MPLS & Frame Relay Alliance

MPLS PVC User to Network Interface

Implementation Agreement

MPLS & FR 2.0.1

MPLS & Frame Relay Alliance Technical Committee
May 2003

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Revision History

Version	Change	Date
MPLS .2	Initial version	September 2002
MPLS & FR.2.0.1	Fixed several typographical errors. Reverse Traffic Parameter TLV type from 0x0810 to 0x3E02 in description text. Corrected length values for Reverse Traffic Parameters, LSPID TLVs and VPN ID TLV. Added field descriptions for Hello Capabilities TLV.	May 2003

1 Introduction

1.1 Purpose

The purpose of this Implementation Agreement (IA) is to document the MPLS Permanent Virtual Connection (PVC) User-to-Network Interface (UNI). The UNI provides an interface to a public MPLS Network for connection of customer-premises equipment. This implementation agreement describes the UNI protocols used for connecting to a provisioned PVC service.

1.2 Overview

This document is organized into a base document and application annexes. The base document describes the base functional elements of the PVC UNI. It also describes the protocol messages, information content and procedures required to provide the base functional elements. This information is organized in the main body of the document and applies to all applications that utilize the UNI.

Each optional application annex describes the protocol messages, information content, and procedures for an application that uses the UNI. An application annex describes the application, the use of the base UNI elements, any additional attributes conveyed in the UNI messages, if needed, and procedural processing of the attributes specific to the application.

1.3 Scope and Service PVC LSP Definition

The MPLS PVC UNI provides access to a provisioned Permanent Virtual Connection (PVC) LSP service for transport of MPLS encapsulated traffic across a public MPLS network. The LSP is a unidirectional transport connection, for transmission or reception of variable length packets over supported layer 2 encapsulations. The layer 2 encapsulations supported are described in section 1.4. The packets are not necessarily delivered in the order in which they are transmitted to the MPLS network. This implies that an application may need to consider reordering of packets.

For each LSP the service includes bandwidth parameters, identification attributes and bi-directional LSP binding attributes that characterize the LSP. The identification of the LSP uses two attributes: an MPLS label significant to the PVC UNI, and an LSP Identifier that uniquely identifies the LSP within a public MPLS network.

As a PVC service, the UNI functions provided to the customer premises equipment are:

1) Status of the LSPs provisioned on the UNI. Specific status to be conveyed is:
   a) newly provisioned LSP
   b) deletion of a LSP. Note that LSP modification is not supported on this interface.
2) Provisioned LSP attributes, e.g., LSPid, traffic parameters and application parameters.
3) Integrity of the UNI link.
4) Assignment of labels used for the LSP. Labels are encoded, as specified in [4].
5) Optional identification of the application in use. This is identified using application- specific TLVs. See Application Appendices.

   Note that the LSP status is conveyed by assigning or withdrawing the label associated with the LSP. The LSP attributes provided by the MPLS network may be used by the CE to automatically

configure the LSP and/or cross check its own LSP configuration, if applicable, and make the LSP known to the corresponding application(s).

As a PVC interface, this specification does not support signaling that allows CEs to modify the LSP attributes or to dynamically establish new LSPs. These capabilities may be included in a future MPLS UNI SVC Interface specification.

1.4 Supported Layer 2 Encapsulations

- PPP [5] [6],
- POS [7],
- 10/100/1G/10G Ethernet [3],
- Frame Relay [2],
- ATM [10].

1.5 Definitions

Must, Shall or Mandatory — the item is an absolute requirement of this implementation agreement.

Should — the item is desirable.

May or Optional — the item is not compulsory, and may be followed or ignored according to the needs of the implementer.

Notes — outside of Tables and Figures are informative.

1.6 Reference Architecture

Figure 1-1 identifies the Reference Architecture for the MPLS PVC UNI. The service provider network contains a number of Label Switching Routers (LSRs). The customer-facing LSRs are known as Provider Edge (PE) LSRs. The customer equipment that directly interacts with the MPLS network is known as Customer Edge equipment (CE). The interface defined in this document is the interface between the PE and CE.

