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ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Y.1417/Q.3151

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ATM and frame relay/MPLS control plane interworking: Client-server

ITU-T Recommendation Y.1417/Q.3151

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ITU-T Recommendation Y.1417/Q.3151

ATM and frame relay/MPLS control plane interworking: Client-server

Summary

ITU-T Recommendation Y.1417/Q.3151 defines the control plane and control protocol client-server interworking procedures for ATM and frame relay connections across an IP/MPLS packet-switched network using pseudo wires.

Source

ITU-T Recommendation Y.1417/Q.3151 was approved on 13 June 2007 by ITU-T Study Group 13 (2005-2008) under the ITU-T Recommendation A.8 procedure.

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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

CONTENTS

Introduction

Many network providers are offering and delivering VC-based services across dedicated frame relay and ATM networks. Many of these same providers have embarked upon a strategy of convergence where many per-service networks and their attendant technologies and services are migrated to a single IP/MPLS packet-switched network (PSN). It is envisaged that existing network services such as frame relay and ATM and emerging new services including IP VPN will operate over this multi-service converged PSN.

ATM networks employ dynamic signalling and routing protocols to expedite connection setup and recovery. PNNI is an example of one such protocol used to dynamically set up switched ATM connections across a native ATM network [ATM pnni-0055]. When transitioning to a PSN, service providers will expect their existing ATM operations infrastructure to work with minimal modifications. In particular, control protocols for routing and signalling must continue to work end-to-end.

The Internet Engineering Task Force (IETF) has developed pseudo wire (PW) technology [b-IETF RFC 3985] to emulate services over a PSN. Specifically, [b-IETF RFC 4717] defines how to emulate ATM connections over a PSN. These specifications, however, only describe the data plane behaviour. They do not define how an ATM connection setup interacts with PW setup.

Other methods enabling switched connection setup across an MPLS network have been defined in [b-ITU-T Y.1416] and [b-ATM cs-0197]. In these approaches, each connection setup or teardown in the client control plane triggers the setup or teardown of a corresponding pseudo wire.

The terminology used in this Recommendation is based upon the terminology associated with the control and user plane protocols of the organization responsible for them. For example, within the MPLS core network IETF terminology is used (e.g., pseudo wire, PE, etc.).

This Recommendation covers issues with *client-server* interworking. It is one of a set of documents addressing control plane interworking of MPLS with ATM and frame relay. See also [b-ITU-T Y.1416].

ITU-T Recommendation Y.1417/Q.3151

ATM and frame relay/MPLS control plane interworking: Client-server

1 Scope

This Recommendation defines the control plane and control protocol interworking procedures for ATM and frame relay connections across an IP/MPLS packet-switched network using pseudo wires.

The following items are not within the scope of this Recommendation:

- Peer-partition interworking between ATM and frame relay control planes.
- Peer-partition interworking between ATM (or frame relay) and IP/MPLS control planes for setting up and managing switched connections between ATM (or frame relay) and IP/MPLS end-points.
- L2TPv3 pseudo wires [b-IETF RFC 3931].

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; 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[IETF RFC 3036] IETF RFC 3036 (2001), *LDP Specification*.

[IETF RFC 4447] IETF RFC 4447 (2006), *Pseudowire Setup and Maintenance using the Label Distribution Protocol (LDP)*.

[ATM pnni-0055] ATM Forum af-pnni-0055.002 (2002), *Private Network-Network Interface Specification Version 1.1*.

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AINI	ATM Inter-Network Interface
ATM	Asynchronous Transfer Mode
BGP	Border Gateway Protocol
DSS2	Digital Subscriber Signalling System No. 2
IGP	Interior Gateway Protocol
IP	Internet Protocol
LDP	Label Distribution Protocol
LER	Label Edge Router

LSP	Label Switched Path
MP-BGP	Multi-Protocol BGP
MPLS	Multi-Protocol Label Switching
NNI	Network Node Interface
PNNI	Private Network-Network Interface
PSN	Packet Switched Network
PW	Pseudo Wire
PWE3	Pseudo wire Emulation Edge-to-Edge group
RSVP-TE	Resource Reservation Protocol – Traffic Engineering
UNI	User Network Interface
VC	Virtual Connection
VCI	Virtual Connection Identifier
VPI	Virtual Path Identifier
VPN	Virtual Private Network

5 Conventions

None.

