Applying BGP-LS Segment Routing over IPv6(SRv6) Extensions to BGP-LS-SPF

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Updates

- Enriched the existing sections with the **TLV usage and format**.
- **Added "Advertising Endpoint Behaviors"** section to describe the Endpoint Behaviors that can be advertised by BGP-LS-SPF.
- **Added "Acknowledgements"** section.

SRv6 Node Attribute TLVs

◻SRv6 Capabilities TLV

- Used to **announce the SRv6-related capabilities** of the node.
- **Mandatory TLV** in the BGP-SPF Node Attribute of SRv6-capable Node.
- **MUST be advertised only once**, when multiple TLVs are received, the first occurrence is valid.
- If SRv6 Capability TLV is **not advertised**, then the node does **not support SRv6**

```
 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             |          Length               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Flags             |         Reserved              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: SRv6 Capability TLV format

The format of this TLV is the same as the BGP-LS SRv6 Capability TLV

SRv6 Node Attribute TLVs

◻SRv6 Node MSD Types

- Used to advertise the **limits and the Segment Routing Header (SRH) operations supported** by the SRv6-capable node.
- **Optional TLV**, the SRv6 MSD types specified in Section 4 of RFC9352 can be used in the BGP-LS-SPF Node MSD TLV.
- **MUST be advertised only once**, when multiple TLVs are received, the first occurrence is valid.
- If there are **multiple MSD-Types that have the same code point** in a Node MSD TLV, then the Node MSD TLV MUST be **ignored by the receiver**.

```
 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             |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    MSD-Type   |  MSD-Value    |  MSD-Type...  |  MSD-Value... |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: SRv6 Node MSD TLV format

The format of this TLV is the same as that in BGP-LS

SRv6 Node Attribute TLVs

◻SR-Algorithm TLV

- Used to advertise the **SRv6 algorithms supported** the node.
- **Optional TLV**, Algorithm 0 is supported by default.
- **MUST be advertised only once**, when multiple TLVs are received, the first occurrence is valid.
- If a SRv6-capable node **does not advertise this TLV**, it **implies that algorithm 0 is the only algorithm** supported by the node.
- If the originating node does advertise the SR-Algorithm TLV, then **algorithm 0 MUST be present.**

```
 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        |     Length    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Algorithm 1   |  Algorithm 2  | Algorithm ... |  Algorithm n  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The format of this TLV is the same as that in BGP-LS

SRv6 Link Attribute TLVs

◻SRv6 End.X SID TLV

- Used to advertise the **SRv6 SIDs corresponding to a point-to-point or adjacency** of the node.
- **Optional TLV,** MAY be advertised by an SRv6-capable node.
- **More than one instance** of this TLV **can be included** in the BGP-LS-SPF Attribute. Multiple SRv6 End.X SID TLVs MAY be associated with the same adjacency.
- All **End.X SIDs MUST be a subnet of a locator** with matching algorithm that is advertised by the same BGP-LS-SPF node in an SRv6 Locator TLV.

```
 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            |          Length               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        Endpoint Behavior      |      Flags    |   Algorithm   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Weight    |   Reserved    |  SID (16 octets) ...          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SID (cont ...)                                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SID (cont ...)                                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SID (cont ...)                                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    SID (cont ...)             | Sub-TLVs (variable) . . .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The format of this TLV is the same as that in BGP-LS

SRv6 Link Attribute TLVs

◻L2 Bundle Member Attributes TLV

- Used to advertise the **L2 bundle member link attributes** when the L2 bundle member link is associated with a parent L3 link.
- BGP-LS-SPF may also includes trunk-link scenarios, so **BGP-SPF MAY support it**.
- **Optional TLV,** MAY be advertised by an SRv6-capable node.
- **Multiple L2 Bundle Member Attributes TLVs MAY be associated** with a Link NLRI.
- **Advertisements MUST be withdrawn** if the link becomes operationally down or it is no longer a member of the identified L2 Bundle.

SRv6 Link Attribute TLVs

◻SRv6 Link MSD Types

- Used to advertise the **limits and the SRH operations supported on the specific link** by the SRv6-capable node.
- **Optional TLV**, the SRv6 MSD types specified in Section 4 of RFC9352 can be used in the BGP-LS-SPF Link MSD TLV.
- **MUST be advertised only once**, when multiple TLVs are received, the first occurrence is valid.

SRv6 Prefix Attribute TLVs

◻SRv6 Locator TLV

- Used to advertise **the locators supported by the node**.
- **Multiple SRv6 Locator TLVs MAY be advertised with different locator**.
- **If multiple TLVs** are received for the **same locator**, the receiver **MUST use the first occurrence.**
- The **Flags field are not used** in BGP-SPF, should be set to 0.
- BGP-LS-SPF defines the **Prefix Metric TLV is mandatory for Prefix NLRI**, so the **Metric field is no longer usable** and SHOULD be set to 0.

```
 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            |          Length               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Flags     |   Algorithm   |           Reserved            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            Metric                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Sub-TLVs (variable) . . .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The format of this TLV is the same as that in BGP-LS

SRv6 SID NLRI

SRv6 SID Information TLV

- Used to **advertise the SRv6 SIDs** associated with a node in a SRv6 SID NLRI.
- **Mandatory TLV** in SRv6 NLRI. For each SRv6 SID NLRI, it MUST contain a single SRv6 SID Information TLV.
- **When multiple TLVs** are received from a given node, the receiver **MUST use the first occurrence.**
- The SRv6 SID **MUST be allocated from its associated locator**. SRv6 SIDs that are NOT allocated from the associated locator MUST be ignored.

SRv6 SID Attributes

□SRv6 Endpoint Behavior TLV

- Used to advertise the behaviors associated with a SID.
- **Mandatory TLV,** must be **included once** in the BGP-LS Attribute associated with the SRv6 SID NLRI.
- When multiple TLVs are received from a given node, the receiver MUST **use the first occurrence.**

□SRv6 SID Structure TLV

- Used to advertise the **length of each individual part** of the SRv6 SID.
- **Optional TLV**, may be used in BGP-SPF in some scenarios using **compressed SID**.
- This TLV **MUST NOT appear more than once** in its parent TLV.
- The sum of all four sizes advertised in SRv6 SID Structure TLV **MUST be less than or equal to 128 bits.**

Advertising Endpoint Behaviors

- The code points for Endpoint behaviors are defined in the "SRv6 Endpoint Behaviors " registry of [RFC8986].
- The Endpoint behaviors and their code points, which MAY be advertised by BGP-LS-SPF is listed.

Endpoint Behavior	Endpoint Behavior Code Point	End SID	End.X SID
End(PSP, USP, USD)	1-4, 28-31	Y	N
End.X(PSP, USP, USD)	5-8, 32-35	N	Y

Table 5: SRv6 Endpoint Behaviors in BGP-LS-SPF

Next Steps

- Welcome for comments and suggestions!
- WG adoption?

Thank You