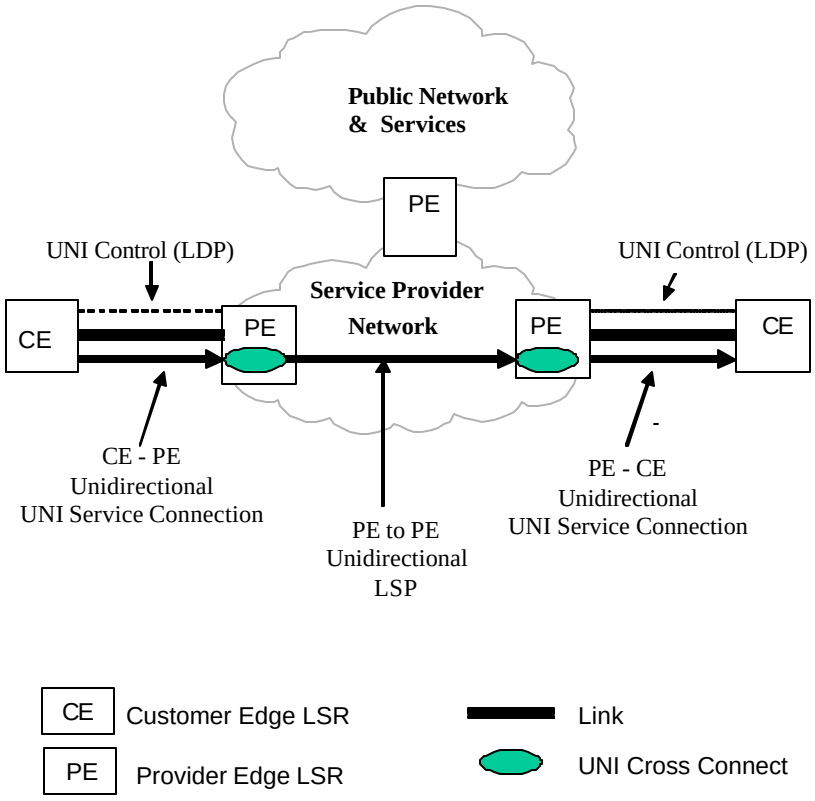


Figure 1-1. MPLS PVC UNI Reference Architecture

Figure 1-2 provides an overview of the Downstream-on-Demand process between the PE and CE used by this specification.

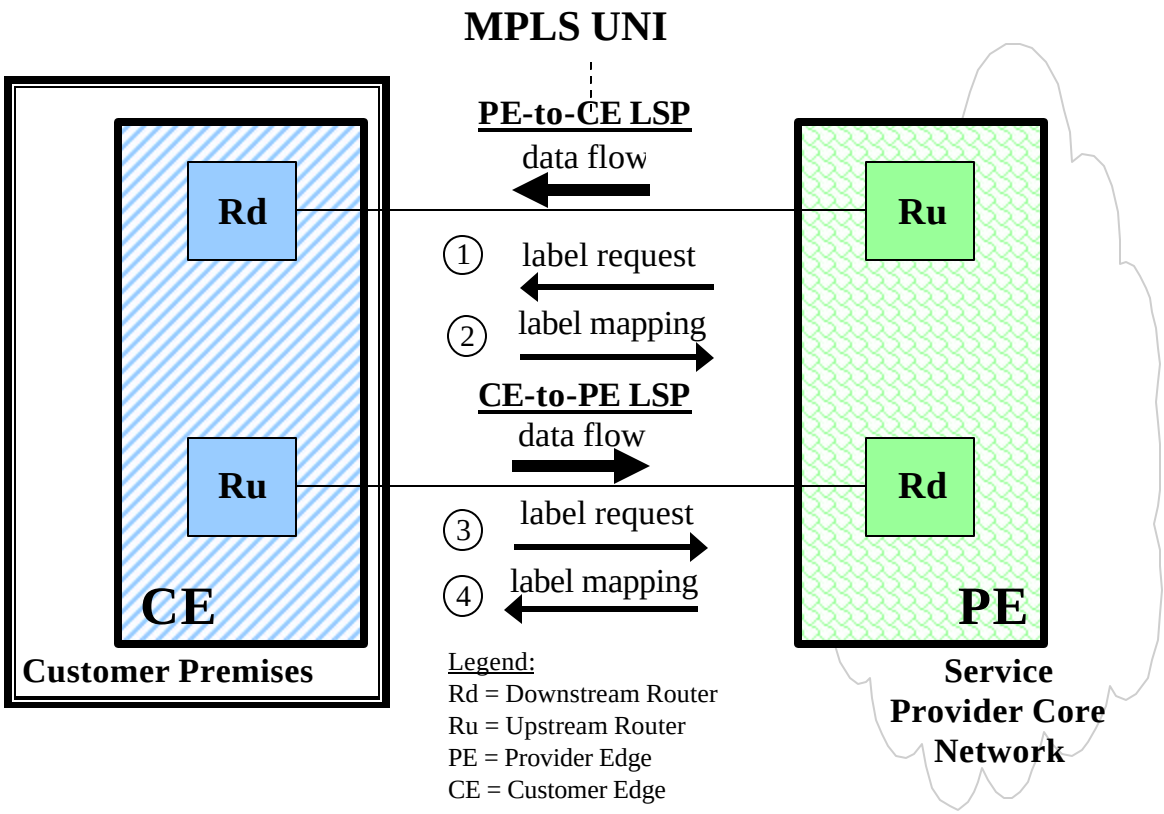


Figure 1-2. Downstream On-demand over MPLS PVC UNI

Figure 1-3 illustrates the UNI Control Protocol Layering, to show the relationship between protocols operating across the UNI. This document specifies the "Signaling Protocol" shown in the figure. The details and internals of the public MPLS network are outside the scope of this agreement.

