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Multipoint Label Distribution Protocol  
In-Band Signaling in a VPN Context  
draft-wijnands-mpls-mlbp-vpn-in-band-signaling-00

## Abstract

Sometimes an IP multicast distribution tree (MDT) traverses both MPLS-enabled and non-MPLS-enabled regions of a network. Typically the MDT begins and ends in non-MPLS regions, but travels through an MPLS region. In such cases, it can be useful to begin building the MDT as a pure IP MDT, then convert it to an MPLS Multipoint LSP (Label Switched Path) when it enters an MPLS-enabled region, and then convert it back to a pure IP MDT when it enters a non-MPLS-enabled region. [[I-D.ietf-mpls-mlbp-in-band-signaling](#)] specifies the procedures for building such a hybrid MDT, using Protocol Independent Multicast (PIM) as the control protocol in the non-MPLS region of the network, and using Multipoint Extensions to Label Distribution Protocol (mLDP) in the MPLS region. This document extends those procedures so that they will work when the links between the MPLS and non-MPLS regions are [[RFC4364](#)] interfaces. While these procedures do not provide a good general multicast VPN solution, they are useful in certain specific situations.

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## 1. Introduction

Sometimes an IP multicast distribution tree (MDT) traverses both MPLS-enabled and non-MPLS-enabled regions of a network. In such cases, it can be useful to begin building the MDT as a pure IP MDT, then convert it to an MPLS Multipoint LSP (Label Switched Path) when it enters an MPLS-enabled region, and then convert it back to a pure IP MDT when it enters a non-MPLS-enabled region.

[\[I-D.ietf-mpls-mlbp-in-band-signaling\]](#) specifies the procedures for building such a hybrid MDT, using Protocol Independent Multicast (PIM) [\[RFC4601\]](#) as the control protocol in the non-MPLS region of the network, and using Multipoint Extensions to Label Distribution Protocol (mLDP) [\[I-D.ietf-mpls-ldp-p2mp\]](#) in the MPLS region.

For a given tree, one or more routers that are at the border between a non-MPLS-enabled region and an MPLS-enabled region receive PIM control messages from the non-MPLS-enabled region, and convert them to mLDP control messages to be sent into the MPLS-enabled region. Another router that is at the border between a non-MPLS-enabled region and an MPLS-enabled region receives mLDP control messages from the MPLS-enabled region and converts them to PIM control messages to be sent into a non-MPLS-enabled region.

In PIM, a tree is identified by a source address (or in the case of bidirectional trees [\[RFC5015\]](#), a rendezvous point address or "RPA") and a group address. The tree is built from the leaves up, by sending PIM control messages in the direction of the source address or the RPA. In mLDP, a tree is identified by a root address and an "opaque value", and is built by sending mLDP control messages in the

direction of the root. The procedures of [\[I-D.ietf-mpls-mldp-in-band-signaling\]](#) explain how to convert a PIM <source address or RPA, group address> pair into an mLDP <root node, opaque value> pair;; and how to convert the mLDP <root node, opaque value> pair back into the original PIM <source address or RPA, group address> pair.

However, those procedures assume that the routers doing the PIM/mLDP conversion have routes to the source address or RPA in their global routing tables. Thus the procedures cannot be applied exactly as specified when the interfaces connecting the non-MPLS-enabled region to the MPLS-enabled region are interfaces that belong to a VPN as described in [\[RFC4364\]](#). This specification extends the procedures of [\[I-D.ietf-mpls-mldp-in-band-signaling\]](#) so that they may be applied in the VPN context.

As in [\[I-D.ietf-mpls-mldp-in-band-signaling\]](#), the scope of this document is limited to the case where the multicast content is distributed in the non-MPLS-enabled regions via PIM-created Source-

Specific or Bidirectional trees. Bidirectional trees are always mapped onto Multipoint-to-Multipoint LSPs, and source-specific trees are always mapped onto Point-to-Multipoint LSPs.

Each multicast tree in the non-MPLS enabled region is mapped 1-1 onto a multipoint LSP in the MPLS-enabled region. For a variety of reasons (discussed in [\[I-D.ietf-l3vpn-2547bis-mcast\]](#)), this is not a suitable for a general purpose multicast VPN solution. But the procedures described herein are much simpler than the general purpose MVPN procedures, and are applicable when the 1-1 mapping is acceptable, and when it is acceptable to use mLDP as the protocol for setting up the multipoint LSPs. For example, some service providers offer multicast content to their customers, but have chosen to use VPNs to isolate the various customers and services. This is a very different scenario than the general MVPN scenario, in which the customers provide their own multicast content, out of the control of the service provider.

