MoFRR based on TILFA

draft-liu-pim-mofrr-tilfa-00

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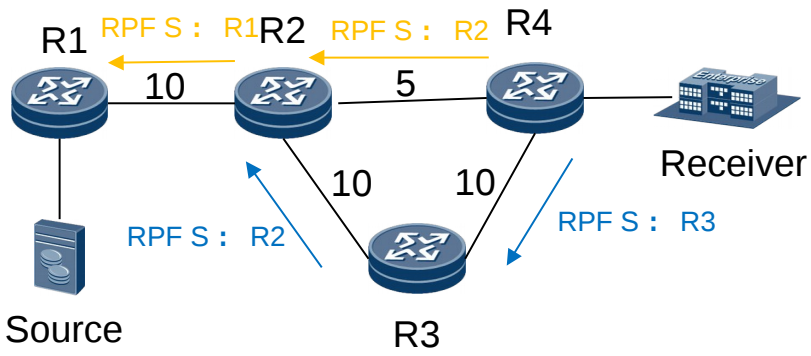
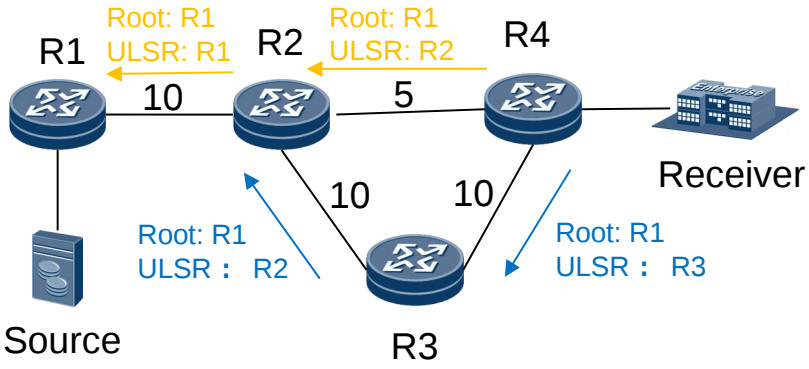
IETF105

Problem Background ---MoFRR based on LFA

- RFC7431 Section 3 describes the selection of the alternate multicast next hop according to the LFA algorithm results.
- The PIM protocol establishes a standby multicast tree according to the normal protocol procedure of RFC7761.
- The MLDP protocol establishes an alternate P2MP LSP according to the normal protocol procedure of RFC6388.





