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                    BGP Extended Communities Attribute

                 draft-ietf-idr-bgp-ext-communities-06.txt

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2. Abstract

   This document describes an extension to BGP-4 which may be used to
   provide flexible control over the distribution of routing
   information.

[3](3). 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 [RFC 2119](RFC 2119) [[RFC2119](RFC2119)].

[4](4). Introduction

The Extended Community Attribute provides two important enhancements
over the existing BGP Community Attribute:

  - It provides an extended range, ensuring that communities can be
    assigned for a plethora of uses, without fear of overlap.

  - The addition of a Type field provides structure for the
    community space.

The addition of structure allows the usage of policy based on the
application for which the community value will be used. For example,
one can filter out all communities of a particular type, or allow
only certain values for a particular type of community. It also
allows one to specify whether a particular community is transitive or
non-transitive across Autonomous system boundary. Without structure,
this can only be accomplished by explicitly enumerating all community
values which will be denied or allowed and passed to BGP speakers in
neighboring ASes based on the transitive property.

[5](5). BGP Extended Communities Attribute

The Extended Communities Attribute is a transitive optional BGP
attribute, with the Type Code 16. The attribute consists of a set of
"extended communities". All routes with the Extended Communities
attribute belong to the communities listed in the attribute.

Each Extended Community is encoded as an eight octet quantity, as
follows:

  - Type Field : 1 or 2 octets
  - Value Field : Remaining octets

```
    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 high    | Type low(*)  |                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+            Value              |
   |                                                             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

*) Present for Extended types only, used for the Value field
   otherwise

Type Field:

   Two classes of Type Field are introduced: Regular type and
   Extended type.

   The size of Type Field for Regular types is 1 octet and the
   size of the Type Field for Extended types is 2 octets.

   The value of the high-order octet of the Type Field determines
   if an extended community is a Regular type or an Extended type.

   The high-order octet of the Type Field is as shown below:


```
     0 1 2 3 4 5 6 7
    +-+-+-+-+-+-+-+-+
    |I|T|         |
    +-+-+-+-+-+-+-+-+
```


   I - IANA authority bit

      Value 0: IANA assignable type using the "First Come First
      Serve" policy

      Value 1: IANA assignable type using the IETF Consensus
      policy and experimental

   T - Transitive bit

      Value 0: The community is transitive across ASes

      Value 1: The community is non-transitive across ASes

   Remaining 6 bits: Indicates the structure of the community

    Value Field:

        The encoding of the Value Field is dependent on the "type" of
        the community as specified by the Type Field.

   Two extended communities are declared equal only when all 8 octets of
   their encoding are equal.

   The two members in the tuple <Type, Value> should be enumerated to
   specify any community value. Based on the value of the Type field,
   the remaining octets of the community should be interpreted.

6. Defined BGP Extended Community Types

   This section introduces a few extended types and defines the format
   of the Value Field for those types. The types introduced here provide
   "templates", where each template is identified by the high order
   octet of the extended community Type field, and the lower order octet
   (sub-type) is used to indicate a particular type of extended commu-
   nity.

6.1. Two-octet AS specific extended community

   This is an extended type with Type Field comprising of 2 octets and
   Value Field comprising of 6 octets.

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | 0x00 or 0x40  |   Sub-Type    |     Global Administrator      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                      Local Administrator                      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The value of the high-order octet of this extended type is either
   0x00 or 0x40. The low-order octet of this extended type is used to
   indicate sub-types.

   The Value Field consists of two sub-fields:

     Global Administrator sub-field: 2 octets
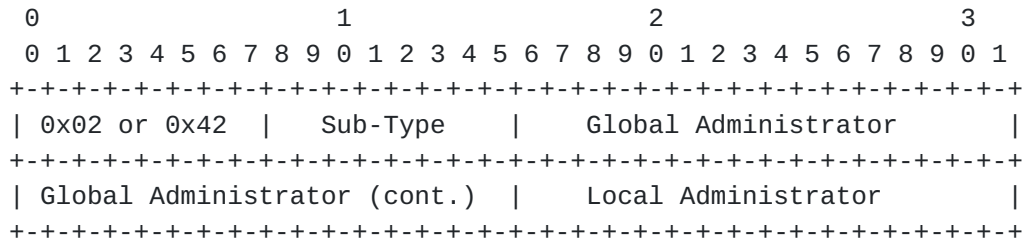
        This sub-field contains an Autonomous System number assigned by
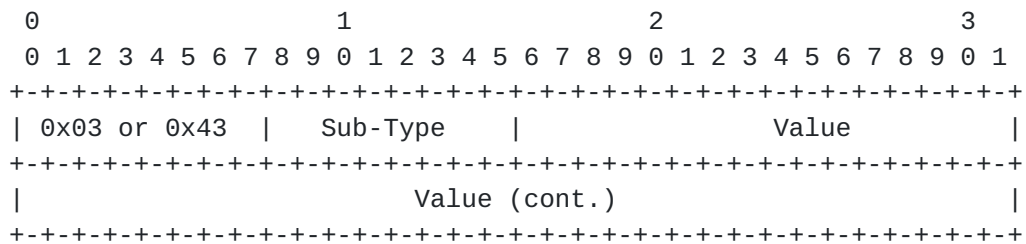   IANA.

   Local Administrator sub-field: 4 octets

      The organization identified by Autonomous System number in the
      Global Administrator sub-field, can encode any information in
      this sub-field. The format and meaning of the value encoded in
      this sub-field should be defined by the sub-type of the commu-
      nity.

6.2. IPv4 address specific extended community

   This is an extended type with Type Field comprising of 2 octets and
   Value Field comprising of 6 octets.

