Generalized IPv6 Tunnel for MPLS

draft-li-mpls-gip6-mpls-00

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Technical Challenges to MPLS

Encoding of MPLS Label Entry

1. MPLS lacks the mechanism of source indication. For MP2P connections, this causes the difficulty and complexity for OAM over MPLS.
   - Although SFL([RFC8957]) is defined, there is few implementation.
2. The type of payload (for example, L2 or L3 packets) cannot be directly determined because there is no payload type indication.
3. There is limited extensibility and it is difficult to encapsulate new forwarding attributes for the new features such as IETF network slicing, IFIT, APN, etc.
4. The process of the ECMP function is complex and affects forwarding performance. Entropy label or Flow label are usually placed at the bottom of the label stack for processing, and the internal IP header information may also be parsed for the purpose of ECMP.

GIP6 Tunnel Introduction

- draft-li-rtgwg-generalized-ipv6-tunnel defines the GIP6 tunnel to support both new features (iOAM/APN…) and the existing functions for the IP tunnels based on extensions to the IPv6 extension headers.
- If the GIP6 tunnel is used for MPLS, there can be the following advantages:
  - The IPv6 source address is used to form a source identifier.
  - The IPv6 NH can indicate the payload type.
  - IPv6 flow labels are used for ECMP.
  - The encapsulations for the new features have been defined well in the IPv6 and can be reused easily.

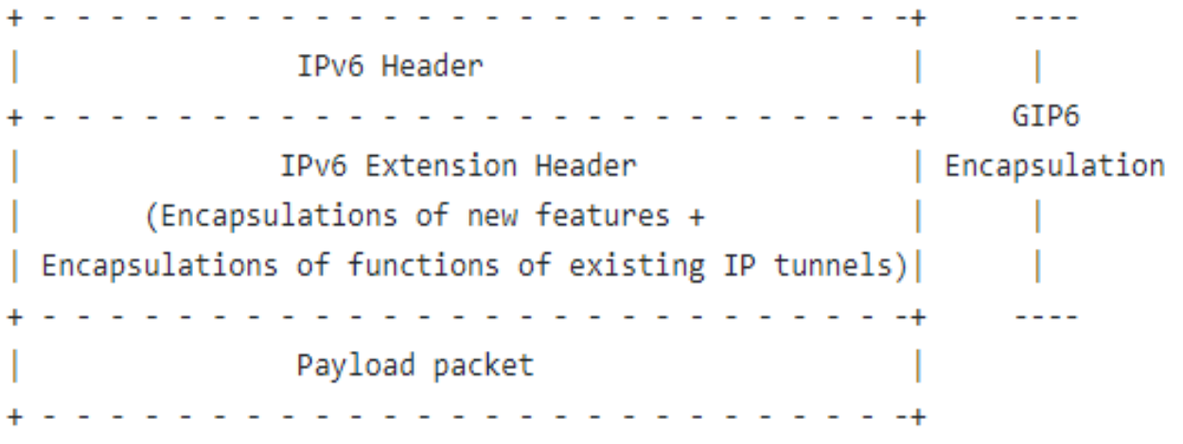


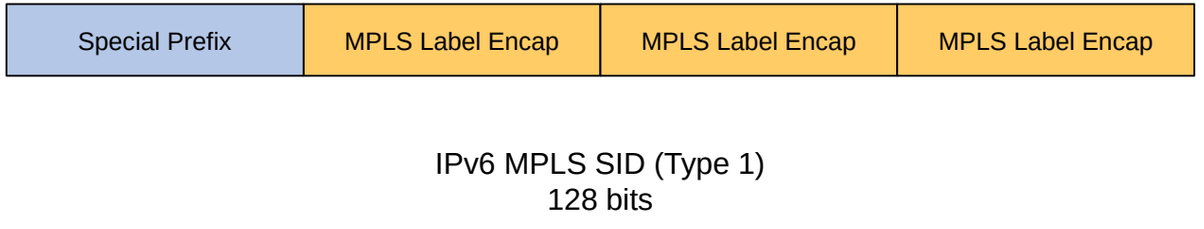
Figure 1. GIP6 Encapsulation

Support of MPLS with GIP6 Tunnel

In order to support MPLS based on the GIP6 tunnel, the method to carry MPLS label stack information is defined as follows:

- A special IPv6 prefix MUST be used to indicate that it is followed by MPLS label encapsulation. The special IPv6 prefix can be specified or a well-known IPv6 prefix can be assigned.

