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RFC 9831
Segment Type Extensions for BGP Segment Routing (SR) Policy

Abstract

This document specifies the signaling of additional Segment Routing (SR) Segment Types for SR Policies in BGP using the SR Policy Subsequent Address Family Identifier (SAFI).

Status of This Memo

This document is not an Internet Standards Track specification; it is published for examination, experimental implementation, and evaluation.

This document defines an Experimental Protocol for the Internet community. This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Not all documents approved by the IESG are candidates for any level of Internet Standard; see Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc9831.

Copyright Notice

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1. Introduction

The BGP Segment Routing (SR) Policy Subsequent Address Family Identifier (SAFI) was introduced by [RFC9830] for the advertisement of SR Policies [RFC8402]. [RFC9830] introduced the base SR Segment Types A and B as specified by the SR Policy Architecture [RFC9256].

This document specifies the extensions for the advertisement of the remaining SR Segment Types defined in [RFC9256] in the SR Policy SAFI for both SR-MPLS (see [RFC8660]) and Segment Routing over IPv6 (SRv6) (see [RFC8754] and [RFC8986]).

The extensions in this document do not impact the SR Policy operations or fault management as specified in [RFC9830].

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. Segment Type Sub-TLVs

The Segment List sub-TLV [RFC9830] encodes a single explicit path towards the endpoint as described in Section 5.1 of [RFC9256]. The Segment List sub-TLV includes the elements of the paths (i.e., segments).

A Segment sub-TLV describes a single segment in a segment list (i.e., a single element of the explicit path).

Section 4 of [RFC9256] defines several Segment Types for SR-MPLS and SRv6 that are listed below as a reminder:

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

[RFC9830] specifies Segment Type Sub-TLVs for the Segment Types A and B. The following subsections specify the sub-TLVs used for encoding each of the other Segment Types above.

As specified in Sections 2.4.4 and 2.4.4.2 of [RFC9830], validation of an explicit path encoded by the Segment List sub-TLV is beyond the scope of BGP and performed by the Segment Routing Policy Module (SRPM) as described in Section 5 of [RFC9830]. As specified in Section 5.1 of [RFC9256], a mix of SR-MPLS and SRv6 segments make the segment-list invalid.

2.1. Segment Type C

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

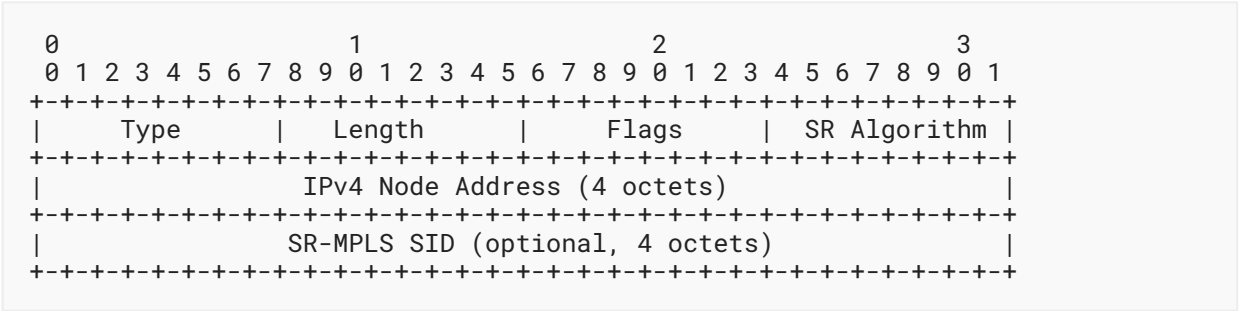

Figure 1: Type C Segment Sub-TLV

Where:

Type: 3

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be 10 when the SR-MPLS SID is present; else, it **MUST** be 6.

Flags: 1 octet of flags as defined in Section 2.10.

SR Algorithm: 1 octet specifying the SR Algorithm as described in Section 3.1.1 of [RFC8402] when the A-Flag as defined in Section 2.10 is set. The SR Algorithm is used by the SRPM [RFC9830] as described in Section 4 of [RFC9256]. When the A-Flag is not set, this field **MUST** be set to zero on transmission and **MUST** be ignored on receipt.

