

Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: April 15, 2013

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October 12, 2012

Proxy LSP Ping
draft-lim-mpls-proxy-lsp-ping-00

Abstract

This document defines a means of remotely initiating Multiprotocol Label Switched Protocol Pings on Label Switched Paths. A proxy ping request is sent to any Label Switching Routers along a Label Switched Path. The primary motivations for this facility are first to limit the number of messages and related processing when using LSP Ping in large Point-to-Multipoint LSPs, and second to enable leaf to leaf/ root tracing.

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1. Introduction

It is anticipated that very large Point-to-Multipoint (P2MP) and Multipoint-to-Multipoint (MP2MP) Label Switched Paths (LSPs) will exist. Further it is anticipated that many of the applications for P2MP/MP2MP tunnels will require OAM that is both rigorous and scalable.

Suppose one wishes to trace a P2MP LSP to localize a fault which is affecting one egress or a set of egresses. Suppose one follows the normal procedure for tracing - namely repeatedly pinging from the root, incrementing the TTL by one after each three or so pings. Such a procedure has the potential for producing a large amount of processing at the P2MP-LSP midpoints and egresses. It also could produce an unwieldy number of replies back to the root.

One alternative would be to begin sending pings from points at or near the affected egress(es) and working backwards toward the root. The TTL could be held constant as say two, limiting the number of responses to the number of next-next-hops of the point where a ping is initiated.

This document defines protocol extensions to MPLS ping [[RFC4379](#)] to allow a third party to remotely cause an MPLS echo request message to be sent down a Label Switched Path (LSP) or part of an LSP. The procedure described in the paragraphs above does require that the initiator know the previous-hop node to the one which was pinged on the prior iteration. This information is readily available in [[RFC4875](#)]. This also document provides a means for obtaining this information for [[RFC6388](#)].

While the motivation for this document came from multicast scaling concerns, its applicability may be wider. However other uses of this facility are beyond the scope of this document. In particular, the procedures defined in this document only allow testing of a FEC stack consisting of a single FEC. It also does not allow the initiator to specify the label assigned to that FEC, nor does it allow the initiator to cause any additional labels to be added to the label stack of the actual MPLS echo request message.

1.1. Requirements Language

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](#).

The term "Must Be Zero" (MBZ) is used in object descriptions for reserved fields. These fields MUST be set to zero when sent and

ignored on receipt.

Based on context the terms leaf and egress are used interchangeably. Egress is used where consistency with[RFC4379] was deemed appropriate. Receiver is used in the context of receiving protocol messages.

[Note (to be removed after assignments occur): <tba> = to be assigned by IANA]

2. Proxy Ping Overview

This document defines a protocol interaction between a first node and a node which is part of an LSP to allow the first node to request that that second node initiate an LSP ping for the LSP on behalf of the first node. Two new LSP Ping messages are defined for remote pinging, the MPLS proxy ping request and the MPLS proxy ping reply.

A remote ping operation on a P2MP LSP generally involves at least three LSRs; in some scenarios none of these are the ingress (root) or an egress (leaf) of the LSP.

We refer to these nodes with the following terms:

Initiator - the node which initiates the ping operation by sending an MPLS proxy ping request message

Proxy LSR - the node which is the destination of the MPLS proxy request message and potential initiator of the MPLS echo request

Receiver(s) - the nodes which receive the MPLS echo request message

Responder - A receiver that responds to a MPLS Proxy Ping Request or an MPLS Echo Request

We note that in some scenarios, the initiator could also be the responder, in which case the response would be internal to the node.

The initiator formats an MPLS proxy ping request message and sends it to the proxy LSR, a node it believes to be on the path of the LSP. This message specifies the MPLS echo request to be sent inband of the LSP. It may request the proxy LSR to either Reply with Proxy information or the send a MPLS echo request. The initiator requests Proxy information so that it can learn additional information it needs to use to form a subsequent MPLS Proxy Ping request. For example during LSP traceroute an initiator needs the downstream map

information to form an Echo request. An initiator may also want to learn a Proxy LSR's FEC neighbor information so that it can form proxy request to various nodes along the LSP.

The proxy LSR either replies with the requested Proxy information or it validates that it has a label mapping for the specified FEC and that it is authorized to send the specified MPLS echo request on behalf of the initiator.