6 Requirements

The requirements for the client-server control plane interworking functions include:

- The architecture should allow and support a wide range of ATM and frame relay control plane protocols, including intra-network and inter-network (NNI) protocols such as PNNI, AINI, IISP, X.76, etc., and UNI protocols such as ATM Forum UNI 3.1 and 4.0, Q.2931 and X.36.
  - Support for these protocols should not be reduced to subsets of functionality.
- This approach needs to be *scalable* in a number of dimensions, to allow it to be used effectively in service provider networks, to support signalling rates commonly found in today's ATM networks, and to allow network growth and expansion. These dimensions include:
  - Performance: This approach should not reduce the signalling capabilities required in current client networks.
  - Network resources: This approach must make effective use of network resources.
- This architecture should allow to the greatest extent possible the reuse of existing specifications and implementations. In particular:
  - Minimal changes to current ATM and frame relay networks should be required to support the architecture.
  - Existing IETF mechanisms should be used whenever possible.
  - The use of MPLS network resilience mechanisms is encouraged to allow ATM and FR VCs to survive switch or link outages within the MPLS network, if at all possible. ATM and FR-layer VC clearing should be avoided if at all possible.
- Support multiple ATM services classes efficiently.

7 Architecture

Figure 1 depicts the high-level architecture. Client networks operating a native client (routing and signalling) control plane attached to label edge routers (LER) that are part of an IP/MPLS PSN. The LERs operate an IP/MPLS control plane (e.g., IGP/BGP, LDP, PWE3, RSVP-TE, etc.) to set up and manage label switched paths (LSP) across the network. The LERs also operate one or more instances of a co-located client control plane or may interface to a client control plane running on a separate physical or logical device.

Client network control plane messages used to dynamically route, set up, manage and tear down client network point-to-point connections (e.g., PNNI) are processed by client network devices and the client control plane instance physically or logically affiliated with the corresponding LER. Receipt of client control plane messages by an LER will dynamically trigger the corresponding IP/MPLS server network control plane functions necessary to carry encapsulated client network payloads contained in pseudo wires across the IP/MPLS PSN from one client network device to another.

The high-level design principles behind this solution are:

- Separation of client and pseudo wire (IP/MPLS) control planes. Some interaction may take place between the control planes but that interaction should be constrained and should allow each to be essentially unaware of the technical details of the other. (The mechanism and interface for interaction, known as the *pseudo wire service interface,* are not issues for standardization.) Optional use of aggregation functionality at the edge of the client network, enables separation of client control and pseudo wire control in different devices.
- Use of IETF defined PW control mechanisms as the PW control plane in all scenarios except those with a null PW control plane. Other PW control plane mechanisms are not precluded.

[b-ITU-T Q.2920] has previously defined techniques that enable switched connection setup across an MPLS network. The client networks are ATM and the client control plane is DSS2. Extensions are defined for DSS2 to signal PW labels between the MPLS edge devices. The client and PW control functions are collapsed into a single protocol.

The solution defined in this Recommendation opts for a different approach by decoupling the client and PW control planes so as to lessen the dependencies of one on the other. Each is allowed to operate and evolve separately from the other. It also enables different client control planes (e.g., frame relay) to employ the same PW control plane. Conversely different PW control planes depending on the PSN type (i.e., MPLS or IP) may be used to support client networks.

The architecture allows two scenarios: one in which both control planes run on the same physical internetworking element at the edge of the MPLS network; the other allowing for separation of client control and pseudo wire control in different physical (or possibly logical) devices.