PIM Primary Join

PIM Backup Join

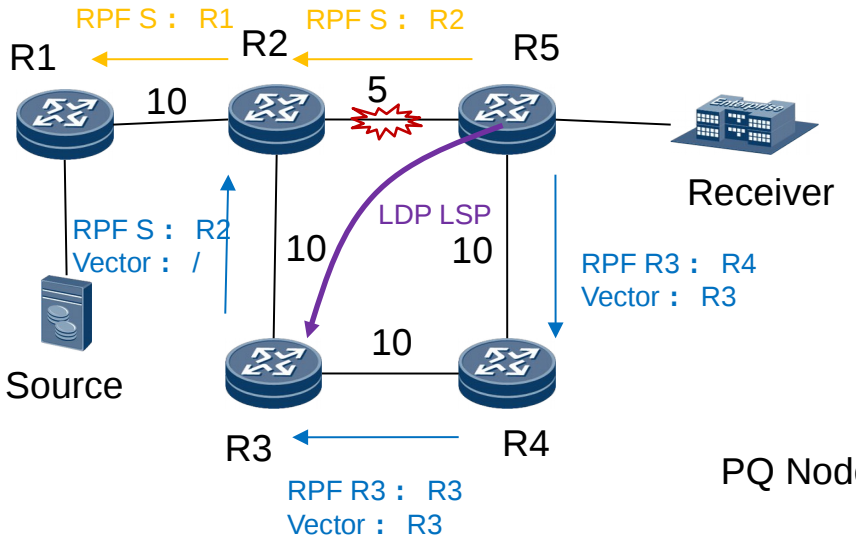
MLDP Primary Label Mapping

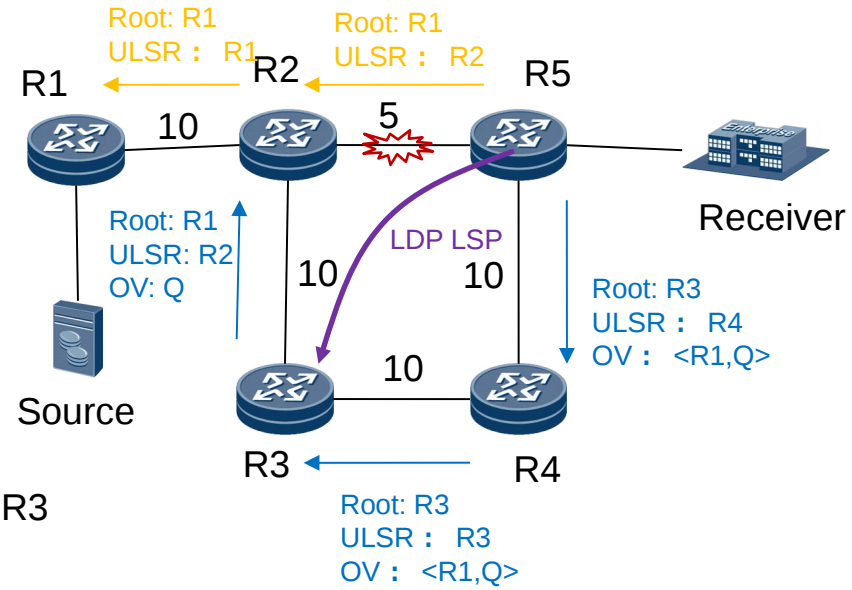
MLDP Backup Label Mapping

ULSR: Upstream LSR

Problem Background ---MoFRR based on RLFA

- RFC7490 extends the LFA to RLFA algorithm and can cover more network deployment scenarios through the tunnel as an alternate path.
- RFC5496 defines that the PIM Join carries the RPF Vector attribute to iteratively establish a PIM multicast tree. The standby PIM multicast tree can be established according to the RLFA algorithm result. The PQ node is set to the RPF Vector attribute, and the PQ node is used as the root to establish the first PIM multicast tree. Then the second PIM multicast tree is established from the PQ node with the multicast source as the root.
- MLDP is similar to PIM. RFC 6512 defines Recursive FEC to iteratively establish MLDP P2MP LSP. The standby MLDP P2MP multicast tree can set the PQ node as the root to establish the first P2MP LSP according to the RLFA, and then use the multicast source as the root to establish the second P2MP LSP from PQ node, so to form a complete MLDP P2MP multicast tree.





