BIER Working Group
Internet-Draft
Intended status: Informational
Expires: 7 May 2026

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3 November 2025

Operations, Administration and Maintenance (OAM) Requirements for Bit Index Explicit Replication (BIER) Layer
draft-ietf-bier-oam-requirements-20

Abstract

This document specifies a list of functional requirements for Operations, Administration, and Maintenance mechanisms, protocols, and tools that support operations in the Bit Index Explicit Replication layer of a network.

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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1. Introduction

[RFC8279] specifies a Bit Index Explicit Replication (BIER) architecture and how it supports forwarding of multicast data packets.

This document lists the Operations, Administration, and Maintenance (OAM) requirements for the BIER layer see Section 4.2 of [RFC8279]) of the multicast domain. The list can further be used for gap analysis of available OAM tools to identify possible enhancements of existing or whether new OAM tools are required to support proactive and on-demand path monitoring and service validation.

1.1. Conventions used in this document

1.1.1. Terminology

The reader is expected to be familiar with:

* [RFC7799], particularly definitions of Active, Passive, and Hybrid measurement methods and metrics.

* The definitions and calculation of performance metrics, e.g., throughput, loss, delay, and delay variation metrics, are defined in [RFC6374].

* The definitions, applicability, and examples of the Continuity Check and Connectivity Verification mechanisms, components of the Fault Management OAM, can be found in [RFC5860],[RFC6371], and [RFC7276].

* The term "BIER OAM" is used in this document interchangeably with a more extended version, "set of OAM protocols, methods, and tools for BIER layer".

* Downstream - is the direction from the ingress toward the egress endpoints of a multicast distribution tree.

* In-band OAM is an active OAM or hybrid OAM method [RFC7799] in which OAM packets traverse the same set of links and interfaces, and receive the same QoS treatment, as the monitored BIER flow (traffic flows in [RFC7011]).

* Out-of-band OAM refers to an active OAM method in which the path traversed through the BIER domain is not topologically identical to that of the monitored BIER flow, or in which the OAM test packets receive different QoS treatment, or both.

* OAM session is a communication established between network nodes to perform OAM functions like fault detection, performance monitoring, and localization [RFC7276]. These sessions can be proactive (continuous, persistent configuration) or on-demand (manual, temporary diagnostics).

1.1.2. 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 BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

The requirements language is used in Section 2 and applies to implementations of BIER OAM conformant to the listed requirements.

1.1.3. Acronyms

BFD: Bidirectional Forwarding Detection [RFC8562]

BFR: Bit-Forwarding Router [RFC8279]

BFER: Bit-Forwarding Egress Router [RFC8279]

BIER: Bit Index Explicit Replication [RFC8279]

OAM: Operations, Administration, and Maintenance [RFC6291]

PMTUD: Path Maximum Transmission Unit Discovery [RFC1191]

p2mp: Point-to-Multipoint [RFC8562]

RDI: Remote Defect Indication [RFC6428]

STAMP: Simple Two-way Active Measurement Protocol [RFC8762]

2. Requirements

This section lists the requirements for OAM of the BIER layer:

1. The listed requirements MUST be supported with any routing underlay [RFC8279] over which the BIER layer can be realized.

2. It MUST be possible to initialize a BIER OAM session from any Bit-Forwarding Router (BFR) of the given BIER domain.

3. It SHOULD be possible to initialize a BIER OAM session from a centralized controller.

4. BIER OAM MUST support proactive and on-demand OAM monitoring and measurement methods.

5. BIER OAM MUST support downstream path continuity check. Bidirectional Forwarding Detection (BFD) [RFC8562] is an example of a protocol that monitors the continuity of a multicast distribution tree.

6. BIER OAM MUST support downstream performance measurement. Simple Two-way Active Measurement Protocol (STAMP) [RFC8762] is an example of a protocol that supports measurement of performance metrics, e.g., packet loss ratio, delay, and delay variation.

7. In the downstream direction, a BIER OAM solution MUST support transmission of the OAM packets that follow the same path and receive the same QoS treatment as the monitored BIER flow, i.e., BIER OAM packets are in-band with the monitored BIER flow, as defined in Section 1.1.1.

8. BIER OAM MUST support bi-directional OAM methods. Such methods MAY combine in-band monitoring or measurement in the downstream direction with out-of-band notification, as defined in Section 1.1.1, in the reverse direction (i.e., from the egress toward the ingress endpoint of the OAM test session, as in Point-to-Multipoint (p2mp) BFD with active tail [RFC9780]).

9. BIER OAM MUST support the ability of any BFR in the given BIER domain to monitor BFER availability proactively. The p2mp BFD with active tail support [RFC9780] is an example of a protocol that provides notifications about the loss of connectivity in a multicast distribution tree.

10. BIER OAM MUST support Path Maximum Transmission Unit discovery (PMTUD). The PMTUD using ICMP [RFC1191] is an example of the mechanism.

11. BIER OAM MUST support an RDI mechanism to notify the BFR, the source of the continuity checking by Bit-Forwarding Egress Routers (BFERs). The Diagnostic field in p2mp BFD with active tail support, as described in Section 5 of [RFC9780], is an example of the RDI mechanism.

12. BIER OAM MUST support active and passive performance measurement methods [RFC7799].

13. BIER OAM MUST support downstream performance measurement method(s) that (together) calculate performance metrics, e.g., throughput, loss, delay, and delay variation metrics [RFC6374]. STAMP ([RFC8762] and [RFC8972]) is an example of an active performance measurement method of performance metrics that may be applied in a BIER domain. The Alternate Marking Method, described in [RFC9341] and [RFC9342], is an example of a hybrid measurement method ([RFC7799]) that may be applied in a BIER domain.

14. BIER OAM MUST support defect notification mechanism(s). Alarm Indication Signal [RFC6427] is an example of the defect notification mechanism.

15. BIER OAM MUST support a way for any BFR in the given BIER domain to originate a fault management message addressed to any subset of BFRs within the domain. [RFC6427] provides an example of a Fault Management messaging mechanism.

16. BIER OAM MUST support methods to enable the survivability of a BIER layer. Protection switching and restoration are examples of survivability methods.

3. IANA Considerations

This document does not propose any IANA consideration. This section may be removed.

4. Security Considerations

This document lists the OAM requirements for a BIER-enabled domain and thus inherits the security considerations discussed in [RFC8279] and [RFC8296]. Another general security aspect results from using active OAM protocols ([RFC7799]) in a multicast network.

Active OAM protocols inject specially constructed test packets. Some active OAM protocols are based on the echo request/reply principle of using those test packets. In the multicast network, test packets are replicated as data packets, thus creating a possible amplification effect of multiple echo replies being transmitted to the sender of the echo request. Thus, following security-related requirements for BIER OAM:

* A BIER OAM solution MUST protect the control plane by controlling the rate of echo request transmission.

* A BIER OAM solution MUST provide control of the number of BIER OAM messages sent to the control plane.

5. Acknowledgements

The authors would like to thank the comments and suggestions from Gunter van de Velde that helped improve this document.

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