LDP Extensions for Multi Topology Routing
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Abstract

   Multi-Topology (MT) routing is supported in IP networks with the use
   of MT aware IGP protocols. In order to provide MT routing within
   Multiprotocol Label Switching (MPLS) Label Distribution Protocol
   (LDP) networks new extensions are required. This document updates
   RFC4379.

   This document describes the LDP protocol extensions required to
   support MT routing in an MPLS environment.

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1. **Terminology**

   This document uses MPLS terminology defined in [RFC5036]. Additional
   terms are defined below:

   o MT-ID: A 16 bit value used to represent the Multi-Topology ID.

   o Default MT Topology: A topology that is built using the MT-ID
      default value of 0.

   o MT Topology: A topology that is built using the corresponding
      MT-ID.

   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].

2. **Introduction**

   Multi-Topology (MT) routing is supported in IP networks with the use
   of MT aware IGP protocols. It would be advantageous for
   communications Service Providers (CSP) to support Multiple Topologies
   (MT) within MPLS environments (MPLS-MT). Beneficial MPLS-MT
   deployment applications include:

   o A CSP may want to assign varying QoS profiles to traffic, based on
      a specific MT.

   o Separate routing and MPLS domains may be used to isolated
      multicast and IPv6 islands within the backbone network.

   o Specific IP address space could be routed across an MT based on
      security or operational isolation requirements.

   o Low latency links could be assigned to an MT for delay sensitive
      traffic.

   o Management traffic could be separated from customer traffic using
      multiple MTs, where the management traffic MT does not use links
      that carries customer traffic.

   This document describes the LDP procedures and protocol extensions
   required to support MT routing in an MPLS environment.

   This document also updates RFC4379 by defining two new FEC types for
   LSP ping.

3. Signaling Extensions

3.1. Topology-Scoped Forwarding Equivalence Class (FEC)

LDP assigns and binds a label to a Forwarding Equivalence Class
(FEC), where a FEC is a list of one of more FEC elements. To setup
LSPs for unicast IP routing paths, LDP assigns local labels for IP
prefixes, and advertises these labels to its peers so that an LSP is
setup along the routing path. To setup MT LSPs for IP prefixes under
a given topology scope, the LDP "prefix-related" FEC element must be
extended to include topology information. This infers that MT-ID
becomes an attribute of Prefix-related FEC element, and all FEC-Label
binding operations are performed under the context of given topology
(MT-ID).

The following Subsection 3.2(New Address Families: MT IP) defines the
extension required to bind "prefix-related" FEC to a topology.

3.2. New Address Families: MT IP

The LDP base specification [RFC5036] (Section 4.1) defines the
"Prefix" FEC Element as follows:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Prefix (2)   |     Address Family            |     PreLen    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Prefix                                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
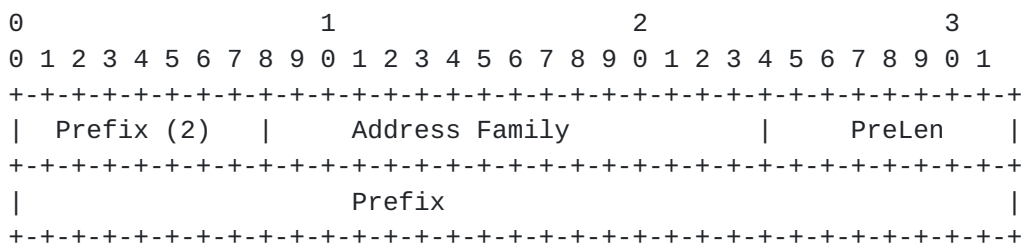
Figure 1: Prefix FEC Element Format [RFC5036]

Where "Prefix" encoding is as defined for given "Address Family", and
whose length (in bits) is specified by the "PreLen" field.

To extend IP address families for MT, two new Address Families named
"MT IP" and "MT IPv6" are used to specify IPv4 and IPv6 prefixes
within a topology scope.

The format of data associated with these new Address Family is:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                         IP Address                            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           Reserved            |            MT-ID              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

               Figure 2: MT IP Address Family Format

   Where "IP Address" is an IPv4 and IPv6 address/prefix for "MT IP" and
   "MT IPv6" AF respectively, and the field "MT-ID" corresponds to 16-
   bit Topology ID for given address.