Figure 1-3. UNI Control Protocol Layering

1.7 Acronyms

ATM	Asynchronous Transfer Mode
CE	Customer Edge
CPE	Customer Premises Equipment
FEC	Forwarding Equivalency Class
IA	Implementation Agreement
IANA	Internet Assigned Number Authority
IETF	Internet Engineering Task Force
IP	Internet Protocol
LDP	Label Distribution Protocol
LER	Label Edge Router
LSB	Least Significant Bit
LSP	Label Switched Path
LSR	Label Switching Router

MPLS	Multi Protocol Label Switching
MSB	Most Significant Bit
PE	Provider Edge
POS	Packet over SONET / SDH
PPP	Point to Point Protocol
PVC	Permanent Virtual Circuit
QoS	Quality of Service
SDH	Synchronous Digital Hierarchy
SONET	Synchronous Optical NETwork
SPVC	Soft PVC
TBD	To Be Determined
TLV	Type, Length, Value
UNI	User to Network Interface
VPN	Virtual Private Network

1.8 References

[1] Andersson, L., et al, LDP Specification, RFC 3036, January 2001.

[2] A. Conta, et al., Use of Label Switching on Frame Relay Networks Specification, RFC 3034, January 2001

[3] IEEE 802 Series.

[4] Rosen, E., et al, MPLS Label Stack Encoding, RFC 3032, January 2001.

[5] Simpson, W., The Point-to-Point Protocol (PPP), STD 51, RFC 1661, July 1994.

[6] Simpson, W., PPP in HDLC-like Framing, STD 51, RFC 1662, July 1994.

[7] Malis, A., et al, PPP over SONET/SDH, RFC 2615, June 1999.

[8] Rosen, E. et al, BGP/MPLS VPNs, draft-ietf-ppvpn-rfc2547bis-01.txt, work in progress, January 2002.

[9] Le Faucheur et al, MPLS Support of Differentiated Services, draft-ietf-mpls-diff-ext-09.txt, work in progress, April 2001

[10] B. Davie, et al., MPLS using LDP and ATM VC Switching, RFC 3035, January 2001

2 Status Signaling and Label Distribution

This section contains the definition for an MPLS PVC UNI Status Signaling and Label Distribution protocol. The MPLS PVC UNI operates between the CE and PE and helps to autoconfigure the CE. More specifically, the MPLS PVC UNI allows the CE to learn what LSPs the provider has defined over the CE-PE interface. The MPLS PVC UNI status signaling protocol is based on the Label

Distribution Protocol (LDP) [1]. It consists of a subset of LDP augmented with a few MPLS PVC UNI specific conventions and extensions.

The following sections modify the LDP specification [1] for the MPLS PVC UNI. If a section in the LDP specification is not mentioned, then it is used as is.

2.1 LDP Peers ([1] Section 1.1)

In MPLS PVC UNI, the CE and PE act as LDP peers to each other.

2.2 LDP Message Exchange ([1] Section 1.2)

The MPLS PVC UNI includes all four categories of LDP messages.

2.3 FECs ([1] Section 2.1)

The MPLS PVC UNI does not use Address Prefix or Host Address FEC element types.

2.4 Label Spaces, Identifiers, Sessions and Transport ([1] Section 2.2)

2.4.1 LDP Sessions and Transport ([1] Sections 2.2.3 and 2.2.4)

If multiple links are used between the CE and PE, then per-interface label spaces must be used..

2.5 LDP Sessions between non-Directly Connected LSRs ([1] Section 2.3)

This section of the LDP specification does not apply because the CE and PE are assumed to be always directly connected at the link layer.

2.6 LDP Discovery ([1] Section 2.4)

Since CE and PE are always directly connected at the link layer, the MPLS PVC UNI only includes the basic discovery mechanism.

2.6.1 Extended Discovery Mechanism ([1] Section 2.4.2)

The MPLS PVC UNI does not include the Extended Discovery mechanism.

2.7 Establishing and Maintaining LDP Sessions ([1] Section 2.5)

2.7.1 Transport Connection Establishment ([1] Section 2.5.2)

Each CE must be uniquely addressable to the PE and have enough reachability information present in each node so that a TCP connection can be established.

Assignment of the IP addresses is beyond the scope of this document.

2.7.2 Initialization State Machine ([1] Section 2.5.4)

This is identical to [1].

2.8 Label Distribution and Management ([1] Section 2.6)

2.8.1 Label Retention Mode ([1] Section 2.6.2)

The CE must use the Conservative Label Retention Mode.

2.8.2 Label Advertisement Mode ([1] Section 2.6.3)

Labels are always advertised using Downstream on Demand, as illustrated in Figure 1-2.

Once LDP is operational across the interface, the PE needs to inform the CE of the labels for the LSPs that have been provisioned across the interface. Since LSPs are unidirectional, labels need to be allocated in each direction across the interface.

The signaling procedure is initiated by the PE, which sends a label request specifying the attributes of the LSP in the PE to CE direction. The CE responds with a label mapping, providing the label for the PE to CE direction. The CE also sends a label request to the PE, with the attributes for the LSP in the CE to PE direction. It includes the Reverse LSPID TLV, if this LSP is part of a bi-directional set. The PE responds with a label mapping providing the label for the CE to PE direction. The two LSPs are correlated together by associating the LSPIDs of each LSP. This results in a correlated bidirectional pair of LSPs.

Note: Some applications may require only unidirectional LSPs. Establishment of LSPs in only one direction is addressed in the application annexes where it is needed. In general, for applications requiring only one LSP at the egress interface the CE replies with a Label Map and does not send a Label Request. For applications requiring only one LSP at the ingress interface, the CE rejects the Label Request from the PE and sends a Label Request.

