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Advertising Segment Routing Policies in BGP
draft-ietf-idr-segment-routing-te-policy-18

Abstract

   This document introduces a BGP SAFI with two NLRIs to advertise a
   candidate path of a Segment Routing (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 paths may be learned via several different
   mechanisms, e.g., CLI, NetConf, PCEP, or BGP. This document
   specifies how BGP may be used to distribute SR Policy candidate
   paths. It defines sub-TLVs for the Tunnel Encapsulation Attribute
   for signaling information about these candidate paths.

   This documents updates RFC9012 with extensions to the Color Extended
   Community to support additional steering modes over SR Policy.

Status of This Memo

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1. Introduction

   Segment Routing (SR) [RFC8402] allows a headend node to steer a
   packet flow along any path. Intermediate per-path states are
   eliminated thanks to source routing.

   The headend node is said to steer a flow into an SR Policy [RFC8402].

   The packets steered into an SR Policy carry an ordered list of
   segments associated with that SR Policy.

   [I-D.ietf-spring-segment-routing-policy] details the concepts of SR
   Policy and steering into an SR Policy. These apply equally to the
   SR-MPLS and Segment Routing for IPv6 (SRv6) data-plane instantiations
   of Segment Routing using SR-MPLS and SRv6 Segment Identifiers (SIDs)
   as described in [RFC8402]. [RFC8660] describes the representation
   and processing of this ordered list of segments as an MPLS label
   stack for SR-MPLS. While [RFC8754] and [RFC8986] describe the same
   for SRv6 with the use of the Segment Routing Header (SRH).

   The SR Policy related functionality described in
   [I-D.ietf-spring-segment-routing-policy] can be conceptually viewed
   as being incorporated in an SR Policy Module (SRPM). Following is a
   reminder of the high-level functionality of SRPM:

   o Learning multiple candidate paths for an SR Policy via various
      mechanisms (CLI, NetConf, PCEP, or BGP).

   o Selection of the best candidate path for an SR Policy.

   o Binding BSID to the selected candidate path of an SR Policy.

   o Installation of the selected candidate path and its BSID in the
      forwarding plane.

This document specifies the way to use BGP to distribute one or more
of the candidate paths of an SR Policy to the headend of that policy.
The document describes the functionality provided by BGP and, as
appropriate, provides references for the functionality which is
outside the scope of BGP (i.e. resides within SRPM on the headend
node).

This document specifies a way of representing SR Policy candidate
paths in BGP UPDATE messages. BGP can then be used to propagate the
SR Policy candidate paths to the headend nodes in the network. The
usual BGP rules for BGP propagation and best-path selection are used.
At the headend of a specific policy, this will result in one or more
candidate paths being installed into the "BGP table". These paths
are then passed to the SRPM. The SRPM may compare them to candidate
paths learned via other mechanisms and will choose one or more paths
to be installed in the data plane. BGP itself does not install SR
Policy candidate paths into the data plane.

This document introduces a BGP subsequent address family (SAFI) for
IPv4 and IPv6 address families. In UPDATE messages of those AFI/
SAFIs, the NLRI identifies an SR Policy Candidate Path while the
attributes encode the segment lists and other details of that SR
Policy Candidate Path.

While for simplicity we may write that BGP advertises an SR Policy,
it has to be understood that BGP advertises a candidate path of an SR
policy and that this SR Policy might have several other candidate
paths provided via BGP (via an NLRI with a different distinguisher as
defined in this document), PCEP, NETCONF, or local policy
configuration.

Typically, a controller defines the set of policies and advertises
them to policy head-end routers (typically ingress routers). These
policy advertisements use the BGP extensions defined in this
document. The policy advertisement is, in most but not all the
cases, tailored for a specific policy head-end. In this case, the
advertisement may be sent on a BGP session to that head-end and not
propagated any further.

Alternatively, a router (i.e., a BGP egress router) advertises SR
Policies representing paths to itself. In this case, it is possible
to send the policy to each head-end over a BGP session to that head-
end, without requiring any further propagation of the policy.

An SR Policy intended only for the receiver will, in most cases, not
traverse any Route Reflector (RR, [RFC4456]).

In some situations, it is undesirable for a controller or BGP egress
router to have a BGP session to each policy head-end. In these
situations, BGP Route Reflectors may be used to propagate the
advertisements, or it may be necessary for the advertisement to
propagate through a sequence of one or more AS. To make this
possible, an attribute needs to be attached to the advertisement that
enables a BGP speaker to determine whether it is intended to be a
head-end for the advertised policy. This is done by attaching one or
more Route Target Extended Communities to the advertisement
([RFC4360]).

The BGP extensions for the advertisement of SR Policies include
following components:

o A Subsequent Address Family Identifier (SAFI) whose NLRIs
   identifies an SR Policy candidate path.

o A Tunnel Type identifier for SR Policy, and a set of sub-TLVs to
   be inserted into the Tunnel Encapsulation Attribute (as defined in
   [RFC9012]) specifying segment lists of the SR Policy candidate
   path, as well as other information about the SR Policy.

o One or more IPv4 address format route target extended community
   ([RFC4360]) attached to the SR Policy advertisement and that
   indicates the intended head-end of such SR Policy advertisement.

The Color Extended Community (as defined in [RFC9012]) is used to
steer traffic into an SR Policy, as described in section 8.8 of
[I-D.ietf-spring-segment-routing-policy]. This document (Section 3)
updates [RFC9012] with modifications to the format of the Color
Extended Community by using the two leftmost bits of the RESERVED
field.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
"OPTIONAL" in this document are to be interpreted as described in BCP
14 [RFC2119] [RFC8174] when, and only when, they appear in all
capitals, as shown here.

2. SR Policy Encoding

2.1. SR Policy SAFI and NLRI

A SAFI is introduced by this document: the SR Policy SAFI with
codepoint 73. The AFI used MUST be IPv4(1) or IPv6(2).

The SR Policy SAFI uses the NLRI format defined as follows:

```
+------------------+
|  NLRI Length     | 1 octet
+------------------+
|  Distinguisher   | 4 octets
+------------------+
|  Policy Color    | 4 octets
+------------------+
|  Endpoint        | 4 or 16 octets
+------------------+
```

where:

o NLRI Length: 1 octet of length expressed in bits as defined in
   [RFC4760]. When AFI = 1 value MUST be 96 and when AFI = 2 value
   MUST be 192.

o Distinguisher: 4-octet value uniquely identifying the policy in
   the context of <color, endpoint> tuple. The distinguisher has no
   semantic value and is solely used by the SR Policy originator to
   make unique (from an NLRI perspective) both for multiple candidate
   paths of the same SR Policy as well as candidate paths of
   different SR Policies (i.e. with different segment lists) with the
   same Color and Endpoint but meant for different head-ends.

o Policy Color: 4-octet value identifying (with the endpoint) the
   policy. The color is used to match the color of the destination
   prefixes to steer traffic into the SR Policy as specified in
   [I-D.ietf-spring-segment-routing-policy].

o Endpoint: identifies the endpoint of a policy. The Endpoint may
   represent a single node or a set of nodes (e.g., an anycast
   address). The Endpoint is an IPv4 (4-octet) address or an IPv6
   (16-octet) address according to the AFI of the NLRI.