If the proxy LSR has a label mapping for the FEC and all authorization checks have passed, the proxy LSR formats an MPLS echo request. If the source address of the IP packet is not the initiator, it includes a Reply-to Address object containing the initiator's address. It then sends it inband of the LSP.

The receivers process the MPLS echo request as normal, sending their MPLS echo replies back to the initiator.

If the proxy LSR failed to send a MPLS echo request as normal because it encountered an issue while attempting to send, a MPLS proxy ping reply message is sent back with a return code indicating that the MPLS echo request could not be sent.

3. Proxy MPLS Echo Request / Reply Procedures

3.1. Procedures for the initiator

The initiator creates an MPLS proxy ping request message.

The message MUST contain a Target FEC Stack that describes the FEC being tested. The topmost FEC in the target FEC stack is used at that the Proxy Router to lookup the MPLS label stack that will be used to encapsulate the MPLS echo request packet.

The MPLS Proxy Ping message MUST contain a Proxy Echo Parameters object. In that object, the address type is set to either IPv4 or IPv6. The Destination IP Address is set to the value to be used in the MPLS echo request packet. If the Address Type is IPv4, an address from the range 127/8. If the Address Type is IPv6, an address from the range ::FFFF:7F00:0/104.

The Reply mode and Global Flags of the Proxy Echo Parameters object are set to the values to be used in the MPLS echo request message header. The Source UDP Port is set to the value to be used in the MPLS echo request packet. The TTL is set to the value to be used in the outgoing MPLS label stack. See [Section 5.1](#) for further details.

If the FEC's Upstream/Downstream Neighbor address information is required, the initiator sets the "Request for FEC neighbor information" Proxy Flags in the Proxy Echo Parameters object.

If a Downstream Detailed or Downstream Mapping TLV is required in a MPLS Proxy Ping Reply, the initiator sets the "Request for Downstream Detailed Mapping" or "Request for Downstream Mapping" Proxy Flags in the Proxy Echo Parameters object. Only one of the two flags can be set.

The Proxy Request reply mode is set with one of the reply modes defined in [[RFC4379](#)] as appropriate.

A list of Next Hop IP Addresses MAY be included to limit the next hops towards which the MPLS echo request message will be sent. These are encoded as Next Hop sub-objects and included in the Proxy Echo Parameters object.

Proxy Echo Parameter object MPLS payload size field may be set to request that the MPLS echo request (including any IP and UDP header) be zero padded to the specified size. When the payload size is non zero, if sending the MPLS Echo Request involves using an IP header, the DF bit MUST be set to 1.

Any of following objects MAY be included; these objects will be copied into the MPLS echo request messages:

Pad

Vendor Enterprise Number

Reply TOS Byte

P2MP Egress Identifier [[RFC6425](#)]

Echo Jitter TLV [[RFC6425](#)]

Vendor Private TLVs

Downstream Detailed Mapping or Downstream Mapping objects MAY be included. These objects will be matched to the next hop address for inclusion in those particular MPLS echo request messages.

The message is then encapsulated in a UDP packet. The source UDP port is chosen by the sender; the destination UDP port is set to 3503. The IP header is set as follows: the source IP address is a routable address of the sender; the destination IP address is a routable address of the midpoint. The packet is then sent with the

IP TTL is set to 255.

3.2. Procedures for the proxy LSR

A proxy LSR that receives an MPLS proxy ping request message, parses the packet to ensure that it is a well-formed packet. It checks that the TLVs that are not marked "Ignore" are understood. If not, it sets the Return Code set to "Malformed echo request received" or "TLV not understood" (as appropriate), and the Subcode set to zero. If the Reply Mode of the message header is not 1(Do not reply), an MPLS proxy ping reply message SHOULD be sent as described below. In the latter case, the misunderstood TLVs (only) are included in an Errored TLVs object.

The Proxy LSR checks that the MPLS proxy ping request message did not arrive via one of its exception processing paths. Packets arriving via IP TTL expiry, IP destination address set to a Martian address or label ttl expiry MUST be treated as "Unauthorized" packets. An MPLS proxy ping reply message MAY be sent with a Return Code of <tba>, "Remote Ping not authorized".

The header fields Sender's Handle and Sequence Number are not examined, but are saved to be included in the MPLS proxy ping reply and MPLS echo request messages.

