The Use of Path Segment in SR-MPLS and MPLS Interworking

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Abstract

This document discusses the SR-MPLS and MPLS interworking scenarios and proposes the solution with the use of Path Segment.

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1. Introduction

Segment Routing (SR) leverages the source routing paradigm. A node steers a packet through a SR Policy instantiated as an ordered list of instructions called "segments". 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.

In some scenarios, for example, mobile backhaul transport network, it is required to provide end-to-end bidirectional tunnel across multiple domains. IP/MPLS technology can be deployed in these domains which may be access network, aggregation network or core network under the control of a single operator. With the SR architecture, the IP/MPLS may be upgraded to support the SR-MPLS technology. There are requirements to support the interworking between MPLS and SR-MPLS networks at the boundaries and provide end-to-end bidirectional service.

[I-D.ietf-spring-mpls-path-segment] defined a Path Segment identifier to support SR path PM, end-to-end 1+1 SR path protection and bidirectional SR paths correlation. This document discusses the interworking scenarios between SR-MPLS and MPLS networks and proposes the solution with the use of Path Segment.

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).

AS: Autonomous System. An Autonomous System is composed by one or more IGP area.

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.

Border Node: Two IGP areas interconnects with an ABR.

Border Link: Two ASes interconnects with an ASBR.

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.

IGP: Interior Gateway Protocol.

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

PM: Performance Measurement.

SR: Segment Routing.

SR-MPLS: Segment Routing with MPLS data plane.

s-Path: Sub-path Path Segment.

VPN: Virtual Private Network.

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. SR-MPLS Interworking with MPLS

It is required to establish the end-to-end VPN service across the access network, aggregation network and core network. For example, SR-MPLS may be deployed in access and core network and MPLS may be
deployed in aggregation network. The network interworking should be taken into account in deployment are the following:

- Border Node or Border Link
- Stitching Model or Nesting Model
- End-to-End OAM or Per-domain OAM

The domains of the networks may be IGP Areas or ASes. The SR-MPLS and MPLS networks can be interconnect with border node between IGP Areas or border link between ASes. This document takes IGP Areas domains for example. MPLS domain can be deployed between two SR-MPLS domains as Figure 1 shown. The packets being transmitted along the SR path in SR-MPLS domains by using the SID list at the ingress node. And the path in MPLS domains can be pre-configuration either via NMS or via the MPLS control plane signaling.

```
A                  SR-MPLS  C                MPLS  G                  SR-MPLS  Z
+      IGP 1       +     .                    +      IGP 3       +
+                    +     .                    +                    +
+                    +     .                    +                    +
D                                    +                    +                    +
|<---Access Network--->|<-Aggregation Network->|<----Core Network---->|
```

Figure 1: SR-MPLS and MPLS interworking Scenario

The VPN service across the SR-MPLS and MPLS domains is an end-to-end bidirectional path. In the SR-MPLS network, a Path Segment uniquely identifies an SR path and can be used for bidirectional path. This document proposed the solution of Path Segment used in interworking scenario including the stitching and nesting models.

### 3.1. Stitching interworking with i-Path

It is a common requirement that SR-MPLS needs to interwork with MPLS when SR is incrementally being deployed in the MPLS domain. Figure 2 shows the stitching model of SR-MPLS inter-working with MPLS.
The end-to-end bidirectional path acrossing the SR-MPLS and MPLS network being split into multiple segments. And each segment can be identified by an inter-domain path segment (i-Path or i-PSID) as defined in draft-xiong-spring-path-segment-sr-inter-domain. The i-Path is valid in the corresponding domain and the border nodes maintain the forwarding entries of that i-Path segment binding the next i-Path and the related labels, e.g, SID list or MPLS labels. In the headend node, the i-Path can correlate the inter-domain path of reverse direction and bind the two unidirectional paths.

--- Figure 2: SR-MPLS and MPLS interworking with Path Segment ---

3.2. Nesting interworking with e-Path

Figure 3 displays the nesting model of SR-MPLS and MPLS interworking. Compared with stitching model, the path segment presents end-to-end encapsulation in the packet from SR-MPLS domain to MPLS domain. As 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 label stack.
4. Security Considerations

TBA

5. Acknowledgements

TBA

6. IANA Considerations

TBA

7. Normative References

[I-D.ietf-spring-mpls-path-segment]

[I-D.ietf-spring-segment-routing-mpls]


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