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Routing Header Based BIER Information Encapsulation draft-wang-bier-rh-bier-04

Abstract

This draft proposes one new encapsulation schema of Bit Index Explicit Replication (BIER) information to transfer the multicast packets within the IPv6 network. By using a new type of IPv6 Routing Header to forward the packet, the original source address and destination address of the multicast packet is kept unchanged along the forwarding path. Such encapsulation schema can make full use of the existing IPv6 quality assurance solutions to provide high-quality multicast service.

Status of This Memo

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

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This Internet-Draft will expire on September 8, 2022.

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1. Introduction

Bit Index Explicit Replication (BIER) is a new multicast technology based on IPv6 defined in [RFC8279]. In BIER domain, the set of destination nodes of multicast message is mapped into a BitString and encapsulated into the BIER header. The position of each bit in the BitString represents an BFER. Compared with the traditional multicast technologies, the nodes in BIER domain do not need to maintain a multicast tree and keep the multicast flow state for each multicast flow.

Currently, there are two methods for encapsulating BIER information based on IPv6 in IETF: BIERin6([I-D.ietf-bier-bierin6]) and BIERv6([I-D.xie-bier-ipv6-encapsulation]).

BIERin6 carries BIER information by defining a new IPv6 next header type. During the forwarding process, the source address and destination address in the header will be changed.

BIERv6 carries bier related information by defining an new type of destination options header (i.e. bier option). The source address in the header remains unchanged but the destination address will be changed along the forwarding path.

The differences between the above two BIER encapsulation and forwarding schemes are unfavorable for the development of BIER and its derivatives. In addition, when there is error in the forward process of the multicast packet, the change of source address and destination address during transmission will increase the difficulty of fault location and traceability.

This draft proposes a BIER information transmission scheme without changing the multicast source and destination addresses in the outer IPv6 header. The relevant BIER information is encapsulated within the newly defined IPv6 Routing Header type, each intermediate BIER router will route the multicast packet based on the BitString information and its associated BIFT. The multicast source and destination address are not changed along the forwarding path.

The characteristics of such schema are helpful to the rapid fault location and traceability, and can make full use of the existing IPv6 quality assurance technologies to provide high-quality multicast service.

2. Conventions used in this document

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] .

3. BIER Routing Header

One new type of IPv6 Routing Header is defined according to [RFC8200]. The message format is shown in Figure 1.

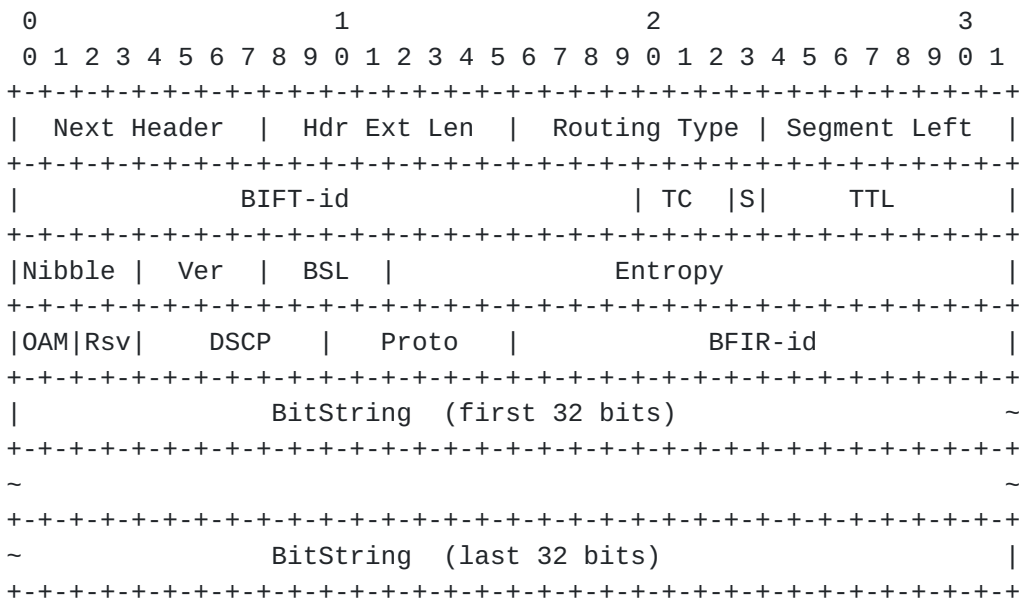


Figure 1: The format of BIER Routing Header

Where:

- Next Header(8 bits): indicating the message header type immediately after the routing header.

