                   BGP Extended Communities Attribute

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Abstract

   This document describes the "extended community" BGP-4 attribute.
   This attribute provides a mechanism for labeling information carried
   in BGP-4. These labels can be used to control the distribution of
   this information, or for other applications.

1. Introduction

   The Extended Community Attribute provides a mechanism for labeling
   information carried in BGP-4 [BGP-4]. It provides two important
   enhancements over the existing BGP Community Attribute [RFC1997]:

      - 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 an Autonomous System (AS) boundary. Without
   structure, this can only be accomplished by explicitly enumerating

all community values that will be denied or allowed and passed to BGP
speakers in neighboring ASes based on the transitive property.
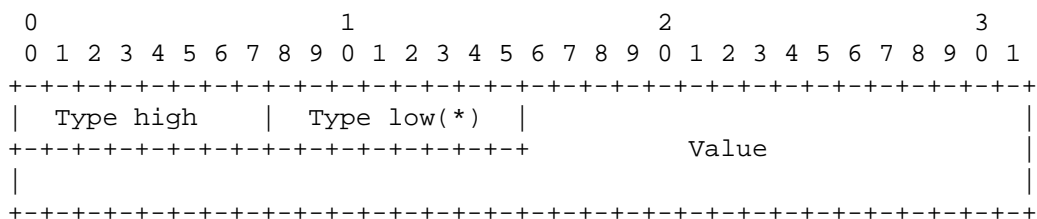
1.1. Specification of Requirements

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 [RFC2119].

2. 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 8-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 class of a type (Regular or Extended) is not encoded in the
   structure of the type itself. The class of a type is specified
   in the document that defines the type and the IANA registry.

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: Part of this Type Field space is for IANA
   assignable types using either the Standard Action or the
   Early IANA Allocation policy. The rest of this Type
   Field space is for Experimental use.

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
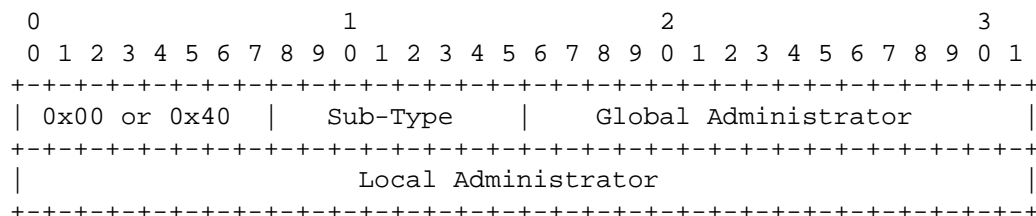the community are equal.

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

3. 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
community.

3.1. Two-Octet AS Specific Extended Community

   This is an extended type with Type Field composed of 2 octets and
   Value Field composed 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
         community.

3.2. IPv4 Address Specific Extended Community

   This is an extended type with Type Field composed of 2 octets and
   Value Field composed 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         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
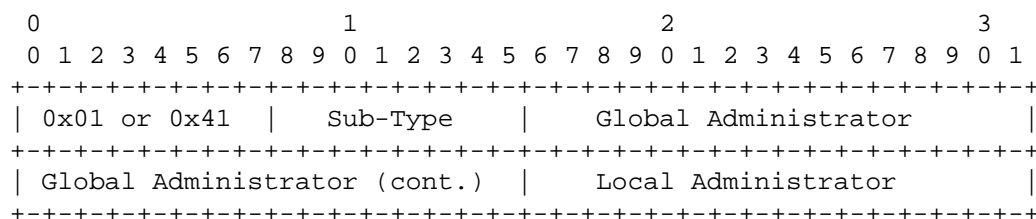
   The value of the high-order octet of this extended type is either
   0x01 or 0x41. The low-order octet of this extended type is used to
   indicate sub-types.

The Value field consists of two sub-fields:

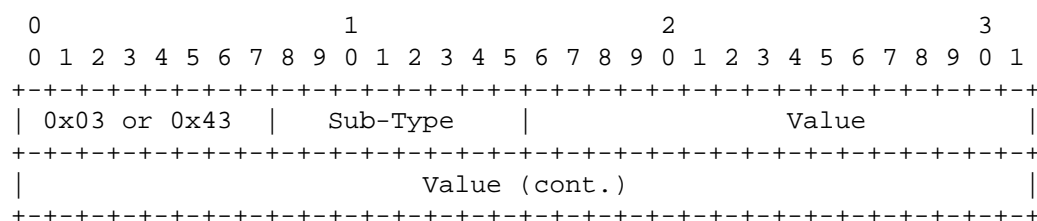   Global Administrator sub-field: 4 octets

      This sub-field contains an IPv4 unicast address assigned by one
      of the Internet registries.

   Local Administrator sub-field: 2 octets

      The organization that 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.

3.3. Opaque Extended Community

This is an extended type with Type Field composed of 2 octets and
Value Field composed 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 that should define the Value Field is to be assigned by IANA.

4. 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
numbering space that is administered by the organization to which the
Autonomous System number carried in the Global Administrator sub-
field 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 that is administered by the organization to which the IP
address carried in the Global Administrator sub-field has been
assigned by an appropriate authority.