The color and endpoint are used to automate the steering of BGP
Payload prefixes on SR Policy as described in
[I-D.ietf-spring-segment-routing-policy].

The NLRI containing the SR Policy candidate path is carried in a BGP
UPDATE message [RFC4271] using BGP multi-protocol extensions
[RFC4760] with an AFI of 1 or 2 (IPv4 or IPv6) and with a SAFI of 73.

An update message that carries the MP_REACH_NLRI or MP_UNREACH_NLRI
attribute with the SR Policy SAFI MUST also carry the BGP mandatory
attributes. In addition, the BGP update message MAY also contain any
of the BGP optional attributes.

The next-hop network address field in SR Policy SAFI (73) updates may
be either a 4-octet IPv4 address or a 16-octet IPv6 address,
independent of the SR Policy AFI. The length field of the next-hop
address specifies the next-hop address family. If the next-hop
length is 4, then the next-hop is an IPv4 address; if the next-hop
length is 16, then it is a global IPv6 address; if the next-hop
length is 32, then it has a global IPv6 address followed by a link-
local IPv6 address. The setting of the next-hop field and its
attendant processing is governed by standard BGP procedures as
described in section 3 in [RFC4760].

It is important to note that any BGP speaker receiving a BGP message
with an SR Policy NLRI, will process it only if the NLRI is among the
best paths as per the BGP best-path selection algorithm. In other
words, this document leverages the existing BGP propagation and best-
path selection rules. Details of the procedures are described in
Section 4.

It has to be noted that if several candidate paths of the same SR
Policy (endpoint, color) are signaled via BGP to a head-end, it is
RECOMMENDED that each NLRI uses a different distinguisher. If BGP
has installed into the BGP table two advertisements whose respective
NLRIs have the same color and endpoint, but different distinguishers,
both advertisements are passed to the SRPM as different candidate
paths along with their respective originator information (i.e. ASN
and BGP Router-ID) as described in section 2.4 of
[I-D.ietf-spring-segment-routing-policy]. The ASN would be the ASN
of origin and the BGP Router-ID is determined in the following order:

o From the Route Origin Community [RFC4360] if present and carrying
   an IP Address

o As the BGP Originator ID [RFC4456] if present

o As the BGP Router-ID of the peer from which the update was
   received as a last resort.

2.2. SR Policy and Tunnel Encapsulation Attribute

The content of the SR Policy Candidate Path is encoded in the Tunnel
Encapsulation Attribute defined in [RFC9012] using a Tunnel-Type
called SR Policy Type with codepoint 15. The use of SR Policy
Tunnel-type is applicable only for the AFI/SAFI pairs of (1/73,
2/73).

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
            SRv6 Binding SID
            Preference
            Priority
            Policy Name
            Policy Candidate Path Name
            Explicit NULL Label Policy (ENLP)
            Segment List
                Weight
                Segment
                Segment
                ...
         ...
```

where:

o   SR Policy SAFI NLRI is defined in [Section 2.1](#).

o   Tunnel Encapsulation Attribute is defined in [[RFC9012](#)].

o   Tunnel-Type is set to 15.

o   Preference, Binding SID, SRv6 Binding SID, Priority, Policy Name,
    Policy Candidate Path Name, ENLP, Segment-List, Weight, and
    Segment sub-TLVs are defined in this document.

o   Additional sub-TLVs may be defined in the future.

A Tunnel Encapsulation Attribute MUST NOT contain more than one TLV
of type "SR Policy".

[2.3](#). Remote Endpoint and Color

The Tunnel Egress Endpoint and Color sub-TLVs, as defined in
[[RFC9012](#)], may also be present in the SR Policy encodings.

The Tunnel Egress Endpoint and Color Sub-TLVs of the Tunnel
Encapsulation Attribute are not used for SR Policy encodings and
therefore their value is irrelevant in the context of the SR Policy
SAFI NLRI. If present, the Tunnel Egress Endpoint sub-TLV and the
Color sub-TLV MUST be ignored by the BGP speaker and not removed from
the Tunnel Encapsulation Attribute during propagation.

2.4. SR Policy Sub-TLVs

   This section specifies the sub-TLVs defined for encoding the
   information about the SR Policy Candidate Path.

   Preference, Binding SID, SRv6 Binding SID, Segment-List, Priority,
   Policy Name, Policy Candidate Path Name, and Explicit NULL Label
   Policy are the sub-TLVs introduced for the BGP Tunnel Encapsulation
   Attribute [RFC9012] being defined in this section.

   Weight and Segment are sub-TLVs of the Segment-List sub-TLV mentioned
   above.

   None of the sub-TLVs defined in the following sub-sections have any
   effect on the BGP best-path selection or propagation procedures.
   These sub-TLVs are not used by BGP and are instead passed on to SRPM
   as SR Policy Candidate Path information for further processing
   described in [I-D.ietf-spring-segment-routing-policy].

   The use of SR Policy Sub-TLVs is applicable only for the AFI/SAFI
   pairs of (1/73, 2/73). Future documents may extend their
   applicability to other AFI/SAFI.

2.4.1. Preference Sub-TLV

   The Preference sub-TLV is used to carry the preference of the SR
   Policy candidate path. The contents of this sub-TLV are used by the
   SRPM as described in section 2.7 in
   [I-D.ietf-spring-segment-routing-policy].

   The Preference sub-TLV is optional and it MUST NOT appear more than
   once in the SR Policy encoding.

   The Preference sub-TLV has 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     |    Flags      |   RESERVED    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Preference (4 octets)                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   where:

   o Type: 12

   o Length: 6.

o Flags: 1 octet of flags. None are defined at this stage. Flags
   SHOULD be set to zero on transmission and MUST be ignored on
   receipt.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o Preference: a 4-octet value.

2.4.2. Binding SID Sub-TLV

The Binding SID sub-TLV is used to signal the binding SID related
information of the SR Policy candidate path. The contents of this
sub-TLV are used by the SRPM as described in section 6 in
[I-D.ietf-spring-segment-routing-policy].

The Binding SID sub-TLV is optional and it MUST NOT appear more than
once in the SR Policy encoding.

When the Binding SID sub-TLV is used to signal an SRv6 SID, the
choice of its SRv6 Endpoint Behavior [RFC8986] to be instantiated is
left to the headend node. It is RECOMMENDED that the SRv6 Binding
SID sub-TLV defined in Section 2.4.3, that enables the specification
of the SRv6 Endpoint Behavior, be used for signaling of an SRv6
Binding SID for an SR Policy candidate path.

The Binding SID 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     |     Flags     |   RESERVED    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Binding SID (variable, optional)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 13

o Length: specifies the length of the value field not including Type
   and Length fields. Can be 2 or 6 or 18.

o Flags: 1 octet of flags. The following flags are defined in the
   registry "SR Policy Binding SID Flags" as described in
   Section 6.6:

