Abstract

This document specifies a Preferred Path Routing (PPR), a routing protocol mechanism to simplify the path description of data plane traffic in Segment Routing (SR) deployments with OSPFv2 and OSPFv3 protocols. PPR aims to mitigate the MTU and data plane processing issues that may result from SR packet overheads; and also supports further extensions along the paths. Preferred path routing is achieved through the addition of path descriptions to the OSPF advertised prefixes, and mapping those to a PPR data-plane identifier.
time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

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1. Introduction

In a network implementing Segment Routing (SR), packets are steered through the network using Segment Identifiers (SIDs) carried in the packet header. Each SID uniquely identifies a segment as defined in [I-D.ietf-spring-segment-routing]. SR capabilities are defined for MPLS and IPv6 data planes called SR-MPLS and SRv6 respectively.

In SR-MPLS, a segment is encoded as a label and an ordered list of segments is encoded as a stack of labels on the data packet. In SRv6, a segment is encoded as an IPv6 address, with in a new type of IPv6 hop-by-hop routing header/extension header (EH) called SRH [I-D.ietf-6man-segment-routing-header], where an ordered list of IPv6 addresses/segments is encoded in SRH.

Preferred path routing can be described as a) enabling route computation based on the specific path described along with the prefix as opposed to shortest path towards the prefix and b) forwarding based on the abstracted path identifier as opposed to the individual segments on the packet. This also further described in Section 2 of [I-D.chunduri-lsr-isis-preferred-path-routing].

Any prefix advertised with a path description from any node in the network is called PPR. A PPR could be an SR path, an explicitly provisioned Fast Re-Route (FRR) path or a service chained path. A PPR can be signaled by any node, which receives the SR path computed by a central controller, or by statically configuring the same on a node in the network.

The issues caused by the large SID depth, and existing methods for mitigation are introduced in [I-D.chunduri-lsr-isis-preferred-path-routing] in Appendix A.1 and A.2. To mitigate these issues and also to facilitate forwarding plane extensibility, this draft proposes a new OSPFv2 PPR TLV (Section 2), OSPFv3 PPR TLV (Section 3) to use the path with a corresponding data plane identifier.

1.1. Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EL</td>
<td>Entropy Label</td>
</tr>
<tr>
<td>ELI</td>
<td>Entropy Label Indicator</td>
</tr>
<tr>
<td>MPLS</td>
<td>Multi Protocol Label Switching</td>
</tr>
<tr>
<td>MSD</td>
<td>Maximum SID Depth</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum Transferrable Unit</td>
</tr>
</tbody>
</table>
2. OSPFv2 PPR TLV

Extended Prefix Opaque LSAs defined in [RFC7684] are used for advertisements of PPRs. This section describes the encoding of PPR TLV. This TLV can be seen as having 4 logical section viz., encoding of the OSPFv2 Prefix, encoding of PPR-ID, encoding of path description with an ordered PDE Sub-TLVs and a set of optional PPR attribute Sub-TLVs, which can be used to describe one or more parameters of the path. Multiple OSPF PPR TLVs MAY be advertised in each OSPF Extended Prefix Opaque LSA, but all TLVs included in a single OSPF Extended Prefix Opaque LSA MUST have the same flooding scope.

The PPR TLV has Type TBD (suggested value xxx), and has the following format:
Figure 1: OSPFV2 PPR TLV Format

- **Type** - TBD (IANA) from OSPF Extended Prefix Opaque LSA registry.
- **Length** - Total length of the value field in bytes (variable).
- **PPR-Flags** - 2 Octet flags for this TLV are described below.
- **AF** - Address family for the prefix. Currently, the only supported value is 0 for IPv4 unicast. The inclusion of address family in this TLV allows for future extension.
- **Reserved** - 1 Octet reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.
- **PPR-Prefix** - This is a variable size Sub-TLV, which represents the prefix for which path description is being attached to. This is defined in Section 2.2.
- **PPR-ID** - This is a variable size Sub-TLV, which represents the data plane or forwarding identifier of the PPR. This is defined in Section 2.3.
- **PPR-PDEs** - Variable number of ordered PDE Sub-TLVs which represent the path. This is defined in Section 2.4.
- **PPR-Attributes** - Variable number of PPR-Attribute Sub-TLVs which represent the path attributes. These are defined in Section 2.5.
2.1. PPR-Flags

Flags: 2 octet field of PPR TLV has following flags defined:

<table>
<thead>
<tr>
<th>IA</th>
<th>A</th>
<th>Reserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2 3 4 5 6 7</td>
</tr>
</tbody>
</table>

Where:

IA-Flag: Inter-Area flag. If set, advertisement is of inter-area type. An Area Boarder Router (ABR) that is advertising the OSPF PPR TLV between areas MUST set this bit.

