



# **The ATM Forum**

## **Technical Committee**

# **ATM-MPLS Network Interworking Signalling Specification Version 1.0**

**af-cs-0197.000**  
**August 2003**

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## Acknowledgements

During preparation of this addendum, the Control Signalling working group was chaired by Gert Oster. The minutes at related working group meetings were recorded by Dave Paw. The editors of this addendum were Andrew Dolganow and Claude Kawa. The editors would like to thank the following contributors for their help with this addendum as well as all participants of the Control Signalling working group for the many days and evenings spent discussing this addendum:

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**Option:** "May" indicates an optional operation without implying a desirability of one operation over another. That is, it identifies an operation that is allowed while still maintaining compliance.

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# 1 Introduction

## 1.1 Scope

### [Normative]

This document is an addendum to [PNNI 1.1] and [AINI 1.1]. It contains the signalling specification for the support of ATM-MPLS network interworking, where an intermediate MPLS network provides a transport between two ATM networks.

This addendum specifies coding and procedures for exchanging interworking labels, for encapsulation mode indication and for optional encapsulation mode negotiation between two ATM-MPLS INEs.

This specification supports the ATM-MPLS network interworking user plane encapsulation modes defined in [ATM-MPLS] and [Y.1411] but is not intended to be restricted to only those modes.

ATM-MPLS network interworking signalling is an optional feature of PNNI 1.1 and AINI 1.1.

A node supporting the ATM-MPLS network interworking signalling shall support the ATM-MPLS network interworking procedures for all connection types (i.e., SVCCs, soft PVCCs, SVPCs, or soft PVPCs) for:

- point-to-point calls, and
- point-to-multipoint calls if point-to-multipoint calls are supported.

### 1.1.1 Support of ATM-MPLS Network Interworking Signalling by PNNI 1.0 Nodes

A node supporting PNNI 1.0 may implement the functionality defined in this addendum by treating this addendum as if it were an optional addendum to [PNNI 1.0] and [PNNI 1.0 Errata and PICS]. No new PNNI 1.1 features are required by ATM-MPLS network interworking signalling.

### 1.1.2 Support of ATM-MPLS Network Interworking Signalling by AINI Nodes

A node supporting AINI may implement the functionality defined in this addendum by treating this addendum as if it were an optional addendum to [AINI]. No new AINI 1.1 features are required by ATM-MPLS network interworking signalling.

## 1.2 Overview

### [Informative]

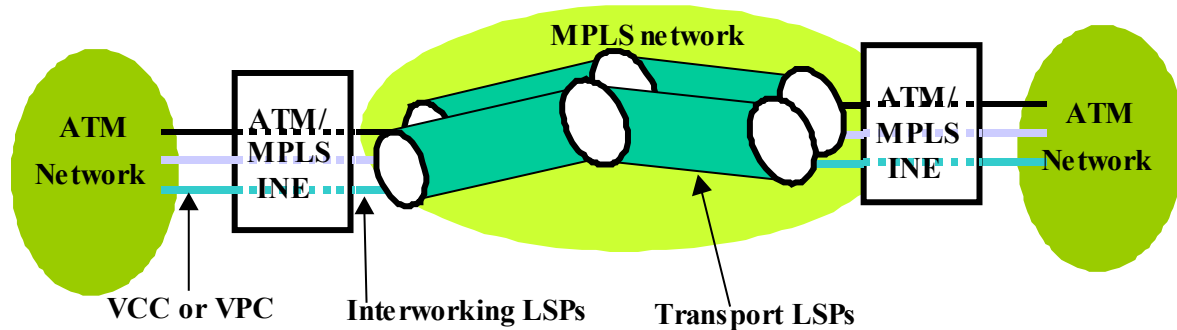


Figure 1-1 ATM-MPLS Network Interworking

Figure 1-1 shows an example of ATM-MPLS network interworking. The MPLS network interconnects the two ATM networks and becomes a transport network between the two ATM networks. The ATM-MPLS INE performs network-interworking functions between the ATM network and the MPLS network. Being a transport network, the MPLS network does not originate, nor terminate the ATM services. However, the MPLS network should be capable of transporting ATM services transparently between the two ATM networks.

At least one transport LSP in each direction connects two ATM-MPLS INEs. The transport LSPs provide a tunnelling functionality for the control plane and user plane connections. The collection of transport LSPs between two ATM-MPLS INEs are modelled as one or more logical ATM interfaces to ATM signalling and routing. There is no signalling or routing protocol conversion from ATM to MPLS and vice versa. The fact that ATM-MPLS INEs have additional MPLS and ATM-MPLS network interworking functions in the control plane and the user plane is transparent to other ATM nodes.

The details of the ATM-MPLS network interworking user plane are not covered by this specification. Two specifications that describe ATM-MPLS network interworking user planes are [ATM-MPLS] and [Y.1411].

One or more interworking LSPs may be nested inside each transport LSP. Each interworking LSP is a component of an ATM virtual path connection (VPC) or virtual channel connection (VCC), which include user connections as well as a signalling channel (PNNI or AINI) and a PNNI routing control channel (if applicable). For each ATM connection, one interworking LSPs is required in each direction to carry bi-directional traffic between the two ATM-MPLS INEs: One interworking LSP carries traffic in one direction; the other LSP carries traffic in the opposite direction.

Being modeled to ATM signalling and routing as an ATM port, each logical ATM interface has its own VPCI/VCI space like a regular ATM port. Although the VPCI/VCI is not required by the user plane between two ATM-MPLS INEs, the control plane still needs to maintain a VPCI/VCI for each call on the logical ATM interface as if the call was on a regular ATM port. This overlay approach allows backward compatibility, and minimizes impact on ATM control and management applications such as SNMP MIBs or Path and Connection Trace, which all use VPCI/VCI broadly. For instance, an existing SNMP-based network management system with existing ATM MIBs is still able to trace a call over a pair of transport LSPs with no need for changes.

ATM-MPLS network interworking inherits PNNI signaling capabilities when PNNI signaling is used for ATM-MPLS network interworking. For example:

- Tandem signaling capability:

PNNI Signaling allows a call to enter a PNNI node over a PNNI interface and to leave the node over another PNNI interface. For a PNNI node supporting ATM-MPLS network interworking, this



functionality allows a call to enter the node via a *transport LSP* and to leave the node via another *transport LSP*. In this case, the node could do switching on an MPLS packet basis rather than converting to cells.

PNNI routing controls access to this functionality. Specifically, the decision whether to progress a call over a path from one transport LSP to another transport LSP is subject to constraints advertised in PNNI routing (e.g. restricted transit) and the path selection algorithm used in implementation of PNNI routing.

Note that when this functionality is allowed, the set of connected transport LSPs forms a PNNI-controlled layer of the MPLS network. This is an addition to the rest of the MPLS network, where IP routing protocols (e.g. OSPF, IS-IS, BGP) and signalling protocols (e.g. RSVP-TE, CR-LDP) may be used.

- ATM interworking capability:

The PNNI Addendum for Generic Application Transport (GAT) [PNNI GAT] supports interworking with Frame relay signaling (FRF.10.1) and ISUP. This addendum is also applicable to this specification.

The above signalling capabilities also apply when AINI signalling is used.

## 2 References and Acronyms

### [NORMATIVE]

#### 2.1 References

- [PNNI 1.1] ATM Forum Technical Committee, "Private Network-Network Interface Specification Version 1.1 (PNNI 1.1)", af-pnni-0055.002, April 2002.
- [AINI 1.1] ATM Forum Technical Committee, "ATM Inter Network Interface Version 1.1 (AINI 1.1) Specification", af-cs-0125.002, September 2002
- [PNNI 1.0] ATM Forum Technical Committee, "Private Network-Network Interface Specification Version 1.0 (PNNI 1.0)", af-pnni-0055.000, April 1996.
- [AINI] ATM Forum Technical Committee, "ATM Inter Network Interface (AINI) Specification Version 1.0", af-cs-0125.000, July 1999.
- [ATM-MPLS] ATM Forum Technical Committee, "ATM-MPLS Network Interworking Version 2.0", af-aic-0178.001, August 2003.
- [N1] ATM Forum Technical Committee, "ATM-MPLS Network Interworking (N-to-one mode), Version 1.0", af-aic-0196.000, August 2003
- [PNNI GAT] ATM Forum Technical Committee, "PNNI Addendum for Generic Application Transport Version 1.0", af-cs-0126.000, July 1999
- [RFC2615] RFC2615 PPP over SONET/SDH, June 1999
- [RFC3031] RFC3031 Multiprotocol Label Switching Architecture, January 2001
- [RFC3032] RFC3032 MPLS Label Stack Encoding, January 2001
- [Y.1411] ITU-T: Recommendation Y.1411 (2003): ATM-MPLS Network interworking – Cell mode user plane interworking
- [Y.1412] ITU-T: Recommendation Y.1412 (2003): ATM-MPLS Network interworking – Frame mode user plane interworking

#### 2.2 Acronyms

AAL	ATM Adaptation Layer
AINI	ATM Inter-Network Interface
ATM	Asynchronous Transfer Mode
B-ISUP	Broad Band-Integrated Service User Part
CDV	Cell Delay Variation
CLP	Cell Loss Priority
CLR	Cell Loss Ratio
DTL	Designated Transit List
INE	Interworking Network Element
ITU-T	International Telecommunication Union - Telecommunication standardization sector
IUT	Implementation Under Test
IWF	Interworking Function
LSP	Label Switched Path
LER	Label Edge Router
LSR	Label Switching Router
MIB	Management Information Base
PICS	Protocol Implementation Conformance Statement

PNNI	Private Network-Network Interface
PVCC	Permanent Virtual Channel Connection
PVPC	Permanent Virtual Path Connection
QoS	Quality of Service
RAIG	Resource Availability Information Group
SPVC	Soft Permanent Virtual Connection
SUT	System Under Test
SVCC	Switched Virtual Channel Connection
SVPC	Switched Virtual Path Connection
UBR	Unspecified Bit Rate
UNI	User-Network Interface
VBR	Variable Bit Rate
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VPC	Virtual Path Connection
VPCI	Virtual Path Connection Identifier
VPI	Virtual Path Identifier

### 3 Reference Model

#### 3.1 Network Reference Model

**[Normative]**

Figure 3-1 is used to define the terminology used in this addendum and to show connections between ATM-MPLS INEs.

