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**Segment Routing Traffic Engineering Leveraging Existing IPv6 Interface  
Addresses  
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Abstract

This document illustrates how an operator may re-use an existing IPv6 address allocation within its domain to deliver SR-based Traffic Engineering service.

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## [1.](#) Introduction

This document illustrates how an operator may re-use an existing IPv6 address allocation within its domain to deliver SR-based Traffic Engineering service by describing:

- o A reference topology with IPv6 address allocation.
- o Binding a SID behavior to existing IPv6 addresses.
- o The life of a packet forwarded via an SR policy.
- o Upper-layer header processing for a SID bound to an existing IPv6 address.

The illustrations cover traffic engineering (TE) SR policy between two border routers of the domain and two hosts of the domain.

## [2.](#) Reference Topology

The reference topology is the same as [Section 6.2 of \[RFC8754\]](#).







## 5. Life Of A Packet

This section uses the abstract representation of an SRH as defined in [Section 6.1 of \[RFC8754\]](#).

It illustrates two examples from [Section 6 of \[RFC8754\]](#) for inter SR domain and intra SR domain packets and the processing at SR source nodes, transit nodes and SR segment endpoint nodes using the SIDs bound to interface addresses.

### 5.1. Inter SR Domain

Host 1 sends a packet (P1) to host 2

P1: (A1,A2)

The SR domain ingress router 3 receives P1 and steers it to SR domain egress router 4 via an SR Policy <2001:db8:0:7::1, 2001:db8:0:4::1>. Router 3 encapsulates the received packet P1 in an outer header with a reduced SRH and sends the packet

P2: (2001:db8:0:3::1, 2001:db8:0:7::1)(2001:db8:0:4::1; SL=1)(A1,A2)

Router 5 acts as a transit node for P2 and forwards it on the interface toward router 7.

Router 7 receives packet P2 and, using the logic in [Section 4.3.1.1 of \[RFC8754\]](#), decrements the Segments Left value and updates the Destination Address to 2001:db8:0:4::1. It sends the resulting packet

P3: (2001:db8:0:3::1, 2001:db8:0:4::1)(2001:db8:0:4::1; SL=0)(A1,A2)

on the interface toward router 6.

Router 6 acts as a transit node for packet P3 and forwards P3 on the interface toward router 4.

Router 4 receives packet P3 and, using the logic in [Section 4.3.1.2 of \[RFC8754\]](#), performs IPv6 decapsulation on P2 and forwards the inner packet P1: (A1,A2) on the interface toward host 2.

### 5.2. Intra SR Domain

When host 8 sends a TCP packet to host 9 via an SR Policy <2001:db8:0:7::1, 2001:db8:0:9::1> the packet is

P4: (2001:db8:0:8::1, 2001:db8:0:7::1)(2001:db8:0:9::1; SL=1) (TCP)



Processing of P4 is similar to P2 above; router 5 forwards while router 7 processes the SRH resulting in the following packet

P5: (2001:db8:0:8::1, 2001:db8:0:9::1)(2001:db8:0:9::1; SL=0) (TCP)

P5 is forwarded by router 6 to host 9 where the packet is consumed and its TCP payload is processed.

## 6. Upper-Layer Header Processing

The SID behavior described in [[RFC8754](#)] permits some upper-layer processing and blocks others. In some use-cases upper-layer processing may be limited when additional SID's are allocated independently of any existing interface address, and as a conservative security measure.

In this use-case the operator re-uses existing interface addresses for SIDs, it is expected that upper-layer processing is preserved and permitted for those addresses.

The following sections describe ping, ping via an SR policy and SSH session initiation for these SIDs.

### 6.1. ICMPv6 Echo Request and Reply

This section illustrates the life of an ICMPv6 echo request from router 3 (2001:db8:0:3::1) to router 4 (2001:db8:0:4::1) and of the corresponding ICMPv6 echo reply.

When router 3 sends an ICMPv6 echo request from 2001:db8:0:3::1 to 2001:db8:0:4::1 on router 4, the packet is

P6: (2001:db8:0:3::1, 2001:db8:0:4::1)(ICMPv6 echo request)

Router 4 receives packet P6 and follows [Section 4.3.1 of \[RFC8754\]](#). Specifically, P6 does not contain an SRH and, since upper-layer header processing is permitted, router 4 processes packet P3 as per [[RFC4443](#)] and sends the response packet

P7: (2001:db8:0:4::1, 2001:db8:0:3::1)(ICMPv6 echo reply)

on the interface toward router 6.

