BGP Logical Link Discovery Protocol (LLDP) Peer Discovery
draft-acee-idr-lldp-peer-discovery-00.txt

Abstract

   Link Layer Discovery Protocol (LLDP) or IEEE 802.1AB is implemented
   in networking equipment from many vendors. It is natural for IETF
   protocols to avail this protocol for simple discovery tasks. This
   document describes how BGP would use LLDP to discover directly
   connected and 2-hop peers when peering is based on loopback
   addresses.

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1. Introduction

Link Layer Discovery Protocol (LLDP) [LLDP] or IEEE 802.1AB is
implemented in networking equipment from many vendors. It is natural
for IETF protocols to avail this protocol for simple discovery tasks.
This document describes how BGP [BGP] would use LLDP to discover
directly connected and 2-hop peers when peering is based on loopback
addresses.

1.1. 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 [RFC-KEYWORDS].

2. LLDP Extensions

2.1. LLDP Organizationally Specific TLV Format

   The format of the LLDP Basic Organizationally Specific TLV (OS-TLV)
   is defined in [LLDP]. It is shown below for completeness.

```
     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 (127)  |    Length    |   OUI (3 Octets) 00-00-5E       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | OUI Continued | Subtype      |      Value                   |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                            ...   (Up to 507 Octets)         |
```

   Type   Organizationally Specific TLV type value, 127.

   Length The length of the remainder of the TLV.

   OUI   Organizationally unique identifier for the
           organization's OUI. For the IANA, this is value is
           00-00-5E as specified in [RFC7042].

   Subtype IETF specific subtype

   Value   Value for organizationally specific TLV. The Length of
           the value is 4 octets less than the TLV length.

                     LLDP Organizationally Specific TLV

   The OUI for the IANA was allocated in section 1.4 of [IEEE-802-IANA].
   This document requests creation of a registry for IETF specific sub-
   types for LLDP Organizationally Specific TLVs.

2.2. Local IP Address OS-TLV Format

   The Local IP Address Organizationally Specific TLV will be used to
   advertise IPv4 or IPv6 addresses that are local to the link. A
   network device can advertise multiple Local IP Address OS-TLVs in its
   LLDP PDU and is only constrained by the length of the PDU. Normally
   a network device would only advertise its own local address but
   advertising addresses local to the link for another networking device
   is not specifically disallowed. The format is shown below.


```
    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 (127)  |    8 or 20      |  OUI (3 Octets) 00-00-5E      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | OUI Continued |      1        | Address Family|   IPv4/IPv6   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |       IPv4/IPv6 Address       | IPv6 Address                  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                        IPv6 Address                           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                        IPv6 Address                           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                 IPv6 Address                  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```


   Length   The length will be 8 for IPv4 addresses or 20 for IPv6
            addresses.

   Subtype IETF specific subtype for a Local IP address for the
            link. The value shall be 1.

   Address IANA Address family (1 for IPv4 or 2 for IPv6)
   Family

   Value   Local IPv4 or IPv6 Address.

2.3. BGP Config OS-TLV Format

   The BGP Config Organizationally Specific TLV (OS-TLV) will be used to
   advertise BGP configuration information. The configuration
   information will be composed of Sub-TLVs. Since the length is
   limited to 507 octets, multiple BGP Config OS-TLVs could be included
   in a single LLDP advertisement.

```
    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 (127)  |    Length      |   OUI (3 Octets) 00-00-5E      |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |OUI Continued  |      2       |    BGP Config Sub-TLVs  ...    |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                              ...   (Up to 507 Octets)         |
```

      Length   The length of the BGP TLV.

      Subtype   IETF specific subtype for BGP Config OS-TLV. The
                 value shall be 2.

      Value   BGP Config Sub-TLVs each with a 1 byte Type and
                 Length. The Length will include solely the value
                 portion of the TLV and not the Type and Length
                 fields themselves.

2.3.1. **BGP Config OS-TLV - Peering Address Sub-TLV**

   The BGP OS-TLV Peering Address Sub-TLV will be used to advertise the
   local IP address used for BGP sessions and the associated address
   families. The format of the BGP Peering Address Sub-TLV is shown
   below.

```
    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 (1)   |     Length    | Address Family| IPv4/IPv6     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~     IPv4/IPv6 Peering Address ...                            ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |          AFI               |      SAFI      |   o  o  o
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
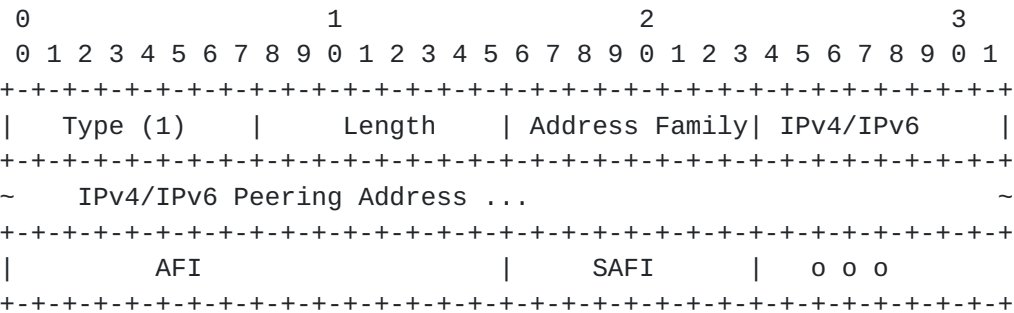
    Type   The Sub-TLV Type value shall be 1.