A: The originator of the PPR TLV MUST set the A bit in order to signal that the prefixes and PPR-IDs advertised in the PPR TLV are directly connected to the originators. If this bit is not set, this allows any other node in the network advertise this TLV on behalf of the originating node of the "OSPF Prefix". If PPR TLV is propagated to other areas the A-flag MUST be cleared. In case if the originating node of the prefix has to be disambiguated for any reason including, if it is a Multi Homed Prefix (MHP) or propagated to a different OSPF area, then PPR-Attribute Sub-TLV Source Router ID SHOULD be included.

Reserved: Reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.

PPR path description for each OSPF area is computed and given to one of the nodes in that area for dissemination. Similarly path information when crossing the area boundaries MUST be relevant to the destination area. If there is no path information available for the destination area, PPR TLV MUST NOT be leaked regardless of the IA bit status.

2.2. PPR-Prefix Sub-TLV

The structure of PPR-Prefix, for which path description is attached to is as follows:
Figure 2: PPR-Prefix Sub-TLV Format

- **Type**: 1 (suggested value, IANA TBD) from OSPFv2 PPR TLV Section 2 Sub-TLV registry.
- **Length**: Total length of the value field in bytes (variable).
- **MT-ID**: Multi-Topology ID (as defined in [RFC4915]).
- **Prefix Len**: contains the length of the OSPF prefix being encoded in bytes.
- **Mask Length**: The length of the prefix in bits. Only the most significant octets of the Prefix are encoded.
- **OSPFv2 Prefix**: represents the OSPFv2 prefix at the tail-end of the advertised PPR. For the address family IPv4 unicast, the prefix itself is encoded as a 32-bit value. The default route is represented by a prefix of length 0.
- **PPR-Prefix Sub-TLVs**: have 2 octet type, 2 octet length and value field is defined per type.

### 2.3. PPR-ID Sub-TLV

This represents the actual data plane identifier in the packet and could be of any data plane as defined in PPR-ID-type field. Both OSPF Prefix and PPR-ID MUST belong to a same node in the network.
Figure 3: PPR-ID Sub-TLV Format

- **Type** - 2 (suggested value, IANA TBD) from OSPFv2 PPR TLV Section 2 Sub-TLV registry.
- **Length** - Total length of the value field in bytes (variable).
- **PPR-ID Type** - Data plane type of PPR-ID. This is a new registry (TBD IANA) for this Sub-TLV and the defined types are as follows:
  - Type: 1 SR-MPLS SID/Label
  - Type: 2 Native IPv4 Address/Prefix
- **PPR-ID Flags** - 2 Octet field for PPR-ID flags:
  
PPR-ID Flags Format
  
  0 1 2 3 4 5 6 7 15
  +------------------+
  | Reserved         |
  +------------------+

  Reserved - Reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.
- **PPR-ID Type** - Data plane type of PPR-ID. Values are defined in [I-D.chunduri-lsr-isis-preferred-path-routing]. Only Type 1 and Type 2 are applicable here.
- **PPR-ID Length** - Length of the PPR-ID field in octets and this depends on the PPR-ID type. See PPR-ID below for the length of this field and other considerations.
o PPR-ID Mask Len - It is applicable for only for PPR-ID Type 2. For Type 1 this value MUST be set to zero. It contains the length of the PPR-ID Prefix in bits. Only the most significant octets of the Prefix are encoded. This is needed, if PPR-ID followed is an IPv4 Prefix instead of 4 octet Address respectively.

o Algo - 1 octet value represents the SPF algorithm. Algorithm registry is as defined in [I-D.ietf-ospf-segment-routing-extensions].

o PPR-ID - This is the Preferred Path forwarding identifier that would be on the data packet. The value of this field is variable and it depends on the PPR-ID Type - for Type 1, this is encoded as SR-MPLS SID/Label. For Type 2 this is a 4 byte IPv4 address encoded similar to PPR-Prefix.

