BGP Extensions of SR Policy for Segment List Identification and Protection

Abstract

This document proposes extensions of BGP to provide identification and protection information of segment lists within a candidate path when delivering SR policy. And it also extends BGP-LS to provide some extra information of the segment list in the advertisement.

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1. Introduction

   Segment Routing [RFC8402] allows a headend node to steer a packet
   flow along any path. [I-D.ietf-spring-segment-routing-policy]
   details the concept of SR Policy and steering into an SR Policy. An
   SR Policy is a set of candidate paths, each consisting of one or
   more segment lists. The headend of an SR Policy may learn multiple
   candidate paths for an SR Policy.

   Candidate path can be used for path protection, that is, the lower
   preference candidate path may be designated as the backup for a
   specific or all (active) candidate path(s). Backup candidate path
   provide protection only when all the segment lists in the active CP
   are invalid.

   If a candidate path is associated with a set of Segment-Lists, each
   Segment-List is associated with weight for weighted load balancing.

   The protection mechanism for SR Policy is not flexible enough. For
   example, there're three segment lists(SL1, SL2, SL3) in candidate
   path 1, it may be desired that SL1 and SL2 are the primary path, SL3
   are the backup path for SL1 and will be active only when SL1 fails.

   [I-D.ietf-pce-multipath] proposes extensions to PCEP to specify the
   protection relationship between segment lists in the candidate path.

   [I-D.ietf-idr-segment-routing-te-policy] specifies BGP extensions
   for the advertisement of SR Policies and each candidate path is
   carried in an NLRI. This document proposes extensions of BGP in

order to provide identification and protection information of segment lists when delivering SR policy.

[I-D.ietf-idr-te-lsp-distribution] describes a mechanism to collect the SR policy information that is locally available in a node and advertise it into BGP Link State (BGP-LS) updates. This document also extends it to provide some extra information of the segment list in a candidate path in the BGP-LS advertisement.

1.1. 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].

2. BGP Extensions for Advertising Segment List

2.1. Extensions of Segment List sub-TLV

Segment List sub-TLV is introduced in [I-D.ietf-idr-segment-routing-te-policy] and it includes the elements of the paths (i.e., segments).

This document introduces a one-bit flag in the RESERVED field.

```
    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             |B|  RESERVED   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   //                          sub-TLVs                          //
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Segment List sub-TLV

B-Flag(Backup Flag): one bit. When set to 0, it indicates that the segment list acts as the active member in the candidate path. When set to 1, it indicates that the segment list acts as the backup path in the candidate path.

Using segment lists for path protection can be compatible with using candidate paths. When a path fails, the backup segment list within the same candidate path is used preferentially for path protection. If the backup list is also invalid, then other candidate path can be enabled for protection.

2.2. List Identifier Sub-TLV

This document introduces a new sub-sub-tlv of Segment List sub-TLV,
where,

```
 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     |           RESERVED            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        List Identifier                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                       Optional sub-TLVs                       ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

                   Figure 2: List Identifier Sub-TLV

*Type: 1 octet. TBD.

*Length: 1 octet, specifies the length of the value field not
 including Type and Length fields.

*RESERVED: 2 octet of reserved bits. SHOULD be unset on
 transmission and MUST be ignored on receipt.

*List Identifier: 4 octets. It is the identifier of the
 corresponding segment list, so that the segment list can be
 operated according to the specified Segment List identifier.

*This sub-TLV is optional and it MUST NOT appear more than once
 inside the Segment List sub-TLV.

