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Y. Liu
China Mobile
C. Lin
New H3C Technologies
Z. Zhang
ZTE Corporation

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Export of BIER Information in IP Flow Information Export (IPFIX)
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Abstract

This document introduces new IP Flow Information Export (IPFIX) Information Elements (IEs) to identify a set of information related to Bit Index Explicit Replication (BIER) such as data contained in BIER header that traffic is being forwarded with.

Status of This Memo

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1. Introduction

[RFC8279] introduces a novel multicast data packet forwarding architecture known as "Bit Index Explicit Replication" (BIER). This architecture achieves optimal forwarding within a "multicast domain" without relying on explicit tree-building protocols or requiring intermediate nodes to maintain per-flow state. Currently, BIER technology has been widely adopted in modern data centers and large-scale networks, significantly enhancing the efficiency and scalability of multicast transmission.

[RFC8296] defines the encapsulation of BIER header that provides the information needed to support the BIER forwarding procedures.

This document specifies new IPFIX Information Elements (IEs) within the "IPFIX Information Elements" registry [RFC7012], for BIER purposes. These IEs are used to export the main parameters of BIER flow. This function can be used to collect statistics on the BIER flow receiving at a current node; and obtain node statistics information of the BIER flow.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

This document makes use of the terms defined in [RFC7011].

The following terms are used as defined in [RFC7011]:

* IPFIX
* IPFIX Information Elements

The following terms are used as defined in [RFC8296]:

* TC
* TTL
* BFR
* BIFT
* BFIR
* BFER
* BSL
* SD
* SI

3. New IPFIX BIER Information Elements

This section specifies the new IPFIX BIER IEs.

bierTTL
The value of the TTL field in the BIER header (Section 2 of [RFC8296]). This IE indicates the incoming Time to Live (TTL) when a BIER packet is received.

bierEncapType
This IE indicates what type of BIER packet encapsulation is used. There are currently three encapsulation methods for BIER packets: Ethernet encapsulation, defined in [RFC8296]; MPLS encapsulation, also defined in [RFC8296]; and IPv6-based encapsulation, defined in [I-D.ietf-bier-bierin6].

bierVersion
The version of the BIER header (Section 2 of [RFC8296]).

bierBSL
The value of the BSL field in the BIER header (Section 2 of [RFC8296]). This IE indicates the length in bits of the BitString defined in the BIER header (Section 2 of [RFC8296]).

bierEntropy
The value of the Entropy field in the BIER header (Section 2 of [RFC8296]). It is can be used for load-balancing purposes.

bierOAMSection
The OAM and Rsv field from the BIER header (Section 2 of [RFC8296]).

bierDSCP
The value of the DSCP field in the BIER header (Section 2 of [RFC8296]). In Non-MPLS networks, it is used to hold a Differentiated Services Codepoint [RFC2474].

bierNextProtocol
The next protocol defined in the Proto field of the BIER header (Section 2 of [RFC8296]). It identifies the type of the payload following the BIER header.

bierBFIRid
The value of the BFIR-id field in the BIER header (Section 2 of [RFC8296]). It indicates the BFR-id of the BFIR in the SD to which the packet has been assigned.

bierBitString
The BitString field defined in the BIER header (Section 2 of [RFC8296]). Together with the packet’s SI and SD, it identifies the destination BFERs for this packet.

4. Operation on bierEncapType

The ‘bierEncapType‘ cannot be directly obtained from the BIER Header; it must be derived from the corresponding encapsulation method.

Different encapsulation types guide BIER packets through different forwarding table entries. For the Collector, knowing the encapsulation type of the BIER packet is helpful for statistical analysis or statistical purposes regarding the corresponding forwarding patterns.

BIER packets can be directly encapsulated using the Ethernet type. In this case, the BIER header is directly encapsulated with Ethernet type 0xAB37. BIER packets can also be encapsulated using an MPLS label stack. The label at the bottom of the stack guides the BIER packet to find the corresponding MPLS forwarding table entry. The definitions of Ethernet type and MPLS encapsulation are both in [RFC8296]. BIER packets can also be encapsulated in IPv6 format. In this mode, the BIER header is encapsulated after the IPv6 header. This method is defined in [I-D.ietf-bier-bierin6].

The node, based on the specific encapsulation information of the received BIER message and other IEs in the message header, sends it to the Collector so that the Collector can perform further statistics and analysis.

5. Sample Use Cases

The IPFIX IEs defined in the Section 3, and some existing IP packet header information [IANA-IPFIX] provide answers to the following questions (amongst others).

* Whether the IP packet is a BIER packet?

* Whether the BIER packet is from an MPLS network?

* What is the incoming TTL of the BIER packet?

* What is BIER version used by the BIER packet?

* What is the type of the payload following the BIER header in the BIER packet?

* What is the destination BFERs for the BIER packet?

6. Security Considerations

There exists no extra security considerations other than those already discussed in Section 11 of [RFC7011] and Section 8 of [RFC7012].

7. IANA Considerations

7.1. IPFIX Information Elements

This document requests IANA to add new IPFIX BIER IEs to the "IPFIX Information Elements" registry [RFC7012] available at [IANA-IPFIX].

