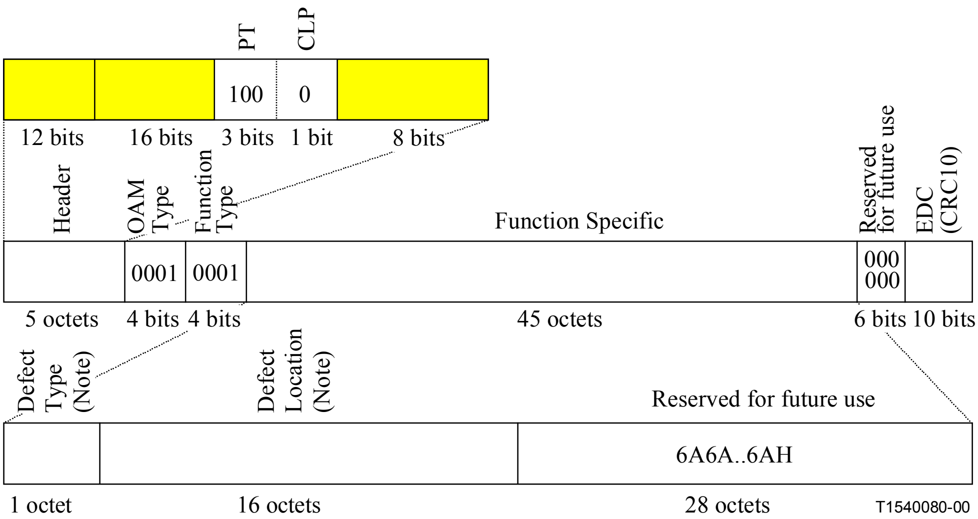
Processes

This function performs VC segment RDI, CC, FPM and BR cell generation as well as activation/deactivation of FPM, FPM&BR and CC on the VC segment level.

Segment VC-RDI:

– Transfer function: This process inserts segment VC-RDI cells from the Layer Management function.

– Layer Management function: Segment VC-RDI cells (Figure D.131) shall be generated according to the Consequent Actions section of the Coordination Function below.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.131/I.732 – Segment VC-RDI OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, Defect Type, Defect Location, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Segment VC-Continuity Check:

– Transfer function: This process inserts segment VC-CC cells from the Layer Management function.

– Layer Management function: segment VC-CC activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the segment VC-CC activation process (MI_CCActive), this process monitors the VC user cell stream activity at the input (VCS_AI) and generates segment VC-CC (Figure 132). There are two options defined in ITU-T I.610 for segment CC. For the case option 1 is implemented or activated (MI_CCOption = 1), a segment VC-CC cell shall be inserted if no user cell has been transmitted for a period of nominally 1 second. For the case option 2 is implemented or activated (MI_CCOption = 2), a segment VC-CC cell shall be inserted with a periodicity of 1 cell/s independently of the VC user cell flow. The procedure of segment VC-CC is described in 9.2.1.1.2/I.610.

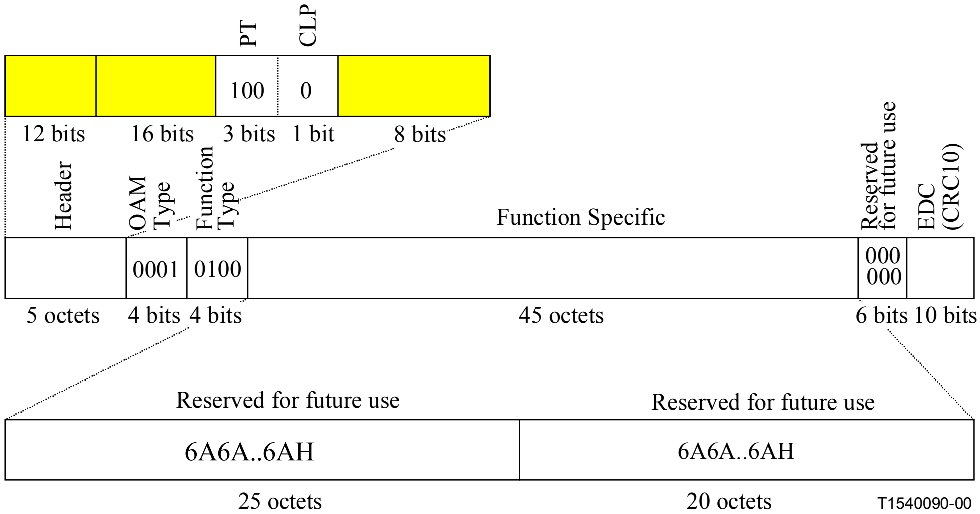


Figure D.132/I.732 – Segment VC-CC OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

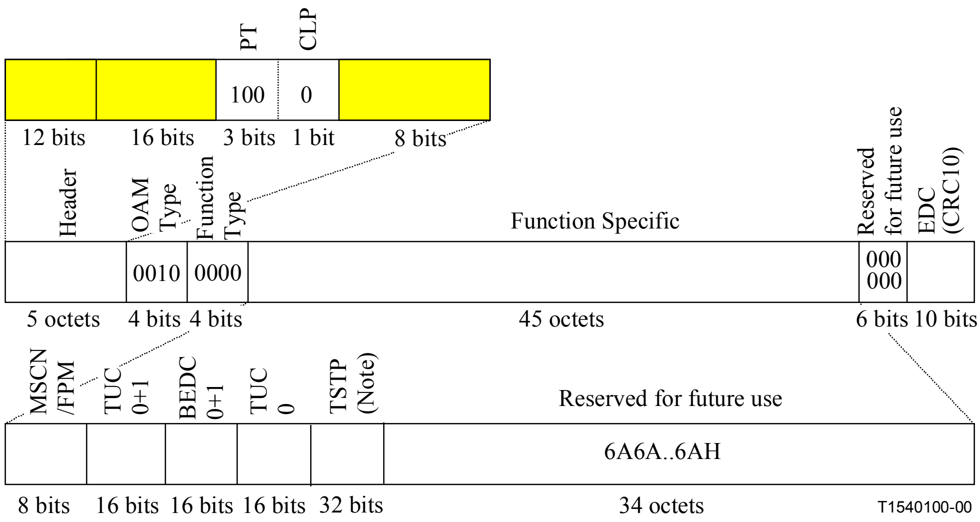
NOTE – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the segment VC-CC OAM cell as an ATM address field.

Segment VC-FPM:

– Transfer function: This process monitors the incoming cell flow and inserts segment VC-FPM cells from the Layer Management function.

– Layer Management function: VC segment FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive for the segment FPM process or MI_PMActive for the segment FPM&BR process. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), segment VC-FPM cells (Figure D.133) shall be generated. Refer to 10.3/I.610.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.133/I.732 – Segment VC-FPM OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The value of the MSCN/FPM, TUC_{0+1}, $BEDC_{0+1}$ and TUC_0 shall be written with the information as specified in 10.3.1/I.610, which is functionally represented in Figure D.134.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

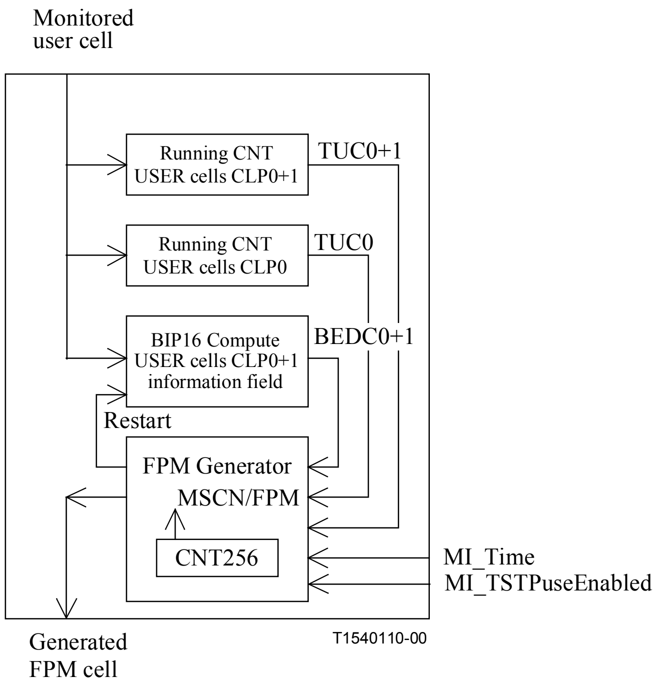


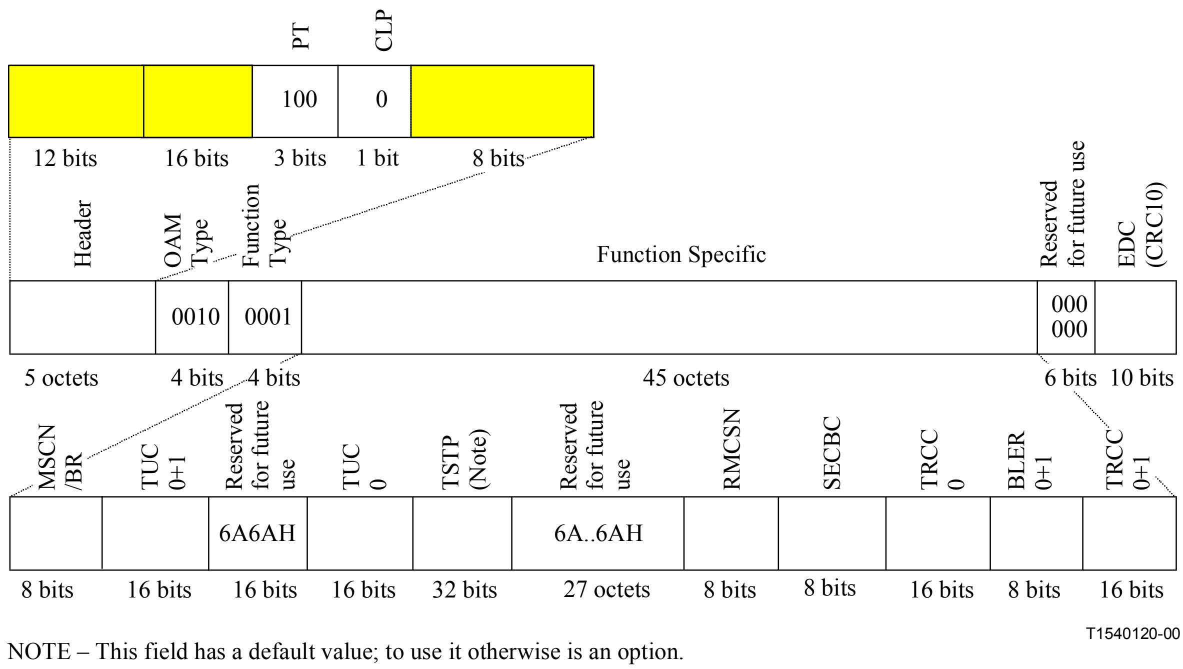
Figure D.134/I.732 – VC segment FPM generation process

Segment VC-BR:

– Transfer function: This process inserts segment VC-BR cells from the Layer Management function.