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

SR-MPLS SID: Optional. A 4-octet field containing a label, Traffic Class (TC), bottom-of-stack (S), and TTL as defined for Segment Type A [RFC9830].

2.2. 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:

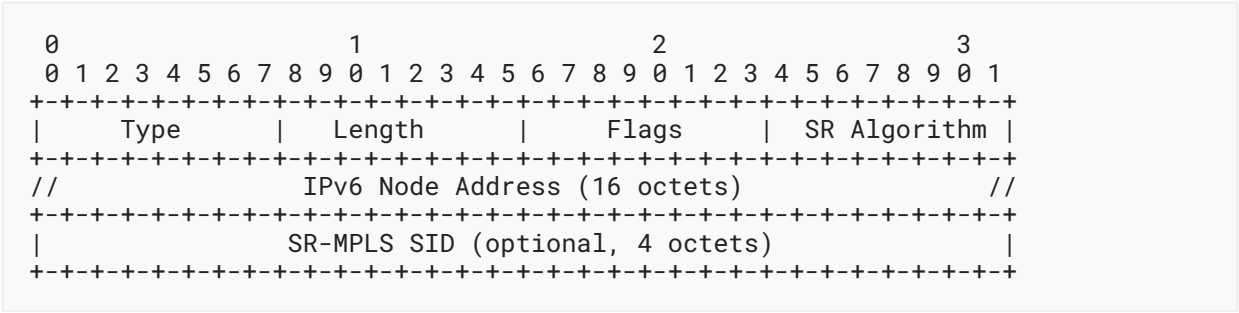

Figure 2: Type D Segment Sub-TLV

Where:

Type: 4

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be 22 when the SR-MPLS SID is present; else, it **MUST** be 18.

Flags: 1 octet of flags as defined in Section 2.10.

SR Algorithm: 1 octet specifying the SR Algorithm as described in Section 3.1.1 of [RFC8402] when the A-Flag as defined in Section 2.10 is set. The SR Algorithm is used by the SRPM [RFC9830] as described in Section 4 of [RFC9256]. When the A-Flag is not set, this field **MUST** be set to zero on transmission and **MUST** be ignored on receipt.

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

SR-MPLS SID: Optional. A 4-octet field containing a label, TC, S, and TTL as defined for Segment Type A [RFC9830].

2.3. 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:

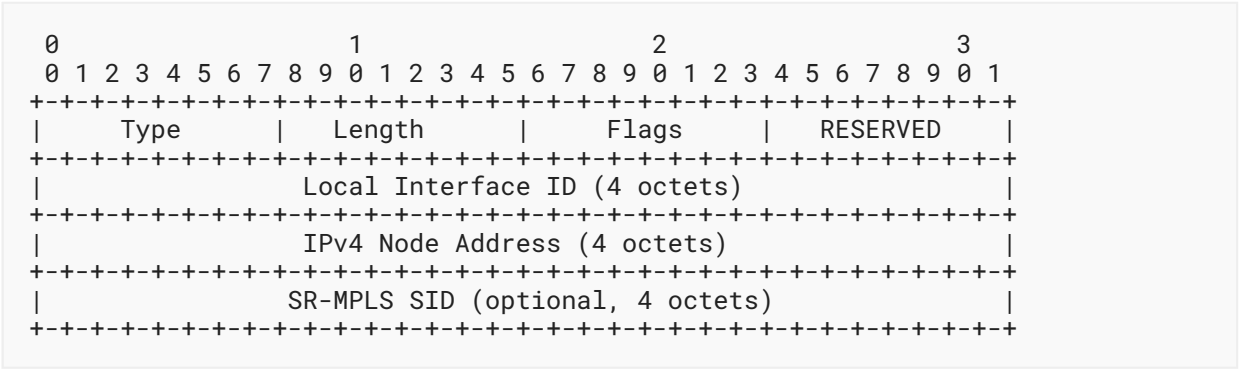

Figure 3: Type E Segment Sub-TLV

Where:

Type: 5

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be 14 when the SR-MPLS SID is present; else, it **MUST** be 10.

Flags: 1 octet of flags as defined in Section 2.10.

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

Local Interface ID: 4 octets carrying the interface index of the local interface (refer to TLV 258 of [RFC9552]).

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

SR-MPLS SID: Optional. A 4-octet field containing a label, TC, S, and TTL as defined for Segment Type A [RFC9830].

