            IPv6 Multicast VPN (MVPN) Support Using PIM Control Plane
           and Selective Provider Multicast Service Interface (S-PMSI)
                               Join Messages

Abstract

   The specification for Multicast Virtual Private Networks (MVPNs)
   contains an option that allows the use of PIM as the control protocol
   between provider edge routers. It also contains an option that
   allows UDP-based messages, known as Selective Provider Multicast
   Service Interface (S-PMSI) Join messages, to be used to bind
   particular customer multicast flows to particular tunnels through a
   service provider's network. This document extends the MVPN
   specification (RFC 6513) so that these options can be used when the
   customer multicast flows are IPv6 flows.

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 5741.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc6516.

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1. Introduction

   The Multicast Virtual Private Network (MVPN) specification [RFC6513]
   defines the notion of a "PMSI" (Provider Multicast Service Interface)
   and specifies how a PMSI can be instantiated by various kinds of
   tunnels through a service provider's network ("P-tunnels"). It also
   specifies the procedures for using PIM (Protocol Independent
   Multicast [RFC4601]) as the control protocol between Provider Edge
   (PE) routers. When PIM is used as the control protocol, PIM messages
   are sent through a P-tunnel from one PE in an MVPN to others in the
   same MVPN. These PIM messages carry customer multicast routing
   information. However, [RFC6513] does not cover the case where the
   customer is using IPv6, but the service provider is using P-tunnels
   created by PIM over an IPv4 infrastructure.

   The MVPN specification [RFC6513] also specifies "S-PMSI (Selective
   PMSI) Join" messages, which are optionally used to bind particular
   customer multicast flows to particular P-tunnels. However, the
   specification does not cover the case where the customer flows are
   IPv6 flows.

   This document extends [RFC6513] by adding the specification for
   handling customer IPv6 multicast flows when a service provider is
   using PE-PE PIM and/or S-PMSI Join messages over an IPv4
   infrastructure. This document also specifies how to send multiple
   S-PMSI Join messages in a single UDP datagram.

   This document uses terminology defined in [RFC6513]: C-source,
   C-group, C-flow, P-group, and (C-S,C-G).
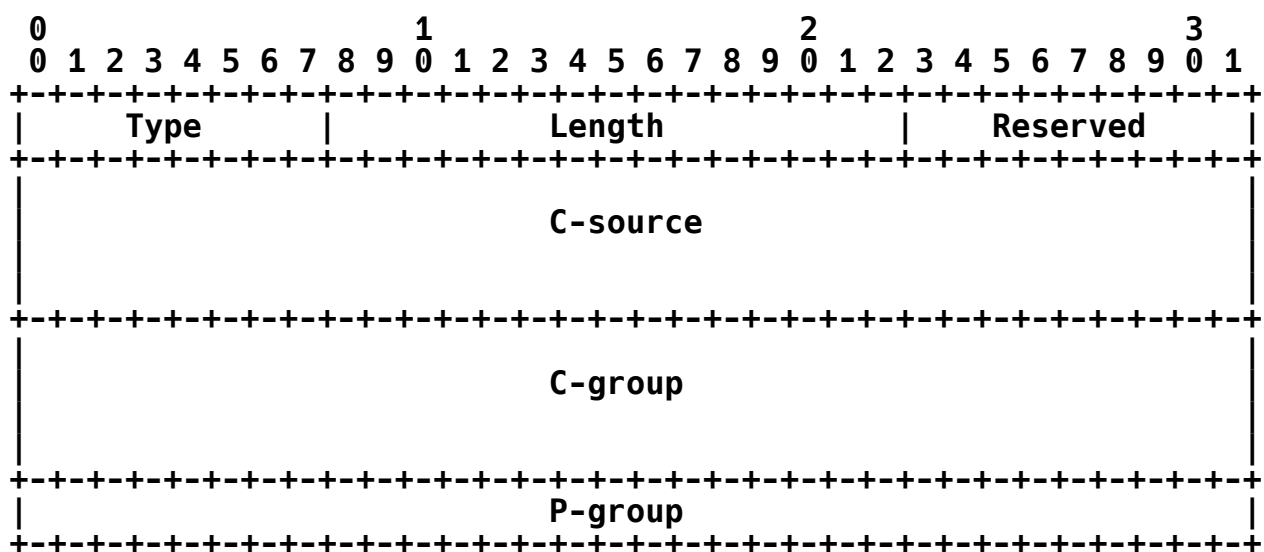
2. Specification of Requirements

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in [RFC2119].