2.9 LDP Identifiers and Next Hop Addresses ([1] Section 2.7)

Section 2.7 does not apply.

2.10 Loop Detection ([1] Section 2.8)

Section 2.8 does not apply.

2.11 Label Distribution for Explicitly Routed LSPs ([1] Section 2.10)

Section 2.10 does not apply.

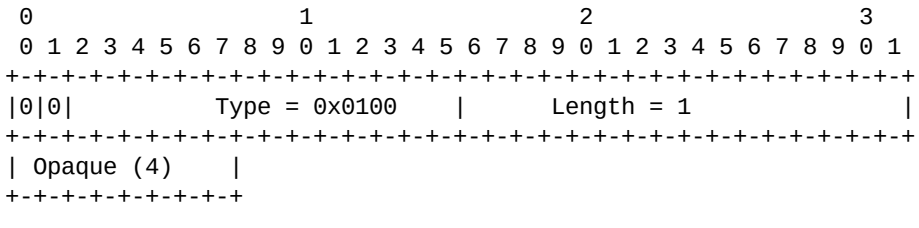
2.12 Type-Length-Value Encoding ([1] Section 3.3)

Section 3.3: The F bit is ignored.

2.13 TLV Encodings for Commonly Used Parameters ([1] Section 3.4)

2.13.1 FEC TLV ([1] Section 3.4.1)

There is always only one FEC element. The FEC type is always set to 4 for Opaque FEC, which is encoded as follows:



Type
A fourteen-bit field carrying the value of the FEC TLV
Type = 0x0100

Length
Specifies the length of the value field in bytes = 1.

Opaque FEC Element Type
0x04

2.13.2 Label TLVs ([1] Section 3.4.2)

2.13.2.1 ATM and Frame Relay Label TLVs ([1] Section 3.4.2.2 and 3.4.2.3)

Sections 3.4.2.2 and 3.4.2.3 apply if this interface is used over ATM or Frame Relay.

2.13.3 Address List TLV ([1] Section 3.4.3)

Section 3.4.3 does not apply.

2.13.4 Hop Count TLV ([1] Section 3.4.4)

Section 3.4.4 does not apply.

2.13.5 Path Vector TLV ([1] Section 3.4.5)

Section 3.4.5 does not apply.

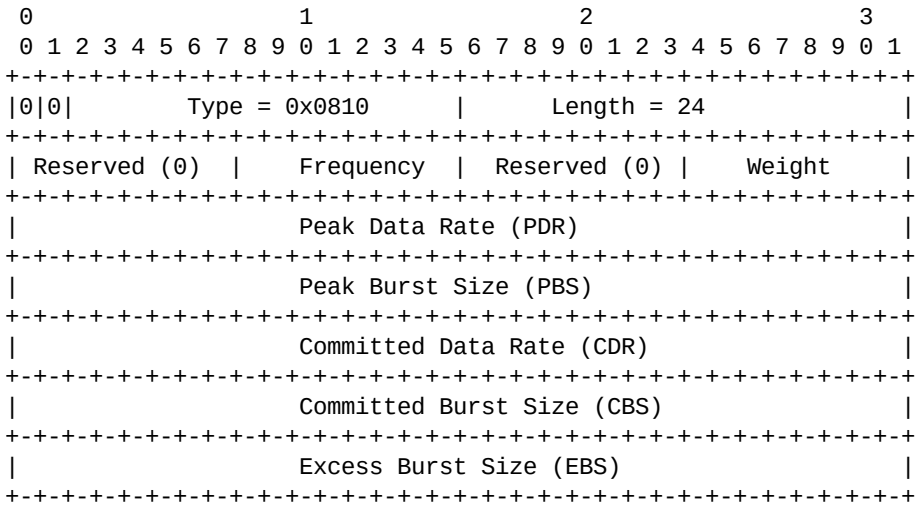
2.13.6 Status TLV ([1] Section 3.4.6)

The F bit is ignored.

2.13.7 Traffic Parameters TLV

The Traffic Parameters TLV is sent from the PE to the CE to identify the parameters to be used for the PE-CE LSP.

The Traffic Parameters TLV contains, a Frequency, a Weight, and the five Traffic Parameters PDR, PBS, CDR, CBS, EBS, as shown:



Type
A fourteen-bit field carrying the value of the Traffic Parameters TLV Type = 0x0810.

Length
Specifies the length of the value field in bytes = 24.

Frequency
The Frequency field is coded as an 8-bit unsigned integer with the following code points defined:

0- Unspecified
1- Frequent
2- Very Frequent
3-255 - Reserved
Reserved - Zero on transmission. Ignored on receipt.

Weight
An 8-bit unsigned integer indicating the weight of the LSP. Valid weight values are from 1 to 255. The value 0 means that weight is not applicable for the LSP.

