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Signalling Interworking for Asynchronous Transfer Mode Virtual
Private Wire Service
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Internet-Draft PNNI-L2VPN Interworking

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Abstract

This Internet Draft describes a method for control plane interworking for Asynchronous Transfer Mode (ATM) pseudo wires, where Provider Edge nodes (PEs) on both sides of an MPLS Packet Switched Network (PSN) connect edge ATM networks using the Private Network-Network Interface (PNNI) or the ATM Inter-Network Interface (AINI). In this method, ATM signalling and routing messages are tunnelled over the PSN using dedicated pseudo wires, enabling ATM pseudo wires carrying user traffic to be established and release dynamically by ATM. The method does not require changes to existing IETF defined protocols in order to support all features of PNNI and AINI.

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[1.](#) Introduction

[1.1](#) Conventions Used in this Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC-2119](#) [1].

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[1.3](#) Objectives and Scope

This informative document extends [7] by including mechanisms for interworking with attachment circuits that are Asynchronous Transfer Mode (ATM) Soft Permanent Virtual Channels or Soft Permanent Virtual Paths (SPVCs/SPVPs) and ATM Switched Virtual Channels or Switched Virtual Paths (SVCs/SPVCs) for Multi Protocol Labels Switching (MPLS) based Packet Switched Networks (PSNs).

Service providers are introducing new PSN based networks and are looking for a seamless way to extend the reach of existing ATM services to new sites attached to this PSN network. One important capability which is used in the existing ATM networks is ATM switched

services. These are mainly SPVC services, and to a lesser extent SVC services. SPVC services are critical in today's networks as they allow simplified provisioning of the ATM services by configuring the endpoints only. They also allow dynamic traffic engineering and a faster restoration in the case of a network failure. Finally, ATM SPVCs extend connectivity to non-ATM endpoints, such as Frame Relay and Ethernet, on an ATM switch. Thus ATM SPVCs support both native ATM, and non-ATM services and are used in both network and service interworking deployment scenarios. Non-ATM services continue to drive deployments of ATM SPVCs. By transparently supporting ATM switched services over the PSN, existing provisioning tools and operational procedures may be used. It is therefore important to provide methods for interworking ATM switched services and PSN based services such as Virtual Private Wire Service (VPWS).

In this document, the attachment circuits on both the ingress and egress Provider Edge Nodes (PEs) are either ATM SPVCs/SPVPs or ATM SVCs/SVPs. In addition, ATM Private Network-Network Interface (PNNI) routing may run between the ingress and egress PEs.

There are no methods to signal port connections in ATM, and thus there is no intent to provide VPWS services for transporting an entire ATM port across the PSN using these services. These services should use standard VPWS services instead. This may include the tunnelling of many VC's including PNNI Routing Control Channels (RCCs) and signalling channels within the same port pseudo wire. There are no control plane interactions between ATM signalling/routing and the underlying PSN, and therefore there are no protocol considerations.

This document describes methods and procedures specified in ATM Forum Specification "ATM-MPLS Network Interworking Signalling Specification, Version 1.0"[5].

1.4 Relevance

This informative document shows how the existing Layer 2 Virtual Private Network framework (L2VPN)[7] and the Pseudo Wire Emulation Edge-to-Edge (PWE3) architecture [3] can be leveraged to tunnel ATM signalling and routing through the PSN. We show how ATM pseudo wires can be established and released as required by the ATM switched service, without requiring changes to existing IETF protocols e.g.

[2], [6], [8]. This addresses work item 2 of the Layer 2 VPN working group charter for signalling layer 2 information.

1.5 Terminology

This document uses the following terms. Formal definitions of some of these terms can be found in [3]

ATM Inter Network Interface (AINI)	An ATM Forum specification for signaling to establish point-to-point and point-to-multipoint connections across an ATM network
Attachment Circuit (AC)	The physical or virtual circuit attaching a PE to a CE. In the context of the application described here, this will be an ATM VCI or VPI.
Integrated Link Management Interface (ILMI)	An ATM Forum specification allowing any ATM device to be provided with status and configuration information.