2.4. 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:

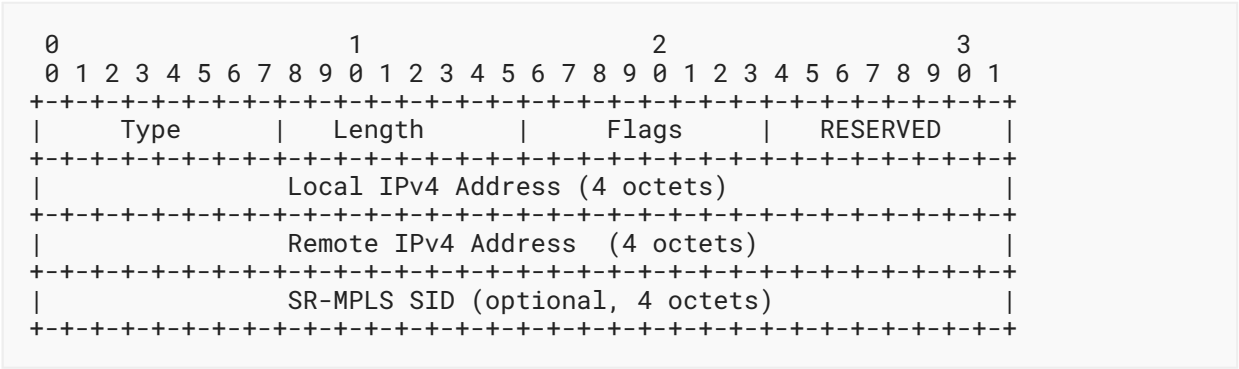

Figure 4: Type F Segment Sub-TLV

Where:

Type: 6

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be 14 when the SR-MPLS SID is present; else, it **MUST** be 10.

Flags: 1 octet of flags as defined in Section 2.10.

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

Local IPv4 Address: A 4-octet IPv4 address representing the local link address of the node.

Remote IPv4 Address: A 4-octet IPv4 address representing the link address of the neighbor node.

SR-MPLS SID: Optional. A 4-octet field containing a label, TC, S, and TTL as defined for Segment Type A [RFC9830].

2.5. Segment Type G

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

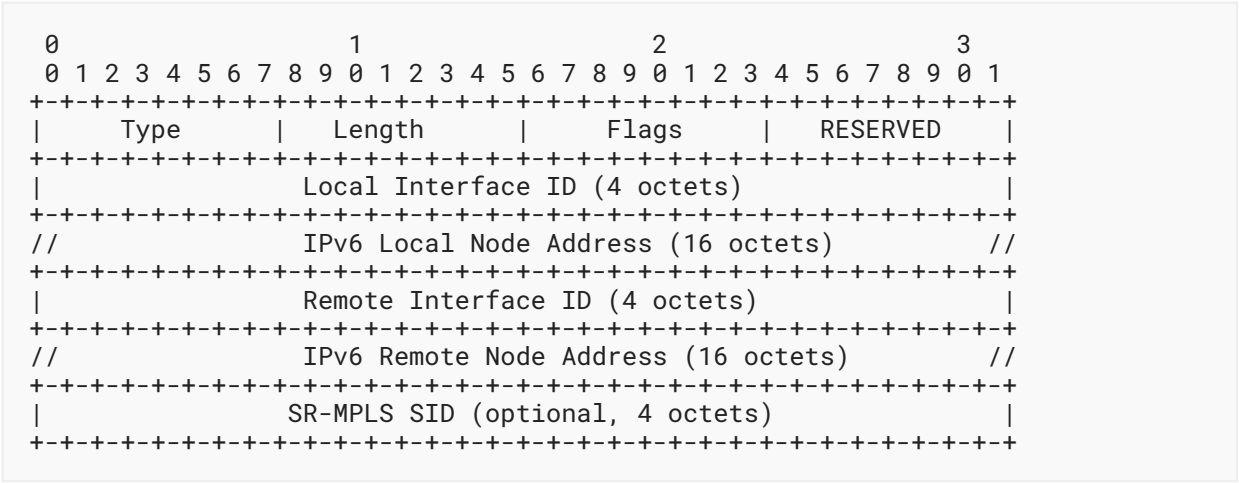

Figure 5: Type G Segment Sub-TLV

Where:

Type: 7

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be 46 when the SR-MPLS SID is present; else, it **MUST** be 42.