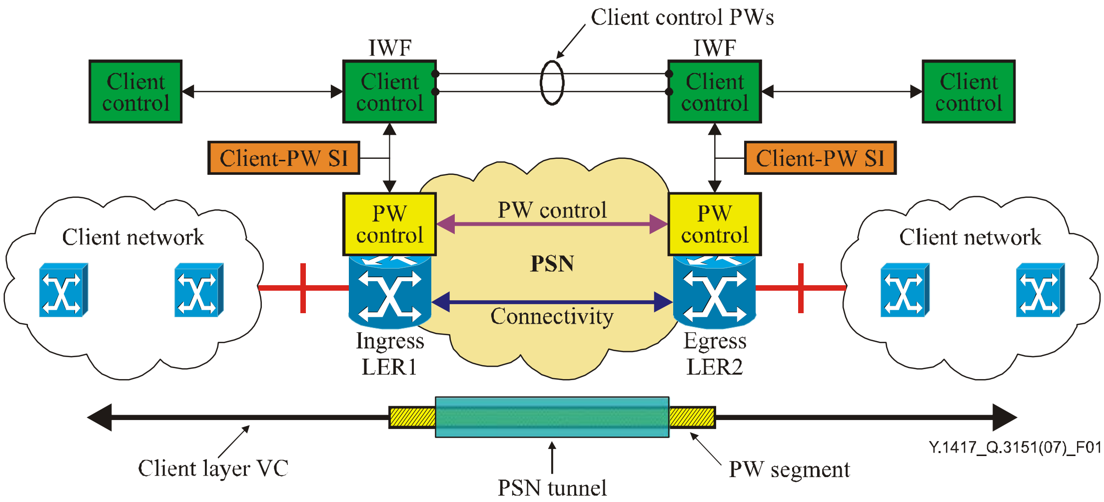

Figure 1 – High-level architecture

A *packet-switched network* (PSN) provides *MPLS* infrastructure to support *pseudo wires.* A *label edge router* (LER) provides an *interworking function* (IWF) that connects the PSN and a segment of the client network. In the user plane, the LER interworks each client virtual connection, including virtual connections for control and management, with a single pseudo wire that emulates the connection across the PSN. The IWF also supports interworking between a *client control plane* and a set of functions which support setup, teardown, and maintenance of pseudo wires, which is called the *pseudo wire control plane.* This is done by means of a *pseudo wire service interface* within the IWF. Pseudo wires may also be used to carry client control plane traffic between LERs. An LER is considered an *ingress LER* if a client control plane setup request first enters the PSN through it, and an *egress LER* if the setup request leaves through it. An ingress LER is always *upstream* of an egress LER, which is *downstream*.

Between the ingress and egress LERs, *PSN tunnels* are established, and pseudo wires are carried encapsulated in these PSN tunnels. PSN tunnels can be any technology, as described in [b-IETF RFC 3985].

The mapping between client connections and pseudo wires is as follows: One pseudo wire is established for each client connection. Each client virtual connection is mapped to a single pseudo wire which meets the service requirements of the client virtual connection, and which is established on-demand. These pseudo wires are carried in PSN tunnels which satisfy connection service requirements.

7.1 Client-pseudo wire control plane interactions

Separation of client and PW control planes is a basic principle.

The PW control plane manages pseudo wire setup and teardown, multiplexing, and service differentiation. Other functionality is left to the client control plane, thus allowing support for simple client control planes such as Ethernet and frame relay, as well as complex client control planes such as ATM PNNI that have significant differences with the PW control plane in state machine, timers, and semantics. Interactions between the client and pseudo wire control planes are discussed in more detail in the clauses below.

8 The pseudo wire control plane

This Recommendation uses IETF-defined control mechanisms [IETF RFC 4447] as the initial PW control plane in all scenarios except those with a null PW control plane. Other PW control plane mechanisms are not precluded.

In providing services to the client control plane, the offered PW control plane capabilities can be:

- Null, with all PW management done by configuration. When the client control plane makes a request, it can only be satisfied by preconfigured pseudo wires.
- Connection management. The PW control plane can know where the connection points are that the client control plane might want, but PW need not be set up until they are needed.

When the PW control plane is used, at a minimum, it is responsible for setup and teardown of pseudo wires between LERs. This requires exchange of pseudo wire-related information between the LERs (such as the pseudo wire labels, the encapsulation used to transport client data in the pseudo wire, and some identification of the attachment circuits to which the pseudo wire is bound at the LERs).