PQ Node： R3

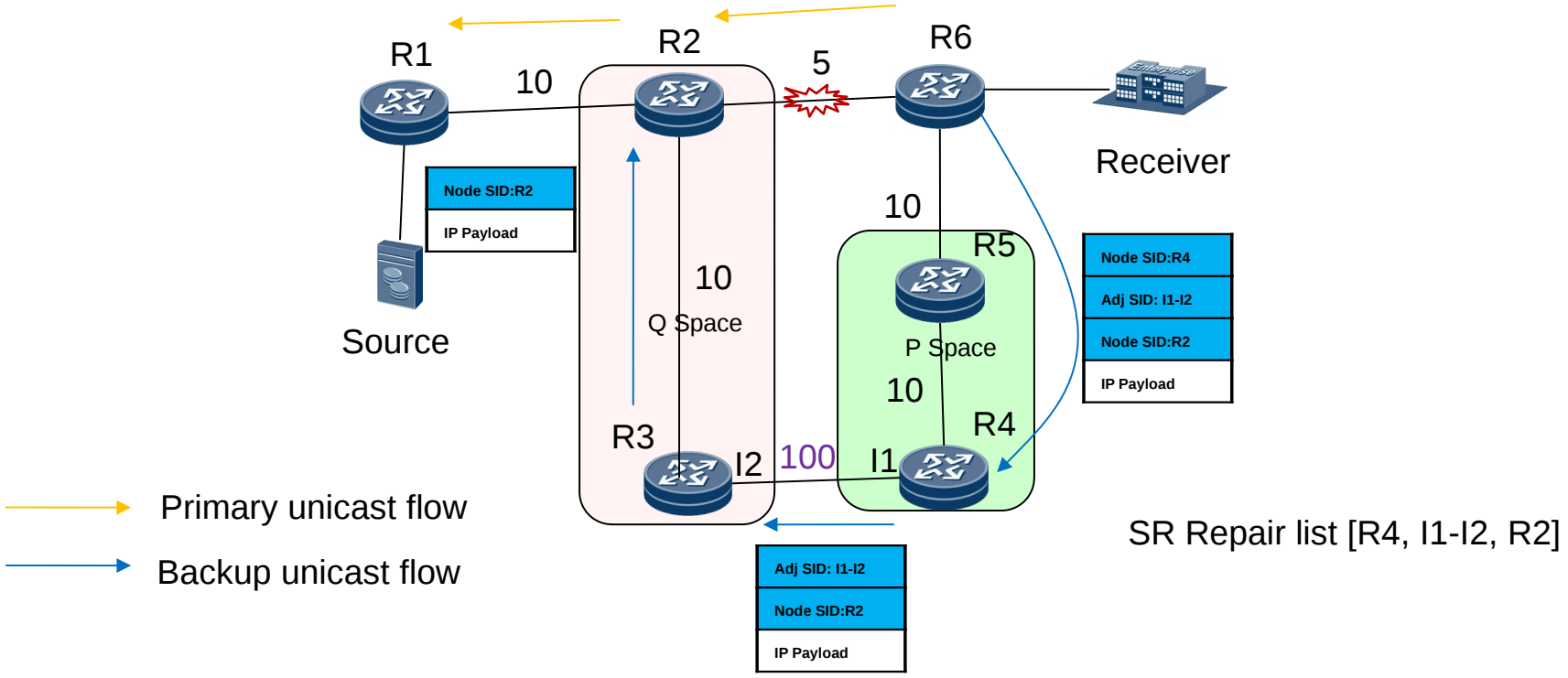
PIM Primary Join

PIM Backup Join

MLDP Primary Label Mapping

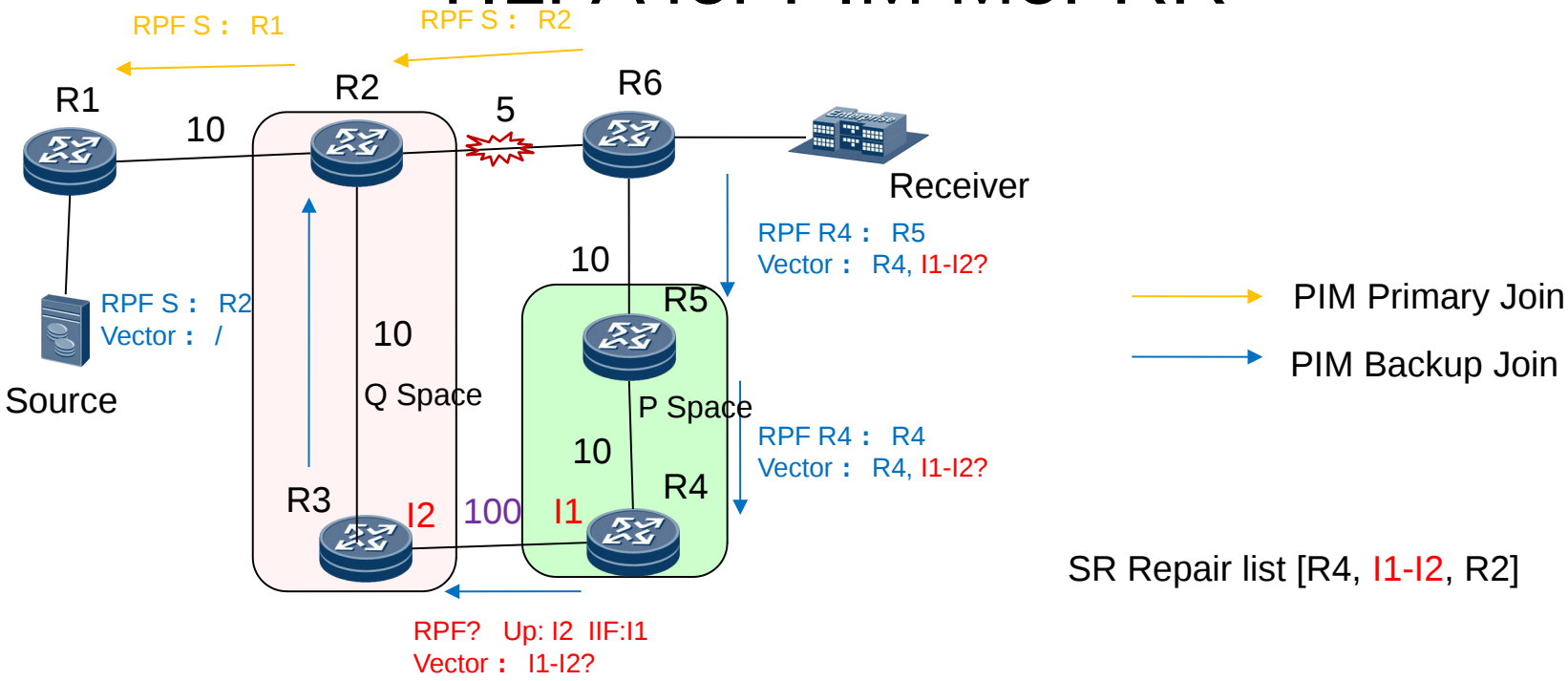
MLDP Backup Label Mapping

Problem Background
---TILFA in unicast FRR



- The draft-ietf-rtgwg-segment-routing-ti-lfa-00 defines the FRR solution of TILFA. The unicast traffic can be protected according to the specified segment list, so that it is independent of the network topology and 100% covers various network deployment scenarios.