– Layer Management function: VC segment FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

If enabled by the FPM&BR activation process (MI_PMActive), the segment VC-BR cells (Figure D.135) shall be generated using the PM data from RI_BRPMdata being collected by the VCS_TT_Sk. Refer to 10.3/I.610.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.135/I.732 – Segment VC-BR OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, MSCN/BR and Reserved fields shall be as specified in ITU-T I.610 and I.361.

The TUC_{0+1}, TUC_0, RMCSN, SECBS, $TRCC_0$, $BLER_{0+1}$ and $TRCC_{0+1}$ fields shall be written with the information received from the VCS_TT_Sk via RI_BRPMdata.

If either the function does not support the Time Stamp (TSTP) option or the function supports the TSTP option and the MI_TSTPuseEnabled is false, the TSTP field shall be set to all-ONEs. If the function supports the TSTP option and if the MI_TSTPuseEnabled is true, the TSTP field shall be written with the content of the MI_Time.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

Segment VC-AD:

– Transfer function: This process inserts segment VC-AD-FPM/BR, segment VC-AD-CC and segment VC-AD-FPM cells from the Layer Management function.

– Layer Management function: For further study.

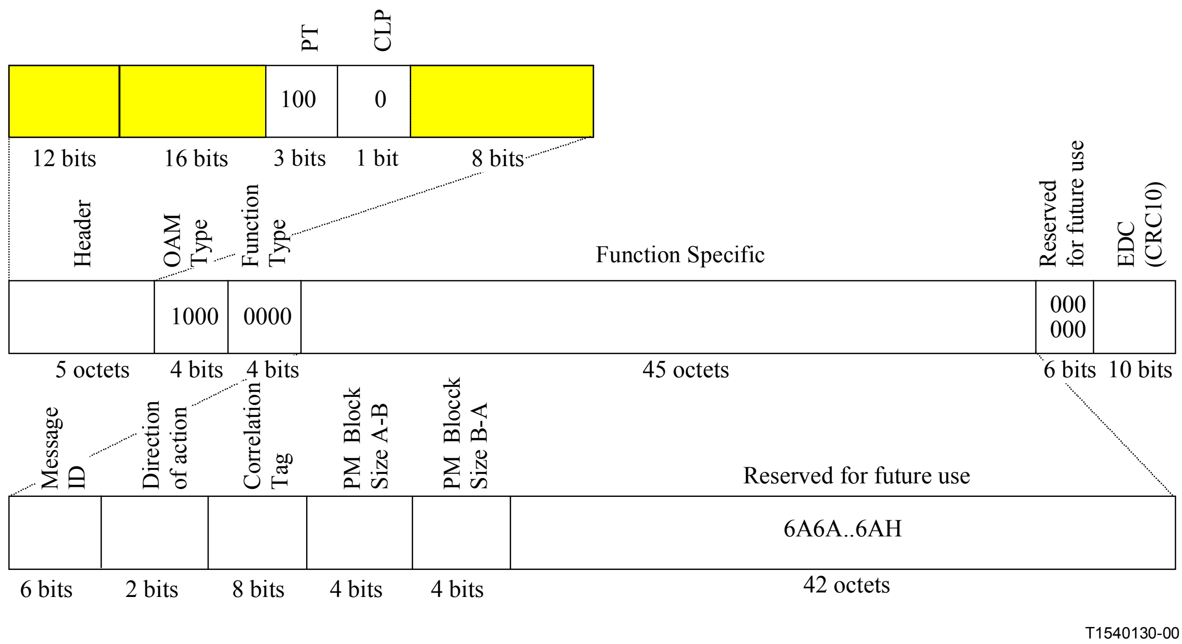


Figure D.136/I.732 – Segment VC-AD-FPM/BR OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, Message ID, Direction of action, Correlation Tag, PM Block Size A-B, PM Block Size B-A, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

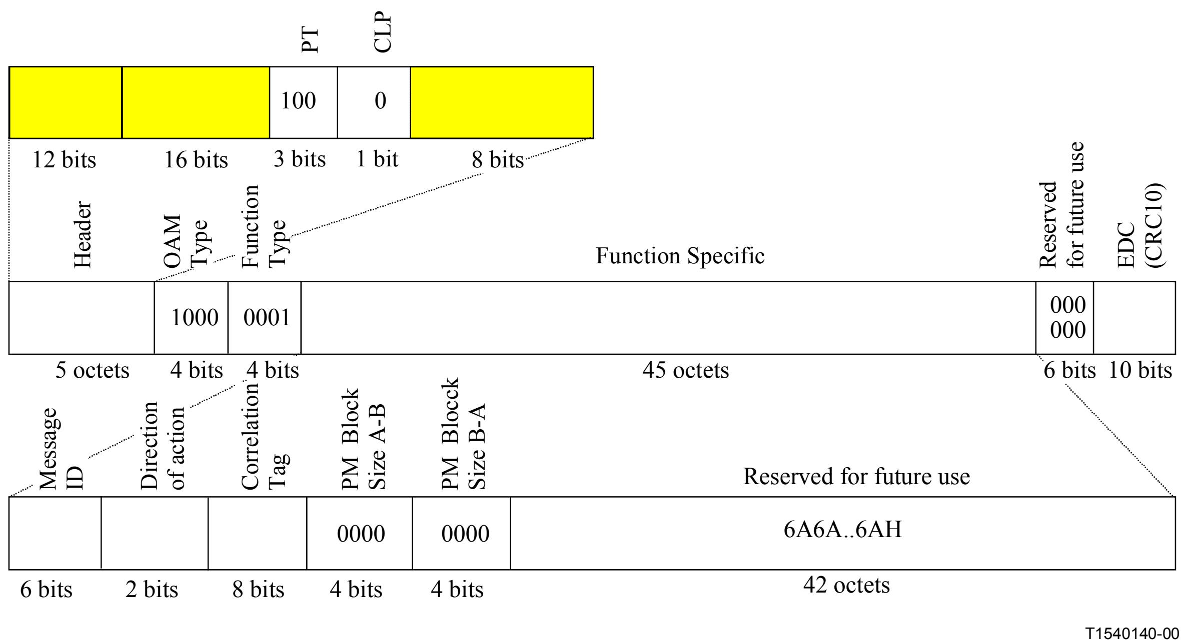


Figure D.137/I.732 – Segment VC-AD-CC OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, Message ID, Direction of action, Correlation Tag, PM Block Size A-B, PM Block Size B-A, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

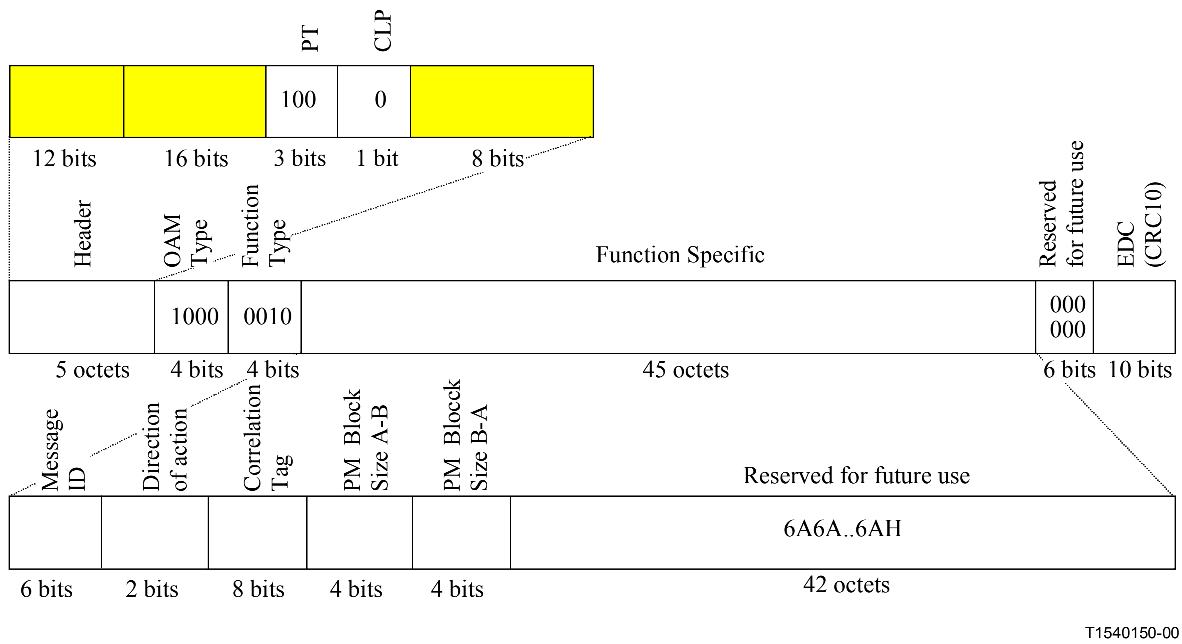


Figure D.138/I.732 – Segment VC-AD-FPM OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, Message ID, Direction of action, Correlation Tag, PM Block Size A-B, PM Block Size B-A, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

On reception of RI_RDI, the function shall output segment VC-RDI cells (Figure D.131) according to 9.2.1.1.1.2/I.610; on clearing of RI_RDI, the generation of segment VC-RDI cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option or the function supports the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the segment VC-RDI cell shall be coded as 6Ahex. If the function supports DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location fields of the segment VC-RDI cell shall contain the value provided by the VCS_TT_Sk via RI_RDI. The insertion of RDI cells should not interrupt any cell flows present on the connection.

Defect Correlations

None.

D.5.4.2 ATM Virtual Channel Segment Trail Termination Sink function VCS_TT_Sk

Symbol

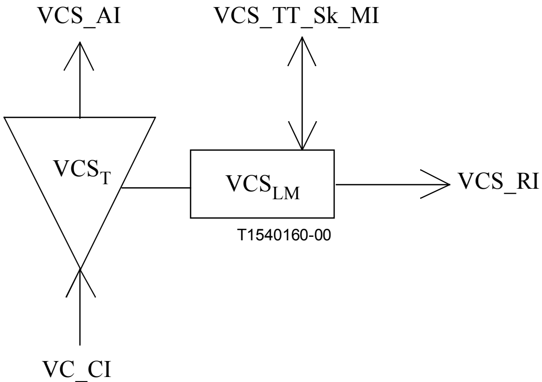


Figure D.139/I.732 – VCS_TT_Sk symbol

Interfaces

Table D.38/I.732 – VCS_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VCS_TT_Sk_MI_SRDIreported VCS_TT_Sk_MI_SAISreported VCS_TT_Sk_MI_SAISuse VCS_TT_Sk_MI_SLOCreported VCS_TT_Sk_MI_CCActive VCS_TT_Sk_MI_FPMActive VCS_TT_Sk_MI_PMActive	VCS_AI_D VCS_AI_ACS VCS_AI_TSF VCS_AI_AIS VCS_RI_BRPMdata VCS_RI_RDI VCS_TT_Sk_MI_cSLOC VCS_TT_Sk_MI_cSRDI VCS_TT_Sk_MI_cSAIS VCS_TT_Sk_MI_SRDIdata VCS_TT_Sk_MI_SAISdata VCS_TT_Sk_MI_AISdata VCS_TT_Sk_MI_FPMdata VCS_TT_Sk_MI_BRPMdata

Processes

This function performs VC segment RDI, Continuity Check, FPM, BR and AIS cell extraction, end-to-end VC-AIS monitoring (in conjunction with segment VC-CC cells) and processing as well as activation/deactivation of FPM, FPM&BR and CC on the VC segment level.

