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BGP Logical Link Discovery Protocol (LLDP) Peer Discovery
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Abstract

Link Layer Discovery Protocol (LLDP) or IEEE Std 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 Std 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 [[RFC4271](#)] would use LLDP to discover directly connected and 2-hop peers when peering is based on loopback addresses.

The OUI for IANA was allocated in [section 1.4 of \[RFC7042\]](#). This document requests creation of a registry for IETF specific sub-types for LLDP IETF Organizationally Specific TLVs.

2.2. BGP Config OS-TLV Format

The BGP Config IETF 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	2	3	4	5	6	7	8	9	0	1																						
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+																+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+																+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+																+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+															
Type (127)																Length																OUI (3 Octets) 00-5E-00																															
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+																+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+																+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+																+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+															
OUI Continued																1																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 1.
---------	--

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.
-------	--

2.2.1. BGP Config OS-TLV - Peering Address Sub-TLV

The BGP OS-TLV Peering Address Sub-TLV will be used to advertise the local IP addresses used for BGP sessions and the associated address families specified by AFI/SAFI tuples. The AFI/SAFI tuple, 0/0, indicates to use the associated peering address for all locally configured address families without an explicit peering address specification. As always, the address families supported for a given BGP session will be determined during capabilities negotiation [RFC4760]. It is RECOMMENDED that the wildcard AFI/SAFI be used in deployments with fairly homogenous address family usage.

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 tuples.

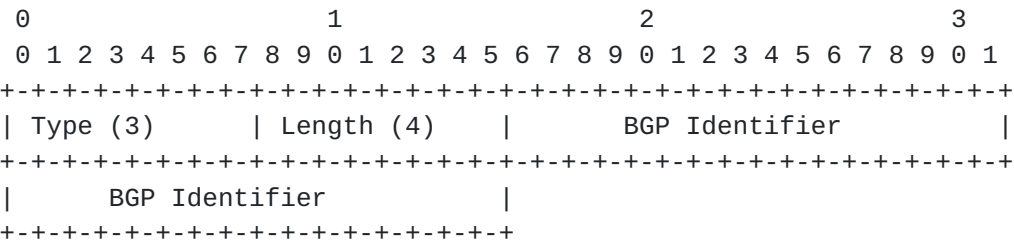
Address Family IANA Address family (1 for IPv4 or 2 for IPv6)

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

AFI/SAFI Pairs One or more AFI/SAFI tuples for BGP session using this peering address. The AFI/SAFI tuple, 0/0, is a wildcard indicating to attempt negotiation for all AFI/SAFIs.

2.2.3. BGP Config OS-TLV - BGP Identifier Sub-TLV

The BGP Config OS-TLV BGP Identifier Sub-TLV will be used to advertise the 4-octet local BGP Identifier. The BGP Identifier is used for debugging purposes and possibly to reduce the likelihood of BGP connection collisions. The format of the BGP Identifier Sub-TLV is shown below.



Type The Sub-TLV Type value shall be 3.

Length The Sub-TLV Length will be 4 octets.

BGP Identifier Local BGP Identifier (aka, BGP Router ID)

2.2.4. BGP Config OS-TLV - Session Group-ID Sub-TLV

The BGP Config OS-TLV Session Group-ID Sub-TLV is an opaque 4-octet value that is used to represent a category of BGP session that is supported on the interface. The format of the Session Group-ID 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 (4)      | Length (4)      |      Session Group-ID      |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|      Session Group-ID      |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Type The Sub-TLV Type value shall be 4.

Length The Sub-TLV Length will be 4 octets.

Session Group-ID The session group-id used to indicate a
class or category of BGP session supported on
the interface.

2.2.5. BGP Config OS-TLV - BGP Session Capabilities Sub-TLV

The BGP Config OS-TLV Session Capabilities Sub-TLV will be used to advertise an 8-octet Session Capabilities field. The session capabilities are represented as bit flags identifying the supported BGP session capabilities. The format of the BGP Session 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 (5)      | Length (8)    | Session Capabilities          |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                Session Capabilities                          |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| Session Capabilities          |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

Type The Sub-TLV Type value shall be 5.

