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The Use of Path Segment in SR Inter-domain Scenarios
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Abstract

This document discusses the inter-domain scenarios for SR-MPLS network and proposes the solution with the use of Path Segment.

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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This Internet-Draft will expire on January 4, 2020.

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1. Introduction

Segment Routing (SR) leverages the source routing paradigm. A node steers a packet through an SR Policy instantiated as an ordered list of instructions called "segments". A segment can represent any instruction, topological or service based. A segment can have a semantic local to an SR node or global within an SR domain. SR supports per-flow explicit routing while maintaining per-flow state only at the ingress nodes of the SR domain. Segment Routing can be instantiated on MPLS data plane which is referred to as SR-MPLS [I-D.ietf-spring-segment-routing-mpls]. SR-MPLS leverages the MPLS label stack to construct the SR path.

[I-D.ietf-spring-mpls-path-segment] defines a Path Segment identifier to support bidirectional path correlation for transport network. In multi-domain scenarios, the SR bidirectional end-to-end tunnel MAY be established with the use of Path Segments. The SR-MPLS inter-domain models include the stitching and nesting inter-domain models. Path Segment MAY be used to indicate the inter-domain path or the end-to-end path and correlate the inter-domain paths or end-to-end unidirectional paths.

This document discusses the inter-domain scenarios for SR-MPLS networks and proposes the solution with the use of Path Segment for end-to-end bidirectional SR path.

2. Conventions used in this document

2.1. Terminology

ABR: Area Border Routers. Routers used to connect two IGP areas (areas in OSPF or levels in IS-IS).

A->B SID list: The SID List from SR node A to SR node B.

AS: Autonomous System.

ASBR: Autonomous System Border Router. Router used to connect together ASes of the same or different service providers via one or more inter-AS links.

Domains:Autonomous System (AS) or IGP Area. An Autonomous System is composed by one or more IGP area.

e-Path: End-to-end Path segment.

s-Path: Sub-path Path Segment.

Inter-Area: Two IGP areas interconnects with an ABR in a AS.

Inter-AS: Two ASes interconnects with an ASBR.

IGP: Interior Gateway Protocol.

i-Path/i-PSID: Inter-domain Path Segment.

SR: Segment Routing.

SR-MPLS: Segment Routing with MPLS data plane.

2.2. 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.

3. Path Segment for SR-MPLS Inter-domain

3.1. Inter-domain Path Segment

In the stitching inter-domain model, the end-to-end SR path being split into multiple segments section 4.2. And each segment can be identified by an inter-domain path segment (i-Path or i-PSID). The inter-domain path segment is valid in the corresponding domain and the border nodes maintain the forwarding entries of that i-Path segment mapping to the next i-Path. In the headend node, the i-Path can be mapped to the inter-domain path of reverse direction and correlates the two unidirectional paths. The border nodes should install the following MPLS data entries for Path segments:

```
  incoming label: i-Path
     outgoing label: the SID list of the next domain or link + next i-Path
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Taking Figure 1 as an example, the border node X installs the MPLS data entries:

```
     incoming label: i-Path(A->X)
        outgoing label: X->Y SID list + i-Path(X->Y)
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The i-Path can be a locally unique label and assigned from the Segment Routing Local Block (SRLB). It is required that the controller(e.g., PCE) assigns the label to ensure the ingress and the egress node can recognize it and it also can be assigned from egress node of each domain. PCEP based i-Path allocation and procedure is defined in [I-D.xiong-pce-stateful-pce-sr-inter-domain].

3.2. End-to-end Path Segment

The nesting inter-domain model is described in [I-D.ietf-spring-mpls-path-segment], an end-to-end path segment, also referred to as e-Path, is used to indicate the end-to-end path, and an s-Path is used to indicate the intra-domain path. The e-Path is encapsulated at the ingress nodes and decapsulated at the egress nodes. The transit nodes, even the border nodes of domains, are not aware of the e-Path segment. The s-Path can be used as stitching label to correlate the two domains. The use of the binding SID [RFC8402] is also recommended to reduce the size of lable stack section 4.2.

The e-Path can be a globally unique or local label. If the e-Path is globally unique, it MUST be assigned from the SRGB block of each domain. If the e-Path is a local label, it is required that the controller(e.g., PCE) or a super controller (e.g., hierarchical PCE) assigns the label to ensure the ingress(A) and the egress node(Z) can recognize it and there is no SID collision in the ingress and egress domains.

4. SR-MPLS Inter-domain Scenarios

The domains of the networks may be IGP Areas or ASes and the inter-domain scenario may be inter-Area or inter-AS. The multiple SR-MPLS domains may be interconnect with a ABR within areas or inter-link between ASes. This document takes IGP Areas domains for example. SR-MPLS domains can be deployed as Figure 1 shown.