For interworking with equipment compliant to the 1995 version of ITU-T I.610 and for network operators that prefer to operate without the use of segment AIS, the function monitors also for end-to-end VC-AIS cells.

Segment VC-RDI:

– Transfer function: This process extracts segment VC-RDI cells and forwards them to the Layer Management function.

– Layer Management function: The segment VC-RDI cell provides information as to the status of the remote receiver, as well as to the defect type and defect location. The defect detection of the segment VC-RDI cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_SRDIdata. Refer to 9.2.1.1.1.2 and 10.2.1/I.610.

Segment VC Continuity Check:

– Transfer function: This process extracts segment VC-CC cells and forwards them to the Layer Management function.

– Layer Management function: VC segment CC activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_CCActive. The corresponding Management Information for AD OAM flow activation/deactivation is ffs.

  If enabled by the VC segment CC activation process (MI_CCActive), the process shall report the segment VC-CC cells according to the Defects section below.

  NOTE 1 – Appendix V/I.610 gives informative material on a possible use of the first 25 octets within the function specific part of the segment VC-CC OAM cell as an ATM address field.

Segment VC-FPM:

– Transfer function: This process monitors the incoming cell flow and extracts segment VC-FPM cells and forwards them to the Layer Management function.

– Layer Management function: VC segment FPM or FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_FPMActive or MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM activation process (MI_FPMActive) or by the FPM&BR activation process (MI_PMActive), the process shall monitor the performance derived from the comparison between received block of user cells and information in a received segment VC-FPM cell, according to the Performance Monitoring section of the Coordination Function below.

Segment VC-BR:

– Transfer function: This process extracts segment VC-BR cells and forwards them to the Layer Management function.

– Layer Management function: VC segment FPM&BR activation (and associated deactivation) can be initiated either by the TMN/end user by one end-point with associated OAM flow or entirely via TMN. The corresponding Management Information for direct TMN activation/deactivation is MI_PMActive. The corresponding Management Information for AD OAM flows activation/deactivation is ffs.

  If enabled by the FPM&BR activation process (MI_PMActive), the process shall process the segment VC-BR cells according to the Performance Monitoring section of the Coordination Function below.

Segment VC-AIS:

– Transfer function: This process extracts segment VC-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The segment VC-AIS provides information as to the status of the VC segment, as well as to the defect type and defect location. The defect detection of the segment VC-AIS cells shall be according to the Defects section below. If enabled (MI_SAISuse = true), the information extracted from the defect type and defect location field is reported to the AEMF via MI_SAISdata and to the paired VCS_TT_So according to the Consequent Actions section of the Coordination Function below.

End-to-end VC-AIS:

– Transfer function: This process monitors end-to-end VC-AIS cells and forwards them to the Layer Management function.

– Layer Management function: The end-to-end VC-AIS provides information as to the status of the VC connection up to this VC segment end-point, as well as to the defect type and defect location. The defect detection of the end-to-end VC-AIS cells shall be according to the Defects section below. The information extracted from the defect type and defect location field is reported to the AEMF via MI_SAISdata.

Segment VC-AD:

– Transfer function: This process extracts segment VC-AD-FPM/BR, segment VC-AD-CC and segment VC-AD-FPM cells and forwards them to the Layer Management function.

– Layer Management function: For further study.

Defects

If enabled by the VC segment CC activation process (MI_CCActive = true), the function shall declare dSLOC if no VC user cell or segment VC-CC cell is received within a time interval of 3.5 s, with a margin of ± 0.5 s (sliding window). Refer to 9.2.1.1.2/I.610. dSLOC shall be cleared when any VC user cell or segment VC-CC cell is received. If disabled by the VC segment CC activation process (MI_CCActive = false), dSLOC shall be cleared.

If enabled (MI_SAISuse = true), the function shall declare dSAIS as soon as a segment VC-AIS cell is received. The dSAIS shall be cleared when a VC user cell or a segment VC-CC cell is received; if VC segment CC is not activated, dSAIS is cleared also if segment VC-AIS cells are absent for a time interval of 2.5 s, with a margin of ± 0.5 s. If disabled (MI_SAISuse = false), dSAIS shall be cleared.

For interworking with equipment that do not generate segment VC-AIS cells or when a network operator prefers not to use segment VC-AIS cells, the function shall declare dAIS as soon as a VC end-to-end AIS cell is received. The dAIS shall be cleared when a VC user cell or a segment VC-CC cell is received; if VC segment CC is not activated, dAIS defect is cleared also if end-to-end VC-AIS cells are absent for 2.5 ± 0.5 s.

The function shall declare dSRDI as soon as a segment VC-RDI cell is received. The dSRDI shall be cleared when no segment VC-RDI cell is received within a time interval of 2.5 s, with a margin of ± 0.5 s.

Performance Monitoring

If activated by the FPM activation process (MI_FPMActive) of by the FPM&BR activation process (MI_PMActive), the function shall monitor the performance derived from the comparison between received block of user cells and information in a received segment VC-FPM cell. The definition of user cells is given in Table 1/I.610.

If activated by the FPM activation process (MI_FPMActive), the result is reported to the AEMF via MI_FPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the result is backward reported via RI_BRPMdata.

If activated by the FPM&BR activation process (MI_PMActive), the received segment VC-BR cell on the near end contains the performance information regarding the unidirectional connection, set up from the near end to the far end. This information is reported to the AEMF via MI_BRPMdata.

NOTE 2 – Supported parameters (e.g. Near/Far End Defect Seconds (pN_DS, pF_DS), Cell Loss Ratio, Cell Error Ratio, Cell Misinsertion Rate) as well as the process need to be added. PM will detect errored blocks and total received user cell counts. Performances or backward report results of the received PM cell are reported to the EMF.

Coordination Functions

Consequent Actions

aTSF ← CI_SSF or dSLOC or dSAIS

aSRDI ← CI_SSF or dSLOC or dSAIS

The consequent action aSRDI is conveyed through RI_RDI to the VCS_TT_So together with the defect type and defect location (if implemented). In case of dSAIS, defect type and location through RI_RDI are as in the received segment VC-AIS cell. In case of CI_SSF and dSLOC, defect type and location are in respect to the equipment this function is built into.

NOTE 3 – As long as the coding scheme of Defect Type and Defect Location fields is not defined, they shall be encoded as 6Ahex.

The consequent action aTSF is conveyed by AI_TSF through the VCS_AI.

aAIS ← dSLOC and not dSAIS and not dAIS

NOTE 4 – VC-AIS insertion is performed in the VCS/VC_A_Sk function under control of AI_AIS.

Defect Correlations

cSAIS ← [dSAIS or (dSLOC and dAIS)] and (not CI_SSF) and SAISreported

cSRDI ← dSRDI and (not dSAIS) and (not CI_SSF) and SRDIreported

cSLOC ← dSLOC and (not dSAIS) and (not dAIS) and (not CI_SSF) and SLOCreported

It shall be an option to report segment AIS as a fault cause. This is controlled by means of the parameter SAISreported. The default shall be SAISreported = false.

It shall be an option to report segment RDI as a fault cause. This is controlled by means of the parameter SRDIreported. The default shall be SRDIreported = false.

It shall be an option to report segment LOC as a fault cause. This is controlled by means of the parameter SLOCreported. The default shall be SLOCreported = false.

D.5.4.3 ATM Virtual Channel Segment to ATM Virtual Channel Adaptation Source function VCS/VC_A_So

Symbol

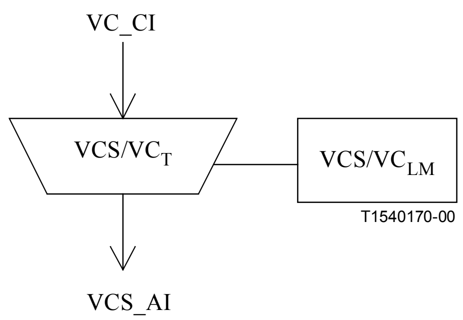


Figure D.140/I.732 – VCS/VC_A_So symbol

Interfaces

Table D.39/I.732 – VCS/VC_A_So input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS	VCS_AI_D VCS_AI_ACS

Processes

This function performs VC segment OAM cell discarding.

VC segment OAM cell discarding:

– Transfer function: This process discards any incoming VC segment OAM cell.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.5.4.4 ATM Virtual Channel Segment to ATM Virtual Channel Adaptation Sink function VCS/VC_A_Sk

Symbol

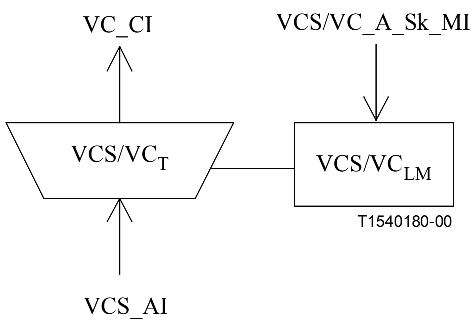


Figure D.141/I.732 – VCS/VC_A_Sk symbol

Interfaces

Table D.40/I.732 – VCS/VC_A_Sk input and output signals

Input(s)	Output(s)
VCS_AI_D VCS_AI_ACS VCS_AI_TSF VCS_AI_AIS VCS/VC_A_Sk_MI_DTDLuseEnabled	VC_CI_D VC_CI_ACS VC_CI_SSF

Processes

This function performs VC segment OAM cell discarding.