- HDR Ext Len(8 bits): indicating the length of the routing header.

- Routing Type(8 bits): TBD. Identifying the newly defined Routing Header to encode BIER information.

- Segments Left(8 bits): indicating the number of explicitly listed intermediate nodes to be accessed before reaching the final destination. It is not used here for the time being, and all are set to 0.

- BIFT-id(20 bits): each < SD, Si, BSL > is assigned a BIFT-id.

- TC(3 bits): see [RFC8296]. This field is set to 0.

- S(1 bit): see [RFC8296]. This field is set to 0.

- TTL(8 bits): indicating the lifetime of the message. It is used to prevent ring. The processing process is the same as that in non MPLS networks.

- Nibble(4 bits): see [RFC8296]. This field is set to 0.

- Ver(4 bits): identifying the version of the BIER header. When an unsupported BIER header version is received, the BFR needs to discard the packet and record the error.

- BSL(4 bits): indicating the length of BitString.

- Entropy(20 bits): this field specifies an "entropy" for ECMP.

- OAM(2 bits): by default, this value will be set to 0 by BFIR, and other BFRs will not be modified. Whether to use this field is optional.

- Rsv(2 bits): unused, set to 0.

- DSCP(6 bits): this field is used to support different service codes.

- Proto(6 bits): see [RFC8296]. This field is set to 0.

- BFIR-id(16 bits): indicating BFR ID of BFIR.

- Reserved (14 bits): reserved field, set to 0.

- BitString(variable): the length must be reflected in the BSL field. The string saved in this field is used to identify the destination BFER of the packet.

4. Multicast Packet Forwarding Procedures

Based on the newly defined BIER Routing Header, the nodes support BIER Routing Header will perform the following steps to forward the multicast packets:

1) When a BFIR receive a multicast packet, it will find out the destination address and RD that relate to the source interface of the packet. BFIR looks up its End.MVPN mapping table to find the associated End.MVPN, and encapsulate a IPv6 Header with BIER Routing Header. The payload is user data, the source address is the IPv6 address of BFIR, and destination address is End.MVPN. BitString in BIER Routing Header indicates the BFERs that want to receives such multicast packet.

2) BFIR checks whether there is BIFT corresponding to the BIFT-id locally. If not, it will discard the packet; otherwise, it will check whether the direct-connected node support BIER Routing Header. If the direct-connected node supports BIER Routing Header, proceeding to step 3). If the direct-connected node doesn't support BIER Routing Header, proceeding to step 2.1) .

2.1) BFIR Calculates the IPv6 address of next hop that support BIER Routing Header.

2.2) Encapsulating an outer IPv6 Header to the multicast packet. The calculated IPv6 address is used as the destination address of the outer IPv6 Header, and its own IPv6 address is used as the source address of the outer IPv6 Header. BitString will not be changed.