```
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|S|I|           |
+-+-+-+-+-+-+-+-+
```

   where:

   * S-Flag: This flag encodes the "Specified-BSID-only" behavior.
      It is used by SRPM as described in section 6.2.3 in
      [I-D.ietf-spring-segment-routing-policy].

   * I-Flag: This flag encodes the "Drop Upon Invalid" behavior. It
      is used by SRPM as described in section 8.2 in
      [I-D.ietf-spring-segment-routing-policy].

   * Unused bits in the Flag octet SHOULD be set to zero upon
      transmission and MUST be ignored upon receipt.

   o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
      transmission and MUST be ignored on receipt.

   o Binding SID: if the length is 2, then no Binding SID is present.
      If the length is 6 then the Binding SID is encoded in 4 octets
      using the format below. TC, S and TTL (Total of 12 bits) are
      RESERVED and SHOULD be set to zero and MUST be ignored.

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |             Label                     | TC  |S|     TTL     |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

      If the length is 18 then the Binding SID contains a 16-octet SRv6
      SID.

2.4.3. SRv6 Binding SID Sub-TLV

   The SRv6 Binding SID sub-TLV is used to signal the SRv6 Binding SID
   related information of the SR Policy candidate path. It enables the
   specification of the SRv6 Endpoint Behavior [RFC8986] to be
   instantiated on the headend node. The contents of this sub-TLV are
   used by the SRPM as described in section 6 in
   [I-D.ietf-spring-segment-routing-policy].

   The SRv6 Binding SID sub-TLV is optional. More than one SRv6 Binding
   SIDs MAY be signaled in the same SR Policy encoding to indicate one
   or more SRv6 SIDs, each with potentially different SRv6 Endpoint
   Behaviors to be instantiated.

The SRv6 Binding SID 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     |     Flags     |   RESERVED    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   SRv6 Binding SID (16 octets)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//     SRv6 Endpoint Behavior and SID Structure (optional)    //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: TBD

o Length is variable

o Flags: 1 octet of flags. The following flags are defined in the
   registry "SR Policy Binding SID Flags" as described in
   Section 6.7:

```
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|S|I|B|         |
+-+-+-+-+-+-+-+-+
```

   where:

     * S-Flag: This flag encodes the "Specified-BSID-only" behavior.
        It is used by SRPM as described in section 6.2.3 in
        [I-D.ietf-spring-segment-routing-policy].

     * I-Flag: This flag encodes the "Drop Upon Invalid" behavior. It
        is used by SRPM as described in section 8.2 in
        [I-D.ietf-spring-segment-routing-policy].

     * B-Flag: This flag, when set, indicates the presence of the SRv6
        Endpoint Behavior and SID Structure encoding specified in
        Section 2.4.4.2.13.

     * Unused bits in the Flag octet SHOULD be set to zero upon
        transmission and MUST be ignored upon receipt.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o SRv6 Binding SID: Contains a 16-octet SRv6 SID.

o SRv6 Endpoint Behavior and SID Structure: Optional, as defined in
   Section 2.4.4.2.13.

2.4.4. Segment List Sub-TLV

The Segment List sub-TLV encodes a single explicit path towards the
endpoint as described in section 5.1 in
[I-D.ietf-spring-segment-routing-policy]. The Segment List sub-TLV
includes the elements of the paths (i.e., segments) as well as an
optional Weight sub-TLV.

The Segment List sub-TLV may exceed 255 bytes in length due to a
large number of segments. Therefore a 2-octet length is required.
According to [RFC9012], the first bit of the sub-TLV codepoint
defines the size of the length field. Therefore, for the Segment
List sub-TLV a code point of 128 or higher is used.

The Segment List sub-TLV is optional and MAY appear multiple times in
the SR Policy encoding. The ordering of Segment List sub-TLVs, each
sub-TLV encoding a Segment List, does not matter.

The Segment List sub-TLV contains zero or more Segment sub-TLVs and
MAY contain a Weight sub-TLV.

The Segment List 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                          //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 128.

o Length: the total length (not including the Type and Length
   fields) of the sub-TLVs encoded within the Segment List sub-TLV.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o sub-TLVs currently defined:

   * An optional single Weight sub-TLV.

      * Zero or more Segment sub-TLVs.

   Validation of an explicit path encoded by the Segment List sub-TLV is
   beyond the scope of BGP and performed by the SRPM as described in
   section 5 in [I-D.ietf-spring-segment-routing-policy].

2.4.4.1. Weight Sub-TLV

   The Weight sub-TLV specifies the weight associated with a given
   segment list. The contents of this sub-TLV are used only by the SRPM
   as described in section 2.11 in
   [I-D.ietf-spring-segment-routing-policy].

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

   The Weight 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     |     Flags     |   RESERVED    |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                            Weight                             |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   where:

   o Type: 9.

   o Length: 6

   o Flags: 1 octet of flags. None are defined at this stage. Flags
      SHOULD be set to zero on transmission and MUST be ignored on
      receipt.

   o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
      transmission and MUST be ignored on receipt.

   o Weight: 4 octets value.

2.4.4.2. Segment Sub-TLVs

   A Segment sub-TLV describes a single segment in a segment list (i.e.,
   a single element of the explicit path). One or more Segment sub-TLVs
   constitute an explicit path of the SR Policy candidate path. The
   contents of these sub-TLVs are used only by the SRPM as described in
   section 4 in [I-D.ietf-spring-segment-routing-policy].

The Segment sub-TLVs are optional and MAY appear multiple times in
the Segment List sub-TLV.

[I-D.ietf-spring-segment-routing-policy] defines several Segment
Types:

Type A: SR-MPLS Label
Type B: SRv6 SID
Type C: IPv4 Prefix with optional SR Algorithm
Type D: IPv6 Global Prefix with optional SR Algorithm for SR-MPLS
Type E: IPv4 Prefix with Local Interface ID
Type F: IPv4 Addresses for link endpoints as Local, Remote pair
Type G: IPv6 Prefix and Interface ID for link endpoints as Local,
         Remote pair for SR-MPLS
Type H: IPv6 Addresses for link endpoints as Local, Remote pair
         for SR-MPLS
Type I: IPv6 Global Prefix with optional SR Algorithm for SRv6
Type J: IPv6 Prefix and Interface ID for link endpoints as Local,
         Remote pair for SRv6
Type K: IPv6 Addresses for link endpoints as Local, Remote pair
         for SRv6

The following sub-sections specify the sub-TLV used for encoding each
of these Segment Types.

2.4.4.2.1. Segment Type A

The Type A Segment Sub-TLV encodes a single SR-MPLS SID. The format
is as follows:

```
 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            Label                      | TC  |S|      TTL      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 1.

o Length is 6.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

   o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
      transmission and MUST be ignored on receipt.

   o Label: 20 bits of label value.

   o TC: 3 bits of traffic class.

   o S: 1 bit of bottom-of-stack.

   o TTL: 1 octet of TTL.

   The following applies to the Type-1 Segment sub-TLV:

   o The S bit SHOULD be zero upon transmission and MUST be ignored
      upon reception.

   o If the originator wants the receiver to choose the TC value, it
      sets the TC field to zero.

   o If the originator wants the receiver to choose the TTL value, it
      sets the TTL field to 255.

   o If the originator wants to recommend a value for these fields, it
      puts those values in the TC and/or TTL fields.

   o The receiver MAY override the originator's values for these
      fields. This would be determined by local policy at the receiver.
      One possible policy would be to override the fields only if the
      fields have the default values specified above.