2.2.1. List Protection Sub-TLV

The List Protection Info sub-TLV is an optional sub-TLV of List
Identifier sub-TLV, where:

```
     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     |           RESERVED            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                     Backup  List ID 1                         |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                            ...                                |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                     Backup  List ID N                         |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
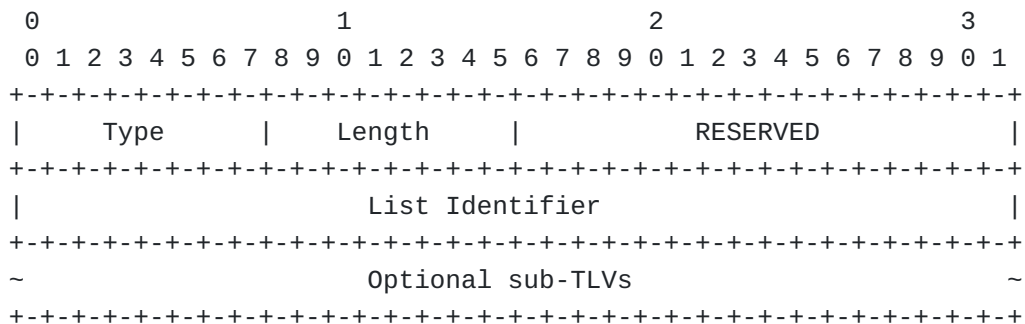
                 Figure 3: List Protection Info Sub-TLV

  *Type: 1 octet. TBD.

  *Length: 1 octet, specifies the length of the value field not
   including Type and Length fields.

  *RESERVED: 2 octet of reserved bits. SHOULD be unset on
   transmission and MUST be ignored on receipt.

  *Backup List ID: 4 octets. It is the List Identifier of the backup
   segment list that protects this segment list. If there're
   multiple backup paths, the list ID of each path should be
   included in the TLV.

As defined in [I-D.ietf-idr-segment-routing-te-policy], the SR
Policy encoding structure is as follows:

   SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
   Attributes:
      Tunnel Encaps Attribute (23)
         Tunnel Type: SR Policy
              Binding SID
              Preference
              Priority
              Policy Name
              Explicit NULL Label Policy (ENLP)
              Segment List
                  Weight
                  Segment
                  Segment
                  ...
              Segment List
                  ...
              ...
```

The new SR Policy encoding structure with List Identifier sub-TLV is
shown as below:

```
 SR Policy SAFI NLRI: <Distinguisher, Policy-Color, Endpoint>
 Attributes:
Tunnel Encaps Attribute (23)
  Tunnel Type: SR Policy
       Binding SID
       SRv6 Binding SID
       Preference
       Priority
       Policy Name
       Policy Candidate Path Name
       Explicit NULL Label Policy (ENLP)
       Segment List
           List Identifier
             List Protection Info
           Weight
           Segment
           Segment
           ...
       Segment List
           ...
       ...
```

3. BGP-LS Extensions for Distributing Segment List States

[I-D.ietf-idr-te-lsp-distribution] describes a mechanism to collect
the SR Policy information that is locally available in a node and
advertise it into BGP Link State (BGP-LS) updates. The SR Policy
information includes status of the candidate path, e.g, whether the
candidate path is administrative shut or not.

SR Segment List TLV is defined in [I-D.ietf-idr-te-lsp-distribution]
to to report the SID-List(s) of a candidate path. Figure 4 shows the
flags in SR Segment List TLV.

```
          0                   1
          0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
         +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
         |D|E|C|V|R|F|A|T|M|S|B|         |
         +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

          Figure 4: Flag Field of SR Segment List TLV

The D,E,C,V,R,F,A,M flags are defined in [I-D.ietf-idr-te-lsp-
distribution].

This document introduces two new flags, where,

  *S-Flag : Indicates the segment list is in administrative shut
   state when set.

  *B-Flag : Indicates the segment list is the backup path within the
   candidate path when set, otherwise it is the active path.

4. IANA Considerations

4.1. New Registry: Flag Field of Segment List sub-TLV

This document introduces a one-bit flag field in the Segment List
sub-TLV [I-D.ietf-idr-segment-routing-te-policy] for the Backup Flag
(B-Flag).

4.2. Existing Registry: BGP Tunnel Encapsulation Attribute sub-TLVs

This document defines a new sub-TLV in the registry "SR Policy List
Sub-TLVs" [I-D.ietf-idr-segment-routing-te-policy] to be assigned by
IANA:

Codepoint	Description	Reference
TBD	List Identifier Sub-TLV	This document

4.3. New Registry: List Identifier Sub-TLVs

This document requests the creation of a new registry called "List
Identifier Sub-TLVs" under the "BGP Tunnel Encapsulation" registry.
Following initial Sub-TLV codepoint are assigned by this document.

Codepoint	Description	Reference
TBD	List Protection Sub-TLV	This document

4.4. Existing Registry: Flag Field of SR Segment List TLV

This document requests bit 9 and bit 10 in the flag field of "SR
Segment List TLV" [I-D.ietf-idr-te-lsp-distribution] under the "BGP-
LS Node Descriptor, Link Descriptor, Prefix Descriptor, and
Attribute TLVs" registry.

Bit	Description	Reference
9	Administrative Shut State Flag(S-Flag)	This document
10	Backup Path State Flag(B-Flag)	This document

5. Security Considerations

   Procedures and protocol extensions defined in this document do not
   affect the security considerations discussed in [I-D.ietf-idr-
   segment-routing-te-policy] and [I-D.ietf-idr-te-lsp-distribution].

6. References

6.1. Normative References

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6.2. Informative References

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[RFC8402] Filsfils, C., Ed., Previdi, S., Ed., Ginsberg, L.,
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