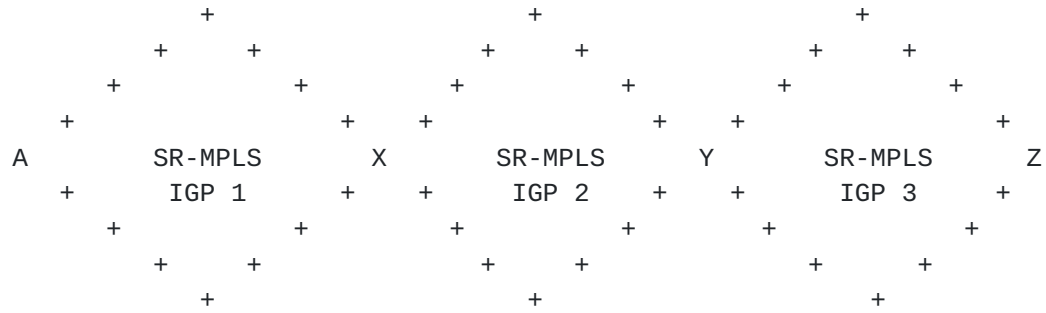

Figure 1: SR-MPLS and MPLS-TP interworking Scenario

Two SR-MPLS inter-domain models are discussed in this document including the stitching and nesting inter-domain model which are described in Section 4.1 and Section 4.2 respectively.

4.1. Stitching Inter-domain with i-Path

The Figure 1 displays the border node inter-domain scenario. SR node X and SR node Y are the border nodes of two different domains. The i-Paths from A->X, X->Y, and Y->Z are used for the inter-domain path segment. The ingress SR node A encapsulates the data packet with i-Path (A->X) and A->X SID list. The data packet is forwarded to SR node X according to the A->X SID list. Node X pushes the i-Path (X->Y) and X->Y SID list based on the above mentioned forwarding entry. The data packet is forwarded to node Y and then to the SR node Z based on the same forwarding procedure. In node Z, the i-Path (Y->Z) can be mapped to the path from Z to Y of reverse direction and correlates the two unidirectional paths. The packet transmission of the reverse direction is the same with the forwarding direction with different i-Paths.

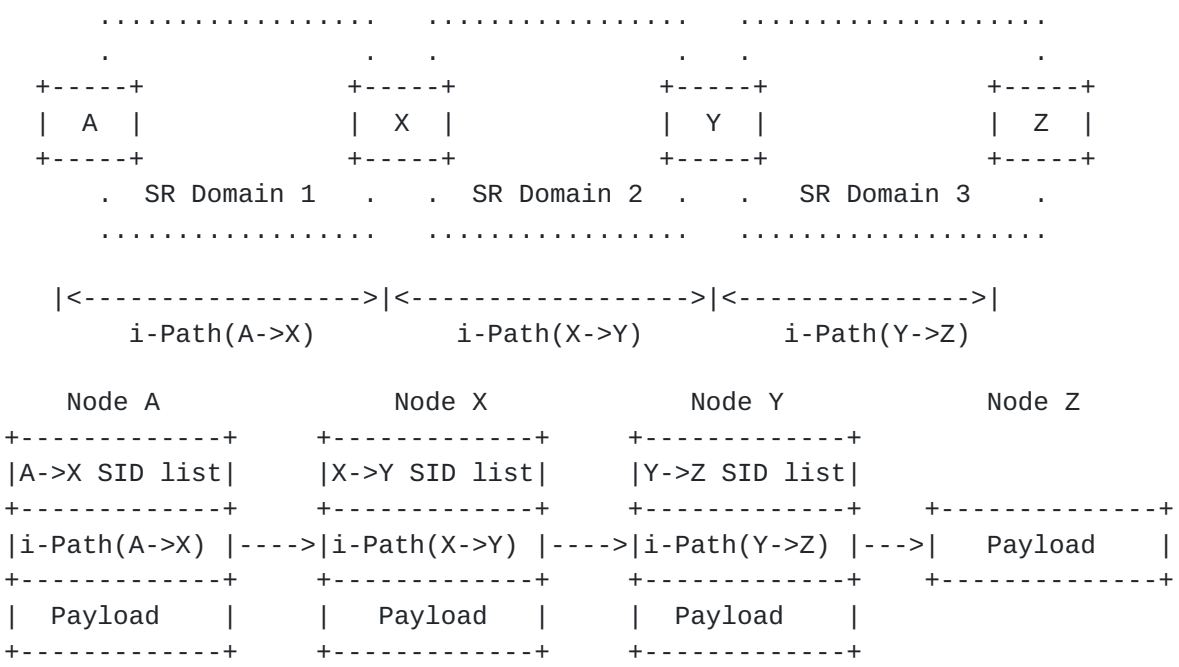

Figure 2: Stitching Border Node Inter-Domain Scenario

4.2. Nesting Inter-domain with e-Path

Figure 3 shows the SR-MPLS nesting inter-domain scenario. The e-Path(A->Z) is used to indicate the end-to-end path. The s-Path is used to identify the domain's sub-path. The e-Path, s-Path and SR list are pushed by the ingress node. The e-Path is used to correlate the two unidirectional SR paths to an SR bidirectional path. The s-Path can be used as stitching label to correlate the two inter-domain sub-paths.