Flags: 1 octet of flags as defined in Section 2.10.

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

Local Interface ID: 4 octets of interface index of local interface (refer to TLV 258 of [RFC9552]).

IPv6 Local Node Address: A 16-octet IPv6 address representing the node.

Remote Interface ID: 4 octets of interface index of remote interface (refer to TLV 258 of [RFC9552]). The value **MAY** be set to zero when the local node address and interface identifiers are sufficient to describe the link.

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.

SR-MPLS SID: Optional. A 4-octet field containing a label, TC, S, and TTL as defined for Segment Type A [RFC9830].

2.6. 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:

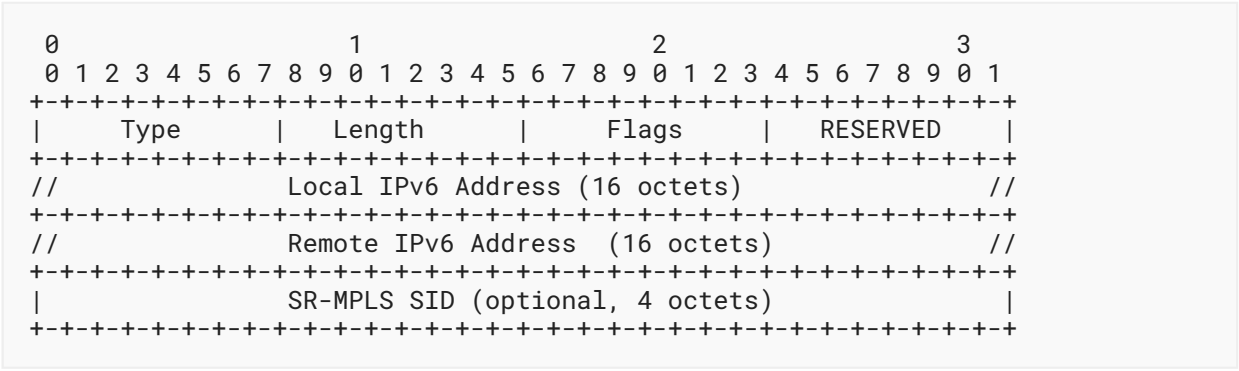

Figure 6: Type H Segment Sub-TLV

Where:

Type: 8

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be 38 when the SR-MPLS SID is present; else, it **MUST** be 34.

Flags: 1 octet of flags as defined in Section 2.10.

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

Local IPv6 Address: A 16-octet IPv6 address representing the local link address of the node.

Remote IPv6 Address: A 16-octet IPv6 address representing the link address of the neighbor node.

SR-MPLS SID: Optional. A 4-octet field containing a label, TC, S, and TTL as defined for Segment Type A [RFC9830].

2.7. Segment Type I

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

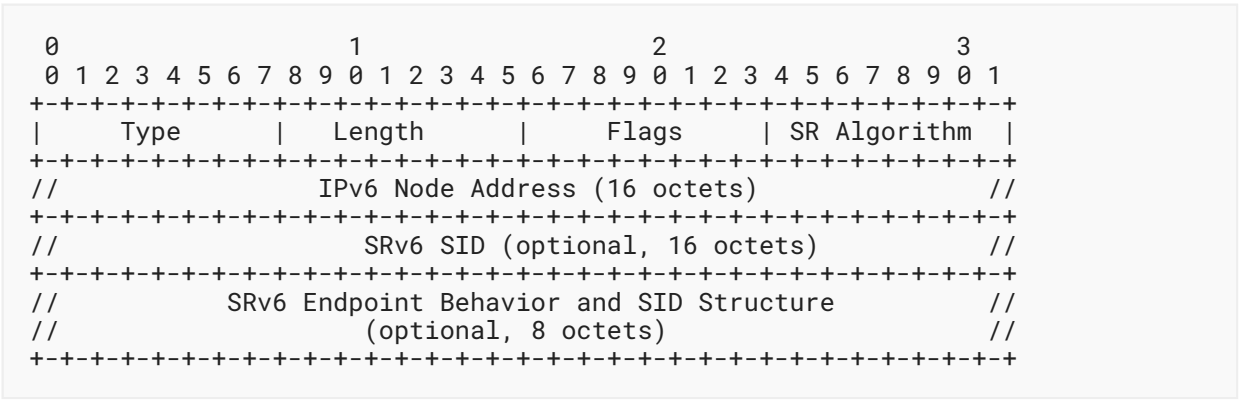

Figure 7: Type I Segment Sub-TLV

Where:

Type: 14

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be one of the following:

- 42 when both SRv6 SID and SRv6 Endpoint Behavior and SID Structure are present,
- 34 when only SRv6 SID is present, or
- 18 when the SRv6 SID is not present.

