BIER   Z. Zhang
Internet-Draft   ZTE Corporation
Intended status: Standards Track   Z. Zhang
Expires: January 31, 2021   Juniper Networks
                                                        I. Wijnands
                                                      Cisco Systems
                                                        H. Bidgoli
                                                              Nokia
                                                        M. McBride
                                                          Futurewei
                                                      July 30, 2020

                       BIER in IPv6 (BIERin6)
                      draft-zhang-bier-bierin6-07

Abstract

   BIER is a new architecture for the forwarding of multicast data
   packets. This document defines native IPv6 encapsulation for BIER
   hop-by-hop forwarding or BIERin6 for short.

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 RFC2119.

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
   provisions of BCP 78 and BCP 79.

   Internet-Drafts are working documents of the Internet Engineering
   Task Force (IETF). Note that other groups may also distribute
   working documents as Internet-Drafts. The list of current Internet-
   Drafts is at https://datatracker.ietf.org/drafts/current/.

   Internet-Drafts are draft documents valid for a maximum of six months
   and may be updated, replaced, or obsoleted by other documents at any
   time. It is inappropriate to use Internet-Drafts as reference
   material or to cite them other than as "work in progress."

   This Internet-Draft will expire on January 31, 2021.

Copyright Notice

Table of Contents

[1](#). Introduction

   BIER [[RFC8279](#)] is a new architecture for the forwarding of multicast
   data packets. It provides optimal forwarding through a "multicast
   domain" and it does not necessarily precondition construction of a
   multicast distribution tree, nor does it require intermediate nodes
   to maintain any per-flow state.

   This document specifies non-MPLS BIER forwarding in an IPv6 [[RFC8200](#)]
   environment, refferred to as BIERin6, using non-MPLS BIER
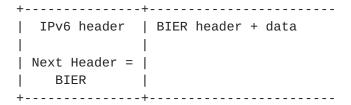   encapsulation specified in [[RFC8296](#)].

   MPLS BIER forwarding in IPv6 is outside the scope of this document.

   This document uses terminology defined in [[RFC8279](#)] and [[RFC8296](#)].

[RFC8296] defines the BIER encapsulation format in MPLS and non-MPLS
environment. In case of non-MPLS environment, a BIER packet is the
payload of an "outer" encapsulation, which has a "next header"
codepoint that is set to a value that means "non-MPLS BIER".

That can be used as is in a pure IPv6 non-mpls environment. Between
two directly connected BFRs, a BIER header could directly follow link
layer header, e.g., an Ethernet header (with the Ethertype set to
0xAB37). But if the downstream BFR can not support Ethernet
encapsulation, IPv6 encapsulation can be used. If a BFR needs to
tunnel BIER packets to another BFR, e.g. per [RFC8279] Section 6.9,
IPv6 encapsulation can be used, with the destination address being
the downstream BFR and the Next Header field set to a to-be-assigned
value for "non-MPLS BIER".

```
          +---------------+------------------------
          |  IPv6 header  | BIER header + data
          |               |
          | Next Header = |
          |    BIER       |
          +---------------+------------------------
```

The IPv6 encapsulation could be used even between two directly
connected BFRs in the following two cases:

o An operator mandates all traffic to be carried in IPv6.

o A BFR does not have BIER support in its "fast forwarding path" and
   relies on "slow/software forwarding path", e.g. in environments
   like [RFC7368] where high throughput multicast forwarding
   performance is not critical.

2. IPv6 Header

Whenever IPv6 encapsulation is used for BIER forwarding, The Next
Header field in the IPv6 Header (if there are no extension headers),
or the Next Header field in the last extension header is set to TBD,
indicating that the payload is a BIER packet.

If the neighbor is directly connected, The destination address in
IPv6 header SHOULD be the neighbor's link-local address on this
router's outgoing interface, the source destination address SHOULD be
this router's link-local address on the outgoing interface, and the
IPv6 TTL MUST be set to 1. Otherwise, the destination address SHOULD
be the BIER prefix of the BFR neighbor, the source address SHOULD be
this router's BIER prefix, and the TTL MUST be large enough to get
the packet to the BFR neighbor.