Router 3 receives packet P7 and applies [Section 4.3.1 of \[RFC8754\]](#). Specifically, P7 does not contain an SRH and, since upper-layer header processing is permitted, router 3 processes packet P4 as per [[RFC4443](#)].





## 6.2. ICMPv6 Echo Request via an SR Policy

This section illustrates the life of an ICMPv6 echo request from router 3 (2001:db8:0:3::1) to router 4 (2001:db8:0:4::1) via router 7 (2001:db8:0:7::1), and of the corresponding ICMPv6 echo reply.

When router 3 sends an ICMPv6 echo request from 2001:db8:0:3::1 to 2001:db8:0:4::1 via an SR Policy <2001:db8:0:7::1, 2001:db8:0:4::1> using a reduced SRH, the packet is

P8: (2001:db8:0:3::1, 2001:db8:0:7::1)(2001:db8:0:4::1; SL=1)(ICMPv6 echo request)

Router 7 eventually receives packet P8 and, using the logic in [Section 4.3.1.1 of \[RFC8754\]](#), decrements the Segments Left value and updates the Destination Address to 2001:db8:0:4::1. It sends the resulting packet

P9: (2001:db8:0:3::1, 2001:db8:0:4::1)(2001:db8:0:4::1; SL=0)(ICMPv6 echo request)

on the interface toward router 6.

Router 4 receives packet P9 and applies [Section 4.3.1 of \[RFC8754\]](#). Specifically, it determines that packet P9 contains an SRH with Segments Left equal to 0 and proceeds to process the next header in the extension header chain, as per [Section 4.3.1.1 of \[RFC8754\]](#). Since upper-layer header processing is permitted, router 4 processes packet P9 as per [\[RFC4443\]](#) and sends the response packet

P10: (2001:db8:0:4::1, 2001:db8:0:3::1)(ICMPv6 echo reply)

on the interface toward router 6.

Packet P10 follows the same return path as packet P7 above.

## 6.3. SSH Session Initiation

This section illustrates the initiation of a SSH session between router 3 (2001:db8:0:3::1) and router 4 (2001:db8:0:4::1).

SSH first establishes a TCP session between the two routers. Router 3 sends an TCP SYN packet from 2001:db8:0:3::1 to 2001:db8:0:4::1 on router 4, resulting in

P11: (2001:db8:0:3::1, 2001:db8:0:4::1)(TCP SYN)



Router 4 receives packet P11 and applies [Section 4.3.1 of \[RFC8754\]](#). Specifically, it determines that packet P11 does not contain an SRH and, since upper-layer header processing is permitted, processes packet P11 as per [\[RFC0793\]](#) and sends the response packet

P12: (2001:db8:0:4::1, 2001:db8:0:3::1)(TCP SYN-ACK)

on the interface toward router 6.

The rest of the communication occurs as normal for SSH [\[RFC4253\]](#).

## **7. Security Considerations**

The SR domain is secured via ingress filtering of packets as described in [\[RFC8754\] Section 5.1](#). In this document packets entering the SR domain destined to infrastructure addresses are dropped at ingress edge nodes since the SID and infrastructure address prefixes are the same (eg. 2001:db8:0::/48).

When an SRv6-capable node receives an IPv6 packet, it performs a longest-prefix-match lookup on the packet's destination address. It processes any SRH in the packet only when the destination address is bound to a SID ([\[RFC8754\] Section 4.3](#)). This further limits the possible attack surface to a subset of the infrastructure address prefix protected by ingress filtering.

The SID behavior bound to an address may limit some upper-layer processing ([\[RFC8754\] Section 4.3.1.2](#)). In the use-case described in this document, upper-layer header processing is not limited for an address the SID behavior is bound to.

## **8. IANA Considerations**

This document has no IANA actions.

## **9. Ecosystem**

The use-case described in this document is supported on Arccus, Broadcom, Cisco, and Linux.

## **10. References**

### **10.1. Normative References**

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