BGP-LS extensions for Preferred Path Routing
draft-chunduri-idr-bgp-ls-ppr-ext-00

Abstract

This document describe extensions to BGP-LS protocol to include Preferred Path Routing (PPR) information. This document also extends BGP-LS protocol and define new SAFIs and NLRIs for propagating path information from a central entity to a node in the network in the south bound direction.

Requirements Language

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 RFC2119 [RFC2119], RFC8174 [RFC8174] when, and only when they appear in all capitals, as shown here.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on November 18, 2019.
1. Introduction

Preferred Path Routing (PPR) is a path routing mechanism where routing happens on path identifier in the packet as opposed to individual segments in the packet as defined in [RFC8402]. PPRs allow path routing for any underlying data plane with abstracted path identifier to represent the path of the data packet. Definition and usage of PPRs by the link state routing protocols (IS-IS, OSPFv2 and OSPFv3) within IGP topologies are detailed in [I-D.chunduri-lsr-isis-preferred-path-routing] and [I-D.chunduri-lsr-ospf-preferred-path-routing].

PPR-Identifier (PPR-ID) TLV allows advertisement of multi-hop Traffic Engineered (TE) paths, Fast Re-Routing (FRR) or certain chained paths. The flooding scope for the IGP extensions for PPRs is an IGP area/
domain. Consequently, the contents of a Link State Database (LSDB) or a Traffic Engineering Database (TED) has the scope of an IGP area/domain and therefore by using the IGP alone it is not enough to construct PPRs across multiple IGP Areas or AS boundaries.

Even though a central entity provisions the PPRs at one of the network node, not all PPRs are active and advertised in IGPs as these could be subjected to the local policies of the network node. PPRs can also be potentially created locally by operators, it is critical to have a complete view of currently active PPRs in the network for creating end-to-end paths crossing multiple IGP areas and AS boundaries.

To take care of the above cases, this document describes extensions to BGP-LS to advertise PPR information in Prefix NLRI as described in Section 2. An external component, which is a BGP-LS [RFC7752] speaker (e.g., a controller) then can collect active PPR information in the network in "north bound" direction across IGP areas or ASes.

In some environments, where single protocol is desired for controller communication with the network nodes, new SAFIs and new NLRI types are defined to signal the PPR paths from external BGP-LS speaker to the network nodes in Section 3. This information is subjected to the local policies of the network node and eventually can be signaled in an IGP as defined in IGP PPR extensions.

1.1. Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGP</td>
<td>Interior Gateway Protocols</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum Transferrable Unit</td>
</tr>
<tr>
<td>PPR</td>
<td>Preferred Path Route/Routing</td>
</tr>
<tr>
<td>SID</td>
<td>Segment Identifier</td>
</tr>
<tr>
<td>SR</td>
<td>Segment Routing</td>
</tr>
<tr>
<td>TE</td>
<td>Traffic Engineering</td>
</tr>
</tbody>
</table>

2. PPR-ID TLVs Supported by a Prefix

This section defines a new TLV, PPR-ID TLV in BGP-LS Prefix Attributes of Prefix NLRI and describes the encoding of the same. The BGP-LS Prefix attribute, PPR-ID TLV has the following format:
Figure 1: Prefix attribute - PPR-ID TLV Format

Type - TBD (Suggested Value 1174, IANA TBD).

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

AF - See Section 2.1.

MT-ID - is the multi-topology identifier defined in [RFC5120] with 4 most significant bits reset on transmission and ignored on receive. The remaining 12-bit field contains the MT-ID. For OSPFv2 this is as defined in [RFC4915]. For OSPFv3 it MUST be set to zero.

Prefix Len - contains the length of the prefix in bits.

Prefix - represents the the tail-end node address of the advertised PPR. Value of this field MUST be encoded as a 32-bit value for IPv4 "Prefix". Value of this field MUST be 16 octets for IPv6 "Prefix", encoded as an even multiple of 32-bit words, padded with zeroed bits as necessary. This encoding consumes ((PrefixLength + 31) / 32) 32-bit words.

Flags: 1 octet field of PPR-ID TLV has flags as defined in respective IGP and encoded based on the Protocol-ID field in BGP-LS node NLRI.