9 The client control plane

A pseudo wire service interface can provide services for a diversity of client control planes, varying both in protocol family and in functionality. Just as the PW control plane can vary, the client control plane functions at the service interface can be any of:

- Null, with all client protocol management done by configuration.
- Connection management only. Connections are set up dynamically but the client control plane expects a particular topology from the PSN.
- Connection and connectivity management. The client control plane explores its connectivity, determines paths to use, and sets up connections dynamically. An example is ATM PNNI.

When a client control plane is used at the LERs, it is responsible for establishment, maintenance, and release of attachment circuits on the LERs' interfaces facing the client networks, as well as propagation of end-to-end client control plane information across the PSN. The information exchanged by the client control plane includes both end-to-end information such as the called party address, traffic descriptors, and endpoint application information, and (at the interfaces connecting the client networks to the LERs) local information such as the ATM VPI/VCI or the frame relay DLCI. The local information is not needed for the user plane connection segment across the PSN, (PW-related information is handled by the pseudo wire control plane), but this information may still be exchanged between the LERs to be used by the control and management planes.

There are several options for routing client control plane connection establishment messages across the PSN:

- Static routes may be configured at the client network and at the LERs, based on prefixes of client control plane addresses.
- Dynamic routing may be included in the client control plane, both between the client network and the LERs, and between LERs across the PSN. For example, if the client layer is ATM, PNNI may be used, with each LER represented as one lowest level node in the PNNI topology. PGL and border node functionality may be used at LERs. The PSN places no restrictions on the use of PNNI hierarchy.

- Prefixes of client control plane addresses can be exchanged across the PSN network using a PSN routing protocol such as MP-BGP. When this information is exchanged between LERs, each LER uses this information to decide dynamically how a setup request should be directed, based upon topology and resource availability at the time, and to respond well to failures.

  The use of MP-BGP for exchanging ATM reachability across the PSN is for further study.
- Combinations of the above may be used.

9.1 Logical links

From the client control plane's point of view, the connectivity between a pair of LERs appears as a logical link over which client connections can be established. The logical link may have a set of resources associated with it, for example, for advertisement in a client routing protocol such as PNNI. Note that these resources need not be exclusive to this client control plane instance. They can be shared by all or a subset of applications at the LER.

A set of client control channels (e.g., ATM signalling, PNNI routing and ILMI) is associated with each logical link.

Typically there will be only one instance of a logical link between a pair of LERs for each client control plane (though presence of multiple logical links is not precluded). If a client routing protocol is used, only one instance of that client routing protocol needs to run between the LERs.

The fact that the connectivity between the LERs appears to the client control plane as a logical link does not imply that there is any restriction on the usage of PSN tunnels. Any PSN tunnel between the LERs is a candidate for transport of the pseudo wires that carry client user connections and client control channels between the LERs, subject to policy, QoS, or other constraints as for any other pseudo wire between the LERs.

9.2 Establishment of control pseudo wires

The support of dynamic client (ATM or frame relay) connections across an intermediate IP or MPLS network requires the transport of client signalling messages and depending upon the configuration client routing and link management messages between the LERs.

Some client layer protocols (i.e., ATM) employ reserved native client encapsulation headers (i.e., ATM uses VPI/VCI values) to identify connections associated with various protocols or functions. These values may have a per-interface context, which means that a native client node can receive the same client encapsulation header from other native client nodes with the understanding that <client encapsulation header, interface> provides a combination that uniquely identifies the sender. MPLS pseudo wires, on the other hand, use a per-platform label range.

Before client control messages can be carried across a PSN tunnel, the LER at each end of the PSN tunnel must be made aware of the labels that will carry the control channel traffic for that instance of the client control plane between the LERs. These client control channels must be identified so that the data on the corresponding control pseudo wire is delivered to the correct instance of the client control plane and not forwarded out an egress interface.

There are three distinct control pseudo wires that can be established between peering LERs:

- Signalling control PW: This is mandatory if the client control plane is non-null.
- Routing control PW: This is optional.
- Link management PW: This is optional.