The proxy LSR validates that it has a label mapping for the specified FEC, it then determines if it is an ingress, egress, transit or bud node and sets the Return Code as appropriate. A new return code (FEC found) has been defined for the case where the Proxy LSR is an ingress (for example head of the TE tunnel or a transit router) because the existing [RFC4379](#) return codes don't match the situation. For example, when a Proxy LSR is a transit router, it's not appropriate for the return code to describe how the packet would transit because the Proxy Request doesn't contain information about what input interface the an MPLS echo request would be switched from at the Proxy LSR.

The proxy LSR then determines if it is authorized to send the specified MPLS echo request on behalf of the initiator. A Proxy LSR MUST be capable of filtering addresses to validate initiators. Other filters on FECs or MPLS echo request contents MAY be applied. If a filter has been invoked (i.e. configured) and an address does not pass the filter, then an MPLS echo request message MUST NOT be sent, and the event SHOULD be logged. An MPLS proxy ping reply message MAY be sent with a Return Code of <tba>, "Remote Ping not authorized".

The destination address specified in the Proxy Echo Parameters object is checked to ensure that it conforms to the address allowed IPv4 or

IPv6 address range. If not, it sets the Return Code set to "Malformed echo request received" and the Subcode set to zero. If the Reply Mode of the message header is not 1, an MPLS proxy ping reply message SHOULD be sent as described below.

If the "Request for FEC Neighbor Address info" flag is set, a Upstream Neighbor Address Object and/or Downstream Neighbor Address Object(s) is/are formatted for inclusion in the MPLS proxy ping reply. If the Upstream or Downstream address is unknown they are not included in the Proxy Reply.

If there are Next Hop sub-objects in the Proxy Echo Parameters object, each address is examined to determine if it is a next hop for this FEC. If any are not, those sub-objects are from the Proxy Echo Parameters object. The updated object is included in the MPLS proxy ping reply.

If the "Request for Downstream Detailed Mapping" or "Request for Downstream Mapping" flag is set the LSR formats (for inclusions in the MPLS proxy ping reply) a Downstream Detailed/Downstream Mapping object for each interface over which the MPLS echo request will be sent.

If the Proxy LSR is the egress of the FEC, a Proxy reply should be sent to the initiator with the return code set to 3 (Reply router is Egress for FEC) with return subcode set to 0.

If the Reply Mode of the message header is 1, 2 or 3 and no errors or modifications have occurred no MPLS proxy ping reply is sent. Otherwise an MPLS proxy ping reply message SHOULD be sent as described below.

3.2.1. Downstream Detailed/Downstream Maps in Proxy Reply

When the Proxy LSR is a transit or bud node, downstream maps corresponding to how the packet is transited can not be supplied unless an ingress interface for the MPLS echo request is specified, since this information is not available or useful since all valid output paths are of interest, the Proxy LSR should include DS/DDMAP(s) to describe the entire set of paths that the packet can be replicated to assuming that the packet was sourced from the Proxy LSR. For mLDP there is a DSMAP/DDMAP per upstream/downstream neighbor for MP2MP LSPs, or per downstream neighbor in the P2MP LSP case.

When the Proxy LSR is a bud node or egress in a MP2MP LSP, the Proxy Reply should contain DSMAP/DDMAPs assuming that the packet is being sourced from a leaf. In this case, there will be no DSMAP/DDMAP

describing the egresses. The Proxy reply return code is either set to "Reply router found mapping for the FEC" or "Reply router is Egress for the FEC" is returned.

3.2.2. Sending an MPLS proxy ping reply

The Reply mode, Sender's Handle and Sequence Number fields are copied from the proxy ping request message. The objects specified above are included. The message is encapsulated in a UDP packet. The source IP address is a routable address of the proxy LSR; the source port is the well-known UDP port for LSP ping. The destination IP address and UDP port are copied from the source IP address and UDP port of the echo request. The IP TTL is set to 255.

3.2.3. Sending the MPLS echo requests

A base MPLS echo request is formed as described in the next section. The section below that describes how the base MPLS echo request is sent on each interface.

3.2.3.1. Forming the base MPLS echo request

A Next_Hop_List is created as follows. If Next Hop sub-objects were included in the received Proxy Parameters object, the Next_Hop_List created from the address in those sub-objects as adjusted above. Otherwise, the list is set to all the next hops to which the FEC would be forwarded.

The proxy LSR then formats an MPLS echo request message. The Global Flags and Reply Mode are copied from the Proxy Echo Parameters object. The Return Code and Return Subcode are set to zero.

The Sender's Handle and Sequence Number are copied from the remote echo request message.