    Length   The Sub-TLV length in octets will be 4 for IPv4 or 16
               for IPv6 plus 3 times the number of AFI/SAFI pairs.

    Address   IANA Address family (1 for IPv4 or 2 for IPv6)
    Family

    Peering   An IPv4 address (4 octets) or an IPv6 address (16
    Address   octet) peering address.

    AFI/SAFI One or more AFI/SAFI pairs for BGP session using this
    Pairs   peering address.

2.3.2. BGP Config OS-TLV - BGP Local AS Sub-TLV

   The BGP Config OS-TLV Local AS Sub-TLV will be used to advertise the
   4-octet local Autonomous System (AS) number. The format of the BGP
   Local AS Sub-TLV is shown below.

```
    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 (2)     | Length (4)    |          Local AS             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   Local AS                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
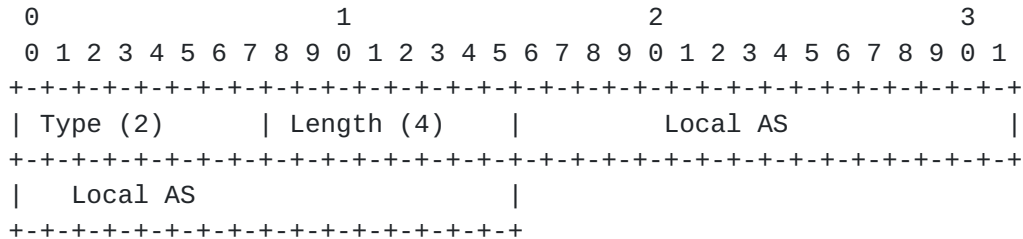

    Type   The Sub-TLV Type value shall be 2.

    Length   The Sub-TLV Length will be 4 octets.

    Local AS Local Autonomous System (AS)

2.3.3. BGP Config OS-TLV - BGP Capabilities Sub-TLV

The BGP Config OS-TLV Capabilities Sub-TLV will be used to advertise
an 8-octet Capabilities field. The capabilities are represented as
bit flags identifying the supported BGP capabilities. The format of
the BGP Capabilities Sub-TLV is shown below.

```
 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 (3)     | Length (8)    |         Capabilities          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Capabilities                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Capabilities           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

> Type   The Sub-TLV Type value shall be 3.
>
> Length   The Sub-TLV Length will be 8 octets.
>
> Capabilities Bit fields identify BGP capabilities

The BGP Capabilities is an 8-octet bit field. The most significant
bit is the first bit (Bit 1) of the Capabilities. The following bits
are defined:

> Bit 1:   This bit indicates that support for TCP MD5
>   authentication [TCP-MD5].
>
> Bit 2:   This bit indicates support for TCP-AO
>   authentication [TCP-AO].
>
> Bit 3:   This bit indicates support for Generalized TTL
>   Security Mechanism (GTSM) [GTSM] with a
>   configured TTL range of 254-255.

TCP MD5 authentication is described in [TCP-MD5]. The TCP
Authentication Option (TCP-AO) is described in [TCP-AO]. The
Generalized TTL Security Mechanism (GTSM) is described in [GTSM]. If
both TCP MD5 authentication and TCP-AO authentication are specified
and TCP-AO is supported, it will take precedence.

3. BGP LLDP Peer Discovery Operations

   The simple use case is to just use the peer address advertised in the
   LLDP Packet Data Unit (PDU) to establish a 1-hop BGP peer session.
   This can be used in data centers using BGP as described in [BGP-DC].
   The more complex use case is when a loopback address in advertised as
   the peering address in the LLDP PDU.

3.1. Advertising BGP Speaker

   A BGP speaker MAY advertise its BGP peering address in an LLDP PDU
   for a link using the BGP Local Address Sub-TLV of BGP-OS TLV Format.
   This can be an IPv4 or IPv6 address local to the link for 1-hop
   peering or a loopback address for 2-hop peering.

   Additionally, a BGP speaker MAY advertise one or more local addresses
   IPv4 and IPv6 addresses. In the case of 2-hop peering, a local
   address on the link can be used as a next-hop for the peering
   address. In this manner both the peering address and reachability
   can be discovered.

   A BGP speaker MAY advertise its local AS number using BGP AS Sub-TLV
   of BGP-OS TLV format. It may also announce relevant capabilities
   using BGP Capabilities Sub-TLV of BGP-OS TLV format.