2.4.4.2.2. Segment Type B

   The Type B Segment Sub-TLV encodes a single SRv6 SID. The format is
   as follows:

```
 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                     SRv6 SID (16 octets)                    //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//     SRv6 Endpoint Behavior and SID Structure (optional)     //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   where:

   o Type: 13.

o Length is 26 when the SRv6 Endpoint Behavior and SID Structure is
   present else it is 18.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o SRv6 SID: 16 octets of IPv6 address.

o SRv6 Endpoint Behavior and SID Structure: Optional, as defined in
   Section 2.4.4.2.13.

The TLV 2 defined for the advertisement of Segment Type B in the
earlier versions of this document has been deprecated to avoid
backward compatibility issues.

2.4.4.2.3. Segment Type C

The Type C Segment Sub-TLV encodes an IPv4 node address, SR Algorithm
and an optional SR-MPLS SID. The format is as follows:

```
 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     |  SR Algorithm |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  IPv4 Node Address (4 octets)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                SR-MPLS SID (optional, 4 octets)               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 3.

o Length is 10 when the SR-MPLS SID is present else it is 6.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o SR Algorithm: 1 octet specifying SR Algorithm as described in
   section 3.1.1 in [RFC8402] when A-Flag as defined in
   Section 2.4.4.2.12 is present. SR Algorithm is used by SRPM as
   described in section 4 in
   [I-D.ietf-spring-segment-routing-policy]. When A-Flag is not
   encoded, this field SHOULD be set to zero on transmission and MUST
   be ignored on receipt.

   o IPv4 Node Address: a 4 octet IPv4 address representing a node.

   o SR-MPLS SID: optional, 4 octet field containing label, TC, S and
      TTL as defined in Section 2.4.4.2.1.

2.4.4.2.4. Segment Type D

   The Type D Segment Sub-TLV encodes an IPv6 node address, SR Algorithm
   and an optional SR-MPLS SID. The format is as follows:

```
 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     |  SR Algorithm |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              IPv6 Node Address (16 octets)                  //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             SR-MPLS SID (optional, 4 octets)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   where:

   o Type: 4

   o Length is 22 when the SR-MPLS SID is present else it is 18.

   o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

   o SR Algorithm: 1 octet specifying SR Algorithm as described in
      section 3.1.1 in [RFC8402] when A-Flag as defined in
      Section 2.4.4.2.12 is present. SR Algorithm is used by SRPM as
      described in section 4 in
      [I-D.ietf-spring-segment-routing-policy]. When A-Flag is not
      encoded, this field SHOULD be set to zero on transmission and MUST
      be ignored on receipt.

   o IPv6 Node Address: a 16-octet IPv6 address representing a node.

   o SR-MPLS SID: optional, 4 octet field containing label, TC, S and
      TTL as defined in Section 2.4.4.2.1.

2.4.4.2.5. Segment Type E

   The Type E Segment Sub-TLV encodes an IPv4 node address, a local
   interface Identifier (Local Interface ID), and an optional SR-MPLS
   SID. The format is as follows:

```
 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Local Interface ID (4 octets)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   IPv4 Node Address (4 octets)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   SR-MPLS SID (optional, 4 octets)            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 5.

o Length is 14 when the SR-MPLS SID is present else it is 10.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o Local Interface ID: 4 octets of interface index as defined in
   [RFC8664].

o IPv4 Node Address: a 4-octet IPv4 address representing a node.

o SR-MPLS SID: optional, 4 octet field containing label, TC, S and
   TTL as defined in Section 2.4.4.2.1.

2.4.4.2.6. Segment Type F

The Type F Segment Sub-TLV encodes an adjacency local address, an
adjacency remote address, and an optional SR-MPLS SID. The format is
as follows:

```
  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    |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |               Local IPv4 Address (4 octets)                  |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |               Remote IPv4 Address  (4 octets)                |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |               SR-MPLS SID (optional, 4 octets)               |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 6.

o Length is 14 when the SR-MPLS SID is present else it is 10.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o Local IPv4 Address: a 4-octet IPv4 address.

o Remote IPv4 Address: a 4-octet IPv4 address.

o SR-MPLS SID: optional, 4 octet field containing label, TC, S and
   TTL as defined in Section 2.4.4.2.1.

2.4.4.2.7. Segment Type G

The Type G Segment Sub-TLV encodes an IPv6 link-local adjacency with
IPv6 local node address, a local interface identifier (Local
Interface ID), IPv6 remote node address, a remote interface
identifier (Remote Interface ID), and an optional SR-MPLS SID. The
format is as follows:

```
 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Local Interface ID (4 octets)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              IPv6 Local Node Address (16 octets)           //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                Remote Interface ID (4 octets)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//             IPv6 Remote Node Address (16 octets)           //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 SR-MPLS SID (optional, 4 octets)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 7

o Length is 46 when the SR-MPLS SID is present else it is 42.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o Local Interface ID: 4 octets of interface index as defined in
   [RFC8664].

o IPv6 Local Node Address: a 16-octet IPv6 address.

o Remote Interface ID: 4 octets of interface index as defined in
   [RFC8664]. The value MAY be set to zero when the local node
   address and interface identifiers are sufficient to describe the
   link.

o IPv6 Remote Node Address: a 16-octet IPv6 address. The value MAY
   be set to zero when the local node address and interface
   identifiers are sufficient to describe the link.

o SR-MPLS SID: optional, 4 octet field containing label, TC, S and
   TTL as defined in Section 2.4.4.2.1.

2.4.4.2.8. Segment Type H

The Type H Segment Sub-TLV encodes an adjacency local address, an
adjacency remote address, and an optional SR-MPLS SID. The format is
as follows:

```
 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Local IPv6 Address (16 octets)                //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Remote IPv6 Address  (16 octets)              //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               SR-MPLS SID (optional, 4 octets)              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 8

o Length is 38 when the SR-MPLS SID is present else it is 34.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o RESERVED: 1 octet of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

o Local IPv6 Address: a 16-octet IPv6 address.

o Remote IPv6 Address: a 16-octet IPv6 address.

o SR-MPLS SID: optional, 4 octet field containing label, TC, S and
   TTL as defined in Section 2.4.4.2.1.

2.4.4.2.9. Segment Type I

The Type I Segment Sub-TLV encodes an IPv6 node address, SR
Algorithm, and an optional SRv6 SID. The format is as follows:

```
 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     | SR Algorithm  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//               IPv6 Node Address (16 octets)                 //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                  SRv6 SID (optional, 16 octets)             //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//      SRv6 Endpoint Behavior and SID Structure (optional)    //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   where:

   o Type: 14

   o Length is variable.

   o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

   o SR Algorithm: 1 octet specifying SR Algorithm as described in
      section 3.1.1 in [RFC8402] when A-Flag as defined in
      Section 2.4.4.2.12 is present. SR Algorithm is used by SRPM as
      described in section 4 in
      [I-D.ietf-spring-segment-routing-policy]. When A-Flag is not
      encoded, this field SHOULD be set to zero on transmission and MUST
      be ignored on receipt.

   o IPv6 Node Address: a 16-octet IPv6 address.

   o SRv6 SID: optional, a 16-octet IPv6 address.

   o SRv6 Endpoint Behavior and SID Structure: Optional, as defined in
      Section 2.4.4.2.13.

