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Performance Measurement (PM) with Flow-ID in Bit Index Explicit Replication (BIER)

Abstract

This document proposes one new performance measurement method of Bit Index Explicit Replication (BIER) IOAM information. The controller can realize the closed-loop control of end-to-end quality assurance for BIER through collecting and analyzing of BIER IOAM and related path algorithms in the new method.

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Table of Contents

1. Introduction

[RFC8279] introduces the architecture of the Bit Index Explicit
Replication (BIER) the forwarding of multicast data packets. [I-
D.wang-bier-rh-bier]introduces a new encapsulation schema of Bit
Index Explicit Replication (BIER) information, and the original
source address and destination address in the IPv6 Header are not
changed during process of the packet forwarding. [I-D.ietf-bier-
pmmm-oam]introduces how to measure packet loss and delay metrics of
a multicast flow in an MPLS network by using the marking method on
the BIER layer. [I-D.ietf-ippm-ioam-data]provides four possible IOAM
option to record telemetry data from the transit nodes. Based on the
[I-D.ietf-ippm-ioam-data], [I-D.ietf-ippm-ioam-direct-
export]provides a new IOAM option type to collect and report
telemetry data.

Multicast performance measurement is the basis of service quality
guarantee. However, nowadays it is difficult for the controller to
collect and association analysis dynamically of IOAM information and
user multicast flow path. [I-D.ietf-ippm-ioam-direct-export]
provides a flow id field to represent the flow identifier, but the
draft did not specify the generation of the flow id field.
Therefore, this draft has evolved from combining some of the
concepts of the Direct Export (DEX) option from [I-D.ietf-ippm-ioam-
direct-export] with the path and algorithm information are saved
during packet forwarding from [I-D.wang-bier-rh-bier].

This document proposes a BIER performance measurement information
collection and transmission method with the IOAM option type of
Direct Export (DEX) option. In the new method, The BFIR will
maintain a mapping table of flow id and (multicast source address,
multicast destination address, BFIR address, End.MVPN, BIER-TE Algo)
tuple (called " flow id mapping table") and BFIR will send the
mapping table to the controller. When the controller receives the

IOAM data, it will get the multicast path information according to
the flow id mapping table. Based on the information, the controller
can analyzes the performance of the multicast flows and optimize the
path, which lays the basis for the normal operation and quality
assurance of multicast services in the carrier network.

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. Performance Measurement method for BIER

