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Authors:
H. Bidgoli, Ed. *Nokia*
S. Venaas *Cisco Systems, Inc.*
M. Mishra *Cisco Systems, Inc.*
Z. Zhang *Juniper Networks*
M. McBride *Futurewei Technologies Inc.*

RFC 9739
Protocol Independent Multicast Light (PIM Light)

Abstract

This document specifies Protocol Independent Multicast Light (PIM Light) and the PIM Light Interface (PLI). A PLI does not need a PIM Hello message to accept PIM Join/Prune messages, and it can signal multicast states over networks that cannot support full PIM neighbor discovery, such as Bit Index Explicit Replication (BIER) networks that connect two or more PIM domains. This document outlines the PIM Light protocol and procedures to ensure loop-free multicast traffic between two or more PIM Light routers.

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/rfc9739.

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1. Introduction

This document specifies procedures for Protocol Independent Multicast Light (PIM Light) and the PIM Light Interface (PLI). The PLI is a new type of PIM interface that allows signaling of PIM Join/Prune packets without full PIM neighbor discovery. A PLI is useful in scenarios where multicast states need to be signaled over networks or media that cannot support full PIM neighborship between routers or, alternatively, where full PIM neighborship is not desired. These types of

networks and media are called "PIM Light domains" within this document. Lack of full PIM neighborship will remove some PIM functionality as explained in Section 3.2 of this document. PIM Light only supports the PIM - Sparse Mode (PIM-SM) protocol, including PIM Source-Specific Multicast (PIM-SSM), as per [RFC7761]. This document details procedures and considerations needed for PIM Light and the PLI to ensure efficient routing of multicast groups for specific deployment environments.

2. Terminology

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.

This document uses terminology from "Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)" [RFC7761].

3. PIM Light Interface

Section 4.3.1 of [RFC7761] describes PIM neighbor discovery via Hello messages. Section 4.5 of [RFC7761] notes that if a router receives a Join/Prune message from a particular IP source address and it has not seen a PIM Hello message from that source address, then the Join/Prune message **SHOULD** be discarded without further processing.

In certain scenarios, it is desirable to establish multicast states between two routers without forming a PIM neighborship. This can be necessary for various reasons, such as signaling multicast states upstream between multiple PIM domains over a network that is not optimized for PIM or that does not necessitate PIM neighbor establishment. An example is a Bit Index Explicit Replication (BIER) [RFC8279] network connecting multiple PIM domains, where PIM Join/Prune messages are tunneled via BIER as specified in [BIER-PIM].

A PLI accepts Join/Prune messages from an unknown PIM router without requiring a PIM Hello message from the router. The absence of Hello messages on a PLI means there is no mechanism to discover neighboring PIM routers or their capabilities or to execute basic algorithms such as Designated Router (DR) election [RFC7761]. Consequently, the PIM Light router does not create any general-purpose state for neighboring PIM routers and only processes Join/Prune messages from downstream routers in its multicast routing table. Processing these Join/Prune messages will introduce multicast states in a PIM Light router.

Due to these constraints, a PLI should be deployed in very specific scenarios where PIM-SM is not suitable. The applications or the networks on which PLIs are deployed **MUST** ensure that there is no multicast packet duplication, such as multiple upstream routers sending the same multicast stream to a single downstream router. For example, an implementation should ensure that DR election is done on upstream redundant PIM routers that are at the edge of the PIM Light domain to ensure that a single DR forwards the PIM Join message from the receiver to the source.

3.1. Message Types Supported by PIM Light

The "PIM Message Types" registry [IANA-PIM-Mess-Types] lists the message types supported by PIM. PIM Light only supports the following message types in that registry:

- type 1 (Register)
- type 2 (Register Stop)
- type 3 (Join/Prune)
- type 8 (Candidate RP Advertisement)
- type 13.0 (PIM Packed Null-Register)
- type 13.1 (PIM Packed Register-Stop)
- Any future PIM message types where the destination is a unicast IP address

No other message types are supported by PIM Light; other message types **MUST NOT** be processed if received on a PLI.

3.2. Considerations for the Absence of Hello Message

Because Hello messages are not processed in a PIM Light domain, the considerations in the subsections below should be taken into account.

