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RFC 9186
Fast Failover in Protocol Independent Multicast - Sparse Mode (PIM-SM) Using Bidirectional Forwarding Detection (BFD) for Multipoint Networks

Abstract

This document specifies how Bidirectional Forwarding Detection (BFD) for multipoint networks can provide sub-second failover for routers that participate in Protocol Independent Multicast - Sparse Mode (PIM-SM). An extension to the PIM Hello message used to bootstrap a point-to-multipoint BFD session is also defined in this document.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc9186.

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1. Introduction

Faster convergence in the control plane minimizes the periods of traffic loss due to the use of stale routing information, transient routing loops, and other situations that may negatively affect service data flow. Faster convergence in the control plane is beneficial to unicast and multicast routing protocols.

[RFC7761] is the current specification of the Protocol Independent Multicast - Sparse Mode (PIM-SM) for IPv4 and IPv6 networks. A conforming implementation of PIM-SM elects a Designated Router (DR) on each PIM-SM interface. When a group of PIM-SM nodes is connected to a shared media segment, e.g., Ethernet, the node elected as the DR acts on behalf of directly connected

hosts in the context of the PIM-SM protocol. Failure of the DR impacts the quality of the multicast services it provides to directly connected hosts because the default failure detection interval for PIM-SM routers is 105 seconds.

Bidirectional Forwarding Detection (BFD) [RFC5880] was originally defined to detect a failure of a point-to-point (P2P) path, single hop [RFC5881], or multihop [RFC5883]. In some PIM-SM deployments, a P2P BFD can be used to detect a failure and enable faster failover. [RFC8562] extends the BFD base specification [RFC5880] for multipoint and multicast networks, which matches the deployment scenarios for PIM-SM over a LAN segment. A BFD system in a point-to-multipoint (P2MP) environment that transmits BFD Control messages using the BFD Demand mode [RFC5880] creates less BFD state than the Asynchronous mode. P2MP BFD can enable faster detection of PIM-SM router failure compared to PIM-SM without BFD and thus minimizes multicast service disruption. The monitored PIM-SM router acts as the head and other routers act as tails of a P2MP BFD session. This document defines the monitoring of a PIM-SM router using P2MP BFD. This document also defines the extension to PIM-SM [RFC7761] to bootstrap a PIM-SM router to join in the P2MP BFD session over a shared media segment.

1.1. Conventions Used in This Document

1.1.1. Terminology

This document uses terminology defined in [RFC5880], [RFC8562], and [RFC7761]. Familiarity with these specifications and the terminology used is expected.

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.

2. BFD Discriminator PIM Hello Option

Figure 1 displays the new optional BFD Discriminator PIM Hello Option to bootstrap a tail of the P2MP BFD session:

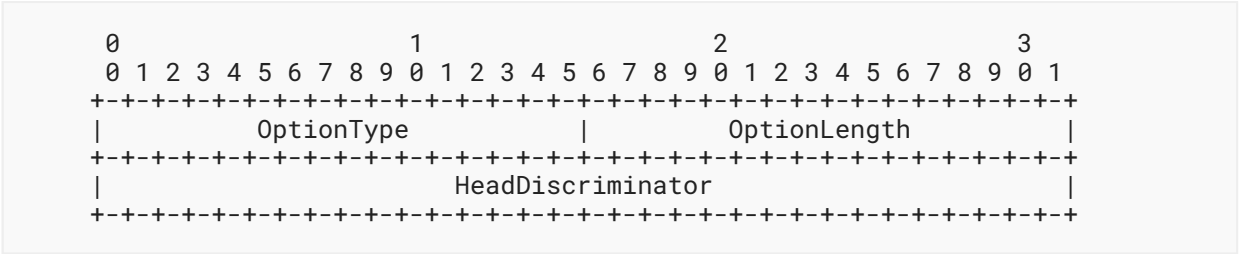

Figure 1: BFD Discriminator PIM Hello Option

where new fields are interpreted as:

OptionType: 39

OptionLength: **MUST** be set to 4.

HeadDiscriminator: the 4-octet field **MUST** be included in the BFD Discriminator PIM-SM Hello Option. The value **MUST NOT** be zero. It equals the value of My Discriminator [RFC5880] allocated by the head.