```
    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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | 0x01 or 0x41  |   Sub-Type    |     Global Administrator      |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Global Administrator (cont.)  |     Local Administrator       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```


   The value of the high-order octet of this extended type is either
   0x01 or 0x41. The low-order octet of this extended type is used to
   indicate sub-types.

   The Value field consists of two sub-fields:

      Global Administrator sub-field: 4 octets

         This sub-field contains an IPv4 address assigned by IANA.

      Local Administrator sub-field: 2 octets

         The organization which has been assigned the IPv4 address in
         the Global Administrator sub-field, can encode any information
         in this sub-field. The format and meaning of this value
         encoded in this sub-field should be defined by the sub-type of
         the community.

6.3. Four-octet AS specific extended community

   This is an extended type with Type Field comprising of 2 octets and
   Value Field comprising of 6 octets.


```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | 0x02 or 0x42 |   Sub-Type    |      Global Administrator      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | Global Administrator (cont.) |     Local Administrator        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```


   The value of the high-order octet of this extended type is either
   0x02 or 0x42. The low-order octet of this extended type is used to
   indicate sub-types.

   The Value Field consists of two sub-fields:

      Global Administrator sub-field: 4 octets

         This sub-field contains a 4-octets Autonomous System number
         assigned by IANA.

      Local Administrator sub-field: 2 octets

         The organization identified by Autonomous System number in the
         Global Administrator sub-field, can encode any information in
         this sub-field. The format and meaning of the value encoded in
         this sub-field should be defined by the sub-type of the commu-
         nity.

6.4. Opaque extended community

   This is an extended type with Type Field comprising of 2 octets and
   Value Field comprising of 6 octets.

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| 0x03 or 0x43  |   Sub-Type    |              Value            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Value (cont.)                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The value of the high-order octet of this extended type is either
0x03 or 0x43. The low-order octet of this extended type is used to
indicate sub-types.

This is a generic community of extended type. The value of the sub-
type which should define the Value Field is to be assigned by IANA.

[7](7). Route Target Community

The Route Target Community identifies one or more routers that may
receive a set of routes (that carry this Community) carried by BGP.
This is transitive across the Autonomous system boundary.

The Route Target Community is of an extended type.

The value of the high-order octet of the Type field for the Route
Target Community can be 0x00, 0x01 or 0x02. The value of the low-
order octet of the Type field for this community is 0x02.

When the value of the high-order octet of the Type field is 0x00 or
0x02, the Local Administrator sub-field contains a number from a num-
bering space which is administered by the organization to which the
Autonomous System number carried in the Global Administrator subfield
has been assigned by an appropriate authority.

When the value of the high-order octet of the Type field is 0x01, the
Local Administrator sub-field contains a number from a numbering
space which is administered by the organization to which the IP
address carried in the Global Administrator subfield has been
assigned by an appropriate authority.

8. Route Origin Community

   The Route Origin Community identifies one or more routers that inject
   a set of routes (that carry this Community) into BGP. This is transi-
   tive across the Autonomous system boundary.

   The Route Origin Community is of an extended type.

   The value of the high-order octet of the Type field for the Route
   Origin Community can be 0x00, 0x01 or 0x02. The value of the low-
   order octet of the Type field for this community is 0x03.

   When the value of the high-order octet of the Type field is 0x00 or
   0x02, the Local Administrator sub-field contains a number from a num-
   bering space which is administered by the organization to which the
   Autonomous System number carried in the Global Administrator subfield
   has been assigned by an appropriate authority.

   When the value of the high-order octet of the Type field is 0x01, the
   Local Administrator sub-field contains a number from a numbering
   space which is administered by the organization to which the IP