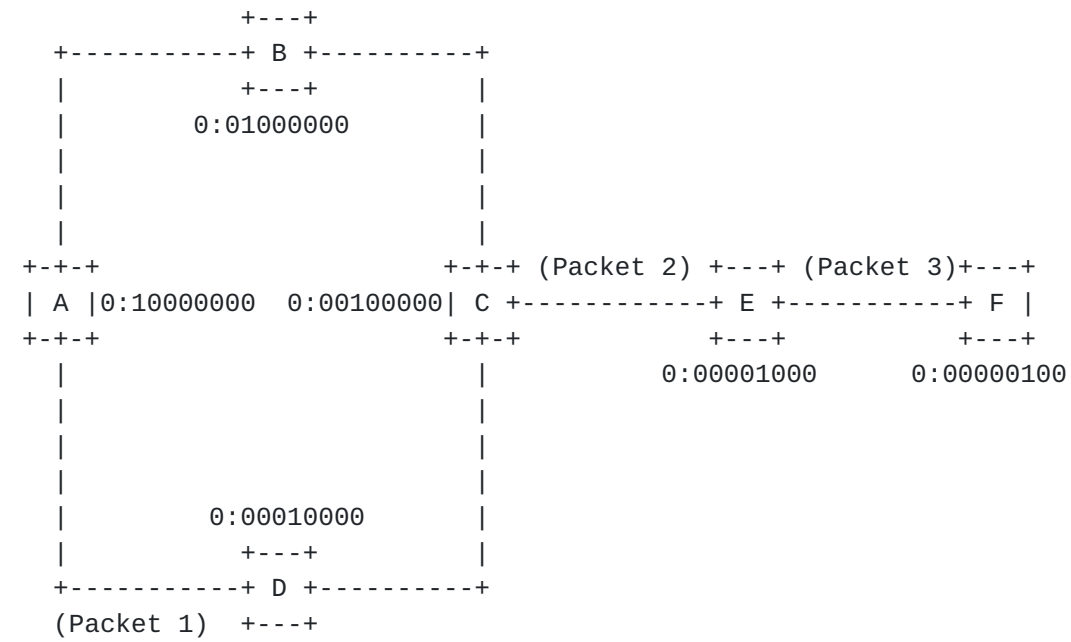
2.3) Sending the encapsulated packet to the direct-connected node, the node will perform normal IPv6 forwarding according to the outer IPv6 Header.

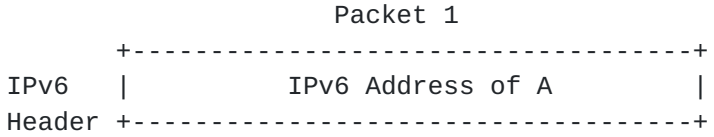
3) Performing the normal BIER forwarding process as described in [RFC8279].

For a BFR, it performs as described in Section 4.2.

The detail procedures for forwarding the multicast packets based on the newly defined Routing Header are described in the following sections.

4.1. All nodes in BIER domain support BIER Routing Header





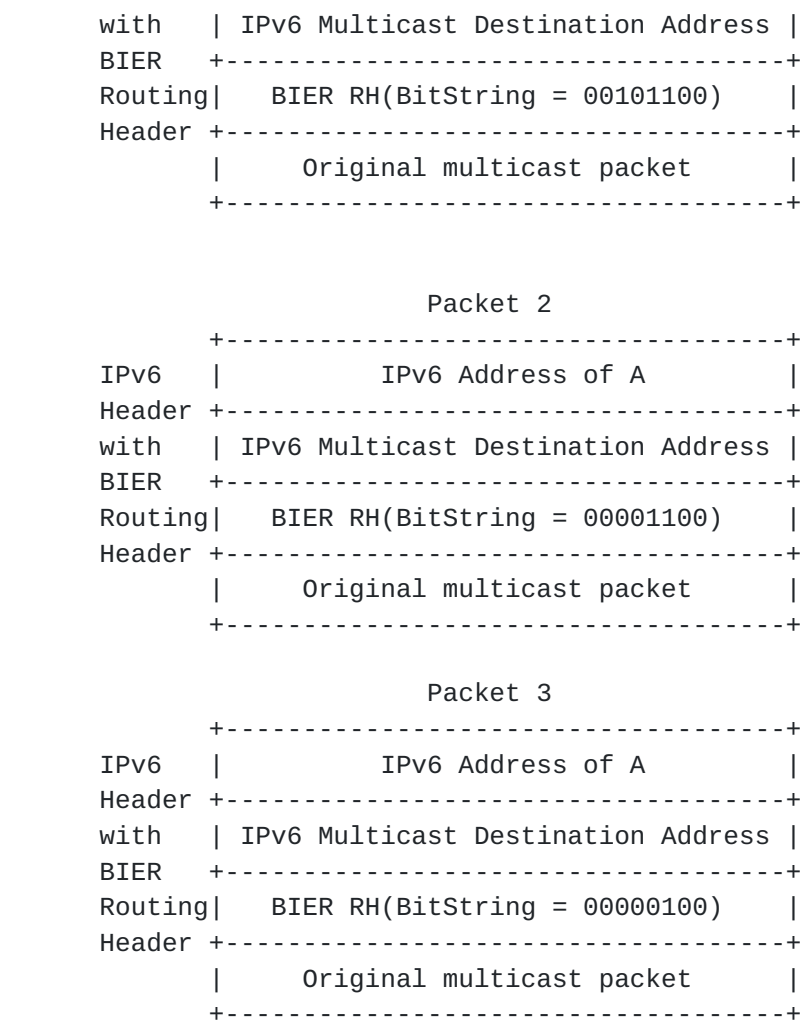


Figure 2: All nodes in BIER domain support BIER Routing Header

The topology is shown in Figure 2, node A-F support BIER Routing Header. The packet need to be transmitted from A to F. The changes of the Routing Header have been given in Figure 2.