   Where 16-bit "MT-ID" field defines the Topology ID, and the
   definition and usage of the rest fields in the FEC Elements are same
   as defined for IP/IPv6 AF. The value of MT-ID 0 corresponds to
   default topology and MUST be ignored on receipt so as to not cause
   any conflict/confusion with existing non-MT procedures.

   The proposed FEC Elements with "MT IP" Address Family can be used in
   any LDP message and procedures that currently specify and allow the
   use of FEC Elements with IP/IPv6 Address Family.

   [Editors Note - RFC[5036] doesn't specify the handling of unknown
   Address Family. After we have introduced the two new address family
   here, RFC[5036] need to be updated to add the handling procedure for
   the unknown address families.

[3.3](). LDP FEC Elements with MT IP AF

   The following section specifies the format extensions of the existing
   LDP FEC Elements. The "Address Family" of these FEC elements will be
   set to "MT IP" or "MT IPv6".

   The MT Prefix FEC element encoding is as follows:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  Prefix (2)   | Address Family (MT IP/MT IPv6)|    PreLen     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                          Prefix                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           Reserved            |            MT-ID              |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 3: MT Prefix FEC Element Format

Similarly, the MT mLDP FEC elements encoding is as follows, where the
mLDP FEC Type can be P2MP(6), MP2MP-up(7), and MP2MP-down(8):

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | mLDP FEC Type | Address Family (MT IP/MT IPv6)| Address Length|
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 ~                      Root Node Address                        ~
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |          Reserved           |            MT-ID                |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |     Opaque Length           |      Opaque Value ...           |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                                +
 ~                                                               ~
 |                                                               |
 |                             +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                             |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
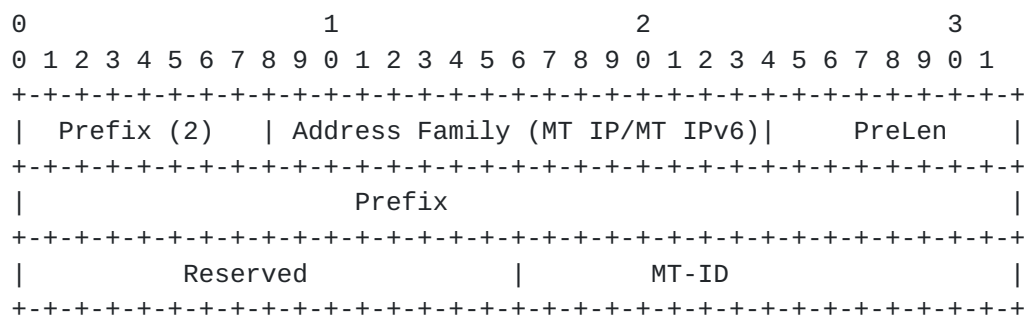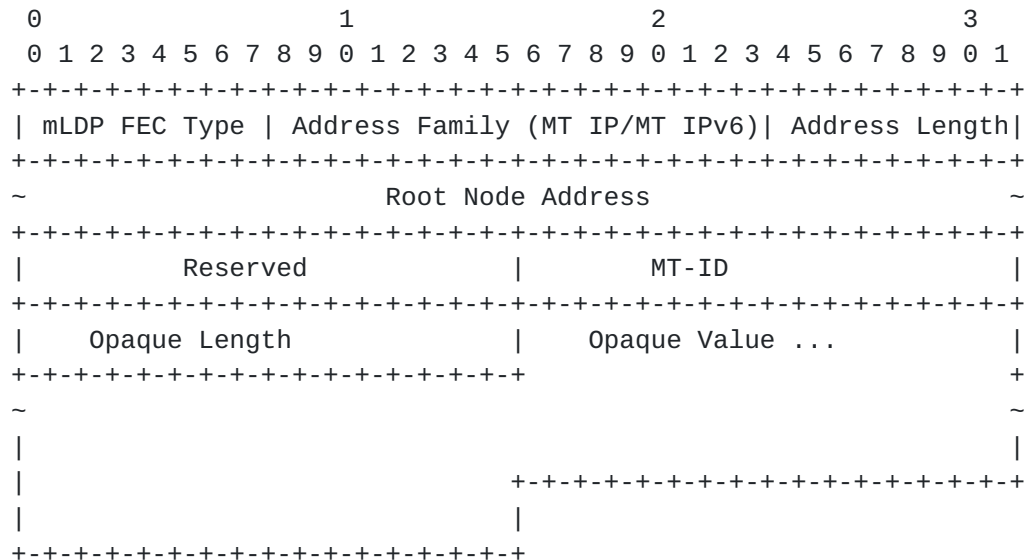
Figure 4: MT mLDP FEC Element Format