2.4. PPR-PDE Sub-TLV

This is a new Sub-TLV type in PPR TLV Section 2 and is called as PPR Path Description Element (PDE). PPR-PDEs are used to describe the path in the form of set of contiguous and ordered Sub-TLVs, where first Sub-TLV represents (the top of the stack in MPLS data plane or) first node/segment of the path. These set of ordered Sub-TLVs can have both topological SIDs and non-topological SIDs (e.g., service segments).

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Type            |            Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| PPR-PDE Type  |  PDE-ID Type  |  PDE-ID Len   | Reserved      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     PPR-PDE Flags             | PDE-ID Value                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//             PDE-ID Value (Contd., Variable size)            //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  PPR-PDE Sub-TLVs (variable)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 4: PPR-PDE Sub-TLV Format

- Type - 3 (TBD IANA, suggested value) from OSPFv2 PPR TLV Section 2 Sub-TLV registry.

- Length - Total length of the value field in bytes (variable).
o **PPR-PDE Type** - This is a new registry (TBD IANA) for this Sub-TLV and the defined types are as follows:

Type: 1 Topological

Type: 2 Non-Topological

o **PDE-ID Type** - 1 Octet PDE-forwarding IDentifier Type. This is a new registry (TBD IANA) for this Sub-TLV and the defined types and corresponding PDE-ID Len, PDE-ID Value are as follows:

Type 0: This value MUST be set only when PPR-PDE Type is Non-Topological. PDE-ID Len specified in bytes and encoded in NBO in PDE-ID Value field which can represent a service/function. This information is provisioned on the immediate topological PDE preceding to this PDE based on the ‘E’ bit.

Type 1: SID/Label Sub-TLV as defined in [I-D.ietf-ospf-segment-routing-extensions]. PDE-ID Len and PDE-ID Value fields are per Section 2.1 of the referenced document.

Type 2: SR-MPLS Prefix SID. PDE-ID Len and PDE-ID Value are same as Type 1.

Type 3: SR-MPLS Adjacency SID. PDE-ID Len and PDE-ID Value are same as Type 1.

Type 4: IPv4 Node Address. PDE-ID Len is 4 bytes and PDE-ID Value is 4 bytes IPv4 address encoded similar to IPv4 Prefix described in Section 2.2.

Type 5: IPv4 P2P interface Address. PDE-ID Len is 4 bytes and PDE-ID Value is 4 bytes IPv4 address encoded similar to IPv4 Prefix described in Section 2.2.

Type 6: IPv4 LAN interface Address. PDE-ID Len is 4 bytes and PDE-ID Value is 4 bytes IPv4 address encoded similar to IPv4 Prefix described in Section 2.2. This type MUST have OSPF Neighbor ID sub-TLV in the PDE.

o **PDE-ID Len** - 1 Octet. Length of PDE-ID field.

o **Reserved** - 1 Octet reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.

o **PPR-PDE Flags** - 2 Octet flags for this TLV are described below:
PPR-PDE Flags Format

```
+-----------------------------------+
|   L |   D |   E | Reserved | Reserved |
+-----------------------------------+
```

L: Loose Bit: This bit indicates the type of next "Topological PDE-ID" in the path description. If set, the next PDE is Loose. If this flag is unset, the next Topological PDE is Strict Type.

D: Destination Bit: By default this bit MUST be unset. This bit MUST be set only for PPR-PDE Type is Topological and this PDE represents the PDE-ID corresponding to the PPR-Prefix Section 2.2.

E: Egress Bit. By default this bit MUST be unset. This bit MUST be set only for PPR-PDE Type is 2 i.e., Non-Topological and the service needs to be applied on the egress side of the topological PDE preceding this PDE.

Reserved: Reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.

- PPR-PDE Sub-TLVs have 2 octet type, 2 octet length and value field is defined per type.

- PPR-PDE Sub-TLV: Type 4 (IANA TBD), Length Total length of value field in bytes, Value: The Router ID of the neighbor for which the LAN interface is advertised. This Sub-TLV MUST NOT be present, if the PPR-PDE Type is not equal to 1 i.e., Topological PDE and PDE-ID Type 6.

2.5. PPR-Attributes Sub-TLV

PPR-Attribute Sub-TLVs describe the attributes of the path. The following Sub-TLVs draw from a new registry for Sub-TLV numbers; this registry is to be created by IANA, and administered using the first come first serve process:

- Type 1 (Suggested Value, IANA TBD): PPR-Metric Sub-TLV. Length 4 bytes, and Value is metric of this path represented through the PPR-ID. Different nodes can advertise the same PPR-ID for the same Prefix with a different set of PPR-PDE Sub-TLVs and the receiving node MUST consider the lowest metric value.
3. OSPFv3 PPR TLV

The OSPFv3 PPR TLV is a top level TLV of the following LSAs defined in [I-D.ietf-ospf-ospfv3-lsa-extend].