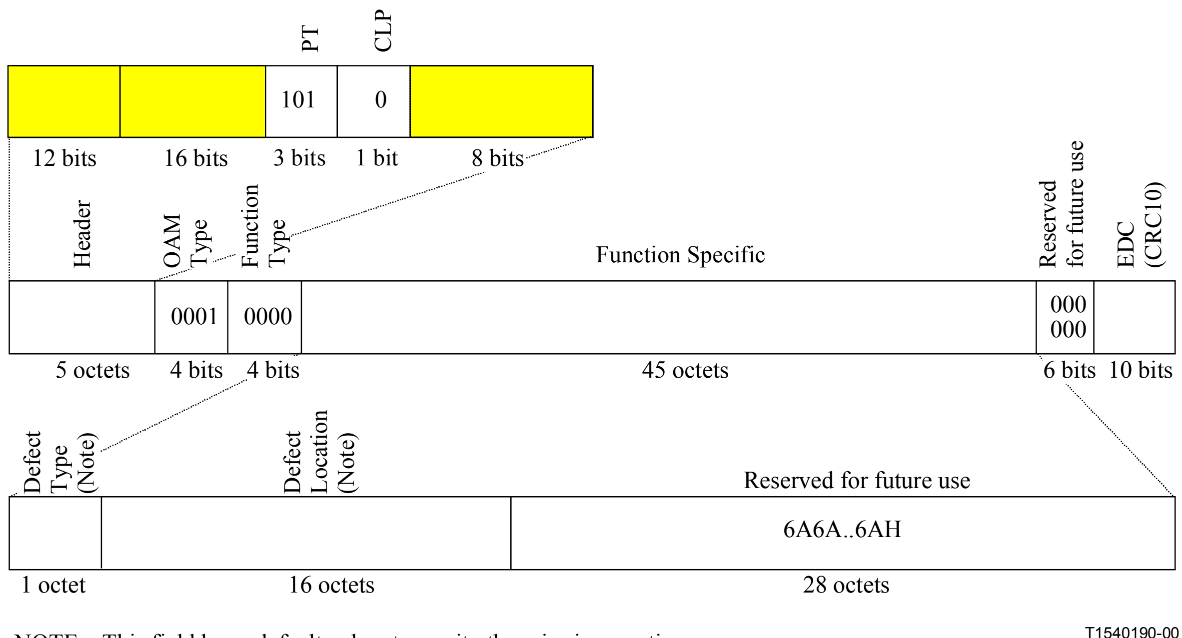
VC segment OAM cell discarding:

– Transfer function: This process discards any incoming VC segment OAM cell.

End-to-end VC-AIS:

– Transfer function: This process inserts end-to-end VC-AIS cells from the Layer Management function.

– Layer Management function: End-to-end VC-AIS cells (Figure D.142) shall be generated according to the Consequent Actions section of the Coordination Function below.



NOTE – This field has a default value; to use it otherwise is an option.

Figure D.142/I.732 – End-to-end VC-AIS OAM cell as part of the VC_CI

The value of the PT, CLP, OAM Type, Function Type, Defect Type, Defect Location, EDC and Reserved fields shall be as specified in ITU-T I.610 and I.361.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

aSSF ← AI_TSF

aAIS ← AI_AIS

On declaration of aAIS, the function shall output end-to-end VC-AIS cells (Figure D.142), according to 9.2.2.1.1.1/I.610. On clearing of aAIS, the generation of VC-AIS cells shall be stopped. If either the function does not support the Defect Type and Defect Location (DTDL) option or the function support the DTDL option and the MI_DTDLuseEnabled is false, the binary contents of the Defect Type and Defect Location fields of the end-to-end VC-AIS cell shall be coded as 6Ahex. If the function supports the DTDL option and if the MI_DTDLuseEnabled is true, the Defect Type and Defect Location values shall be inserted in the information field of the end-to-end VC-AIS cell.

NOTE – As long as the coding scheme of Defect Type and Defect Location fields is not defined, they shall be encoded as 6Ahex.

The consequent action aSSF is conveyed by CI_SSF through the VC_CI.

Defect Correlations

None.

D.5.5 ATM Virtual Channel Traffic Management Functions

NOTE – The ATM Virtual Channel Traffic Management Functions are, if activated, always present as a set. If active, the VC_AI output of the VCTM_TT_Sk is always connected to the VC_AI input of the VCTM_TT_So as shown in Figure D.143 below. This model allows the insertion of additional traffic management functions by not inserting an additional sub-layer in the network architecture view.

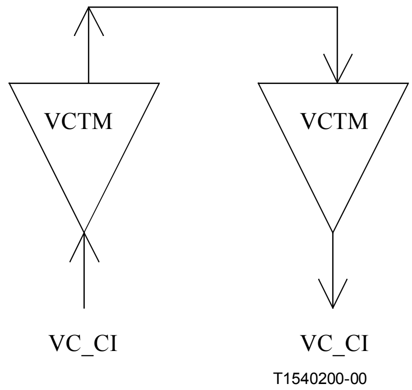


Figure D.143/I.732 – Model of active VCTM Traffic Management functions

D.5.5.1 ATM Virtual Channel Traffic Management Trail Termination Source function VCTM_TT_So

Symbol

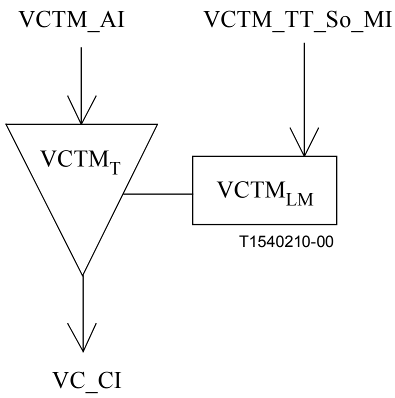


Figure D.144/I.732 – VCTM_TT_So symbol

Interfaces

Table D.41/I.732 – VCTM_TT_So input and output signals

Input(s)	Output(s)
VCTM_AI_D VCTM_AI_ACS VCTM_AI_TSF VCTM_AI_CNGI	VC_CI_D VC_CI_ACS VC_CI_SSF

Processes

This function performs EFCI setting and RM cells insertion.

EFCI setting:

– Transfer function: This process is optional. It applies in ingress direction only. It inserts the EFCI field under control of the Layer Management function.

– Layer Management function: The insertion of EFCI is driven by the input VCTM_AI_CNGI from the VP/VC_A_Sk. The EFCI setting is done in the PTI field of the cell header on all cells of the CI. For the coding, refer to ITU-T I.361. The PTI field shall not be changed if the NE is not congested.

RM cells insertion: This process is for further study.

Defect

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

aSSF ← AI_TSF

On reception of AI_CNGI, any congested NE, 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. For the use of EFCI, refer to ITU-T I.371. This function is optional.

The consequent action aSSF is conveyed by CI_SSF through the VC_CI.

Defect Correlations

None.

D.5.5.2 ATM Virtual Channel Traffic Management Trail Termination Sink function (VCTM_TT_Sk)

Symbol

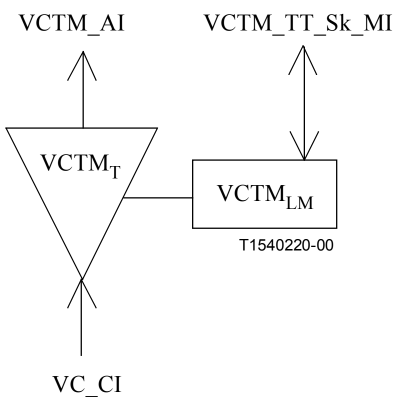


Figure D.145/I.732 – VCTM_TT_Sk symbol

Interfaces

Table D.42/I.732 – VCTM_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VC_CI_CNGI VCTM_TT_Sk_MI_VCusgActive VCTM_TT_Sk_MI_ShapingActive VCTM_TT_Sk_MI_UPC/NPCActive	VCTM_AI_D VCTM_AI_ACS VCTM_AI_TSF VCTM_AI_CNGI

Processes

This function performs the VC usage measurement, UPC/NPC, VC traffic shaping and RM cells extraction per VCC.

VC usage measurement:

– Transfer function: This process is optional. Cell reception is indicated to layer management.

– Layer Management function: The process shall count the transmitted cells for cell measurement purposes. If enabled by VCusgActive, this process shall count the incoming cells on a VCC basis.

UPC/NPC:

– Transfer function: This process is optional and can only be present at the ingress direction of the Network Element. VCC cells may be passed, discarded or tagged (if used), depending on indication from layer management.

– Layer Management function: If implemented, the UPC/NPC process can be activated/deactivated per VCC by UPC/NPCActive. If activated, it shall detect violations of negotiated traffic parameters for purpose of protecting the QoS of other VCCs. The use of UPC may be required, whereas the use of NPC is optional. Actions and requirements of UPC/NPC are described in ITU-T I.371.

NOTE 1 – The use of UPC in ATM equipment on the user side of S_B and T_B reference point of optional.

VC traffic shaping:

– Transfer function: This process is optional. If activated, it shall perform traffic shaping according to ITU-T I.371.

– Layer Management function: If implemented, the shaping process can be activated/deactivated per VCC by ShapingActive.

NOTE 2 – The VC traffic shaping process should not be simultaneously activated on both ingress and egress directions of the same VCC.

RM cells extraction: This process is for further study.

Defects

None.

Performance Monitoring

The Performance Monitoring parameters are for further study. The parameters for the following functions need to be defined:

- VC usage measurement: Count for CLP = 0+1; Count for CLP = 0 Separate counters for ingress and egress direction shall be maintained.
- UPC/NPC (tagged cell count): Count for CLP = 0+1; Count for CLP = 0

Coordination Functions

Consequent Actions

aCNGI ← CI_CNGI

aTSF ← CI_SSF

The consequent action aTSF is conveyed by AI_TSF through the VCT_AI.

The consequent action aCNGI is conveyed by AI_CNGI through the VCT_AI.

Defect Correlations

None.

D.5.6 ATM Virtual Channel Loopback Functions

D.5.6.1 ATM virtual channel loopback trail termination source function VCLB_TT_So

Symbol

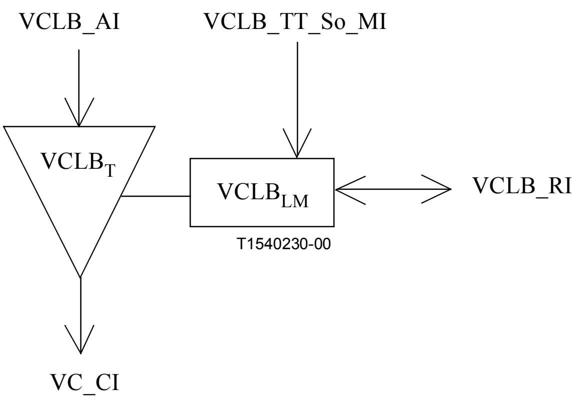


Figure D.146/I.732 – VCLB_TT_So symbol

Interfaces

Table D.43/I.732 – VCLB_TT_So input and output signals

Input(s)	Output(s)
VCLB_AI_D VCLB_AI_ACS VCLB_RI_LBresponse VCLB_TT_So_MI_LBeteRequest VCLB_TT_So_MI_LBsegRequest VCLB_TT_So_MI_LBlocID VCLB_TT_So_MI_LOCALlocID VCLB_TT_So_MI_SIDuseEnabled	VC_CI_D VC_CI_ACS VCLB_RI_LBeteTimer VCLB_RI_LBsegTimer VCLB_RI_LBeteCorrTag VCLB_RI_LBsegCorrTag

Processes

This function can operate as a loopback source point source and as a loopback point source at VC connection points, VC termination connection points (I.610: connection end points) and VC segment termination connection points (I.610: segment end points). It adds F5 loopback OAM cells to the passing through signal.