The "Flow label" field in the IPv6 packet SHOULD be copied from the entropy field in the BIER encapsulation.

2.1. IPv6 Options Considerations

For directly connected BIER routers, IPv6 Hop-by-Hop or Destination options are irrelevant and SHOULD NOT be inserted by BFIR on the BIERin6 packet. In this case IPv6 header, Next Header field should be set to TBD. Any IPv6 packet arriving on BFRs and BFERs, with multiple extension header where the last extension header has a Next Header field set to TBD, SHOULD be discard and the node should transmit an ICMP Parameter Problem message to the source of the packet (BFIR) with an ICMP code value of TBD10 ('invalid options for BIERin6').

This also indicates that for disjoint BIER routers using IPv6 encapsulation, there SHOULD NOT be any IPv6 Hop-by-Hop or Destination options be present in a BIERin6 packet. In this case, if additional traffic engineering is required, IPv6 tunneling (i.e. BIERin6 over SRv6) can be implemented.

BIER has its own OAM function, so generally the IPv6 OAM function is not needed. But if the network operator takes the IPv6 packet OAM function into account, the IPv6 OAM function can be used also.

3. BIER Header

The BIER header MUST be encoded per Section 2.2 of [RFC8296].

The BIFT-id is either encoded per [I-D.ietf-bier-non-mpls-bift-encoding] or per advertised by BFRs, as specificed in [I-D.ietf-bier-lsr-ethernet-extensions].

4. IPv6 Encapsulation Advertisement

When IPv6 encapsulation is not required between directly connected BFRs, no signaling in addition to that specified in [I-D.ietf-bier-lsr-ethernet-extensions] is needed.

Otherwise, a node that requires IPv6 encapsualtion MUST advertise the BIER IPv6 transportation sub-sub-sub-TLV/sub-sub-TLV according to local configuration or policy in the BIER domain to request other BFRs to always use IPv6 encapsulation.

In presence of multiple encapsulation possibilities hop-by-hop it is a matter of local policy which encapsulation is imposed and the receiving router MUST accept all encapsulations that it advertised.