Private Network to Network Interface	ATM Forum specification to establish point to point and point to multipoint connections across an ATM network including source, routing, crankback, and alternate routing
Provider Edge (PE)	A device that provides PWE3 to a CE.
Pseudo Wire (PW)	A mechanism that carries the essential elements of an emulated service from one PE to one or more other PEs over a PSN.
Pseudo Wire Emulation Edge to Edge (PWE3)	A mechanism that emulates the essential attributes of a service (such as an ATM VCC) over a PSN.
PSN Tunnel	A tunnel across a PSN inside which one or more PWs can be carried.
Routing Control Channel (RCC)	An ATM connection that carries PNNI routing messages between PNNI neighbouring peer

nodes

Tunnel	A method of transparently carrying information over a network.
Virtual Private Wire Service (VPWS)	A point-to-point circuit (link) connecting two Customer Edge devices.

1.6 A Note on Terminology Differences

There are some differences in terminology between the IETF, and that used by the ATM Forum in [5]. Figure 2 summarizes the main terms.

IETF Term	ATM Forum Term
Pseudo Wire	Interworking LSP
Pseudo Wire Label	Interworking Label
PSN Tunnel	Transport LSP
Provider Edge	Interworking Network Element

Figure 2: Terminology

2. ATM Signalled to ATM Signalled Networks

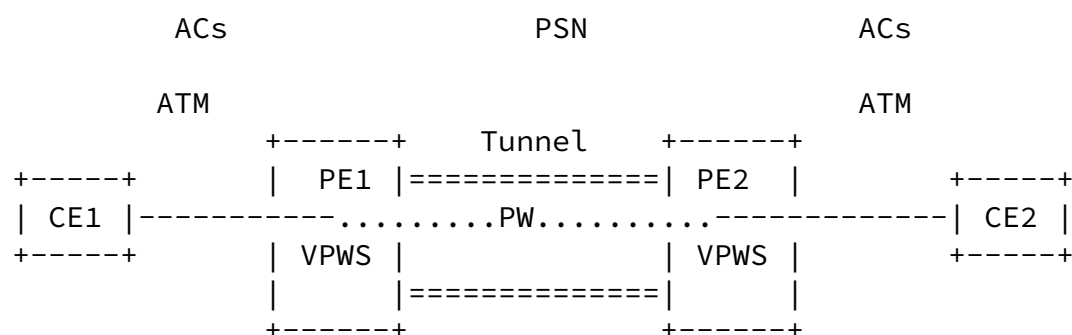


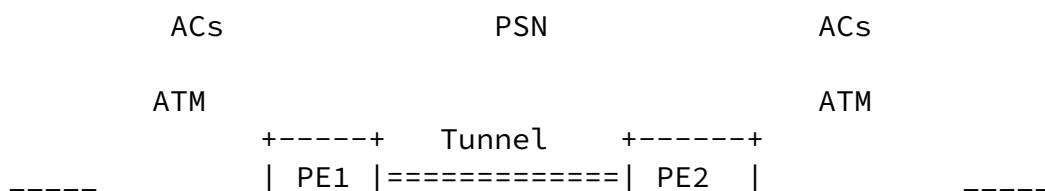
Figure 3: Architecture

Figure 3 shows the general architecture for ATM VPWS. The attachment circuits are ATM VCCs or VPCs that span an ATM network. ATM connections are mapped to Pseudo Wires (PWs) in the PSN tunnel. ATM SVC services start and terminate on the attached CE devices, while the signalling for the SPVC services originates and terminates on the ATM switches in the ATM networks that the CEs are physically attached to, or on the PE where there is only a single hop path between the CE and the PE. The objective is to provide service over a PSN without impacting the ATM signalling that occurs between the CE devices, and without requiring changes to non-ATM protocols between PE1 and PE2 e.g. MPLS [2], the PWE3 control protocol [8], or RSVP-TE [6].