The MT Typed Wildcard FEC element encoding is as follows:

```
 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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |Typed Wcard (5)|    FEC Type   |   Len = 6     |  AF = MT IP ..|
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |... or MT IPv6 |          MT ID                |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
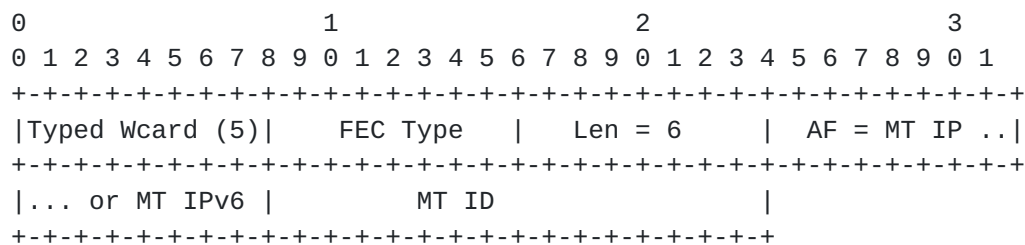
Figure 5: MT Typed Wildcard FEC Element

3.4. IGP MT-ID Mapping and Translation

The non-reserved non-special IGP MT-ID values can be used/carried in
LDP as-is and need no translation. However, there is a need for
translating reserved/special IGP MT-ID values to corresponding LDP
MT-IDs. The corresponding special/reserved LDP MT-ID values are
defined in later section 10.

3.5. LDP MT Capability Advertisement

   We specify a new LDP capability, named "Multi-Topology (MT)", which
   is defined in accordance with LDP Capability definition guidelines
   [RFC5561]. The LDP "MT" capability can be advertised by an LDP
   speaker to its peers either during the LDP session initialization or
   after the LDP session is setup to announce LSR capability to support
   MTR for the given IP address family.

   The "MT" capability is specified using "Multi-Topology Capability"
   TLV. The "Multi-Topology Capability" TLV format is in accordance
   with LDP capability guidelines as defined in [RFC5561]. To be able
   to specify IP address family, the capability specific data (i.e.
   "Capability Data" field of Capability TLV) is populated using "Typed
   Wildcard FEC Element" as defined in [RFC5918].

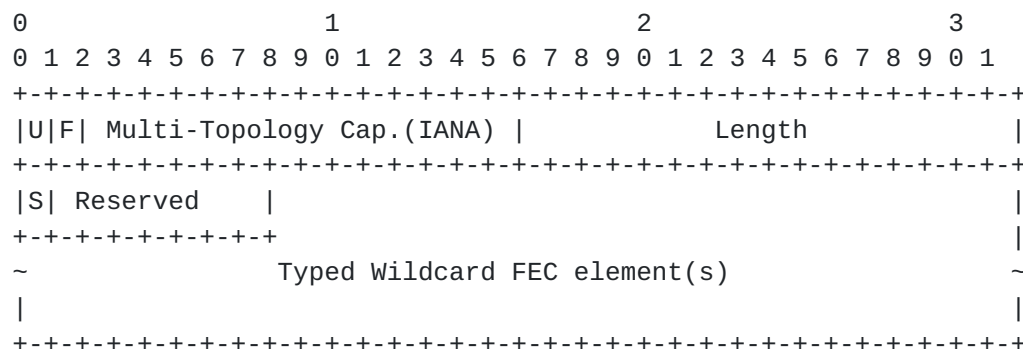   The format of "Multi-Topology Capability" TLV is as follows:

```
 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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |U|F| Multi-Topology Cap.(IANA) |            Length             |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |S| Reserved    |                                               |
 +-+-+-+-+-+-+-+-+                                               |
 ~               Typed Wildcard FEC element(s)                   ~
 |                                                               |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

                 Figure 6: Multi-Topology Capability TLV Format

   o Where:

   o U- and F-bits: MUST be 1 and 0, respectively, as per Section 3.
      (Signaling Extensions) of LDP Capabilities [RFC5561].

   o Multi-Topology Capability: Capability TLV type (IANA assigned)

   o S-bit: MUST be 1 if used in LDP "Initialization" message. MAY be
      set to 0 or 1 in dynamic "Capability" message to advertise or
      withdraw the capability respectively.

   o Typed Wildcard FEC element(s): One or more elements specified as
      the "Capability data".

   o Length: The length (in octets) of TLV.

   o The encoding of Typed Wildcard FEC element, as defined in
      [RFC5561], is defined in the section 4.1 (Typed Wildcard FEC
      Element) of this document.