3.2.1. Join Attribute

Since a PLI does not use PIM Hello messages, it also does not support the Join Attribute option in PIM Hello as specified in [RFC5384]. As such, PIM Light is unaware of its neighbor's capability to process Join Attributes and **SHOULD NOT** send a Join message containing a Join Attribute.

There are two cases in which a PLI can support a Join Attribute:

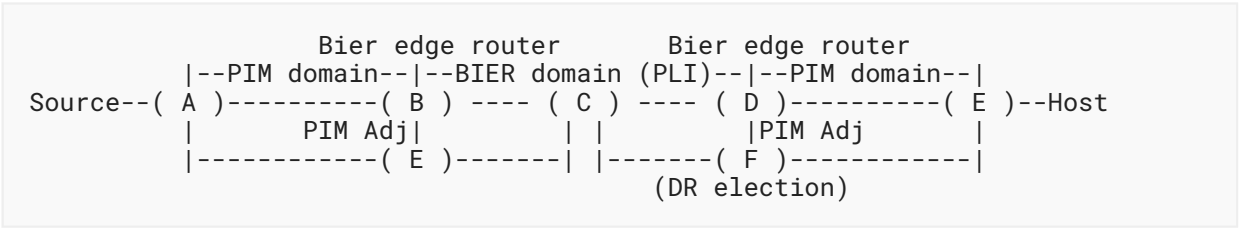
- The neighbors on the PLI are known via configuration to be capable of processing the attribute.
- Internet-Drafts and RFCs may dictate that certain Join Attributes are allowed to be used without explicit configuration of the PLI in certain scenarios. The details are left to those Internet-Drafts and RFCs.

3.2.2. DR Election

Due to the absence of Hello messages, DR election is not supported on a PIM Light router. The network design must ensure DR election occurs within the PIM domain, assuming the PIM Light domain interconnects PIM domains.

For instance, in a BIER domain connecting two PIM domains as in the figure below, a PLI can be used between BIER edge routers solely for multicast state communication and transmit only PIM Join/Prune messages. If there are redundant PIM routers at the edge of the BIER domain, they **MUST** establish PIM adjacency as per [RFC7761] to prevent multicast stream duplication and to ensure DR election at the edge of the BIER domain. For example, DR election could be between

router D and F in the figure below. When the Join or Prune message arrives from a PIM domain to the downstream BIER edge router, it can be forwarded over the BIER tunnel to the upstream BIER edge router only via the DR.



3.2.3. PIM Assert

In scenarios where multiple PIM routers peer over a shared LAN or a point-to-multipoint medium, more than one upstream router may have valid forwarding state for a packet, which can potentially cause packet duplication. PIM Assert is used to select a single transmitter when such duplication is detected. According to Section 4.6 of [RFC7761], PIM Assert should only be accepted from a known PIM neighbor.

In PIM Light implementations, care must be taken to avoid duplicate streams arriving from multiple upstream PIM Light routers to a single downstream PIM Light router. If network design constraints prevent this, the implemented network architecture must take measures to avoid traffic duplication. For example, in a scenario with PIM Light over a BIER domain, a downstream IBBR (Ingress BIER Border Router) in a BIER domain can identify the nearest EBBRs (Egress BIER Border Routers) to the source using the Shortest Path First (SPF) algorithm with post-processing as described in Appendix A.1 of [BIER-PIM]. If the downstream IBBR identifies two EBBRs, it can select one using a unique IP selection algorithm, such as choosing the EBBR with the lowest or highest IP address. If the selected EBBR goes offline, the downstream router can use the next EBBR based on the IP selection algorithm, which is beyond the scope of this document.

3.3. PLI Configuration

Since a PLI doesn't require PIM Hello Messages and PIM neighbor adjacency is not checked for arriving Join/Prune messages, there needs to be a mechanism to enable PLIs on interfaces. Join/Prune messages not received from a PIM neighbor **MUST** be dropped unless PLI is enabled on the interface. In some cases, a PLI may be enabled automatically via an underlying mechanism on a logical interface. For example, in a BIER domain, a logical interface can connect two or more BIER edge routers as per [BIER-PIM].

3.4. Failures in PLR Domain

Because Hello messages are not processed on the PLI, PLI failures may not be discovered in a PIM Light domain, and multicast routes will not be pruned toward the source on the PIM Light domain. This results in the upstream routers continuously sending multicast streams until the outgoing interface (OIF) expires.