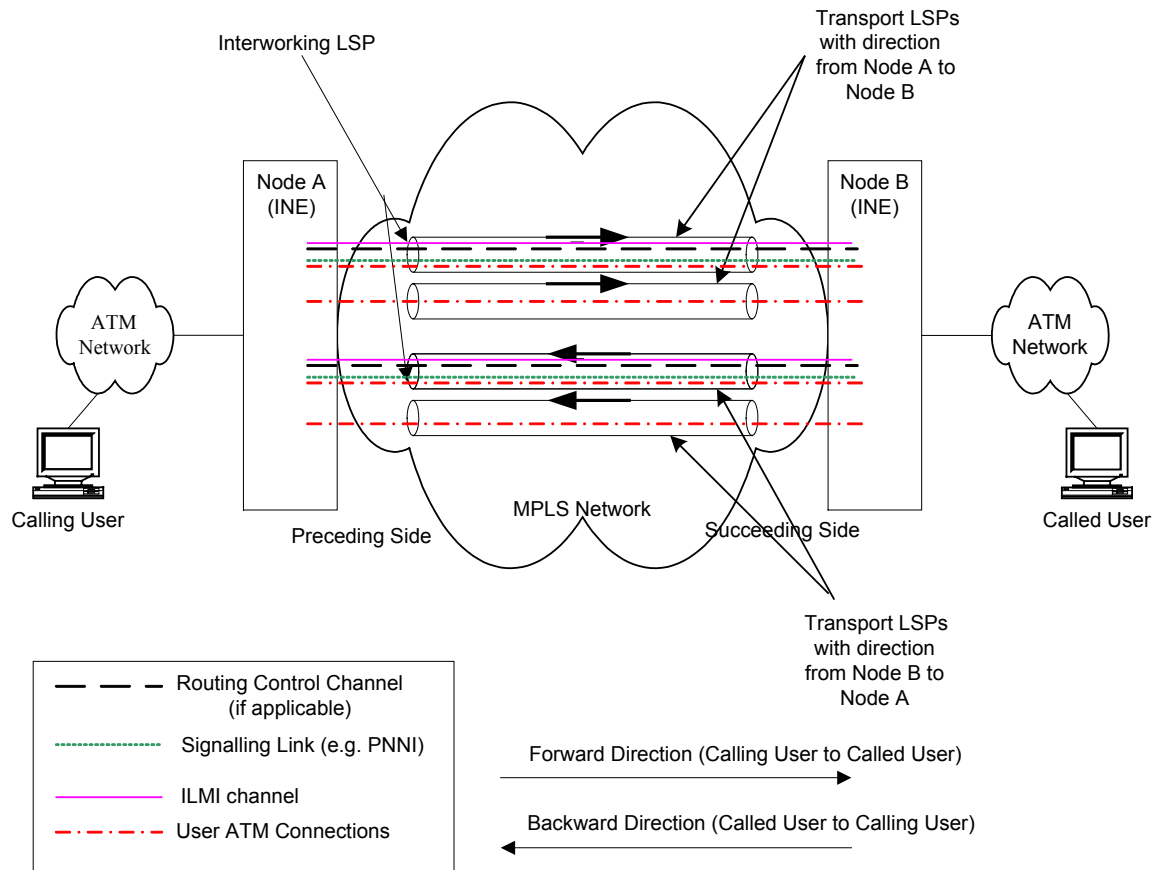


Figure 3-1 Network Reference Model

**Forward/Backward direction:** The forward direction is the direction from the calling user to the called user. The backward direction is the direction from the called user to the calling user.

**Preceding/Succeeding side:** A preceding side is a network node that comes before another network node in the call setup path. A succeeding side is a network node that comes after another network node in the call setup path.

**Interworking Function (IWF):** An IWF includes the conversion between protocols and the mapping of one protocol to another. The functionality required between networks can be separated from the functionality, if any, required in end systems. The former functionality is considered to reside in an interworking network element (INE). Additional details may be found in [ATM-MPLS].

**Interworking Network Element (INE):** The INE is an entity where user plane, control plane and management plane interworking functions (IWFs) may be implemented. The INE could be a standalone

network\_element, part of an ATM switch or part of a Label Edge Router (LER) located at the edge of the MPLS network.

**Transport LSP:** An LSP used to transport traffic between two ATM-MPLS INEs. The transport LSP label is an MPLS label as defined by IETF RFCs 3031 and 3032. This label is visible to the MPLS core network. A transport LSP carries one or more interworking LSPs. Since LSPs are unidirectional, at least one transport LSP is required in each direction to carry bi-directional traffic between two ATM-MPLS INEs: One transport LSP carries traffic in one direction; another transport LSP carries traffic in the opposite direction.

**Interworking LSP:** An LSP within a transport LSP. Each interworking LSP carries traffic for one direction of an ATM VPC or VCC. See [ATM-MPLS] for more details.

**Logical ATM Interface:** A logical ATM interface is an abstract representation of the MPLS connectivity between two ATM-MPLS INEs controlled by a single ATM signalling channel. There may be more than one logical ATM interfaces between two ATM-MPLS INEs. Each logical ATM interface contains one interworking LSP in each direction for the signalling channel, and if the logical ATM interface is a PNNI interface, one interworking LSP in each direction for the interface's routing control channel. A logical ATM interface has its own VPCI/VCI space. The label space available for a given direction of a logical ATM interface may or may not be shared by other interfaces, ATM or non-ATM (see [ATM-MPLS] for a discussion of the implications).

**Encapsulation Mode:** The format of the MPLS frames used to carry ATM traffic in a given interworking LSP between two ATM-MPLS INEs across an MPLS network. The details of several encapsulation modes can be found in [ATM-MPLS], [Y.1411] and [Y.1412].

**Forward/Backward Label:** The forward label is a label that is used by an LSP to transport traffic from the preceding side to the succeeding side. The backward label is a label that is used by an LSP to transport traffic from the succeeding side to the preceding side.

## 3.2 Call Setup between ATM-MPLS INEs

### [Informative]

In order to establish switched ATM connections and the related interworking LSPs over a logical ATM interface, ATM signalling messages are exchanged over the pair of interworking LSPs comprising the ATM signalling channel. The normal procedures for basic call control are followed, with extensions to support MPLS label exchange and indication or negotiation of encapsulation modes and applicable interworking parameters.

The following examples are equally applicable to PNNI and AINI.

### 3.2.1 Basic point-to-point call label exchange

With respect to Figure 3-1, an overview of interworking label assignment for a basic point-to-point call setup between ATM-MPLS INEs is described below:

1. The preceding side sends a SETUP message, which always includes a Connection identifier information element. The Connection identifier information element carries the backward interworking label assigned by the preceding side for this call. The backward interworking label identifies the interworking LSP that carries traffic in the backward direction.
2. The succeeding side replies to the SETUP message with a CALL PROCEEDING message, which always includes a Connection identifier information element. The Connection identifier information element carries the forward interworking label assigned by the succeeding side for this call. The forward interworking label identifies the interworking LSP that carries traffic in the forward direction.

### **3.2.2 Point-to-multipoint call label exchange**

When the preceding side receives a setup request, the same procedures as for a basic point-to-point label exchange apply between the preceding side and the succeeding side (i.e. both backward and forward interworking labels are also assigned). However, because the backward interworking LSP has zero bandwidth, the call is still forwardly unidirectional. This is consistent with the characteristics of an ATM connection, in which each ATM connection is bi-directional and its backward traffic cell rate is set to zero to yield a forwardly unidirectional connection.

### **3.2.3 Indication and Negotiation of the Encapsulation Mode**

The preceding side includes the Interworking information element in the SETUP message. The Interworking information element contains either a single encapsulation mode (indication of the encapsulation mode case), or a list of encapsulation modes in order of preference (negotiation of the encapsulation mode case). The succeeding side determines whether it can support any of the signaled encapsulation modes starting from the most preferred encapsulation mode listed in the SETUP message. If the succeeding side cannot support any of the encapsulation modes listed in the SETUP message, the succeeding side releases the call. Otherwise, the succeeding side sends the chosen encapsulation mode in the Interworking information element in the CONNECT message. Support of alternative encapsulation mode negotiation is optional for both preceding and succeeding sides. If the succeeding side does not support alternative encapsulation mode negotiation, it processes only the most preferred encapsulation mode and ignores the additional encapsulation modes.

When present, forward/backward maximum number of cells or maximum frame size are always negotiated with the succeeding side.

Typically, the negotiation of encapsulation mode is local between two ATM-MPLS INEs; however, in the case of back to back ATM-MPLS network interworking interfaces (Tandem signalling capability) it may be desirable to have the same encapsulation modes for both interfaces.

## 4 Coding Requirements

### [Normative]

This section specifies the coding of the extensions to the Connection identifier information element and the Interworking information element for ATM-MPLS network interworking signalling.

#### 4.1 Connection Identifier Information Element Coding

For ATM-MPLS network interworking signalling, the Connection identifier information element is used for interworking label exchange. This is achieved by the following changes applied to section 6.4.5.22 of [PNNI 1.1]:

- *Add the following new octet group 10 to the Connection identifier information element depicted in Figure 4-22/Q.2931:*

Bits								Octets
8	7	6	5	4	3	2	1	
ATM-MPLS Network Interworking Identifier								10* (Note 1)
0	0	0	0	0	0	0	1	
ATM-MPLS Network Interworking length								10.1*
ATM-MPLS Network Interworking value								10.2* – 10.4*

Note 1 – This octet group shall be present, if and only if, the connection is established over an MPLS interface.

Figure 4-1 Connection identifier information element modifications for ATM-MPLS network interworking signalling

#### *ATM-MPLS Network Interworking length (octet 10.1)*

Length of the ATM-MPLS Network Interworking contents in octets, i.e. excluding the octets used for ATM-MPLS Network Interworking length and identifier.

#### *ATM-MPLS Network Interworking value (octet 10.2 – 10.4)*

Reserved				Interworking Label (Most significant 4 bits)				10.2
0	0	0	0					
Interworking Label (2 <sup>nd</sup> most significant 8 bits)								10.3
Interworking Label (3 <sup>rd</sup> most significant 8 bits)								10.4

#### *Interworking Label*

The label is an MPLS label as defined by IETF RFC 3031 and 3032.

- *Section 2 §4.5.16/Q.2931 of UNI Signalling 4.1 is amended as follows:*

The following codepoints are added to the preferred/exclusive field of Octet 5 in table 4-16/Q.2931.

Bits

3 2 1

1 0 0 Exclusive VPCI; no VCI (used for switched VPCs)

0 1 1 Any VPCI; any VCI (used for ATM-MPLS network interworking)

1 0 1 Any VPCI; no VCI (used for switched VPCs in ATM-MPLS network interworking)

- Add the following to Section 2 §4.5.16/Q.2931 of UNI Signalling 4.1:

Add the following note on octets 6 and 7 (VPCI) to Figure 4-22/Q.2931:

Note: If the preferred/exclusive field indicates “any VPCI”, the VPCI field shall be ignored.

## 4.2 Interworking Information Element Coding

The Interworking information element is used to indicate and optionally negotiate the encapsulation mode used for an ATM connection.