- The IPv6 special prefix can be followed by multiple MPLS label encapsulations to form a 128-bit IPv6 MPLS SID (Type 1).



IPv6 MPLS SID (Type 1) in IPv6 Destination Address

- Processing of the first label following the special prefix is as follows:
  - If the local action of the MPLS label is POP, the followed label encapsulations are shifted left by 32 bits after the label is popped. The following figure shows the process.

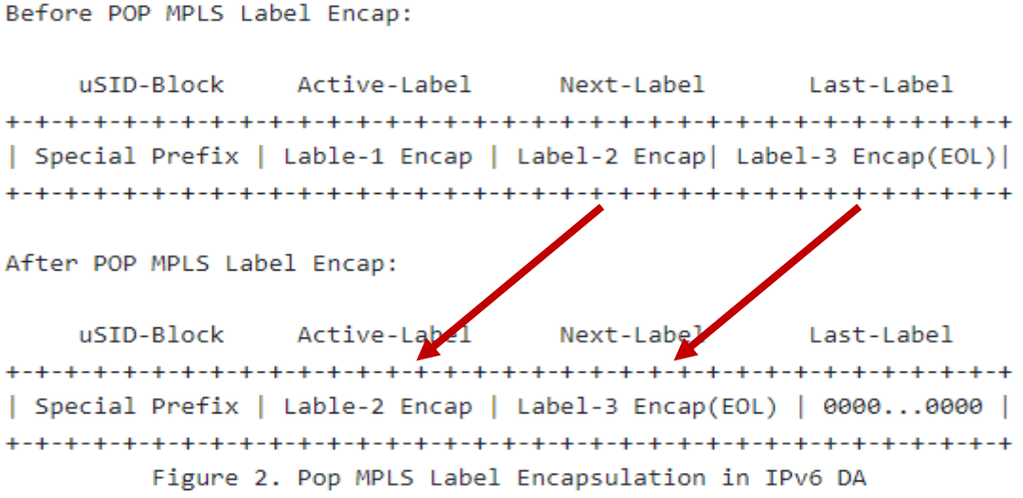
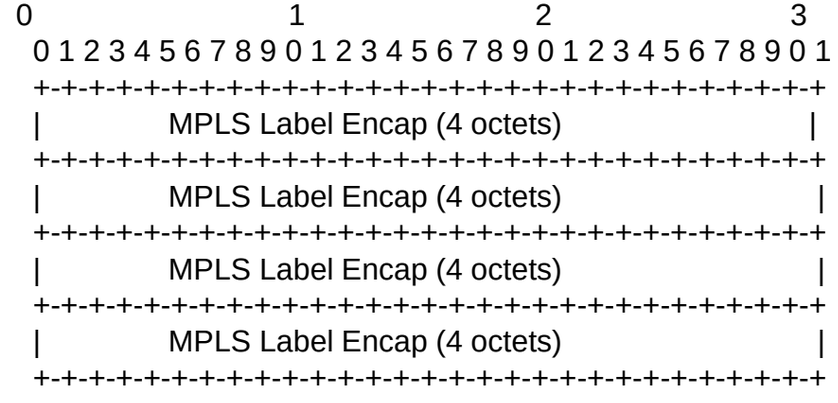


Figure 2. Pop MPLS Label Encapsulation in IPv6 DA

  - If the local action of the MPLS label is SWAP, the label encapsulation is changed to the new label after swap.

IPv6 MPLS SID (Type 2)

- If all the MPLS label stack cannot be placed in the IPv6 destination address, IPv6 RH can be used to house the remaining MPLS label stack.
  - IPv6 MPLS SID (Type 2) is defined to house multiple (<= 4) label encapsulations. The format of the IPv6 MPLS SID (Type 2) is shown in the following figure.



  - IPv6 MPLS SID (Type 2) is used as the segment in the RH. After all of the label encapsulations in the IPv6 destination address are popped, the first label encapsulation in the segment indicated by the SL of the RH will be processed.

Control Plane Considerations

- GIP6 only provides a way to carry MPLS label encapsulations in the data plane.
- The MPLS control plane does not need to be changed.
    - MPLS labels for IPv4, IPv6, L2, etc. can still be distributed using existing control plane

Next Steps

- Comments are welcome

Thank You