   address carried in the Global Administrator subfield has been
   assigned by an appropriate authority.

9. Link Bandwidth Community

   When a router receives a route from a directly connected external
   neighbor (the external neighbor that is one IP hop away), and adver-
   tises this route (via IBGP) to internal neighbors, as part of this
   advertisement the router may carry the bandwidth of the link that
   connects the router with the external neighbor. The bandwidth of such
   a link is carried in the Link Bandwidth Community.

   The Link Bandwidth Community is of an extended type.

   The value of the high-order octet of the Type Field is 0x00. The
   value of the low-order octet of the Type field for this community is
   0x04.

   The value of the Global Administrator sub-field in the Value Field
   MUST represent the Autonomous System of the router that attaches the
   Link Bandwidth Community.

   The bandwidth of the link is expressed as 4 octets in IEEE floating
   point format, units being bytes per second. It is carried in the
   Local Administrator sub-field of the Value Field.

10. Operations

   A BGP speaker may use the Extended Communities attribute to control
   which routing information it accepts or distributes to its peers.

   The Extended Community attribute MUST NOT be used to modify the BGP
   best path selection algorithm in a way that leads to forwarding
   loops.

   A BGP speaker receiving a route that doesn't have the Extended Commu-
   nities attribute MAY append this attribute to the route when propa-
   gating it to its peers.

   A BGP speaker receiving a route with the Extended Communities
   attribute MAY modify this attribute according to the local policy.

   By default if a range of routes is to be aggregated and the resultant
   aggregates path attributes do not carry the ATOMIC_AGGREGATE
   attribute, then the resulting aggregate should have an Extended Com-
   munities path attribute which contains the set union of all the
   Extended Communities from all of the aggregated routes. The default
   behavior could be overriden via local configuration, in which case
   handling the Extended Communities attribute in the presence of route
   aggregation becomes a matter of the local policy of the BGP speaker
   that performs the aggregation.

   If a route has a non-transitivity extended community, then before
   advertising the route across the Autonomous system boundary the com-
   munity SHOULD be removed from the route. However, the community
   SHOULD NOT be removed when advertising the route across the BGP Con-
   federation boundary.

   A route may carry both the BGP Communities attribute as defined in
   [RFC1997]), and the Extended BGP Communities attribute. In this case
   the BGP Communities attribute is handled as specified in [RFC1997],
   and the Extended BGP Communities attribute is handled as specified in
   this document.

11. IANA Considerations

   The value of the high-order octet of the Type Field determines if an
   extended community is a regular type or an extended type. The value
   of the high-order octet of the Type Field defined as regular type (or
   extended type) for a extended community MUST NOT be reused as the
   value of the high-order octet of the Type Field defined as extended
   type (or regular type).

   For the high-order octet of the Type Field, values 0x00 through 0x03
   and 0x40 through 0x43 are assigned in this document and are defined
   as extended types.

   For the combination of the high-order and low-order octets of the
   Type Field values 0x0002-0x0004, 0x0102-0x0103, and 0x0202-0x0203 are
   assigned in this document.

   The Type Field values 0x04-0x3f and 0x44-0x7f for regular types
   (0x0400-0x3fff and 0x4400-0x7fff when expressed as extended types)
   are to be assigned by IANA, using the "First Come First Served" pol-
   icy defined in RFC 2434.

   The extended Type Field values 0x0000-0x0001, 0x0005-0x00ff,
   0x0100-0x0101, 0x0104-0x01ff, 0x0200-0x0201, 0x0204-0x02ff,
   0x0300-0x03ff, and 0x4000-0x43ff are to be assigned by IANA, using
   the "First Come First Served" policy defined in RFC 2434.

   The Type Field values 0x90-0xbf and 0xd0-0xff for regular types
   (0x9000-0xbfff and 0xd000-0xffff when expressed as extended types)
   are to be assigned by IANA, using the "IETF Consensus" policy defined
   in RFC2434.

   The Type Field values 0x80-0x8f and 0xc0-0xcf for regular types
   (0x8000-0x8fff and 0xc000-0xcfff when expressed as extended types)
   are experimental, and are not to be assigned by IANA.

[12](#). Security Considerations

   This extension to BGP does not change the underlying security issues.

[13](#). Acknowledgements

   The authors would like to thank John Hawkinson, Jeffrey Haas, Bruno
   Rijsman, and Alex Zinin for their suggestions and feedback.

[14](#). References

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