Bits								Octets
8	7	6	5	4	3	2	1	
Interworking								1
0	1	1	1	1	0	1	0	
information element identifier								
1	Coding		IE Instruction Field					2
Ext	Standard							
Length of Interworking contents								3-4
Related Standard								5

Further contents depending on Related Standard (see below)

Figure 4-2 Interworking Information Element

*Coding standard (octet 2)*

Bits								Meaning
8	7	6	5	4	3	2	1	
0	0							ITU-T specified



*Related Standard (octet 5)*

Bits								Meaning
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	ATM-MPLS Network Interworking (Note 1)
X	X	X	X	X	X	X	X	All other values are reserved

Note 1: This value is used between two ATM-MPLS INEs.

**Further contents for Related Standard set to “ATM-MPLS Network Interworking”**

Bits								Octets
8	7	6	5	4	3	2	1	
Encapsulation Identifier								6 (Note 1, 2)
0	0	0	0	0	0	0	1	
Length of encapsulation contents								6.1
CII flag	Encapsulation mode							6.2
Forward maximum number of cells identifier								6.3* (Note 3)
0	0	0	0	0	0	1	0	
Forward maximum number of cells value								6.3.1*
								6.3.2*
Backward maximum number of cells identifier								6.4* (Note 3)
0	0	0	0	0	0	1	1	
Backward maximum number of cells value								6.4.1*
								6.4.2*
Forward maximum frame size identifier								6.5* (Note 4)
0	0	0	0	0	1	0	0	
Forward maximum frame size value								6.5.1*
								6.5.2*
Backward maximum frame size identifier								6.6* (Note 4)
0	0	0	0	0	1	0	1	
Backward maximum frame size value								6.6.1*
								6.6.2*

Note 1: When present in the SETUP message, the octet group may be repeated up to six times in the order of preference for the encapsulation modes to be used, where the first appearance is considered to be the most desirable.

When present in the CONNECT message, this octet group shall occur only once.

Note 2: The octet groups within octet group 6 are identified using subfield identifiers and are position independent, i.e. they need not appear in a certain order within octet group 6.

Note 3: The Forward/Backward maximum number of cells octet groups may be included for one-to-one cell mode, N-to-one cell mode, and AAL5 PDU frame mode. Absence of these subgroups indicates single cell mode.

Note 4: The Forward/Backward maximum frame size octet groups are required for AAL5 SDU frame mode.

#### *Encapsulation (octet group 6)*

This octet group defines an encapsulation for this call.

#### *Length of encapsulation contents (octet 6.1)*

Length of the Encapsulation contents in octets, i.e. excluding octets 6 and 6.1.

#### *Encapsulation mode (octet 6.2 bits 1-7)*

Bits								Meaning
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	One-to-one cell mode with no VCIP optimization [Y.1411] and [ATM-MPLS] (Note 1)
0	0	0	0	0	0	1	0	One-to-one cell mode with VCIP optimization [Y.1411] and [ATM-MPLS] (Note 1)
0	0	0	0	0	0	1	1	AAL5 PDU frame mode [Y.1412] and [ATM-MPLS] (Note 2)
0	0	0	0	0	1	0	0	N-to-one cell mode with single call restriction [Y.1411] and [N1] (Notes 3,4)
0	0	0	0	0	1	0	1	AAL5 SDU frame mode [Y.1412]

Note 1: If the Forward/Backward maximum number of cells is set to "1" then the encapsulation mode shall be one-to-one cell mode with single cell encapsulation [Y.1411] or single cell mode [ATM-MPLS]. If the Forward/Backward maximum number of cells is set to a value greater than "1" then the encapsulation mode shall be one-to-one cell mode with concatenated cell encapsulation [Y.1411] or concatenated cell mode [ATM-MPLS].

Note 2: If the Forward/Backward maximum number of cells is set to "1" then the encapsulation mode shall be one-to-one cell mode with single cell encapsulation [Y.1411] or single cell mode [ATM-MPLS].

Note 3: If the Forward/Backward maximum number of cells is set to "1" then the encapsulation mode shall be N-to-one cell mode with single cell encapsulation [Y.1411]. If the Forward/Backward maximum number of cells is set to a value greater than "1" then the encapsulation mode shall be N-to-one cell mode with concatenated cell encapsulation [Y.1411].

Note 4: The single call restriction means each interworking LSP is restricted to encapsulate only one VCC or one VPC. See Annex A for additional procedures regarding usage

of VPI/VCI in the user plane when using the N-to-one cell mode as specified in [Y.1411] and [N1].

*Common interworking indicators (CII flag) (octet 6.2 bit 8)*

This bit indicates the presence of the common interworking indicators field.

Bits								Meaning
8	7	6	5	4	3	2	1	
0								Common interworking indicators field absent (Note 1)
1								Common interworking indicators field present (Note 1)

Note 1 This field is referred to as the “Common interworking indicators” field in [Y.1411]. In [ATM-MPLS], this is referred to as the “Reserved” and “Sequence Number” fields.

*Forward Maximum Number of Cells Value (octet 6.3.1 – 6.3.2)*

The forward maximum number of cells value specifies the maximum number of cells that the preceding side shall encapsulate into a single MPLS frame, using the one-to-one cell, AAL5 PDU frame, or N-to-one cell mode.

*Backward Maximum Number of Cells Value (octet 6.4.1 – 6.4.2)*

The backward maximum number of cells value specifies the maximum number of cells that the succeeding side shall encapsulate into a single MPLS frame, using the one-to-one cell, AAL5 PDU frame, or N-to-one cell mode.

*Forward Maximum Frame Size value (octets 6.5.1 – 6.5.2)*

The forward maximum frame size value specifies the maximum size in octets of the AAL5 SDU frame (for AAL5 SDU frame mode) that can be transported over the forward interworking LSP.

*Backward Maximum Frame Size value (octets 6.6.1 – 6.6.2)*

The backward maximum frame size value specifies the maximum size in octets of the AAL5 SDU frame (for AAL5 SDU frame mode) that can be transported over the backward interworking LSP.

## 5 PNNI Support of ATM-MPLS Network Interworking [Normative]

### 5.1 Protocol Model

The following figure replaces Figure 6-2: PNNI Control plane of [PNNI 1.1] for ATM-MPLS network interworking:

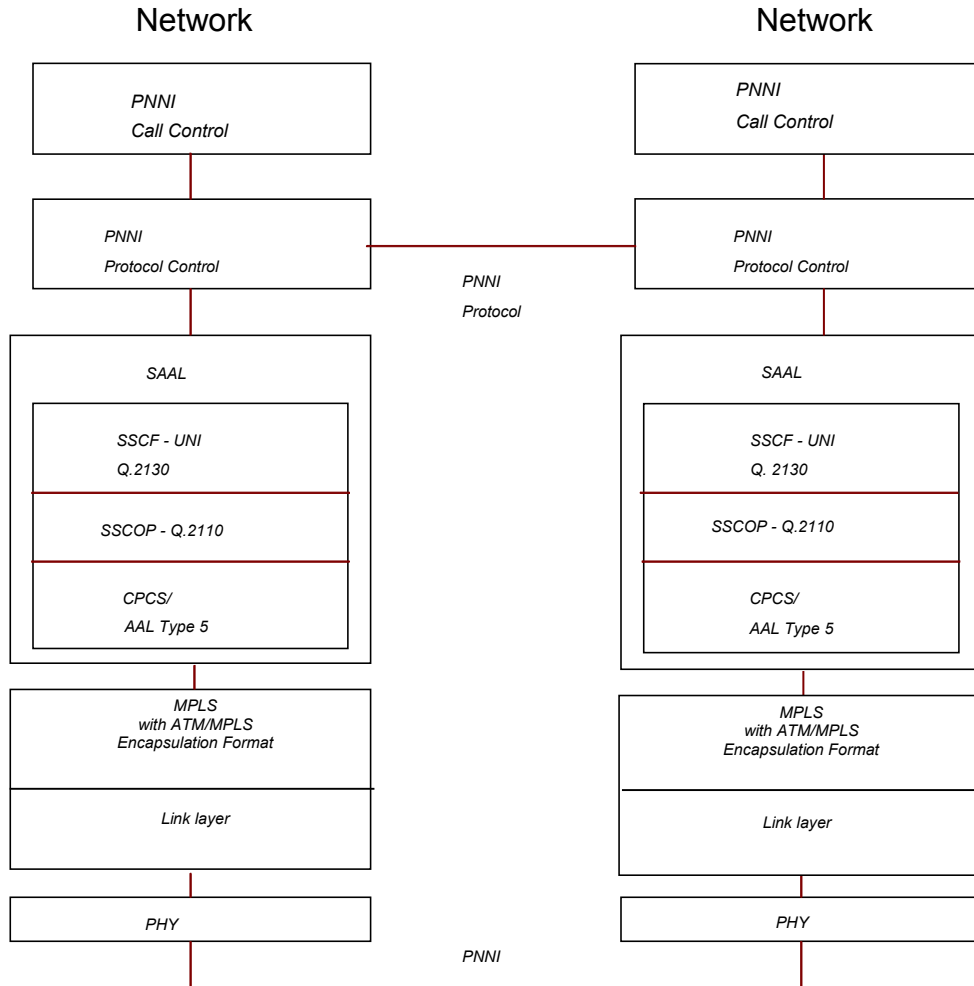


Figure 5-1 PNNI Control Plane for ATM-MPLS network interworking

All subsections of 6.1.3 of [PNNI 1.1] containing protocol layer descriptions are applicable to ATM-MPLS network interworking. In addition, this specification defines a new protocol layer, the MPLS Layer, as follows:

#### 5.1.1 MPLS Layer

PNNI signalling can be used over an MPLS interface to establish interworking LSPs to carry data associated with an ATM virtual connection or path. In this case, the MPLS layer provides a transparent transport for the SAAL layer between two communicating entities. The encapsulation format used for the

signalling channel shall be one of the encapsulation formats of the interworking LSPs supported by this specification. This includes all the formats supported by the encoding of the Interworking information element specified in Section 4.2. If more than one encapsulation mode is supported for the signalling channel, the ATM-MPLS INE shall support provisioning of the encapsulation mode and applicable interworking parameters for the signalling channel. If supported, it is recommended that the “AAL5 PDU frame mode” encapsulation be used for the interworking LSPs carrying the signalling channel.

## 5.2 Additions to PNNI Signalling messages

This section specifies the necessary additions/changes for ATM-MPLS network interworking signalling.

*ATM-MPLS network interworking adds the Interworking row and modifies the Connection identifier row in Table 6-5 of [PNNI 1.1] as follows:*

Bits		Information Element	Max Length	Min Length	Max no of Occurrences	Reference
8 7 6 5	4 3 2 1					
0 1 0 1	1 0 1 0	Connection identifier	14	9	1	Section 4.1
0 1 1 1	1 0 1 0	Interworking	59	8	1	Section 4.2

Figure 5-2 Information element changes for ATM-MPLS network interworking

### 5.2.1 CALL PROCEEDING

*Replace the Connection identifier row of Figure 6-4 of [PNNI 1.1] as follows:*

Information Element name	Reference	Type	Length
Connection identifier	Section 4.1	M	14 <sup>(1)</sup>

Note 1: The length of this information element applies for ATM-MPLS network interworking.