One possible use of the Route Target Community is specified in
[RFC4364].

5. 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
transitive 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
numbering space that is administered by the organization to which the
Autonomous System number carried in the Global Administrator sub-
field 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 that is administered by the organization to which the IP
address carried in the Global Administrator sub-field has been
assigned by an appropriate authority.

One possible use of the Route Origin Community is specified in
[RFC4364].

6. 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
   Communities attribute MAY append this attribute to the route when
   propagating 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
   Communities path attribute that contains the set union of all the
   Extended Communities from all of the aggregated routes. The default
   behavior could be overridden 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
   community SHOULD be removed from the route. However, the community
   SHOULD NOT be removed when advertising the route across the BGP
   Confederation 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.

7. IANA Considerations

   All the BGP Extended Communities contain a Type field. The IANA has
   created a registry entitled, "BGP Extended Communities Type". The
   IANA will maintain this registry.

   The Type could be either regular or extended. For a regular Type the
   IANA allocates an 8-bit value; for an extended Type the IANA
   allocates a 16-bit value.

The value allocated for a regular Type MUST NOT be reused as the
value of the high-order octet when allocating an extended Type. The
value of the high-order octet allocated for an extended Type MUST NOT
be reused when allocating a regular Type.

The Type field indicates where the Extended Community is transitive
or not. Future requests for assignment of a Type value must specify
whether the Type value is intended for a transitive or a non-
transitive Extended Community.

Future assignment are to be made using either the Standards Action
process defined in [RFC2434], the Early IANA Allocation process
defined in [RFC4020], or the "First Come First Served" policy defined
in [RFC2434].

The following table summarizes the ranges for the assignment of
Types:

Type	Standard Action Early IANA Allocation	First Come First Served
regular, transitive	0x90-0xbf	0x00-x3f
regular, non-transitive	0xd0-0xff	0x40-0x7f
extended, transitive	0x9000-0xbfff	0x0000-0x3fff
extended, non-transitive	0xd000-0xffff	0x4000-0x7fff

Assignments consist of a name and the value.

The Type values 0x80-0x8f and 0xc0-0xcf for regular Types, and
0x8000-0x8fff and 0xc000-0xcfff for extended Types are for
Experimental use as defined in RFC 3692.

This document defines a class of extended communities called two-
octet AS specific extended community for which the IANA is to create
and maintain a registry entitled "Two-octet AS Specific Extended
Community". All the communities in this class are of extended Types.
Future assignment are to be made using the "First Come First Served"
policy defined in [RFC2434]. The Type values for the transitive
communities of the two-octet AS specific extended community class are
0x0000-0x00ff, and for the non-transitive communities of that class
are 0x4000-0x40ff. Assignments consist of a name and the value.

This document makes the following assignments for the two-octet AS
specific extended community:

```
   Name                                    Type Value
   ----                                    ----------
   two-octet AS specific Route Target      0x0002
   two-octet AS specific Route Origin      0x0003
```

This document defines a class of extended communities called IPv4
address specific extended community for which the IANA is to create
and maintain a registry entitled "IPv4 Address Specific Extended
Community". All the communities in this class are of extended Types.
Future assignment are to be made using the "First Come First Served"
policy defined in [RFC2434]. The Type values for the transitive
communities of the two-octet AS specific extended community class
are 0x0100-0x01ff, and for the non-transitive communities of that
class are 0x4100-0x41ff. Assignments consist of a name and the
value.

This document makes the following assignments for the IPv4 address
specific extended community:

```
   Name                                    Type Value
   ----                                    ----------
   IPv4 address specific Route Target      0x0102
   IPv4 address specific Route Origin      0x0103
```

This document defines a class of extended communities called opaque
extended community for which the IANA is to create and maintain a
registry entitled "Opaque Extended Community". All the communities
in this class are of extended Types. Future assignment are to be
made using the "First Come First Served" policy defined in [RFC2434].
The Type values for the transitive communities of the opaque extended
community class are 0x0300-0x03ff, and for the non-transitive
communities of that class are 0x4300-0x43ff. Assignments consist of
a name and the value.

When requesting an allocation from more than one registry defined
above, one may ask for allocating the same Type value from these
registries. If possible, the IANA should accommodate such requests.

8. Security Considerations

This extension to BGP has similar security implications as BGP
Communities [RFC1997].

This extension to BGP does not change the underlying security issues.
Specifically, an operator who is relying on the information carried
in BGP must have a transitive trust relationship back to the source
of the information. Specifying the mechanism(s) to provide such a
relationship is beyond the scope of this document.

9. Acknowledgements

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

10. Normative References

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   [RFC2434]   Narten, T. and H. Alvestrand, "Guidelines for Writing
                   an IANA Considerations Section in RFCs", BCP 26, RFC
                   2434, October 1998.

   [RFC4020]   Kompella, K. and A. Zinin, "Early IANA Allocation of
                   Standards Track Code Points", BCP 100, RFC 4020,
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11. Informative References

   [RFC4364]   Rosen, E. and Y. Rekhter, "BGP/MPLS IP Virtual Private
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