The Use of Path Segment in SR-MPLS and MPLS Interworking
draft-xiong-mpls-path-segment-sr-mpls-interworking-01

Abstract

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

Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on April 19, 2020.

Copyright Notice

Copyright (c) 2019 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust’s Legal Provisions Relating to IETF Documents (https://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.
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". SR supports a 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, a 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 serve as an access, aggregation, or core network. Further, using SR architecture, the IP/MPLS network may be upgraded to support the SR-MPLS technology. As such transformation is performed incrementally, by one domain at the time, operators are faced with a requirement to support the interworking between MPLS and SR-MPLS networks at the boundaries to provide the 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.

As defined in [RFC8402], the headend of an SR Policy binds a Bingding Segment ID (BSID) to a policy. The BSID could be bound to a SID List or selected path and used to stitch the service across multiple domains. For example, as discussed in Section 3 [I-D.ietf-spring-mpls-path-segment], the BSID can be used to identify a sub-path and stitched them into an end-to-end SR path in the nesting model. The BSID and path segment can be combined to achieve the inter-domain path monitoring. But the solution is not appropriate for the stitching model. The policy MUST be instantiated
before the end-to-end service and it can not deploy domains incrementally. Moreover, all of the BSIDs MUST be pushed onto the label stack at the headend but not all of them are popped at an edge node. The edge node pops one BSID that is bound to a SID List. That cannot meet the independence requirement in the stitching model especially when the domains belong to different operators.

This document discusses the interworking scenarios between SR-MPLS and MPLS networks and proposes the solution with the use of path segments. The stitching and correlation of Path Segments are proposed to realize the inter-domain stitching and path monitoring.

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 areas.

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

Border Node: An ABR that interconnects two or more IGP areas.

Border Link: Two ASes are interconnected with ASBRs.

BSID: Binding Segment ID.

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

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 the 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 interconnected with a border node between IGP areas or border links between ASes. This document takes IGP Areas domains for example. MPLS domain can be deployed between two SR-MPLS domains, as Figure 1 shows. 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.
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 the bidirectional path. This document proposed the solution with path segment used in the interworking scenario including the stitching and nesting models.

3.1. Stitching Model with Path Segment

It is a common requirement that SR-MPLS needs to interwork with MPLS when SR is incrementally deployed in the MPLS domain. Figure 2 shows the stitching model of SR-MPLS inter-working with MPLS.

The end-to-end bidirectional path across the SR-MPLS and MPLS network is split into multiple segments. And each segment can be identified by an inter-domain path segment (i-Path or i-PSID) as defined in [I-D.xiong-spring-path-segment-sr-inter-domain]. The correlation of path segments can stitch the inter-domain paths and bind unidirectional paths. The i-Paths are valid in the corresponding domain and the border nodes maintain the forwarding entries of that i-Path segment that maps to 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. The interworking with path segments can support the inter-domain stitching and path monitoring.
### Nesting Model with Path Segment

Figure 3 displays the nesting model of SR-MPLS and MPLS interworking. Comparing with the stitching model, the path segment presents end-to-end encapsulation in the packet from an SR-MPLS domain to an 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 a stitching label to correlate the two domains. The use of the binding SID [RFC8402] is also recommended to reduce the size of the label stack and stitch the inter-domain paths.
Figure 3: Nesting Model of SR-MPLS and MPLS interworking

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]


Quan Xiong
ZTE Corporation
No.6 Huashi Park Rd
Wuhan, Hubei 430223
China
Phone: +86 27 83531060
Email: xiong.quan@zte.com.cn

Greg Mirsky
ZTE Corporation
USA
Email: gregimirsky@gmail.com

Weiqiang Cheng
China Mobile
Beijing
China
Email: chengweiqiang@chinamobile.com