Length The Sub-TLV Length will be 8 octets.

Session
Capabilities Bit fields identify BGP session capabilities

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

Bit 1: This bit indicates 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 [RFC2385]. The TCP Authentication Option (TCP-AO) is described in [RFC5925]. The Generalized TTL Security Mechanism (GTSM) is described in [RFC5082]. If both TCP MD5 authentication and TCP-AO authentication are specified and TCP-AO is supported, it will take precedence.

2.2.6. BGP Config OS-TLV - Key Chain Sub-TLV

The BGP Config OS-TLV Key Chain Sub-TLV is a string specifying the name for the key chain used for session authentication. Key chains [RFC8177] are commonly used for protocol authentication and encryption key specification. Given the limited length of all BGP configuration information, the key chain name will be limited to 64 characters and will not include a trailing string delimiter. The format of the Session Group-ID 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 (6)           |Length (1 - 64)|           Key Chain Name       |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|                                     Key Chain Name (Up to 64 Octets)   |
|                                     0                                   |
|                                     0                                   |
|                                     0                                   |
|      Key Chain Name                                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

Type The Sub-TLV Type value shall be 6.

Length The Sub-TLV Length will be 1 - 64 octets.

Key Chain Name The name of a key chain to be used for
MD5 or TCP-AO authentication.

2.2.7. BGP Config OS-TLV - Local Address Sub-TLV

The BGP OS-TLV Local Address Sub-TLV will be used to advertise a local IP addresses used for BGP next-hops. Advertising a local interface address is useful when the address family is different from the advertised BGP peering address.

The format of the BGP Local Interface 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 (7)  |      Length      | Address Family| IPv4/IPv6      |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
~    IPv4/IPv6 Local Address ...                                ~
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

Type The Sub-TLV Type value shall be 7.

Length	The Sub-TLV length in octets will be 4 for IPv4 or 16 for IPV6 plus 3 times the number of AFI/SAFI tuples.
--------	--

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

Local Address	An IPv4 address (4 octets) or an IPv6 address (16 octets)
---------------	---

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 [[RFC7938](#)]. The use case where a loopback address or other local address is advertised as the peering address is also supported. However, reachability to a peering address other than the interface address is beyond the scope of this document.

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 the BGP-OS TLV. This can be an IPv4 or IPv6 local address associated with the LLDP link for 1-hop peering. For 2-hop peering, it could be a loopback address or any other address that is local to the node but not the LLDP link. As noted above, reachability to the loopback address is beyond the scope of this document.

A BGP speaker MAY advertise its local AS number using the BGP Local AS Sub-TLV of the BGP-OS TLV. During AS transitions, a second local AS number may be included in the Local AS Sub-TLV. The local BGP identifier may also be advertised using the BGP Identifier Sub-TLV of the BGP-OS TLV. While not specifically required for session establishment, the values may be used for validation, troubleshooting, and connection collision avoidance. A BGP speaker may also announce a Session Group-ID indicating the class or category of session(s) supported and/or mapping to a set of session parameters. Additionally, a BGP speaker MAY also announce relevant capabilities using BGP Session Capabilities Sub-TLV of the BGP-OS TLV.

If TCP MD5 authentication [[RFC2385](#)] or TCP Authentication Option (TCP-AO) [[RFC5925](#)] is to be used on the session, the Key Chain Sub-TLV of the BGP-OS TLV MAY be used to specify the key chain name.

3.2. Receiving BGP Speaker

A BGP speaker configured for LLDP peer discovery WILL attempt to establish BGP sessions 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 is 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 peer must be reachable for the session to be established and the mechanisms for establishing reachability are beyond the scope of this specification. If the BGP speaker receives

the same BGP peering address in LLDP PDUs received on multiple links, it will not establish multiple sessions. Rather, a single 2-hop session will be established.