4.1. Format

The BIER IPv6 transportation is a new sub-sub-TLV of BIER Ethernet
Encapsulation sub-TLV defined in OSPFv3, and a new sub-sub-sub-TLV of
BIER Ethernet Encapsulation sub-sub-TLV defined in ISIS, as per
[I-D.ietf-bier-lsr-ethernet-extensions].

```
   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       |   Length      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

o Type: For OSPF, value TBD1 (prefer 1) is used to indicate it is
   the IPv6 transportation sub-TLV. For ISIS, value TBD2 (prefer 1)
   is used to indicate it is the IPv6 transportation sub-sub-TLV.

o Length: 0.

4.2. Inter-area prefix redistribution

When BFR-prefixes are advertised across IGP areas per
[I-D.ietf-bier-lsr-ethernet-extensions] or redistributed across
protocol boundaries per [I-D.zwzw-bier-prefix-redistribute], the BIER
IPv6 transportation sub-sub-TLV or sub-sub-sub-TLV MAY be re-
advertised/re-distributed as well.

5. IANA Considerations

IANA is requested to assign a new "BIER" type for "Next Header" in
the "Assigned Internet Protocol Numbers" registry.

IANA is requested to assign a new "BIERin6" type for "invalid
options" in the "ICMP code value" registry.

IANA is requested to assign a new "BIER IPv6 transportation Sub-sub-
TLV" type in the "OSPFv3 BIER Ethernet Encapsulation sub-TLV"
Registry.

IANA is requested to set up a new "BIER IPv6 transportation Sub-sub-
sub-TLV" type in the "IS-IS BIER Ethernet Encapsulation sub-sub-TLV"
Registry.

6. Security Considerations

General IPv6 and BIER security considerations apply.

7. Acknowledgement

The authors would like to thank Tony Przygienda, Nagendra Kumar, Gyan Mishra for their review and valuable comments.

8. References

8.1. Normative References

[RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6
           (IPv6) Specification", STD 86, RFC 8200,
           DOI 10.17487/RFC8200, July 2017,
           <https://www.rfc-editor.org/info/rfc8200>.

[RFC8279] Wijnands, IJ., Ed., Rosen, E., Ed., Dolganow, A.,
           Przygienda, T., and S. Aldrin, "Multicast Using Bit Index
           Explicit Replication (BIER)", RFC 8279,
           DOI 10.17487/RFC8279, November 2017,
           <https://www.rfc-editor.org/info/rfc8279>.

[RFC8296] Wijnands, IJ., Ed., Rosen, E., Ed., Dolganow, A.,
           Tantsura, J., Aldrin, S., and I. Meilik, "Encapsulation
           for Bit Index Explicit Replication (BIER) in MPLS and Non-
           MPLS Networks", RFC 8296, DOI 10.17487/RFC8296, January
           2018, <https://www.rfc-editor.org/info/rfc8296>.

[RFC8401] Ginsberg, L., Ed., Przygienda, T., Aldrin, S., and Z.
           Zhang, "Bit Index Explicit Replication (BIER) Support via
           IS-IS", RFC 8401, DOI 10.17487/RFC8401, June 2018,
           <https://www.rfc-editor.org/info/rfc8401>.

8.2. Informative References

[I-D.ietf-bier-bar-ipa]
           Zhang, Z., Przygienda, T., Dolganow, A., Bidgoli, H.,
           Wijnands, I., and A. Gulko, "BIER Underlay Path
           Calculation Algorithm and Constraints", draft-ietf-bier-
           bar-ipa-06 (work in progress), November 2019.

[I-D.ietf-bier-idr-extensions]
           Xu, X., Chen, M., Patel, K., Wijnands, I., and T.
           Przygienda, "BGP Extensions for BIER", draft-ietf-bier-
           idr-extensions-07 (work in progress), September 2019.

   [I-D.ietf-bier-lsr-ethernet-extensions]
             Dhanaraj, S., Wijnands, I., Psenak, P., Zhang, Z., Yan,
             G., and J. Xie, "LSR Extensions for BIER over Ethernet",
             draft-ietf-bier-lsr-ethernet-extensions-01 (work in
             progress), July 2019.

   [I-D.ietf-bier-non-mpls-bift-encoding]
             Wijnands, I., Xu, X., and H. Bidgoli, "An Optional
             Encoding of the BIFT-id Field in the non-MPLS BIER
             Encapsulation", draft-ietf-bier-non-mpls-bift-encoding-02
             (work in progress), August 2019.

   [I-D.ietf-bier-ospfv3-extensions]
             Psenak, P., Nainar, N., and I. Wijnands, "OSPFv3
             Extensions for BIER", draft-ietf-bier-ospfv3-extensions-02
             (work in progress), May 2020.

   [I-D.zhang-bier-babel-extensions]
             Zhang, Z. and T. Przygienda, "BIER in BABEL", draft-zhang-
             bier-babel-extensions-03 (work in progress), May 2020.

   [I-D.zwzw-bier-prefix-redistribute]
             Zhang, Z., Bo, W., Zhang, Z., Wijnands, I., and Y. Liu,
             "BIER Prefix Redistribute", draft-zwzw-bier-prefix-
             redistribute-07 (work in progress), July 2020.

   [RFC7368] Chown, T., Ed., Arkko, J., Brandt, A., Troan, O., and J.
             Weil, "IPv6 Home Networking Architecture Principles",
             RFC 7368, DOI 10.17487/RFC7368, October 2014,
             <https://www.rfc-editor.org/info/rfc7368>.

Authors' Addresses

   Zheng(Sandy) Zhang
   ZTE Corporation

   EMail: zzhang_ietf@hotmail.com

   Zhaohui Zhang
   Juniper Networks

   EMail: zzhang@juniper.net

IJsbrand Wijnands
Cisco Systems

EMail: ice@cisco.com

Hooman Bidgoli
Nokia

EMail: hooman.bidgoli@nokia.com

Mike McBride
Futurewei

EMail: mmcbride@futurewei.com