E-Intra-Area-Prefix-LSA
E-Inter-Area-Prefix-LSA
E-AS-External-LSA
E-Type-7-LSA

Multiple OSPFv3 PPR TLVs MAY be advertised in each LSA mentioned above. The OSPFv3 PPR TLV has the following format:

```
+----------------+----------------+----------------+
| 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |
+----------------+----------------+----------------+
| 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |
+----------------+----------------+----------------+
| Type            | Length          |
+----------------+----------------+----------------+
| PPR-Flags       | AF              | Reserved       |
+----------------+----------------+----------------+
| OSPFv3 PPR-Prefix Sub-TLV (variable size) |
+----------------+----------------+----------------+
| PPR-ID          | Sub-TLV (variable size) |
+----------------+----------------+----------------+
| PPR-PDE Sub-TLVs (variable) |
+----------------+----------------+----------------+
| PPR-Attribute Sub-TLVs (variable) |
+----------------+----------------+----------------+
```

Figure 5: OSPFv3 PPR TLV Format

- Type - TBD (IANA) from OSPF Extended Prefix Opaque LSA registry.
- Length - Total length of the value field in bytes (variable).
- PPR-Flags - 2 Octet flags for this TLV are described below.
- AF: Address family for the prefix.
  - AF: 0 - IPv4 unicast
  - AF: 1 - IPv6 unicast
Reserved - 1 Octet reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.

Flags: 2 octet field. The following flags are defined:

OSPFv3 PPR TLV Flags Format

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>
+---|IA|A|Reserved|---+---|Reserved|---+---|

IA-Flag: Inter-Area flag. If set, advertisement is of inter-area type. An ABR that is advertising the OSPF PPR TLV between areas MUST set this bit.

A: The originator of the PPR TLV MUST set the A bit in order to signal that the prefixes and PPR-IDs advertised in the PPR TLV are directly connected to the originators. If this bit is not set, this allows any other node in the network advertise this TLV on behalf of the originating node of the "OSPF Prefix". If PPR TLV is propagated to other areas the A-flag MUST be cleared. In case if the originating node of the prefix has to be disambiguated for any reason including, if it is a Multi Homed Prefix (MHP) or propagated to a different OSPF area, then PPR-Attribute Sub-TLV Source Router ID SHOULD be included.

Reserved - reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.

PPR path description for each OSPF area is computed and given to one of the nodes in that area for dissemination. Similarly path information when crossing the area boundaries MUST be relevant to the destination area. If there is no path information available for the destination area, PPR TLV MUST NOT be leaked regardless of the IA bit status.

3.1. OSPFv3 PPR-Prefix Sub-TLV

The structure of OSPFv3 PPR-Prefix, for which path description is attached to is as follows:
o Type - 1 (suggested value, IANA TBD) from OSPFv3 PPR TLV Section 3 Sub-TLV registry.

o Length - Total length of the value field in bytes (variable).

o Prefix Len - contains the length of the prefix in bits. Only the most significant octets of the Prefix are encoded.

o Mask Length - The length of the prefix in bits. Only the most significant octets of the Prefix are encoded.

o OSPFv3 Prefix - represents the OSPFv3 prefix at the tail-end of the advertised PPR. For the address family IPv4 unicast, the prefix itself is encoded as a 32-bit value. The default route is represented by a prefix of length 0. For the address family (AF in OSPFv3 PPR TLV) in IPv6 unicast, the prefix, encoded as an even multiple of 32-bit words, padded with zeroed bits as necessary. This encoding consumes \((\text{PrefixLength} + 31) / 32\) 32-bit words.

o PPR-Prefix Sub-TLVs have 2 octet type, 2 octet length and value field is defined per type.

