                       Hierarchical Join/Prune Attributes

Abstract

   This document defines a hierarchical method of encoding Join/Prune
   attributes that provides a more efficient encoding when the same
   attribute values need to be specified for multiple sources in a PIM
   Join/Prune message. This document updates RFC 5384 by renaming the
   encoding type registry specified there.

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
   http://www.rfc-editor.org/info/rfc7887.

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1. Introduction

   PIM Join attributes as defined in [RFC5384] allow for specifying a
   set of attributes for each of the joined or pruned sources in a PIM
   Join/Prune message. Attributes must be separately specified for each
   individual source in the message. However, in some cases, the same
   attributes and values need to be specified for some, or even all, the
   sources in the message. The attributes and their values then need to
   be repeated for each of the sources where they apply.

   This document provides a hierarchical way of encoding attributes and
   their values in a Join/Prune message so that if the same attribute
   and value is to apply for all the sources, it only needs to be
   specified once in the message. Similarly, if all the sources in a
   specific group set share a specific attribute and value, it only
   needs to be specified once for the entire group set.

   This document extends [RFC5384] by specifying that the encoding type
   defined there also applies to Encoded-Unicast and Encoded-Group
   formats. This document also updates [RFC5384] by renaming the "PIM
   Encoded-Source Address Encoding Type Field" registry to "PIM Address
   Encoding Types". The content of the registry remains the same. The
   encoding type used for Join attributes is, however, still limited to
   use in Join/Prune messages. Note that Join attributes, as they are
   referred to in [RFC5384], also apply to pruned sources in a Join/
   Prune message. Thus, the more correct name "Join/Prune attributes"
   will be used throughout the rest of this document.

   This document allows Join/Prune attributes to be specified in the
   Upstream Neighbor Address field, and also in the Multicast Group
   Address field, of a Join/Prune message. It defines how this is used
   to specify the same Join/Prune attribute and value for multiple
   sources. This document also defines a new Hello Option to indicate
   support for the hierarchical encoding specified.

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. Hierarchical Join/Prune Attribute Definition

   The format of a PIM Join/Prune message is defined in [RFC7761] as
   follows:

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |PIM Ver| Type  |   Reserved    |            Checksum           |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |          Upstream Neighbor Address (Encoded-Unicast format)   |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    Reserved     |  Num groups   |            Holdtime          |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |         Multicast Group Address 1 (Encoded-Group format)      |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Number of Joined Sources    |   Number of Pruned Sources    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Joined Source Address 1 (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               .                               |
    |                               .                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Joined Source Address n (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Pruned Source Address 1 (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               .                               |
    |                               .                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Pruned Source Address n (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               .                               |
    |                               .                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |         Multicast Group Address m (Encoded-Group format)      |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |   Number of Joined Sources    |   Number of Pruned Sources    |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Joined Source Address 1 (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               .                               |
    |                               .                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Joined Source Address n (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Pruned Source Address 1 (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                               .                               |
    |                               .                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |        Pruned Source Address n (Encoded-Source format)        |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The message contains a single Upstream Neighbor Address and one or
more group sets. Each group set contains a Group Address and two
source lists: the Joined Sources and the Pruned Sources. The
Upstream Neighbor Address, the group addresses, and the source
addresses are encoded in Encoded-Unicast format, Encoded-Group
format, and Encoded-Source format, respectively. This document
extends the use of the source address encoding defined in [RFC5384]
to also apply to the Upstream Neighbor Address and the Group Address
fields (see Section 4).

For a Join/Prune message, a hierarchy of Join/Prune attributes is
defined. Attributes at the highest level, which is the least
specific, apply to every source in the message. These are encoded in
the Upstream Neighbor Address. Attributes at the next, more-specific
level apply to every source in a group set. They are encoded in a
Group Address. And finally, there are attributes that apply to a
single source and are encoded in the source address as defined in
[RFC5384].

The complete set of attributes that apply to a given source is
obtained by combining the message-wide attributes, the attributes of
the group set that the source belongs to, and the source-specific
attributes. However, if the same attribute is specified at multiple
levels, then the one at the most specific level overrides the other
instances of the attribute. Note that the set of attributes and
their values is formed before processing the attributes. Hence, a
value that is invalid for a given type might override a valid value
at a higher level.

