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PIM Flooding Mechanism Enhancements

Abstract

PIM Flooding Mechanism is a generic PIM message exchange mechanism that allows multicast information to be exchanged between PIM routers hop-by-hop. One example is PIM Flooding Mechanism and Source Discovery which allows Last Hop Routers to learn about new sources using PFM messages, without the need of initial data registers, RPs or shared trees.

This document defines a methodology that enhances forwarding efficiency in PFM deployments. This enhancement can avoid extra processing at PIM routers when PFM messages are forwarded.

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 25 December 2023.

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1. Introduction

PIM Flooding Mechanism [RFC8364] allows a PIM router in the network to originate a PFM message to distribute multicast information to its PIM neighbors [RFC7761] . All PIM neighbors then process this PFM message and flood it further on their PIM-enabled links. To prevent loops, the originator address as defined in Section 3.1 [RFC8364] is used for RPF checking at each router. This RPF check is defined in Section 3.4.1 [RFC8364]. Periodic PFM messages are triggered, see Section 3.4.2 [RFC8364] and exchanged to keep the multicast information updated across the PIM domain. At present, a PIM router will flood a PFM message on all its PIM enabled links. It is the recipient's responsibility to perform RPF checks on all received PFM messages and then decide whether to accept or drop a particular message. This means that if two routers have PIM neighborships over more than one link, the same PFM messages are exchanged or dropped over more than one link between the same two routers. This leads to extra processing at each PIM router, periodically, or every time a new source is discovered (in case of a PFM-SD implementation). This document defines a mechanism to exchange PFM messages only on one ONE link per router-pair, even though they may maintain PIM neighborships over multiple links. In other words, when there are multiple links between two PIM routers, routers should not send the same message on all the links between them. This is achieved by identifying the PIM routers in the network using Router Identifier that are announced via PIM hellos, as per RFC 6395.

1.1. Conventions Used in This Document

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.

1.2. Terminology

RP: Rendezvous Point

RPF: Reverse Path Forwarding

PFM: PIM Flooding Mechanism

2. Methodology

2.1. RFC 6395 Compliance

For the PFM enhancement specified in this document to be adopted, all PIM routers MUST be compliant with RFC [RFC6395]. This means that PIM routers announce a unique domain-wide router ID in their PIM Hellos. A PIM router announces the same 4-byte Router-ID in PIM Hellos that it sends to all neighbors on all links. It also caches of the Router-Ids of its neighbors, when it receives Hellos from RFC 6395 Compliant PIM neighbors. This can be used to determine that different PIM neighbors are really the same router. In a VRF context, if the router has multiple interfaces with only one neighbor per interface, the router SHOULD check if those neighbors announce an RFC 6395 router ID. If the router can see the same router ID for multiple neighbors, PFM message exchange is optimized, as discussed in Section 2.

2.2. PFM optimization Hello option

A PIM router indicates that it supports the mechanism specified in this document by including the new PFM optimization Hello option. When this optimization is included in the PIM hello, the router MUST also include the router-ID Hello Option defined in [RFC6395] with a non-zero router-ID.

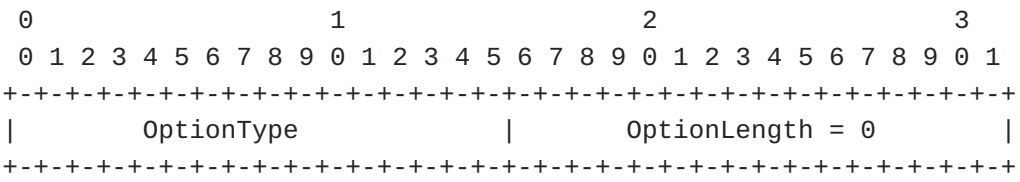

Figure 1: PFM optimization Hello option

OptionType = TBD

OptionLength = 0 Note that there is no option value included. When a PIM hello with OptionType TBD is received from a PIM neighbor, the router MUST cache this information so that it can make forwarding and dropping decisions for PFM messages for that neighbor. When this option is included, the router MUST also cache the non-zero router-ID of this neighbor.

2.3. PFM message sending

Consider a topology where two PIM routers maintain PIM neighborships over more than one links in the same PIM domain. From each router's point of view, there is a single neighbor on each link. Traditionally, each of the routers will send out PFM messages out over all the links to its neighbor. RPF checks are one of the commonly used ways to prevents loops, hence the recipient router performs an RPF check and accepts only on one link, thereby dropping packets from all the others. Since, the sender does not know which link will be chosen as the RPF-source on the neighbor, it cannot make the decision of choosing one of the links, without knowing its neighbor's decision.

If the optimization specified in this document is advertised by both routers, the sender should choose one of the links and send and forward PFM messages to its neighbor using only that link. It is imperative that the sender does this only when the receiver is capable of the optimization and is advertising the same. Otherwise, the messages may be dropped because of RPF failures. Mechanism to choose a link is left to the implementation.

2.4. PFM message receiving and RPF check relaxation

Consider a router that is advertising its capability to optimize PFM exchanges in the network. Upon receiving a PFM message, this router MUST first check whether this message is sent by a PFM optimization enabled router. If the check returns true, the receiver should relax its RPF check and accept the message. When a PFM message is received, the receiver SHOULD keep track of the router ID of the sender, so that the receiver does not forward the message back to the sender on any other link, as explained in the next section. If

it receives this message from a router that is not advertising the PFM optimization specified in this document, however the optimization is enabled on the receiver, the receiver SHOULD NOT relax its RPF check. This is because the sender will be still sending out messages on all the links between them.

2.5. PFM message forwarding

Traditionally, a PIM router forwards a PFM message on all its PIM enabled links. However, this is now optimized. Consider a router that is advertising its capability to optimize PFM exchanges in the network. When this router receives a PFM message from a router that also has the PFM optimization enabled, the forwarding mechanism is as follows. The receiver MUST NOT send the PFM message on out on any links where there is only one neighbor and the neighbor has the same router ID as the sender.

3. Operational Considerations

Existing neighbor on a new link: When a new neighbor is detected announcing support for the optimization and announcing a non-zero router ID, and it is the only neighbor on the link, a PIM router needs to check if there is an existing neighbor on another link with the same router ID (it does not need to be the sole neighbor on the other link). A mechanism SHOULD be implemented to prevent PFM messages being sent on this link.

New neighbor on a new link: Appropriate logic SHOULD be implemented to handle new neighbor additions so that extra messages are not forwarded to same neighbor, as well as ensuring that a new neighbor quickly gets the correct state.

Removal of a neighbor: Appropriate logic SHOULD also be implemented to handle neighbor removals.

4. Acknowledgments

5. Normative References

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

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC7761] Fenner, B., Handley, M., Holbrook, H., Kouvelas, I., Parekh, R., Zhang, Z., and L. Zheng, "Protocol

Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)", STD 83, RFC 7761, DOI 10.17487/RFC7761, March 2016, <https://www.rfc-editor.org/info/rfc7761>.

[RFC8364] Wijnands, IJ., Venaas, S., Brig, M., and A. Jonasson, "PIM Flooding Mechanism (PFM) and Source Discovery (SD)", RFC 8364, DOI 10.17487/RFC8364, March 2018, <https://www.rfc-editor.org/info/rfc8364>.

[RFC6395] Gulrajani, S. and S. Venaas, "An Interface Identifier (ID) Hello Option for PIM", RFC 6395, DOI 10.17487/RFC6395, October 2011, <https://www.rfc-editor.org/info/rfc6395>.

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