1). Node A is BFIR, when it receives a multicast packet, it will encapsulate a IPv6 Header with BIER Routing Header to the packet.

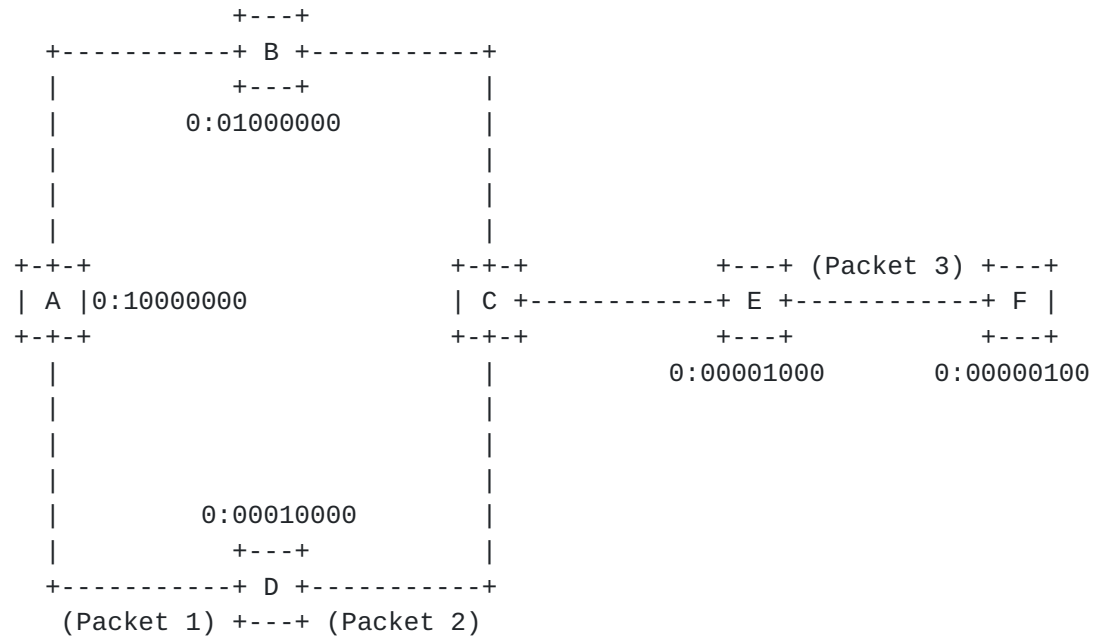
2). Node A checks whether there is BIFT corresponding to the BIFT-id locally. If not, discarding the packet; otherwise, forwarding the packet according to the BIFT related to the BIFT-id.

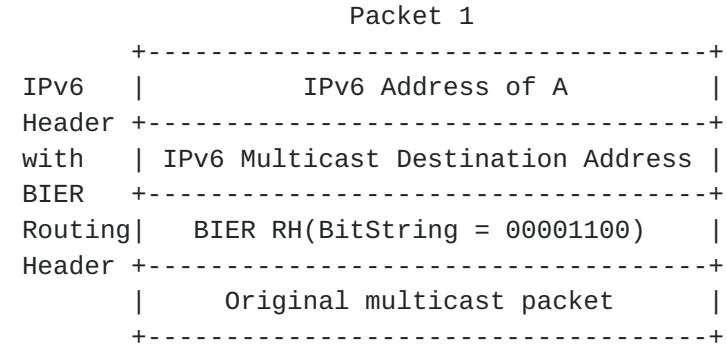
3). Node D-E repeat the step 2).