As an example, say that for a given source, we have attributes T_1
with value V_1, T_2 with value V_2, and T_3 with value V_3. Also
assume that in the Group Address of the source's group set, we have
attributes T_1 with value V_6 and T_4 with value V_4. And assume
that we in the Upstream Neighbor Address have encoded the attributes
T_1 with value V_7, T_4 with value V_8, and T_5 with value V_5. The
attributes applied to the given source will be T_1 with value V_1,
T_2 with value V_2, T_3 with value V_3, T_4 with value V_4, and T_5
with value V_5. Here we have T_1 with different values at each
level, so we use the value specified at the source level. Also, we
have T_4 with different values at the group and message levels, so we
use the value at the group level. Here it could be that V_1 is not a
valid value for T_1, but it still overrides the values at the higher
levels as we do not process the attributes until after forming the
set.

Note that Join/Prune attributes are still applied to sources as
specified in [RFC5384]. This document does not change the meaning of
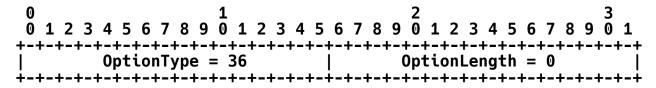any attributes; it is simply a more compact way of encoding an

attribute when the same attribute and value applies to multiple
sources, e.g., with the example above, we would have the exact same
meaning if we instead had encoded all the attributes T1, ..., T5 with
the respective values V1, ..., V5 in the source address.

4. PIM Address Encoding Types

   Addresses in PIM messages are specified together with an address
   family and an encoding type. This applies to Encoded-Unicast,
   Encoded-Group, and Encoded-Source addresses. The encoding types
   allow the address to be encoded according to different schemes. An
   encoding type indicates how an address is encoded irrespective of
   address type, Encoded-Unicast, Encoded-Group, or Encoded-Source. It
   is possible that there will be future encoding types that do not
   apply to all address types though. This means that as currently
   defined, 0 is native encoding [RFC7761], and 1 is Join/Prune
   attributes encoding [RFC5384]. Note that as specified in [RFC5384],
   a type 1 Encoded Address MUST contain at least one Join/Prune
   attribute.

5. Hierarchical Join/Prune Attribute Hello Option

   A PIM router indicates that it supports the mechanism specified in
   this document by including the Hierarchical Join/Prune Attribute
   Hello Option in its PIM Hello message. When this new Hello Option is
   included, it MUST also include the Join Attribute Hello Option as
   specified in [RFC5384]. The format of the Hierarchical Join/Prune
   Attribute Hello Option is defined to be:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          OptionType = 36       |          OptionLength = 0     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   OptionType = 36, OptionLength = 0. Note that there is no option
   value included.

   A PIM router MUST NOT send a Join/Prune message with Join/Prune
   attributes encoded in the Upstream Neighbor Address or any of the
   group addresses out of any interface on which there is a PIM neighbor
   that has not included this option in its Hellos. Even a router that
   is not the upstream neighbor must be able to parse the message in
   order to perform Join suppression and Prune override.

6. Security Considerations

   This document specifies a more compact encoding of Join/Prune
   attributes. Use of the encoding has no impact on security aside from
   using the encoding in [RFC5384]. For instance, an attack with a
   forged message with certain attribute values is equally difficult
   independent of which encoding is used. If an attribute that applies
   to the entire message is wrong, then that may cause an issue for all
   the sources in the message. But without this encoding, one would
   instead include that attribute for every single source, and that
   would also cause an issue for all the sources in the message.

7. IANA Considerations

   IANA has renamed the "PIM Encoded-Source Address Encoding Type Field"
   registry to "PIM Address Encoding Types".

   The Hierarchical Join/Prune Attribute (36) has been added to the
   "PIM-Hello Options" registry.

8. Normative References

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
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   [RFC5384] Boers, A., Wijnands, I., and E. Rosen, "The Protocol
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              RFC 5384, DOI 10.17487/RFC5384, November 2008,
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   [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
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