3.2. OSPFv3 PPR-ID Sub-TLVs

This represents the actual data plane identifier in the packet and could be of any data plane as defined in PPR-ID-type field. Both OSPF Prefix and PPR-ID MUST belong to a same node in the network.
o Type - 2 (suggested value, IANA TBD) from OSPFv3 PPR TLV Section 3 Sub-TLV registry.

o Length - Total length of the value field in bytes (variable).

o PPR-ID Type - Data plane type of PPR-ID. This is a new registry (TBD IANA) for this Sub-TLV and the defined types are as follows:

  Type: 1 SR-MPLS SID/Label
  Type: 2 Native IPv4 Address/Prefix
  Type: 3 Native IPv6 Address/Prefix
  Type: 4 IPv6 SID in SRv6 with SRH

o PPR-ID Flags - 2 Octet field for PPR-ID flags:

  PPR-ID Flags Format

  0 1 2 3 4 5 6 7 15
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  |L|A| Reserved                  |
  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  Reserved - Reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.

o PPR-ID Length - Length of the PPR-ID field in octets and this depends on the PPR-ID type. See PPR-ID below for the length of this field and other considerations.
o **PPR-ID Mask Len** - It is applicable for only for PPR-ID Type 2, 3 and 4. For Type 1 this value MUST be set to zero. It contains the length of the PPR-ID Prefix in bits. Only the most significant octets of the Prefix are encoded. This is needed, if PPR-ID followed is an IPv4/IPv6 Prefix instead of 4/16 octet Address respectively.

o **Algo** - 1 octet value represents the SPF algorithm. Algorithm registry is as defined in [I-D.ietf-ospf-ospfv3-segment-routing-extensions].

o **PPR-ID** - This is the Preferred Path forwarding identifier that would be on the data packet. The value of this field is variable and it depends on the PPR-ID Type - for Type 1, this is encoded as SR-MPLS SID/Label. For Type 2 this is encoded as 4 byte IPv4 address. For Type 3 this is encoded as 16 byte IPv6 address. For Type 2 and Type 3 encoding is similar to OSPF Prefix as specified in Section 2.2. For Type 4, this is encoded as 16 byte IPv6 SID.