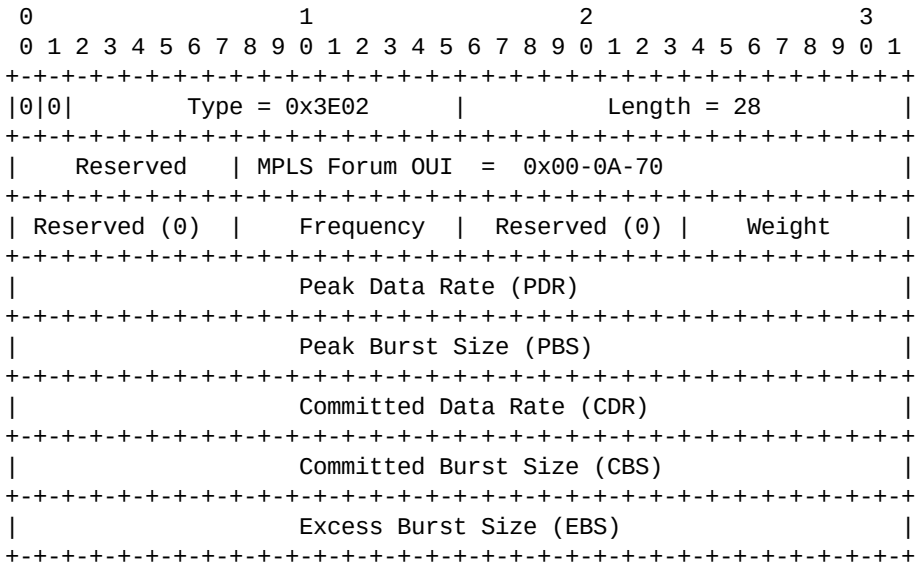
Traffic Parameters
Each Traffic Parameter is encoded as a 32-bit IEEE single-precision floating-point number. A value of positive infinity is represented as an IEEE single-precision floating-point number with an exponent of all ones (255) and a sign and mantissa of all zeros. The values PDR and CDR are in units of bytes per second. The values PBS, CBS and EBS are in units of bytes.

The value of PDR MUST be greater than or equal to the value of CDR in a correctly encoded Traffic Parameters TLV.

2.13.8 Reverse Traffic Parameters TLV

The Reverse Traffic Parameters TLV is sent from the PE to the CE to identify the parameters to be requested for the CE-PE LSP. The parameter values in this TLV are copied into the Traffic Parameter TLV sent on the Label Request from CE to PE for the CE-PE LSP.

The Reverse Traffic Parameters TLV contains, a Frequency, a Weight, and the five Traffic Parameters PDR, PBS, CDR, CBS, EBS, as shown.



Type
A fourteen-bit field carrying the value of the Reverse Traffic Parameters TLV Type = 0x3E02.

Length
Specifies the length of the value field in bytes = 28.

Reserved
Zero on transmission. Ignored on receipt.

MPLS Forum OUI
Specifies the IEEE value of the MPLS Forum Organization Unique Identifier.

Frequency
The Frequency field is coded as an 8-bit unsigned integer with the following code points defined:

0- Unspecified
1- Frequent
2- Very Frequent
3-255 - Reserved
Reserved - Zero on transmission. Ignored on receipt.

Weight
An 8-bit unsigned integer indicating the weight of the LSP. Valid weight values are from 1 to 255. The value 0 means that weight is not applicable for the LSP.

Traffic Parameters
Each Traffic Parameter is encoded as a 32-bit IEEE single-precision floating-point number. A value of positive infinity is represented as an IEEE single-precision floating-point

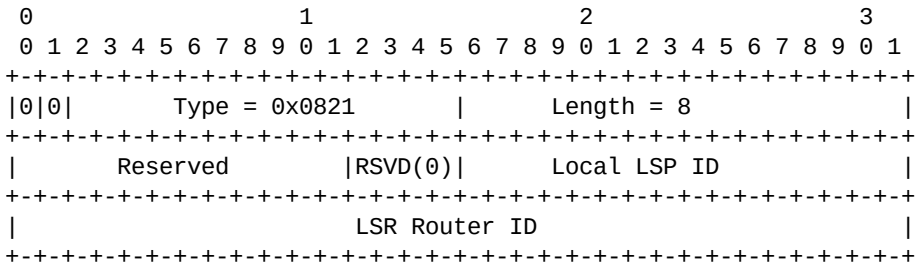
number with an exponent of all ones (255) and a sign and mantissa of all zeros. The values PDR and CDR are in units of bytes per second. The values PBS, CBS and EBS are in units of bytes.

The value of PDR MUST be greater than or equal to the value of CDR in a correctly encoded Reverse Traffic Parameters TLV.

2.13.9 LSPID TLV

The LSPID is a unique identifier for an LSP within an MPLS network.

The LSPID is composed of the ingress LSR Router ID (or any of its own IPv4 addresses) and a locally unique LSP ID to that LSR.



Type
A fourteen-bit field carrying the value of the LSPID-TLV Type = 0x0821.

Length
Specifies the length of the value field in bytes = 8.

Reserved
Zero on transmission. Ignored upon receipt.