Problem Statement
---TILFA for PIM MoFRR



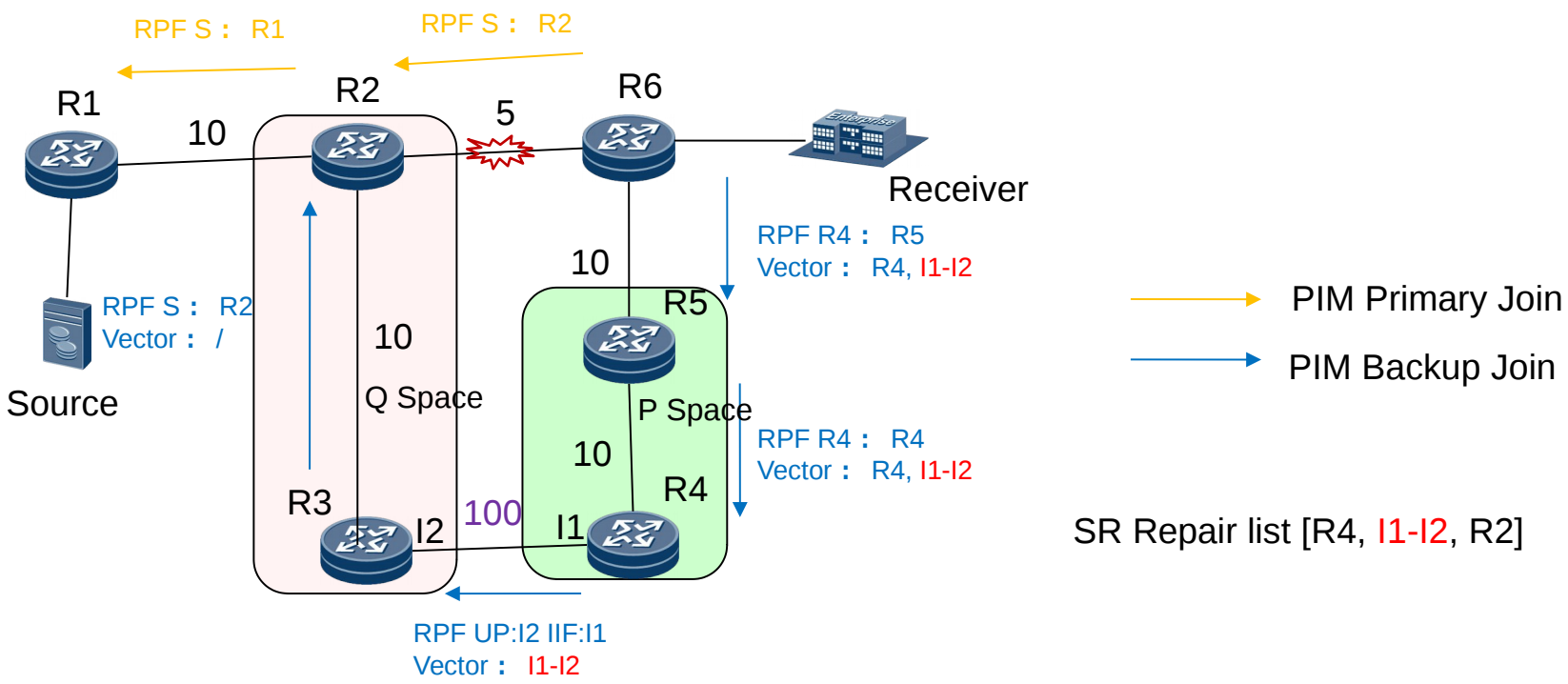
- The alternate path provided by the TI-LFA algorithm is actually the Segment List path, which gives the P node NodeSID, and the Adjacency SID between P-Q nodes (possibly multiple)
- PIM and MLDP cannot directly send protocol packets according to the path of the Segment List to establish an alternate multicast tree.

✓ PIM: The PIM RPF Vector attribute defined by RFC5496 can carry the node IP address expressed by the NodeSID, and the explicit RPF Vector defined by RFC7891 can carry the peer IP address expressed by the Adjacency SID. PIM can select RPF upstream with these two Vector attributes to establish a segmentally iterative PIM multicast tree.

✓ PIM: If there are multiple PIM neighbors with the same peer IP address of the Adjacency SID (anycast IP), the RPF selection may be incorrect. Therefore, the PIM join cannot be sent according to the path calculated by TILFA.

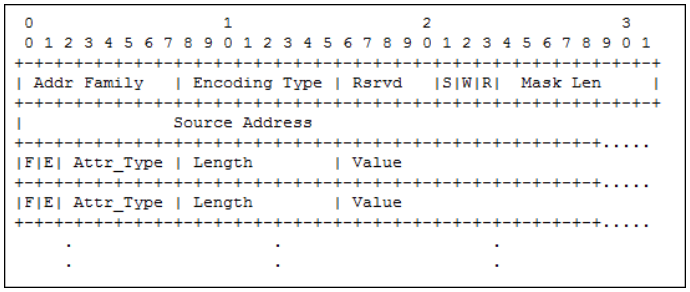
✓ MLDP: The recursive FEC defined by RFC6512 can carry the IP address of the node expressed by NodeSID, but cannot carry the content of the Adjacency SID between P-Q nodes.

