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SRv6 NET-PGM extension: Insertion
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Abstract

Traffic traversing an SR domain is encapsulated in an outer IPv6 header for its journey through the SR domain.

To implement transport services strictly within the SR domain, the SR domain may require insertion or deletion of an SRH after the outer IPv6 header of the SR domain. Any segment within the SRH is strictly contained within the SR domain.

This document extends SRv6 Network Programming [RFC8986] with new SR endpoint and transit behaviors to be performed only within the SR domain in any packet owned by the domain.

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.

Status of This Memo

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

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1. Introduction

Packets transiting an SR Domain may be steered into an SR Policy for a variety of reasons. For example, a PLR router reroutes traffic on a TI-LFA repair path [I-D.ietf-rtgwg-segment-routing-ti-lfa] or when a Binding-SID is expanded [I-D.ietf-spring-segment-routing-policy].

This document extends the SRv6 Network Programming [RFC8986] model with new endpoint and transit behaviors enabling the insertion of an SRH after the outer IPv6 header of the SR domain. The operations described in this document must take into account the considerations described in [I-D.voyer-6man-extension-header-insertion].

2. SRv6 endpoint behaviors

SRv6 Network Programming Section 4 defines a base set of SRv6 endpoint behaviors. This is extended with the behaviors described in this section.

2.1. End.B6.Insert: Endpoint bound to an SRv6 policy

The "Endpoint bound to an SRv6 Policy" is a variant of the End behavior.

One of its applications is to express scalable traffic-engineering policies across multiple domains. It is the one of the SRv6 instantiations of a Binding SID [RFC8402].

An End.B6.Insert SID is never the last segment in a SID list, and any SID instantiation must be associated with an SR Policy B[I-D.ietf-spring-segment-routing-policy].

When N receives a packet whose IPv6 DA is S and S is a local End.B6.Insert SID, does:

```
S01. When an SRH is processed {
S02.   If (Segments Left == 0) {
S03.      Send an ICMP Parameter Problem message to the Source Address
             Code TBD-SRH (SR Upper-layer Header Error),
             Pointer set to the offset of the upper-layer header,
             interrupt packet processing and discard the packet
S04.   }
S04.   If (IPv6 Hop Limit <= 1) {
S05.       Send an ICMP Time Exceeded message to the Source Address,
             Code 0 (Hop limit exceeded in transit),
             interrupt packet processing and discard the packet
S06.   }
S07.   max_LE = (Hdr Ext Len / 2) - 1
S08.   If ((Last Entry > max_LE) or (Segments Left > (Last Entry+1)){
S09.      Send an ICMP Parameter Problem to the Source Address,
             Code 0 (Erroneous header field encountered),
             Pointer set to the Segments Left field,
             interrupt packet processing and discard the packet
S11.   }
S12.   Decrement Hop Limit by 1
S13.   Insert a new SRH in between the IPv6 Header and the received
        SRH containing the list of segments of B
S14.   Set the IPv6 DA to the first segment of B
S15.   Resubmit the packet to the egress IPv6 FIB lookup and
          transmission to the new destination
S16. }
```

When processing the Upper-layer header of a packet matching a FIB entry locally instantiated as an SRv6 End.B6.Insert SID, send an ICMP parameter problem message to the Source Address and discard the packet. Error code "SR Upper-layer Header Error", Pointer set to the offset of the upper-layer header.

2.2. End.B6.Insert.Red: [...] with reduced SRH

This is an optimization of the End.B6.Insert behavior.

End.B6.Insert.Red reduces the size of the new SRH by one SID by avoiding the insertion of the first SID in the pushed SRH. In this way, the first SID is only written in the DA and the packet is forwarded according to it.

The new SRH is created as described in Section 4.1.1 of [RFC8754].

3. SR Policy Headend Behaviors

SRv6 Network Programming defines in Section 5 a set of SR Policy Headend Behaviors. This is extended with the following behaviors defined in this section.

3.1. H.Insert: SR Headend with insertion of an SRv6 Policy

Node N receives two packets P1=(A, B2) and P2=(A,B2)(B3, B2, B1; SL=1). B2 is neither a local address nor SID of N.

N steers the transit packets P1 and P2 into an SRv6 Policy with one SID list <S1, S2, S3>.

The "H.Insert" transit insertion behavior is defined as follows:

1. insert the SRH (B2, S3, S2, S1; SL=3) ;; Ref1, Ref1bis
2. set the IPv6 DA = S1
3. forward along the shortest path to S1

Ref1: The received IPv6 DA is placed as last SID of the inserted SRH.