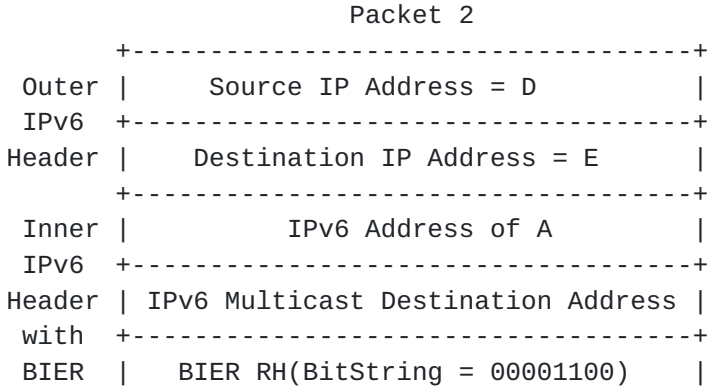
4). Node F looks up the associated table and submits the packet to the new multicast downstreams.

During the forwarding procedures, the source & destination address in IPv6 header are not changed, only the BitString in BIER Routing Header is updated.

4.2. Some nodes in BIER domain do not support BIER Routing Header







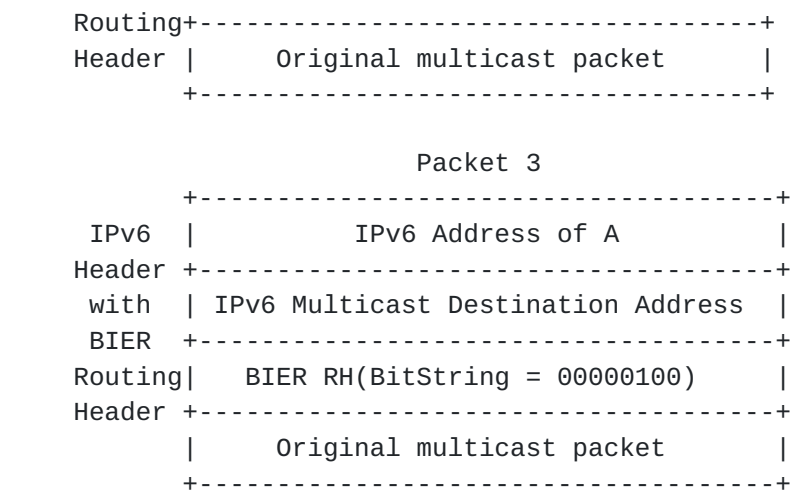


Figure 3: Some nodes in BIER domain do not support BIER Routing Header

The topology is shown in Figure 3, all nodes expect node C support BIER Routing Header. The packet need to be transmitted from A to F. The change of the Header has been given in the Figure 3.

1). After receiving a multicast packet, node A encapsulates a IPv6 Header with BIER Routing Header to it, and forwards the packet to node D according to the BIFT.

2). Node D calculates the IPv6 address of next hop node(Node E) that supports BIER Routing Header, and encapsulates an outer IPv6 Header to the packet. The source IPv6 address is the IPv6 address of itself, and the destination IPv6 address is the IPv6 address of node E. Then, sending the packet to node C.

3). Node C performs normal IPv6 forwarding according to the outer IPv6 header and sends the packet to node E.

4). Node E decapsulates the outer IPv6 header and forwards the packet according to the BIFT to node F.

5). Node F looks up the associated table and submits the packet to the new multicast downstreams.

In the forwarding procedures, the source address and destination address in the Inner IPv6 Header are not changed, only the BitString in BIER Routing Header is updated.

5. Security Considerations

TBD

6. IANA Considerations

This document defines a new type of IPv6 Routing Header - BIER Routing Header. The code point is from the "Internet Protocol Version 6 (IPv6) Parameters - Routing Types". It is recommended to set the code point of BIER Routing Header to 7.

7. References

7.1. Normative References

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[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>.

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7.2. Informative References

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[I-D.xie-bier-ipv6-encapsulation]
Xie, J., Geng, L., McBride, M., Asati, R., Dhanaraj, S., Zhu, Y., Qin, Z., Shin, M., Mishra, G., and X. Geng, "Encapsulation for BIER in Non-MPLS IPv6 Networks", draft-xie-bier-ipv6-encapsulation-10 (work in progress), February 2021.

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