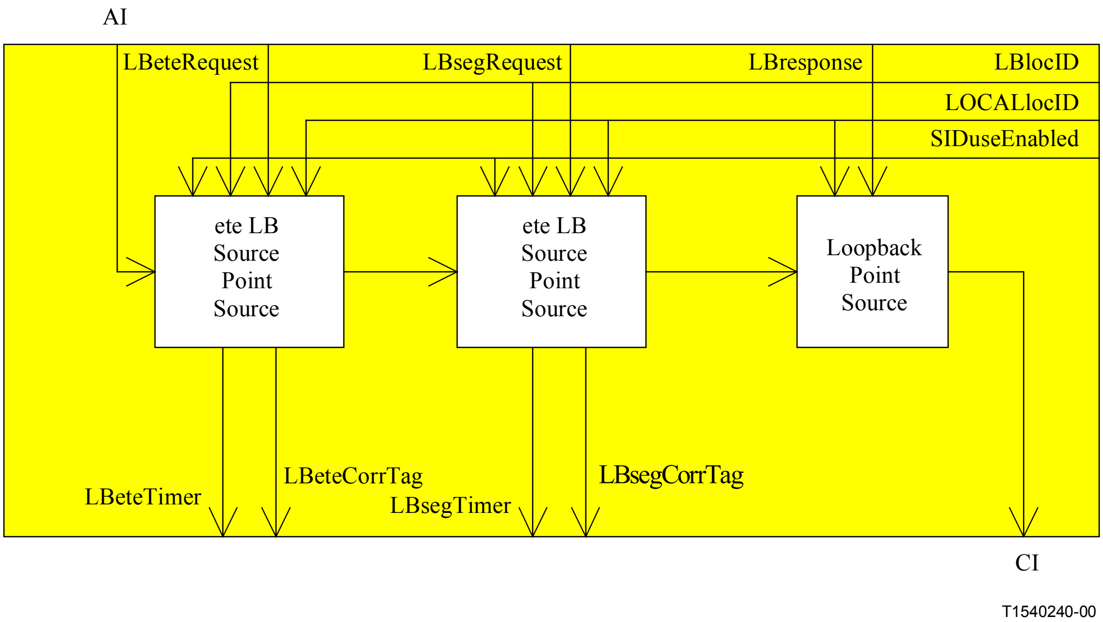


Figure D.147/I.732 – VCLB_TT_So process block diagram

Loopback process types:

The function shall be able to operate as:

1) end-to-end loopback source point source (for end-to-end loopback cells);

2) segment loopback source point source (for segment loopback cells);

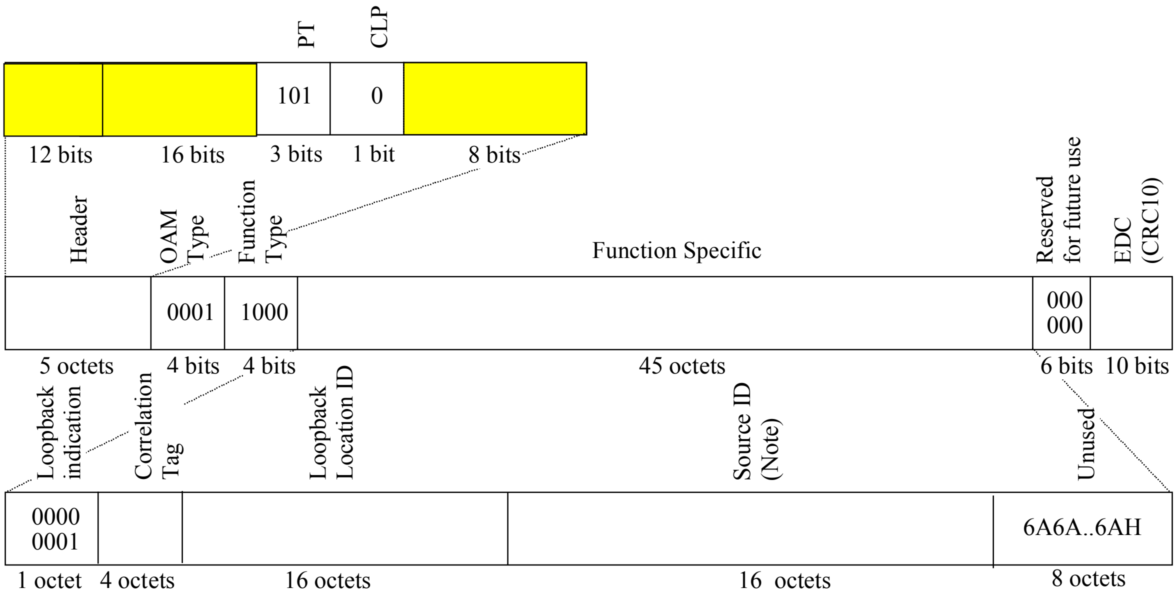
3) loopback point source (for both end-to-end and segment loopback cells).

The function shall be able to operate any combination of the above three types simultaneously.

End-to-end Loopback Source Point (ELSP) Source process:

– Transfer function: This process inserts end-to-end VC-LB cells on request of the Layer Management function.

– Layer Management function: On MI_LBeteRequest, an F5 VC end-to-end loopback source OAM cell (Figure D.148) shall be generated.



NOTE – This field has a default value; to fill it otherwise is an option.

Figure D.148/I.732 – VC end-to-end LB source OAM cell as part of VCLB_CI

The value of the PT, CLP, OAM Type, Function Type, Reserved, Loopback Indication fields shall be as specified in ITU-T I.361 and I.610.

The Loopback Location ID (LLID) field shall be written with the content of the MI_LBlocID.

If either the function does not support the Source ID (SID) or the function supports the SID and the MI_SIDuseEnabled is false, the SID field shall be set to all-ONEs. If the function supports the SID and if the MI_SIDuseEnabled is true, the SID field shall be written with the content of MI_LOCALlocID.

NOTE 1 – The LLID and SID contain the addresses of the loopback point (single loopback technique), resp. of the source point. The default value of the SID field is the all ONE's pattern. If the LLID field contains an all ONE's pattern, it indicates connection end point that receive this loopback cell and support loopback processing should send back the received loopback cell.

The Correlation Tag field shall be written with the value of the correlation tag included in MI_LBeteRequest, and this correlation tag value shall be output to the paired VCLB_TT_Sk via RI_LBeteCorrTag.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

The time interval of sending consecutive end-to-end Loopback cells shall be longer than 5 s. A MI_LBeteRequest received within a period of 5 s after the previous request shall be rejected.

An indication VCLB_RI_LBeteTimer shall be generated to start the timer at the paired VCLB_TT_Sk when the end-to-end loopback cell is generated. Refer to 9.2.1.1.3/I.610.

Segment Loopback Source Point Source process:

– Transfer function: This process inserts segment VC-LB cells on request of the Layer Management function.

– Layer Management function: On MI_LBsegRequest, an F5 VC segment loopback source OAM cell (Figure D.149) shall be generated.

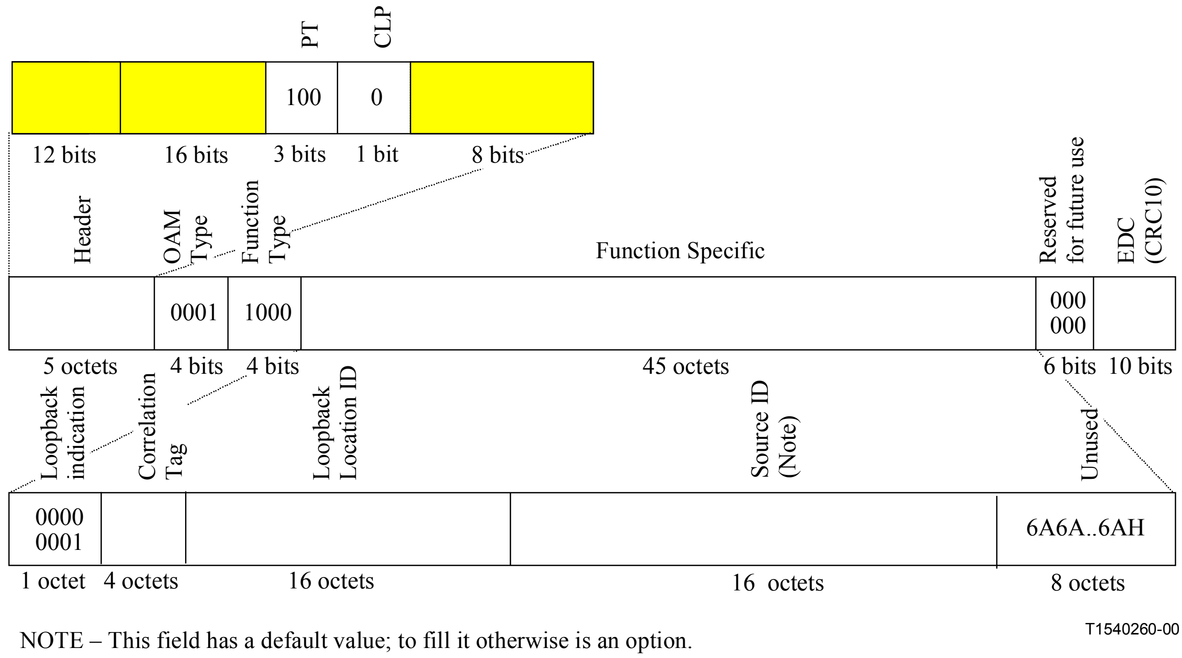


Figure D.149/I.732 – VC segment LB source OAM cell as part of VCLB_CI

The value of the PT, CLP, OAM Type, Function Type, Reserved, Loopback Indication fields shall be as specified in ITU-T I.361 and I.610.

The Loopback Location ID (LLID) field shall be written with the content of the MI_LBlocID.

If either the function does not support the Source ID (SID) or the function supports the SID and the MI_SIDuseEnabled is false, the SID field shall be set to all-ONEs. If the function supports the SID and if the MI_SIDuseEnabled is true, the SID field shall be written with the content of MI_LOCALlocID.

NOTE 2 – The LLID and SID contain the addresses of the loopback point (single loopback technique), resp. of the source point. The default value of the SID field is the all ONEs pattern. If the LLID field contains an all ONEs pattern, it indicates that the segment end point (that support loopback processing) that receive this loopback cell should send back the received loopback cell. If the LLID field contains an all ZEROs pattern, it indicates that all connection points (that support loopback processing, for which the LLID option is enabled and are compliant with the 1999 version of ITU-T I.610) and the segment end point (that support loopback processing and are compliant with the 1999 version of ITU-T I.610) that receive this loopback cell should send back the received loopback cell (multiple loopback technique). Connection points outside a segment for which the LLID option is enabled, will also loopback segment loopback cells incoming due to e.g. a misconnection in the path.