3.1. Performance Measurement method

During the transimission of multicast packet, the transit nodes send
the IOAM data to the controller. When the IOAM data contains the
multicast flow information, the controller can quickly locate faults
and optimize paths.

```
                         +----+-----+
                         |          |
                         |Controller|
                         |          |
                         +----------+
                              ^
                              |Exported IOAM data
                              |
                              |
                              |
         +--------------+------+-------+--------------+
         |              |      |       |              |
         |              |      |       |              |
  User   +---+----+    +---+----+    +---+----+    +---+----+
 packets |Encapsu-|    | Transit|    | Transit|    |Decapsu-|
--------->|lating  |====>| Node   |====>| Node   |====>|lating  |---->
         |Node    |    | A      |    | B      |    |Node    |
         +--------+    +--------+    +--------+    +--------+
         Insert DEX     Export        Export       Remove DEX
         option and    IOAM data     IOAM data     option and
         export data                              export data
            BFIR           BFR           BFR          BFER
```
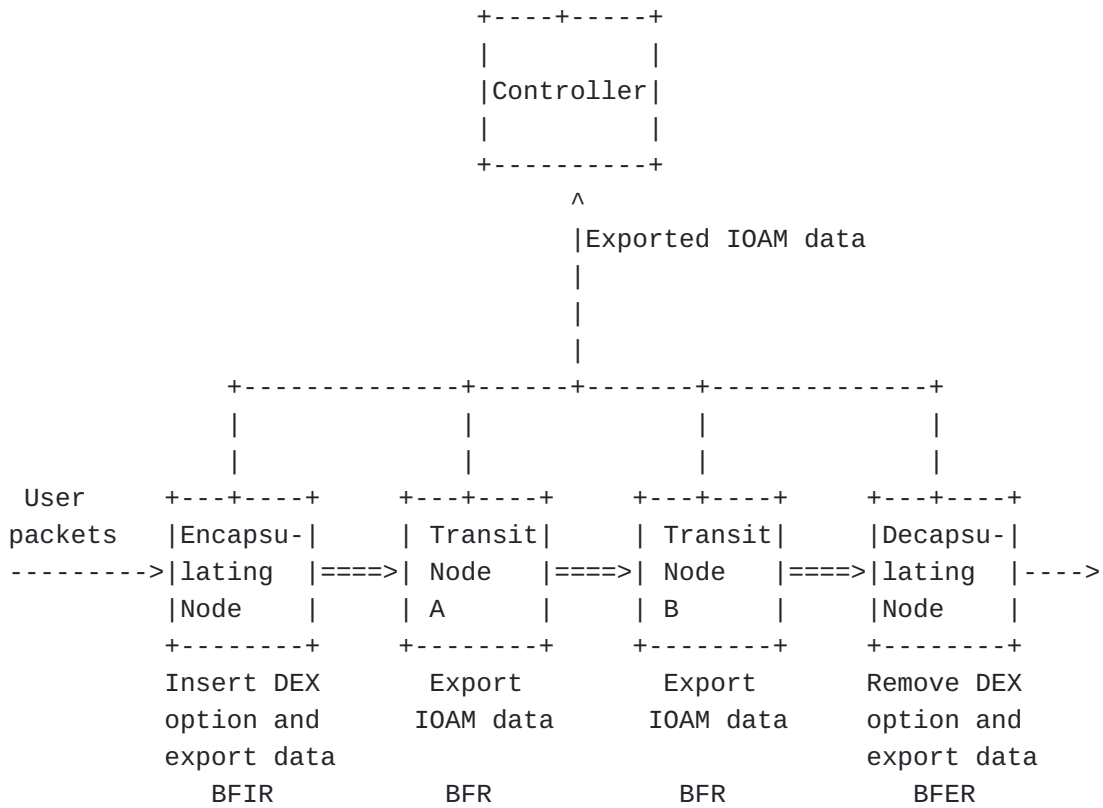
Figure 2: IOAM data transfer process

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

1) When a BFIR receives a multicast packet, it will encapsulate the
data as the method in [I-D.wang-bier-rh-bier].

2) The BFIR hashes the quintuple information (multicast source
address, Multicast destination address, BFIR address, End.MVPN,
BIER-TE Algo) into a 32-bit flow id field. Where, multicast source
address is the IPv6 address of the multicast packet, multicast
destination address is IPv6 multicast destination address, and the
fields of End.MVPN, BIER-TE Algo are consistent with those mentioned
in [I-D.wang-bier-rh-bier]. The BFIR saves the flow id field and its
corresponding quintuple information in the flow id mapping table,
and sends the flow id mapping table to the controller.

3) The BFIR encapsulates the hashed flow id field into the direct-
export header. And then, the multicast packet is forwarded according
to BIFT table.

4) The BFR and BFER collect and export IOAM data to the controller.

5) The controller analyzes IOAM data and proposes performance
optimization suggestions for each forwarding path for the multicast
flows based on the flow id field in the performance sampling data
and the flow id mapping table reported by the BFIR.

3.2. Flow ID mapping table

Due to the IOAM header is encapsulated by ingress router, it needs a
method to determine which multicast flow information should be
assigned to the flow id field.

On ingress router, a "Flow ID mapping table" should be maintain to
save the mapping between Flow ID field and (multicast source
address, Multicast destination address, BFIR address, End.MVPN,
BIER-TE Algo). Its structure is as follow:

```
+----------+----------------------------------------------------------+
| flow id1 | (multicast source address1, multicast destination        |
|          |   address1, BFIR address1,End.MVPN1, BIER-TE Algo1)      |
+----------+----------------------------------------------------------+
| flow id2 | (multicast source address2, multicast destination        |
|          |   address2, BFIR address2,End.MVPN2, BIER-TE Algo2)      |
+----------+----------------------------------------------------------+
| ...      | ...                                                      |
+----------+----------------------------------------------------------+
            Figure 1: Flow ID mapping table
```

4. Security Considerations

To be added.

5. IANA Considerations

To be added.

6. Informative References

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