ATM signalling and routing typically operates over PNNI [10] or AINI [11] interfaces. Signalling and routing messages for these protocols are carried on dedicated ATM VCCs. These are known as Signalling Channels for signalling messages and Routing Control Channels (RCCs) for PNNI routing messages. For ATM link management messages, an ILMI channel [13] may be used. For AINI, static ATM routing is assumed and so no RCC is present.

2.1 Tunnelling of the ATM Control Plane

The terminology used in this section follows the L2VPN naming conventions. The use of the pseudo wire label in this section can be related to the use of the interworking label within [5].



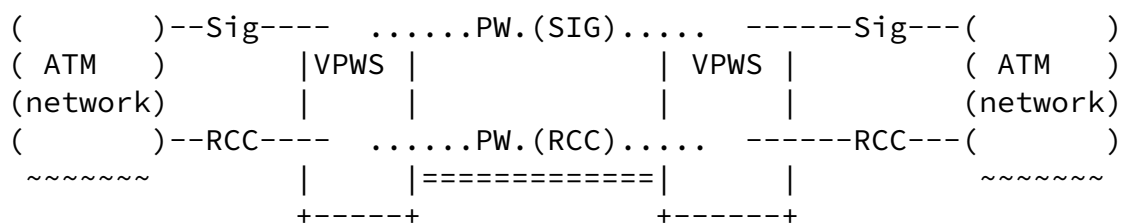


Figure 4: Extending ATM Signalling and Routing Across the PSN

Figure 4 shows how ATM signalling and routing is extended across the PSN between attached ATM networks. In the case of ILMI, a PW would also be present that represents an ILMI channel in the ATM network.

[2.1.1](#) Extending ATM Signalling Across the PSN

In the case of signalling, a bidirectional PW MUST established, using the PW signalling protocol [8], or by configuration. to carry the ATM signalling channel messages transparently across the PSN for either PNNI or AINI. This allows all of the existing and future ATM signalling capabilities to be carried transparently.

[5] explains how ATM signalling is extended across the PSN to advertise PW labels between PE1 and PE2. The PNNI and AINI protocol extensions described in [5] add an Interworking Information Element (IE) which supports label exchange between the PE pair for the ATM connection pseudo wire and the negotiation of encapsulation methods for the connection. There is no requirement for any ATM capable system, other than the PEs, to understand or support the Interworking IE. Therefore legacy systems can take advantage of the interworking capabilities without need for software modifications. Since ATM signalling messages are carried transparently between the PE pairs, there are no protocol considerations for the PSN related to the signalling and establishment of ATM connection pseudo wires.

The pseudo wire label for an ATM connection is carried between the two PEs in the Interworking IE within the PNNI or AINI signalling messages. As the label is significant only to the PE devices at either end of the PSN tunnel, this IE can be added to the signalling message by the PE. Where other non-ATM VPWS services are also supported by the PE and pseudo wire labels are allocated from the same label space as ATM pseudo wires, the PE will need to manage common resources between multiple control plane protocols e.g. [5]

and [8]. This is a common capability in current PE devices.

Implementations should provide a mechanism to restrict the maximum the number of PWs that can be established on the PSN tunnel so that the PW label space in the downstream PE does not become exhausted. The details of this mechanism are outside the scope of this document.

[2.1.2](#) Extending PNNI Routing Across the PSN

ATM Routing is also extended between PE1 and PE2 as explained in [5]. Before the ATM routing can start exchanging ATM reachability across the PSN tunnel, a PNNI RCC MUST be set up between PE1 and PE2 in Figure 4. As in the case of signalling, the PW control protocol [8], or configuration, sets up a bidirectional PW to carry the ATM routing messages in each direction. This PW represents an RCC between PE1 and PE2.

For PNNI, the PSN tunnel can be modelled as a PNNI link between PE1 and PE2, thus extending ATM reachability across the MPLS network using any desired meshing. Therefore, PNNI Routing can take advantage of any parallel or alternate tunnels through the MPLS network. This includes the use of multiple hops (i.e. a sparse mesh), whereby the pseudo wire leaves one PSN tunnel at a given PE, is processed by the ATM signalling on that PE, and enters another PSN tunnel before terminating at the egress PE.