The TimeStamp Sent is set to the time-of-day (in seconds and microseconds) that the echo request is sent. The TimeStamp Received is set to zero.

A Reply-to Address object containing the initiator's address is included.

The following objects are copied from the MPLS proxy ping request message. Note that of these, only the Target FEC Stack is REQUIRED to appear in the MPLS proxy ping request message.

Target FEC Stack

Pad

Vendor Enterprise Number

Reply TOS Byte

P2MP Egress Identifier [[RFC6425](#)]

Echo Jitter TLV [[RFC6425](#)]

Vendor Private TLVs

The message is then encapsulated in a UDP packet. The source UDP port is copied from the Proxy Echo Parameters object. The destination port copied from the proxy ping request message.

The source IP address is set to a routable address of the proxy LSR. Per usual the TTL of the IP packet is set to 1.

If the Explicit DSCP flag is set, the Requested DSCP byte is examined. If the setting is permitted then the DSCP byte of the IP header of the MPLS Echo Request message is set to that value. Otherwise the DSCP byte is set to a default value. In this case the MPLS Proxy Echo Parameters with the Explicit DSCP flag cleared MUST be included in any MPLS proxy ping reply message. The return code MUST be set to <tba>, "Proxy ping parameters modified". The DSCP field of the MPLS Proxy Echo Parameters SHOULD be set to the actual value used.

3.2.3.2. Per interface sending procedures

The proxy LSR now iterates through the Next_Hop_List modifying the base MPLS echo request to form the MPLS echo request packet which is then sent on that particular interface.

For each next hop address, the outgoing label stack is determined. The TTL for the label corresponding to the FEC specified in the FEC stack is set such that the TTL on the wire will be one less than the TTL specified in the Proxy Echo Parameters. If any additional labels are pushed onto the stack, their TTLs are set to 255.

If the MPLS proxy ping request message contained Downstream Mapping/Enhanced Downstream Mapping objects, they are examined. If the Downstream IP Address matches the next hop address that Downstream Mapping object is included in the MPLS echo request.

The packet is then transmitted on this interface.

4. Proxy Ping Request / Reply Messages

This document defines two new LSP Ping messages, the MPLS proxy ping request and the MPLS proxy ping reply.