3. S-PMSI Joins Binding IPv6 Flows to GRE/IPv4 P-Tunnels

   The S-PMSI Join message is defined in Section 7.4.2.2 of [RFC6513].
   These messages contain a type field, and [RFC6513] defines only Type
   1 S-PMSI Joins. A Type 1 S-PMSI Join may be used to assign a
   customer IPv4 (C-S,C-G) flow to a P-tunnel that is created by
   PIM/IPv4. To transmit data or control packets over such a P-tunnel,
   the packets are encapsulated in GRE (Generic Routing Encapsulation)
   within IPv4, as specified in Section 12 of [RFC6513].

   In this document, we define the Type 4 S-PMSI Join. A Type 4 S-PMSI
   Join may be used to assign a customer IPv6 (C-S,C-G) flow to a
   P-tunnel that is created by PIM/IPv4. GRE/IPv4 encapsulation is used
   to send data or control packets on the P-tunnel.

3.1. Encoding

```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |     Type      |             Length            |   Reserved    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                                                               |
    |                          C-source                             |
    |                                                               |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                                                               |
    |                          C-group                              |
    |                                                               |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                          P-group                              |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   Type (8 bits): 4

   Length (16 bits): 40, the length in octets of the entire S-PMSI Join
   message, including the Type, Length, Reserved, C-source, C-group, and
   P-group fields.

Reserved (8 bits): this field SHOULD be zero when transmitted and
MUST be ignored when received.

C-source (128 bits): the IPv6 address of the traffic source in the
VPN.

C-group (128 bits): the IPv6 group address of the multicast traffic.

P-group (32 bits): the IPv4 group address identifying the P-tunnel.
Data packets sent on this tunnel are encapsulated in IPv4 GRE packets
with this group address in the IP destination address field of the
outer header.

3.2. Encapsulation of S-PMSI Joins in UDP Datagrams

All S-PMSI Joins are encapsulated in UDP datagrams [RFC768]. A Type
4 S-PMSI Join MUST be encapsulated in an IPv6 UDP datagram. The IPv6
source address field of these datagrams SHOULD be the IPv4-mapped
IPv6 address [RFC4291] corresponding to the IPv4 address that the
originating PE router uses as its source address in the instance of
PIM that is used to create the specified P-tunnel.

A single UDP datagram MAY carry multiple S-PMSI Join messages, as
many as can fit entirely within it. If there are multiple S-PMSI
Joins in a UDP datagram, they MUST be of the same S-PMSI Join type.
The end of the last S-PMSI Join (as determined by the S-PMSI Join
length field) MUST coincide with the end of the UDP datagram, as
determined by the UDP length field. When processing a received UDP
datagram that contains one or more S-PMSI Joins, a router MUST
process all the S-PMSI Joins that fit into the datagram.

4. PE-PE PIM/IPv6 over an IPv4 P-Tunnel

If a VPN customer is using PIM over IPv6, but the SP (service
provider) is using an IPv4 infrastructure (i.e., is using an
IPv4-based control protocol to construct its P-tunnels), then the PE
routers will need to originate IPv6 PIM control messages. The IPv6
Source Address field of any such IPv6 PIM control message SHOULD be
the IPv4-mapped IPv6 address [RFC4291] corresponding to the IPv4
address that the originating PE router uses as its source address in
the instance of PIM that is used to create the specified P-tunnel.
If the IPv6 Destination Address field is the multicast address ALL-
PIM-ROUTERS, the IPv6 form of the address (ff02::d) is used. These
IPv6 PIM control messages are, of course, not transmitted natively
over the service provider's network but rather are encapsulated in
GRE/IPv4.

5. IANA Considerations

[RFC6513] created an IANA registry for the "S-PMSI Join Message Type Field". This document registers a new value in that registry:

     Value: 4
     Description: GRE S-PMSI for IPv6 traffic (unaggregated)

6. Security Considerations

There are no additional security considerations beyond those of [RFC6513].

7. Acknowledgments

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8. Normative References

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[RFC4291] Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, February 2006.

[RFC4601] Fenner, B., Handley, M., Holbrook, H., and I. Kouvelas, "Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)", RFC 4601, August 2006.

[RFC6513] Rosen, E., Ed., and R. Aggarwal, Ed., "Multicast in MPLS/BGP IP VPNs", RFC 6513, February 2012.

Authors' Addresses

    Yiqun Cai
    Cisco Systems, Inc.
    170 Tasman Drive
    San Jose, CA 95134
    EMail: ycai@cisco.com

    Eric C. Rosen (editor)
    Cisco Systems, Inc.
    1414 Massachusetts Avenue
    Boxborough, MA 01719
    EMail: erosen@cisco.com

    IJsbrand Wijnands
    Cisco Systems, Inc.
    De kleetlaan 6a Diegem 1831
    Belgium
    EMail: ice@cisco.com