PNNI Routing can also properly traffic engineer the usage of any traffic engineered MPLS PSN tunnels. This is achieved by PNNI Routing advertising the available bandwidth of an MPLS PSN tunnel for use by the pseudo wires to the attached ATM networks. Any of the ATM addressing formats can be used in these network situations and is fully transparent to the PSN.

This method supports all currently deployed PNNI network scenarios, including PNNI Hierarchy.

Note that signalling of the PSN tunnel is beyond the scope of this document.

[2.1.3](#) ATM Control Plane Association to PSN Tunnels

There is no stipulation or restriction on how PSN Tunnels are established between two PE devices. The architecture requires at least one bidirectional PSN Tunnel between two PE devices, but can also support multiple PSN Tunnels modeled as a single PNNI or AINI link. In its simplest default case, a single PSN Tunnel is represented as a single PNNI or AINI link. The control pseudo wires i.e those representing Signalling Channels and RCCs, are carried

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"in-band" - that is within the PSN tunnel whose ATM PWs they control.

In other cases, where multiple PSN Tunnels may be used to support QoS guarantees, resiliency requirements or more efficient usage of PSN resources, a single set of control pseudo wires may be used to manage the resources of all PSN tunnels available for ATM established between the two PEs. These control pseudo wires may be carried within one of the PSN Tunnel pairs, but are not required to be associated directly with the tunnels they control.

[2.1.4](#) Encapsulation Format

Any of the ATM PW encapsulations can be used for both PWs carrying user data, and those used for RCC, ILMI or Signalling channels. The PW types as defined in [\[4\]](#) are used for user connections based on the signalled ATM parameters, as defined in [\[5\]](#). The choice of encapsulation will depend on its ability to support the requirements of the ATM service, as described in [\[4\]](#).

Negotiation of an encapsulation mode is a local matter between a pair of PEs. While an ATM end system may add the Interworking IE to request a specific encapsulation mode at any interworking interface, it is not required. The PE should support a default mode for connections signalled without a specific encapsulation indicated. Alternatively, the PE may select from among its supported encapsulations based on local policies. It is expected that the default will be to use a cell mode pseudo wire.

[2.1.5](#) Quality of Service

Many of the ATM QoS guarantees can continue to be met through the PSN core. This is possible with the use of traffic-engineered MPLS DiffServ PSN tunnels [\[14\]](#). This is discussed in more detail in [\[9\]](#) [section 9](#) and [Appendix V](#). PNNI can use these mappings to advertise the resources available for ATM connections on the PSN tunnel to the attached ATM networks. The attached ATM networks will see these resources as native ATM resources. Generalized Connection Admission

Control (GCAC) of PNNI running in the attached ATM networks can then use these advertised resources as a part of the route selection decision.

Note that the translation of ATM traffic parameters into bandwidth parameters for utilization in the PSN needs to take into account the overhead associated with the PW type.