2.1. PPR-ID Encoding

This TLV can be seen as having 3 logical section viz., encoding of Prefix, encoding of PPR-ID with description of ordered path with sub-TLVs and a set of optional PPR-Attribute Sub-TLVs, which can be used to describe one or more parameters of the PPR. Out of the above only the first logical section i.e., encoding Prefix is described here in
The advertisement of PPR-ID TLV in IS-IS has following semantics:

The IS-IS 'PPR-ID Encoding' as defined in Section 2 is encoded in the BGP-LS Prefix Attribute TLV and the format is as defined in [I-D.chunduri-lsr-isis-preferred-path-routing] including PPR-ID, PPR-PDE Sub-TLVs and all possible PPR-Attribute Sub-TLVs. The AF field for IS-IS MUST be set to zero. The flags of the PPR-ID TLV are semantically mapped to the definition in [I-D.chunduri-lsr-isis-preferred-path-routing] section 2.

The advertisement of PPR-ID TLV in OSPF has following semantics:

The OSPFv2/OSPFv3 "PPR-ID Encoding" as defined in Section 2 is encoded in the BGP-LS Prefix Attribute TLV and the format is as defined in [I-D.chunduri-lsr-ospf-preferred-path-routing] including PPR-ID, PPR-PDE Sub-TLVs and all possible PPR-Attribute Sub-TLVs. The flags and AF of the PPR-ID TLV are semantically mapped to the definition in [I-D.chunduri-lsr-ospf-preferred-path-routing] section 2 for OSPFv2 or section 3 for OSPFv3.

3. Southbound BGP-LS SAFI and NLRIs

This document extends the [RFC7752] by defining two new South Bound (SB) SAFIs to be used with BGP-LS AFI 16388. All non-VPN SB prefix information SHALL be encoded using AFI 16388 / SAFI 75 (suggested value for SB-BGP-LS SAFI, IANA TBD). VPN SB prefix information SHALL be encoded using AFI 16388 / SAFI 76 (suggested value for SB-BGP-LS-VPN SAFI, IANA TBD).

This document also extends then BGP-LS by defining 2 new south bound NLRI types, one for SB IPv4 Topology Prefix (type 5, suggested value, IANA TBD) and one for SB IPv6 Topology Prefix NLRI (type 6, suggested value, IANA TBD). As with other BGP-LS SAFIs, in order for two BGP speakers to exchange SB Link-State NLRI, they MUST use BGP Capabilities Advertisement to advertise SB SAFIs to ensure that they are both capable of properly processing such NLRI.

Encoding for the new SB SAFIs and new SB NLRIs are applicable to [RFC7752], including the parameters as defined in "BGP-LS Protocol-IDs", "BGP-LS Well-Known Instance-IDs" and "BGP-LS Node Descriptor, Link Descriptor, Prefix Descriptor, and Attribute TLVs".
PPR-ID Prefix Attribute TLV as defined in Section 2 can be advertised with SB IPv4/IPv6 Topology Prefix NLRIs. When this is done this information is advertised in the corresponding underlying IGP subjected to the local node policy.

4. Acknowledgements
TBD.

5. IANA Considerations

5.1. New BGP-LS Attribute

This document requests IANA to assign a code point from the "BGP-LS Node Descriptor, Link Descriptor, Prefix Descriptor, and Attribute TLVs" registry as follows: BGP-LS Node Attribute - PPR-ID TLV as described in Section 2.

<table>
<thead>
<tr>
<th>TLV #</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD</td>
<td>PPR-ID TLV in Prefix attribute</td>
</tr>
</tbody>
</table>

5.2. New BGP-LS SAFIs

This document defines a new SAFIs in the registry "Subsequent Address Family Identifiers (SAFI) Parameters" that has been assigned by IANA:

<table>
<thead>
<tr>
<th>SAFI #</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>SB-BGP-LS</td>
<td>This Document</td>
</tr>
<tr>
<td>76</td>
<td>SB-BGP-LS-VPN</td>
<td>This Document</td>
</tr>
</tbody>
</table>

5.3. New BGP-LS NLRIs

This document requests IANA to assign a code point from the "BGP-LS NLRI-Types" registry as follows:

<table>
<thead>
<tr>
<th>NLRI #</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>SB IPv4 Topology Prefix</td>
<td>This Document</td>
</tr>
<tr>
<td>6</td>
<td>SB IPv6 Topology Prefix</td>
<td>This Document</td>
</tr>
</tbody>
</table>
6. Security Considerations

This document does not introduce security issues beyond those discussed in [RFC7752]

7. References

7.1. Normative References

[I-D.chunduri-lsr-isis-preferred-path-routing]

[I-D.chunduri-lsr-ospf-preferred-path-routing]


7.2. Informative References


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