PIM TILFA MoFRR Solution

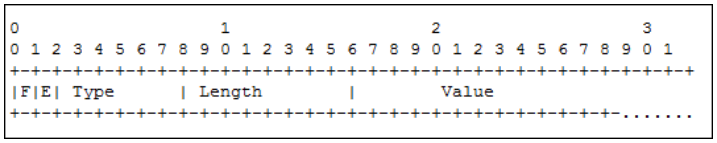


- R4 corresponding to the NodeSID is looked as the normal RPF vector attribute. PIM look up the unicast routing to R4, and select RPF incoming interface and upstream, and joins hop-by-hop to establish the PIM multicast tree until R4.
- I1-I2 as the RPF Vector attribute of the adjacency relationship corresponding to the Adjacency SID
  - ✓ I2 address is looked as the PIM neighbor and is looked up the interface of the local device. If there are multiple PIM neighbors with the same address, the corresponding local interfaces all needs to be checked.
  - ✓ The interface that is the only one corresponding to the I1 address is sent as the RPF incoming interface to send PIM Joins, and the I2 address is used as the RPF upstream address.
- After the PIM joins the node in the Q space, PIM can look up the unicast route of the multicast source to select the incoming interface and upstream, and so joins hop-by-hop to establish the PIM multicast tree..

PIM RPF Vector Extension Format

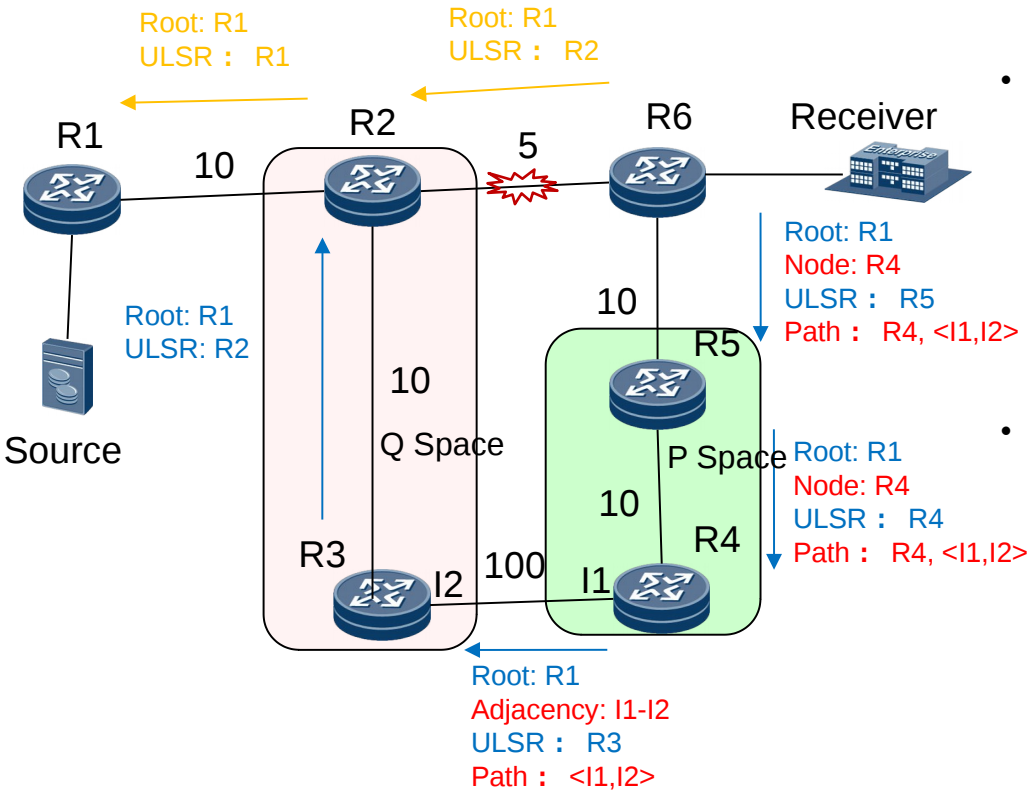


- The original PIM join attribute already defined in RFC5384 ：
- Attr_Type：
- ✓ 0-Vector ;
- ✓ 4-Explicit RPF Vector;
- ✓ Other existing definitions are not related to RPF Vector Attribute.