3.6. Procedures

   To announce its MT capability for an IP address family, LDP FEC type,
   and Multi Topology, an LDP speaker MAY send an "MT Capability"
   including the exact Typed Wildcard FEC element with corresponding
   "AddressFamily" field (i.e., set to "MT IP" for IPv4 and set to "MT
   IPv6" for IPv6 address family), corresponding "FEC Type" field (i.e.,
   set to "P2P", "P2MP", "MP2MP"), and corresponding "MT-ID". To
   announce its MT capability for both IPv4 and IPv6 address family, or
   for multiple FEC types, or for multiple Multi Topologies, an LDP
   speaker MAY send "MT Capability" with one or more MT Typed FEC
   elements in it.

   o The capability for supporting multi-topology in LDP can be
      advertised during LDP session initialization stage by including
      the LDP MT capability TLV in LDP Initialization message. After an
      LDP session is established, the MT capability can also be
      advertised or withdrawn using Capability message (only if "Dynamic
      Announcement" capability [RFC5561] has already been successfully
      negotiated).

   o If an LSR has not advertised MT capability, its peer must not send
      messages that include MT identifier to this LSR.

   o If an LSR receives a Label Mapping message with an MT parameter
      from downstream LSR-D and its upstream LSR-U has not advertised MT
      capability, an LSP for the MT will not be established.

   o This document proposes to add a new notification event to signal
      the upstream that the downstream is not capable.

   o If an LSR is changed from non-MT capable to MT capable, it sets
      the S bit in MT capability TLV and advertises via the Capability
      message. The existing LSP is treated as LSP for default MT (ID
      0).

   o If an LSR is changed from LDP-MT capable to non-MT capable, it may
      initiate withdraw of all label mapping for existing LSPs of all
      non-default MTs. Then it clears the S bit in MT capability TLV
      and advertises via the Capability message.

   o If an LSR is changed from IGP-MT capable to non-MT capable, it may
      wait until the routes update to withdraw FEC and release the label
      mapping for existing LSPs of specific MT.

3.7. LDP Sessions

If a single global label space is supported, there will be an LDP
session supported for each pair of peers, regardless of the number of
MTs supported between peers. If there are different label spaces
supported for different topologies, which means that label spaces
overlap with each other for different MTs, then it is recommended to
establish multiple sessions for multiple topologies between these two
peers. In this case, multiple LSR-IDs will need to be allocated so
that each multiple topology can have its own label space ID.

3.8. Reserved MT ID Values

Certain MT topologies are assigned to serve predetermined purposes:

Default-MT: Default topology. This corresponds to OSPF default IPv4
and IPv6, as well as ISIS default IPv4. A value of 0 is proposed.

ISIS IPv6 MT: ISIS default MT-ID for IPv6.

Wildcard-MT: This corresponds to All-Topologies. A value of 65535
(0xffff) is proposed.

In Section 9. (IANA Considerations) this document proposes a new
IANA registry "LDP Multi-Topology ID Name Space" under IANA "LDP
Parameter" namespace to keep an LDP MT-ID reserved value.

If an LSR receives a FEC element with an "MT-ID" value that is
"Reserved" for future use (and not IANA allocated yet), the LSR must
abort the processing of the FEC element, and SHOULD send a
notification message with status code "Invalid MT-ID" to the sender.

4. MT Applicability on FEC-based features

4.1. Typed Wildcard FEC Element

[RFC5918] extends base LDP and defines Typed Wildcard FEC Element
framework. Typed Wildcard FEC element can be used in any LDP message
to specify a wildcard operation/action for given type of FEC.

The MT extensions proposed in document do not require any extension
in procedures for Typed Wildcard FEC element, and these procedures
apply as-is to MT wildcarding. The MT extensions, though, allow use
of "MT IP" or "MT IPv6" in the Address Family field of the Typed
Wildcard FEC element in order to use wildcard operations in the
context of a given topology. The use of MT-scoped address family
also allows us to specify MT-ID in these operations.