When the deployment of address families is fairly homogenous across the deployment, the wildcard AFI/SAFI can be utilized to simplify LLDP advertisement. When there is variance in the address families supported, usage of the wildcard could result in session establishment delay due to capabilities negotiation [[RFC5492](#)].

A BGP speaker MAY receive a remote neighbor's local AS number(s) in an LLDP PDU in the BGP Local AS Sub-TLV of the BGP-OS TLV. A BGP speaker MAY use the received local AS number(s) to perform validation checking of the AS received in the OPEN message. A BGP speaker MAY receive a remote neighbor's BGP Identifier in the BGP Identifier Sub-TLV of the BGP-OS TLV. This can be used to avoid connection collisions by delaying session establishment if the remote BGP Identifier is greater than the receiving speaker's BGP Identifier.

A BGP speaker MAY receive a Session Group-ID Sub-TLV in the LLDP BGP-OS TLV. This Session Group-ID may be used for validation and/or mapping the session to a particular set of session parameters. For example, the Session Group-ID could be mapped to a spine, leaf, or Top-of-Rack (ToR) session in a data center deployment and can be used to detect cabling problems when an unexpected Session Group-ID is received.

Additionally, A BGP speaker MAY receive a remote neighbor's capabilities in LLDP in the BGP Session Capabilities Sub-TLV of the BGP-OS TLV. A BGP speaker MAY use the received capabilities to ensure appropriate local neighbor configuration in order to facilitate session establishment.

If TCP MD5 authentication [[RFC2385](#)]. or TCP Authentication Option (TCP-AO) [[RFC5925](#)] is to be used on the session as determined either via the Session Capabilities Sub-TLV, Session Group-ID, or local policy, the key chain name in the Key Chain Sub-TLV of the BGP-OS TLV MAY be used to identify the correct key chain [[RFC8177](#)].

4. LLDP Authentication/Encryption

The IEEE 802.1AE [[MACsec](#)] standard can be used for encryption and/or authentication to provide privacy and integrity. MACsec utilizes the Galois/Counter Mode Advanced Encryption Standard (AES-GCM) for authenticated encryption and Galois Message Authentication Code (GMAC) if only authentication, but not encryption is required.

The MACsec Key Agreement (MKA) is included as part of the IEEE 802.1X-20200 Port-Based Network Access Control Standard [[MKA](#)]. The purpose of MKA is to provide a method for discovering MACsec peers and negotiating the security keys needed to secure the link.

5. Security Considerations

This security considerations for BGP [[RFC4271](#)] 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](#)].

LLDP Authentication and/or encryption can provided as described in section [Section 4](#).

6. IANA Considerations

6.1. IANA Assigned LLDP Subtype

IANA is requested to create a registry for IANA assigned subtypes in the IETF Organizationally Specific TLV assigned to IANA (OUI of 000-00-53 [[RFC7042](#)]). Assignment is requested for 1 for the BGP Config OS-TLV.

Range	Assignment Policy
0	Reserved (not to be assigned)
1	BGP Configuration
2-127	Unassigned (IETF Review)
128-254	Reserved (Not to be assigned now)
255	Reserved (not to be assigned)

IANA LLDP IETF Organizationally Specific TLV Sub-Types

- o Types in the range 2-127 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 [[RFC5226](#)].

- 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.

6.2. 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 BGP Identifier Sub-TLV, 4 for the BGP Session Group-ID, 5 for the Session Capabilities Sub-TLV, and 6 for the Key Chain Name.

Range	Assignment Policy
0	Reserved (not to be assigned)
1	Peering Address
2	Local AS
3	BGP Identifier
4	Session Group-ID
5	Session Capabilities
6	Key Chain Name
7	Local Address
8-127	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 8-127 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 [[RFC5226](#)].

- 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.

7. Contributors

Contributors' Addresses

8. References

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[Appendix A](#). Acknowledgments

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