Flags: 1 octet of flags as defined in Section 2.10.

SR Algorithm: 1 octet specifying the SR Algorithm as described in Section 3.1.1 of [RFC8402] when the A-Flag as defined in Section 2.10 is set. The SR Algorithm is used by the SRPM [RFC9830] as described in Section 4 of [RFC9256]. When the A-Flag is not set, this field **MUST** be set to zero on transmission and **MUST** be ignored on receipt.

IPv6 Node Address: A 16-octet IPv6 address representing the node.

SRv6 SID: Optional. A 16-octet IPv6 address. The value 0 **MAY** be used when the controller wants to indicate the desired SRv6 Endpoint Behavior or SID Structure without specifying the SID.

SRv6 Endpoint Behavior and SID Structure: Optional, as defined in Section 2.4.4.2.4 of [RFC9830]. The SRv6 Endpoint Behavior or SID Structure **MUST NOT** be included when the SRv6 SID has not been included.

TLV 10 defined for the advertisement of Segment Type I in the early draft versions of [RFC9830] has been deprecated to avoid backward-compatibility issues.

2.8. Segment Type J

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

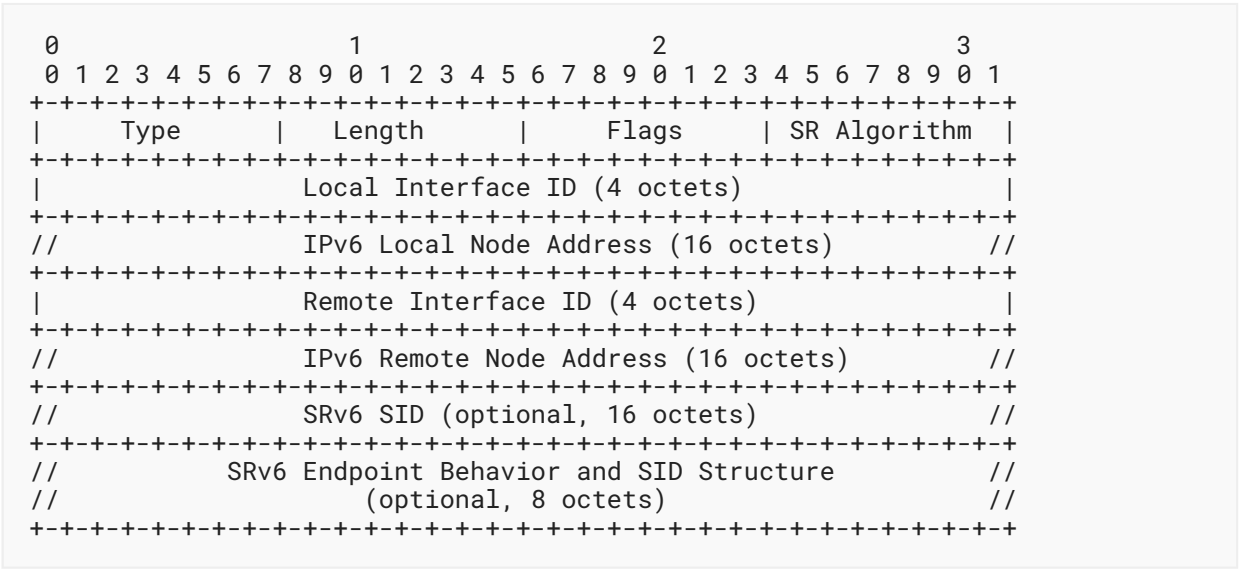

Figure 8: Type J Segment Sub-TLV

Where:

Type: 15

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be one of the following:

- 66 when both SRv6 SID and SRv6 Endpoint Behavior and SID Structure are present,
- 58 when only SRv6 SID is present, or
- 42 when the SRv6 SID is not present.