4.1. Proxy Ping Request / Reply Message formats

Except where noted, the definitions of all fields in the messages are identical to those found in [RFC4379]. The messages have the following format:

```

      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
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                               Version Number                               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| Message Type | Reply mode | Return Code | Return Subcode |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                               Sender's Handle                               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                               Sequence Number                               |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                               TLVs ...                                     |
.                                                                           .
.                                                                           .
.                                                                           .
|                                                                           |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Version Number

The Version Number is currently 1. (Note: the Version Number is to be incremented whenever a change is made that affects the ability of an implementation to correctly parse or process an MPLS echo request/reply. These changes include any syntactic or semantic changes made to any of the fixed fields, or to any TLV or sub-TLV assignment or format that is defined at a certain version number. The Version Number may not need to be changed if an optional TLV or sub-TLV is added.)

Message Type

Type	Message
5	MPLS proxy ping request (Pending IANA assignment)
6	MPLS proxy ping reply (Pending IANA assignment)

4.2. Proxy Ping Request Message contents

The MPLS proxy ping request message MAY contain the following objects:

Type	Object
----	-----
1	Target FEC Stack
2	Downstream Mapping
3	Pad
5	Vendor Enterprise Number
10	Reply TOS Byte
11	P2MP Egress Identifier [RFC6425]
12	Echo Jitter TLV [RFC6425]
20	Downstream Detailed Mapping
30	Proxy Echo Parameters (Pending IANA assignment) Vendor Private TLVs

4.3. Proxy Ping Reply Message Contents

The MPLS proxy ping reply message MAY contain the following objects:

Type	Object
----	-----
1	Target FEC Stack
2	Downstream Mapping
5	Vendor Enterprise Number
9	Errored TLVs
20	Downstream Detailed Mapping
30	Proxy Echo Parameters (Pending IANA assignment)
31	Upstream Neighbor Address
32	Downstream Neighbor Address (0 or more) Vendor Private objects

5. Object formats

5.1. Proxy Echo Parameters Object

The Proxy Echo Parameters object is a TLV that MUST be included in an MPLS Proxy Echo Request message. The length of the TLV is $12 + K + S$, where K is the length of the Destination IP Address field and S is the total length of the sub-objects. The Proxy Echo Parameters object can be used to either to 1) control attributes used in Composing and Sending an MPLS echo request or 2) query the Proxy LSR for information about the topmost FEC in the target FEC stack but not

both. In the case where the Proxy LSR is being queried (ie information needs to be returned in a Proxy Reply), no MPLS echo request will be sent from the Proxy LSR. The MPLS Proxy Echo request echo header's Reply Mode should be set to "Reply with Proxy Info".

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								
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+									
Address Type										Reply mode										Proxy Flags																			
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+									
TTL										Rqst'd DSCP										Source UDP Port																			
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+									
Global Flags										MPLS Payload size																													
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+									
										Destination IP Address																													
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+									
										Sub-Objects																													
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+										+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+									

Address Type

The type and length of the address found in the in the Destination IP Address and Next Hop IP Addresses fields. The type codes appear in the table below:

Address Family	Type	Length
IPv4	1	4
IPv6	3	16

Reply mode

The reply mode to be sent in the MPLS Echo Request message; the values are as specified in [\[RFC4379\]](#).

Proxy Flags

Request for FEC Neighbor Address info 0x01

When set this requests that the proxy LSR supply the Upstream and Downstream neighbor address information in the MPLS proxy ping reply message. This flag is only applicable

