                           PIM Join Attributes
            for Locator/ID Separation Protocol (LISP) Environments

Abstract

   This document defines two PIM Join/Prune attributes that support the
   construction of multicast distribution trees where the root and
   receivers are located in different Locator/ID Separation Protocol
   (LISP) sites. These attributes allow the receiver site to select
   between unicast and multicast underlying transport and to convey the
   RLOC (Routing Locator) address of the receiver ETR (Egress Tunnel
   Router) to the control plane of the root ITR (Ingress Tunnel Router).

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1. Introduction

   The construction of multicast distribution trees where the root and
   receivers are located in different LISP sites [RFC6830] is defined in
   [RFC6831]. Creation of (root-EID,G) state in the root site requires
   that unicast LISP-encapsulated Join/Prune messages be sent from an
   ETR on the receiver site to an ITR on the root site. The term "EID"
   is short for "Endpoint ID".

   [RFC6831] specifies that (root-EID,G) data packets are to be LISP-
   encapsulated into (root-RLOC,G) multicast packets. However, a wide
   deployment of multicast connectivity between LISP sites is unlikely
   to happen any time soon. In fact, some implementations are initially
   focusing on unicast transport with head-end replication between root
   and receiver sites.

The unicast LISP-encapsulated Join/Prune message specifies the
(root-EID,G) state that needs to be established in the root site, but
conveys nothing about the receiver's capability or desire to use
multicast as the underlying transport. This document specifies a
Join/Prune attribute that allows the receiver ETR to select the
desired transport.

The term "transport" in this document is intentionally somewhat
vague. Currently, it is used just to indicate whether multicast or
head-end replication is used; this means that the outer destination
address is either a unicast or multicast address. Future documents
may specify how other types of delivery, encapsulation, or underlay
are used.

Knowledge of the receiver ETR's RLOC address is essential to the
control plane of the root ITR. The RLOC address determines the
downstream destination for unicast head-end replication and
identifies the receiver ETR that needs to be notified should the root
ITR of the distribution tree move to another site. The root ITR can
change when the source EID is roaming to another LISP site.

Service providers may implement unicast reverse path forwarding
(uRPF) policies requiring that the outer source address of the LISP-
encapsulated Join/Prune message be the address of the receiver ETR's
core-facing interface used to physically transmit the message.
However, due to policy and load-balancing considerations, the outer
source address may not be the RLOC on which the receiver site wishes
to receive a particular flow. This document specifies a Join/Prune
attribute that conveys the appropriate receiver ETR's RLOC address to
the control plane of the root ITR.

This document uses terminology defined in [RFC6830], such as EID,
RLOC, ITR, and ETR.

2. Requirements Notation

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. PIM Join/Prune Attributes

PIM Join/Prune attributes are defined in [RFC5384] by introducing a
new Encoded-Source type that, in addition to the Join/Prune source,
can carry multiple Type-Length-Value (TLV) attributes. These
attributes apply to the individual Join/Prune sources on which they
are stored.

The attributes defined in this document conform to the format of the
encoding type defined in [RFC5384]. The attributes would typically
be the same for all the sources in the Join/Prune message. Hence, we
RECOMMEND using the hierarchical Join/Prune attribute scheme defined
in [RFC7887]. This hierarchical system allows attributes to be
conveyed in the Upstream Neighbor Address field, thus enabling the
efficient application of a single attribute instance to all the
sources in the Join/Prune message.

LISP Tunnel Routers (xTRs) do not exchange PIM Hello Messages, and
hence no Hello option is defined to negotiate support for these
attributes. Systems that support unicast head-end replication are
assumed to support these attributes.

4. The Transport Attribute

It is essential that a mechanism be provided by which the desired
transport can be conveyed by receiver sites. Root sites with
multicast connectivity will want to leverage multicast replication.
However, not all receiver sites can be expected to have multicast
connectivity. It is thus desirable that root sites be prepared to
support (root-EID,G) state with a mixture of multicast and unicast
output state. This document specifies a Join/Prune attribute that
allows the receiver to select the desired underlying transport.