Figure 5-3 CALL PROCEEDING message content changes

### 5.2.2 CONNECT

*Add the following row to Figure 6-5 of [PNNI 1.1]:*

Information Element name	Reference	Type	Length
Interworking	Section 4.2	M <sup>(1)</sup>	8-14

Note 1: This information element shall be present for ATM-MPLS network interworking.

Figure 5-4 CONNECT message content changes

### 5.2.3 SETUP

Replace the Connection identifier row and add a row for the Interworking information element to Figure 6-8 of [PNNI 1.1] as follows:

Information Element name	Reference	Type	Length
Connection identifier	Section 4.1	M <sup>(1)</sup>	14
Interworking	Section 4.2	M <sup>(2)</sup>	8-59

Note 1: The Type and Length of this information element applies for ATM-MPLS network interworking

Note 2: This information element shall be present for ATM-MPLS network interworking.

Figure 5-5 SETUP message content changes

### 5.2.4 RESTART

Replace the Connection identifier row of Figure 6-17 of [PNNI 1.1] as follows:

Information Element name	Reference	Type	Length
Connection identifier	Section 4.1	O	9-14

Figure 5-6 RESTART message content changes

### 5.2.5 RESTART ACKNOWLEDGE

Replace the Connection identifier row of Figure 6-17 of [PNNI 1.1] as follows:

Information Element name	Reference	Type	Length
Connection identifier	Section 4.1	O <sup>(2)</sup>	9-14

Figure 5-7 RESTART ACKNOWLEDGE message content changes

## 5.3 Additions to PNNI Information Elements

Add the following Crankback cause values to the Crankback information element in Section 6.4.6.3 of [PNNI 1.1]:

Bits	Number	Meaning	Diagnostics
8 7 6 5 4 3 2 1			
1 0 1 0 0 0 0 1	161	Requested interworking label not available	
1 0 1 0 0 0 1 0	162	No interworking label available	
1 0 1 1 0 0 0 0	176	Specified encapsulation not available	

Figure 5-8 New Crankback Causes for ATM-MPLS Network Interworking

## 5.4 PNNI Signalling Procedures for ATM-MPLS Network Interworking

This section defines the additional signalling procedures to support ATM-MPLS network interworking signalling. The procedures for the basic call control in sections 6.5 of [PNNI 1.1] and 6.6 of [PNNI 1.1] shall apply. This section describes additional procedures to handle calls that transit MPLS interfaces.

### 5.4.1 Interworking Label Exchange and VPCI/VCI Allocation

When the preceding side receives a setup request, the procedures for the Connection identifier (VPCI/VCI) allocation/selection in section 6.5.2.2 of [PNNI 1.1], modified as follows, shall apply:

For non-associated signalling:

*Replace case "c" of 6.5.2.2.2.1 of [PNNI 1.1] with:*

- c) Any VPCI; any VCI.

*Replace case "c" of 6.5.2.2.2.2 of [PNNI 1.1] with:*

- c) Any VPCI; no VCI; or,

Note: In some of the ATM-MPLS encapsulation modes (e.g. one-to-one cell mode, AAL5 PDU frame mode, AAL5 SDU frame mode, N-to-one cell mode with single call restriction), the allocated VPCI/VCI values are not used during user plane data transfer.

The preceding side shall assign a backward interworking label and encode it into the Connection identifier information element included in the SETUP message.

If the preceding side cannot allocate a backward interworking label, the call shall be cranked back with cause # 47, "Resource unavailable, unspecified" and crankback cause #162, "No interworking label available".

When the succeeding side supporting ATM-MPLS interworking receives a SETUP message and the Connection identifier information element is not present in the message, the succeeding side shall invoke the procedures for mandatory information element missing, section 6.5.6.7.1 of [PNNI 1.1].

When the succeeding side receives a SETUP message and the Connection identifier information element is present in the SETUP message, and octet group 10 is not present then the succeeding side shall clear the call by invoking mandatory information element content error procedures.

When the succeeding side receives the SETUP message, the succeeding side shall retrieve the backward interworking label. If the succeeding side determines that the label is in use, then:

- the call shall be cranked back with cause # 35, "Requested VPCI/VCI not available" and crankback cause # 161, "Requested interworking label not available", and
- the succeeding side shall notify the entity controlling the use of that label. If it is ATM signalling that is notified, then the call using that label shall be cleared.

The succeeding side shall use the label for the interworking LSP in the backward direction. Then the succeeding side shall allocate the forward interworking label and shall encode it into the Connection identifier information element included in the CALL PROCEEDING message sent in reply to the SETUP message.

If the succeeding side cannot allocate a forward interworking label, the call shall be cranked back with cause # 47 "Resource unavailable, unspecified" and crankback cause #162, "No interworking label available".

When the preceding side receives a CALL PROCEEDING message and the Connection identifier information element is present, and octet group 10 is not present then the preceding side shall clear the call by invoking mandatory information element content error procedures.

The preceding side shall retrieve the forward interworking label. If the preceding side determines that the label is in use, then:

- the call shall be cranked back with cause # 35, "Requested VPCI/VCI not available" and crankback cause # 161 "Requested interworking label not available", and
- the preceding side shall notify the entity controlling the use of that label. If it is ATM signalling that is notified, then the call using that label shall be cleared.

The preceding side shall use the received forward interworking label for the interworking LSP in the forward direction.

## 5.4.2 Indication and Negotiation of Encapsulation Mode

Within this section, the term “Encapsulation mode octet” refers to the combination of the Encapsulation mode (Octet 6.2, bits 1-7) and the CII flag (Octet 6.2 bit 8).

### 5.4.2.1 The procedures at the preceding side

The preceding side shall include the Interworking information element in the SETUP message. The Information Element Instruction Field of the Interworking information element shall be set as follows: bit 5 shall be set to 1 (“follow explicit instruction”), bit 4 shall be set to 0 (“no pass along request”) and the Information Element Action Indicator shall be set to “000” (“clear call”).

If the preceding side does not wish to negotiate the encapsulation mode (including the CII flag), then the preceding side shall encode a single Encapsulation octet group containing the Encapsulation mode octet and forward/backward maximum number of cells or maximum frame size.

If the preceding side wishes to perform negotiation of the encapsulation mode, then the preceding side shall encode multiple Encapsulation octet groups in the Interworking information element in the SETUP message. Each Encapsulation octet group shall contain the Encapsulation mode octet and forward/backward maximum number of cells or maximum frame size. Note that in the case of back to back ATM-MPLS network interworking interfaces (Tandem signalling capability) it may be desirable to have the same Encapsulation mode octets for both interfaces. In such a case, the Encapsulation mode octets for the next hop should be restricted to the Encapsulation mode octets received in the SETUP message.

If the Interworking information element is not present in the CONNECT message, then the preceding side shall invoke the procedures for mandatory information element missing, section 6.5.6.7.1 of [PNNI 1.1].

Otherwise, upon receipt of the CONNECT message, the preceding side shall perform validation of the Encapsulation octet group as indicated below. If an error is detected, the preceding side shall clear the call with cause #100, “Invalid information element contents”. An error is detected if any of the following conditions is true:

1. The received Encapsulation octet group indicates an Encapsulation mode octet that was not included in any Encapsulation octet group of the Interworking information element sent in the SETUP message.
2. More than one Encapsulation octet group is present in the Interworking information element.
3. The received Forward/Backward maximum number of cells value (for one-to-one cell mode, AAL5 PDU frame mode, or N-to-one cell mode) or maximum frame size value (for AAL5 SDU frame mode) exceeds the corresponding value specified for the matching Encapsulation mode octet in the SETUP message.

Upon successful validation of the received Interworking information element, the preceding side shall use the encapsulation mode, CII flag value and, if applicable, forward and backward maximum number of cells or maximum frame size indicated in the received Encapsulation octet group.

### 5.4.2.2 The procedures at the succeeding side

If the Interworking information element with the Encapsulation octet group is not present in the SETUP message, then the succeeding side shall invoke the procedures for mandatory information element missing, section 6.5.6.7.1 of [PNNI 1.1].

The succeeding side shall perform validation of each Encapsulation octet group as indicated below. In the following procedures, an Encapsulation octet group will be considered as not supported if any of the following conditions exist:

1. The Encapsulation mode is not supported.
2. The CII flag value is not supported for the indicated encapsulation mode.
3. A forward/backward maximum number of cells or maximum frame size that is required for the indicated encapsulation mode is missing.



4. An forward/backward maximum number of cells or maximum frame size specified that is not supported for the indicated encapsulation mode.

If the succeeding side does not support encapsulation mode negotiation, it shall only process the first Encapsulation octet group and it shall ignore any additional Encapsulation octet groups.

If the succeeding side supports encapsulation mode negotiation and multiple Encapsulation octet groups were received, the succeeding side shall attempt to support the most preferred Encapsulation octet group (i.e. the first Encapsulation octet group). If the most preferred Encapsulation octet group is not supported for this call, the succeeding side shall attempt to support the second most preferred Encapsulation octet group (i.e. the second Encapsulation octet group) and so on.

If no received Encapsulation octet group can be supported for this call, the call shall be cranked back with cause #127 "Interworking, unspecified" and Crankback cause #176 "Specified encapsulation not available".

The succeeding side shall include the Interworking information element with the selected Encapsulation octet group in the CONNECT message. The values of the forward and backward maximum number of cells or maximum frame size present in the Encapsulation octet group may be negotiated downwards from the values received in the SETUP message. Note that in the case of back to back ATM-MPLS network interworking interfaces (Tandem signalling capability) it may be desirable to have the same encapsulation modes for both interfaces. In such a case, if consistent with the procedures specified above in this section, the Encapsulation octet group received on the next hop shall be included in the Interworking information element of the CONNECT message.

The Information Element Instruction Field of the Interworking information element shall be set as follows: bit 5 shall be set to 1 ("follow explicit instruction"), bit 4 shall be set to 0 ("no pass along request") and the Information Element Action Indicator shall be set to "000" ("clear call").

The succeeding side shall use the indicated encapsulation mode, CII flag value and, if applicable, forward and backward maximum number of cells or maximum frame size.

### 5.4.3 QoS Parameter Selection Procedures

When INEs update the values of cumulative parameters in a SETUP message, as specified in Section 6.5.2.3.5/[PNNI 1.1], the INEs shall account for the effects of MPLS encapsulation. See Section 6.6.1 of [ATM-MPLS] for a discussion concerning the INE's contribution to the accumulated end-to-end maximum CTD and peak-to-peak CDV.