for the topmost FEC in the FEC stack if the FEC types corresponds with a P2MP or MP2MP LSPs. The Proxy LSR MUST respond as applicable with a Upstream Neighbor Address Object and Downstream Neighbor Address Object(s) in the MPLS Proxy ping reply message. Upstream Neighbor Address Object needs be included only if there is an upstream neighbor. Similarly, one Downstream Neighbor Address Object needs to be included for each Downstream Neighbor for which the LSR learned bindings from.

Setting this flag will cause the proxy LSR to cancel sending an Echo request as the information being requested needs to be returned for use in a subsequent Proxy Request.

Request for Downstream Mapping 0x02

When set this requests that the proxy LSR supply a Downstream Mapping object see [[RFC4379](#)] in the MPLS proxy ping reply message. It's not valid to have Request for Enhanced Downstream Mapping flag set when this flag is set.

Setting this flag will cause the proxy LSR to cancel sending an Echo request as the information being requested needs to be returned for use in a subsequent Proxy Request.

Request for Enhanced Downstream Mapping 0x04

When set this requests that the proxy LSR supply a Enhanced Downstream Mapping object see [[RFC6424](#)] in the MPLS proxy ping reply message. It's not valid to have Request for Downstream Mapping flag set when this flag is set.

Setting this flag will cause the proxy LSR to cancel sending an Echo request as the information being requested needs to be returned for use in a subsequent Proxy Request.

Explicit DSCP Request 0x08

When set this requests that the proxy LSR use the supplied "Rqst'd DSCP" byte in the echo request message

TTL

The TTL to be used in the label stack entry corresponding to the topmost FEC in the in the MPLS Echo Request packet

Requested DSCP

This field is valid only if the Explicit DSCP flag is set. If not set, the field MUST be zero on transmission and ignored on receipt. When the flag is set this field contains the DSCP value to be used in the MPLS echo request packet IP header.

Source UDP Port

The source UDP port to be sent in the MPLS Echo Request packet

Global Flags

The Global Flags to be sent in the MPLS Echo Request message

MPLS Payload Size

Used to request that the MPLS payload (IP header + UDP header + MPLS echo request) be padded using a zero filled Pad TLV so that the IP header, UDP header nad MPLS echo request total the specified size. Field set to zero means no size request is being made. If the requested size is less than the minimum size required to form the MPLS echo request, the request will be treated as a best effort request with the Proxy LSR building the smallest possible packet (ie not using a Pad TLV). The IP header DF bit should be set when this field is non zero.

Destination IP Address

If the Address Type is IPv4, an address from the range 127/8;
If the Address Type is IPv6, an address from the range
::FFFF:7F00:0/104

Sub-Objects

A TLV encoded list of sub-objects. Currently one is defined.

Sub-Type	Length	Value Field
-----	-----	-----
1	8+	Next Hop

[5.1.1.](#) Next Hop sub-Object

This sub-object is used to describe a particular next hop towards which the Echo Request packet should be sent. If the topmost FEC in the FEC-stack is a multipoint LSP, this sub-object may appear multiple times.

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	2	3	4	5	6	7	8	9	0	1
+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+											
Addr Type										MUST be Zero																															
+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+											
										Next Hop IP Address (4 or 16 octets)																															
+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+											
										Next Hop Interface (0, 4 or 16 octets)																															
+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+										+--+--+--+--+--+--+--+--+--+											

Address Type

Type	Type of Next Hop	Addr Length	IF Length
1	IPv4 Numbered	4	4
2	IPv4 Unnumbered	4	4
3	IPv6 Numbered	16	16
4	IPv6 Unnumbered	16	4
5	IPv4 Protocol Adj	4	0
6	IPv6 Protocol Adj	16	0

Note: Types 1-4 correspond to the types in the DS Mapping object. They are expected to be populated with information obtained through a previously returned DS Mapping object. Types 5 and 6 are intended to be populated from the local address information obtained from a previously returned Previous Hop Address Object.

Next Hop IP Address

A next hop address that the echo request message is to be sent towards

Next Hop Interface

Identifier of the interface through which the echo request message is to be sent

5.2. Reply-to Address Object

Used to specify the MPLS echo request IP source address. This address must be IP reachable via the Proxy LSR otherwise it will be rejected.