- New definition of Adjacency RPF Vector attribute：
- ✓ F bit: 0 , indicating that the unrecognized device does not forward the attribute
- ✓ E bit： indicates the last join attribute
- ✓ Type： TBD
- ✓ Length： depends on the address family of Encoded-Unicast address, including the length of 2 addresses.
- ✓ Value： Encoded-Unicast Address format defined in [RFC7761] Section 4.9.1, including 2 addresses. The first one indicates the address of the local interface, and the second one indicates the address of the peer interface. Only the case of the same address family is supported.

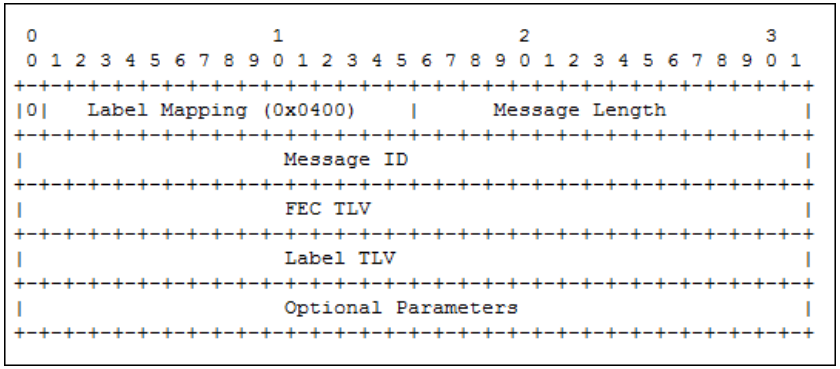
MLDP P2MP TILFA MoFRR Solution

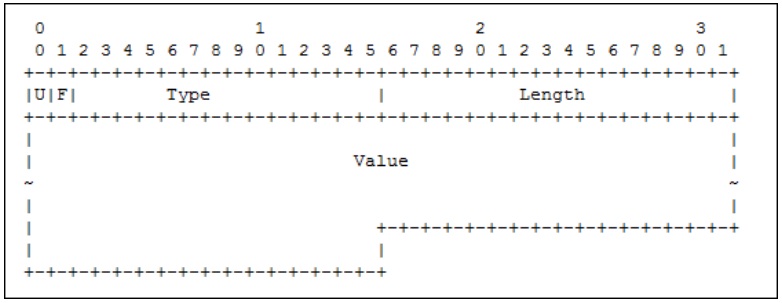


SR Repair list [R4, I1-I2, R2]

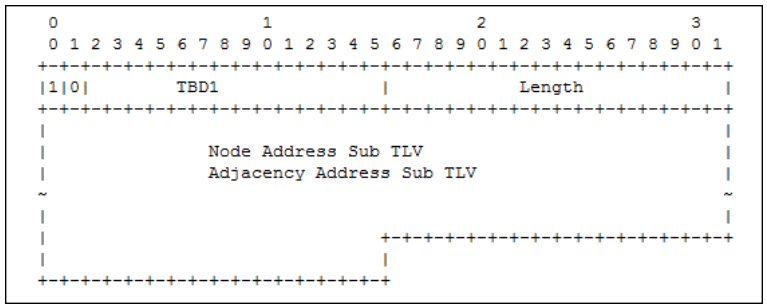
- R4 corresponding to the NodeSID is as the upstream node. The MLDP looks up the upstream interface and the upstream LSR of the unicast route to R4, and sends the Label Mapping messages hop by hop to establish the P2MP multicast tree to R4. After the R4 is reached, the Node Address Sub TLV corresponding to the R4 is deleted from the Label Mapping message.
- I1-I2 as the upstream adjacency corresponding to the Adjacency SID
  - ✓ The MLDP neighbors of the I2 address are looked up the corresponding local interface on the local device. If there are multiple MLDP neighbors with the same address, the corresponding local interfaces all needs to be checked.
  - ✓ Label mapping is sent on the interface that is unique to the I1 address, and the I2 address is used as the upstream LSR address.
  - ✓ After reaching R3, delete the Adjacency Address Sub TLV in the Label Mapping message and check if it is the last Sub TLV then delete the entire Explicit Path TLV.
- After the node R3 of the Q space is reached, the Explicit Path TLV is no longer existed. The MLDP selects the upstream interface and the upstream LSR of the unicast route to the root R1, and continues to send the Label Mapping messages to establish the P2MP multicast tree.