Flags: 1 octet of flags as defined in Section 2.10.

SR Algorithm: 1 octet specifying the SR Algorithm as described in Section 3.1.1 of [RFC8402] when the A-Flag as defined in Section 2.10 is set. The SR Algorithm is used by the SRPM [RFC9830] as described in Section 4 of [RFC9256]. When the A-Flag is not set, this field **MUST** be set to zero on transmission and **MUST** be ignored on receipt.

Local Interface ID: 4 octets of interface index of local interface (refer to TLV 258 of [RFC9552]).

IPv6 Local Node Address: A 16-octet IPv6 address representing the node.

Remote Interface ID: 4 octets of interface index of remote interface (refer to TLV 258 of [RFC9552]). The value **MAY** be set to zero when the local node address and interface identifiers are sufficient to describe the link.

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.

SRv6 SID: Optional. A 16-octet IPv6 address. The value 0 **MAY** be used when the controller wants to indicate the desired SRv6 Endpoint Behavior or SID Structure without specifying the SID.

SRv6 Endpoint Behavior and SID Structure: Optional, as defined in Section 2.4.4.2.4 of [RFC9830]. The SRv6 Endpoint Behavior and SID Structure **MUST NOT** be included when the SRv6 SID has not been included.

TLV 11 defined for the advertisement of Segment Type J in the early draft versions of [RFC9830] has been deprecated to avoid backward-compatibility issues.

2.9. 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:

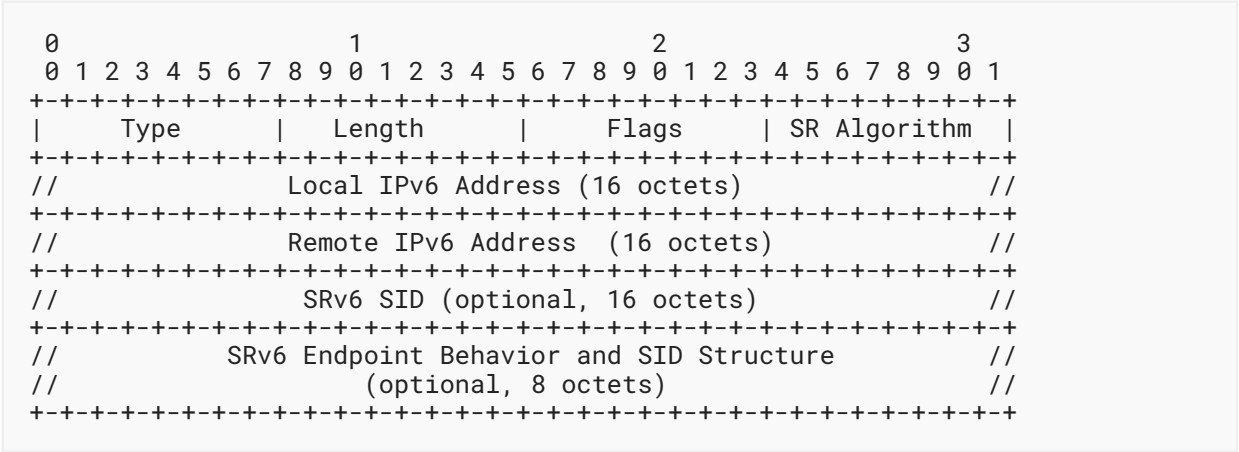

Figure 9: Type K Segment Sub-TLV

Where:

Type: 16

Length: Specifies the length of the value field (i.e., not including Type and Length fields) in terms of octets. The value **MUST** be one of the following:

- 58 when both SRv6 SID and SRv6 Endpoint Behavior and SID Structure are present,
- 50 when only SRv6 SID is present, or

- 34 when the SRv6 SID is not present.

Flags: 1 octet of flags as defined in Section 2.10.

SR Algorithm: 1 octet specifying the SR Algorithm as described in Section 3.1.1 of [RFC8402] when the A-Flag as defined in Section 2.10 is set. The SR Algorithm is used by the SRPM [RFC9830] as described in Section 4 of [RFC9256]. When the A-Flag is not set, this field **MUST** be set to zero on transmission and **MUST** be ignored on receipt.

