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Performance Measurement (PM) with Marking Method in Bit Index Explicit Replication (BIER) Layer
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Abstract

This document describes a passive performance measurement method for multicast service over Bit Index Explicit Replication (BIER) domain.

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 July 27, 2017.

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1. Introduction

[I-D.ietf-bier-architecture] introduces and explains Bit Index Explicit Replication (BIER) architecture and how it supports forwarding of multicast data packets. [I-D.ietf-bier-mpls-encapsulation] specified that in case of BIER encapsulation in MPLS network a BIER-MPLS label, label that is at the bottom of the label stack, uniquely identifies the multicast flow. [I-D.tempia-ippm-p3m] describes passive performance measurement method , Packet Network Performance Monitoring (PNPM), which can be used to measure packet loss, latency and jitter on live traffic. Because this method is based on marking consecutive batches of packets the method often referred as Marking Method (MM).

This document defines how marking method can be used on BIER layer to measure packet loss and delay metrics of a multicast flow in MPLS network.

2. Conventions used in this document

2.1. Terminology

BFR: Bit-Forwarding Router

BFER: Bit-Forwarding Egress Router

BFIR: Bit-Forwarding Ingress Router

BIER: Bit Index Explicit Replication

MM: Marking Method

OAM: Operations, Administration and Maintenance

2.2. Requirements Language

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 [RFC2119].

3. OAM Field in BIER Header

[I-D.ietf-bier-mpls-encapsulation] defined two bit long field, referred as OAM, designated for the marking performance measurement method. The OAM field MUST NOT be used in defining forwarding and/or quality of service treatment of a BIER packet. The OAM field MUST be used only for the performance measurement of data traffic in BIER layer. Because setting of the field to any value does not affect forwarding and/or quality of service treatment of a packet, the marking method in BIER layer can be viewed as true example of passive performance measurement method.

The Figure 1 displays format of the OAM field

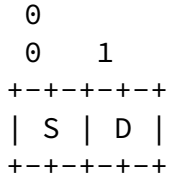

Figure 1: OAM field of BIER Header format

where:

- o S- Single mark method;

- o D - Double mark method.

4. Theory of Operation

The marking method can be successfully used in the multicast environment supported by BIER layer. Without limiting any generality consider multicast network presented in Figure 2. Any combination of markings, Loss and/or Delay, can be applied to a multicast flow by any Bit Forwarding Router (BFR) at either ingress or egress point to

perform node, link, segment or end-to-end measurement to detect performance degradation defect and localize it efficiently.

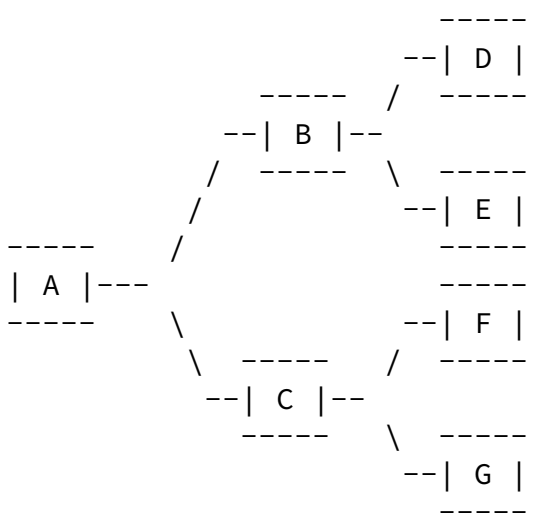

Figure 2: Multicast network

Using the marking method a BFR creates distinct sub-flows in the particular multicast traffic over BIER layer. Each sub-flow consists of consecutive blocks that are unambiguously recognizable by a monitoring point at any BFR and can be measured to calculate packet loss and/or packet delay metrics.

4.1. Single Mark Enabled Measurement

As explained in the [I-D.tempia-ippm-p3m], marking can be applied to delineate blocks of packets based either on equal number of packets in a block or based on equal time interval. The latter method offers better control as it allows better account for capabilities of downstream nodes to report statistics related to batches of packets and, at the same time, time resolution that affects defect detection interval.

If the Single Mark measurement used, then the D flag MUST be set to zero on transmit and ignored by monitoring point.

The S flag is used to create alternate flows to measure the packet loss by switching value of the S flag every N-th packet or at certain time intervals. Delay metrics MAY be calculated with the alternate flow using any of the following methods:

- First/Last Packet Delay calculation: whenever the marking, i.e. value of S flag, changes a BFR can store the timestamp of the

first/last packet of the block. The timestamp can be compared with the timestamp of the packet that arrived in the same order through a monitoring point at downstream BFR to compute packet delay. Because timestamps collected based on order of arrival this method is sensitive to packet loss and re-ordering of packets

- Average Packet Delay calculation: an average delay is calculated by considering the average arrival time of the packets within a single block. A BFR may collect timestamps for each packet received within a single block. Average of the timestamp is the sum of all the timestamps divided by the total number of packets received. Then difference between averages calculated at two monitoring points is the average packet delay on that segment. This method is robust to out of order packets and also to packet loss (only a small error is introduced). This method only provides single metric for the duration of the block and it doesn't give the minimum and maximum delay values. This limitation could be overcome by reducing the duration of the block by means of an highly optimized implementation of the method.

4.2. Double Mark Enabled Measurement

Double Mark method allows measurement of minimum and maximum delays for the monitored flow but it requires more nodal and network resources. If the Double Mark method used, then the S flag MUST be used to create the alternate flow, i.e. mark larger batches of packets. The D flag MUST be used to mark single packets to measure delay jitter.

The first marking (S flag alternation) is needed for packet loss and also for average delay measurement. The second marking (D flag is put to one) creates a new set of marked packets that are fully identified over the BIER network, so that a BFR can store the timestamps of these packets; these timestamps can be compared with the timestamps of the same packets on a second BFR to compute packet delay values for each packet. The number of measurements can be easily increased by changing the frequency of the second marking. But the frequency of the second marking must be not too high in order to avoid out of order issues. This method is useful to have not only the average delay but also the minimum and maximum delay values and, in wider terms, to know more about the statistic distribution of delay values.

5. IANA Considerations

This document requests IANA to register format of the OAM field of BIER Header as the following:

Bit Position	Marking	Description	Reference
0	S	Single Mark Measurement	This document
1	D	Double Mark Measurement	This document

Table 1: OAM field of BIER Header

6. Security Considerations

This document list the OAM requirement for BIER-enabled domain and does not raise any security concerns or issues in addition to ones common to networking.

7. Acknowledgement

TBD

8. References

8.1. Normative References

[I-D.ietf-bier-architecture]
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[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

8.2. Informative References

[I-D.tempia-ippm-p3m]
Capello, A., Cociglio, M., Fioccola, G., Castaldelli, L., and A. Bonda, "A packet based method for passive performance monitoring", draft-tempia-ippm-p3m-03 (work in progress), March 2016.

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