The Correlation Tag field shall be written with the value of the correlation tag included in MI_LBeteRequest, and this correlation tag value shall be output to the paired VCLB_TT_Sk via RI_LBsegCorrTag.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

The time interval of sending consecutive segment Loopback cells shall be longer than 5 s. An MI_LBsegRequest received within a period of 5 s after the previous request shall be rejected.

An indication VCLB_RI_LBsegTimer shall be generated to start the timer at the paired VCLB_TT_Sk when the segment loopback cell is generated. Refer to ITU-T I.610.

Loopback Point Source process:

– Transfer function: This process inserts end-to-end or segment VC-LB cells on request of the Layer Management function.

– Layer Management function: On VCLB_RI_LBresponse, an F5 VC end-to-end or segment loopback cell identical to the cell received through VCLB_RI_LBresponse shall be generated, but with modified LI bit 8 and LLID fields and recalculated EDC field (Figure D.150).

Bit 8 of the Loopback Indication (LI) field shall be set to "0".

LLID field shall be written with the content of MI_LOCALlocID.

NOTE 3 – The MI_LOCALlocID contains the CP, SEP or CEP ID of the loopback point. Refer to 9.2.2.1.3 and 10.2.3/I.610.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

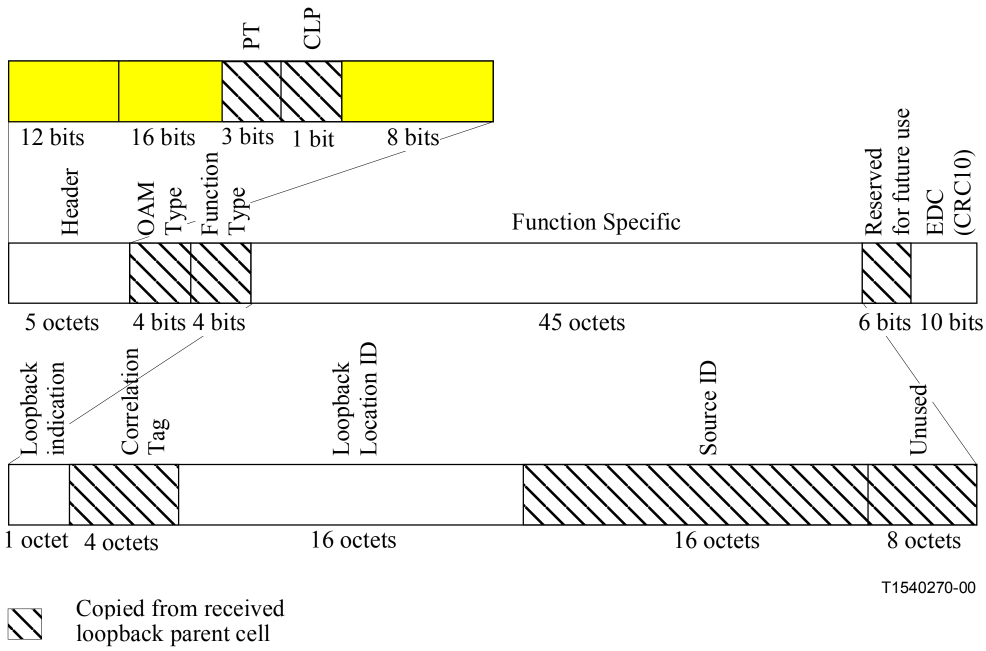


Figure D.150/I.732 – VC LB return OAM cell as part of VCLB_CI

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.5.6.2 ATM virtual channel loopback trail termination sink function VCLB_TT_Sk

Symbol

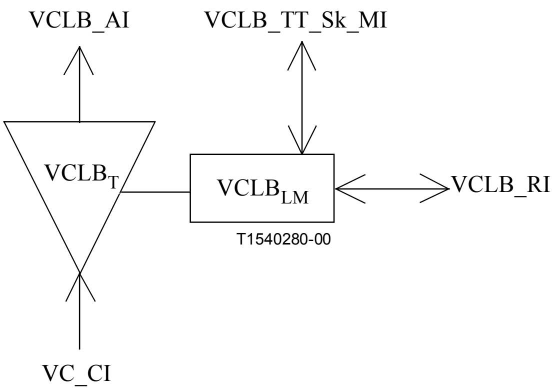


Figure D.151/I.732 – VCLB_TT_Sk symbol

Interfaces

Table D.44/I.732 – VCLB_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VCLB_RI_LBeteTimer VCLB_RI_LBsegTimer VCLB_RI_LBeteCorrTag VCLB_RI_LBsegCorrTag VCLB_TT_Sk_MI_RefPointType VCLB_TT_Sk_MI_LLIDoption VCLB_TT_Sk_MI_LBeparDiscard VCLB_TT_Sk_MI_LBsparDiscard VCLB_TT_Sk_MI_LBretDiscard VCLB_TT_Sk_MI_LOCALlocID VCLB_TT_Sk_MI_SIDuseEnabled	VCLB_AI_D VCLB_AI_ACS VCLB_AI_TSF VCLB_RI_LBresponse VCLB_TT_Sk_MI_eteLBdata VCLB_TT_Sk_MI_segLBdata VCLB_TT_Sk_MI_eteLBtestEnd VCLB_TT_Sk_MI_segLBtestEnd

Processes

This function can operate as a loopback source point sink as well as a loopback point sink at VC connection points, VC termination connection points (I.610: connection end points) and VC segment termination connection points (I.610: segment end points). It performs F5 OAM Loopback cells processing on the passing through signal.

Loopback process types:

The function shall be able to operate as:

1) end-to-end loopback source point sink;

2) segment loopback source point sink;

3) loopback point sink, determined by the RefPointType:

   a) connection end point;

   b) segment end point;

   c) connection point.

The function shall be able to operate any combination of the above three types simultaneously.

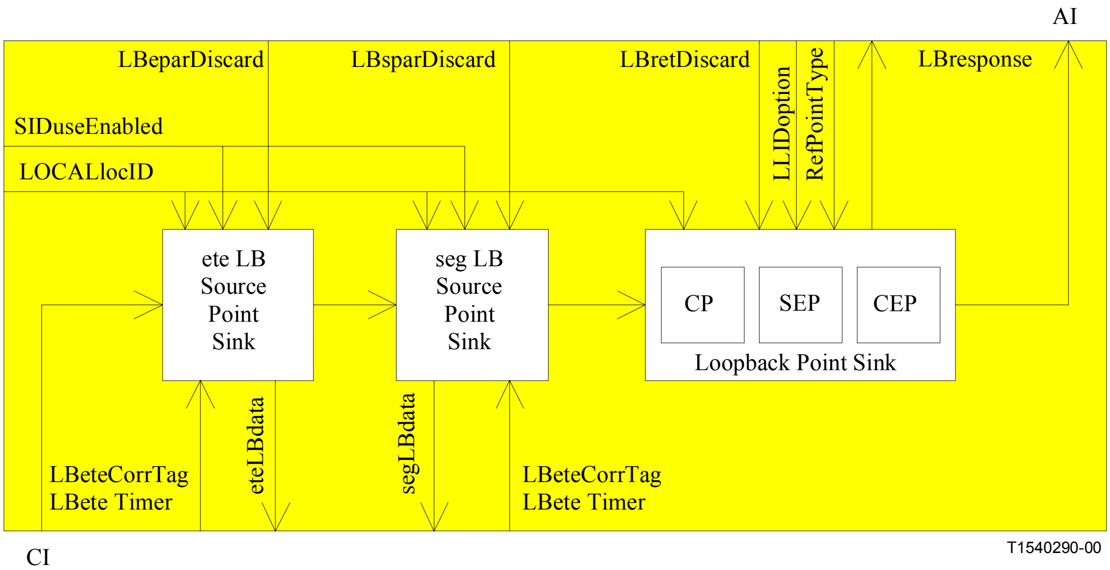


Figure D.152/I.732 – VCLB_TT_Sk function process block diagram

A cell within the incoming VC_CI shall be detected as a:

- End-to-end VC-LB cell if the PT field is 101, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct
- Segment VC-LB cell if the PT field is 100, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.

End-to-end Loopback Source Point (ELSP) Sink process:

– Transfer function: The end-to-end VC-LB cells shall be extracted and sent to the Layer Management function. The process shall insert end-to-end VC-LB cells on request of the Layer Management function.

– Layer Management function: On RI_LBeteTimer from the paired VCLB_TT_So, a 6 ± 1 s end-to-end LB timer shall be started and an end-to-end loopback (ELB) state shall be entered and the ELSP sink process shall be monitoring for incoming end to end LB OAM cells. At expiry of the end-to-end LB timer, the ELB state shall be cleared (entering the IDLE state), the ELSP sink process shall stop monitoring for incoming end to end LB OAM cells and report the expiry via MI_eteLBtestEnd. In the IDLE state LB OAM cells shall be passed through without further processing.

  The ELSP sink process shall perform the operation as specified in Figure D.91 (refer to 9.2.2.1.3, 10.2.3 and Annex C/I.610).

Segment Loopback Source Point (SLSP) Sink process:

– Transfer function: The segment VC-LB cells shall be extracted and sent to the Layer Management function. The process shall insert segment VC-LB cells on request of the Layer Management function.

– Layer Management function: On RI_LBsegTimer from the paired VCLB_TT_So, a 6 ± 1 s segment VC-LB timer shall be started and a segment loopback (SLB) state shall be entered and the SLSP sink process shall be monitoring for incoming segment VC-LB OAM cells.

  At expiry of the segment VC-LB timer, the SLB state shall be cleared (entering the IDLE state), the SLSP sink process shall stop monitoring for incoming segment VC-LB OAM cells and report the expiry via MI_eteLBtestEnd. In the IDLE state LB OAM cells shall be passed through without further processing.

  The SLSP sink process shall perform the operation as specified in Figure D.92 (refer to 9.2.2.1.3, 10.2.3 and Annex C/I.610).

Loopback Point (LP) Sink process:

– Transfer function: The end-to-end and segment VC-LB cells shall be extracted and sent to the Layer Management function. The process shall insert end-to-end and segment VC-LB cells on request of the Layer Management function.

– Layer Management function: The behavior of the LP_Sk process depends on the reference point (CEP, SEP, CP) it is associated with.