Due to the 1-1 mapping and the multicast source and group information being encoded in the mLDP FEC, there is deterministic mapping between the multicast tree and the mLDP LSP in the core network. This improves and simplifies fault resolution.

In order to use the mLDP in-band signaling procedures for a particular group address in a particular VPN, the Provider Edge (PE) routers that attach to that VPN MUST be configured with a range of multicast group addresses for which mLDP in-band signaling is to be enabled. This configuration is per VRF ("Virtual Routing and Forwarding table", defined in [RFC4364](#)). For those groups, and those groups only, the procedures of this document are used instead of the general purpose Multicast VPN procedures. This configuration must be present in all PE routers that attach to sites containing senders or receivers for the given set of group addresses.

### [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](#) [[RFC2119](#)].

### [1.2](#). Terminology

IP multicast tree : An IP multicast distribution tree identified by an source IP address and/or IP multicast destination address, also referred to as (S,G) and (\*,G).

mLDP : Multicast LDP.

In-band signaling : Using the opaque value of a mLDP FEC element to encode the (S,G) or (\*,G) identifying a particular IP multicast tree.

P2MP LSP: An LSP that has one Ingress LSR and one or more Egress LSRs (see [[I-D.ietf-mpls-ldp-p2mp](#)]).

MP2MP LSP: An LSP that connects a set of leaf nodes, acting indifferently as ingress or egress (see [[I-D.ietf-mpls-ldp-p2mp](#)]).

MP LSP: A multipoint LSP, either a P2MP or an MP2MP LSP.

Ingress LSR: Source of a P2MP LSP, also referred to as root node.

## 2. VPN In-band signaling for MP LSPs

Suppose that a PE router, PE1, attaching to a particular VPN, receives a PIM Join(S,G) message over one of its VRF interfaces. Following the procedure of section 5.1 of [\[I-D.ietf-l3vpn-2547bis-mcast\]](#), PE1 determines the "upstream RD", the "upstream PE", and the "upstream multicast hop" (UMH) for the source address S. Please note that sections [5.1.1](#) and [5.1.2](#) of [\[I-D.ietf-l3vpn-2547bis-mcast\]](#) are applicable.

In order to transport the multicast tree via a MP LSP using VPN in-band signaling, an mLDP Label Mapping Message is sent by PE1. This message will contain either a P2MP FEC or an MP2MP FEC (see [\[I-D.ietf-mpls-ldp-p2mp\]](#), depending upon whether the PIM tree being transported is a source-specific tree, or a bidirectional tree, respectively. The FEC contains a "root" and an "opaque value".

If the UMH and the upstream PE have the same IP address (i.e., the Upstream PE is the UMH), then the root of the Multipoint FEC is set to the IP address of the Upstream PE. If, in the context of this VPN, (S,G) refers to a source-specific MDT, then the values of S, G, and the upstream RD are encoded into the opaque value. If, in the context of this VPN, G is a bidirectional group address, then S is replaced with the value of the RPA associated with G. The coding details are specified in [Section 3](#). Conceptually, the Multipoint FEC can be thought of as an ordered pair: <root=Upstream-PE,

opaque\_value=<S or RPA ,G ,Upstream-RD>. The mLDP Label Mapping Message is then sent by PE1 on its LDP session to the "next hop" on its path to the upstream PE. The "next hop" is usually the IGP next hop, but see [\[I-D.napierala-mpls-targeted-ldp\]](#) for cases in which the next hop is not the IGP next hop.

If the UMH and the upstream PE do not have the same IP address, the procedures of section 2 of [\[I-D.ietf-mpls-ldp-recurs-fec\]](#) should be

applied. The root node of the multipoint FEC is set to the UMH. The recursive opaque value is then set as follows: the root node is set to the upstream PE, and the opaque value is set to the multipoint FEC described in the previous paragraph. That is, the multipoint FEC can be thought of as the following recursive ordered pair: <root=UMH, opaque\_value=<root=Upstream-PE, opaque\_value =<S or RPA, G, Upstream-RD>>.

The encoding of the multipoint FEC also specifies the "type" of PIM MDT being spliced onto the multipoint LSP. Four types of MDT are defined: IPv4 source-specific tree, IPv6 source-specific tree, IPv4 bidirectional tree, and IPv6 bidirectional tree.

When a PE router receives an mLDP message with a P2MP or MP2MP FEC, where the PE router itself is the root node, and the opaque value is one of the types defined in [Section 3](#), then it uses the RD encoded in the opaque value field to determine the VRF context. (This RD will be associated with one of the PEs VRFs.) Then, in the context of that VRF, the PE follows the procedure specified in section 2 of [\[I-D.ietf-mpls-mldp-in-band-signaling\]](#).