The proposed format in Section 4.1 (Typed Wildcard FEC Element)
allows an LSR to perform wildcard FEC operations under the scope of a
topology. If an LSR wishes to perform wildcard operation that
applies to all topologies, it can use a "Wildcard Topology" MT-ID.
For example, upon local configuration of topology "x", an LSR may
send a wildcard label withdraw request with MT-ID "x" to withdraw all
its labels from the peer that advertized under the scope of topology
"x". Additionally, upon a global configuration change, an LSR may
send a wildcard label withdraw with the MT-ID set to "Wildcard
Topology" to withdraw all its labels under all topologies from the
peer.

4.2. End-of-LIB

[RFC5919] specifies extensions and procedures for an LDP speaker to
signal its convergence for a given FEC type towards a peer. The
procedures defined in [RFC5919] applies as-is to an MT FEC element.
This MAY allow an LDP speaker to signal its IP convergence using
Typed Wildcard FEC element, and its MT IP convergence per topology
using a MT Typed Wildcard FEC element.

4.3. LSP Ping

[RFC4379] defines procedures to detect data-plane failures in MPLS
LSPs via LSP ping. The specification defines a "Target FEC Stack"
TLV that describes the FEC stack being tested. This TLV is sent in
an MPLS echo request message towards LSPs egress LSR, and is
forwarded along the same data path as other packets belonging to the
FEC.

"Target FEC Stack" TLV contains one or more sub-TLVs pertaining to
different FEC types. Section 3.2 of [RFC-4379] defines Sub-Types and
format for the FEC. To support LSP ping for MT LDP LSPs, this
document proposes following extensions to [RFC-4379].

4.3.1. New FEC Sub-Types

We define two new FEC types for LSP ping:

o MT LDP IPv4 FEC

o MT LDP IPv6 FEC

We also define following new sub-types for sub-TLVs to specify these
FECs in the "Target FEC Stack" TLV of [RFC-4379]:

```
        Sub-Type          Length              Value Field
        --------          ------              -----------------
          TBA5               5              MT LDP IPv4 prefix
          TBA6              17              MT LDP IPv6 prefix
```

Figure 7: new sub-types for sub-TLVs

The rules and procedures of using these sub-TLVs in an MPLS echo request message are same as defined for LDP IPv4/IPv6 FEC sub-TLV types in [RFC-4379].

4.3.2. MT LDP IPv4 FEC Sub-TLV

The format of "MT LDP IPv4 FEC" sub-TLV to be used in a "Target FEC Stack" [RFC4379] is:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  Type = TBA5(MT LDP IPv4 FEC) |          Length = 8           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                          IPv4 prefix                          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Prefix Length |      MBZ      |          MT-ID                |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 8: MT LDP IPv4 FEC sub-TLV

The format of this sub-TLV is similar to LDP IPv4 FEC sub-TLV as defined in [RFC-4379]. In addition to "IPv4 prefix" and "Prefix Length" fields, this new sub-TLV also specifies MT-ID (Multi-Topology ID). The Length for this sub-TLV is 5.

4.3.3. MT LDP IPv6 FEC Sub-TLV

The format of "MT LDP IPv6 FEC" sub-TLV to be used in a "Target FEC Stack" [RFC4379] is:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  Type = TBA6(MT LDP IPv6 FEC) |          Length = 20          |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   |                         IPv6 prefix                           |
   |                                                               |
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Prefix Length |     MBZ       |          MT-ID                |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
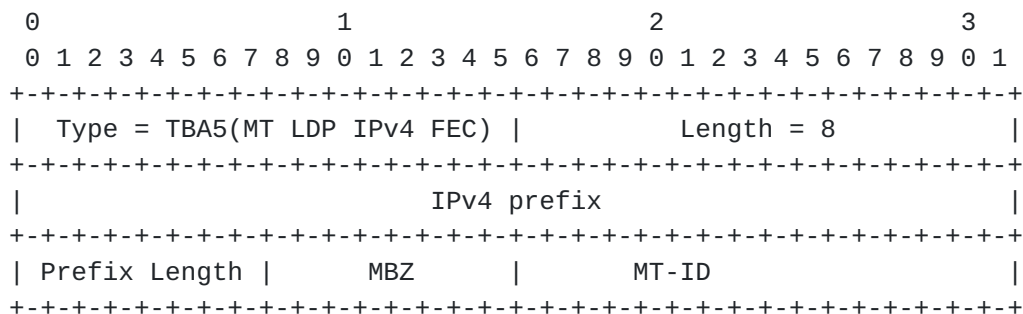
Figure 9: MT LDP IPv6 FEC sub-TLV

The format of this sub-TLV is similar to LDP IPv6 FEC sub-TLV as
defined in [RFC-4379]. In addition to "IPv6 prefix" and "Prefix
Length" fields, this new sub-TLV also specifies MT-ID (Multi-Topology
ID). The Length for this sub-TLV is 17.