   The TLV 10 defined for the advertisement of Segment Type I in the
   earlier versions of this document has been deprecated to avoid
   backward compatibility issues.

2.4.4.2.10. Segment Type J

   The Type J Segment Sub-TLV encodes an IPv6 link-local adjacency with
   local node address, a local interface identifier (Local Interface
   ID), remote IPv6 node address, a remote interface identifier (Remote
   Interface ID), and an optional SRv6 SID. The format is as follows:

```
 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     | SR Algorithm  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Local Interface ID (4 octets)               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                IPv6 Local Node Address (16 octets)         //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Remote Interface ID (4 octets)              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                IPv6 Remote Node Address (16 octets)        //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                SRv6 SID (optional, 16 octets)              //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//    SRv6 Endpoint Behavior and SID Structure (optional)     //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 15

o Length is variable.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o SR Algorithm: 1 octet specifying SR Algorithm as described in
   section 3.1.1 in [RFC8402] when A-Flag as defined in
   Section 2.4.4.2.12 is present. SR Algorithm is used by SRPM as
   described in section 4 in
   [I-D.ietf-spring-segment-routing-policy]. When A-Flag is not
   encoded, this field SHOULD be set to zero on transmission and MUST
   be ignored on receipt.

o Local Interface ID: 4 octets of interface index as defined in
   [RFC8664].

o IPv6 Local Node Address: a 16-octet IPv6 address.

o Remote Interface ID: 4 octets of interface index as defined in
   [RFC8664]. The value MAY be set to zero when the local node
   address and interface identifiers are sufficient to describe the
   link.

o IPv6 Remote Node Address: a 16-octet IPv6 address. The value MAY
   be set to zero when the local node address and interface
   identifiers are sufficient to describe the link.

o SRv6 SID: optional, a 16-octet IPv6 address.

o SRv6 Endpoint Behavior and SID Structure: Optional, as defined in
   Section 2.4.4.2.13.

The TLV 11 defined for the advertisement of Segment Type J in the
earlier versions of this document has been deprecated to avoid
backward compatibility issues.

2.4.4.2.11. Segment Type K

The Type K Segment Sub-TLV encodes an adjacency local address, an
adjacency remote address, and an optional SRv6 SID. The format is as
follows:

```
 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     | SR Algorithm  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Local IPv6 Address (16 octets)                //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Remote IPv6 Address  (16 octets)              //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//               SRv6 SID (optional, 16 octets)               //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//    SRv6 Endpoint Behavior and SID Structure (optional)     //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

o Type: 16

o Length is variable.

o Flags: 1 octet of flags as defined in Section 2.4.4.2.12.

o SR Algorithm: 1 octet specifying SR Algorithm as described in
   section 3.1.1 in [RFC8402] when A-Flag as defined in
   Section 2.4.4.2.12 is present. SR Algorithm is used by SRPM as
   described in section 4 in
   [I-D.ietf-spring-segment-routing-policy]. When A-Flag is not
   encoded, this field SHOULD be set to zero on transmission and MUST
   be ignored on receipt.

o Local IPv6 Address: a 16-octet IPv6 address.

o Remote IPv6 Address: a 16-octet IPv6 address.

o SRv6 SID: optional, a 16-octet IPv6 address.

o SRv6 Endpoint Behavior and SID Structure: Optional, as defined in
   Section 2.4.4.2.13.

The TLV 12 defined for the advertisement of Segment Type K in the
earlier versions of this document has been deprecated to avoid
backward compatibility issues.

2.4.4.2.12. Segment Flags

The Segment Types sub-TLVs described above MAY contain the following
flags in the "Flags" field defined in Section 6.8:

```
 0 1 2 3 4 5 6 7
+-+-+-+-+-+-+-+-+
|V|A|S|B|       |
+-+-+-+-+-+-+-+-+
```

where:

   V-Flag: This flag, when set, is used by SRPM for "SID
   verification" as described in Section 5.1 in
   [I-D.ietf-spring-segment-routing-policy].

   A-Flag: This flag, when set, indicates the presence of SR
   Algorithm id in the "SR Algorithm" field applicable to various
   Segment Types. SR Algorithm is used by SRPM as described in
   section 4 in [I-D.ietf-spring-segment-routing-policy].

   S-Flag: This flag, when set, indicates the presence of the SR-MPLS
   or SRv6 SID depending on the segment type.

   B-Flag: This flag, when set, indicates the presence of the SRv6
   Endpoint Behavior and SID Structure encoding specified in
   Section 2.4.4.2.13.

   Unused bits in the Flag octet SHOULD be set to zero upon
   transmission and MUST be ignored upon receipt.

The following applies to the Segment Flags:

o V-Flag applies to all Segment Types.

o A-Flag applies to Segment Types C, D, I, J, and K. If A-Flag
   appears with Segment Types A, B, E, F, G, and H, it MUST be
   ignored.

o S-Flag applies to Segment Types C, D, E, F, G, H, I, J, and K. If
   S-Flag appears with Segment Types A or B, it MUST be ignored.

o B-Flag applies to Segment Types B, I, J, and K. If B-Flag appears
   with Segment Types A, C, D, E, F, G, and H, it MUST be ignored.

2.4.4.2.13. SRv6 SID Endpoint Behavior and Structure

The Segment Types sub-TLVs described above MAY contain the SRv6
Endpoint Behavior and SID Structure [RFC8986] encoding as described
below:

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Endpoint Behavior       |             Reserved          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   LB Length  |  LN Length   | Fun. Length  |  Arg. Length  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

where:

   Endpoint Behavior: 2 octets. It carries the SRv6 Endpoint
   Behavior code point for this SRv6 SID as defined in section 9.2 of
   [RFC8986]. When set with the value 0, the choice of SRv6 Endpoint
   Behavior is left to the headend.

   Reserved: 2 octets of reserved bits. SHOULD be set to zero on
   transmission and MUST be ignored on receipt.

   Locator Block Length: 1 octet. SRv6 SID Locator Block length in
   bits.

   Locator Node Length: 1 octet. SRv6 SID Locator Node length in
   bits.

   Function Length: 1 octet. SRv6 SID Function length in bits.

   Argument Length: 1 octet. SRv6 SID Arguments length in bits.

The total of the locator block, locator node, function, and argument
lengths MUST be less than or equal to 128.

2.4.5. Explicit NULL Label Policy Sub-TLV

To steer an unlabeled IP packet into an SR policy, it is necessary to
create a label stack for that packet, and push one or more labels
onto that stack.

The Explicit NULL Label Policy (ENLP) sub-TLV is used to indicate
whether an Explicit NULL Label [RFC3032] must be pushed on an
unlabeled IP packet before any other labels.

If an ENLP Sub-TLV is not present, the decision of whether to push an
Explicit NULL label on a given packet is a matter of local
configuration.