### 5.4.4 Crankback Procedures

When Call Control forwards a call clearing request that was received with a Crankback information element with crankback cause # 176 "Specified encapsulation not available", # 161, "Requested interworking label not available", or #162, "No interworking label available" to a non-MPLS interface then the crankback cause in the call clearing request shall be replaced with # 47 "Resource unavailable, unspecified".

### 5.4.5 Call/Connection Clearing Procedures

The procedures of Section 6.5.3.3/[PNNI 1.1] shall apply with the following addition:

On sending or receipt of a RELEASE message, the INE shall not transmit user plane traffic on the corresponding interworking LSPs, and discard received traffic on the corresponding interworking LSP. On sending or receipt of a RELEASE COMPLETE message, the INE shall clear the corresponding Interworking LSPs (including label release and withdraw).

The procedures of Section 6.5.3.4/[PNNI 1.1] shall apply with the following addition:

If the preceding or succeeding side receives a RELEASE message while in the Release Request State, the INE shall also clear the corresponding Interworking LSPs (including label release and withdraw).

## 5.4.6 Restart Procedures

### 5.4.6.1 VPCI/VCI restart procedures

The procedures in section 6.5.5 of [PNNI 1.1] shall apply.

- Note that as a result of these procedures, the interworking LSP labels associated with the restarted connections shall also be released.

### 5.4.6.2 Interworking LSP restart procedures

In order to restart a single Interworking LSP label used for reception (and any LSPs, connection, resources that may be associated with that label at the peer entity) when an ATM-MPLS INE has the Interworking LSP label used for reception and does not have the corresponding VPCI/VCI, the restart procedures in PNNI 1.1 section 6.5.5 shall be followed with the following modifications:

The Restart indicator information element included in the RESTART and RESTART ACKNOWLEDGE messages shall be encoded with Class set to “000” (indicated virtual channel). Note that although Class is set to “000”, the LSP being restarted may correspond to an ATM VPC or VCC.

The Connection identifier information element included in the RESTART message shall be present and encoded as follows:

- The Coding Standard field shall be set to “00” (ITU-T specified).
- The Preferred/Exclusive field shall be set to “011” (“any VPCI; any VCI”).
- Octet group 10 shall be present and shall contain the corresponding Interworking LSP label allocated for reception.

The entity receiving the RESTART message shall initiate the appropriate actions to return the Interworking LSP label specified in octet 10 of the Connection identifier information element (locally used for transmission), any corresponding connections, and any corresponding Interworking LSP labels (locally used for reception) to the idle condition and to release all associated call references.

Even if the specified interworking LSP label is in the idle condition or already in the process of restart to the idle condition, the receiving entity shall send a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message.

When an INE transmits a RESTART ACKNOWLEDGE message, the Connection identifier information element shall contain the same Interworking LSP label as specified in the RESTART message received from the originator.

When a RESTART or RESTART ACKNOWLEDGE message is received with:

- the Preferred/Exclusive field set to “011” (any VPCI; any VCI) and the octet group 10 not present in the Connection identifier information element; or
- the Class in the Restart indicator information element not coded as “000” (indicated virtual channel),

the Connection identifier information element shall be treated as described in 5.6.7.2/Q.2931 (Mandatory information element content error).

When an Interworking LSP label has been specified in a restart request, the label shall not be considered free for reuse until the restart procedure have been completed.

## 5.5 PNNI Routing Changes for ATM-MPLS Network Interworking

This section specifies the changes to Section 5 of [PNNI 1.1] required for ATM-MPLS network interworking signalling.

### **5.5.1 PNNI routing control channel over an MPLS interface.**

*Section 5.5 of [PNNI 1.1] applies with the addition of the following text at the end of case 1 and 2:*

When PNNI operates over an MPLS interface, the PNNI routing protocol exchange will take place over a pair of interworking LSPs that are identified by a pair of interworking labels. The encapsulation format used for the PNNI routing control channel shall be one of the encapsulation formats of the interworking LSPs supported by this specification. This includes all the formats supported by the encoding of the Interworking information element specified in Section 4.2. If more than one encapsulation mode is supported for the PNNI routing control channel, the ATM-MPLS INE shall support provisioning of the encapsulation mode, and applicable interworking parameters for the PNNI routing control channel. If supported, it is recommended that the "AAL5 PDU frame mode" encapsulation be used for the interworking LSPs carrying the PNNI routing control channel.

### **5.5.2 PNNI Resource Availability Information**

The aggregate traffic characteristics of a logical ATM interface supported by the MPLS layer must be translated into PNNI resource availability information that is advertised to other PNNI nodes. This translation is network specific.

## **6 AINI Support of ATM-MPLS Network Interworking [Normative]**

### **6.1 Additions to AINI Signalling Messages**

The message coding changes defined in section 5.2 shall apply.

### **6.2 Additions to AINI Information Elements**

The information element coding changes defined in section 5.3 shall apply.

### **6.3 AINI Signalling Procedures for ATM-MPLS Network Interworking**

The procedures in section 5.4 shall apply.

## **Annex A Additional User Plane Procedures for N-to-one Cell Mode as Defined in [Y.1411] and [N1].**

### **A.1 Problem Description**

In [Y.1411], translation of the VPI/VCI at the ingress IWF is not required in all cases for N-to-one cell mode. Quoting from Section 7.2 of [Y.1411]:

Note: When multiple VCCs or VPCs are transported in one interworking LSP, VPI/VCI values shall be unique. When the multiple VCCs or VPCs are from different physical transmission paths, it may be necessary to assign unique VPI/VCI values to the ATM connections. If they are from the same physical transmission path, the VPI/VCI values are unique.

Quoting from Section 9.6 of [Y.1411]:

#### **VPI**

The ingress IWF shall copy the VPI field from the incoming cell into this field. See note in figure 7.2 for more detail.

#### **VCI**

The ingress IWF shall copy the VCI field from the incoming ATM cell header into this field. See note in figure 7.2 for more detail.

Note that if the VPI/VCI is not translated at the ingress IWFs, then the VPI/VCI values of encapsulated cells will typically differ in the forward and backward directions.

Whether an IWF translates VPI/VCI values in the ATM-to-MPLS direction is not signalled between the IWFs. Thus, an IWF sending or receiving a SETUP message that indicates “N-to-one cell mode with single call restriction” cannot assume that the remote IWF is translating VPI/VCI values in the ATM-to-MPLS direction. So, an IWF cannot assume that the VPCI/VCI values specified in the Connection identifier information element are related to the VPI/VCI values received in the user plane. For this reason, new user plane procedures are required when N-to-one cell mode is used with this specification.

### **A.2 New Procedures for N-to-one Cell Mode with Single Call Restriction**

For a VCC, the preceding side shall ignore the VPI/VCI received in the backward direction in the user plane, and the succeeding side shall ignore the VPI/VCI received in the forward direction in the user plane. For a VPC, the preceding side shall ignore the VPI received in the backward direction in the user plane, and the succeeding side shall ignore the VPI received in the forward direction in the user plane.

## Annex B Protocol Implementation Conformance Statement (PICS) for the PNNI 1.1 Components of the Signalling support of ATM-MPLS Network Interworking.

### B.1 Introduction

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

#### B.1.1 Scope

This document provides the PICS pro-forma for the PNNI 1.1 components of the ATM-MPLS Network Interworking defined in [ATM-MPLS-SIG] in compliance with the relevant requirements, and in accordance with the relevant guidelines, given in ISO/IEC 9646-7. In most cases, statements contained in notes in the specification, which were intended as information, are not included in the PICS.

#### B.1.2 Normative References

- [9646-1] ISO/IEC 9646-1: 1994, Information technology – Open systems interconnection – Conformance testing methodology and framework – Part 1: General Concepts (See also ITU Recommendation X.290 (1995)).
- [9646-7] ISO/IEC 9646-7: 1995, Information technology – Open systems interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements (See also ITU Recommendation X.296 (1995))
- [9646-3] ISO/IEC 9646-3:1998, Information technology – Open systems interconnection – Conformance testing methodology and interconnection – Part 3: The Tree and Tabular Combined Notation (TTCN) (See also ITU telecommunication X.292 (1998)).
- [ATM-MPLS-SIG] ATM Forum Technical Committee, “ATM-MPLS Network Interworking Signalling, Version 1.0”, af-cs-0197.000, August 2003.
- [PNNI 1.1] ATM Forum Technical Committee, “Private Network-Network Interface Specification Version 1.1 (PNNI 1.1)”, af-pnni-0055.002, April 2002.

#### B.1.3 Definitions

Terms defined in [ATM-MPLS-SIG]

Terms defined in ISO/IEC 9646-1 and in ISO/IEC 9646-7

In particular, the following terms defined in ISO/IEC 9646-1 apply:

**Protocol Implementation Conformance Statement (PICS):** A statement made by the supplier of an implementation or system, stating which capabilities have been implemented for a given protocol.

**PICS proforma:** A document, in the form of a questionnaire, designed by the protocol specifier or conformance test suite specifier, which when completed for an implementation or system becomes the PICS.

#### B.1.4 Acronyms

ASN.1 Abstract Syntax Notation One  
ATS Abstract Test Suite  
IUT Implementation Under Test  
PICS Protocol Implementation Conformance Statement  
SUT System Under Test

### **B.1.5 Conformance**

The PICS does not modify any of the requirements detailed in the signalling support of ATM-MPLS Network Interworking. In case of apparent conflict between the statements in the base specification and in the annotations of “m” (mandatory) and “o” (optional) in the PICS, the text of the base specification takes precedence.

The supplier of a protocol implementation, which is claimed to conform to the PNNI 1.1 components of the ATM Forum signaling support of ATM-MPLS Network Interworking, is required to complete a copy of the PICS pro-forma provided in this document and is required to provide the information necessary to identify both the supplier and the implementation.

## **B.2 Identification of the Implementation**

Identification of the Implementation Under Test (IUT) and system in which it resides (the System Under Test (SUT)) should be filled in so as to provide as much detail as possible regarding version numbers and configuration options.

The product supplier information and client information should both be filled in if they are different.

A person who can answer queries regarding information supplied in the PICS should be named as the contact person.

### **B.2.1 Date of Statement**

---

#### **B.2.2 Implementation Under Test (IUT) Identification**

**IUT Name:**

**IUT Version:**

#### **B.2.3 System Under Test (SUT) Identification**

**SUT Name:**

**Hardware Configuration:**

**Operating System:**

## **B.2.4 Product Supplier**

**Name:**

**Address:**

**Telephone Number:**

**Facsimile Number:**

**Email Address:**

**Additional Information:**

## **B.2.5 Client**

**Name:**

**Address:**

**Telephone Number:**

**Facsimile Number:**

**Email Address:**

**Additional Information:**

## **B.2.6 PICS Contact Person**

(A person to contact if there are any queries concerning the content of the PICS)

**Name:**

**Telephone Number:**

**Facsimile Number:**

**Email Address:**



**Additional Information:****Identification of the Protocol Specification**

This PICS pro-forma applies to the following standard:

[ATM-MPLS-SIG] ATM Forum Technical Committee, "ATM-MPLS Network Interworking Signalling, Version 1.0", af-cs-0197.000, August 2003.