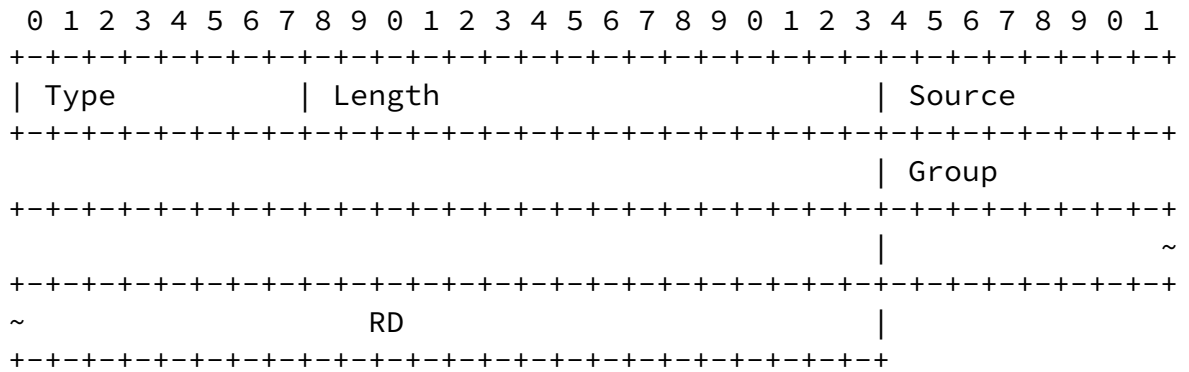
### [3](#). Encoding the Opaque Value of an LDP MP FEC

This section documents the different transit opaque encodings.

#### [3.1](#). Transit VPNv4 Source TLV

This opaque value type is used when transporting a source-specific mode multicast tree whose source and group addresses are IPv4 addresses.





Type: (to be assigned by IANA).

Length: 16

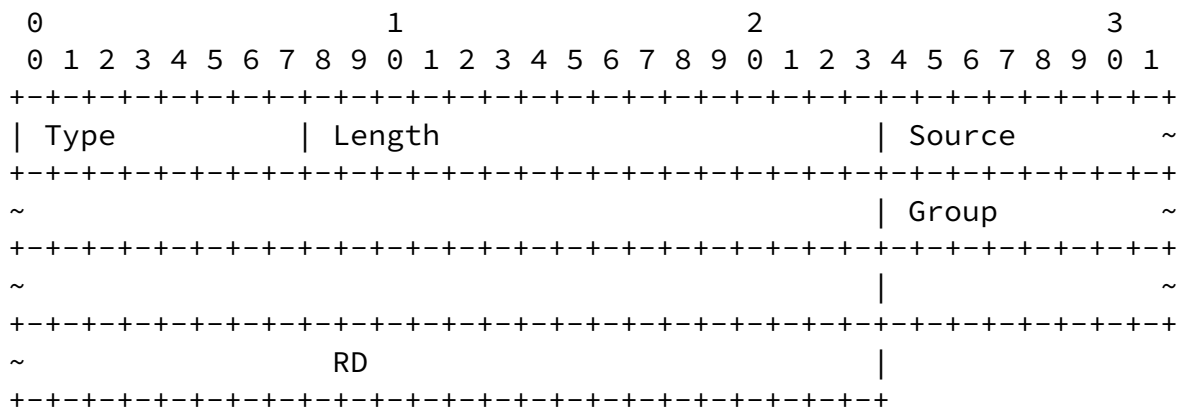
Source: IPv4 multicast source address, 4 octets.

Group: IPv4 multicast group address, 4 octets.

RD: Route Distinguisher, 8 octets.