4.3.4. Operation Considerations

When detect data-plane failures using LSP Ping for a specific topoly,
the router will intiate an LSP Ping request with the targer FEC stack
TLV containing LDP MT IP Prefix Sub-TLV in the Echo Request packet.
The Echo Request packet is sent with the label binded to the IP
Prefix in the topolgy. Once the echo request packet reaches the
target router, it will process the packet and perform checs for the
LDP MT IP Prefix sub-TLV present in the Target FEC Stack as described
in [RFC4379] and respond according to [RFC4379] processing rules.
For the case that the LSP ping with return path not specified , the
reply packet may go through the default topology instead of the
topology where the Echol Request goes through.

5. Error Handling

The extensions defined in this document utilise the existing LDP
error handling defined in [RFC5036]. If an LSR receives an error
notification from a peer for an MPLS-MT session, it terminates the
LDP session by closing the TCP transport connection for the session
and discarding all MT-ID label mappings learned via the session.

5.1. MT Error Notification for Invalid Topology ID

If an LSR has advertized an MT Capability TLV using the
Initialization message or Capability message, which includes Typed
Wildcard FEC elements with specific MT-IDs, and it receives an MT

message with a MT-ID which is not included in the supported list, it
should response this "Invalid Topology ID" status code.

6. Backwards Compatibility

The MPLS-MT solution is backwards compatible with existing LDP
enhancements defined in [RFC5036], including message authenticity,
integrity of message, and topology loop detection.

7. MPLS Forwarding in MT

Although forwarding is out of the scope of this draft, we include
some forwarding consideration for informational purpose here.

The specified signaling mechanisms allow all the topologies to share
the platform-specific label space; this is the feature that allows
the existing data plane techniques to be used; and the specified
signaling mechanisms do not provide any way for the data plane to
associate a given packet with a context-specific label space.

8. Security Consideration

No specific security issues with the proposed solutions are known.
The proposed extensions in this document do not introduce any new
security considerations beyond that already apply to the base LDP
specification [RFC5036] and [RFC5920].

9. IANA Considerations

The document introduces following new protocol elements that require
IANA consideration and assignments:

o   New LDP Capability TLV: "Multi-Topology Capability" TLV (requested
    code point: TBA1 from LDP registry "TLV Type Name Space").

o   New Status Code: "Multi-Topology Capability not supported"
    (requested code point: TBA2 from LDP registry "Status Code Name
    Space").

o   New Status Code: "Invalid Topology ID" (requested code point: TBA3
    from LDP registry "Status Code Name Space").

o   New Status Code: "Unknown Address Family" (requested code point:
    TBA4 from LDP registry "Status Code Name Space").

```
         Registry:
         Range/Value     E     Description
         -------------   ---   ------------------------------
         0x00000051      1     Invalid Topology ID
```

Figure 10: New Status Codes for LDP Multi Topology Extensions

o New address families under IANA registry "Address Family Numbers":

     - MT IP: Multi-Topology IP version 4 (requested codepoint: 26)
     - MT IPv6: Multi-Topology IP version 6 (requested codepoint: 27)

Figure 11: Address Family Numbers

o New registry "LDP Multi-Topology (MT) ID Name Space" under "LDP
   Parameter" namespace. The registry is defined as:

```
     Range/Value               Name
     -----------               -----------------------
     0                         Default Topology (ISIS and OSPF)
     1-4095                    Unassigned
     4096                      ISIS IPv6 routing topology
                               (i.e. ISIS MT ID #2)
     4097-65534                Reserved (for future allocation)
     65535                     Wildcard Topology (ISIS or OSPF)
```

Figure 12: LDP Multi-Topology (MT) ID Name Space

o New Sub-TLV Types for LSP ping: Following new sub-type values
   under TLV type 1 (Target FEC Stack) from "Multi-Protocol Label
   Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters"
   registry, and "TLVs and sub-TLVs" sub-registry.

```
     Sub-Type       Value Field
     --------       -----------
        TBA5        MT LDP IPv4 prefix
        TBA6        MT LDP IPv6 prefix
```

Figure 13: New Sub-TLV Types for LSP ping

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[11](#). Acknowledgement

[12](#). References

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