If the value of the OptionLength field is not equal to 4, the BFD Discriminator PIM Hello Option is considered malformed, and the receiver **MUST** stop processing PIM Hello Options. If the value of the HeadDiscriminator field equals zero, then the BFD Discriminator PIM Hello Option **MUST** be considered invalid, and the receiver **MUST** ignore it. The receiver **SHOULD** log a notification regarding the malformed or invalid BFD Discriminator Hello Option under the control of a throttling logging mechanism.

2.1. Using P2MP BFD in PIM Router Monitoring

If the head is no longer serving the function that prompted it to be monitored, then it **MUST** cease including the BFD Discriminator PIM Hello Option in its PIM Hello message, and it **SHOULD** shut down the BFD session following the procedures described in [RFC8562], Section 5.9.

The head **MUST** create a BFD session of type MultipointHead [RFC8562]. Note that any PIM-SM router, regardless of its role, **MAY** become a head of a P2MP BFD session. To control the volume of BFD Control traffic on a shared media segment, an operator should carefully select PIM-SM routers configured as a head of a P2MP BFD session. The head **MUST** include the BFD Discriminator PIM Hello Option in its PIM Hello messages.

A PIM-SM router that is configured to monitor the head by using P2MP BFD is referred to throughout this document as a "tail". When such a tail receives a PIM Hello packet with the BFD Discriminator PIM Hello Option, the tail **MAY** create a P2MP BFD session of type MultipointTail, as defined in [RFC8562].

The node that includes the BFD Discriminator PIM Hello Option transmits BFD Control packets periodically. For the tail to correctly demultiplex BFD [RFC8562], the source address and My Discriminator of the BFD packets **MUST** be the same as the source address and the HeadDiscriminator, respectively, of the PIM Hello message. If that is not the case, the tail BFD node would not be able to monitor the state of the PIM-SM node -- that is, the head of the P2MP BFD session -- though the regular PIM-SM mechanisms remain fully operational.

If the tail detects a MultipointHead failure [RFC8562], it **MUST** delete the corresponding neighbor state and follow procedures defined in [RFC7761] for the DR and additional neighbor state deletion after the neighbor timeout expires.

If the head ceases to include the BFD Discriminator PIM Hello Option in its PIM Hello message, the tail **SHOULD** close the corresponding MultipointTail BFD session without affecting the PIM state in any way. Thus, the tail stops using BFD to monitor the head and reverts to the procedures defined in [RFC7761].

2.2. P2MP BFD in PIM DR Load Balancing

[RFC8775] specifies the PIM Designated Router Load-Balancing (DRLB) functionality. Any PIM router that advertises the DR Load-Balancing Capability (DRLB-Cap) Hello Option can become the head of a P2MP BFD session, as specified in Section 2.1. The head router administratively sets the bfd.SessionState to Up in the MultipointHead session [RFC8562] only if it is a Group Designated Router (GDR) Candidate, as specified in Sections 5.5 and 5.6 of [RFC8775]. If the router is no longer the GDR, then it **MUST** shut down following the procedures described in [RFC8562], Section 5.9. For each GDR Candidate that includes the BFD Discriminator Option in its PIM Hello, the PIM DR **MUST** create a MultipointTail session [RFC8562]. PIM DR demultiplexes BFD sessions based on the value of the My Discriminator field and the source IP address. If PIM DR detects a failure of one of the sessions, it **MUST** remove that router from the GDR Candidate list and immediately transmit a new DRLB-List option.

2.3. Multipoint BFD Encapsulation

The MultipointHead of a P2MP BFD session when transmitting BFD Control packets:

- **MUST** set the TTL or Hop Limit value to 255 ([RFC5881], Section 5). Similarly, all received BFD Control packets that are demultiplexed to the session **MUST** be discarded if the received TTL or Hop Limit is not equal to 255, and
- **MUST** use the group address ALL-PIM-ROUTERS ("224.0.0.13" for IPv4 and "ff02::d" for IPv6) as the destination IP address.

3. IANA Considerations

IANA has allocated a new OptionType value in the "PIM-Hello Options" registry according to Table 1:

Value	Length	Name	Reference
39	4	BFD Discriminator Option	RFC 9186

Table 1: BFD Discriminator Option Type

4. Security Considerations

This document defines a way to accelerate detection of a failure that affects PIM functionality by using BFD. The operation of either protocol is not changed.

The security considerations discussed in [RFC5880], [RFC5881], [RFC7761], [RFC8562], and [RFC8775] apply to this document.

5. References

5.1. Normative References

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