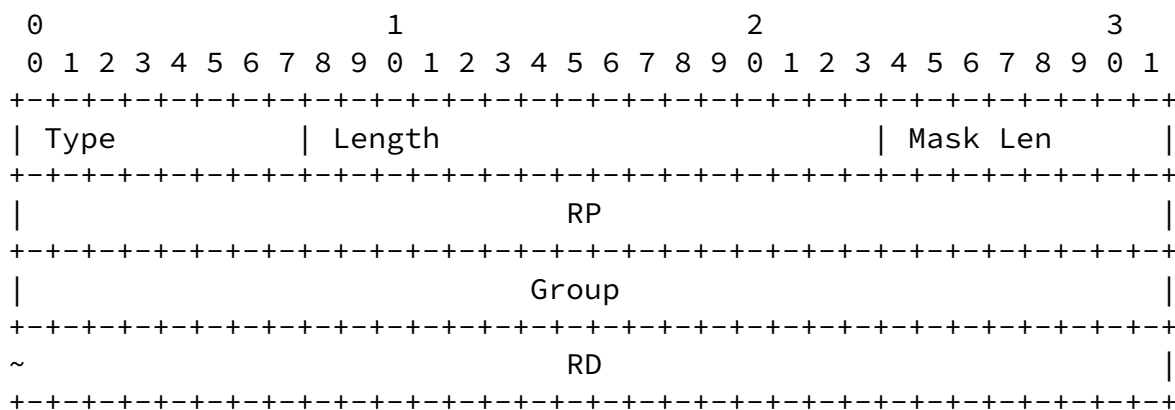
### 3.2. Transit VPNv6 Source TLV

This opaque value type is used when transporting a source-specific mode multicast tree whose source and group addresses are IPv6 addresses.



RD: Route Distinguisher, 8 octets.

This opaque value type is used when transporting a bidirectional multicast tree whose group address is an IPv4 address. The RP address is also an IPv4 address in this case.



Mask Len: The number of contiguous one bits that are left justified and used as a mask, 1 octet.

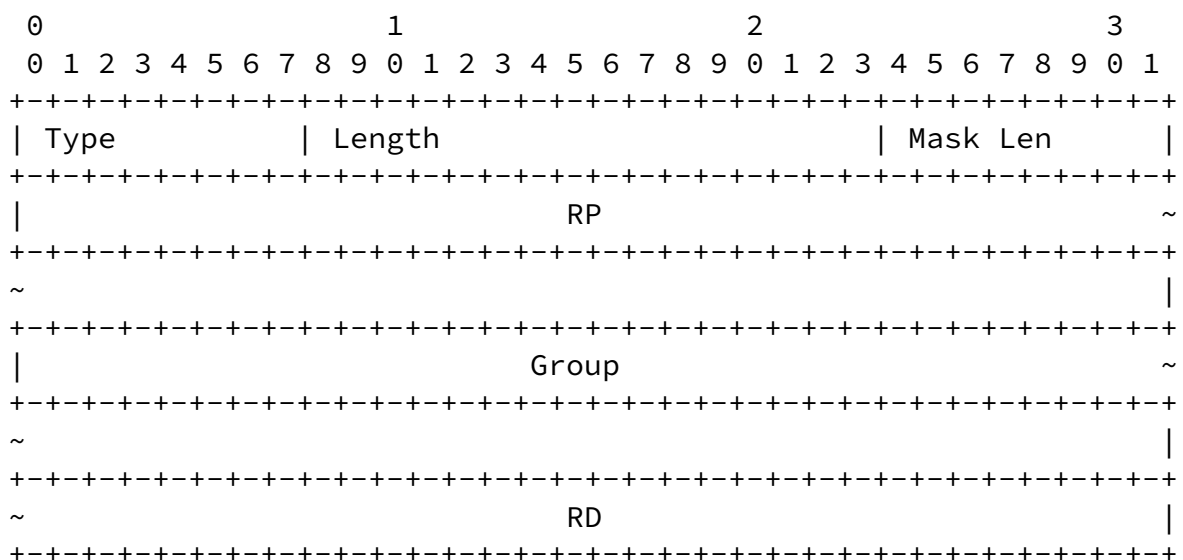
RP: Rendezvous Point (RP) IPv4 address used for encoded Group, 4 octets.

Group: IPv4 multicast group address, 4 octets.

RD: Route Distinguisher, 8 octets.

### 3.4. Transit VPNv6 bildir TLV

This opaque value type is used when transporting a bidirectional multicast tree whose group address is an IPv6 address. The RP address is also an IPv6 address in this case.



Type: (to be assigned by IANA).

Length: 41

Mask Len: The number of contiguous one bits that are left justified and used as a mask, 1 octet.

RP: Rendezvous Point (RP) IPv6 address used for encoded group, 16 octets.

Group: IPv6 multicast group address, 16 octets.

RD: Route Distinguisher, 8 octets.

#### [4.](#) Security Considerations

The same security considerations apply as for the base LDP specification, described in [[RFC5036](#)], and the base mLDP specification, described in [[I-D.ietf-mpls-ldp-p2mp](#)]

#### [5.](#) IANA considerations

[I-D.ietf-mpls-ldp-p2mp] defines a registry for "The LDP MP Opaque Value Element Basic Type". This document requires the assignment of four new code points in this registry:

Transit VPNv4 Source TLV type - requested 10

Transit VPNv6 Source TLV type - requested 11

Transit VPNv4 Bidir TLV type - requested 12

Transit VPNv6 Bidir TLV type - requested 13

#### [6.](#) Acknowledgments

Thanks to Eric Rosen and Andy Green for their comments on the draft.

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