  If MI_RefPointType = CEP (connection end-point), the process shall process the cell flow of end-to-end VC-LB cells inserted by remote VCLB_TT_So functions. If an end-to-end VC-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s is received, the end-to-end VC-LB cell is copied and forwarded via RI_LBresponse to the VCLB_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefPointType = SEP (segment end-point), the process shall process the cell flow of segment VC-LB cells inserted by remote VCLB_TT_So functions. If a segment VC-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s or an LLID = all "0"s is received, this process copies and forwards the cell via RI_LBresponse to the VCLB_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefType = CP (connection point), the process shall process the cell flow of segment VC-LB cells inserted by remote VCLB_TT_So functions. If a segment VC-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID is received, this process copies and forwards the cell via RI_LBresponse to the VCLB_TT_So function for insertion of the Loopback cell in reverse direction and, if the MI_LBretDiscard = true, discards it. If a segment VC-LB cell with Loopback Indication set to "1" and an LLID = all "0"s is received and the LLID option is activated (MI_LLIDoption), this process copies and forwards the cell via RI_LBresponse to the VCLB_TT_So function for insertion of the Loopback cell in reverse direction.

  The LP_Sk process shall perform the operation as specified in Figure D.93 (refer to 9.2.2.1.3, 10.2.3 and Annex C/I.610).

Defects

None.

Performance Monitoring

None.

Coordination function

Consequent Actions

aTSF ← CI_SSF

The consequent action aTSF is conveyed by AI_TSF through the VCLB_AI.

Defect Correlations

None.

D.5.6.3 ATM virtual channel loopback point trail termination source function VCLBR_TT_So

Symbol

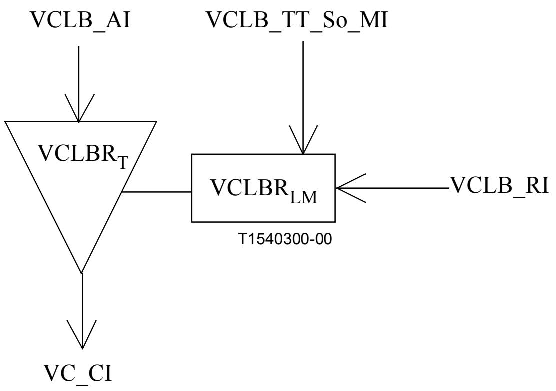


Figure D.153/I.732 – VCLBR_TT_So symbol

Interfaces

Table D.45/I.732 – VCLBR_TT_So input and output signals

Input(s)	Output(s)
VCLB_AI_D VCLB_AI_ACS VCLB_RI_LBresponse VCLBR_TT_So_MI_LOCALlocID	VC_CI_D VC_CI_ACS

Processes

This function can operate as a loopback point source at VC connection points, VC termination connection points (I.610: connection end points) and VC segment termination connection points (I.610: segment end points). It adds F5 loopback OAM cells to the passing through signal.

NOTE 1 – VCLBR_TT_So has reduced functionality compared to VCLB_TT_So since it contains functionality for the loopback point only. It can be used to reduce complexity of implementation.

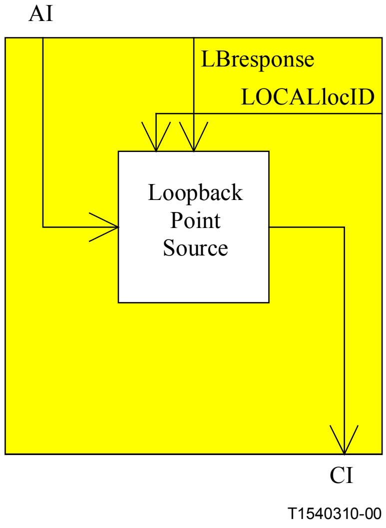


Figure D.154/I.732 – VCLBR_TT_So process block diagram

Loopback Point Source process:

– Transfer function: This process inserts end-to-end or segment VC-LB cells on request of the Layer Management function.

– Layer Management function: On VCLB_RI_LBresponse, an F5 VC end-to-end or segment loopback cell identical to the cell received through VCLB_RI_LBresponse shall be generated, but with modified LI bit 8 and LLID fields and recalculated EDC field (Figure D.154).

Bit 8 of the Loopback Indication (LI) field shall be set to "0".

LLID field shall be written with the content of MI_LOCALlocID.

NOTE 2 – The MI_LOCALlocID contains the CP, SEP or CEP ID of the loopback point. Refer to 9.2.2.1.3 and 10.2.3/I.610.

The EDC field shall be written with the CRC-10 value of the 48 payload octets of the OAM cell as specified in 10.1/I.610.

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.5.6.4 ATM virtual channel loopback point trail termination sink function VCLBR_TT_Sk

Symbol

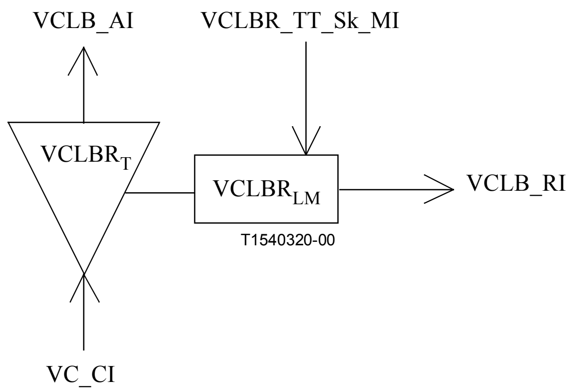


Figure D.155/I.732 – VCLBR_TT_Sk symbol

Interfaces

Table D.46/I.732 – VCLBR_TT_Sk input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS VC_CI_SSF VCLBR_TT_Sk_MI_RefPointType VCLBR_TT_Sk_MI_LLIDoption VCLBR_TT_Sk_MI_LBretDiscard VCLBR_TT_Sk_MI_LOCALlocID	VCLB_AI_D VCLB_AI_ACS VCLB_AI_TSF VCLB_RI_LBresponse

Processes

This function can operate as a loopback point sink at VC connection points, VC termination connection points (I.610: connection end points) and VC segment termination connection points (I.610: segment end points). It performs F5 OAM Loopback cells processing on the passing through signal.

NOTE – VCLBR_TT_So has reduced functionality compared to VCLB_TT_So since it contains functionality for the loopback point only. It can be used to reduce complexity of implementation.

Loopback process types:

The function shall be able to operate as loopback point sink, determined by the RefPointType:

a) connection end point;

b) segment end point;

c) connection point.

A cell within the incoming VC_CI shall be detected as a:

- End-to-end VC-LB cell if the PT field is 101, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.
- Segment VC-LB cell if the PT field is 100, the OAM type field is "0001", the Function type field is "1000", and the CRC-10 is correct.

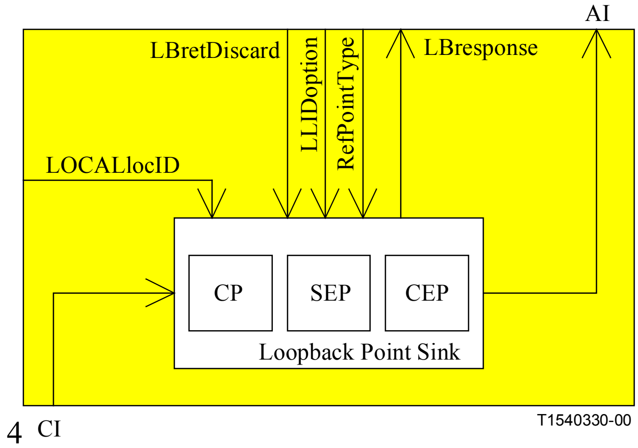


Figure D.156/I.732 – VCLBR_TT_Sk function process block diagram

Loopback Point (LP) Sink process:

– Transfer function: The end-to-end and segment VC-LB cells shall be extracted and sent to the Layer Management function. The process shall insert end-to-end and segment VC-LB cells on request of the Layer Management function.

– Layer Management function: The behavior of the LP_Sk process depends on the reference point (CEP, SEP, CP) it is associated with.

  If MI_RefPointType = CEP (connection end-point), the process shall process the cell flow of end-to-end VC-LB cells inserted by remote VCLB_TT_So functions. If an end-to-end VC-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s is received, the end-to-end VC-LB cell is copied and forwarded via RI_LBresponse to the VCLBR_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefPointType = SEP (segment end-point), the process shall process the cell flow of segment VC-LB cells inserted by remote VCLB_TT_So functions. If a segment VC-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID or an LLID = all "1"s or an LLID = all "0"s is received, this process copies and forwards the cell via RI_LBresponse to the VCLBR_TT_So function for insertion of the Loopback cell in reverse direction.

  If MI_RefType = CP (connection point), the process shall process the cell flow of segment VC-LB cells inserted by remote VCLB_TT_So functions. If a segment VC-LB cell with Loopback Indication set to "1" and an LLID matching the MI_LOCALlocID is received, this process copies and forwards the cell via RI_LBresponse to the VCLBR_TT_So function for insertion of the Loopback cell in reverse direction and, if the MI_LBretDiscard = true, discards it. If a segment VC-LB cell with Loopback Indication set to "1" and an LLID = all "0"s is received and the LLID option is activated (MI_LLIDoption), this process copies and forwards the cell via RI_LBresponse to the VCLBR_TT_So function for insertion of the Loopback cell in reverse direction.

The LP_Sk process shall perform the operation as specified in Figure D.156 (refer to 9.2.2.1.3, 10.2.3 and Annex C/I.610).

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

aTSF ← CI_SSF

The consequent action aTSF is conveyed by AI_TSF through the VCLB_AI.

Defect Correlations

None.

D.5.6.5 ATM virtual channel loopback to ATM VC adaptation source function VCLB/VC_A_So

Symbol

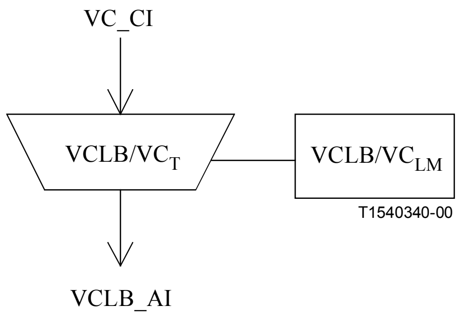


Figure D.157/I.732 – VCLB/VC_A_So symbol

Interfaces

Table D.47/I.732 – VCLB/VC_A_So input and output signals

Input(s)	Output(s)
VC_CI_D VC_CI_ACS	VCLB_AI_D VCLB_AI_ACS

Processes

None.

Defects

None.

Performance Monitoring

None.

Coordination Function

Consequent Actions

None.

Defect Correlations

None.

D.5.6.6 ATM virtual channel loopback to ATM VC adaptation sink function VCLB/VC_A_Sk

Symbol

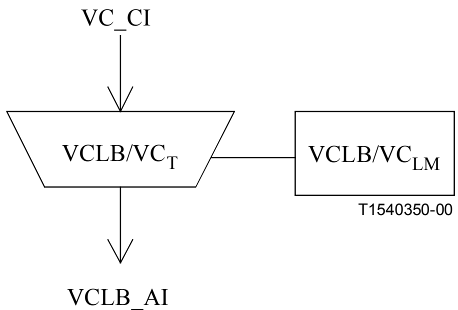


Figure D.158/I.732 – VCLB/VC_A_Sk symbol

Interfaces

Table D.48/I.732 – VCLB/VC_A_Sk input and output signals

Input(s)	Output(s)
VCLB_AI_D VCLB_AI_ACS VCLB_AI_TSF	VC_CI_D VC_CI_ACS VC_CI_SSF

Processes

None.