9.2.1 Control pseudo wire signalling

The native client control channel to pseudo wire label bindings are distributed as defined in [IETF RFC 4447]. The LERs establish an LDP session using the extended discovery mechanism described in [IETF RFC 3036]. An LDP Label Mapping message is used to establish the relationship between the client control channels and labels. An LDP Label Mapping message contains a FEC TLV, a label TLV, and zero or more optional parameter TLVs.

To remain consistent with the signalling procedures for the establishment of data-bearing pseudo wires outlined in clause 10, it is mandatory that LDP signalling of control pseudo wires employ the generalized ID FEC element (type 129).

MPLS packets on a given control PW (or any PW) are forwarded within an LER by a forwarder. The concept of an attachment identifier (AI) is used to identify the forwarder to which a pseudo wire is attached. The AI is unique within the context of the LER in which the forwarder resides, so the combination of <LER, AI> is globally unique in the network.

Forwarders within an LER can be associated with a group, where pseudo wires may only be set up among members of the group. Forwarders associated with the group are identified by an attachment group identifier (AGI) and an attachment individual identifier (AII). This pair represents the AI.

The AGI, source AII (SAII), and target AII (TAII) are encoded as TLVs and described in Figure 2. This Recommendation does not define any restrictions on the contents of the AGI.

The format for an AII is illustrated in Figure 2. This format is used for both the SAII and the TAII.

0	15		31
AII Type	Length	Control channel type	Control plane instance identifier
Control plane instance identifier (cont'd)			

Figure 2 – SAI and TAI format for control PW setup

AII (type) field

This one-byte field contains the AII type codepoint used for establishing control PWs. The length of the corresponding value associated with this AII type is specified by IANA and shown in Table 1.

Table 1 – AII type codepoint for control PW setup

AII Type Codepoint	Length	Meaning
0x03	Variable (1-33 bytes)	ATM/FR control channel

Control channel type

This one-byte field indicates the control channel type as specified in Table 2 below.

Table 2 – Control channel type field values

Control channel type	Meaning
0	PNNI_routing control channel
1	ATM signalling
2	ILMI
3	Frame relay signalling

Control plane instance identifier

The control plane instance identifier is used to distinguish among multiple client control plane instances running between the same two LERs. This could be due to the possibility of multiple different control planes being used between the two LERs, e.g., ATM and frame relay, or due to multiple instances of the same client control plane being used between the two LERs.

Connections for the same logical link shall use the same value of the CPII in the AII. Connections for different logical links between the same two LERs that use the same value for the AGI shall use different values in the AII.

The control plane instance identifier takes the form of a variable length human-readable character string conforming to [b-IETF RFC 2277] and is not to exceed 32 octets in length. The default value for the CPII is the null string specified by setting the length field to 1.

10 ATM and FR to LDP signalling interworking

This clause contains the procedures for interworking ATM and FR signalling with IETF PW signalling, and will employ the following terminology:

- PW source LER – first LER to initiate a PW control plane message directed towards the PW target LER.
- PW target LER – Receiver of initial PW control plane message sent from the PW source LER.

The ingress and egress LERs respectively are defined in clause 7.

10.1 ATM and FR to LDP signalling interworking procedures

When the client control plane's SETUP message arrives at the ingress LER, the setup request is passed to the client control plane's call control in the usual fashion. PW signalling shall not be initiated. If PW connection admission control is supported, the LER shall determine whether the PSN has adequate resources to support the connection across the PSN to the egress LER. If the PSN does not have adequate resources, the call shall be cleared (possibly using crankback) using normal client control plane procedures.

When the client control plane's SETUP message arrives at the egress LER, the setup request is passed to the client control plane's call control in the usual fashion. If PW connection admission control is supported, the LER shall determine whether the PSN has adequate resources to support the connection across the PSN to the ingress LER. If the PSN does not have adequate resources, the call shall be cleared (possibly using crankback) using normal client control plane procedures.