The ENLP sub-TLV is optional and it MUST NOT appear more than once in
the SR Policy encoding.

The contents of this sub-TLV are used by the SRPM as described in
section 4.1 in [I-D.ietf-spring-segment-routing-policy].

```
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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     ENLP      |
+-+-+-+-+-+-+-+-+
```

Where:

   Type: 14.

   Length: 3.

   Flags: 1 octet of flags. None are defined at this stage. Flags
   SHOULD be set to zero on transmission and MUST be ignored on
   receipt.

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

   ENLP (Explicit NULL Label Policy): Indicates whether Explicit NULL
   labels are to be pushed on unlabeled IP packets that are being
   steered into a given SR policy. This field has one of the
   following values:

      0: Reserved.

      1: Push an IPv4 Explicit NULL label on an unlabeled IPv4
      packet, but do not push an IPv6 Explicit NULL label on an
      unlabeled IPv6 packet.

2: Push an IPv6 Explicit NULL label on an unlabeled IPv6
packet, but do not push an IPv4 Explicit NULL label on an
unlabeled IPv4 packet.

3: Push an IPv4 Explicit NULL label on an unlabeled IPv4
packet, and push an IPv6 Explicit NULL label on an unlabeled
IPv6 packet.

4: Do not push an Explicit NULL label.

5 - 255: Reserved.

The ENLP reserved values may be used for future extensions and
implementations SHOULD ignore the ENLP Sub-TLV with these values.
The behavior signaled in this Sub-TLV MAY be overridden by local
configuration. The section 4.1 of
[I-D.ietf-spring-segment-routing-policy] describes the behavior on
the headend for the handling of the explicit null label.

2.4.6. Policy Priority Sub-TLV

An operator MAY set the Policy Priority sub-TLV to indicate the order
in which the SR policies are re-computed upon topological change.
The contents of this sub-TLV are used by the SRPM as described in
section 2.11 in [I-D.ietf-spring-segment-routing-policy].

The Priority sub-TLV is optional and it MUST NOT appear more than
once in the SR Policy encoding.

The Priority sub-TLV has 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     |   Priority    |   RESERVED    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Where:

Type: 15

Length: 2.

Priority: a 1-octet value.

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

2.4.7. Policy Candidate Path Name Sub-TLV

An operator MAY set the Policy Candidate Path Name sub-TLV to attach
a symbolic name to the SR Policy candidate path.

Usage of Policy Candidate Path Name sub-TLV is described in section
2.6 in [I-D.ietf-spring-segment-routing-policy].

The Policy Candidate Path Name sub-TLV may exceed 255 bytes in length
due to a long name. Therefore a 2-octet length is required.
According to [RFC9012], the first bit of the sub-TLV codepoint
defines the size of the length field. Therefore, for the Policy
Candidate Path Name sub-TLV, a code point of 128 or higher is used.

It is RECOMMENDED that the size of the symbolic name for the
candidate path is limited to 255 bytes. Implementations MAY choose
to truncate long names to 255 bytes when signaling via BGP.

The Policy Candidate Path Name sub-TLV is optional and it MUST NOT
appear more than once in the SR Policy encoding.

The Policy Candidate Path Name sub-TLV has 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//              Policy Candidate Path Name                     //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Where:

   Type: 129.

   Length: Variable.

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

   Policy Candidate Path Name: Symbolic name for the SR Policy
   candidate path without a NULL terminator as specified in section
   2.6 of [I-D.ietf-spring-segment-routing-policy].

2.4.8. Policy Name Sub-TLV

An operator MAY set the Policy Name sub-TLV to associate a symbolic
name with the SR Policy for which the candidate path is being
advertised via the SR Policy NLRI.

Usage of Policy Name sub-TLV is described in section 2.1 of
[I-D.ietf-spring-segment-routing-policy].

The Policy Name sub-TLV may exceed 255 bytes in length due to a long
policy name. Therefore a 2-octet length is required. According to
[RFC9012], the first bit of the sub-TLV codepoint defines the size of
the length field. Therefore, for the Policy Name sub-TLV, a code
point of 128 or higher is used.

It is RECOMMENDED that the size of the symbolic name for the SR
Policy is limited to 255 bytes. Implementations MAY choose to
truncate long names to 255 bytes when signaling via BGP.

The Policy Name sub-TLV is optional and it MUST NOT appear more than
once in the SR Policy encoding.

The Policy Name sub-TLV has 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      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                        Policy Name                        //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Where:

   Type: TBD

   Length: Variable.

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

   Policy Name: Symbolic name for the policy. It SHOULD be a string
   of printable ASCII characters, without a NULL terminator.

3. Color Extended Community

The Color Extended Community [RFC9012] is used to steer traffic
corresponding to BGP routes into an SR Policy with matching color
value. The Color Extended Community MAY be carried in any BGP UPDATE
message whose AFI/SAFI is 1/1 (IPv4 Unicast), 2/1 (IPv6 Unicast), 1/4
(IPv4 Labeled Unicast), 2/4 (IPv6 Labeled Unicast), 1/128 (VPN-IPv4
Labeled Unicast), 2/128 (VPN-IPv6 Labeled Unicast), or 25/70
(Ethernet VPN, usually known as EVPN). Use of the Color Extended
Community in BGP UPDATE messages of other AFI/SAFIs is outside the
scope of this document.