Table 1 lists the new IPFIX BIER IEs:

Element ID	Name	Reference
TBD1	bierTTL	This document
TBD2	bierEncapType	This document
TBD3	bierVersion	This document
TBD4	bierBSL	This document
TBD5	bierEntropy	This document
TBD6	bierOAMSection	This document
TBD7	bierDSCP	This document
TBD8	bierNextProtocol	This document
TBD9	bierBFIRid	This document
TBD10	bierBitString	This document

Table 1: New BIER IEs in the "IPFIX Information Elements" Registry

7.1.1. bierTTL

ElementID: TBD1

Name: bierTTL

Abstract Data Type: unsigned8

Data Type Semantics: default

Status: current

Description: The value of the TTL field in the BIER header. This Information Element indicates the incoming TTL when a BIER packet is received.

Units: hops

Additional Information: See Section 2 of [RFC8296] for more details about the TTL fields.

Reference: [this document]

7.1.2. bierEncapType

ElementID: TBD2

Name: bierEncapType

Abstract Data Type: unsigned8

Data Type Semantics: default

Status: current

Description: This IE indicates the encapsulation type of BIER packet. When the value is set to 0, it indicates Ethernet encapsulation; when the value is set to 1, it indicates MPLS encapsulation; when the value is set to 2, it indicates IPv6 encapsulation.

Reference: [this document]

7.1.3. bierVersion

ElementID: TBD3

Name: bierVersion

Abstract Data Type: unsigned8

Data Type Semantics: identifier

Status: current

Description: The version value of the Ver field in the BIER header.

This Information Element encodes only the 4 bits of the Ver field. Therefore, its value may range from 0 to 0xF.

Additional Information: See Section 2 of [RFC8296] for more details about the Ver field of the BIER header.

Reference: [this document]

7.1.4. bierBSL

ElementID: TBD4

Name: bierBSL

Abstract Data Type: unsigned8

Data Type Semantics: default

Status: current

Description: The value of the BSL field in the BIER header. This Information Element indicates the length in bits of the BitString defined in the BIER header.

This Information Element encodes only the 4 bits of the BSL field. Therefore, its value may range from 0 to 15.

Additional Information: See Section 2 of [RFC8296] for more details about the BSL field of the BIER header.

Reference: [this document]

7.1.5. bierEntropy

ElementID: TBD5

Name: bierEntropy

Abstract Data Type: unsigned32

Data Type Semantics: default

Status: current

Description: The value of the Entropy field in the BIER header. This Information Element indicates the function of load-balancing.

This Information Element encodes only the 20 bits of the Entropy field. Therefore, its value may range from 0 to 0xFFFFF.

Additional Information: See Section 2 of [RFC8296] for more details about the Entropy field of the BIER header.

Reference: [this document]

7.1.6. bierOAMSection

ElementID: TBD6

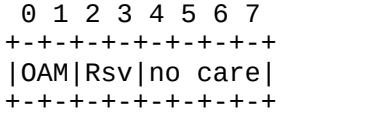
Name: bierOAMSection

Abstract Data Type: unsigned8

Data Type Semantics: flags

Status: current

Description: The OAM and Rsv field from the BIER header.



Bits 0-1: OAM field.
Bits 2-3: Rsv field, unused.
Bits 4-7: No care, value is irrelevent.

Additional Information: See Section 2 of [RFC8296] for more details about the OAM and Rsv field of the BIER header.

Reference: [this document]

7.1.7. bierDSCP

ElementID: TBD7

Name: bierDSCP

Abstract Data Type: unsigned8

Data Type Semantics: identifier

Status: current

Description: The value of the DSCP field in the BIER header. In Non-MPLS networks, it is used to hold a Differentiated Services Codepoint.

This Information Element encodes only the 6 bits of the DSCP field. Therefore, its value may range from 0 to 63.

Additional Information: See Section 2 of [RFC8296] for more details about the DSCP field of the BIER header.

Reference: [this document]

7.1.8. bierNextProtocol

ElementID: TBD8

Name: bierNextProtocol

Abstract Data Type: unsigned8

Data Type Semantics: identifier

Status: current

Description: The next protocol defined in the Proto field of the BIER header. This Information Element identifies the type of the payload following the BIER header.

This Information Element encodes only the 6 bits of the Proto field. Therefore, its value may range from 0 to 63.

Additional Information: See Section 2 of [RFC8296] for more details about the Proto field of the BIER header.

Reference: [this document]

7.1.9. bierBFIRid

ElementID: TBD9

Name: bierBFIRid

Abstract Data Type: unsigned16

Data Type Semantics: identifier

Status: current

Description: The value of the BFIR-id field in the BIER header. This Information Element identifies the BFR-id of the BFIR in the SD to which the packet has been assigned.

Additional Information: See Section 2 of [RFC8296] for more details about the BFIR-id field of the BIER header.

Reference: [this document]

7.1.10. bierBitString

ElementID: TBD10

Name: bierBitString

Abstract Data Type: octetArray

Data Type Semantics: identifier

Status: current

Description: The BitString field defined in the BIER header. Together with the packet's SI and SD, this information Element identifies the destination BFERs for this packet.

Additional Information: See Section 2 of [RFC8296] for more details about the BitString field of the BIER header.

Reference: [this document]

8. References

8.1. Normative References

[I-D.ietf-bier-bierin6]
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8.2. Informative References

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Authors' Addresses

Yisong Liu
China Mobile
32 Xuanwumen West Street
Beijing
Xicheng District, 100053
China
Email: liuyisong@chinamobile.com

Changwang Lin
New H3C Technologies
8 Yongjia North Road
Beijing
Haidian District, 100094
China
Email: linchangwang.04414@h3c.com

Zheng Zhang
ZTE Corporation
Nanjing
China
Email: zhang.zheng@zte.com.cn