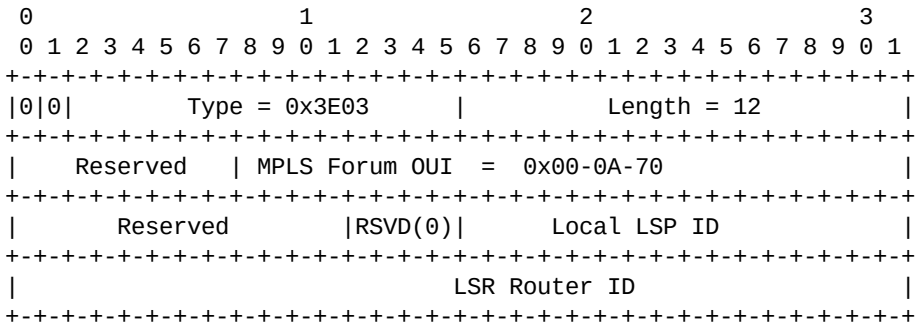
Local LSP ID
The Local LSP ID is an identifier of the LSP; it is locally unique within the LSR originating the LSP.

Ingress LSR Router ID
An LSR may use any of its own IPv4 addresses in this field.

2.13.10 Reverse LSPID TLV

The Reverse LSPID is a unique identifier for an LSP within an MPLS network.

The Reverse LSPID is the LSPID received from the PE on the PE-CE LSP Label Request. The Reverse LSPID is sent in the Label Request from the CE to the PE. It is used by the PE to bind the CE-PE LSP to the PE-CE LSP, forming a bi-directional set of LSPs.



Type
A fourteen-bit field carrying the value of the Reverse LSPID-TLV Type = 0x3E03.

Length
Specifies the length of the value field in bytes = 12.

Reserved
Zero on transmission. Ignored upon receipt.

MPLS Forum OUI
Specifies the IEEE value of the MPLS Forum Organization Unique Identifier.

Reserved
Zero on transmission. Ignored on receipt.

Local LSP ID
The Local LSP ID is set from the Local LSP ID received on the PE-CE LSP Label Request.

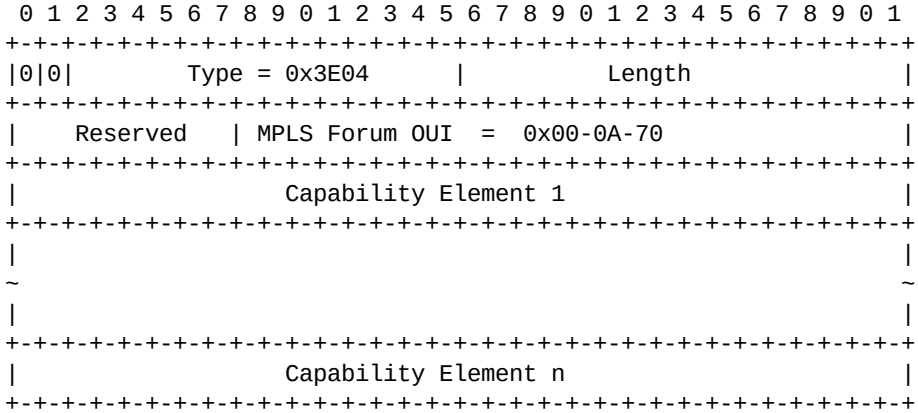
LSR Router ID
The LSR Router ID is set from the Ingress LSR Router ID received on the PE-CE LSP Label Request.

2.14 LDP Messages ([1] Section 3.5)

All message types are used, except for the Address and Address Withdraw messages.

2.14.1 Hello Message ([1] Section 3.5.2)

The T and R bits must be set to zero. A Hello Capabilities TLV is added as follows:



```
Type
      A fourteen-bit field carrying the value of the Hello Capability TLV
      Type = 0x3E04.

Length
      Specifies the length of the value field in bytes (variable).

Reserved
      Zero on transmission.  Ignored on receipt.

MPLS Forum OUI
      Specifies the IEEE value of the MPLS Forum Organization Unique
      Identifier.

Capability Element 1 to Capability Element n
   There are several types of Capability elements.  The encoding of the
   Capability element depends on the type of Capability element.

   A Capability Element value is encoded as a 1-octet field that specifies
   the element type, and a variable length field that is the type-
   dependent element value.  Note that while the representation of
   the Capability element value is type-dependent, the encoding of the
   Capability element itself is one where standard LDP TLV encoding is not used.

   UNI Capability Element value encoding:

    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |    UNI (1)    |            UNI Capabilities                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

   UNI Capabilities:
   Bits 8-29: Reserved
   Bit 30: SVC UNI
   Bit 31: PVC UNI
```

2.14.2 Initialization Message ([1] Section 3.5.3)

Label Advertisement Discipline is always Downstream on Demand.

Loop Detection bit D is always zero.

2.14.3 Address Message ([1] Section 3.5.5)

Section 3.5.5 does not apply.

2.14.4 Address Withdraw Message ([1] Section 3.5.6)

Section 3.5.6 does not apply.

2.14.5 Label Mapping Message ([1] Section 3.5.7)

There is always only one FEC element. The FEC type is always set to 4 for Opaque FEC (see Section 2.13.1).

The Label Message Request ID and LSPID TLVs are mandatory.

The Traffic Parameter TLV is optional; It is included when traffic parameters are associated with the LSP.Hop Count and Path Vector Optional Parameters do not apply.