Two bits from the Flags field of the Color Extended Community are
used as follows to support the requirements of Color-Only steering as
specified in Section 8.8 of [I-D.ietf-spring-segment-routing-policy]:

```
                    1
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|C O|         RESERVED          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The CO bits together form the Color-Only Type field which indicates
the various matching criteria between BGP NH and SR Policy endpoint
in addition to the matching of the color value. Following types are
defined:

o Type 0: Specific Endpoint Match: Request match for the endpoint
   that is the BGP NH

o Type 1: Specific or Null Endpoint Match: Request match for either
   the endpoint that is the BGP NH or a null endpoint (e.g., like a
   default gateway)

o Type 2: Specific, Null, or Any Endpoint Match: Request match for
   either the endpoint that is the BGP NH or with a null or any
   endpoint

o Type 3: reserved for future use and SHOULD NOT be used. Upon
   reception, an implementation MUST treat it like Type 0.

The details of the SR Policy steering mechanisms based on these
Color-Only types are specified in section 8.8 of
[I-D.ietf-spring-segment-routing-policy].

One or more Color Extended Communities MAY be associated with a BGP
route update. Sections 8.4.1, 8.5.1, and 8.8.2 of

[I-D.ietf-spring-segment-routing-policy] specify the steering behaviors over SR Policies when multiple Color Extended Communities are associated with a BGP route.

4. SR Policy Operations

As described in this document, BGP is not the actual consumer of an SR Policy NLRI. BGP is in charge of the origination and propagation of the SR Policy NLRI but its installation and use are outside the scope of BGP. The details of SR Policy installation and use are specified in [I-D.ietf-spring-segment-routing-policy].

4.1. Advertisement of SR Policies

Typically, but not limited to, an SR Policy is computed by a controller or a path computation engine (PCE) and originated by a BGP speaker on its behalf.

Multiple SR Policy NLRIs may be present with the same <color, endpoint> tuple but with different content when these SR policies are intended for different head-ends.

The distinguisher of each SR Policy NLRI prevents undesired BGP route selection among these SR Policy NLRIs and allows their propagation across route reflectors [RFC4456].

Moreover, one or more route target SHOULD be attached to the advertisement, where each route target identifies one or more intended head-ends for the advertised SR Policy update.

If no route target is attached to the SR Policy NLRI, then it is assumed that the originator sends the SR Policy update directly (e.g., through a BGP session) to the intended receiver. In such case, the NO_ADVERTISE community MUST be attached to the SR Policy update.

4.2. Reception of an SR Policy NLRI

On reception of an SR Policy NLRI, a BGP speaker first determines if it is acceptable and then if it is usable.

4.2.1. Acceptance of an SR Policy NLRI

When a BGP speaker receives an SR Policy NLRI from a neighbor it MUST first, determine if it's acceptable. The following rules apply in addition to the validation described in Section 5:

o The SR Policy NLRI MUST include a distinguisher, color and
   endpoint field which implies that the length of the NLRI MUST be
   either 12 or 24 octets (depending on the address family of the
   endpoint).

o The SR Policy update MUST have either the NO_ADVERTISE community
   or at least one route target extended community in IPv4-address
   format or both. If a router supporting this specification
   receives an SR Policy update with no route target extended
   communities and no NO_ADVERTISE community, the update MUST be
   considered as malformed.

o The Tunnel Encapsulation Attribute MUST be attached to the BGP
   Update and MUST have a Tunnel Type TLV set to SR Policy (codepoint
   is 15).

A router that receives an SR Policy update that is not valid
according to these criteria MUST treat the update as malformed and
the SR Policy candidate path MUST NOT be passed to the SRPM.

4.2.2. Usable SR Policy NLRI

An SR Policy update that has been determined to be acceptable is
further evaluated for its usability by the receiving node.

An SR Policy NLRI update without any route target extended community
but having the NO_ADVERTISE community is considered usable.

If one or more route targets are present, then at least one route
target MUST match the BGP Identifier of the receiver for the update
to be considered usable. The BGP Identifier is defined in [RFC4271]
as a 4-octet IPv4 address. Therefore, the route target extended
community MUST be of the same format.

If one or more route targets are present and none matches the local
BGP Identifier, then, while the SR Policy NLRI is acceptable, it is
not usable on the receiver node.

When the SR Policy tunnel type includes any sub-TLV that is
unrecognized or unsupported, the update SHOULD NOT be considered
usable. An implementation MAY provide an option for ignoring
unsupported sub-TLVs.

4.2.3. Passing a usable SR Policy NLRI to the SRPM

Once BGP on the receiving node has determined that the SR Policy NLRI
is usable, it passes the SR Policy candidate path to the SRPM. Note
that, along with the candidate path details, BGP also passes the

originator information for breaking ties in the candidate path
selection process as described in section 2.4 in
[I-D.ietf-spring-segment-routing-policy].

When an update for an SR Policy NLRI results in its becoming
unusable, BGP MUST delete its corresponding SR Policy candidate path
from the SRPM.

The SRPM applies the rules defined in section 2 in
[I-D.ietf-spring-segment-routing-policy] to determine whether the SR
Policy candidate path is valid and to select the best candidate path
among the valid ones for a given SR Policy.

4.2.4. Propagation of an SR Policy

SR Policy NLRIs that have been determined acceptable and valid can be
evaluated for propagation, even the ones that are not usable.

SR Policy NLRIs that have the NO_ADVERTISE community attached to them
MUST NOT be propagated.

By default, a BGP node receiving an SR Policy NLRI MUST NOT propagate
it to any EBGP neighbor. An implementation MAY provide an explicit
configuration to override this and enable the propagation of
acceptable SR Policy NLRIs to specific EBGP neighbors.

A BGP node advertises a received SR Policy NLRI to its IBGP neighbors
according to normal IBGP propagation rules.

By default, a BGP node receiving an SR Policy NLRI SHOULD NOT remove
route target extended community before propagation. An
implementation MAY provide support for configuration to filter and/or
remove route target extended community before propagation.

5. Error Handling

This section describes the error handling actions, as described in
[RFC7606], that are to be performed for the handling of the BGP
update messages for BGP SR Policy SAFI.

A BGP Speaker MUST perform the following syntactic validation of the
SR Policy NLRI to determine if it is malformed. This includes the
validation of the length of each NLRI and the total length of the
MP_REACH_NLRI and MP_UNREACH_NLRI attributes.

When the error determined allows for the router to skip the malformed
NLRI(s) and continue the processing of the rest of the update
message, then it MUST handle such malformed NLRIs as 'Treat-as-

withdraw'. In other cases, where the error in the NLRI encoding
results in the inability to process the BGP update message (e.g.
length related encoding errors), then the router SHOULD handle such
malformed NLRIs as 'AFI/SAFI disable' when other AFI/SAFI besides SR
Policy are being advertised over the same session. Alternately, the
router MUST perform 'session reset' when the session is only being
used for SR Policy or when it 'AFI/SAFI disable' action is not
possible.

The validation of the TLVs/sub-TLVs introduced in this document and
defined in their respective sub-sections of Section 2.4 MUST be
performed to determine if they are malformed or invalid. The
validation of the Tunnel Encapsulation Attribute itself and the other
TLVs/sub-TLVs specified in [RFC9012] MUST be done as described in
that document. In case of any error detected, either at the
attribute or its TLV/sub-TLV level, the "treat-as-withdraw" strategy
MUST be applied. This is because an SR Policy update without a valid
Tunnel Encapsulation Attribute (comprising of all valid TLVs/sub-
TLVs) is not usable.

An SR Policy update that is determined to be not acceptable, and
therefore malformed, based on rules described in Section 4.2.1 MUST
be handled by the "treat-as-withdraw" strategy.

The validation of the individual fields of the TLVs/sub-TLVs defined
in Section 2.4 are beyond the scope of BGP as they are handled by the
SRPM as described in the individual TLV/sub-TLV sub-sections. A BGP
implementation MUST NOT perform semantic verification of such fields
nor consider the SR Policy update to be invalid or not acceptable/
usable based on such validation.

An implementation SHOULD log an error for any errors found during the
above validation for further analysis.

6. IANA Considerations

This document requests codepoint allocations in the following
existing registries:

o Subsequent Address Family Identifiers (SAFI) Parameters registry

o BGP Tunnel Encapsulation Attribute Tunnel Types registry under the
   BGP Tunnel Encapsulation registry

o BGP Tunnel Encapsulation Attribute sub-TLVs registry under the BGP
   Tunnel Encapsulation registry

   o Color Extended Community Flags registry under the BGP Tunnel
      Encapsulation registry

   This document also requests the creation of the following registries:

   o SR Policy Segment List Sub-TLVs under the BGP Tunnel Encapsulation
      registry

   o SR Policy Binding SID Flags under the BGP Tunnel Encapsulation
      registry

   o SR Policy Segment Flags under the BGP Tunnel Encapsulation
      registry

   o Color Extended Community Color-Only Types registry under the BGP
      Tunnel Encapsulation registry

[6.1]. Existing Registry: Subsequent Address Family Identifiers (SAFI) Parameters

   This document introduces a SAFI in the registry "Subsequent Address
   Family Identifiers (SAFI) Parameters" that has been assigned a
   codepoint by IANA as follows:

            Codepoint   Description   Reference
            ----
               73   SR Policy SAFI   This document

[6.2]. Existing Registry: BGP Tunnel Encapsulation Attribute Tunnel Types

   This document introduces a Tunnel-Type in the registry "BGP Tunnel
   Encapsulation Attribute Tunnel Types" that has been assigned a
   codepoint by IANA as follows:

            Codepoint   Description   Reference
            ----
               15   SR Policy   This document

[6.3]. Existing Registry: BGP Tunnel Encapsulation Attribute sub-TLVs

   This document defines sub-TLVs in the registry "BGP Tunnel
   Encapsulation Attribute sub-TLVs" that has been assigned codepoints
   by IANA as follows via the early allocation process:

```
     Codepoint          Description                   Reference
     ----------------------------------------------------------------
     12          Preference sub-TLV                   This document
     13          Binding SID sub-TLV                  This document
     14          ENLP sub-TLV                         This document
     15          Priority sub-TLV                     This document
     20          SRv6 Binding SID sub-TLV             This document
     128         Segment List sub-TLV                 This document
     129         Policy Candidate Path Name sub-TLV   This document
     130         Policy Name sub-TLV                  This document
```

[6.4](#). Existing Registry: Color Extended Community Flags

   This document requests allocations in the registry called "Color
   Extended Community Flags" under the "BGP Tunnel Encapsulation"
   registry.

   The following bits have been assigned by IANA via the early
   allocation process to form the Color-Only Types field:

```
       Bit
     Position    Description                        Reference
     -------------------------------------------------------------------
       0-1       Color-only Types Field             This document
```

[6.5](#). New Registry: SR Policy Segment List Sub-TLVs

   This document requests the creation of a new registry called "SR
   Policy Segment List Sub-TLVs" under the "BGP Tunnel Encapsulation"
   registry. The allocation policy of this registry is "Standards
   Action" according to [[RFC8126](#)].

   Following initial Sub-TLV codepoints are assigned by this document:

```
        Value   Description                      Reference
        -------------------------------------------------------
          0     Reserved                         This document
          1     Segment Type A sub-TLV           This document
          2     Deprecated                       This document
          3     Segment Type C sub-TLV           This document
          4     Segment Type D sub-TLV           This document
          5     Segment Type E sub-TLV           This document
          6     Segment Type F sub-TLV           This document
          7     Segment Type G sub-TLV           This document
          8     Segment Type H sub-TLV           This document
          9     Weight sub-TLV                   This document
         10     Deprecated                       This document
         11     Deprecated                       This document
         12     Deprecated                       This document
         13     Segment Type B sub-TLV           This document
         14     Segment Type I sub-TLV           This document
         15     Segment Type J sub-TLV           This document
         16     Segment Type K sub-TLV           This document
        17-255 Unassigned
```

6.6. New Registry: SR Policy Binding SID Flags

This document requests the creation of a new registry called "SR
Policy Binding SID Flags" under the "BGP Tunnel Encapsulation"
registry. The allocation policy of this registry is "Standards
Action" according to [RFC8126].

The following flags are defined:

```
   Bit     Description                           Reference
   ------------------------------------------------------------------
    0       Specified-BSID-Only Flag (S-Flag)     This document
    1       Drop Upon Invalid Flag (I-Flag)       This document
   2-7      Unassigned
```

6.7. New Registry: SR Policy SRv6 Binding SID Flags

This document requests the creation of a new registry called "SR
Policy SRv6 Binding SID Flags" under the "BGP Tunnel Encapsulation"
registry. The allocation policy of this registry is "Standards
Action" according to [RFC8126].

The following flags are defined:

```
 Bit     Description                       Reference
 -----------------------------------------------------------------
   0      Specified-BSID-Only Flag (S-Flag)    This document
   1      Drop Upon Invalid Flag (I-Flag)      This document
   2      SRv6 Endpoint Behavior &
          SID Structure Flag (B-Flag)          This document
 3-7      Unassigned
```

6.8. New Registry: SR Policy Segment Flags

This document requests the creation of a new registry called "SR
Policy Segment Flags" under the "BGP Tunnel Encapsulation" registry.
The allocation policy of this registry is "Standards Action"
according to [RFC8126].

The following Flags are defined:

```
 Bit     Description                       Reference
 -----------------------------------------------------------------
   0      Segment Verification Flag (V-Flag)   This document
   1      SR Algorithm Flag (A-Flag)           This document
   2      SID Specified Flag (S-Flag)          This document
   3      SRv6 Endpoint Behavior &
          SID Structure Flag (B-Flag)          This document
 4-7      Unassigned
```

6.9. New Registry: Color Extended Community Color-Only Types

This document requests the creation of a new registry called "Color
Extended Community Color-Only Types" under the "BGP Tunnel
Encapsulation" registry for assignment of codepoints (values 0
through 3) in the Color-Only Type field of the Color Extended
Community Flags field. The allocation policy of this registry is
"Standards Action" according to [RFC8126].

The following types are defined:

```
 Type  Description                       Reference
 -------------------------------------------------------------
   0    Specific Endpoint Match              This document
   1    Specific or Null Endpoint Match      This document
   2    Specific, Null, or Any Endpoint Match This document
   3    Unallocated & reserved for future    This document
```

7. **Security Considerations**

   The security mechanisms of the base BGP security model apply to the
   extensions described in this document as well. See the Security
   Considerations section of [RFC4271] for a discussion of BGP security.
   Also, refer to [RFC4272] and [RFC6952] for analysis of security
   issues for BGP.

   The BGP SR Policy extensions specified in this document enable
   traffic engineering and service programming use-cases within the SR
   domain as described in [I-D.ietf-spring-segment-routing-policy]. SR
   operates within a trusted SR domain [RFC8402] and its security
   considerations also apply to BGP sessions when carrying SR Policy
   information. The SR Policies distributed by BGP are expected to be
   used entirely within this trusted SR domain i.e. within a single AS
   or between multiple AS/domains within a single provider network.
   Therefore, precaution is necessary to ensure that the SR Policy
   information advertised via BGP sessions is limited to nodes in a
   secure manner within this trusted SR domain. BGP peering sessions
   for address-families other than SR Policy SAFI may be set up to
   routers outside the SR domain. The isolation of BGP SR Policy SAFI
   peering sessions may be used to ensure that the SR Policy information
   is not advertised by accident or error to an EBGP peering session
   outside the SR domain.

   Additionally, it may be considered that the export of SR Policy
   information, as described in this document, constitutes a risk to
   confidentiality of mission-critical or commercially sensitive
   information about the network (more specifically endpoint/node
   addresses, SR SIDs, and the SR Policies deployed). BGP peerings are
   not automatic and require configuration; thus, it is the
   responsibility of the network operator to ensure that only trusted
   nodes (that include both routers and controller applications) within
   the SR domain are configured to receive such information.

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