Defects

None.

Performance Monitoring

None.

Coordination function

Consequent Actions

aSSF ← AI_TSF

The consequent action aSSF is conveyed by CI_SSF through the VC_CI.

Defect Correlations

None.

D.5.7 ATM Virtual Channel Linear Trail Protection Functions

D.5.7.1 ATM Virtual Channel Linear Trail Protection Adaptation Source Function VC/VCP_A_So

Symbol

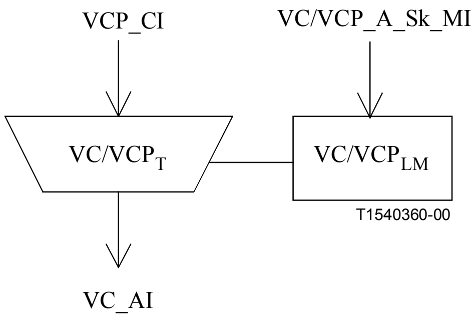


Figure D.159/I.732 – VC/VCP_A_So symbol

Interfaces

Table D.49/I.732 – VC/VCP_A_So input and output signals

Input(s)	Output(s)
for protection signal only: VCP_CI_APS VC/VCP_A_So_MI_APSenabled	VC_AI_D VC_AI_ACS

Processes

This function performs end-to-end VC-APS cell generation for 1+1 bidirectional and 1:1 protection switching functions.

End-to-end VC-APS cell generation:

– Transfer function: This function inserts end-to-end VC-APS cells from the Layer Management function.

– Layer Management function: If activated by the MI_APSenabled, for protection section in 1:1 and bidirectional 1+1 protection schemes, end-to-end VC-APS cells shall be generated. Refer to 5.8/I.630.

The value of the VCI, PT, CLP, OAM Type, Function Type and Reserved Fields shall be as specified in ITU-T I.630, I.610 and I.361.

The value of the K1 and K2 fields shall be written with the information received from the CI_APS.

The EDC field shall be written with the CRC-10 value of the 48-payload octets of the OAM cell as specified in 5.8/I.630.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

None.

Defect Correlations

None.

D.5.7.2 ATM Virtual Channel Linear Trail Protection Adaptation Sink Function VC/VCP_A_Sk

Symbol

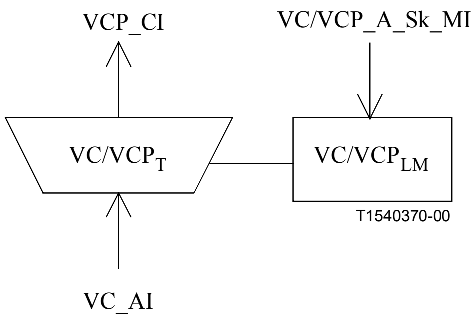


Figure D.160/I.732 – VC/VCP_A_Sk symbol

Interfaces

Table D.50/I.732 – VC/VCP_A_Sk input and output signals

Input(s)	Output(s)
VC_AI_D VC_AI_ACS VC_AI_TSF VC_AI_TSD VC/VCP_A_Sk_MI_APSenabled	VCP_CI_SSF for protection signal only: VCP_CI_APS

Processes

This function performs end-to-end VC-APS cell extraction for 1+1 bidirectional and 1:1 protection switching functions.

End-to-end VC-APS cell extraction:

– Transfer function: This function extracts end-to-end VC-APS cells to the Layer Management function.

– Layer Management function: If activated by the MI_APSenabled, for protection section in 1:1 and bidirectional 1+1 protection schemes, the information extracted from the K1 and K2 field is reported through the VCP_CI_APS. Refer to 5.8/I.630.

Defects

None.

Performance Monitoring

None.

Coordination Functions

Consequent Actions

aSSF ← AI_TSF

Defect Correlations

None.

D.6 ATM Virtual Channel to ATM Client Adaptation Functions

D.6.1 ATM Virtual Channel to ATM Client Adaptation Source VC/XXX_A_So

Symbol

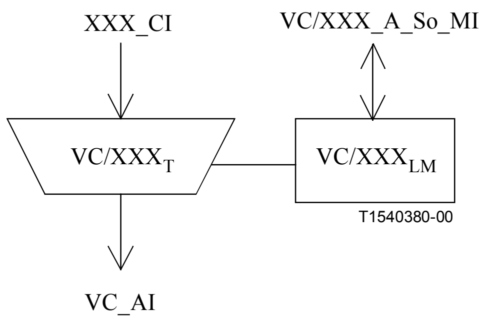


Figure D.161/I.732 – VC/XXX_A_So symbol

Interfaces

Table D.51/I.732 – VC/XXX_A_So input and output signals

Input(s)	Output(s)
XXX_CI_D XXX_CI_FS XXX_CI_SSF XXX_CI_other VC/XXX_A_So_MI_Active VC/XXX_A_So_MI_other	VC_AI_D VC_AI_ACS

Processes

This function performs an AAL process for a given VCC in source direction. It is for further study. The following is a non-exhaustive list of possible candidates for payloads to be supported:

- CE 2 – 140 Mbit/s;
- CE n*64 kbit/s;
- X.25, Frame Relay, HDLC;
- Internet Protocol;
- CBDS;
- N-ISDN interworking (BA, PRA);
- LAN (IEEE 802x).

Defects

Performance Monitoring

Coordination Functions

Consequent Actions

Defect Correlations

D.6.2 ATM Virtual Channel to ATM Client Adaptation Sink VC/XXX_A_Sk

Symbol

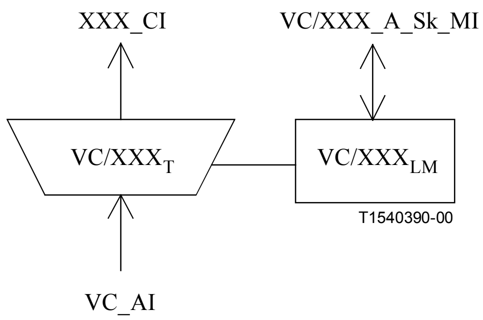


Figure D.162/I.732 – VC/XXX_A_Sk symbol

Interfaces

Table D.52/I.732 – VC/XXX_A_Sk input and output signals

Input(s)	Output(s)
VC_AI_D VC_AI_ACS VC_AI_TSF VC/XXX_A_Sk_MI_Active VC/XXX_A_Sk_MI_other	XXX_CI_D XXX_CI_FS XXX_CI_SSF XXX_CI_other

Processes

This function performs an AAL process for a given VCC in sink direction. It is for further study.

F5 OAM cell discarding:

– Transfer function: In case this function detects F5 end-to-end or segment OAM cells that were not extracted by the termination functions, this process shall discard these cells at this point.

The following is a non-exhaustive list of possible candidates for payloads to be supported:

- CE 2 – 140 Mbit/s;
- CE n*64 kbit/s;
- X.25, Frame Relay, HDLC;
- Internet Protocol;
- CBDS;
- N-ISDN interworking (BA, PRA)
- LAN (IEEE 802x).

Defects

Performance Monitoring

Coordination Functions

Consequent Actions

Defect Correlations

APPENDIX I

Functional requirements for ABR transfer capability

Introduction

ITU-T I.371 has defined the service and flow control model for ABR transfer capability, as well as the Resource Management (RM) cell format and fields. The functional model/requirements for the ATM NE supporting ABR ATC should be based directly on that model and be consistent with the procedures described in ITU-T I.371.

Considering these ABR procedures, the generic requirements described below may be used as a basis for the ABR functional modelling in this Recommendation. It should be noted also that for the case of "segmented" ABR feedback control loops, any ATM NE may be configured to act as a "Virtual Source" (VS) and "Virtual Destination" (VD), as opposed to the " end-to-end" Source and Destination of ABR traffic. Consequently, the description need not essentially distinguish between end Source/Destination or VS/VD requirements.

For simplicity this description only focuses on ABR requirements for virtual channel connections (VCCs). The extension to VPCs is for further study.

ABR functional requirements

I.1 Location in I.732 Model

Processing of the RM cells is performed in the Virtual Path and Virtual Channel Traffic Management function (VPTM and VCTM), in both B to A and A to B directions. (See Table 4-1.)

I.2 Transfer Functions

Extraction of RM cells/Insertion of RM cells.

Setting of RM cell fields. Loopback of RM cells after setting of RM cell fields.

I.3 Report to Layer Management

RM cell payload (see ITU-T I.371).

I.4 Control from Layer Management

Processed RM cell payload.

I.5 Layer Management Functions

Processing of the RM cell payload should be in accordance with the procedures defined in ITU-T I.371. The following functional requirements relate to the processing of RM cell fields.

NOTE – The algorithms/mechanisms for setting the individual fields are implementation specific and not subject to standardization.

I.5.1 The ATM NE supporting ABR may indicate a congestion state by one or more of the following actions:

1) Setting EFCI value in the ATM cell header PTI field.
2) Setting the Congestion Indication (CI) bit in the RM cell to 1.
3) Setting the Explicit Cell Rate (ECR) field of forward and/or backward RM cells to the appropriate value. This value should be greater or equal to the Minimum Cell Rate (MCR) value (if specified) and less than or equal to the Peak Cell Rate (PCR) value.

The algorithm for ECR processing is implementation specific and not subject to standardization.

NOTE – The criteria for determining "congestion state" or threshold used in the ATM NE for the above is implementation specific and not subject to standardization.

I.5.2 BECN Function

An ATM NE may generate a backward RM cell (BECN Cell) independent of the end-to-end RM cell flow, in accordance with I.371 procedures. For this case the BECN field is set to 1 and the CI and NI fields are set to 1. The ECR field is set to the appropriate value. The maximum rate BECN cells may be generated is for further study.

NOTE – The control function for BECN Cell generation is for further study.

I.5.3 The NE may set the No Increase (NI) bit to 1 under AEMF control, in conjunction with the CI bit to indicate to the source to not increase cell rate.

I.5.4 The NE may use the Current Cell Rate (CCR) field in the determination of ECR. The use of the CCR information is implementation specific. For BECN RM cells the CCR field is set to 0.

I.5.5 The use of the Queue Length field is an implementation option. (See ITU-T I.371.)

I.5.6 The use of the Sequence Number (SN) field by the source or Virtual Source (VS) is an implementation option (see ITU-T I.371). When not used the SN field is set to 0. If used the intermediate NEs leave the SN unchanged. The SN value is transferred unchanged from the forward RM cell to the backward RM cell at the destination or VD.

I.5.7 Definition of the Layer Management functions for ABR support is for further study. The need for AEMF Indications for ABR support is for further study.

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Geneva, 2001