2.2 Resiliency

The tunnelling of PNNI through the PSN means that either PSN-based

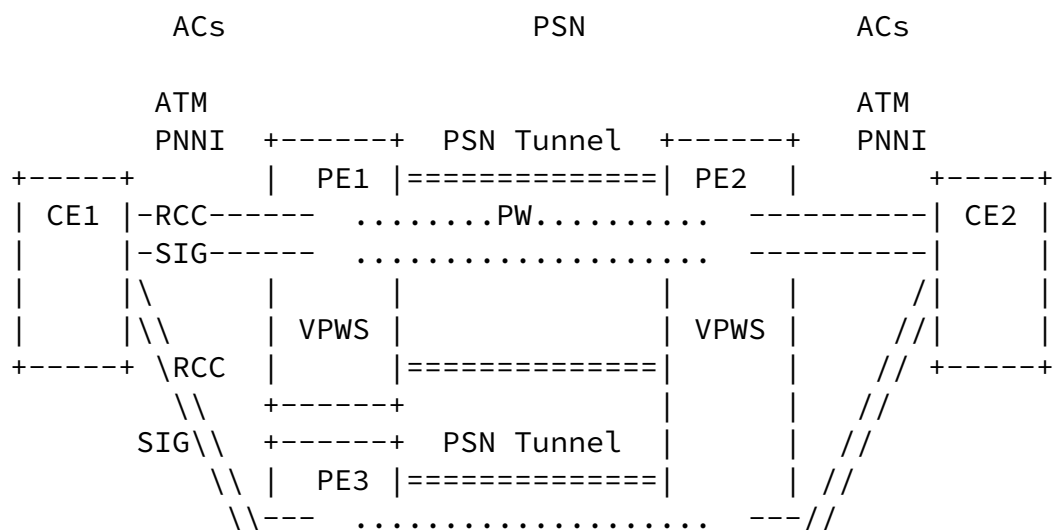
protection mechanisms may be used to provide resiliency, or optionally PNNI-based mechanisms, or both. Failure detection timers of each mechanism may need to be adjusted in order to allow one mechanism priority over the other.

2.2.1 PSN-based Protection of the PSN Tunnel

The PSN tunnel can be protected from failures in the PSN using PSN specific mechanisms, for example MPLS Fast Reroute [12]. Whichever mechanism is chosen, the PSN tunnel needs to continue to support any QoS guarantees given to the ATM connections following any restorative action.

2.2.2 PNNI-based Protection of the Pseudo Wires

PNNI has its own mechanisms to provide resiliency in a native ATM network. These same mechanisms can be used without modification to provide protection for the ATM pseudo wires carried through the PSN. Two examples are given below.



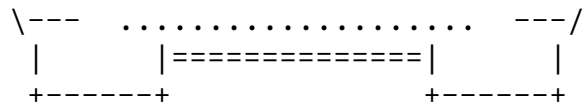


Figure 5: Dual Homing Example

Figure 5 shows an example of multi-homing of the ATM network into the PSN cloud, using PNNI rerouting to protect against failures of PE1 or the PSN tunnel. An additional PE, PE3, is shown in the network above that is connected to the ATM network, together with an additional PSN tunnel from PE3 to PE2. Both PSN tunnels are configured as PNNI links, with associated RCCs and Signalling Channels. If PSN tunnel PE1->PE2 fails, then PNNI can automatically

reroute all ATM connections on PSN tunnel PE1->PE2 to PSN tunnel PE3->PE2.