Other protocols can be used to detect these failures in the PIM Light domain, and they can be implementation specific. As an example, the interface on which PIM Light is configured can be protected via Bidirectional Forwarding Detection (BFD) or similar technology. If BFD to the far-end PLI goes down and the PIM Light router is upstream and has an OIF for a multicast route (S,G), PIM must remove that PLI from its OIF list.

In another example, the PLI is configured automatically between the BIER Edge Routers (BERs) as in the figure below. When the Downstream BIER Edge Router (DBER) is no longer reachable on the Upstream BIER Edge Router (UBER), the UBER (which is also a PIM Light router) can prune the (S,G) advertised toward the source on the PIM domain to stop the transmission of the multicast stream.

3.5. Reliable Transport Mechanism for PIM Light

[RFC6559] defines a reliable transport mechanism called PIM Over Reliable Transport (PORT) for PIM transmission of Join/Prune messages, using either TCP or SCTP as the transport protocol. Both TCP and SCTP use destination port number 8471. SCTP is explained in [RFC9260] and is used as a second option for PORT. [RFC6559] mentions that when a router is configured to use PIM over TCP on a given interface, it **MUST** include the PIM-over-TCP-Capable Hello Option in its Hello messages for that interface. The same is true for SCTP; the router **MUST** include the PIM-over-SCTP-Capable Hello Option in its Hello messages on that interface.

These Hello options contain a Connection ID, which is an IPv4 or IPv6 address used to establish the SCTP or TCP connection. For PORT using TCP, the Connection ID is used to determine which peer is doing an active transport open to the neighbor and which peer is doing passive transport open, as per Section 4 of [RFC6559]. When the router is using SCTP, the Connection ID is not used to determine the active and passive peer since SCTP can handle call collision.

Because PIM Light lacks Hello messages, the PLI can be configured with the Connection ID (i.e., the IPv4 or IPv6 address used to establish the SCTP or TCP connection). For PIM Light using the TCP PORT option, each end of the PLI must be explicitly and correctly configured as being either active transport open or passive transport open to ensure that call collision is avoided.

3.6. PIM Variants Not Supported

The following PIM variants are not supported with PIM Light and not covered by this document:

- PIM - Dense Mode (PIM-DM) [RFC3973]
- Bidirectional PIM (BIDIR-PIM) [RFC5015]

4. IANA Considerations

This document has no IANA actions.

5. Security Considerations

Since PIM Light does not require PIM Hello messages and does not verify PIM neighbor adjacency for incoming Join/Prune messages, for security reasons, it is crucial that implementations ensure that only Join/Prune messages arriving at a configured PLI are processed. Any Join/Prune messages received on an interface that is not configured as a PLI **MUST** be discarded and not processed. Additionally, as a secondary line of defense, route policies **SHOULD** be implemented to process only the Join/Prune messages associated with the desired (S,G) pairs, while all other (S,G) pairs **MUST** be discarded and not processed.

Furthermore, because PIM Light can be used for signaling PIM-SM Join/Prune messages, the security considerations outlined in [RFC7761] and [RFC4607] **SHOULD** be considered where appropriate.

Per Section 6.1.1 of [RFC7761], only forged Join/Prune messages should be considered as a potential attack vector, as PIM Light does not process Hello or Assert messages. In addition, as detailed in Section 6.3 of [RFC7761], the authentication mechanisms described in [RFC5796] can be applied to PIM Light via IPsec Encapsulating Security Payload (ESP) or, optionally, the Authentication Header (AH).

6. References

6.1. Normative References

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Authors' Addresses

Hooman Bidgoli (EDITOR)
Nokia
March Road
Ottawa Ontario K2K 2T6
Canada
Email: hooman.bidgoli@nokia.com

Stig Venaas
Cisco Systems, Inc.
Tasman Drive
San Jose, CA 95134
United States of America
Email: stig@cisco.com

Mankamana Mishra
Cisco Systems, Inc.
Tasman Drive
San Jose, CA 95134
United States of America
Email: mankamis@cisco.com

Zhaohui Zhang
Juniper Networks
Boston, MA
United States of America
Email: zzhang@juniper.net

Mike McBride
Futurewei Technologies Inc.
Santa Clara, CA
United States of America
Email: michael.mcbride@futurewei.com