MLDP Label Mapping TLV Extension Format



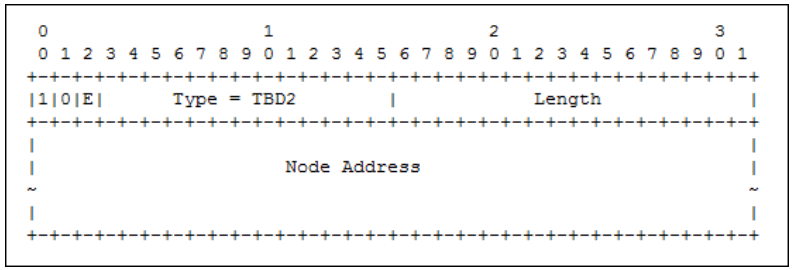


- The LDP Label Mapping message format is defined in the RFC5036 Section 3.5.7. The MLDP P2MP protocol uses the message to establish a P2MP multicast tree. The Optional Parameters field can be extended to carry the node or link IP address list specified by the Segment List



- The TLV format definition in RFC5036 Section 3.3 can be used for the Explicit Path TLV carrying the specified path of the Segment List
  - ✓ U bit： 1 referenced in RFC5036 Section 3.3
  - ✓ F bit： 0 referenced in RFC5036 Section 3.3
  - ✓ Type： TBD1
  - ✓ Length： contains all Sub-TLV lengths
  - ✓ Value： contains one or more Sub-TLVs, which are recorded in the order of TILFA's Segment List. There are two types of Sub TLVs now.
    - One of the two types is called Node Address Sub TLV which carries the node IP address corresponding to the NodeSID
    - The other is called Adjacency Address Sub TLV which carries the local interface address and the peer interface address corresponding to the Adjacency SID

MLDP Label Mapping Sub TLV Extension Format



- Node Address Sub TLV carrying the node IP address corresponding to the NodeSID

✓ U bit： 1 referenced in RFC5036 Section 3.3

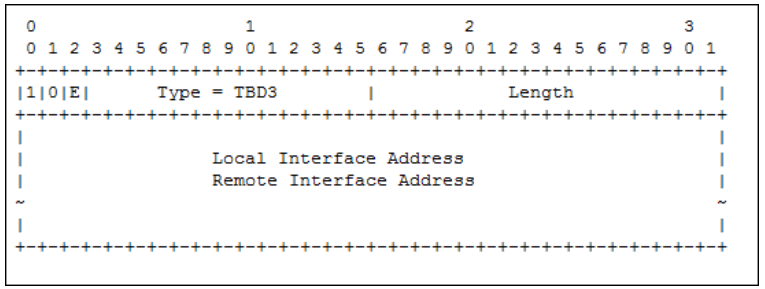
✓ F bit： 0 referenced in RFC5036 Section 3.3

✓ E bit： 1 indicates the last Sub TLV

✓ Type： TBD2

✓ Length： IPv4 address 4 octet， IPv6 address 16 octet

✓ Value： The IP address of the node corresponding to the NodeSID in the Segment List generated by TILFA



- Adjacency Address Sub TLV carrying the local interface address and the peer interface address corresponding to the Adjacency SID

✓ U bit： 1 referenced in RFC5036 Section 3.3

✓ F bit： 0 referenced in RFC5036 Section 3.3

✓ E bit： 1 indicates the last Sub TLV

✓ Type： TBD3

✓ Length： IPv4 address 8 octet， IPv6 address 32 octet

✓ Value： The IP address of the local interface and the IP address of the peer interface corresponding to the Adjacency SID in the Segment List generated by TILFA must be recorded in order, and must be the same address family.

Next Step

- Any questions or comments are Welcomed
- Seeking for interested co-authors involved
- Seeking for feedback