2.14.5.1 Independent Control Mapping ([1] Section 3.5.7.1.1)

Section 3.5.7.1.1 does not apply.

2.14.5.2 Ordered Control Mapping ([1] Section 3.5.7.1.2)

Section 3.5.7.1.2 does not apply.

2.14.5.3 Downstream on Demand Label Advertisement ([1] Section 3.5.7.1.3)

Section 3.5.7.1.3 does not apply.

2.14.5.4 Downstream Unsolicited Label Advertisement ([1] Section 3.5.7.1.4)

Section 3.5.7.1.4 does not apply.

2.14.6 Label Request Message ([1] Section 3.5.8)

There is always only one FEC element. The FEC type is always set to 4 for Opaque FEC (see Section 2.13.1). The LSPID TLV is mandatory in both directions. The Reverse LSPID TLV is included in the CE-PE Label Request. The Traffic Parameter TLV and the Reverse Traffic Parameter TLV are optional; they are included when traffic parameters are associated with the LSP. The Hop Count and Path Vector Optional Parameters do not apply.

2.14.6.1 Label Request Message Procedures ([1] Section 3.5.8.1)

The PE sends a Label Request message to the CE when it learns that the CE is an egress for a new LSP that terminates at the PE-CE interface. Also see Section 2.8.2 for further details on this procedure.

2.14.7 Label Abort Request Message ([1] Section 3.5.9)

There is always only one FEC element. The FEC type is always set to 4 for Opaque FEC (see Section 2.13.1).

2.14.7.1 Label Abort Request Message Procedures ([1] Section 3.5.9.1)

The PE MAY send a Label Abort Request message to abort an outstanding Label Request for a FEC sent to the CE in the following circumstances:

1. The PE is a non-merge LSR and it learns that it is not anymore an egress for the LSP that terminated at the PE-CE interface.
2. The PE is a merge LSR and it learns that it is not anymore an egress for the last LSP that terminated at the PE-CE interface.

Otherwise the procedures are as described in section 3.5.9.1 of the LDP specification.

2.14.8 Label Withdraw Message ([1] Section 3.5.10)

There is always only one FEC element. The FEC type is always set to 4 for Opaque FEC (see Section 2.13.1). The Label TLV is mandatory.

2.14.8.1 Label Withdraw Message Procedures ([1] Section 3.5.10.1)

The PE transmits a Label Withdraw message to the CE when it learns that it is no longer an ingress for an LSP for which it had previously advertised a label.

Otherwise the procedures are as described in section 3.5.10.1 of the LDP specification.

2.14.9 Label Release Message ([1] Section 3.5.11)

There is always only one FEC element. The FEC type is always set to 4 for Opaque FEC (see Section 2.13.1). The Label TLV is mandatory.

2.14.9.1 Label Release Message Procedures ([1] Section 3.5.11.1)

The PE sends a Label Release message to the CE under any of the following conditions:

1. The PE is a non-merge LSR and it learns that it is not anymore an egress for an LSP that terminated at the PE-CE interface and for which it had previously requested and received a label from the CE.
2. The PE is a merge LSR and it learns that it is not anymore an egress for the last LSP that terminated at the PE-CE interface and for which it had requested and received a label from the CE.

The CE sends a Label Release message as a response to a Label Withdraw message from the PE.

Otherwise the procedures are as described in section 3.5.11.1 of the LDP specification.

2.15 Implicit NULL Label ([1] Section 3.10.2)

The Implicit Null Label in not supported across this interface.

2.16 Diff-Serv TLV [9]

The Diff-Serv LDP TLV defined in section 6 of [9] may be optionally supported on this interface.

Annex A Layer 3 VPN

(NORMATIVE, OPTIONAL)

A.1 Introduction

LSPs established over an MPLS UNI may be used to provide access to Layer 3 VPN services of one or more IP networks. This annex describes the MPLS UNI elements necessary to support Layer 3 VPN services. This facility allows the interconnection of multiple sites, each of which are part of one or more different VPNs over the same physical interface. This application also allows for the connection of one or more sites to a default service, such as the public Internet. The service allows the CE to learn all VPN identification information from the provider network.

