SR Policy Extensions for Path Segment and Bidirectional Path
draft-li-idr-sr-policy-path-segment-01

Abstract

   A Segment Routing (SR) policy is a set of candidate SR paths
   consisting of one or more segment lists with necessary path
   attributes. For each SR path, it may also have its own path
   attributes, and Path Segment is one of them. A Path Segment is
   defined to identify an SR path, which can be used for performance
   measurement, path correlation, and end-2-end path protection. Path
   Segment can be also used to correlate two unidirctional SR paths into
   a bidirectional SR path which is required in some scenarios, for
   example, mobile backhaul transport network.

   This document defines extensions to BGP to distribute SR policies
   carrying Path Segment and bidirectional path information.

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 RFC 2119 [RFC2119].

Status of This Memo

time. It is inappropriate to use Internet-Drafts as reference
material or to cite them other than as "work in progress."

This Internet-Draft will expire on February 9, 2020.

Copyright Notice

Table of Contents

1. Introduction

Segment routing (SR) [RFC8402] is a source routing paradigm that
explicitly indicates the forwarding path for packets at the ingress
node. The ingress node steers packets into a specific path according
to the Segment Routing Policy (SR Policy) as defined in
[I-D.ietf-spring-segment-routing-policy]. For distributing SR
policies to the headend, [I-D.ietf-idr-segment-routing-te-policy]

specifies a mechanism by using BGP, and new sub-TLVs are defined for
SR Policies in BGP UPDATE message.

In many use cases such as performance measurement, the path to which
the packets belong is required to be identified. Futhermore, in some
scenarios, for example, mobile backhaul transport network, there are
requirements to support bidirectional path. However, there is no
path identification information for each Segment List in the SR
Policies defined in [I-D.ietf-spring-segment-routing-policy]. Also,
the SR Policies defined in [I-D.ietf-spring-segment-routing-policy]
only supports unidirectional SR paths.

Therefore, this document defines the extension to SR policies that
carry Path Segment in the Segment List and support bidirectional
path. The Path Segment can be a Path Segment in SR-MPLS
[I-D.ietf-spring-mpls-path-segment] , or other IDs that can identify
a path. Also, this document defines extensions to BGP to distribute
SR policies carriying Path Segment and bidirectional path
information.

2. Terminology

This memo makes use of the terms defined in [RFC8402] and
[I-D.ietf-idr-segment-routing-te-policy].

3. Path Segment in SR Policy

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
                 ...
            ...
```

An SR path can be specified by an Segment List sub-TLV that contains
a set of segment sub-TLVs and other sub-TLVs as shown above. As

defined in [I-D.ietf-spring-segment-routing-policy], a candidate path
includes multiple SR paths specified by SID list. The Path Segment
can be used for idendifying an SR path(specified by SID list). Also,
it can be used for identifying an SR candidate path or an SR Policy
in some use cases if needed. New SR Policy encoding structure is
expressed as below:

```
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)
            Path Segment
            Segment List
                Weight
                Path Segment
                Segment
                Segment
                ...
            Segment List
                Weight
                Path Segment
                Segment
                Segment
                ...
         ...
```

The Path Segment can appear at both segment-list level and candidate
path level, and generally it SHOULD also appear only at one level
depending upon use case. Path segment at segment list level and at
candidate path level may be same or may be different based on usecase
and the ID allocation scope. When multiple Path Segments appear in
both levels, it means the the Path Segment associated with candidate
path and segment list SHOULD both be inserted into the SID list.

3.1. SR Path Segment Sub-TLV

This section defines an SR Path Segment sub-TLV.

An SR Path Segment sub-TLV can be included in the segment list sub-
TLV to identify an SID list, and it MUST appear only once within a
Segment List sub-TLV. It has the following format:
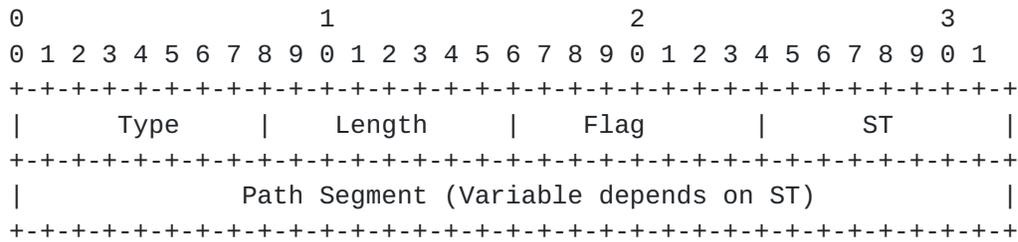
```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |      Type       |     Length      |     Flag       |     ST       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |              Path Segment (Variable depends on ST)            |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     Figure 1. Path Segment sub-TLV
```

Where:

Type: to be assigned by IANA (suggested value 10).

Length: the total length of the value field not including Type and
Length fields.

Flag: 8 bits of flags. Following flags are defined:

```
   0  1  2  3  4  5  6  7
+--+--+--+--+--+--+--+--+
|    Reserved       |G |
+--+--+--+--+--+--+--+--+
```
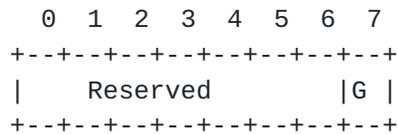
G-Flag: Global flag. Set when the Path Segment is global within an
SR domain.

Reserved: 5 bits reserved and MUST be set to 0 on transmission and
MUST be ignored on receipt.

ST: Segment type, specifies the type of the Path Segment, and it has
following types:

o   0: SR-MPLS Path Segment

o   1-255:Reserved

Path Segment: The Path Segment of an SR path. The Path Segment type
is indicated by the Segment Type(ST) field. It can be a Path Segment
in SR-MPLS [I-D.ietf-spring-mpls-path-segment], which is 32-bits
value, which is a 128-bits value, or other IDs that can identify a
path.

4. SR Policy for Bidirectional Path

In some scenarios, for example, mobile backhaul transport network,
there are requirements to support bidirectional path. In SR, a
bidirectional path can be represented as a binding of two
unidirectional SR paths. This document also defines new sub-TLVs to

describe an SR bidirectional path. An SR policy carrying SR
bidirectional path information is expressed as below:

```
    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)
            Bidirectioanl Path
                Segment List
                    Weight
                    Path Segment
                    Segment
                    Segment
                    ...
                Reverse Segment List
                    Weight
                    Path Segment
                    Segment
                    Segment
                    ...
```

4.1. SR Bidirectional Path Sub-TLV

This section defines an SR bidirectional path sub-TLV to specify a
bidirectional path, which contains a Segment List sub-TLV
[I-D.ietf-idr-segment-routing-te-policy] and an associated Reverse
Path Segment List as defined at section 4.2. The SR bidirectional
path sub-TLV has the following format:
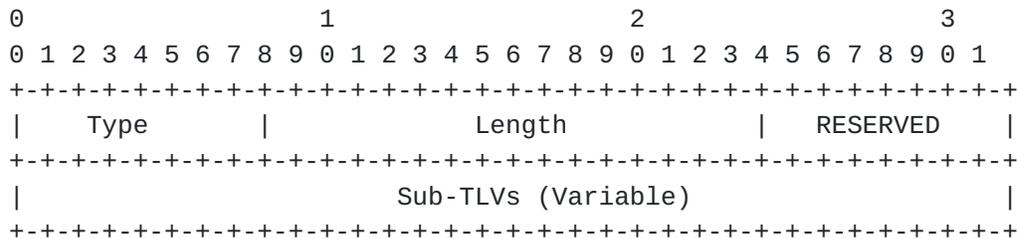
```
  0                   1                   2                   3
  0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |    Type       |            Length         |    RESERVED      |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                    Sub-TLVs (Variable)                       |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
             Figure 2. SR Bidirectional path sub-TLV
```

Where:

Type: TBA, and the suggest value is 14.

Length: the total length of the sub-TLVs encoded within the SR
Bidirectional Path Sub-TLV not including Type and Length fields.

RESERVED: 1 octet of reserved bits. SHOULD be unset on transmission
and MUST be ignored on receipt.

Sub-TLVs:

o An Segment List sub-TLV

o An associated Reverse Path Segment List sub-TLV

4.2. SR Reverse Path Segment List Sub-TLV

An SR Reverse Path Segment List sub-TLV is defined to specify an SR
reverse path associated with the path specified by the Segment List
in the same SR Bidirectional Path Sub-TLV, and it has the following
format:

```
  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    |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                       Sub-TLVs (Variable)                     |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
          Figure 2. SR Reverse Path Segment List Sub-TLV
```

where:

Type: TBA, and suggest value is 127.

Length: the total length of the sub-TLVs encoded within the SR
Reverse Path Segment List Sub-TLV not including the Type and Length
fields.

RESERVED: 1 octet of reserved bits. SHOULD be unset on transmission
and MUST be ignored on receipt.

sub-TLVs, reuse the sub-TLVs in Segment List defined in
[I-D.ietf-idr-segment-routing-te-policy].

o An optional single Weight sub-TLV.

o An mandatory SR Path Segment sub-TLV that contains the Path
   Segment of the reverse SR path.

o Zero or more Segment sub-TLVs to specify the reverse SR path.

The Segment sub-TLVs in the Reverse Path Segment List sub-TLV
provides the information of the reverse SR path, which can be used
for directing egress BFD peer to use specific path for the reverse
direction of the BFD session [I-D.ietf-mpls-bfd-directed] or other
applications.

5. Operations

The document does not bring new operation beyong the description of
operations defined in [I-D.ietf-idr-segment-routing-te-policy]. The
existing operations defined in
[I-D.ietf-idr-segment-routing-te-policy] can apply to this document
directly.

Typically but not limit to, the unidirectional or bidirectional SR
policies carrying path identification infomation are configured by a
controller.

After configuration, the unidirectional or bidirectional SR policies
carrying path identification infomation will be advertised by BGP
update messages. The operation of advertisement is the same as
defined in [I-D.ietf-idr-segment-routing-te-policy], as well as the
receiption.

The consumer of the unidirectional or bidirectional SR policies is
not the BGP process, it can be any applications, such as performance
measurement [I-D.gandhi-spring-udp-pm]. The operation of sending
information to consumers is out of scope of this document.

6. IANA Considerations

This document defines new Sub-TLVs in following registries:

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

This document defines new sub-TLVs in the registry "BGP Tunnel
Encapsulation Attribute sub-TLVs" to be assigned by IANA:

```
     Codepoint   Description                           Reference
     ---------------------------------------------------------------
     14          Path Segment sub-TLV                  This document
     15          SR Bidirectional Path sub-TLV         This document
     127         Reverse Segment List sub-TLV          This document
```

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

```
       Codepoint   Description                     Reference
       ---------------------------------------------------------------
       14          Path Segment sub-TLV            This document
```

7. Security Considerations

   TBA

8. Acknowledgements

   Many thanks to Shraddha Hedge for her detailed review and
   professional comments.

9. References

9.1. Normative References

   [I-D.ietf-idr-segment-routing-te-policy]
             Previdi, S., Filsfils, C., Mattes, P., Rosen, E., Jain,
             D., and S. Lin, "Advertising Segment Routing Policies in
             BGP", draft-ietf-idr-segment-routing-te-policy-07 (work in
             progress), July 2019.

   [I-D.ietf-spring-mpls-path-segment]
             Cheng, W., Li, H., Chen, M., Gandhi, R., and R. Zigler,
             "Path Segment in MPLS Based Segment Routing Network",
             draft-ietf-spring-mpls-path-segment-00 (work in progress),
             March 2019.

   [I-D.ietf-spring-segment-routing-policy]
             Filsfils, C., Sivabalan, S., daniel.voyer@bell.ca, d.,
             bogdanov@google.com, b., and P. Mattes, "Segment Routing
             Policy Architecture", draft-ietf-spring-segment-routing-
             policy-03 (work in progress), May 2019.

   [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
             Requirement Levels", BCP 14, RFC 2119,
             DOI 10.17487/RFC2119, March 1997,
             <https://www.rfc-editor.org/info/rfc2119>.

   [RFC8402] Filsfils, C., Ed., Previdi, S., Ed., Ginsberg, L.,
             Decraene, B., Litkowski, S., and R. Shakir, "Segment
             Routing Architecture", RFC 8402, DOI 10.17487/RFC8402,
             July 2018, <https://www.rfc-editor.org/info/rfc8402>.

9.2. Informative References

   [I-D.gandhi-spring-udp-pm]
              Gandhi, R., Filsfils, C., daniel.voyer@bell.ca, d.,
              Salsano, S., Ventre, P., and M. Chen, "UDP Path for In-
              band Performance Measurement for Segment Routing
              Networks", draft-gandhi-spring-udp-pm-02 (work in
              progress), September 2018.

   [I-D.ietf-mpls-bfd-directed]
              Mirsky, G., Tantsura, J., Varlashkin, I., and M. Chen,
              "Bidirectional Forwarding Detection (BFD) Directed Return
              Path", draft-ietf-mpls-bfd-directed-11 (work in progress),
              April 2019.

Authors' Addresses

   Cheng Li
   Huawei Technologies
   Huawei Campus, No. 156 Beiqing Rd.
   Beijing 100095
   China

   Email: chengli13@huawei.com

   Huanan Chen
   China Telecom
   109 West Zhongshan Ave
   Guangzhou
   China

   Email: chenhn8.gd@chinatelecom.cn

   Mach(Guoyi) Chen
   Huawei Technologies
   Huawei Campus, No. 156 Beiqing Rd.
   Beijing 100095
   China

   Email: Mach.chen@huawei.com

Jie Dong
Huawei Technologies
Huawei Campus, No. 156 Beiqing Rd.
Beijing 100095
China

Email: jie.dong@huawei.com

Zhenbin Li
Huawei Technologies
Huawei Campus, No. 156 Beiqing Rd.
Beijing 100095
China

Email: lizhenbin@huawei.com