3.3. OSPFv3 PPR-PDE Sub-TLV

This is a new Sub-TLV type in PPR TLV Section 3 and is called as PPR Path Description Element (PDE). PPR-PDEs are used to describe the path in the form of set of contiguous and ordered Sub-TLVs, where first Sub-TLV represents (the top of the stack in MPLS data plane or) first node/segment of the path. These set of ordered Sub-TLVs can have both topological SIDs and non-topological SIDs (e.g., service segments).

```
+---+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type       |            Length             |
+---+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  PPR-PDE Type  |  PDE-ID Type  |  PDE-ID Len   |  Reserved      |
+---+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  PPR-PDE Flags |  PDE-ID Value                 //
+---+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//  PDE-ID Value (Contd., Variable size)  //
+---+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  PPR-PDE Sub-TLVs (variable)          |
+---+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

**Figure 8: OSPFv3 PPR-PDE Sub-TLV Format**

o **Type** - 3 (suggested value, IANA TBD) from OSPFv3 PPR TLV Section 3 Sub-TLV registry.
o Length - Total length of the value field in bytes (variable).

o PPR-PDE Type - This is a new registry (TBD IANA) for this Sub-TLV and the defined types are as follows:

  Type: 1 Topological
  Type: 2 Non-Topological

o PDE-ID Type - 1 Octet PDE-forwarding IDentifier Type. This is a new registry (TBD IANA) for this Sub-TLV and the defined types and corresponding PDE-ID Len, PDE-ID Value are as follows:

  Type 0: This value MUST be set only when PPR-PDE Type is Non-Topological. PDE-ID Len specified in bytes and encoded in NBO in PDE-ID Value field which can represent a service/function. This information is provisioned on the immediate topological PDE preceding to this PDE based on the ‘E’ bit.

  Type 1: SID/Label Sub-TLV as defined in [I-D.ietf-ospf-segment-routing-extensions]. PDE-ID Len and PDE-ID Value fields are per Section 2.1 of the referenced document.

  Type 2: SR-MPLS Prefix SID. PDE-ID Len and PDE-ID Value are same as Type 1.

  Type 3: SR-MPLS Adjacency SID. PDE-ID Len and PDE-ID Value are same as Type 1.

  Type 4: IPv4 Node Address. PDE-ID Len is 4 bytes and PDE-ID Value is 4 bytes IPv4 address encoded similar to IPv4 Prefix described in Section 2.2.

  Type 5: IPv4 P2P interface Address. PDE-ID Len is 4 bytes and PDE-ID Value is 4 bytes IPv4 address encoded similar to IPv4 Prefix described in Section 2.2.

  Type 6: IPv4 LAN interface Address. PDE-ID Len is 4 bytes and PDE-ID Value is 4 bytes IPv4 address encoded similar to IPv4 Prefix described in Section 2.2. This type MUST have OSPF Neighbor ID Sub-TLV in the PDE.

  Type 7: IPv6 Node Address. PDE-ID Len is 16 bytes and PDE-ID Value is 16 bytes IPv6 address encoded similar to IPv6 Prefix described in Section 2.2.
Type 8: IPv6 P2P interface Address. PDE-ID Len is 16 bytes and PDE-ID Value is 16 bytes IPv6 address encoded similar to IPv6 Prefix described in Section 2.2.

Type 9: IPv6 LAN interface Address. PDE-ID Len is 16 bytes and PDE-ID Value is 16 bytes IPv6 address encoded similar to IPv6 Prefix described in Section 2.2. This type MUST have OSPF Neighbor ID Sub-TLV in the PDE.

Type 10: SRv6 Node SID as defined in [I-D.li-ospf-ospfv3-srv6-extensions]. PDE-ID Len and PDE-ID Value are as defined in SRv6 SID.

Type 11: SRv6 Adjacency-SID. PDE-ID Len and PDE-ID Value are as defined in Type 6.

- PDE-ID Len - 1 Octet. Length of PDE-ID field.
- Reserved - 1 Octet reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.
- PPR-PDE Flags - 2 Octet flags for this TLV are described below:

  PPR-PDE Flags Format

  0 1 2 3 4 5 6 7... 15
  ++++++++++++++++++++++++++++++
  |L|D|E| Reserved |
  ++++++++++++++++++++++++++++++

  L: Loose Bit. This bit indicates the type of next "Topological PDE-ID" in the path description and overrides the L bit in Section 3.2. If set, the next PDE is Loose. If this flag is unset, the next Topological PDE is Strict Type.

  D: Destination Bit. By default this bit MUST be unset. This bit MUST be set only for PPR-PDE Type is Topological and this PDE represents the PDE-ID corresponding to the PPR-Prefix Section 3.1.

  E: Egress Bit. By default this bit MUST be unset. This bit MUST be set only for PPR-PDE Type is 2 i.e., Non-Topological and the service needs to be applied on the egress side of the topological PDE preceding this PDE.

  Reserved - Reserved bits for future use. Reserved bits MUST be reset on transmission and ignored on receive.
o PPR-PDE Sub-TLVs have 2 octet type, 2 octet length and value field is defined per type.

o PPR-PDE Sub-TLV: Type 4 (IANA TBD), Length Total length of value field in bytes, Value: The Router ID of the neighbor for which the LAN interface is advertised. This Sub-TLV MUST NOT be present, if the PPR-PDE Type is not equal to 1 i.e., Topological PDE and PDE-ID Type 6/9.

3.4. OSPFv3 PPR-Attributes Sub-TLV

PPR-Attribute Sub-TLVs describe the attributes of the path. The following Sub-TLVs draw from a new registry for Sub-TLV numbers; this registry is to be created by IANA, and administered using the first come first serve process:

o Type 1 (suggested value, IANA TBD): PPR-Metric Sub-TLV. Length 4 bytes, and Value is metric of this path represented through the PPR-ID. Different nodes can advertise the same PPR-ID for the same Prefix with a different set of PPR-PDE Sub-TLVs and the receiving node MUST consider the lowest metric value.

4. Other Considerations

Please refer to [I-D.chunduri-isis-preferred-path-routing] section 4, 5, 6 and 7.

5. Acknowledgements

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Earlier versions of draft-ietf-ospf-segment-routing-extensions have a mechanism to advertise EROs through Binding SID.

6. IANA Considerations

This document requests the following new TLV in IANA OSPFv2 and OSPFv3 TLV code-point registry as specified in Section 2 Section 3 respectively.
This document also requests IANA to create new registries for PPR TLV Flags field, PPR Flags, and PPR Sub-TLVs in PPR TLV as described in Section 2 and Section 3.

7. Security Considerations

Existing security extensions as described in [RFC2328] and [RFC7684] apply to the extensions specified in this document. While OSPF is under a single administrative domain, there can be deployments where potential attackers have access to one or more networks in the OSPF routing domain. In these deployments, stronger authentication mechanisms such as those specified in [RFC7474] SHOULD be used.

Advertisement of the additional information defined in this document introduces no new security concerns in OSPF protocol. However as this extension is related to SR-MPLS and SRH data planes as defined in [I-D.ietf-spring-segment-routing], those particular data plane security considerations does apply here.

8. References

8.1. Normative References


8.2. Informative References

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