Encapsulation for BIER in Non-MPLS IPv6 Networks

draft-xie-bier-6man-encapsulation-01

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• To quote BIER-Arch RFC (RFC8279):

• In the event that unicast traffic to the BFR-NBR is being sent via a "bypass tunnel" of some sort, the BIER-encapsulated multicast traffic sent to the BFR-NBR SHOULD also be sent via that tunnel. This allows any existing "fast reroute" schemes to be applied to multicast traffic as well as to unicast traffic. ----> The above Case 1;

• unicast tunnels are used to bypass non-BFRs ----> The above Case 2;
Problem Statement (cont.)

• The Key of ‘bypassing’ is the capability of the MPLS Label Stacking.
• BIER MPLS Encapsulation can easily stacking on any MPLS Label (e.g. Bypass tunnel Label).
• While BIER Non-MPLS Encapsulation (or Eth Encapsulation) can’t run over a bypass tunnel!
• Even more, BIER Eth Encapsulation can’t run on links except Ethernet link!

![Diagram]

- Bypass tunnel Label can stack here.
- Can run on any link that support MPLS.
- Bypass tunnel Labels Can’t Stack here!
- Can’t run on links except Ethernet link!
Requirements & Considerations

- How can BIER IPv6 encapsulation behaves like MPLS?
  - BIER-MPLS encapsulation over Various Links / Unicast MPLS bypass tunnel.
  - BIER-IPv6 encapsulation over Various Links / Unicast SRH bypass tunnel.

Where to put the BIER Header?
- Opt-1: Re-invent a new IPv6 Extension Header.
- Opt-2: Re-use the existing IPv6 Extension Header.

How can BIER run over SRH?
- Bypass tunnel uses SRH in IPv6 Non-MPLS Networks.
- SRH behaves like a Label Stack.
Checking existing IPv6 Options

RFC8200: When more than one extension header is used in the same packet, it is recommended that those headers appear in the following order:

**IPv6 header**
Hop-by-Hop Options header [Not use]
Destination Options header [Not use]----by every destination along the SRH.
**Routing header [SRH is here]----**consider BIER over SRH as a requirement.
Fragment header [Not use]
Authentication header [Not use]
Encapsulating Security Payload header [Not use]
**Destination Options header [BIER option TLV]----**by the final destination only.
Indicating the Payload

- When the BIER Destination Option Header is included in a Destination Option Header, then it SHOULD be the only Destination header.

- And the Payload format can be further identified by the ‘Proto’ field of the BIER Header, so the Destination Option Header is carried with a Next Header = 59 (The 3rd of the left 3 pictures).
BIER IPv6: Hop-by-hop

- **IPv6 Header** (DA=Multicast Addr) + **Dest Opt Hdr** (TLV<T=bier, L, V=BIER Hdr>)
- The IPv6 BIER Option is the only one TLV in the Destination Options, with a Option Type BIER [IANA].
- The Destination Options that carry a BIER Header, has a recommended Next Header Value of 59.
- Only be checked when the Destination Address is a Multicast Address indicating BIER.
- [IANA] is expected to specify a Multicast Address for BIER.
- [RFC82000]: Each extension header is an integer multiple of 8 octets long. OK.
BIER IPv6: Over SRH tunnel (optional)

Routing Header (Optional)
- Next Header = 60 (Dest Opt Hdr)
- Routing Type = 4 (SRH)
- Last SID (SL[0]) = Multicast Address
- Penultimate SID (SL[1]) = Bier SID
- Optional TLV Objects = null

Destination Option Header
- Next Header = 59 (No Next Header)
- Option Type = BIER (IANA)
- Option Value = BIER Header (RFC8296)
- Proto = 1/2/3/4/5/6 (RFC8296)

IPv6 Header (DA=Unicast Addr) + SRH + Dest Opt Hdr (TLV<T=bier, L, V=BIER Hdr>)
Why use Dest Opt Header and so on

- [RFC8200] Defining *new IPv6 extension headers is not recommended*, unless there are no existing IPv6 extension headers that can be used by specifying a new option for that IPv6 extension header.

- [RFC8200] it is *recommended that the Destination Options header is used* to carry optional information that must be examined only by a packet's destination node(s), because they provide better handling and backward compatibility.

- [RFC8200] Extension headers are not processed until the packet reaches the node (or each of the set of nodes, in the case of multicast) identified in the Destination Address field of the IPv6 header.
  - The reason why we select Using [Multicast Addr + Dest Opt Hdr] to pilot the hop-by-hop replication.

- [RFC6744] As of this writing, IPv6 Destination Options headers, and the options carried by such headers, are extremely uncommon in the deployed Internet. So, it is expected that this Nonce Option commonly would be the only IPv6 Destination Option present in a given IPv6 packet.
  - The reason why we suggest BIER Option TLV being the only IPv6 Destination Option.

- The very rare Destination Options can be referred to: RFC8200, 2473, 6275, 6744.
Thank you !