**B.3 PICS Proforma****B.3.1 Global statement of conformance**

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

YES

NO

Note: Answering "No" indicates non-conformance to the specified protocol. Non-supported mandatory capabilities are to be identified in the following tables, with an explanation by the implementor explaining why the implementation is non-conforming.

**B.3.2 Instructions for Completing the PICS Proforma**

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

The following notations, defined in ISO/IEC 9647-7, are used for the support column:

Yes supported by the implementation  
 No not supported by the implementation

The following notations, defined in ISO/IEC 9647-7, are used for the status column:

m mandatory – the capability is required to be supported.  
 o optional – the capability may be supported or not.  
 o.i qualified optional – for mutually exclusive or selectable options from a set. "i" is an integer which identifies a unique group of related optional items and the logic of their selection is defined immediately following the table.

A supplier may also provide additional information, categorized as exceptional or supplementary information. These additional information should be provided as items labeled X.<i> for exceptional information, or S.<i> for supplemental information, respectively, for cross reference purposes, where <i> is any unambiguous identification for the item. The exception and supplementary information are not mandatory and the PICS is complete without such information. The presence of optional supplementary or exception information should not affect test execution, and will in no way affect interoperability

verification. The column labeled 'Reference' gives a pointer to sections of the protocol specification for which the PICS Proforma is being written.

## B.4 PICS for the support of ATM-MPLS Network Interworking at the PNNI interface

### B.4.1 Major Capability at PNNI the interface (MCP)

Item Number	Item Description	Status	Condition for status	Reference	Support
MCP1	Does the IUT support the ATM-MPLS Network Interworking feature at the PNNI interface?	M		1.1	Yes__ No__
Comments:					

### B.4.2 Subsidiary Capability at the PNNI interface (SCP)

Item Number	Item Description	Status	Condition for status	Reference	Support
SCP1	Does the IUT support ATM-MPLS Network Interworking for the establishment of point-to-point calls?	M		1.1	Yes__ No__
SCP2	Does the IUT support ATM-MPLS Network Interworking for the establishment of point-to-multipoint calls, if point-to-multipoint calls are supported?	M		1.1	Yes__ No__
SCP3	Does the IUT support negotiation of encapsulation mode?	O		5.4.2	Yes__ No__
Comments:					

### B.4.3 Supported Information Elements at the PNNI Interface (SIEP)

Item Number	Item Description	Status	Condition for status	Reference	Support
SIEP1	Does the IUT support the Connection identifier information element, coded as specified in section 4.1 for ATM-MPLS Network Interworking, in the CALL PROCEEDING message?	M		5.2.1	Yes__ No__
SIEP2	Does the IUT support the Interworking information element with the Encapsulation octet group, coded as specified in section 4.2, in the CONNECT message?	M		5.2.2	Yes__ No__
SIEP3	Does the IUT support the Connection identifier information element, coded as specified in section 4.1 for ATM-MPLS	M		5.2.3	Yes__ No__

	Network Interworking, in the SETUP message?				
SIEP4	Does the IUT support the Interworking information element with the Encapsulation octet group, coded as specified in section 4.2, in the SETUP message?	M		5.2.3	Yes__ No__
SIEP5	Does the IUT support the Connection identifier information element, coded as specified in section 4.1, in the RESTART message?	M		5.2.4	Yes__ No__
SIEP6	Does the IUT support the Connection identifier information element, coded as specified in section 4.1, in the RESTART ACKNOWLEDGE message?	M		5.2.5	Yes__ No__
SIEP7	Does the IUT support new crankback cause values as specified in section 5.3 of this specification?	M		5.3	Yes__ No__
Comments:					

#### B.4.4 Signalling Procedures at the PNNI Interface (SPP)

Item Number	Item Description	Status	Condition for status	Reference	Support
SPP1	Does the IUT support provisioning of encapsulation mode and, as applicable, the forward and backward maximum number of cells or maximum frame size for the signaling channels, if more than one encapsulation is supported for signalling channels?	O		5.1.1	Yes__ No__
SPP2	Does the IUT use the "AAL5 PDU frame mode" encapsulation for the interworking LSPs carrying the signalling channels, if the IUT supports "AAL5 PDU frame mode" encapsulation?	O		5.1.1	Yes__ No__
SPP3	Does the IUT on the preceding side assign a backward Interworking label and encode the label into the Connection identifier information element, coded as specified in section 4.1, in a SETUP message when it receives a setup request?	M		5.4.1	Yes__ No__
SPP4	Does the IUT on the preceding side crank back a call with cause # 47, "Resource unavailable, unspecified" and crankback cause # 162, "No interworking label available", if it cannot allocate a backward interworking label on receiving a setup request?	M		5.4.1	Yes__ No__
SPP5	Does the IUT on the succeeding side	M		5.4.1	Yes__ No__

	invoke the procedures for mandatory information element missing, if the Connection identifier information element is not present in the received SETUP message?				
SPP6	Does the IUT on the succeeding side clear a call by invoking mandatory information element content error procedures if octet group 10 is not present in the Connection identifier information element in the received SETUP message?	M		5.4.1	Yes__ No__
SPP7	Does the IUT on the succeeding side crankback the call with cause # 35, "Requested VPCI/VCI not available" and crankback cause # 161, "Requested interworking label not available", and notify the entity controlling the use of the label, if the retrieved backward interworking label from the Connection identifier information element in the received SETUP message is already in use?	M		5.4.1	Yes__ No__
SPP8	Does the IUT clear the call or multiple calls, if ATM signalling is the entity controlling the use of backward interworking labels and the IUT is notified of a label conflict as described in section 5.4.1?	M		5.4.1	Yes__ No__
SPP9	Does the IUT on the succeeding side use the backward interworking label it for the interworking LSP in the backward direction?	M		5.4.1	Yes__ No__
SPP10	Does the IUT on the succeeding side allocate a forward Interworking label and encode the label into the Connection identifier information element, coded as specified in section 4.1, in the CALL PROCEEDING message sent in reply to a SETUP message with a valid Connection identifier information element?	M		5.4.1	Yes__ No__
SPP11	Does the IUT on the succeeding side crankback the call using cause # 47 "Resource unavailable, unspecified", and crankback cause # 162, "No interworking label available", if it cannot allocate a forward interworking label on receiving a SETUP message?	M		5.4.1	Yes__ No__
SPP12	Does the IUT on the preceding side clear a call by invoking mandatory information element content error procedures if octet group 10 is not present in the Connection identifier	M		5.4.1	Yes__ No__

	information element in the received CALL PROCEEDING message?				
SPP13	Does the IUT on the preceding side crankback the call with cause # 35, "Requested VPCI/VCI not available", and crankback cause # 161, "Requested interworking label not available", and notify the entity controlling the use of the label, if the retrieved forward interworking label from the Connection identifier information element in the received CALL PROCEEDING message is already in use?	M		5.4.1	Yes__ No__
SPP14	Does the IUT clear the call or multiple calls, if ATM signalling is the entity controlling the use of forward interworking labels and the IUT is notified of a label conflict as described in section 5.4.1?	M		5.4.1	Yes__ No__
SPP15	Does the IUT on the preceding side use the received forward interworking label for the interworking LSP in the forward direction?	M		5.4.1	Yes__ No__
SPP16	Does the IUT on the preceding side include the Interworking information element in a SETUP message, with the Information Element Instruction Field, coded as specified in section 5.4.2.1?	M		5.4.2.1	Yes__ No__
SPP17	Does the IUT on the preceding side include the Interworking information element in the SETUP message with a single Encapsulation octet group containing the Encapsulation mode octet and forward/backward maximum number of cells or maximum frame size, as required, if the IUT does not wish to negotiate the encapsulation mode?	M		5.4.2.1	Yes__ No__
SPP18	Does the IUT on the preceding side encode multiple Encapsulation octet groups in the Interworking information element in the SETUP message, with each Encapsulation octet group containing the Encapsulation mode octet and forward/backward maximum number of cells or maximum frame size, as required, if it wishes to perform negotiation of encapsulation mode?	M	SCP3	5.4.2.1	Yes__ No__
SPP19	Does the IUT on the preceding side restrict the encapsulation mode octets included in the Encapsulation octet groups of the Interworking information element encoded into the SETUP message to those in the SETUP message received at the succeeding side of the	O		5.4.2.1	Yes__ No__

	previous hop?				
SPP20	Does the IUT on the preceding side invoke the procedures for mandatory information element missing, if the Interworking information element is not present in the received CONNECT message?	M		5.4.2.1	Yes__ No__
SPP21	Does the IUT on the preceding side clear a call with cause #100 "Invalid information element contents", if an Interworking information element with invalid contents, as specified in section 5.4.2.1, is received in a CONNECT message?	M		5.4.2.1	Yes__ No__
SPP22	Does the IUT on the preceding side use the encapsulation mode, CII flag value, and, if applicable, the forward and backward maximum number of cells or maximum frame size indicated in the received Encapsulation octet group upon successful validation of the received Interworking information element?	M		5.4.2.1	Yes__ No__
SPP23	Does the IUT on the succeeding side invoke the procedures for mandatory information element missing, if the Interworking information element is not present in the received SETUP message?	M		5.4.2.2	Yes__ No__
SPP24	Does the IUT on the succeeding side clear a call according to the procedures for mandatory information element with content error, when an Interworking information element with invalid Encapsulation octet group, as specified in section 5.4.2.2, is received in a SETUP message?	M		5.4.2.2	Yes__ No__
SPP25	Does the IUT on the succeeding side process only the first Encapsulation octet group, if the IUT does not support encapsulation mode negotiation?	M		5.4.2.2	Yes__ No__
SPP26	Does the IUT on the succeeding side attempt to support the Encapsulation octet groups of the Interworking information element of the received SETUP message, in the order the Encapsulation octet groups appear, if multiple Encapsulation octet groups are received and the IUT supports encapsulation mode negotiation?	M	SCP3	5.4.2.2	Yes__ No__
SPP27	Does the IUT on the succeeding side clear a call with cause #127, "Interworking, unspecified" and Crankback information element with crankback cause #176 "Specified encapsulation not available", if none of	M		5.4.2.2	Yes__ No__

	the encapsulation modes can be supported?				
SPP28	Does the IUT on the succeeding side include the Interworking information element with the selected Encapsulation octet group with, as applicable, values for the forward and backward maximum number of cells or maximum frame size negotiated downwards from the values received in the SETUP message, in the CONNECT message?	M		5.4.2.2	Yes__ No__
SPP29	Does the IUT on the succeeding side include the Encapsulation octet group received on the next hop in the Interworking information element of the CONNECT message?	O		5.4.2.2	Yes__ No__
SPP30	Does the IUT at the succeeding side encode the Interworking information element with the Information Element Instruction Field encoded as specified in section 5.4.2.2?	M		5.4.2.2	Yes__ No__
SPP31	Does the IUT at the succeeding side use the indicated encapsulation mode, CII flag value, and, if applicable, forward and backward maximum number of cells or maximum frame size?	M		5.4.2.2	Yes__ No__
SPP32	Does the IUT account for the effects of MPLS encapsulation when it updates values of cumulative parameters in a SETUP message as specified in 6.5.2.3.5/[PNNI 1.1]?	M		5.4.3	Yes__ No__
SPP33	Does the IUT replace the crankback cause with # 47, "Resource unavailable, unspecified", when Call Control forwards to a non-MPLS interface a call clearing request that was received with a Crankback information element with crankback cause # 176 "Specified encapsulation not available", # 161, "Requested interworking label not available", or #162, "No interworking label available"?	M		5.4.4	Yes__ No__
SPP34	Does the IUT follow the procedures of Section 6.5.3.3/[PNNI 1.1], not transmit user plane traffic on the corresponding interworking LSPs, and discard received traffic on the corresponding interworking LSP, on sending or receipt of a RELEASE message?	M		5.4.5	Yes__ No__
SPP35	Does the IUT follow the procedures of Section 6.5.3.3/[PNNI 1.1] and also clear the corresponding Interworking LSPs, on sending or receipt of a RELEASE COMPLETE message?	M		5.4.5	Yes__ No__