The use of the binding SID [RFC8402] is also recommended to replace the SR list of each domain. As shown in Figure 3, the B-SID(X->Y) is used to replace the X->Y SID list. Ingress node A pushes e-Path(A->Z), B-SID(Y->Z), B-SID(X-Y), s-Path(A->X) and A->X SID list in turn. When the packet is received at node X, the s-Path(A-X) and X->Y SID list are popped, and the new s-Path(X->Y) is pushed. Also, X->Y SID list replaces B-SID(X->Y) to indicate that packet to be forwarded from node X to node Y. The data packet reaches the SR node Z according to the same forwarding procedure. In SR node Z, the e-Path (A->Z) is used to correlate the two unidirectional end-to-end paths.

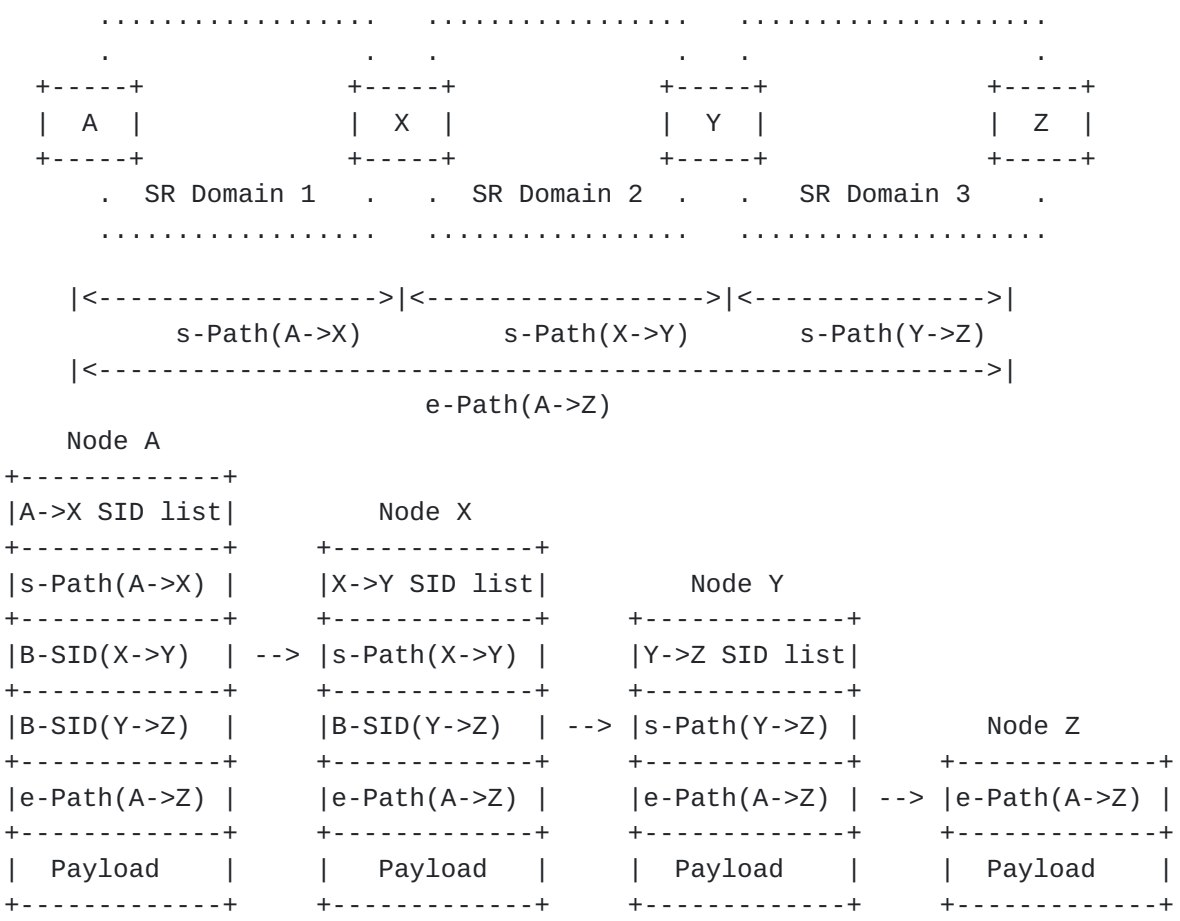

Figure 3: Nesting Inter-Domain Scenario

5. Security Considerations

TBA

6. Acknowledgements

TBA

7. IANA Considerations

TBA

8. Normative References

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