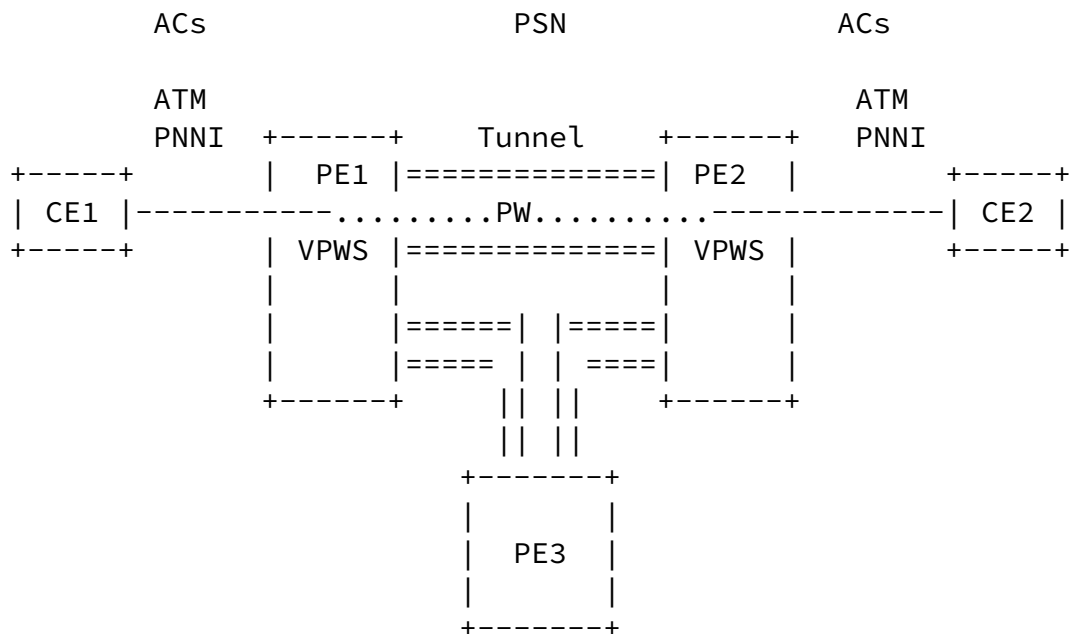


Figure 6: Multi-Hop ATM Routing

Figure 6 shows a third PE, PE3, attached to an additional ATM network. PE3 is connected to PE1 and PE2 using PSN tunnels. All three tunnels (PE1->PE2, PE1->PE3, PE3->PE2) can be configured as

PNNI links so that PNNI can automatically use the alternate path formed by PSN tunnels PE1->PE3 and then PE3->PE2 if tunnel PE1->PE2 fails. PE3 simply acts as a transit ATM/PNNI node in this scenario.

[2.3](#) Operations, Administration and Maintenance

ATM OAM is tunnelled through the PSN, as described in [\[4\]](#). ATM OAM is notified of PSN tunnel failures in the same way as it handles port or virtual port failures in an ATM switched network. The mechanisms for detecting tunnel failures depends on the PSN mechanisms used and is outside the scope of this document. Fault management procedures for ATM PWs are outside the scope of this document.

[3.](#) Security Considerations

Extended PNNI uses pseudo wires to transport ATM signalling and routing across a PSN. The security of the transported ATM service will only be as good as the security of the PSN. This level of security might be less rigorous than a native ATM service.

[4.](#) IANA Considerations

This document has no IANA actions.

[5.](#) References

[5.1](#) Normative References

- [1] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [RFC 2119](#), March 1997.

- [2] Rosen, E., "Multiprotocol Label Switching Architecture", [RFC 3031](#), January 2001.
- [3] Bryant, S., "The PWE3 Architecture, [draft-ietf-pwe3-arch-07.txt](#)", March 2004.
- [4] Martini, L., "Encapsulation Methods for Transport of ATM Cells/Frame Over IP and MPLS Networks, [draft-ietf-pwe3-atm-encap-07.txt](#)", October 2004.
- [5] ATM Forum Technical Committee, "ATM-MPLS Network Interworking Signalling Specification, Version 1.0, AF-CS-0197.000", August 2003.

[5.2](#) Informative References

- [6] Awduche, D., "RSVP-TE: Extensions to RSVP for LSP Tunnels", [RFC 3209](#), December 2001.
- [7] Andersson, L., "L2VPN Framework, [draft-ietf-l2vpn-l2-framework-05.txt](#)", June 2004.
- [8] Martini, L., "Pseudowire Setup and Maintenance using LDP, [draft-ietf-pwe3-control-protocol-11.txt](#)", October 2004.
- [9] ATM Forum Technical Committee, "ATM-MPLS Network Interworking, Version 2.0, AF-AIC-0178.001", August 2003.
- [10] ATM Forum Technical Committee, "Private Network-Network Interface Specification, Version 1.1 (PNNI 1.1), af-pnni-0055.002", April 2003.
- [11] ATM Forum Technical Committee, "ATM Inter-Network Interface Specification, Version 1.1 (ANNI 1.1), af-cs-0125.002", September 2002.
- [12] Pan, P., "Fast Reroute Extensions to RSVP-TE for LSP Tunnels, [draft-ietf-mpls-rsvp-lsp-fastreroute-07.txt](#)", September 2004.
- [13] ATM Forum Technical Committee, "ILMI (Integrated Link Management Interface)", September 1996.

- [14] Le Faucheur, F., "Multi-Protocol Label Switching (MPLS) Support of Differentiated Services", [RFC 3270](#), May 2002.

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