SPP36	Does the IUT follow the procedures of Section 6.5.3.4/[PNNI 1.1] and clear the corresponding Interworking LSPs, on receipt of a RELEASE message while in the Release Request State?	M		5.4.5	Yes__ No__
SPP37	Does the IUT release the Interworking LSP labels associated with the restarted connection?	M		5.4.6.1	Yes__ No__
SPP38	Does the IUT set the Class to "000" (indicated virtual channel) in the RESTART and RESTART ACKNOWLEDGE messages?	M		5.4.6.2	Yes__ No__
SPP39	Does the IUT include the Connection identifier information element encoded as specified in 5.4.6.2 in the RESTART and RESTART ACKNOWLEDGE messages?	M		5.4.6.2	Yes__ No__
SPP40	Does the IUT initiate the appropriate actions to return the Interworking LSP label specified in octet 10 of the Connection identifier information element (locally used for transmission), any corresponding connections, and any corresponding Interworking LSP labels (locally used for reception) to the idle condition and to release all associated call references, on receipt of a RESTART message?	M		5.4.6.2	Yes__ No__
SPP41	Does the IUT send a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message, even if the specified interworking LSP label is in the idle condition or already in the process of restart to the idle condition?	M		5.4.6.2	Yes__ No__
SPP42	Does the IUT encode the same Interworking LSP label as specified in the RESTART message received from the originator in the Connection identifier information element, when an INE transmits a RESTART ACKNOWLEDGE message?	M		5.4.6.2	Yes__ No__
SPP43	Does the IUT invoke the procedures for Mandatory Information Element content error on receipt of a RESTART or RESTART ACKNOWLEDGE message with content error as described in 5.4.6.2?	M		5.4.6.2	Yes__ No__
SPP44	Does the IUT ensure the Interworking LSP label specified in the restart request is not reused for a new connection until the restart procedure have been completed?	M		5.4.6.2	Yes__ No__
SPP45	Does the IUT support provisioning of	O		5.5.1	Yes__ No__



	encapsulation mode and, as applicable, the forward and backward maximum number of cells or maximum frame size for the PNNI routing control channels, if more than one encapsulation is supported for PNNI routing control channels?				
SPP46	Does the IUT use the “AAL5 PDU frame mode” encapsulation for the interworking LSPs carrying the PNNI routing control channels, if the IUT supports “AAL5 PDU frame mode” encapsulation?	O		5.5.1	Yes__ No__
Comments:					

## Annex C Protocol Implementation Conformance Statement (PICS) for the AINI Components of the Signalling support of ATM-MPLS Network Interworking.

### C.1 Introduction

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

#### C.1.1 Scope

This document provides the PICS proforma for the AINI components of signalling support of ATM-MPLS Network Interworking defined in [ATM-MPLS-SIG] in compliance with the relevant requirements, and in accordance with the relevant guidelines, given in ISO/IEC 9646-7. In most cases, statements contained in notes in the specification, which were intended as information, are not included in the PICS.

#### C.1.2 Normative References

- [9646-1] ISO/IEC 9646-1: 1994, Information technology – Open systems interconnection – Conformance testing methodology and framework – Part 1: General Concepts (See also ITU Recommendation X.290 (1995)).
- [9646-7] ISO/IEC 9646-7: 1995, Information technology – Open systems interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements (See also ITU Recommendation X.296 (1995)).
- [9646-3] ISO/IEC 9646-3:1998, Information technology – Open systems interconnection – Conformance testing methodology and interconnection – Part 3: The Tree and Tabular Combined Notation (TTCN) (See also ITU telecommunication X.292 (1998)).
- [ATM-MPLS-SIG] ATM Forum Technical Committee, “ATM-MPLS Network Interworking Signalling, Version 1.0”, af-cs-0197.000, August 2003.
- [PNNI 1.1] ATM Forum Technical Committee, “Private Network-Network Interface Specification Version 1.1 (PNNI 1.1)”, af-pnni-0055.002, April 2002.

#### C.1.3 Definitions

Terms defined in [ATM-MPLS-SIG]

Terms defined in ISO/IEC 9646-1 and in ISO/IEC 9646-7

In particular, the following terms defined in ISO/IEC 9646-1 apply:

**Protocol Implementation Conformance Statement (PICS):** A statement made by the supplier of an implementation or system, stating which capabilities have been implemented for a given protocol.

**PICS proforma:** A document, in the form of a questionnaire, designed by the protocol specifier or conformance test suite specifier, which when completed for an implementation or system becomes the PICS.

#### C.1.4 Acronyms

ASN.1 Abstract Syntax Notation One

ATS	Abstract Test Suite
IUT	Implementation Under Test
PICS	Protocol Implementation Conformance Statement
SUT	System Under Test

### **C.1.5 Conformance**

The PICS does not modify any of the requirements detailed in the signalling support of ATM-MPLS Network Interworking. In case of apparent conflict between the statements in the base specification and in the annotations of “m” (mandatory) and “o” (optional) in the PICS, the text of the base specification takes precedence.

The supplier of a protocol implementation, which is claimed to conform to the AINI components of the ATM Forum signalling support of ATM-MPLS Network Interworking, is required to complete a copy of the PICS proforma provided in this document and is required to provide the information necessary to identify both the supplier and the implementation.

## **C.2 Identification of the Implementation**

Identification of the Implementation Under Test (IUT) and system in which it resides (the System Under Test (SUT)) should be filled in so as to provide as much detail as possible regarding version numbers and configuration options.

The product supplier information and client information should both be filled in if they are different.

A person who can answer queries regarding information supplied in the PICS should be named as the contact person.

### **C.2.1 Date of Statement**

---

### **C.2.2 Implementation Under Test (IUT) Identification**

**IUT Name:**

**IUT Version:**

### **C.2.3 System Under Test (SUT) Identification**

**SUT Name:**

**Hardware Configuration:**

**Operating System:**

### **C.2.4 Product Supplier**

**Name:**

**Address:**

**Telephone Number:**

**Facsimile Number:**

**Email Address:**

**Additional Information:**

### **C.2.5 Client**

**Name:**

**Address:**

**Telephone Number:**

**Facsimile Number:**

**Email Address:**

**Additional Information:**

### **C.2.6 PICS Contact Person**

(A person to contact if there are any queries concerning the content of the PICS)

**Name:**

**Telephone Number:**

**Facsimile Number:**

**Email Address:**

**Additional Information:**

### **Identification of the Protocol Specification**

This PICS proforma applies to the following standard:

[ATM-MPLS-SIG] ATM Forum Technical Committee, "ATM-MPLS Network Interworking Signalling, Version 1.0", af-cs-0197.000, August 2003.

## **C.3 PICS Proforma**

### **C.3.1 Global statement of conformance**

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

YES

NO

Note: Answering "No" indicates non-conformance to the specified protocol. Non-supported mandatory capabilities are to be identified in the following tables, with an explanation by the implementor explaining why the implementation is non-conforming.

### **C.3.2 Instructions for Completing the PICS Proforma**

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

The following notations, defined in ISO/IEC 9647-7, are used for the support column:

Yes supported by the implementation

No not supported by the implementation

The following notations, defined in ISO/IEC 9647-7, are used for the status column:

m mandatory – the capability is required to be supported.

o optional – the capability may be supported or not.

- o.i qualified optional – for mutually exclusive or selectable options from a set. “i” is an integer which identifies a unique group of related optional items and the logic of their selection is defined immediately following the table.

A supplier may also provide additional information, categorized as exceptional or supplementary information. These additional information should be provided as items labelled X.<i> for exceptional information, or S.<i> for supplemental information, respectively, for cross reference purposes, where <i> is any unambiguous identification for the item. The exception and supplementary information are not mandatory and the PICS is complete without such information. The presence of optional supplementary or exception information should not affect test execution, and will in no way affect interoperability verification. The column labelled ‘Reference’ gives a pointer to sections of the protocol specification for which the PICS Proforma is being written.