```

      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
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| Address Type |                               MUST be Zero |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|
:                               Reply-to Address                               :
|
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

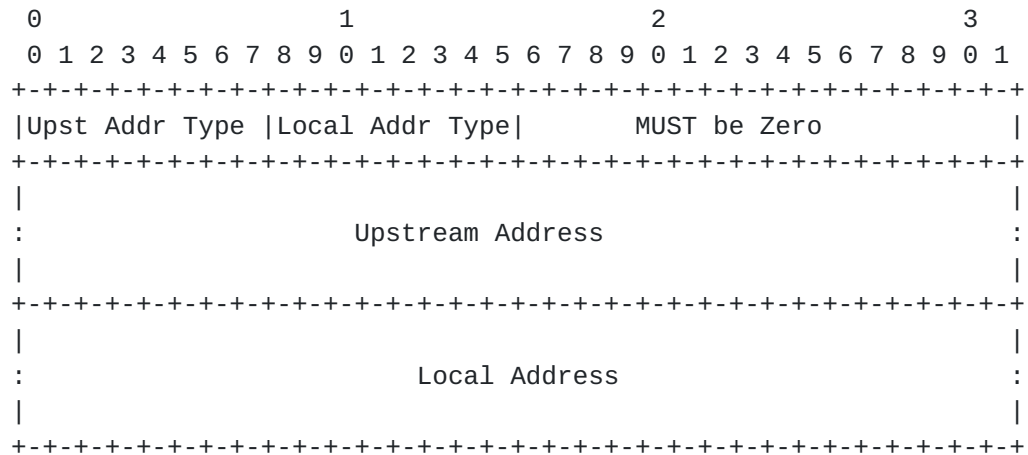
```

Address Type

A type code as specified in the table below:

Type	Type of Address
1	IPv4
3	IPv6

[5.3.](#) Upstream Neighbor Address Object



Upst Addr Type; Local Addr Type

These two fields determine the type and length of the respective addresses. The codes are specified in the table below:

Type	Type of Address	Length
0	No Address Supplied	0
1	IPv4	4
3	IPv6	16

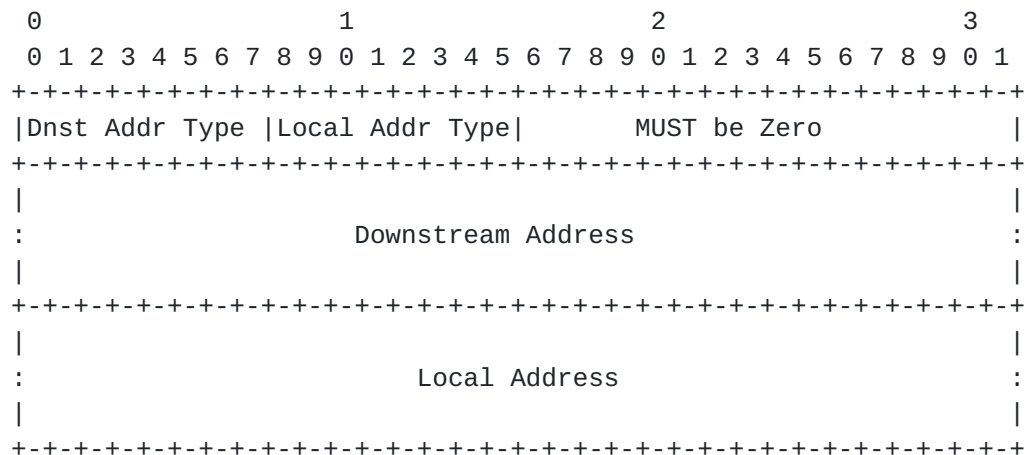
Upstream Address

The address of the immediate upstream neighbor for the topmost FEC in the FEC stack. If protocol adjacency exists by which the label for this FEC was exchanged, this address MUST be the address used in that protocol exchange.

Local Address

The local address used in the protocol adjacency exists by which the label for this FEC was exchanged.

[5.4.](#) Downstream Neighbor Address Object



Upst Addr Type; Local Addr Type

These two fields determine the type and length of the respective addresses. The codes are specified in the table below:

Type	Type of Address	Length
0	No Address Supplied	0
1	IPv4	4
3	IPv6	16

Upstream Address

The address of a immediate downstream neighbor for the topmost FEC in the FEC stack. If protocol adjacency exists by which the label for this FEC was exchanged, this address MUST be the address used in that protocol exchange.

Local Address

The local address used in the protocol adjacency exists by which the label for this FEC was exchanged.

6. Security Considerations

The mechanisms described in this document are intended to be used within a Service Provider network and to be initiated only under the authority of that administration.

If such a network also carries internet traffic, or permits IP access from other administrations, MPLS proxy ping message SHOULD be

discarded at those points. This can be accomplished by filtering on source address or by filtering all MPLS ping messages on UDP port.

Any node which acts as a proxy node SHOULD validate requests against a set of valid source addresses. An implementation MUST provide such filtering capabilities.

MPLS proxy ping request messages are IP addressed directly to the Proxy node. If a node which receives an MPLS proxy ping message via IP or Label TTL expiration, it MUST NOT be acted upon.

MPLS proxy ping request messages are IP addressed directly to the Proxy node. If a MPLS Proxy ping request IP destination address is a Martian Address, it MUST NOT be acted upon.

if a MPLS Proxy ping request IP source address is not IP reachable, it MUST NOT be acted upon.

MPLS proxy ping requests are limited to making their request via the specification of a FEC. This ensures that only valid MPLS echo request messages can be created. No label spoofing attacks are possible.

7. IANA Considerations

This document makes the following assignments (pending IANA action)

LSP Ping Message Types

Type	Value Field
----	-----
03(tba)	MPLS proxy ping request message
04(tba)	MPLS proxy ping reply

Objects and Sub-Objects

Type	Sub-Type	Value Field
----	-----	-----
22(tba)	1	Proxy Echo Parameters
		Next Hop
23(tba)		Reply-to Address
24(tba)		Upstream Neighbor Address
25(tba)		Downstream Neighbor Address

Return Code [pending IANA assignment]

Value	Meaning
-----	-----
16(tba)	Proxy ping not authorized.
17(tba)	Proxy ping parameters need to be modified.
18(tba)	MPLS Echo Request Could not be sent.
18(tba)	Replying router has FEC mapping for topmost FEC.

8. References

8.1. Normative References

- [RFC4379] Kompella, K. and G. Swallow, "Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures", [RFC 4379](#), February 2006.
- [RFC6424] Bahadur, N., Kompella, K., and G. Swallow, "Mechanism for Performing Label Switched Path Ping (LSP Ping) over MPLS Tunnels", [RFC 6424](#), November 2011.
- [RFC6425] Saxena, S., Swallow, G., Ali, Z., Farrel, A., Yasukawa, S., and T. Nadeau, "Detecting Data-Plane Failures in Point-to-Multipoint MPLS - Extensions to LSP Ping", [RFC 6425](#), November 2011.

8.2. Informative References

- [RFC4875] Aggarwal, R., Papadimitriou, D., and S. Yasukawa, "Extensions to Resource Reservation Protocol - Traffic Engineering (RSVP-TE) for Point-to-Multipoint TE Label Switched Paths (LSPs)", [RFC 4875](#), May 2007.
- [RFC6388] Wijnands, IJ., Minei, I., Kompella, K., and B. Thomas, "Label Distribution Protocol Extensions for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths", [RFC 6388](#), November 2011.

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