Local IPv6 Address: A 16-octet IPv6 address representing the local link address of the node.

Remote IPv6 Address: A 16-octet IPv6 address representing the link address of the neighbor node.

SRv6 SID: Optional. A 16-octet IPv6 address. The value 0 **MAY** be used when the controller wants to indicate the desired SRv6 Endpoint Behavior or SID Structure without specifying the SID.

SRv6 Endpoint Behavior and SID Structure: Optional, as defined in Section 2.4.4.2.4 of [RFC9830]. The SRv6 Endpoint Behavior and SID Structure **MUST NOT** be included when the SRv6 SID has not been included.

TLV 12 defined for the advertisement of Segment Type K in the early draft versions of [RFC9830] has been deprecated to avoid backward-compatibility issues.

2.10. SR Policy Segment Flags

The Segment Type sub-TLVs described above may contain the following SR Policy Segment Flags [RFC9830] in their Flags field (see also Section 3.2). This document introduces additional flags below:

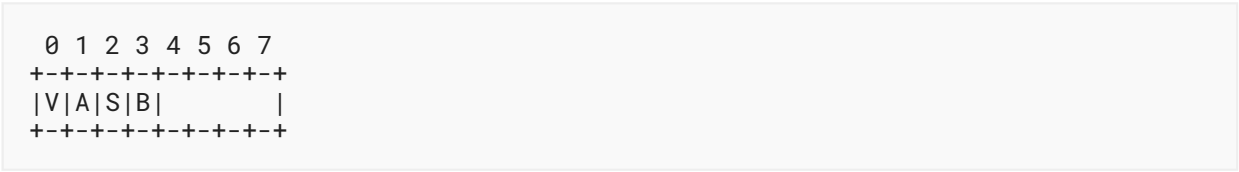

Figure 10: SR Policy Segment Flags

Where:

V-Flag: This is an existing flag as defined in [RFC9830].

A-Flag: When set, this flag indicates the presence of the SR Algorithm id in the SR Algorithm field applicable to various Segment Types. The SR Algorithm is used by the SRPM [RFC9830] as described in Section 4 of [RFC9256].

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

B-Flag: This is an existing flag as defined in [RFC9830].

The following applies to the Segment Flags:

- The V-Flag applies to all Segment Types including those introduced by this document.
- The A-Flag applies to Segment Types C, D, I, J, and K. The value of the A-Flag **MUST** be ignored for Segment Types A, B, E, F, G, and H.
- The S-Flag applies to Segment Types C, D, E, F, G, H, I, J, and K. The value of the S-Flag **MUST** be ignored for Segment Types A and B.
- The B-Flag applies to Segment Types B, I, J, and K. The value of the B-Flag **MUST** be ignored for Segment Types A, C, D, E, F, G, and H.

3. IANA Considerations

3.1. SR Policy Segment List Sub-TLVs

IANA has allocated the following code points from the "SR Policy Segment List Sub-TLVs" registry [RFC9830] under the "Border Gateway Protocol (BGP) Tunnel Encapsulation" registry group.

Value	Description	Reference
3	Type C Segment sub-TLV	RFC 9831
4	Type D Segment sub-TLV	RFC 9831
5	Type E Segment sub-TLV	RFC 9831
6	Type F Segment sub-TLV	RFC 9831
7	Type G Segment sub-TLV	RFC 9831
8	Type H Segment sub-TLV	RFC 9831
14	Type I Segment sub-TLV	RFC 9831
15	Type J Segment sub-TLV	RFC 9831
16	Type K Segment sub-TLV	RFC 9831

Table 1: SR Policy Segment List Code Points

3.2. SR Policy Segment Flags

IANA has allocated code points from the "SR Policy Segment Flags" registry [RFC9830] under the "Border Gateway Protocol (BGP) Tunnel Encapsulation" registry group.

Bit	Description	Reference
1	SR Algorithm Flag (A-Flag)	RFC 9831
2	SID Specified Flag (S-Flag)	RFC 9831

Table 2: SR Policy Segment Flags

4. Security Considerations

The security considerations in [RFC9830] apply to the Segment Types defined in this document. No additional security considerations are introduced.

5. Manageability Considerations

The operations and manageability considerations in [RFC9830] apply to the Segment Types defined in this document. No additional operations and manageability considerations are introduced.

6. Normative References

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