If the PSN has adequate resources or if PW connection admission control is not supported, the client control plane's call control shall trigger the PW control plane to initiate PW establishment using the generalized PW ID FEC element (FEC Type 129), as defined in [IETF RFC 4447]. Details of construction of the TAI are discussed in clause 10.2

If the egress LER's PW control plane is unable to send the Label Mapping message for any reason such as no label resources available, the call shall be cleared (possibly using crankback) using normal client control plane procedures. If the reason why the PW control plane is unable to send the Label Mapping message is due to congestion in the PW control plane (i.e., lack of internal resources such as queuing resources, memory and CPU realtime), and the client control plane is ATM PNNI or AINI including support for signalling congestion control, the call shall be cleared using crankback with cause and crankback cause #42 "Switching Equipment Congestion" [ATM pnni-0055]. In the absence of errors, the egress LER shall start the PseudoWireFailureTimer with initial value the same as T310 (as defined for ATM and frame relay signalling) for this client control plane instance. The egress LER has two options for the propagation of the SETUP message in the client control plane:

1) hold the SETUP message until the PW control plane indicates that PW establishment has been completed; or

2) immediately forward the SETUP message towards the called party.

Option 1 must be employed if the client control plane requires that the data plane be established as the SETUP message is progressed. This is the case when the setup request indicates "susceptible to clipping" in the broadband bearer capability information element. Figure 3 illustrates option 2, and also clarifies that the egress LER is performing the role of PW source LER.

When the Label Mapping message is received at an LER, the normal procedures for the generalized PW ID FEC element defined in [IETF RFC 4447] shall be followed. If the TAI does not indicate a known pseudo wire for which an LSP has already been set up in the opposite direction, then it is assumed that this is the ingress LER (i.e., PW target LER). The TAI is used to associate the control information for the client connection and pseudo wire. If the TAI contains a call reference value that is not known to the indicated client control plane instance, then the procedures for a TAI that cannot be mapped to a forwarder shall be followed (defined in [IETF RFC 4447]), causing the Label Mapping message to be rejected.

If the TAI contains a call reference value that is known to the indicated client control plane instance, then that call reference shall be used to determine the appropriate forwarder as the pseudo wire endpoint. If a forwarder has been determined but the corresponding client control connection is not in a compatible pending state on the logical link (for example, if this router is not an ingress LER for this client connection), then the Label Mapping message shall be rejected and the client connection shall be cleared in both directions using normal client control plane procedures.

If a forwarder has been determined and there are any errors in the Label Mapping message that cause it to be rejected, then the client connection shall be cleared in both directions using normal client control plane procedures. If the ingress LER's PW control plane is unable to send the Label Mapping message for the second LSP of the pseudo wire for any reason such as no label resources available, then the first LSP of the pseudo wire shall be released and the client connection shall be cleared using normal client control plane procedures. If the reason why the ingress LER's PW control plane is unable to send the Label Mapping message for the second LSP is congestion in the pseudo wire control plane (i.e., lack of internal resources such as queuing resources, memory and CPU realtime), and the client control plane is ATM PNNI or AINI including support for signalling congestion control, the call shall be cleared using crankback with cause and crankback cause #42 "Switching Equipment Congestion" [ATM pnni-0055].

When the Label Mapping message is received at an LER and the TAI indicates a known pseudo wire for which an LSP has already been set up in the opposite direction, then it is assumed that this is the egress LER (i.e., PW source LER). If there are any errors in the Label Mapping message that cause it to be rejected, then in addition to replying with a Label Release message as per normal pseudo wire control plane procedures, the label for the other direction of the pseudo wire shall be withdrawn using normal PW control plane procedures and the client connection shall be cleared in both directions using normal client control plane procedures. Otherwise, in addition to the normal procedures defined in [IETF RFC 4447], an indication shall be passed to the client control plane that the PW control plane has completed and the PseudoWireFailureTimer shall be stopped. If option 1 was employed above, the egress LER shall propagate the client control plane's SETUP message towards the called party.