4.1. Transport Attribute Format

```
    0                   1                   2
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |F|E|  Type = 5 | Length = 1    |  Transport    |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

F bit: The Transitive bit. Specifies whether the attribute is
   transitive or non-transitive. MUST be set to zero. This
   attribute is ALWAYS non-transitive.

E bit: End-of-Attributes bit. Specifies whether this attribute is
   the last. Set to zero if there are more attributes. Set to 1 if
   this is the last attribute.

Type: The Transport Attribute type is 5.

Length: The length of the Transport Attribute value. MUST be set
   to 1.

   Transport: The type of transport being requested. Set to zero for
      multicast. Set to 1 for unicast. The values from 2 to 255 may be
      assigned in the future.

4.2. Using the Transport Attribute

   Hierarchical Join/Prune attribute instances [RFC7887] SHOULD be used
   when the same Transport Attribute is to be applied to all the sources
   within the Join/Prune message or all the sources within a group set.
   The root ITR MUST accept Transport Attributes in the Upstream
   Neighbor Encoded-Unicast address, Encoded-Group addresses, and
   Encoded-Source addresses.

   There MUST NOT be more than one Transport Attribute within the same
   encoded address. If an encoded address has more than one instance of
   the attribute, the root ITR MUST discard all affected Join/Prune
   sources. The root ITR MUST also discard all affected Join/Prune
   sources if the Transport Attribute value is unknown.

5. Receiver ETR RLOC Attribute

   When a receiver ETR requests unicast head-end replication for a given
   (root-EID,G) entry, the PIM control plane of the root ITR must
   maintain an outgoing interface list ("oif-list") entry for the
   receiver ETR and its corresponding RLOC address. This allows the
   root ITR to perform unicast LISP-encapsulation of multicast data
   packets to each and every receiver ETR that has requested unicast
   head-end replication.

   The PIM control plane of the root ITR could potentially determine the
   RLOC address of the receiver ETR from the outer source address field
   of the LISP-encapsulated Join/Prune message. However, receiver ETRs
   are subject to uRPF checks by the network providers on each core-
   facing interface. The outer source address must therefore be the
   RLOC of the core-facing interface used to physically transmit the
   LISP-encapsulated Join/Prune message. Due to policy and load-
   balancing considerations, that may not be the RLOC on which the
   receiver site wishes to receive a particular flow. This document
   specifies a Join/Prune attribute that conveys the appropriate
   receiver RLOC address to the PIM control plane of the root ITR.

   To support root-EID mobility, receiver ETRs must also be tracked by
   the LISP control plane of the root ITR, regardless of the underlying
   transport. When the root-EID moves to a new root ITR in a different
   LISP site, the receiver ETRs do not know the root-EID has moved and
   therefore do not know the RLOC of the new root ITR. This is true for
   both unicast and multicast transport modes. The new root ITR does
   not have any receiver ETR state. Therefore, it is the responsibility

of the old root ITR to inform the receiver ETRs that the root-EID has
moved. When the old root ITR detects that the root-EID has moved, it
sends a LISP Solicit-Map-Request (SMR) message to each receiver ETR.
The receiver ETRs do a mapping database lookup to retrieve the RLOC
of the new root ITR. The old root ITR detects that the root-EID has
moved when it receives a Map-Notify from the Map-Server. The
transmission of the Map-Notify is triggered when the new root ITR
registers the root-EID [EID-MOBILITY]. When a receiver ETR
determines that the root ITR has changed, it will send a LISP-
encapsulated PIM prune message to the old root xTR and a LISP-
encapsulated PIM join message to the new root xTR.

5.1. Receiver RLOC Attribute Format

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |F|E|  Type = 6 |    Length     |  Addr Family  |  Receiver RLOC
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-...
```

   F bit: The Transitive bit. Specifies whether this attribute is
      transitive or non-transitive. MUST be set to zero. This
      attribute is ALWAYS non-transitive.

   E bit: End-of-Attributes bit. Specifies whether this attribute is
      the last. Set to zero if there are more attributes. Set to 1 if
      this is the last attribute.

   Type: The Receiver RLOC Attribute type is 6.

   Length: The length in octets of the attribute value. MUST be set
      to the length in octets of the receiver RLOC address plus 1 octet
      to account for the Address Family field.

   Addr Family: The PIM Address Family of the receiver RLOC as defined
      in [RFC7761].

   Receiver RLOC: The RLOC address on which the receiver ETR wishes to
      receiver the unicast-encapsulated flow.

5.2. Using the Receiver RLOC Attribute

   Hierarchical Join/Prune attribute instances [RFC7887] SHOULD be used
   when the same Receiver RLOC Attribute is to be applied to all the
   sources within the message or all the sources within a group set.
   The root ITR MUST accept Transport Attributes in the Upstream
   Neighbor Encoded-Unicast address, Encoded-Group addresses, and
   Encoded-Source addresses.

There MUST NOT be more than one Receiver RLOC Attribute within the
same encoded address. If an encoded address has more than one
instance of the attribute, the root ITR MUST discard all affected
Join/Prune sources. The root ITR MUST also discard all affected
Join/Prune sources if the address family is unknown or the address
length is incorrect for the specified address family.

6. Security Considerations

Security of Join/Prune attributes is only guaranteed by the security
of the PIM packet. The attributes specified herein do not enhance or
diminish the privacy or authenticity of a Join/Prune message. A site
that legitimately or maliciously sends and delivers a Join/Prune
message to another site will equally be able to append these and any
other attributes it wishes. See [RFC5384] for general security
considerations for Join/Prune attributes.

7. IANA Considerations

Two new PIM Join/Prune attribute types have been assigned: value 5
for the Transport Attribute and value 6 for the Receiver RLOC
Attribute.

The "PIM Join/Prune Transport Types" registry has been created for
the Join/Prune Transport attribute. The registration policy is IETF
Review [RFC5226], and the values are in the range 0-255. This
document assigns value 0 for multicast and value 1 for unicast.

8. References

8.1. Normative References

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