
Stream: Internet Engineering Task Force (IETF)
RFC: [9739](#)
Category: Standards Track
Published: February 2025
ISSN: 2070-1721
Authors:
H. Bidgoli, Ed. S. Venaas M. Mishra Z. Zhang
Nokia Cisco Systems, Inc. Cisco Systems, Inc. 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>.

Copyright Notice

Copyright (c) 2025 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions

with respect to this document. Code Components extracted from this document must include Revised BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Revised BSD License.

Table of Contents

1. Introduction	2
2. Terminology	3
3. PIM Light Interface	3
3.1. Message Types Supported by PIM Light	4
3.2. Considerations for the Absence of Hello Message	4
3.2.1. Join Attribute	4
3.2.2. DR Election	4
3.2.3. PIM Assert	5
3.3. PLI Configuration	5
3.4. Failures in PLR Domain	6
3.5. Reliable Transport Mechanism for PIM Light	6
3.6. PIM Variants Not Supported	7
4. IANA Considerations	7
5. Security Considerations	7
6. References	7
6.1. Normative References	7
6.2. Informative References	8
Acknowledgments	9
Authors' Addresses	9

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 neighborhood between routers or, alternatively, where full PIM neighborhood is not desired. These types of

networks and media are called "PIM Light domains" within this document. Lack of full PIM neighborhood 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 adjacent Layer 3 routers without forming a PIM neighborhood. 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. For example, in 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 a single DR to forward the PIM Join message from reviver 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) (Note that this type is from the ALL-PIM-ROUTERS message types listed in [[RFC7761](#)].)
- type 8 (Candidate RP Advertisement)
- type 13 (PIM Packed Null-Register)
- type 13.1 (PIM Packed Register-Stop)
- Any future PIM message types that use unicast destination IP

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

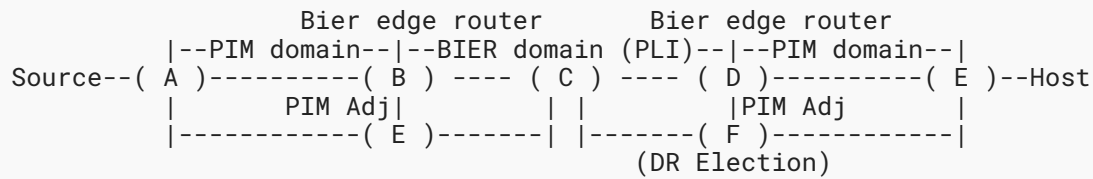
Since a PLI does not process PIM Hello messages, it also does not support the join attribute option in PIM Hello as specified in [[RFC5384](#)]. As such, PIM Light is unaware of its neighbor's capability to process join attributes, and it **SHOULD NOT** process a Join message containing it.

There are two cases in which a PLI can send and process a join attribute:

- The join attribute must be configured with an appropriate join attribute type that the PLI is capable of processing as per the "PIM Join Attribute Types" registry [[IANA-PIM-Attr-Types](#)].
- 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 networks, 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, to prevent multicast stream duplication, they **MUST** establish PIM adjacency as per [RFC7761] to ensure DR election at the edge of BIER domain. An example DR election could be DR election between router D and F in the figure above. 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. If a router supports PIM Light, arriving Join/Prune messages **MUST** be processed only when a PLI is enabled on an interface; otherwise, they **MUST** be dropped. A PLI may be enabled automatically or via an underlying mechanism on some logical interfaces (for example, the logical interface connecting two or more BIER edge routers in a BIER subdomain [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.

```

                                UBER                                DBER
                                |--PIM domain--|--BIER domain (PLI)--|--PIM domain--|
Source--( A )----- ( B ) ---- ( C ) ---- ( D )----- ( E )--Host
                                <--Prune <S,G>                                <failure on D>

```

In another example, the PLI is configured automatically between the BIER Edge Routers (BERs). 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 for PIM transmission of Join/Prune messages, using either TCP or SCTP as the transport protocol. For TCP, PIM Over Reliable Transport (PORT) uses port 8471, which was assigned by IANA. 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 message 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 IP address comparison need not be done since SCTP can handle call collision.

Because PIM Light lacks Hello messages, the PLI can be configured with the Connection ID IPv4 or IPv6 addresses 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 Source-Specific and Sparse Mode 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

- [IANA-PIM-Attr-Types] IANA, "PIM Join Attribute Types", <<https://www.iana.org/assignments/pim-parameters>>.
- [IANA-PIM-Mess-Types] IANA, "PIM Message Types", <<https://www.iana.org/assignments/pim-parameters>>.
- [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>>.

- [RFC4607] Holbrook, H. and B. Cain, "Source-Specific Multicast for IP", RFC 4607, DOI 10.17487/RFC4607, August 2006, <<https://www.rfc-editor.org/info/rfc4607>>.
- [RFC5015] Handley, M., Kouvelas, I., Speakman, T., and L. Vicisano, "Bidirectional Protocol Independent Multicast (BIDIR-PIM)", RFC 5015, DOI 10.17487/RFC5015, October 2007, <<https://www.rfc-editor.org/info/rfc5015>>.
- [RFC5384] Boers, A., Wijnands, I., and E. Rosen, "The Protocol Independent Multicast (PIM) Join Attribute Format", RFC 5384, DOI 10.17487/RFC5384, November 2008, <<https://www.rfc-editor.org/info/rfc5384>>.
- [RFC5796] Atwood, W., Islam, S., and M. Siami, "Authentication and Confidentiality in Protocol Independent Multicast Sparse Mode (PIM-SM) Link-Local Messages", RFC 5796, DOI 10.17487/RFC5796, March 2010, <<https://www.rfc-editor.org/info/rfc5796>>.
- [RFC6559] Farinacci, D., Wijnands, IJ., Venaas, S., and M. Napierala, "A Reliable Transport Mechanism for PIM", RFC 6559, DOI 10.17487/RFC6559, March 2012, <<https://www.rfc-editor.org/info/rfc6559>>.
- [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>>.
- [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>>.
- [RFC8279] Wijnands, IJ., Ed., Rosen, E., Ed., Dolganow, A., Przygienda, T., and S. Aldrin, "Multicast Using Bit Index Explicit Replication (BIER)", RFC 8279, DOI 10.17487/RFC8279, November 2017, <<https://www.rfc-editor.org/info/rfc8279>>.
- [RFC9260] Stewart, R., Tüxen, M., and K. Nielsen, "Stream Control Transmission Protocol", RFC 9260, DOI 10.17487/RFC9260, June 2022, <<https://www.rfc-editor.org/info/rfc9260>>.

6.2. Informative References

- [BIER-PIM] Bidgoli, H., Ed., Xu, F., Kotalwar, J., Wijnands, I., Mishra, M., and Z. Zhang, "PIM Signaling Through BIER Core", Work in Progress, Internet-Draft, draft-ietf-bier-pim-signaling-12, 25 July 2021, <<https://datatracker.ietf.org/doc/html/draft-ietf-bier-pim-signaling-12>>.
- [RFC3973] Adams, A., Nicholas, J., and W. Siadak, "Protocol Independent Multicast - Dense Mode (PIM-DM): Protocol Specification (Revised)", RFC 3973, DOI 10.17487/RFC3973, January 2005, <<https://www.rfc-editor.org/info/rfc3973>>.

Acknowledgments

The authors would like to thank Zheng (Sandy) Zhang and Tanmoy Kundu for their suggestions and contributions to this document.

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.com

Mike McBride

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