When the client control plane's CONNECT message arrives at the egress LER from the direction of the called party, the connect request is passed to the client control plane's call control in the usual fashion. If no indication has been received indicating that the PW control plane has completed (this is never the case if option 1 was employed above), then the client control plane's call control shall hold the connect request. Once the indication is received from the PW control plane, the client control plane shall resume processing of the connect request, causing the egress LER to progress the CONNECT message to the ingress LER according to normal client control plane procedures. The egress LER shall enable the user plane for the client connection and the corresponding pseudo wire before progressing the CONNECT message. If no indication that the PW control plane has completed is received before the PseudoWireFailureTimer expires, then the pseudo wire shall be cleared using normal PW control plane procedures, and the client connection shall be cleared in both directions using normal client control plane procedures.

When the client control plane's CONNECT message arrives at the ingress LER, normal client control plane procedures are followed. The ingress LER shall enable the user plane for the client connection and the corresponding pseudo wire before progressing the CONNECT message towards the called party. If there is no active pseudo wire for this client connection, then the call shall be cleared in both directions using normal client control plane procedures and the remaining state in the pseudo wire control plane, if any, shall also be cleared.

If a Label Withdraw or Label Release message is received for any pending or active connection, then the pseudo wire shall be cleared using normal PW control plane procedures and the client connection shall be cleared in both directions using normal client control plane procedures.

If a client control plane call clearing message is received for any pending or active connection, or upon initiating call clearing due to client control plane error handling procedures, then in addition to normal client control plane procedures, the pseudo wire shall be cleared using normal PW control plane procedures.

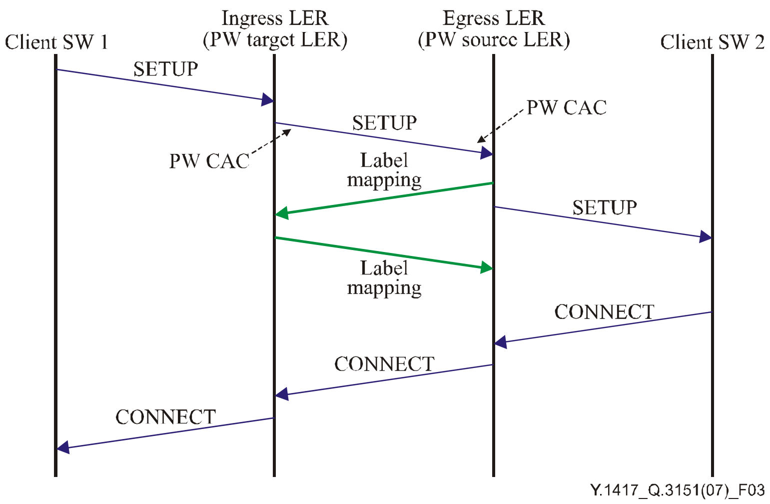

Figure 3 – PW establishment triggered by client connection SETUP at egress LSR

10.2 The SAI and the TAI in LDP signalling

The TAI is used as the key that allows the *PW Target LER* to correlate an incoming Label Mapping message with an ATM or frame relay connection created in response to client control plane messages.

For switched connections established using the client and pseudo wire control planes, the TAII and SAII are encoded as illustrated in Figure 4:

0	15	31
AII type	Length	LDP call reference flag (1 bit) and call reference value
Call reference value (cont'd)	Control plane instance identifier	

Figure 4 – SAI and TAI encoding for client connection PW setup

AII (type) field

This one-byte field contains the AII type codepoint for data-plane PWs. The length of the corresponding value associated with this AII type codepoint is specified by IANA and shown in Table 3.

Table 3 – AII type codepoint for data plane PW setup

AII type codepoint	Length	Meaning
0x04	Variable (3-35 bytes)	ATM/FR signalling call reference

LDP call reference flag

Bit 8	
0	The LER that originated the call reference has a smaller IP address than the opposite LER, based on the IP addresses used to establish this LDP session between the LERs.
1	The LER that originated the call reference has a larger IP address than the opposite LER, based on the IP addresses used to establish this LDP session between the LERs.

Call reference value

The call reference value used in the client (i.e., ATM or frame relay) control plane between the LERs.

Control plane instance identifier

See clause 9.2.1.

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