## C.4 PICS for the support of ATM-MPLS Network Interworking at the AINI interface

### C.4.1 Major Capability at AINI the interface (MCA)

Item Number	Item Description	Status	Condition for status	Reference	Support
MCA1	Does the IUT support the ATM-MPLS Network Interworking feature at the AINI interface?	M		1.1	Yes__ No__
Comments:					

### C.4.2 Subsidiary Capability at the AINI interface (SCA)

Item Number	Item Description	Status	Condition for status	Reference	Support
SCA1	Does the IUT support ATM-MPLS Network Interworking for the establishment of point-to-point calls?	M		1.1	Yes__ No__
SCA2	Does the IUT support ATM-MPLS Network Interworking for the establishment of point-to-multipoint calls, if point-to-multipoint calls are supported?	M		1.1	Yes__ No__
SCA3	Does the IUT support negotiation of encapsulation mode?	O		6.3	Yes__ No__
Comments:					

### C.4.3 Supported Information Elements at the AINI Interface (SIEA)

Item Number	Item Description	Status	Condition for status	Reference	Support
SIEA1	Does the IUT support the Connection identifier information element, coded as specified in section 4.1 for ATM-MPLS Network Interworking, in the CALL	M		6.1	Yes__ No__

	PROCEEDING message?				
SIEA2	Does the IUT support the Interworking information element with the Encapsulation octet group, coded as specified in section 4.2, in the CONNECT message?	M		6.1	Yes__ No__
SIEA3	Does the IUT support the Connection identifier information element, coded as specified in section 4.1 for ATM-MPLS Network Interworking, in the SETUP message?	M		6.1	Yes__ No__
SIEA4	Does the IUT support the Interworking information element with the Encapsulation octet group, coded as specified in section 4.2, in the SETUP message?	M		6.1	Yes__ No__
SIEA5	Does the IUT support the Connection identifier information element, coded as specified in section 4.1, in the RESTART message?	M		6.1	Yes__ No__
SIEA6	Does the IUT support the Connection identifier information element, coded as specified in section 4.1, in the RESTART ACKNOWLEDGE message?	M		6.1	Yes__ No__
SIEA7	Does the IUT support new crankback cause values as specified in section 5.3 of this specification?	M		6.2	Yes__ No__
Comments:					

#### C.4.4 Signalling Procedures at the AINI Interface (SPA)

Item Number	Item Description	Status	Condition for status	Reference	Support
SPA1	Does the IUT support provisioning of encapsulation mode and, as applicable, the forward and backward maximum number of cells or maximum frame size for the signalling channels, if more than one encapsulation is supported for signalling channels?	O		6.3	Yes__ No__
SPA2	Does the IUT use the "AAL5 PDU frame mode" encapsulation for the interworking LSPs carrying the signalling channels, if the IUT supports "AAL5 PDU frame mode" encapsulation?	O		6.3	Yes__ No__
SPA3	Does the IUT on the preceding side assign a backward Interworking label and encode the label into the Connection identifier information element, coded as specified in section 4.1, in a SETUP message when it receives a setup	M		6.3	Yes__ No__

	request?				
SPA4	Does the IUT on the preceding side crank back a call with cause # 47, "Resource unavailable, unspecified" and crankback cause # 162, "No interworking label available", if it cannot allocate a backward interworking label on receiving a setup request?	M		6.3	Yes__ No__
SPA5	Does the IUT on the succeeding side invoke the procedures for mandatory information element missing, if the Connection identifier information element is not present in the received SETUP message?	M		6.3	Yes__ No__
SPA6	Does the IUT on the succeeding side clear a call by invoking mandatory information element content error procedures if octet group 10 is not present in the Connection identifier information element in the received SETUP message?	M		6.3	Yes__ No__
SPA7	Does the IUT on the succeeding side crankback the call with cause # 35, "Requested VPCI/VCI not available" and crankback cause # 161, "Requested interworking label not available", and notify the entity controlling the use of the label, if the retrieved backward interworking label from the Connection identifier information element in the received SETUP message is already in use?	M		6.3	Yes__ No__
SPA8	Does the IUT clear the call or multiple calls, if ATM signalling is the entity controlling the use of backward interworking labels and the IUT is notified of a label conflict as described in section 5.4.1?	M		6.3	Yes__ No__
SPA9	Does the IUT on the succeeding side use the backward interworking label for the interworking LSP in the backward direction?	M		6.3	Yes__ No__
SPA10	Does the IUT on the succeeding side allocate a forward Interworking label and encode the label into the Connection identifier information element, coded as specified in section 4.1, in the CALL PROCEEDING message sent in reply to a SETUP message with a valid Connection identifier information element?	M		6.3	Yes__ No__
SPA11	Does the IUT on the succeeding side crankback the call using cause # 47 "Resource unavailable, unspecified" and	M		6.3	Yes__ No__



	crankback cause # 162, "No interworking label available", if it cannot allocate a forward interworking label on receiving a SETUP message?				
SPA12	Does the IUT on the preceding side clear a call by invoking mandatory information element content error procedures if octet group 10 is not present in the Connection identifier information element in the received CALL PROCEEDING message?	M		6.3	Yes__ No__
SPA13	Does the IUT on the preceding side crankback the call with cause # 35, "Requested VPCI/VCI not available" and crankback cause # 161, "Requested interworking label not available", and notify the entity controlling the use of the label, if the retrieved forward interworking label from the Connection identifier information element in the received CALL PROCEEDING message is already in use?	M		6.3	Yes__ No__
SPA14	Does the IUT clear the call or multiple calls, if ATM signalling is the entity controlling the use of forward interworking labels and the IUT is notified of a label conflict as described in section 5.4.1?	M		6.3	Yes__ No__
SPA15	Does the IUT on the preceding side use the received forward interworking label for the interworking LSP in the forward direction?	M		6.3	Yes__ No__
SPA16	Does the IUT on the preceding side include the Interworking information element in a SETUP message, with the Information Element Instruction Field, coded as specified in section 4.2?	M		6.3	Yes__ No__
SPA17	Does the IUT on the preceding side include the Interworking information element in the SETUP message with a single Encapsulation octet group containing the Encapsulation mode octet and forward/backward maximum number of cells or maximum frame size, as required, if the IUT does not wish to support negotiation of encapsulation mode?	M		6.3	Yes__ No__
SPA18	Does the IUT on the preceding side encode multiple Encapsulation octet groups in the Interworking information element in the SETUP message, with each Encapsulation octet group containing the Encapsulation mode octet and forward/backward maximum	M	SCA3	6.3	Yes__ No__

	number of cells or maximum frame size, as required, if it wishes to perform negotiation of encapsulation mode?				
SPA19	Does the IUT on the preceding side restrict the Encapsulation mode octets included in the Encapsulation octet groups of the Interworking information element encoded into the SETUP message to those in the SETUP message received at the succeeding side of the previous hop?	O		6.3	Yes__ No__
SPA20	Does the IUT on the preceding side invoke the procedures for mandatory information element missing, if the Interworking information element is not present in the received CONNECT message?	M		6.3	Yes__ No__
SPA21	Does the IUT on the preceding side clear a call with cause #100 "Invalid information element contents", if an Interworking information element with invalid contents, as specified in section 5.4.2.1, is received in a CONNECT message?	M		6.3	Yes__ No__
SPA22	Does the IUT on the preceding side use the encapsulation mode, CII flag value, and, if applicable, the forward and backward maximum number of cells or maximum frame size indicated in the received Encapsulation octet group for the bearer channel upon successful validation of the received Interworking information element?	M		6.3	Yes__ No__
SPA23	Does the IUT on the succeeding side invoke the procedures for mandatory information element missing, if the Interworking information element is not present in the received SETUP message?	M		6.3	Yes__ No__
SPA24	Does the IUT on the succeeding side clear a call according to the procedures for mandatory information element with content error, when an Interworking information element with invalid Encapsulation octet group contents, as specified in section 5.4.2.2, is received in a SETUP message?	M		6.3	Yes__ No__
SPA25	Does the IUT on the succeeding side process only the first Encapsulation octet group, if the IUT does not support encapsulation mode negotiation?	M		6.3	Yes__ No__
SPA26	Does the IUT on the succeeding side attempt to support the Encapsulation octet groups of the Interworking information element of the received	M	SCA3	6.3	Yes__ No__

	SETUP message, in the order the Encapsulation octet groups appear, if multiple Encapsulation octet groups are received and the IUT supports encapsulation mode negotiation?				
SPA27	Does the IUT on the succeeding side clear a call with cause #127, "Interworking, unspecified" and Crankback information element with crankback cause #176, "Specified encapsulation not available", if none of the encapsulation modes can be supported?	M		6.3	Yes__ No__
SPA28	Does the IUT on the succeeding side include the Interworking information element with the selected Encapsulation octet group with, as applicable, values for the forward and backward maximum number of cells or maximum frame size negotiated downwards from the values received in the SETUP message, in the CONNECT message?	M		6.3	Yes__ No__
SPA29	Does the IUT on the succeeding side include the Encapsulation octet group received on the next hop in the Interworking information element of the CONNECT message?	O		6.3	Yes__ No__
SPA30	Does the IUT at the succeeding side encode the Interworking information element with the Information Element Instruction Field encoded as specified in section 5.4.2.2?	M		6.3	Yes__ No__
SPA31	Does the IUT at the succeeding side use the indicated encapsulation mode, CII flag value, and, if applicable, forward and backward maximum number of cells or maximum frame size?	M		6.3	Yes__ No__
SPA32	Does the IUT account for the effects of MPLS encapsulation when it updates values of cumulative parameters in a SETUP message as specified in 6.5.2.3.5/[PNNI 1.1]?	M		6.3	Yes__ No__
SPA33	Does the IUT replace the crankback cause with # 47, "Resource unavailable, unspecified", when Call Control forwards to a non-MPLS interface a call clearing request that was received with a Crankback information element with crankback cause # 176 "Specified encapsulation not available", # 161, "Requested interworking label not available", or #162, "No interworking label available"?	M		6.3	Yes__ No__
SPA34	Does the IUT follow the procedures of	M		6.3	Yes__ No__

	Section 6.5.3.3/[PNNI 1.1], not transmit user plane traffic on the corresponding interworking LSPs, and discard received traffic on the corresponding interworking LSP, on sending or receipt of a RELEASE message?				
SPA35	Does the IUT follow the procedures of Section 6.5.3.3/[PNNI 1.1] and also clear the corresponding Interworking LSPs, on sending or receipt of a RELEASE COMPLETE message?	M		6.3	Yes__ No__
SPA36	Does the IUT follow the procedures of Section 6.5.3.4/[PNNI 1.1] and clear the corresponding Interworking LSPs, on receipt of a RELEASE message while in the Release Request State?	M		6.3	Yes__ No__
SPA37	Does the IUT release the Interworking LSP labels associated with the restarted connection?	M		6.3	Yes__ No__
SPA38	Does the IUT set the Class to "000" (indicated virtual channel) in the RESTART and RESTART ACKNOWLEDGE messages?	M		6.3	Yes__ No__
SPA39	Does the IUT include the Connection identifier information element encoded as specified in 5.4.6.2 in the RESTART and RESTART ACKNOWLEDGE messages?	M		6.3	Yes__ No__
SPA40	Does the IUT initiate the appropriate actions to return the Interworking LSP label specified in octet 10 of the Connection identifier information element (locally used for transmission), any corresponding connections, and any corresponding Interworking LSP labels (locally used for reception) to the idle condition and to release all associated call references, on receipt of a RESTART message?	M		6.3	Yes__ No__
SPA41	Does the IUT send a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message, even if the specified interworking LSP label is in the idle condition or already in the process of restart to the idle condition?	M		6.3	Yes__ No__
SPA42	Does the IUT encode the same Interworking LSP label as specified in the RESTART message received from the originator in the Connection identifier information element, when an INE transmits a RESTART ACKNOWLEDGE message?	M		6.3	Yes__ No__
SPA43	Does the IUT invoke the procedures for	M		6.3	Yes__ No__

	Mandatory Information Element content error on receipt of a RESTART or RESTART ACKNOWLEDGE message with content error as described in 5.4.6.2?				
SPA44	Does the IUT ensure the Interworking LSP label specified in the restart request is not reused for a new call until the restart procedure have been completed?	M		6.3	Yes__ No__
Comments:					