3.2. Receiving BGP Speaker

   A BGP speaker configured for LLDP peer discovery will attempt to
   establish peers using the address in the BGP Local Address Sub-TLV of
   BGP-OS TLV format. If the peering address is directly accessible
   over the link on which the LLDP PDU was received, the BGP speaker
   will attempt to establish a 1-hop BGP session with the peer.

   If the received BGP Peering Address is not directly accessible over
   the link, the BGP speaker may add a route to the access the BGP peer.
   The next-hop for the route MAY be one of the addresses the BGP
   speaker has advertised in the Local IP Address OS-TLV. If the BGP
   speaker receives the same BGP peering address in LLDP PDU on multiple
   links, it will not establish multiple sessions. Rather a single
   2-hop session will be established. Optionally, ECMP routes are added
   to the BGP peering session over each link on which an LLDP PDU
   containing the same Peering Address is received.

   A BGP speaker MAY receive remote neighbor's local AS number in LLDP
   in BGP AS Sub-TLV of the BGP-OS TLV. A BGP speaker MAY use the
   received local AS number to perform validation check of AS received
   in the OPEN message. Furthermore, A BGP speaker MAY receive remote
   neighbor's capabilities in LLDP in BGP Capabilities Sub-TLV of the

BGP-OS TLV. A BGP speaker MAY use the received capabilities to
ensure appropriate neighbor based configuration is done locally so as
to facilitate the session establishment.

4. Security Considerations

This security considerations for BGP [BGP] apply equally to this
extension.

Additionally, BGP peering address discovery should only be done on
trusted links (e.g., in a data center network) since LLDP packets are
not authenticated or encrypted [LLDP].

5. IANA Considerations

5.1. IANA Assigned LLDP Subtype

IANA is requested to create a registry for IANA assigned subtypes in
the Organizationally Specific TLV assigned to IANA (OUI of 000-00-53
[IEEE-802-IANA]. Assignment is requested for 1 for the Local IP
Address OS-TLV. Assignment is also requested for 2 for the BGP
Config OS-TLV.

```
+-------------+----------------------------------+
| Range       | Assignment Policy                |
+-------------+----------------------------------+
| 0           | Reserved (not to be assigned)    |
|             |                                  |
| 1           | Local IP Address                 |
|             |                                  |
| 2           | BGP Configuration                |
|             |                                  |
| 3-127       | Unassigned (IETF Review)         |
|             |                                  |
| 128-254     | Reserved (Not to be assigned now) |
|             |                                  |
| 255         | Reserved (not to be assigned)    |
+-------------+----------------------------------+
```

           IANA LLDP Organizationally Specific TLV Sub-Types

o Types in the range 3-127 are to be assigned subject to IETF
   Review. New values are assigned only through RFCs that have been
   shepherded through the IESG as AD-Sponsored or IETF WG Documents
   [IANA-GUIDE].

o Types in the range 128-254 are reserved and not to be assigned at
   this time. Before any assignments can be made in this range,

      there MUST be a Standards Track RFC that specifies IANA
      Considerations that covers the range being assigned.

5.2. BGP Config LLDP OS-TLV Sub-TLVs

   IANA is requested to create a registry for Sub-TLVs of the BGP Config
   LLDP OS-TLV. Assignment is requested for 1 for the BGP Peering
   Address Sub-TLV. Assignment is also requested for 2 for the Local AS
   Sub-TLV. Additionally, assignment is requested for 3 for the
   Capabilities Sub-TLV.

```
        +-------------+----------------------------------+
        | Range       | Assignment Policy                |
        +-------------+----------------------------------+
        | 0           | Reserved (not to be assigned)    |
        |             |                                  |
        | 1           | Peering Address                  |
        |             |                                  |
        | 2           | Local AS                         |
        |             |                                  |
        | 3           | Capabilities                     |
        |             |                                  |
        | 4-127       | Unassigned (IETF Review)         |
        |             |                                  |
        | 128-254     | Reserved (Not to be assigned now)|
        |             |                                  |
        | 255         | Reserved (not to be assigned)    |
        +-------------+----------------------------------+
```

                  LLDP BGP Config OS-TLV Types

   o Types in the range 4-127 are to be assigned subject to IETF
      Review. New values are assigned only through RFCs that have been
      shepherded through the IESG as AD-Sponsored or IETF WG Documents
      [IANA-GUIDE].

   o Types in the range 128-254 are reserved and not to be assigned at
      this time. Before any assignments can be made in this range,
      there MUST be a Standards Track RFC that specifies IANA
      Considerations that covers the range being assigned.

6. References

6.1. Normative References

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              Protocol 4 (BGP-4)", RFC 4271, January 2006.

   [BGP-DC]   Lapukhov, P., Premji, A., and J. Mitchell, "BGP Routing in
              Data Centers", RFC 7938, August 2016.

   [LLDP]   IEEE, "IEEE Standard for Local and metropolitan area
              networks-- Station and Media Access Control Connectivity
              Discovery Corrigendum 2: Technical and Editorial
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6.2. Informative References

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Appendix A. Acknowledgments

   The RFC text was produced using Marshall Rose's xml2rfc tool.

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