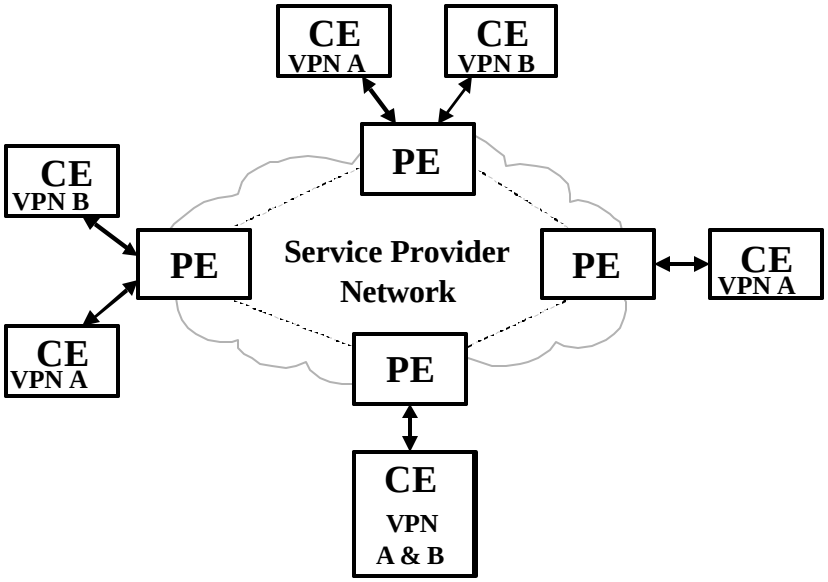


Figure A-1 - Example VPN Configuration

In this figure, the CEs are grouped into 2 VPNs, A and B. The CEs are connected to the network using the MPLS UNI and connected to their respective VPNs using LSPs. Note that on the left, CEs in two different VPNs share the same PE, and on the bottom of the figure, a CE belongs to both VPNs by having some LSPs for VPN A and other LSPs for VPN B.

A.2 Messages and TLVs

The sections below describe the use of existing MPLS UNI TLVs and define new TLVs to be used specifically for L3 VPN.

A.2.1 Base TLV Specifications

A.2.1.1 Traffic Parameters TLV

The traffic parameter TLV may be used for this application but only has significance to the PE. If traffic parameters are not required, the TLV is omitted from the signaling messages.

A.2.1.2 Status TLV

The following Status Code for the Notification message is defined:

Status Code Name	E	Status Data	Description
Unknown VPN ID	0	0x20000000	The VPN ID TLV contains a VPN ID to which the receiver does not belong.

A.2.2 Application Specific TLV Specifications

The LSPs used for Layer 3 VPNs are either associated with a particular customer VPN (identified by the VPN TLV), or with a default VPN defined by the service provider (typically, but not necessarily, the public Internet). The service provider network assigns the association <VPN ID, LSP>. The Layer 3 VPN ID TLV is used to signal this association.

A.2.2.1 Layer 3 VPN ID TLV

The Layer 3 VPN ID TLV is included on the Label Request message to identify the Layer 3 VPN to which the LSP belongs. Label Request messages for Layer 3 VPN LSPs must contain a Layer 3 VPN ID TLV. An LSP belongs to only one VPN. Only one Layer 3 VPN ID TLV shall be specified per Label Request.

The format of the Layer 3 VPN ID TLV is:

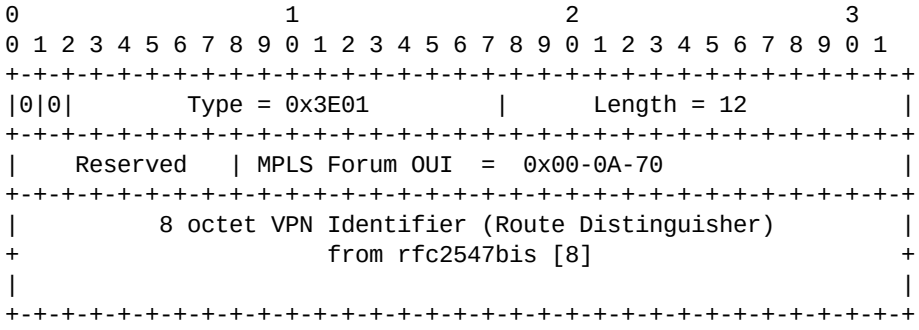


Figure A-2 - Layer 3 VPN ID TLV

TLV Type Name	Layer 3 VPN ID
Type	0x3E01 - from the LDP Vendor-private extensions space (0x3E00 is reserved.)
VPN ID Length	12 octets
VPN ID	The 8-octet Route Distinguisher of the VPN. If the VPN ID value is zero, then the LSP belongs to the default VPN. (Note 1)

Note 1 - If the 8-octet VPN Identifier was not previously configured on the CE, the CE may accept the label and "auto-configure" the VPN. This can simplify the configuration requirements for the CE.

A.3 Procedures

A.3.1 Additional Label Request and Mapping Procedures

The PE sends a Label Request message to the CE when it learns that it is an end-point for a new VPN that terminates at the UNI.

The CE responds with a Label Mapping message or with a Notification message indicating why it cannot satisfy the request.

If the CE receives a Label Request message with a VPN ID that has not been previously configured, the CE shall either:

1. respond with a Notification message including a Status Code of Unknown VPN, or
2. respond with a Label Mapping and "auto-configure" the VPN (the choice is at the discretion of the CE).

If the CE responds with a Label Mapping message, it shall also send a Label Request message with the same Layer 3 VPN ID TLV to the PE to establish an LSP for the VPN in the reverse direction.

The PE responds with a Label Mapping message or with a Notification message indicating why it cannot satisfy the request.

A.3.2 Label Release and Withdrawal Procedures

If a VPN is de-provisioned from the network, the PE transmits a Label Release message to the CE for the label corresponding to the egress VPN LSP. The PE also transmits a Label Withdraw message to the CE for the label corresponding to the ingress VPN LSP.

If a VPN is de-provisioned from the CE, the CE transmits a Label Withdraw message to the PE for the label corresponding to the egress VPN LSP. The CE also transmits a Label Release message to the PE for the label corresponding to the ingress VPN LSP.

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