Ref1bis: The SRH is inserted [I-D.voyer-6man-extension-header-insertion] before any other IPv6 Routing Extension Header.

After the H.Insert behavior, P1 and P2 respectively look like:

-(A, S1) (B2, S3, S2, S1; SL=3)

-(A, S1) (B2, S3, S2, S1; SL=3) (B3, B2, B1; SL=1)

3.2. H.Insert.Red: H.Insert with reduced insertion

The H.Insert.Red behavior is an optimization of the H.Insert behavior. It is defined as follows:

1. insert the SRH (B2, S3, S2; SL=3)
2. set the IPv6 DA = S1
3. forward along the shortest path to S1

H.Insert.Red will reduce the size of the SRH by one segment by avoiding the insertion of the first SID in the pushed SRH. In this way, the first segment is only introduced in the DA and the packet is forwarded according to it.

After the H.Insert.Red behavior, P1 and P2 respectively look like:

- (A, S1) (B2, S3, S2; SL=3)

- (A, S1) (B2, S3, S2; SL=3) (B3, B2, B1; SL=1)

4. Maximum H.Insert MSD Type

This document defines the MSD (Maximum SID Depth) for H.Insert behavior and requests the MSD type assignment from the IGP MSD-Types registry created by [RFC8491].

The Maximum H.Insert MSD Type specifies the maximum number of SIDs that can be inserted as part of the "H.insert" behavior:

-Max H.insert Type: 43 (Suggested value - to be assigned by IANA)

If the advertised value is zero or no value is advertised then the router is assumed not to support any variation of the "H.insert" behavior.

5. IANA Considerations

5.1. SRv6 Endpoint Behaviors

This document requests IANA to allocate the following codepoints within the "SRv6 Endpoint Behaviors" sub-registry under the top-level "Segment Routing Parameters" registry.

Value	Hex	Endpoint behavior	Reference
13	0x000D	End.B6.Insert	[This.ID]
26	0x001A	End.B6.Insert.Red	[This.ID]

Table 1: IETF - SRv6 Endpoint Behaviors

5.2. MSD Types

This document requests IANA to allocate the following codepoint within the "IGP MSD-Types" sub-registry under the top-level "IGP Parameters" registry.

Value	Hex	Endpoint behavior	Reference
43	0x2B	Max H.Insert	[This.ID]

Table 2: IETF - MSD Types

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8. References

8.1. Normative References

[I-D.voyer-6man-extension-header-insertion]
Voyer, D., Filsfils, C., Dukes, D., Matsushima, S., Leddy, J., Li, Z., and J. Guichard, "Deployments With Insertion of IPv6 Segment Routing Headers", draft-voyer-6man-extension-header-insertion-10 (work in progress), November 2020.

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

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

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

[RFC8491] Tantsura, J., Chunduri, U., Aldrin, S., and L. Ginsberg, "Signaling Maximum SID Depth (MSD) Using IS-IS", RFC 8491, DOI 10.17487/RFC8491, November 2018, <https://www.rfc-editor.org/info/rfc8491>.

[RFC8754] Filsfils, C., Ed., Dukes, D., Ed., Previdi, S., Leddy, J., Matsushima, S., and D. Voyer, "IPv6 Segment Routing Header (SRH)", RFC 8754, DOI 10.17487/RFC8754, March 2020, <https://www.rfc-editor.org/info/rfc8754>.

[RFC8986] Filsfils, C., Ed., Camarillo, P., Ed., Leddy, J., Voyer, D., Matsushima, S., and Z. Li, "Segment Routing over IPv6 (SRv6) Network Programming", RFC 8986, DOI 10.17487/RFC8986, February 2021, <https://www.rfc-editor.org/info/rfc8986>.

8.2. Informative References

[I-D.ietf-rtgwg-segment-routing-ti-lfa]
Litkowski, S., Bashandy, A., Filsfils, C., Francois, P., Decraene, B., and D. Voyer, "Topology Independent Fast Reroute using Segment Routing", draft-ietf-rtgwg-segment-routing-ti-lfa-06 (work in progress), February 2021.

[I-D.ietf-spring-segment-routing-policy]
Filsfils, C., Talaulikar, K., Voyer, D., Bogdanov, A., and P. Mattes, "Segment Routing Policy Architecture", draft-ietf-spring-segment-routing-policy-11 (work in progress), April 2021.

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